National Park Service
U.S. Department of the Interior

FINAL
Oil and Gas Management Plan
Environmental Impact Statement
Big Thicket National Preserve

TEXAS

December 2005









In 1916, Congress created the NATIONAL PARK SERVICE in the Department of the Interior to

> …promote and regulate the use of the Federal areas known as national parks, monuments, and reservations…by such means and measures as conform to the fundamental purpose of said parks, monuments, and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations. (NPS Organic Act, 16 USC 1)

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Final
OIL AND GAS MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT
December 2005

BIG THICKET
National Preserve
Hardin, Jefferson, Orange, Liberty, Tyler, Jasper and Polk Counties
Texas

Prepared by
United States Department of the Interior • National Park Service

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IN REPLY REFER TO:
D18 (BITH)
X(L3025)

Dear Reader:

Enclosed is the Final Oil and Gas Management Plan (Final Plan) and Environmental Impact Statement (EIS) for Big Thicket National Preserve, Texas. This document describes and analyzes the impacts of three alternatives, including the No-Action alternative, for managing existing and anticipated oil and gas operations associated with the exercise of nonfederal interests underlying Big Thicket National Preserve.

The Draft O&GMP/EIS was released in December 2004. The National Park Service received 71 comment letters on the Draft Plan/EIS, containing 199 substantive comments on the adequacy of the Draft Plan/EIS and the merits of the alternatives presented. The Final Plan/EIS includes responses to the substantive comments received on the Draft Plan/EIS (Chapter 5). This document contains the Preferred Alternative (Alternative B), which is a slightly modified version of the Preferred Alternative published in the Draft Plan/EIS.

The Final Plan/EIS will have a 30-day "no action" period as required by the National Environmental Policy Act regulations, which will begin when the U.S. Environmental Protection Agency Notice of Availability is published in the *Federal Register*. Following the 30-day "no action" period, a Record of Decision will be published.

All questions or inquiries should be directed to:
Linda Dansby, EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Region
National Park Service
P.O. Box 728
Santa Fe, New Mexico 87504-0728

Sincerely,

Art Hutchinson
Superintendent

Department of the Interior • National Park Service

Final
Oil and Gas Management Plan
Environmental Impact Statement
for
Big Thicket National Preserve
Hardin, Jefferson, Orange, Liberty, Tyler, Jasper, and Polk Counties
Texas

Abstract: This Final Oil and Gas Management Plan and Environmental Impact Statement (Final Plan/EIS) describes and analyzes three alternatives for managing existing and anticipated oil and gas operations associated with the exercise of nonfederal oil and gas interests underlying the Preserve, and existing transpark oil and gas pipelines and activities in their associated rights-of-way:

- Alternative A (No-Action/Current Management)
- Alternative B (Preferred Alternative)
- Alternative C (Environmentally-Preferable Alternative)

Lead Agency: National Park Service

Type of Action: (X) Administrative ( ) Legislative

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The 30-day No-Action period will begin when the U.S. Environmental Protection Agency Notice of Availability is published in the *Federal Register*.

Recommended:

8/11/05

Art Hutchinson **Date**
Superintendent
Big Thicket National Preserve

Approved:

8/11/05

Michael D. Snyder **Date**
Director
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ACRONYMS AND ABBREVIATIONS

2-D	2-dimensional seismic survey
3-D	3-dimentional seismic survey
9B Regulations	NPS's Nonfederal Oil and Gas Rights Regulations (36 CFR 9B)
ACHP	Advisory Council on Historic Preservation
ARPA	Archeological Resources Protection Act
ASMIS	NPS Archeological Sites Management Information System
bbl	barrel (of petroleum product)
bcf	billion cubic feet (of gas)
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLI	Cultural Landscape Inventory
CLPR	Current Legal and Policy Requirements
CO	carbon monoxide
COAs	Conditions of Approval
COE	U.S. Army Corps of Engineers
CZMP	Coastal Zone Management Program
CWA	Clean Water Act
dBA	decibels (signifies A-weighting network has been used)
DM	Departmental Manual
DO	dissolved oxygen
DO-12	Director's Order 12, NPS National Environmental Policy Act Guidelines
DO-28	Director's Order 28, NPS Cultural Resources Management Guidelines
DO-77-1	Director's Order 77-1, Protection of Wetlands
DO-77-2	Director's Order 77-2, Floodplain Management
DOT	Department of Transportation
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EO	Executive Order
ESA	Endangered Species Act of 1973
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Maps
FONSI	Finding of No Significant Impact
FR	*Federal Register*
FWS	U.S. Fish and Wildlife Service
GLO	Texas General Land Office
GMP	General Management Plan
GPS	Global Positioning System
H_2S	hydrogen sulfide
IDT	Interdisciplinary Team
km	kilometer
L_{90}	Measure of background sound level exceeded 90 percent of the time
m^3	cubic meter
M	thousand
MMGD	Millions of Gallons per Day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMB	million barrels
NAAQS	National Ambient Air Quality Standards

NAD	North American Datum
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act of 1969
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent [to Prepare an Environmental Impact Statement]
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NPS-66	NPS Minerals Management Guidelines
NPS-77	NPS Natural Resources Management Guidelines
NRHP	National Register of Historic Places
NSU	No Surface Use
NWI	National Wetlands Inventory
PA	NPS Servicewide Programmatic Agreement Between NPS, SHPO, and ACHP
ONRW	Outstanding Natural Resource Waters
OPA	Oil Pollution Act
pers. comm.	personal communication
pH	Potential of Hydrogen (measure of acidity)
P.L.	Public Law
PM	Particulate Matter
PNV	Potential Natural Vegetation
ppt	parts per trillion
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RRC	Railroad Commission of Texas
RFD	Reasonably Foreseeable Development
RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right-of-Way
RV	recreational vehicle
SFM	Statement for Management
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan (Clean Air Act)
SMA	Special Management Area
SO_2	sulfur dioxide
SOF	Statement of Findings
SPCC	Spill Prevention, Control, and Countermeasure Plan
SSWCB	State Soil and Water Conservation Board
TDS	total dissolved solids
T&E	Threatened and Endangered (plants, animals and invertebrates)
TCEQ	Texas Commission on Environmental Quality (formerly TNRCC –Texas Natural Resource Conservation Commission
TPWD	Texas Parks and Wildlife Department
TWC	Texas Water Commission
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USMAB	U.S. Man and the Biosphere Program
USCG	U.S. Coast Guard
U.S.C.	U.S. Codes
USGS	U.S. Geological Survey
VOCs	volatile organic compounds
§	section symbol

SUMMARY



SUMMARY

PURPOSE AND NEED FOR THIS PLAN

When the Preserve was created, the U.S. Government acquired surface ownership within the area, but either private entities or the State of Texas retained subsurface mineral interests. Thus, the federal government does not own any of the subsurface oil and gas rights in the Preserve. Also, the U.S. Government did not acquire any of the transpark oil and gas pipeline encumbrances. While no statutory authority exists for granting new rights-of-way for oil and gas pipelines, pipelines may be constructed within existing rights-of-way in conformance with the terms of the legal document creating the rights-of-way.

The National Park Service (NPS) evaluates project-specific proposals for oil and gas production and transportation on a case-by-case basis by applying a variety of Current Legal and Policy Requirements prior to issuing a permit under the NPS's Nonfederal Oil and Gas Rights Regulations at 36 CFR Part 9, Subpart B, or Special Use Permits under 36 CFR Parts 1-5. Many Current Legal and Policy Requirements involve other state and federal agencies who either are responsible for issuing specific resource-protection permits, or are agencies with whom the NPS consults to seek technical reviews and recommendations. It is important to keep in mind that NPS-specific regulations only apply to nonfederal oil and gas operations occurring within park boundaries. When the NPS is concerned about the spillover effects of operations outside park boundaries on park resources and values, the NPS works cooperatively with others (e.g., state and local governmental entities, other federal agencies, operators and landowners) to get park protection concerns addressed up front. In the event that activities outside park boundaries cause damage to park resources or values, the NPS can seek damages through special authority set forth at 16 U.S.C. § 19jj. The best practice, however, is to convince others to put measures in place to avoid such damages in the first place.

At this time, while the NPS has comprehensive regulations governing nonfederal oil and gas development in parks, the Service does not have a comprehensive plan guiding oil and gas activities within the Preserve. Operators are often uncertain of the impact mitigation stipulations that apply in different areas of the Preserve to protect Preserve resources and values, visitor use and experience, and human health and safety. Unique areas of the Preserve having special resource values are vulnerable to impacts from a wide range of oil and gas activities. Existing and future oil and gas operations in the Preserve have the potential to impact Preserve resources and values.

The purpose of this Oil and Gas Management Plan (Plan) for the Preserve is to clearly define a direction for long-term management of existing and anticipated oil and gas operations associated with the exercise of nonfederal oil and gas interests underlying the Preserve, and existing transpark oil and gas pipelines and activities in their associated rights-of-way, while protecting Preserve resources, visitor use and experience, and human health and safety, and preventing impairment to Preserve resources and values. When approved, this Oil and Gas Management Plan/EIS will be the first comprehensive plan ever prepared for the Preserve to manage activities associated with the exploration and development of nonfederal oil and gas within the Preserve. It is the intent of this planning effort to provide comprehensive, consistent direction for the Preserve for the next 15 to 20 years, and possibly longer, if there are no major changes in technology, and impacts do not significantly change from those described; and to arrive at that direction through public participation. This is a programmatic management plan that establishes a general framework for managing oil and gas operations. By itself, it does not authorize any on-the-ground activities. The NPS will authorize specific projects by reviewing and approving operator-submitted plans of operations or special use permit applications. Before doing so, the NPS will conduct further analysis in accordance with the

National Environmental Policy Act of 1969 (NEPA), the National Historic Preservation Act of 1966 (NHPA), the Endangered Species Act of 1973 (ESA), and other applicable federal laws.

Figure S.1 is a Region/Vicinity Map. The Preserve contains 15 separate units, comprising 98,735 acres. However, this Plan/EIS addresses only 12 units comprising 88,132 acres because the Federal Government has not acquired the 10,600 acres in the remaining 3 units that were added to the Preserve in 1993. Until the Federal Government acquires the remaining lands, they lie outside the scope of the NPS's Nonfederal Oil and Gas Rights Regulations (36 CFR 9B).

The NPS Nonfederal Oil and Gas Rights regulations (36 CFR Part 9, Subpart B), hinge on an operator needing access on or across federally-owned or controlled lands or waters in the Preserve. When an operator can reach his/her private oil and gas right in a park without such access, the regulations do not apply.

Transpark oil and gas pipelines have their point of origin and end point outside parks, and, for the most part are not supporting nonfederal oil and gas operations in parks. As a result, they are not subject to the NPS's 9B regulations. However, if a nonfederal oil and gas operation in the Preserve connects to such a pipeline via a flowline or gathering line, then that portion of the flowline or gathering line crossing the Preserve would be subject to the 36 CFR 9B regulations.

While most transpark oil and gas pipelines are not subject to the 36 CFR 9B regulations, they are either subject to federal Department of Transportation (DOT) regulations at 49 CFR Subtitle B, Ch 1, Parts 190-199, Texas State (Railroad Commission of Texas) requirements, and other applicable federal and state laws. With respect to activities within transpark oil and gas pipeline rights-of-ways, the NPS has existing regulatory authority to control those activities codified at 36 CFR Parts 1-5, which consists of general regulations controlling a variety of activities in parks. To the extent that a proposed activity in a right-of-way triggers the general regulations, a special use permit must be obtained from the NPS before the conduct of the activity. Mowing and trimming vegetation, inspection or testing pipelines, and installing, shutting down or replacing pipelines, are common activities in pipeline rights-of-way requiring a Special Use Permit.

PLANNING DIRECTION

This Plan/EIS has been prepared with guidance provided through special mandates and direction. These include the NPS Organic Act, the Preserve's enabling act, the Service's 36 CFR 9B regulations, the Preserve's General Management Plan, and a variety of existing laws, regulations and policies. These "Current Legal and Policy Requirements" are described in Chapter 1, Chapter 2 (Part II) and Appendix C.

On November 16, 1998, the NPS published a Notice of Intent to Prepare an Oil and Gas Management Plan/Draft Environmental Impact Statement in the *Federal Register*. The publication of this notice, in addition to the mailing of a Public Scoping Newsletter, and a scoping open house held in Beaumont, Texas, on December 3, 1998, invited the general public, as well as federal, state, and local government agencies, to identify issues and submit comments to the NPS regarding the proposed planning effort. In December 2004, the NPS released the Draft Plan/EIS for a 60-day public review and comment period that was subsequently extended 30 days until March 10, 2005. A total of 71 comment letters were received from which the NPS determined there were 199 substantive comments. A description of the consultation and coordination process, and a reprint of the comment letters and NPS responses are included in Chapter 5.

Figure S.1. Region/Vicinity Map for Big Thicket National Preserve

Based on internal and public scoping, the interdisciplinary team developed the following planning objectives and a list of resources and concerns to evaluate in this Plan/EIS.

Planning Objectives:

- Identify Preserve resources and values susceptible to adverse impacts from oil and gas operations.
- Establish performance standards and impact mitigation measures for oil and gas operations to protect and prevent impairment to Preserve resources and values from adverse impacts from oil and gas operations.
- Establish performance standards and impact mitigation measures for oil and gas operations to avoid or minimize impacts from oil and gas operations on visitor use and enjoyment, and human health and safety.
- Provide holders of oil and gas rights reasonable access for exploration and development.
- Provide pertinent information to oil and gas operators to facilitate planning and compliance with NPS and other applicable regulations.

Resources and concerns evaluated in this Plan/EIS include:

- Nonfederal Oil and Gas Development
- Air Quality
- Geologic Resources
- Water Resources
- Floodplains
- Vegetation
- Wetlands
- Fish and Wildlife
- Species of Special Concern
- Cultural Resources
- Visitor Use and Experience
- Adjacent Land Uses and Resources

For each of the resources and concerns listed above, the interdisciplinary team developed issue statements to define problems or benefits that might occur should oil and gas operations continue. Based on the evaluation of these resources and concerns, and public input received during scoping, the planning team also identified Special Management Areas (SMAs) to protect Preserve resources and values that are most susceptible to adverse impacts from oil and gas operations. The issue statements, and particularly the SMAs, were used in developing and evaluating alternatives. The issue statements are in Chapter 1. A description of the affected environment is in Chapter 3.

PLAN ALTERNATIVES

Reasonably Foreseeable Development Scenario

The United States Geological Survey (USGS) and the NPS collaborated during the EIS planning process to estimate the undiscovered hydrocarbon resources in the Preserve and to develop a projection of the type and extent of operations that could occur to develop these resources. The USGS assessment is in Appendix E. Based on the USGS assessment, the NPS prepared a reasonably foreseeable development (RFD) scenario that projects the types of activities and the amount of surface disturbance that could occur to explore for and produce the remaining oil and gas resources underlying the Preserve. The NPS developed the RFD scenario with the assumption that 3-D seismic surveys would be conducted throughout the Preserve.

When preparing the RFD scenario for the Draft Plan/EIS, the NPS used USGS's mean probability (average) of undiscovered oil and gas resources. In the Draft Plan/EIS, it was estimated that over the next 15 to 20 years, up to 29 wells could be drilled which could disturb up to 153 acres within and outside the Preserve. Since the NPS prepared the RFD scenario in 1999, 19 wells have been drilled to explore for and produce the hydrocarbons underlying the Preserve. Even though 29 wells have not been drilled to-date, it is possible that these estimates could be attained in the near future. Conversely, it is possible that drilling may slow down and the RFD scenario in the Draft Plan/EIS may still be valid for the life of the Plan/EIS.

Due to the public comments received on the Draft Plan/EIS and the current increase in drilling activity, the NPS has decided to develop a revised RFD scenario for the Final Plan/EIS. The NPS has decided to use the 25% probability estimate in the revised RFD scenario. It is estimated that over the next 15 to 20 years, up to 40 wells could be drilled which could disturb up to 241 acres within and outside the Preserve. The RFD scenario is further described in Chapter 2, Part I, Plan Alternatives.

Summary of Plan Alternatives

Three alternatives are presented in Chapter 2, Part I. These alternatives were developed to meet the stated objectives of this Plan/EIS to a large degree and provide a reasonable range of options to manage exploration, drilling, production and transportation of nonfederal oil and gas within the Preserve. Alternative A – No Action is required by the National Environmental Policy Act (NEPA) and describes the continued management of oil and gas operations in the Preserve under Current Legal and Policy Requirements (CLPR). Alternatives B and C incorporate the use of Special Management Areas, performance standards, and mitigation measures to protect specific resources and values in the Preserve, consistent with the purposes and values of the Preserve and state and federal resource protection mandates. Alternative B is the NPS's preferred alternative. Alternative C is the environmentally preferred alternative. Table S.1 is a Summary of Operating Stipulations under Each Alternative. Following is a summary of the three plan alternatives.

Under any alternative:

- The level of development theorized in the RFD scenario, summarized above, would be the same under all three alternatives.
- If a drilling operation is not permitted in a Protected/Special Management Area, the operator could directionally drill a well from a surface location outside the area.
- In all areas of the Preserve, Current Legal and Policy Requirements would be applied and could result in the discovery of previously unknown, important cultural resources, species of special concern, and other resource areas in which No Surface Use, timing stipulations, and other mitigation measures could be applied. The term "Current Legal and Policy Requirements," as used in the description of alternatives means application of all pertinent federal and state laws, regulations, policies, and direction governing oil and gas operations conducted in the Preserve. These include NPS regulations at 36 CFR 9B, which require operators to use technology and methods least damaging to Preserve resources (i.e., performance standards and implementation strategies) while ensuring the protection of human health and safety. The CLPR are listed in Table 1.1 and Chapter 2, Part II, and are described in Appendix B – National Park Service Nonfederal Oil and Gas Rights Regulations at 36 CFR Part 9B, and Appendix C – Federal Laws, Regulations, Executive Orders, Policies and Guidelines that Apply to Nonfederal Oil and Gas Operations.
- There are existing and abandoned but unreclaimed operations on approximately 989 acres, some of which are in areas where new operations would not be permitted under Alternatives A, B, and C. Existing operations would continue to operate, but must comply with applicable CLPR, performance standards, operating stipulations, and mitigation measures presented in this Plan/EIS.

Table S.1. Summary of Operating Stipulations under Each Alternative

(Acreage totals exclude overlapping areas for each Protected Area/SMA.)

Big Thicket National Preserve		**Total Area: 88,132 Acres**	
ALTERNATIVES	**PROTECTED AREAS under ALTERNATIVE A**	**SMAs under ALTERNATIVE B**	**SMAs under ALTERNATIVE C**
Total Area with Operating Stipulations[1]	56,538 acres[2]	<75,293 acres[3]	75,293 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	7,462 acres[2]	11,512 acres	39,657 acres
Designated Areas	Fire Monitoring Plots with no offset Long-term Monitoring Plots with no offset Royal Fern Bog Research Plot w/no offset Visitor Use, Administrative and Other Use Areas with 500'offset[1] Waterways with 500' offset[1]	Fire Monitoring Plots with 50' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with150' offset Visitor Use, Administrative and Other Use Areas with 500' offset[1] Waterways with 500' offset[1]	Fire Monitoring Plots with 50' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with 150' offset Visitor Use, Administrative and Other Use Areas with 500'offset[1] Waterways with 500' offset[1] Riparian Corridors Rare Vegetation Communities Rare Forested Wetland Communities
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	52,272 acres[2]	52,272 acres	52,272 acres
Designated Areas	Birding Hot Spots with 500' offset[1] (3/1-5/30 and 9/1-11/30) Hunting Areas (10/1-1/15)	Birding Hot Spots with 500' offset[1] (3/1-5/30 and 9/1-11/30) Hunting Areas (10/1-1/15)	Birding Hot Spots with 500' offset[1] (3/1-5/30 and 9/1-11/30) Hunting Areas (10/1-1/15)
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	7,493 acres[2]	<46,273[3]	46,273 acres
Designated Areas	Fire Monitoring Plots with no offset Long-term Monitoring Plots with no offset Royal Fern Bog Research Plot with no offset Visitor Use, Administrative and Other Use Areas with 500' offset[1] Birding Hot Spots with 500' offset[1] Waterways with 500' offset[1]	Fire Monitoring Plots with 150' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with 150' offset Visitor use, Administrative and Other Use Areas with 1500' offset Birding Hot Spots with 1500' offset Waterways with 500' offset[1] Riparian Corridors[3] Rare Vegetation Communities Rare Forested Wetland Communities	Fire Monitoring Plots with 150' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with 150' offset Visitor Use, Administrative and Other Use Areas with 1500' offset Birding Hot Spots with 1500' offset Waterways with 500' offset[1] Riparian Corridors Rare Vegetation Communities Rare Forested Wetland Communities

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by a plan of operations, as per CLPR at 36 CFR § 9.41(a). The area covered by this operating stipulation from waterways has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses.

ENVIRONMENTAL CONSEQUENCES

Table S.2 is a Summary of Impacts. The full impact analysis is in Chapter 4, Environmental Consequences. For all of the alternatives in this Plan/EIS, impacts from operations in the Preserve would be mitigated to avoid impairment of Preserve resources and values.

Under all three alternatives, the impacts are generally the same because the level of development projected under each alternative would be the same as theorized under the RFD scenario. The key difference between the alternatives and their potential impacts is where impacts could occur. Under Alternative A, Current Legal and Policy Requirements would preclude operations in Protected Areas. Under Alternatives B and C, Protected Areas and additional resource areas with offsets are formally designated as Special Management Areas where the No Surface Use stipulation would preclude operations from occurring in an increasingly larger acreage of the Preserve. Alternative C would preclude operations in the greatest area of the Preserve, and is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve.

Impairment findings are included in each conclusion statement for each Preserve resource or value. A comparative analysis of the potential for impairment to Preserve resources and values is also provided at the end of Chapter 4. Under all three alternatives, impairment to Preserve resources and values would not occur because current law, regulation, and policy preclude Preserve resource managers from authorizing nonfederal oil and gas operations that would impair Preserve resources and values.

Alternative A, Status Quo/Current Management, would provide less information to guide operators in planning and development of plans of operations and directional drilling applications than the other alternatives presented in this Plan/EIS. There has been no formalized Preserve-wide oil and gas management plan and specific resource protection goals (called performance standards) and operating stipulations would continue to be applied on a case-by-case basis. This increases the likelihood that the location of certain resources and application of mitigation measures could be overlooked on any given proposed operations.

Alternatives B and C were developed to provide consistent oversight of oil and gas operations and ensure protection of Preserve resources and values. The formal designation of Special Management Areas and operating stipulations in Alternatives B and C would reduce the level of potential impact or impairment to resources and values particularly susceptible to adverse impacts from oil and gas operations. The implementation of a comprehensive oil and gas management plan under any of the three alternatives would provide more certainty to oil and gas operators and consistent application of Current Legal and Policy Requirements. The formal designation of SMAs and operating stipulations under Alternatives B and C would provide better assurance for the protection of Preserve resources and values from potential impairment from nonfederal oil and gas operations.

THE NEXT STEP

The Final Plan/EIS has been released for a standard 30-day “No Action” period. The 30-day No Action period begins from the publication date of the U.S. Environmental Protection Agency’s Notice of Availability of this Final Plan/EIS in the *Federal Register*. Following the 30-day No Action period, the NPS will issue a Record of Decision (ROD), and publish the ROD in the *Federal Register*. Upon issuance of the ROD, the selected plan alternative will be implemented.

Table S.2. Summary of Impacts

The following terms are used in this impact summary chart:

Short-term – up to 3 years duration **Long-Term** – up to 20 years or more **CLPR** – Current Legal and Policy Requirements **NSU** – No Surface Use

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
SUMMARY OF ALTERNATIVES		
Geophysical Exploration would not occur in Protected Areas where CLPR would not permit operations on 7,462 acres; or within 500 feet of waterways. In addition to the areas where the NSU stipulation would apply year-round, surface uses for geophysical exploration operations would not be permitted in hunting areas (52,272 acres) or within 500 feet of birding hot spots (135 acres) during specified times. In all other areas of the Preserve, exploration operations could be permitted on up to 465 acres.	**Geophysical Exploration** would not occur in SMAs where the No Surface Use stipulation would be applied on 11,512 acres, or within 500 feet of waterways. In addition to the areas where the NSU stipulation would apply year-round, surface uses for geophysical exploration operations would not be permitted in the Hunting Areas SMA (52,272 acres) or within 500 feet of Birding Hot Spots (135 acres) during specified times. In all other areas of the Preserve, exploration operations could be permitted on up to 465 acres.	**Geophysical Exploration** would not occur in SMAs where the No Surface Use stipulation would be applied on 39,657 acres, or within 500 feet of waterways. In addition to the areas where the NSU stipulation would apply year-round, surface uses for geophysical exploration operations would not be permitted in the Hunting Areas SMA (52,272 acres) or within 500 feet of Birding Hot Spots (135 acres) during specified times. In all other areas of the Preserve, exploration operations could be permitted on up to 465 acres.
Drilling and production operations would not occur in Protected Areas where operations would not be permitted under Current Legal and Policy Requirements on 7,493 acres; or within 500 feet of waterways. Operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) would continue to adversely impact geologic resources in the Preserve. In all other areas of the Preserve, up to 40 new wells could be located on up to 241 acres.	**Drilling and Production** would not occur in designated SMAs where the No Surface Use stipulation is applied on up to 46,273 acres, or within 500 feet of waterways. Drilling and production operations may be permitted in the Hunting Areas SMA (52,272 acres). Operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) would continue to adversely impact geologic resources in the Preserve. In all other areas of the Preserve, up to 40 new wells could be located on up to 241 acres.	**Drilling and Production** would not occur in designated SMAs where the No Surface Use stipulation is applied on 46,273 acres, or within 500 feet of waterways. Drilling and production operations may be permitted in the Hunting Areas SMA (52,272 acres). Operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) would continue to adversely impact geologic resources in the Preserve. In all other areas of the Preserve, up to 40 new wells could be located on up to 241 acres.
Plugging/Abandonment/Reclamation: There would be no new operations to plug, abandon or reclaim in areas where exploration, drilling and production would not be permitted in Protected Areas. In all other areas of the Preserve where exploration, drilling and production operations could be permitted, there is a potential for up to 465 acres to be reclaimed in association with exploration operations, and up to 241 acres to be reclaimed in association with new drilling and production operations. In addition, there are operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) located throughout the Preserve that would be reclaimed in the future, some of which are in Protected Areas.	**Plugging/Abandonment/Reclamation:** There would be no new operations to plug, abandon or reclaim in areas where exploration, drilling and production would not be permitted in SMAs. In all other areas of the Preserve where exploration, drilling and production operations could be permitted, there is a potential for up to 465 acres to be reclaimed in association with exploration operations, and up to 241 acres to be reclaimed in association with new drilling and production operations. In addition, there are operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) located throughout the Preserve that would be reclaimed in the future, some of which are in SMAs.	**Plugging/Abandonment/Reclamation:** There would be no new operations to plug, abandon or reclaim in areas where exploration, drilling and production would not be permitted in SMAs. In all other areas of the Preserve where exploration, drilling and production operations could be permitted, there is a potential for up to 465 acres to be reclaimed in association with exploration operations, and up to 241 acres to be reclaimed in association with new drilling and production operations. In addition, there are operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) located throughout the Preserve that would be reclaimed in the future, some of which are in SMAs.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
1. IMPACTS ON NONFEDERAL OIL AND GAS DEVELOPMENT		
Project Planning – minor, beneficial impacts. **Geophysical Exploration** – minor to moderate, adverse impacts. **Drilling and Production** – minor to moderate, adverse impacts. **Plugging/Abandonment/Reclamation** – minor to moderate, adverse impacts. **Cumulative Impacts** – negligible, adverse impacts.	**Project Planning** – minor to moderate, beneficial impacts. **Geophysical Exploration** – similar to Alternative A. **Drilling and Production** – similar to Alternative A. **Plugging/Abandonment/Reclamation** – minor, adverse impacts. **Cumulative Impacts** – negligible, adverse impacts.	**Project Planning** – same as Alternative B. **Geophysical Exploration** – minor to major, adverse impacts. **Drilling and Production** – minor to major, adverse impacts. **Plugging/Abandonment/Reclamation** – same as Alternative B. **Cumulative Impacts** – negligible, adverse impacts.
2. IMPACTS ON AIR QUALITY		
Impacts could be localized, as well as contribute to regional air quality impacts. **Geophysical Exploration** – short-term, negligible, adverse impacts. **Drilling and Production** – short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – short-term, negligible, adverse impacts from operations in the Preserve; and ranging from no affect to short-term, negligible, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – moderate adverse impacts on the regional airsheds. But, with adherence to state and federal standards and requirements, regional airsheds are expected to be maintained or improved. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that air quality in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that air quality in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that air quality in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of air quality in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that air quality in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that air quality in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation SMAs over a larger area with the NSU stipulation would ensure widespread protection of air quality in these areas of the Preserve. **Impairment Analysis** – no impairment.
3. IMPACTS ON GEOLOGIC RESOURCES		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to	**Geophysical Exploration** – similar to Alternative A, except that geologic resources in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that geologic resources in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that geologic resources in designated SMAs would be better protected.	**Geophysical Exploration** – similar to Alternative B, except that geologic resources in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that geologic resources in designated SMAs would be better protected.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
indirect, localized to widespread, short-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and negligible to minor, adverse impacts on geologic resources in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of geologic resources in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternative A and B, except that NSU designation in all SMAs except the Hunting Areas SMA would ensure widespread protection of geologic resources in the Preserve. **Impairment Analysis** – no impairment.
4. IMPACTS ON WATER RESOURCES		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that water resources in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that water resources in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that water resources in designated SMAs would be better protected. Indirect effects from wells directionally drilled and produced from outside the Preserve would range from no affect to localized to widespread, short- to long-term, moderate, adverse impacts. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of water resources in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that water resources in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that water resources in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of water resources in the Preserve. **Impairment Analysis** – no impairment.
5. IMPACTS ON FLOODPLAINS		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve.	**Geophysical Exploration** – similar to Alternative A, except that floodplains in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that floodplains in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that floodplains in designated SMAs would be better protected.	**Geophysical Exploration** – localized, short-term, negligible adverse impacts. **Drilling and Production** – indirect, short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the. **Plugging/Abandonment/Reclamation** – same as Alternatives A and B.

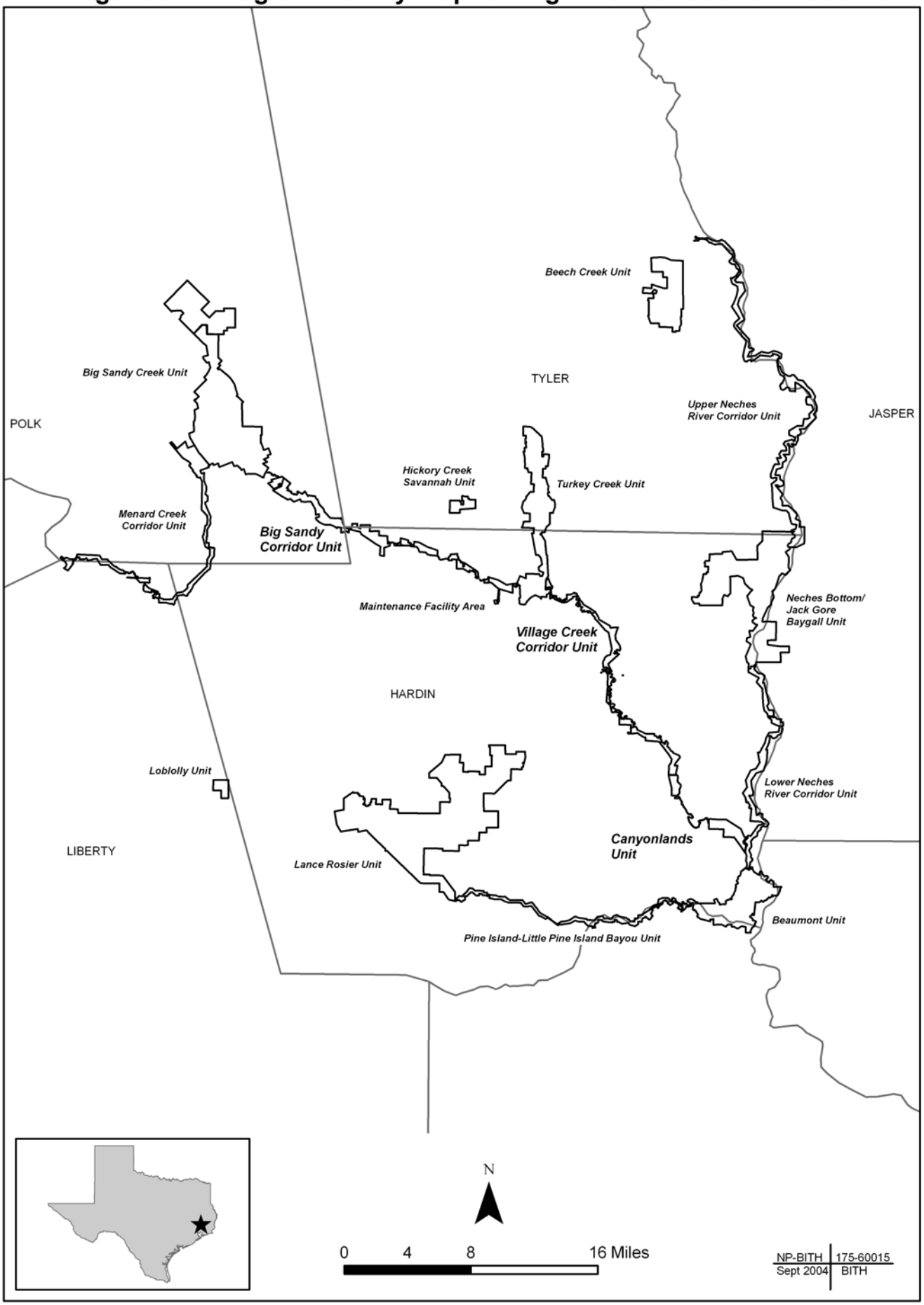
Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
Cumulative Impacts – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of floodplains in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of floodplains in the Preserve. **Impairment Analysis** – no impairment.
6. IMPACTS ON VEGETATION		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, minor to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that vegetation in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that vegetation in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that vegetation in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of vegetation in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – localized, short-term, negligible to moderate, adverse impacts. **Drilling and Production** – localized, short- to long-term minor to moderate, adverse impacts from operations in the Preserve, and ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that vegetation in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of vegetation in the Preserve. **Impairment Analysis** – no impairment.
7. IMPACTS ON WETLANDS		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that wetlands in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that wetlands in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that wetlands in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of wetlands in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that wetlands in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that wetlands in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of wetlands in the Preserve. **Impairment Analysis** – no impairment.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
8. IMPACTS ON FISH AND WILDLIFE		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, minor to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and negligible to minor, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that fish and wildlife in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that fish and wildlife in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that fish and wildlife in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of fish and wildlife in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that fish and wildlife in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that fish and wildlife in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of fish and wildlife in the Preserve. **Impairment Analysis** – no impairment.
9. IMPACTS ON SPECIES OF SPECIAL CONCERN		
Geophysical Exploration – no adverse impacts. **Drilling and Production** – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that species of special concern in designated SMAs would be better protected. **Drilling and Production** – same as Alternative A. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that species of special concern in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of species of special concern and perpetuate habitat for species in the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that species of special concern in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that species of special concern in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of species of special concern and perpetuate habitat for species in the Preserve. **Impairment Analysis** – no impairment.
10. IMPACTS ON CULTURAL RESOURCES		
Geophysical Exploration – no adverse impacts.	**Geophysical Exploration** – similar to Alternative A, except that cultural resources in designated SMAs would be better protected.	**Geophysical Exploration** – similar to Alternative B, except that cultural resources in designated SMAs would be better protected.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
Drilling and Production – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve.	**Drilling and Production** – similar to Alternative A, except that cultural resources in designated SMAs would be better protected.	**Drilling and Production** – same as Alternative B.
Plugging/Abandonment/Reclamation – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve.	**Plugging/Abandonment/Reclamation** – similar to Alternative A, except that cultural resources in designated SMAs would be better protected.	**Plugging/Abandonment/Reclamation** – same as Alternative B.
Cumulative Impacts – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of cultural resources in these areas of the Preserve.	**Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of cultural resources in the Preserve.
Impairment Analysis – no impairment.	**Impairment Analysis** – no impairment.	**Impairment Analysis** – no impairment.
11. IMPACTS ON VISITOR USE AND EXPERIENCE AND ADMINISTRATIVE AREAS		
Visitor Use and Experience – exploration, drilling and production operations in the Preserve would result in localized, short- to long-term, negligible to moderate, adverse impacts, and reclamation operations would result in localized, long-term, moderate, beneficial impacts. Wells directionally drilled from outside the Preserve would result in impacts ranging from no affect to indirect, localized, short- to long-term, moderate, adverse impacts; and reclamation would result in indirect, localized moderate, adverse and beneficial impacts.	**Visitor Use and Experience** – similar to Alternative A, except that visitor use and experience and administrative areas in designated SMAs would be better protected.	**Visitor Use and Experience** – exploration, drilling and production operations in the Preserve would result in localized, negligible to minor, adverse impacts, and reclamation operations would result in localized, moderate, beneficial impacts. Drilling and production of wells directionally drilled from outside the Preserve would result in impacts ranging from no affect to short- to long-term, moderate, adverse impacts; and reclamation would result in localized moderate, adverse and beneficial impacts.
Human Health and Safety – negligible, adverse impacts.	**Human Health and Safety** – similar to Alternative A, except that visitor use and experience and administrative areas in designated SMAs would be better protected.	**Human Health and Safety** – similar to Alternative B, except that visitor use and experience and administrative areas in designated SMAs would be better protected.
Cumulative Impacts – negligible, adverse impacts.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of visitor use and experience and human health and safety in these areas of the Preserve.	**Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs with the NSU stipulation would ensure more widespread protection of visitor use and experience and human health and safety in these areas of the Preserve.
12. IMPACTS ON SOCIOECONOMICS – ADJACENT LAND USES AND RESOURCES		
Geophysical Exploration – localized, short-term, negligible to moderate, adverse impacts.	**Geophysical Exploration** – localized, short-term, minor to major, adverse impacts.	**Geophysical Exploration** – similar to Alternative B.
Drilling and Production – short- to long-term, minor to major, adverse impacts, depending on the resource protection measures employed.	**Drilling and Production** – similar to Alternative A.	**Drilling and Production** – similar to Alternative B.
Plugging/Abandonment/Reclamation – localized, negligible to major, adverse impacts, depending on the amount of reclamation performed.	**Plugging/Abandonment/Reclamation** – localized, negligible to major, adverse impacts, depending on the amount of reclamation performed.	**Plugging/Abandonment/Reclamation** – similar to Alternative B.
Cumulative Impacts – minor to major, adverse impacts.	**Cumulative Impacts** – similar to Alternative A.	**Cumulative Impacts** – similar to Alternative B.

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Figure S.1. Region/Vicinity Map for Big Thicket National Preserve



INTRODUCTION

CHAPTER 1



CHAPTER 1
INTRODUCTION

PURPOSE AND NEED FOR THIS PLAN

The purpose of this Oil and Gas Management Plan/Environmental Impact Statement (Plan/EIS) for Big Thicket National Preserve (hereinafter referred to as the "Preserve") is to analyze alternative approaches that could be implemented over the next 15-20 years for managing existing and anticipated oil and gas operations associated with the exercise of nonfederal oil and gas interests underlying the Preserve, and surface activities for existing transpark oil and gas pipelines in their associated rights-of-way. This is a programmatic management plan that establishes a general framework for managing oil and gas operations. By itself, it does not authorize any on-the-ground activities. The NPS will authorize specific projects by reviewing and approving operator-submitted plans of operations or special use permit applications. Before doing so, the NPS will conduct further analysis in accordance with the National Environmental Policy Act of 1969 (NEPA), the National Historic Preservation Act of 1966 (NHPA), the Endangered Species Act of 1973 (ESA), and other applicable federal laws.

Congress established Big Thicket National Preserve in 1974 "to assure the preservation, conservation, and protection of the natural, scenic, and recreational values of a significant portion of the Big Thicket area in the State of Texas and to provide for the enhancement and public enjoyment thereof." (16 U.S.C. 698(a)) When the Preserve was created, private entities retained the subsurface mineral interests on most of these lands, while the State of Texas retained the subsurface mineral interests underlying the Neches River and navigable reaches of Pine Island Bayou. Thus, the Federal Government does not own any of the subsurface oil and gas rights in the Preserve, yet the National Park Service (NPS) is required by its laws, policies and regulations to protect the Preserve from any actions, including oil and gas operations, that may adversely impact or impair Preserve resources and values. Prior to the NPS promulgating regulations pertinent to activities associated with nonfederal oil and gas rights, the NPS managed these activities by issuing special use permits. Since the implementation of NPS regulations in 1979 to manage nonfederal oil and gas rights at 36 CFR 9B, the NPS has annually requested funds to develop an Oil and Gas Management Plan/EIS. Funding was approved in 1997 to proceed with development of the Plan/EIS.

The proposed action is to adopt a comprehensive plan for management of oil and gas operations consistent with the purpose and values of the Preserve and NPS mandates for resource protection. At this time, there is no comprehensive oil and gas management plan to guide oil and gas activities within the Preserve. Currently, the NPS evaluates project-specific proposals for oil and gas exploration, production, and transportation on a case-by-case basis by applying a variety of Current Legal and Policy Requirements prior to issuing a permit under the regulatory framework of the NPS's Nonfederal Oil and Gas Rights Regulations (36 CFR 9B regulations) or Special Use Permits (36 CFR Parts 1-5). Many Current Legal and Policy Requirements involve other state and federal agencies who either are responsible for issuing specific resource-protection permits, or are agencies with whom the NPS consults to seek technical reviews and recommendations. Operators are often uncertain of the standards and requirements that NPS applies to protect resources, visitor use and experience, and human health and safety.

This Plan/EIS will be the first comprehensive plan ever prepared for the Preserve to manage activities associated with the exploration and development of nonfederal oil and gas. It is the intent of this planning effort to provide comprehensive, consistent direction for the Preserve for the next 15 to 20 years, and possibly longer, if there are no major changes in technology, and impacts do not

significantly change from those described; and to arrive at that direction through public participation. This Plan/EIS is the result of ongoing interaction with the public and affected government agencies which began in November 1998 (see Chapter 5, Consultation and Coordination sections).

The analysis area for this Plan/EIS includes the Preserve and extends approximately ½-mile outside the Preserve boundaries to include directional wells sited outside Preserve boundaries.

Oil and gas operations and transpark pipelines could potentially adversely impact natural and cultural resources, visitor use and experience, and human health and safety. The NPS must ensure that only appropriately planned and designed operations are approved; and that cumulative impacts are fully analyzed so that resources are not impaired to the degree that compromises the ecological integrity of the Preserve. Identifying potential impacts and applying appropriate operating standards, including no surface access and time/seasonal restrictions, along with other mitigation techniques, will avoid or mitigate adverse impacts. This Plan/EIS will provide up-front information on the location of Special Management Areas and suggest needed mitigation. Current Legal and Policy Requirements that apply to nonfederal oil and gas operations are explained in this document. Mitigation measures that may be included in plans of operations or attached as conditions of approval are also described.

Three alternatives are presented in this Plan/EIS. Alternative A, No Action/Current Management, is required by the National Environmental Policy Act and describes the continued management of oil and gas operations in the Preserve under Current Legal and Policy Requirements. Current Legal and Policy Requirements would apply to any alternative management plan that is selected for implementation. Alternative B emphasizes the development of a programmatic oil and gas management plan that would guide nonfederal oil and gas operations in the Preserve. Special Management Areas (SMAs) would be formally designated in the Preserve where resources and values would be particularly susceptible to adverse impacts from oil and gas operations, and operating stipulations specific to each SMA would be applied. Alternative B is the preferred alternative. Alternative C emphasizes avoiding new surface disturbance and its associated impacts throughout the Preserve. Alternative C is the environmentally preferred alternative.

SPECIAL MANDATES AND DIRECTION

This section describes the special mandates and direction that govern the scope of the Oil and Gas Management Plan for the Preserve. Special mandates define the constraints of what the Plan/EIS must include. It comprises the Preserve's enabling act which defines the purpose and significance of the Preserve, and Current Legal and Policy Requirements which define existing guidance based on laws, regulations, manuals, policies, and executive orders that apply to nonfederal oil and gas operations. Direction is also provided in planning documents for the Preserve.

NPS Organic Act and General Authorities Act

The NPS Organic Act (16 U.S.C. §§ 1 *et seq.*) provides the fundamental management direction for all units of the National Park System. Section 1 states that the NPS shall:

> "…promote and regulate the use of the federal areas known as national parks, monuments, and reservations…by such means and measures as conform to the fundamental purpose of said parks, monuments and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The National Park System General Authorities Act, 16 U.S.C. § 1a-1, affirms that while all national park system units remain "distinct in character," they are "united through their interrelated purposes and resources into one national park system as cumulative expressions of a single national heritage." The act makes it clear that the NPS Organic Act and other protective mandates apply equally to all units of the system. Further, the Redwood Act Amendments to the General Authorities Act clarified Congress' mandate to the NPS to protect park resources and values. The Amendments state, in part: "The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established except as may have been or shall be directly and specifically provided by Congress." (16 U.S.C. § 1a-1)

The NPS Organic Act and the General Authorities Act prohibit an impairment of park resources. The NPS Management Policies state that an impact to any park resource or value may constitute impairment. An impact would be more likely to constitute an impairment to the extent it affects a resource or value whose conservation is: 1) necessary to fulfill a specific purpose identified in the establishing legislation or proclamation of the park; 2) key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or 3) identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment is an impact that, in the professional judgement of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot be reasonably further mitigated, of an action necessary to preserve or restore the integrity of park resources or values.

NPS Management Policies use the terms "resources and values" to mean the full spectrum of tangible and intangible attributes for which the parks are established and are being managed, including the Organic Act's fundamental purposes (as supplemented), and any additional purposes as stated in a park's establishing legislation. Park resources and values that are subject to the no impairment standard include: the biological and physical processes which created the park and that continue to act upon it; scenic features; natural visibility; natural soundscapes and smells; water and air resources; soils; geological resources; paleontological resources; archeological resources; cultural landscapes; ethnographic resources; historic and prehistoric sites, structures and objects; museum collections; and native plants and animals.

The NPS also includes the park's role in contributing to the national dignity, the high public value and integrity, and the superlative environmental quality of the National Park System, and the benefit and inspiration provided to the American people by the National Park System among the values that are subject to the no impairment standard. Finally, unless the activity is required by statute, NPS cannot allow an activity in a park if it would involve or result in:

1) inconsistency with the park's enabling legislation or proclamation, or derogation of the values or purposes for which the park was established;
2) unacceptable impacts on visitor enjoyment due to interference or conflict with other visitor use activities;
3) consumptive use of park resources;
4) unacceptable impacts on park resources or natural processes; and
5) unacceptable levels of danger to the welfare or safety of the public.

For these reasons, this Plan/EIS provides an analysis of the potential of each alternative to leave park resources and values unimpaired relative to existing and future oil and gas operations. The Plan/EIS provides in Chapter 4 an analysis of oil and gas operations for each resource identified as potentially affected by oil and gas operations to determine the potential for impairment.

Big Thicket National Preserve Enabling Act

Congress established the Big Thicket National Preserve on October 11, 1974 (Public Law 93-439, 16 U.S.C. § 698 – 698e).

Under the NPS Organic Act (16 U.S.C. § 3) and § 4(b) of the Big Thicket National Preserve enabling Act (16 U.S.C. § 698c(b)), Congress authorized the Secretary of the Interior to promulgate regulations to manage nonfederal oil and gas operations associated with development of nonfederal oil and gas underlying the Preserve. These regulations, the NPS's Nonfederal Oil and Gas Rights Regulations, are published at Title 36 of the Code of Federal Regulations, Part 9, Subpart B (36 CFR Part 9B).

The establishment of Big Thicket as a national preserve created a new National Park System category, which meets different criteria than other parks and recreation areas within the System. These criteria were set forth in the House of Representatives committee report (House Committee Report No. 93-676) pertaining to the establishment of Big Thicket National Preserve and Big Cypress National Preserve, approved on the same date, as follows:

> "In the past, the Congress has authorized and established many areas for inclusion in the National Park System: national parks, national monuments, national recreation areas, national historic sites, and others. A systematic effort has been made to establish standards or criteria for each of these different categories in an effort to maintain the integrity of the values which each attempts to serve. The description of the [Big Thicket] area as a national preserve will establish a new category which can serve as a feasible and desirable vehicle for the consideration of other nationally significant natural areas which differ from the qualities attributed to national parks and national recreation areas. The committee chose to call the area a preserve rather than a reserve, feeling that such distinction may be important. Reserve refers to stock – a commodity held for future use. Preserve refers more definitively to the keeping or safeguarding of something basically protected and perpetuated for an intended or stated purpose, as with the specific objectives for [Big Thicket] provided by this legislation.
>
> In general, national preserves will be areas of land and/or water which may vary in size, but which possess within their boundaries exceptional values or qualities illustrating the natural heritage of the Nation. Such areas would often be characterized by significant scientific values, including, but not limited to, ecological communities illustrating the process of succession, natural phenomena, or climax communities. In addition, they could be characterized by a habitat supporting a vanishing, rare or restricted species; a relict flora or fauna persisting from an earlier period; or large concentrations of wildlife species. Other scientific, geologic, geomorphic or topographic values might also contribute to the purposes for which an area might be recognized.
>
> The principal purpose of these areas should be the preservation of the natural values which they contain. They might differ, in some respects, from national parks and monuments insofar as administrative policies are concerned. Hunting, for example, subject to reasonable regulation by the Secretary, could be permitted to the extent compatible with the purposes for which the area is established. Other activities, including the extraction of minerals, oil, and gas could be permitted if such activities could be conducted without jeopardizing the natural values for which the area seeks to preserve. Management of the watershed resources might also be appropriate if that would enhance the value of the preserve as it serves other needs.
>
> All management activities within these areas should be directed toward maintaining the natural and scientific values of the area, including the preservation of the flora and fauna and the reestablishment of the indigenous plant and animal life, if possible. Areas where

scientific discoveries or historical events took place would contribute to the values of the preserve and should be managed in a manner which will maximize both the natural and historical values.

National preserves may accommodate significant recreational uses without impairing the natural values, but such public use and enjoyment would be limited to activities where, or periods when, such human visitation would not interfere with or disrupt the values which the area is created to preserve.

Construction of physical facilities of any kind would be minimized and would be limited to those developments which are essential to the preservation and management of the area and the safety of the public. To the extent such facilities are deemed necessary and appropriate they would be constructed in a manner which would minimize their impact on the environment and their intrusion on the natural setting."

General Management Plan Direction

The General Management Plan (GMP) is the major planning document for all National Park System units. The GMP sets forth the basic philosophy of the unit, and provides strategies for resolving issues and achieving identified management objectives required for resource management and visitor use. The GMP includes environmental analysis and other required compliance documentation.

The NPS approved a General Management Plan for the Preserve in September 1980. In the GMP, all decisions concerning the management, use, and development of the Preserve are directed toward achieving the following objectives:

Natural Resource Management

- To perpetuate and protect the Preserve's unique mixture of temperate and subtropical botanical communities
- To initiate joint planning and natural resource management programs with neighboring landowners to promote continued compatible land use
- To establish cooperative agreements or memorandums of understanding with all necessary state agencies to ensure adequate control, preservation, and management of Preserve lands
- To proceed with research activities that provide baseline data necessary for future planning and management efforts and for the evaluation of the environmental impacts of human use on the Preserve

Cultural Resource Management

- To identify, protect, preserve, and interpret the Preserve's cultural resources (including the remains of pioneer homesteads, early lumber mills, oil drilling operations, and Indian archeological sites, [and ethnographic and cultural landscape resources]) in accordance with legislation, executive requirements, NPS policies, and the purpose for which the Preserve was established

Land Acquisition

- To continue to acquire land through the approved land acquisition plan, ensuring preservation of the biological ecotones and providing interpretive capabilities within the authorized boundary

Development

- To complete initial planning documents and initiate interpretive and development concepts as soon as practical, keeping in mind the limiting constraints placed in P.L. 93-439

- To encourage by whatever means available the use of private capital in the development of necessary visitor accommodations and facilities at strategic locations outside the boundaries of the Preserve

Interpretation and Education

- To foster understanding and appreciation of the Preserve's unique and interesting mixture of vegetative communities, wildlife, and cultural resources through provision of varied interpretive and educational programs

- To encourage educational use and scientific study of the preserve by schools and other groups interested in the Preserve's rich variety of natural resources

- The GMP recognized human use of resources such as oil, gas, timber, homesteads, and hunting and fishing as an interpretive theme.

Maintenance

- To maintain the Preserve's resources in a manner that most effectively and efficiently responds to the decentralized nature of the Preserve units

Special Uses

- To develop and maintain the capability to realistically assess impacts caused by allowable special uses within required regulation time frames

Management Zoning

- The General Management Plan designated management zones for the Preserve, taking into consideration that the diverse biological, physical, and historical resources within the Preserve have different inherent values and varying sensitivity to human use. The intent of zoning is to recognize these differences and to focus future management on the particular types of activities and developments appropriate for each zone. The zoning system applied is common to most National Park System units – the natural, historic, development, and special use zones. Most of the Preserve is designated "natural zone", which places management emphasis on conservation of natural resources and processes while providing for uses that do not adversely affect these resources and processes. However, public hunting, trapping, and fishing preclude any attempt at strict fauna preservation. And, because mineral rights were not acquired by the National Park Service, the exploration for and extraction of oil and gas continues in and around the Preserve. The National Park Service recognizes that it cannot enforce more restrictive zoning within the Preserve while the foregoing uses continue. All new nonfederal oil and gas production sites are placed in an Exploration/Mining Subzone, and the sites are removed from their previous

management zones. When nonfederal oil and gas operations end, the area is reclaimed and the zone reclassified.

NPS Nonfederal Oil and Gas Regulations, 36 CFR 9B

The NPS Nonfederal Oil and Gas Rights Regulations at 36 CFR Part 9, Subpart B, and other regulatory requirements establish standards for the conduct of oil and gas activities within a unit so park managers can ensure that those activities are conducted in a manner that protects park resources and values. The NPS must determine that these activities do not impair park resources and values to the extent they preclude visitor enjoyment of the park now and for future generations. The 9B regulations provide the NPS with an existing regulatory framework to manage the effects of oil and gas operations within the parks. The application and implementation of these regulations must be assessed parkwide as well as for each site specific oil and gas activity to determine if these activities have the potential to impair park resources and values.

The NPS, as a Federal Governmental entity, has authority to regulate nonfederal oil and gas exploration and production in units of the National Park System, including Big Thicket National Preserve. The authority to manage and protect federal property arises from the Property Clause of the United States Constitution. The Property Clause provides that "Congress shall have Power to dispose of and make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States . . ." U.S. Const. Art. IV, § 3, cl. 2.

Congress' power over federally-owned lands is without limitations, and extends to conduct that occurs on or off federal land that affects federal lands. Courts have consistently upheld Congress' broad delegation of authority to federal land managing agencies under the Property Clause in a variety of contexts. See Kleppe v. New Mexico, 426 U.S. 526 (1976); Stupak-Thrall v. United States, 70 F.3d 881 (6th Cir. 1995) (upholding Forest Service's authority to regulate privately-held surface rights to a lake within a wilderness area); Duncan Energy Co. v. Forest Service, 50 F.3d 584 (8th Cir. 1995) (upholding Forest Service's authority to regulate activities related to private mineral rights underlying National Forest); United States v. Vogler, 859 F.2d 638 (9th Cir. 1988) (upholding NPS regulation of access to a private mining claim in a park); Free Enterprise Canoe Renter's Assoc. v. Watt, 711 F.2d 852 (8th Cir. 1983) (upholding NPS regulations requiring permit for canoe rental businesses located outside park); Minnesota v. Block, 660 F.2d 1240 (8th Cir. 1981) (upholding Forest Service regulation of snowmobile activities on state land).

In 1916, Congress exercised its power under the Property Clause and passed the NPS Organic Act, 16 U.S.C. §§ 1 *et seq*. Congress directed the NPS to "promote and regulate" units of the National Park System "to conserve the scenery and the natural and historic objects and the wild life therein to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (16 U.S.C. § 1) Congress also mandated that the protection, management, and administration of such units "shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established…" (16 U.S.C. § 1a-1) Congress further authorized the Secretary of the Interior to "make and publish such rules and regulations as he may deem necessary or proper for the use of the parks…" (16 U.S.C. § 3)

Pursuant to Section 3 of the NPS Organic Act and individual park statutes (including the enabling act for Big Thicket National Preserve) the Secretary of the Interior promulgated regulations at 36 CFR Part 9, Subpart B ("9B regulations") in 1979 to "insure that activities undertaken pursuant to [nonfederal oil and gas rights] are conducted in a manner consistent with the purposes for which the National Park System and each unit thereof were created, to prevent or minimize damage to the environment and other resource values, and to insure to the extent feasible that all units of the National Park System are left unimpaired for the enjoyment of future generations" (see 36 CFR §

9.30). The 9B regulations apply to operations that require access on or through federally-owned or controlled lands or waters in connection with nonfederally owned oil and gas in all National Park System units (36 CFR § 9.30(a)). "Operations" is broadly defined under the regulations to include all activities associated with the exploration for and production of nonfederally owned or controlled oil and gas, from gathering basic information to comply with the regulations to the transport of petroleum products (36 CFR § 9.31(c)). The critical component of the regulations is the requirement that an operator submit and obtain NPS approval of a proposed Plan of Operations before commencing oil and gas exploration or production activities (36 CFR § 9.36). Such plans are essentially a prospective operator's "blueprint" for conducting activities including impact mitigation and site reclamation. Operators are responsible for preparing a Plan of Operations that addresses all information requirements applicable to proposed operations. Operators must supply this information in sufficient detail to enable the NPS to effectively analyze the impacts of the proposed operations on the particular unit's resources and values, and to determine whether to approve the proposed plan (36 CFR § 9.36(c)). The park Superintendent's or Regional Director's decisions under the 36 CFR Part 9B regulations can be administratively appealed by the operator (see 36 CFR § 9.49). The 36 CFR 9B regulations are presented in Appendix B.

The 36 CFR 9B regulations fall within the broad scope of authority granted to the NPS from Congress under the NPS Organic Act – authority that includes the power to regulate conduct that occurs on or off federal land, which may affect federal lands. The United States need not own the mineral interest beneath Big Thicket National Preserve to regulate rights associated with that interest that may affect the federally-owned surface. However, the NPS limited the application of the 9B regulations to situations where operators must cross federally-owned or controlled lands or waters to reach their oil and gas rights in parks.

Both state and federal law govern the conduct of oil and gas operations at Big Thicket National Preserve. However, to the extent that state laws conflict with the federal statutory and regulatory requirements governing the exercise of nonfederal oil and gas rights at the Preserve, the state law must yield to federal requirements.

This planning effort is designed to provide Preserve staff and oil and gas operators with a comprehensive framework for the NPS to manage the development of nonfederal oil and gas. The planning process will not (indeed it cannot) effect a substantive change to the laws and regulations governing the management of park system resources. Changes to the NPS's governing laws and regulations are made either by Congress or by the NPS through rulemaking under the Administrative Procedures Act, respectively.

Directional Drilling. Most of the wells currently developing hydrocarbons beneath the Preserve have been directionally drilled from surface locations outside the Preserve. Section 9.32(e) of the NPS's 36 CFR 9B regulations governs operators that propose to develop their nonfederal oil and gas rights in any unit of the National Park System by directionally drilling a well from a surface location outside unit boundaries to a location under federally-owned or controlled lands within park boundaries. Per § 9.32(e), an operator may obtain an exemption from the 9B regulations if the Regional Director is able to determine from available data that a proposed drilling operation under the park poses *"no significant threat of damage to park resources, both surface and subsurface, resulting from surface subsidence, fracture of geological formations with resultant fresh water acquifer [sic] contamination or natural gas escape or the like."* It is limited in scope to those aspects of the directional drilling operation occurring within park boundaries. The regulations define operations as "*all functions, work and activities <u>within a unit</u> in connection with exploration for and development of oil and gas resources, the right to which is not owned by the United States…"* (36 CFR § 9.31(c), underlining added). Operators seeking an exemption to the NPS 9B regulations must submit a § 9.32(e) Application for Directional Drilling. Further guidance on the NPS's directional drilling provision under § 9.32(e) is provided in Chapter 2, Part II.

Regulation of Transpark Oil and Gas Pipelines and Activities in Associated Rights-of-Way

Existing transpark oil and gas pipelines and their rights-of-way lie outside the scope of the 9B regulations. Transpark oil and gas pipelines have their point of origin and end point outside parks, and are operated by persons or entities exercising rights not tied to the oil and gas ownership within the park boundary. As a result, they are not subject to the existing 9B regulations. If a nonfederal oil and gas operation in a park connects to such a pipeline **via a flowline or gathering line** then that portion of the flowline or gathering line crossing the park would be subject to the 9B regulations, including the Plan of Operations requirement.

While most transpark oil and gas pipelines are not subject to the 9B regulations, they are either subject to federal Department of Transportation (DOT) regulations at 49 CFR Subtitle B, Chapter 1, Parts 190-199, Texas State requirements, and other applicable federal and state laws. The DOT regulations govern safety and environmental protection considerations affiliated with interstate pipelines. Specifically, the DOT regulations cover testing, reporting, inspection, maintenance, corrosion control and spill contingency plans of these pipelines. State regulations often mirror the federal requirements and govern intrastate pipelines. In the State of Texas, the Railroad Commission of Texas administers state requirements on oil and gas pipelines under Texas law (*See* Tx. Rev. Stat. S81.011(a) *et seq.*). Transpark pipeline operators should note that if park system resources are damaged from operation of that pipeline in a park unit, the NPS can exercise its authority under the Act of July 27, 1990, Pub. L. No. 101-337, 104 Stat. 379, codified as amended at 16 U.S.C. §§ 19jj through 19jj-4 (2000), to undertake all necessary actions to protect park system resources. Operators will be held liable to the United States for its response costs as well as for any damages to park system resources. See id. at § 19jj-1.

NOTE: In Big Thicket National Preserve, no statutory authority exists for granting new rights-of-way for oil and gas pipelines. However, new pipelines may be constructed within existing rights-of-way in conformance with the terms of the legal document creating the rights-of-way. When an entity seeks to construct a new pipeline carrying natural gas, it must first obtain a *certificate of public convenience and necessity* from the Federal Energy Regulatory Commission (FERC) (see 18 CFR § 157.7). FERC determines “where” new natural gas pipelines can be built while DOT regulates the “hows” from a public safety and resource protection perspective. FERC does not oversee the construction of oil and gas pipelines or regulate the supply and price of oil or oil products. In addition to authorizing the siting of natural gas lines, FERC also is responsible for establishing just and reasonable pricing rates for moving both natural gas and oil through pipelines in interstate commerce throughout the country.

With respect to activities within rights-of-way associated with transpark oil and gas pipelines, the NPS has existing regulatory authority to control those activities. The regulations are codified at 36 CFR Parts 1 and 5. They consist of general regulations controlling a variety of activities in parks. To the extent that a proposed activity in a right-of-way triggers the general regulations, a Special Use Permit must be obtained from the NPS before the conduct of the activity. Mowing and trimming vegetation, inspection or testing pipelines, and installing, shutting down or replacing pipelines, are common activities in pipeline rights-of-way requiring a Special Use Permit. Such activities are routine and provide for personal safety, leak or spill detection, and unencumbered response in the event of a spill or emergency.

Applicable Legal and Policy Requirements

Table 1.1, below, summarizes many, but not all, of the legal and policy mandates governing nonfederal oil and gas operations in the units of the National Park System. These include statutes, regulations, executive orders and NPS policies. All of the alternatives presented in this Plan/EIS are subject to these requirements. Appendix C, Federal Laws, Regulations, Executive Orders, Policies and Guidelines that Apply to Nonfederal Oil and Gas Operations contains summary descriptions of many of the Current Legal and Policy Requirements listed in Table 1.1.

Table 1.1. Legal and Policy Mandates Governing Nonfederal Oil and Gas Operations

AUTHORITIES	RESOURCES AND VALUES AFFORDED PROTECTION
National Park Service Laws and Applicable Regulations	
NPS Organic Act of 1916, as amended, 16 U.S.C. §§ 1 *et seq.*	All resources, including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, threatened and endangered species, visitor use and experience, and visual resources
National Park System General Authorities Act, 16 U.S.C. §§ 1a-1 *et seq.*	All resources, including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, threatened and endangered species, visitor use and experience, and visual resources
National Park Service Omnibus Management Act of 1998, 16 U.S.C. §§ 5901 *et seq.*	Any living or non-living resource
NPS Nonfederal Oil and Gas Regulations – 36 CFR Part 9, Subpart B	All, e.g., air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, Threatened and Endangered species, visitor use and experience
Park System Resource Protection Act, 16 U.S.C. § 19jj	Any living or non-living resource that is located within the boundaries of a unit of the National Park System, except for resources owned by a nonfederal entity
Enabling Act for Big Thicket National Preserve, 16 U.S.C., § 698a	Natural, scenic, and recreational values
Other Applicable Federal Laws and Regulations	
American Indian Religious Freedom Act , as amended, 42 U.S.C. §§ 1996 – 1996a; 43 CFR Part 7	Cultural and historic resources
Antiquities Act of 1906, 16 U.S.C. §§ 431-433; 43 CFR Part 3	Cultural, historic, archeological, paleontological resources
Archaeological Resources Protection Act of 1979, 16 U.S.C. §§ 470aa – 470mm; 18 CFR Part 1312; 32 CFR Part 229; 36 CFR Part 296; 43 CFR Part 7	Archeological resources
Clean Air Act, as amended, 42 U.S.C. §§ 7401-7671q; 40 CFR Parts 23, 50, 51, 52, 58, 60, 61, 82, and 93; 48 CFR Part 23	Air resources
Coastal Zone Management Act of 1972, 16 U.S.C. § 1451 *et seq*., 15 CFR Parts 923, 930, 933	Coastal waters and adjacent shoreline areas
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §§ 9601-9675; 40 CFR Parts 279, 300, 302, 355, and 373	Human health and welfare and the environment
Endangered Species Act of 1973, as amended, 16 U.S.C. §§ 1531-1544; 36 CFR Part 13; 50 CFR Parts 10, 17, 23, 81, 217, 222, 225, 402, and 450	Plant and animal species or subspecies and their habitat, which have been listed as threatened or endangered by the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS)
Federal Insecticide, Fungicide, and Rodenticide Act, as amended (commonly referred to as Federal Environmental Pesticide Control Act of 1972), 7 U.S.C. §§ 136 *et. seq.;* 40 CFR Parts 152-180, except Part 157	Human health and safety and the environment
Federal Land Policy and Management Act of 1976, 43 U.S.C. §§ 1701 *et seq.;* 43 CFR Part 2200 for land exchanges and 43 CFR Parts 1700-9000 for all other BLM activities	Federal lands and resources administered by the Bureau of Land Management
Federal Water Pollution Control Act of 1972 (commonly	Water resources, wetlands, and waters of the U.S.

AUTHORITIES	RESOURCES AND VALUES AFFORDED PROTECTION
referred to as Clean Water Act), 33 U.S.C. §§ 1251 *et seq.;* 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328	
Historic Sites, Buildings, and Antiquities Act (Historic Sites Act of 1935), 16 U.S.C. §§ 461-467; 18 CFR Part 6; 36 CFR Parts 1, 62, 63, and 65	Historic sites, buildings and objects
Lacey Act, as amended, 16 U.S.C. §§ 3371 *et seq.;* 15 CFR Parts 10, 11, 12, 14, 300, and 904	Fish and wildlife, vegetation
Migratory Bird Treaty Act, as amended, 16 U.S.C. §§ 703-712; 50 CFR Parts 10, 12, 20, and 21	Migratory birds
National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321 *et seq.;* 40 CFR Parts 1500-1508	The human environment (e.g., cultural and historic resources, natural resources, biodiversity, human health and safety, socioeconomic environment, visitor use and experience)
National Historic Preservation Act of 1966, as amended, 16 U.S.C. §§ 470-470x-6; 36 CFR Parts 60, 63, 78, 79, 800, 801, and 810	Cultural and historic properties listed in or determined to be eligible for listing in the National Register of Historic Places
Native American Graves Protection and Repatriation Act, 25 U.S.C. §§ 3001-3013; 43 CFR Part 10	Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony
Noise Control Act of 1972, 42 U.S.C. §§ 4901-4918; 40 CFR Part 211	Human health and welfare
Oil Pollution Act, 33 U.S.C. §§ 2701-2761; 15 CFR Part 990; 33 CFR Parts 135, 137, and 150; 40 CFR Part 112; 49 CFR Part 106	Water resources, natural resources
Pipeline Safety Act of 1992, 49 U.S.C. §§ 60101 *et seq*.; 49 CFR Subtitle B, Ch 1, Parts 190-199	Human health and safety, and the environment
Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901 *et. seq*.; 40 CFR Parts 240-280; 49 CFR Parts 171-179	Natural resources, human health and safety
Rivers and Harbors Act of 1899, as amended, 33 U.S.C. §§ 401 *et. seq*.; 33 CFR Parts 114, 115, 116, 321, 322, and 333	Shorelines and navigable waterways, tidal waters, wetlands
Safe Drinking Water Act of 1974, 42 U.S.C. §§ 300f *et seq*.; 40 CFR Parts 141-148	Human health, water resources
Executive Orders	
Executive Order 11593 – Protection and Enhancement of the Cultural Environment, 36 Fed. Reg. 8921 (1971)	Cultural resources
Executive Order 11988 – Floodplain Management, 42 Fed. Reg. 26951 (1977)	Floodplains, human health, safety, and welfare
Executive Order 11990 – Protection of Wetlands, 42 Fed. Reg. 26961 (1977)	Wetlands
Executive Order 12088 – Federal Compliance with Pollution Control Standards, 43 Fed. Reg. 47707 (1978)	Natural resources, human health and safety
Executive Order 12630 – Governmental Actions and Interference with Constitutionally Protected Property Rights, 53 Fed. Reg. 8859 (1988)	Private property rights, public funds
Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, amended by Exec. Order No. 12948, 60 Fed. Reg. 6379 (1995)	Human health and safety Minority populations and low-income populations
Executive Order 13007 – Indian Sacred Sites, 61 Fed. Reg. 26771 (1996)	Native Americans' sacred sites
Executive Order 13112 – Invasive Species, 64 Fed. Reg. 6183 (1999)	Vegetation and wildlife
Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3853 (2001)	Migratory birds
Executive Order 13212 – Actions to Expedite Energy-Related Projects, 66 Fed. Reg. 28357 (2001)	Production, transmission, and conservation of energy

AUTHORITIES	RESOURCES AND VALUES AFFORDED PROTECTION
Policies, Guidelines and Procedures	
NPS Management Policies (2001)	All resources including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, threatened and endangered species, visitor use and experience, visual resources
Dept. of the Interior, Departmental Manual, DM 516 – NEPA policies (1980)	All resources including cultural resources, historic resources, natural resources, human health and safety
Dept. of the Interior, Departmental Manual, DM 517 – Pesticides (1981)	Human health and safety, and the environment
Dept. of the Interior, Departmental Manual, DM 519 – Protection of the Cultural Environment (1994)	Archeological, prehistoric resources, historic resources, Native American human remains, and cultural objects
Dept. of the Interior, Onshore Oil and Gas Order Number 2, Section III, Drilling Abandonment Requirements, 53 Fed. Reg. 46,810 - 46,811 (1988)	Human health and safety
NPS Director's Order 12 and Handbook – Conservation Planning, Environmental Impact Analysis, and Decision Making (2001)	All resources including natural resources, cultural resources, human health and safety, socioeconomic environment, visitor use
NPS Director's Order 28 – Cultural Resource Management (1998)	Cultural, historic, and ethnographic resources
NPS Director's Order and Reference Manual 53 – Special Park Uses (2000)	All resources, including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, threatened and endangered species, visitor use and experience, and visual resources
NPS 66 – Minerals Management Guideline (1990)	Natural resources, human health and safety
NPS Reference Manual 77 – Natural Resources Management (1991)	Natural resources
NPS Director's Order and Procedural Manual 77-1 – Wetland Protection (2002)	Wetlands
NPS Director's Order and Procedural Manual 77-2 – Floodplain Management (2003)	Floodplains
Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation," 48 Fed. Reg. 44716 (1983), also published as Appendix C of NPS Director's Order 28 – Cultural Resource Management	Cultural and historic resources
Government-to-Government Relations with Native American Tribal Governments, Presidential Memorandum (April 29, 1994)	Native Americans – Tribal rights and interests
Selected Texas Laws and Regulations	
Texas Natural Resources Code, Title 2, Chapter 40 (Oil Spill Prevention and Response Act of 1991, also liability for natural resources damages from spills), TX. NAT. RES. CODE tit. 2, § 40 (1991)	Human health and safety, natural resources
Texas Natural Resources Code, Title 3, Chapters 81 through 85 (oil and gas operations) (TAC tit. 16, part 1, § 3)	Human health and safety, natural resources
Title 16 Texas Administrative Code Part 1 – Railroad Commission of Texas, Chapter 3 – Oil and Gas Division	Human health and safety, natural resources

THE PLANNING PROCESS

The oil and gas management planning process consists of the following steps:

- establish a planning team;
- develop the purpose and need for the plan and the planning objectives;
- scope with the public and governmental agencies;
- identify resources and concerns, and collect data;
- identify resources and concerns to be addressed in the plan, and those to be dropped from further analysis;
- generate alternatives;
- assess the impacts of each alternative; and,
- document the results of the analysis.

Establishing a Planning Team

The first step in the planning process was to establish an interdisciplinary planning team (IDT). The IDT consists of approximately 55 team members, including NPS, U.S. Geological Survey (USGS), and contract technical specialists. Eighteen NPS staff are chiefly responsible for developing the Plan/EIS. Two members have worked in the oil and gas industry, while eight others have experience working with the oil and gas industry on regulatory and operational issues. Other NPS staff who contributed to the production of the Plan/EIS provide expertise in the areas of geographic information systems; environmental statutes and regulations; and a range of resource issues and concerns including nonfederal oil and gas development, air quality, geology, water resources, floodplains, vegetation, wetlands, fish and wildlife, threatened and endangered species, cultural resources, visitor use and experience, and adjacent land uses and resources.

Through internal and public scoping, the planning team identified no cooperating agencies in the development of the Oil and Gas Management Plan/EIS.

Through internal scoping, the planning team identified the following federal and state agencies that may be involved in the permitting process for nonfederal oil and gas operations and transpark pipeline activities within the Preserve. None of these agencies asked to be a cooperating agency. The agencies and affiliated groups include:

- The NPS consults with the following entities on a project-by-project basis if a proposal could have effects on floodplains or wetlands:

  U.S. Environmental Protection Agency,
  Federal Emergency Management Agency,
  U.S. Fish and Wildlife Service,
  U.S. Geological Survey,
  U.S. Army Corps of Engineers,
  Natural Resources Conservation Service,
  State A-95 (EO12372) Clearinghouse, and
  River Basin Commissions, which may include the Trinity River Authority, Upper Neches River Municipal Water Authority, Angelina and Neches River Authority, and Lower Neches Valley Authority.

  If the proposed action involves locating operations in a floodplain or wetland, a Statement of Findings (SOF) will be prepared. The Statement of Findings documents why there is no practicable alternative to locating in or impacting these areas and certifies that no critical

actions are involved. The SOF is made available for review and comment concurrently with the NEPA analysis.

- **U.S. Fish and Wildlife Service (FWS).** Pursuant to the Endangered Species Act, the NPS consults with the FWS on a project-by-project basis to request an updated list of federally-listed threatened, endangered, and sensitive species in the project area, and to evaluate the adequacy of resource survey information and associated mitigation measures being employed to avoid potential adverse impacts to listed species or their habitat.

- Also pursuant to the Endangered Species Act, the NPS consults with the **Texas Parks and Wildlife Department** on a project-by-project basis to request an updated list of state-listed species, and to evaluate the adequacy of resource survey information and associated mitigation measures being employed to avoid or mitigate potential impacts to state-listed threatened/endangered species or their habitat.

- **Texas Parks and Wildlife Department, Texas State General Land Office, and Texas Commission on Environmental Quality (formerly the Texas Natural Resource Conservation Commission)** share natural resource trusteeship of the biota (plant and animal life), submerged lands, and groundwater, respectively, at Big Thicket National Preserve.

- **Texas Commission on Environmental Quality (TCEQ)** is the designated state on-scene coordinator for onshore oil and all chemical releases. The TCEQ also is the state agency designated by the U.S. Environmental Protection Agency to administer the statewide permitting program under the Clean Air Act. Pursuant to Section 401 of the Clean Water Act, TCEQ is also responsible for conducting Section 401 state water quality certification reviews of COE Section 404 permit applications for the discharge of dredge or fill material into the water of the United States, including wetlands. TCEQ is the lead agency that administers the Section 401 certification program except with respect to oil and gas exploration and production, which is the responsibility of the Railroad Commission of Texas (TNRCC, 1999).

- **Texas State General Land Office** administers the leasing program for state-owned oil and gas. In the Preserve, the state's oil and gas are located beneath the Neches River and navigable reaches of Pine Island Bayou. It also administers the federally-approved Coastal Zone Management Program (CZMP), which includes a portion of the Beaumont Unit of Big Thicket National Preserve. The NPS would coordinate with the Coastal Coordination Council to seek a consistency determination with the CZMP whenever a plan of operations may have the potential to adversely affect coastal natural resource areas.

- **U.S. Coast Guard and U.S. Environmental Protection Agency** respond to releases of contaminating and hazardous substances in coastal and terrestrial environments, respectively. The NPS reports releases of oil and contaminating and hazardous substances to the National Response Center under the requirements of the National Contingency Plan.

- **Texas State Historic Preservation Officer (SHPO).** Pursuant to § 106 of the National Historic Preservation Act, the NPS consults with the SHPO on a project-by-project basis to evaluate the adequacy of cultural resources information and to assess and mitigate effects on cultural resources.

- **Railroad Commission of Texas (RCT).** This State agency administers state requirements for oil and gas production and pipeline safety and environmental protection under its Statewide Oil and Gas Rules. RCT regulates and controls the orderly exploration, development, and production of oil, gas, and geothermal resources for the State under its Conservation Rules and Regulations, which apply to all fields and districts in the State. Operations within RCT jurisdiction include, but are not limited to: a) drilling, operating, or producing any oil, gas, or oil and gas waste disposal well; b) transporting, reclaiming, treating, processing, or refining crude oil, gas, and products; c) discharging, storing, handling, transporting, reclaiming, or disposing of oil and gas waste; d) operating a directional survey company; e) operating a pipeline; and f) operating as a cementer approved for plugging wells.

- **U.S. Army Corps of Engineers (COE)** administers § 404 permitting for dredge and fill into waters of the United States. Operations that require a § 404 permit would consult with the Corps of Engineers. The COE would also approve wetlands delineations by operators and evaluate potential direct and indirect impacts on wetlands.

  However, in many cases, the § 404 permit program does not meet the wetlands protection directives of E.O. 11990 for National Park resources. E.O. 11990 covers a broader range of actions that can adversely impact wetlands, including groundwater withdrawals, water diversions, drainage, pumping, flooding, dredging, channelizing, filling, nutrient enrichment, diking, impounding, placement of structures or other facilities, and other activities that degrade natural wetland processes, functions, or values.

  The Corps of Engineers also administers permitting under § 10 of the Rivers and Harbors Appropriation Act of 1899. A Department of Army authorization is required for work in, on, or below navigable waters of the United States. Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. (33 CFR § 329.4)

- **Department of Transportation** administers several federal statutes pertinent to oil and gas pipeline safety and environmental protection. The Department's pipeline regulations are codified at 49 CFR Parts 190 through 195.

In addition to the state and federal agencies listed above, the NPS identified groups with ethnographic affiliation with Big Thicket National Preserve. Pursuant to Section 106 of the National Historic Preservation Act, the NPS is responsible for determining whether or not historic properties to which American Indian Tribes may ascribe cultural or religious significance may be affected by its undertakings. The **Alabama-Coushatta Tribe of Texas** and **Coushatta Tribe of Louisiana** were consulted during the development of this plan because their customary homeland was in the north and west edges of the Big Thicket. The NPS consulted with the Tribes to inform them of the planning process and issues that could affect lands and resources that may be significant to them, and to determine if there were any resource issues with which the Alabama and Coushatta Tribes had traditional cultural association. During an October 1998 meeting between the NPS and representatives of the tribes, specific ethnographic resources that might be affected by oil and gas developments were identified. In particular, preservation of the Coushatta Trace, bisecting the Big Sandy Unit, was identified. To ensure the preservation of ethnographic resources, the NPS will continue to consult with the Tribes on a case-by-case basis as proposed plans of operations are submitted.

Developing Planning Objectives

The planning objectives of this Plan/EIS are to:

- Identify Preserve resources and values susceptible to adverse impacts from oil and gas operations.
- Establish performance standards and impact mitigation measures for oil and gas operations to protect and prevent impairment to Preserve resources and values from adverse impacts from oil and gas operations.
- Establish performance standards and impact mitigation measures for oil and gas operations to avoid or minimize impacts from oil and gas operations on visitor use and enjoyment, and human health and safety.
- Provide holders of oil and gas rights reasonable access for exploration and development.
- Provide pertinent information to oil and gas operators to facilitate planning and compliance with NPS and other applicable regulations.

Scoping with the Public and Governmental Agencies

Public scoping is required under the National Environmental Policy Act (NEPA). Scoping involves the solicitation of comments from the public regarding projects that are considered "major federal actions" under the NEPA. Issues and concerns raised by the public during scoping are used by the NPS to establish what topics needs to be addressed in the EIS and to develop a reasonable range of alternatives to address these issues and concerns. The public scoping process undertaken during the development of the Plan/EIS is described in Chapter 5, Consultation and Coordination.

All issues, concerns, and alternatives identified during public scoping have were considered by the NPS for inclusion in the Plan/EIS. A Scoping Analysis is provided in Table 5.1, Consultation and Coordination chapter, which lists public comments received during scoping.

While the NPS considers public comments throughout the EIS process, specific opportunities for the public to submit comments are during the public scoping period and during the public review of a Draft Plan/EIS. During the review of the Draft Plan/EIS, the public was encouraged to review and evaluate the analysis and provide written comments to the NPS whether the issues that were raised during scoping have been adequately addressed and whether the analysis of environmental impacts is sufficient. The Draft Plan/EIS is followed by the Final Plan/EIS that includes corrections and additions to the text. All substantive written comments submitted on the Draft Plan/EIS are addressed by the NPS either by providing clarification of information, modifying text, or directly responding in the Final Plan/EIS. This Final Plan/EIS contains a reprint of all substantive comment letters and NPS responses. The Final Plan/EIS will be released for a standard 30-day "No Action" period prior to the NPS issuing a Record of Decision (ROD). Upon issuance of the ROD, the selected plan alternative will be implemented.

Identifying Resources and Concerns, and Collecting Data

The interdisciplinary team, through comments submitted during the public scoping period, identified the following resources and concerns that could be affected by implementation of the Plan/EIS:

Resources

- Air quality
- American beech-southern magnolia-loblolly pine forests
- Cultural resources
- Ecological research and monitoring plots
- Fish and wildlife
- Geology and soils
- Old growth trees
- Park administrative areas
- Royal Fern Bog research plot
- Riparian corridors
- Sandhill pine forests
- Swamp cypress-tupelo forests
- Species of special concern
- Upland pine forests
- Vegetation
- Visitor use areas
- Water resources and floodplains
- Wetland baygall shrub thickets
- Wetland pine savannas
- Wetlands

Concerns

- Adjacent land uses and resources
- Local and regional economies
- Park operations (prescribed fire and facility management)
- Nonfederal oil and gas development
- Visitor use and experience, including human health and safety

During 1998 and 1999, additional information and field data were collected in the areas of wetlands, archeology, noise, and visitor use and experience. All of the topics listed above were analyzed by the planning team and presented and discussed during the public scoping process described above. Criteria were developed to evaluate relative importance of these resources and concerns in relation to the Preserve and the proposed oil and gas operations.

Based on the planning team's evaluation of these resources and concerns, and input received during public scoping, Special Management Areas were identified as being particularly susceptible to adverse impacts from oil and gas activities or are essential to maintain the ecological integrity of the Preserve. These Special Management Areas are:

Table 1.2. Special Management Areas

RESOURCE/VALUE	SPECIAL MANAGEMENT AREA (SMA)
Floodplains	Riparian Corridors, including: • Floodplain Hardwood Forests • Floodplain Hardwood Pine Forests
Vegetation	Ecological Research and Monitoring Plots, including: • Fire Monitoring Plots • Long-term Monitoring Plots Rare Vegetation Communities, including: • Upland Pine Forests • American Beech-Southern Magnolia-Loblolly Pine Forests • Sandhill Pine Forests • Old Growth Trees

RESOURCE/VALUE	SPECIAL MANAGEMENT AREA (SMA)
Wetlands	Rare Forested Wetland Communities, including: • Wetland Baygall Shrub Thickets • Swamp Cypress-Tupelo Forests • Wetland Pine Savannas • Old Growth Trees Ecological Research and Monitoring Plots, including: • Royal Fern Bog Research Plot
Visitor Use, Administrative and Other Use Areas	Visitor Use and Other Use Areas • Day-Use Areas (26 boat ramps, picnic areas and parking areas) • Hiking Trails (9) • Canoe Routes (4) • Administrative Areas (4) • Cemeteries (3) • Private Residences (2) • Birding Hot Spots (seasonally at 8 locations) • Hunting Areas (seasonally in 5 units)

Resources and Concerns to be Addressed in the Plan

The Council on Environmental Quality regulations, at 40 CFR § 1501.7(a)(2) require the NPS to "Determine the scope and the significant issues to be analyzed in depth in the environmental impact statement," and (3) "Identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review, narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere."

Of the resources and concerns initially listed, the following were considered environmental issues warranting further study, and are carried through the EIS for detailed analysis.

- Nonfederal Oil and Gas Development
- Air Quality
- Geologic Resources
- Water Resources
- Floodplains
- Vegetation
- Wetlands
- Fish and Wildlife
- Species of Special Concern
- Cultural Resources
- Visitor Use and Experience
- Adjacent Land Uses and Resources

For each of the resources and concerns listed above, the interdisciplinary team developed issue statements to define problems (or benefits) pertaining to oil and gas development in the Preserve (Table 1.3.). Issue statements describe a cause and effect relationship between an activity and a resource.

The remaining topics on the initial list of resources and concerns were not carried through for detailed analysis. The reasons for dismissing them are discussed at the end of this chapter.

Table 1.3. Issue Statements

ISSUE STATEMENTS
NONFEDERAL OIL AND GAS DEVELOPMENT
A comprehensive oil and gas management plan would provide pertinent information about Current Legal and Policy Requirements, resource-specific performance standards, mitigation measures and operating stipulations that would guide nonfederal oil and gas operations in the Preserve so that both operators and NPS staff plan more efficiently for nonfederal oil and gas operations in the Preserve.
An operator's uncertainty regarding applicable legal and policy requirements, performance standards, and mitigation measures could cause delays and increase planning time and costs. The lack of a comprehensive plan could result in project delays or, at worst, the denial of a Plan of Operations.
AIR QUALITY
Air quality in the Preserve is influenced by the Beaumont/Port Arthur/Orange and Houston/Galveston airsheds, and the Preserve is within the Nonattainment Area for ozone in Liberty, Hardin, Jefferson and Orange Counties. Specific pollutants can impair visibility, injure vegetation and fish and wildlife, damage materials, affect water quality (e.g., acidify water), and affect human health and welfare.
Construction of roads, wellpads, production facilities, flowlines and pipelines; vehicle use on and off paved roads; and exhaust from combustion of gasoline and diesel-powered vehicles and equipment used for drilling and production operations will increase emissions of particulate matter which could affect air quality, including visibility in the general vicinity of the Preserve.
Drilling, production, transport and storage of hydrocarbons; the use of gasoline and diesel-powered engines (vehicles, generators, compressors, etc.); and maintenance activities such as use of herbicides for vegetation control on and around operations sites, emit pollutants including nitrogen oxides, volatile organic compounds carbon monoxide, sulfur dioxide, particulate matter, and objectionable odors. These emissions could degrade air quality within the Preserve and could contribute towards regional air quality degradation. Nitrogen oxides and volatile organic compounds are primary precursors to ozone formation, which, depending on ambient concentrations, can have damaging effects on some vegetation and the health of humans and wildlife.
GEOLOGIC RESOURCES
Oil and gas activities including off-road vehicle use; shothole drilling and detonation; and construction, maintenance, and use of roads, wellpads, production facilities, flowlines and pipelines could increase surface runoff; increase soil erosion, rutting and compaction; affect the permeability of soils (and other soil characteristics); and could directly and indirectly affect the growth and regeneration of vegetation.
Soils compacted by foot or vehicle use could reduce soil permeability, change surface drainage patterns, and hinder the penetration of plant roots. In general, clayey soils are more subject to compaction than sandy soils.
The release of hydrocarbons or other contaminating and hazardous substances from vehicles and equipment, exploration and production operations, and flowlines and pipelines could alter the soil's chemical and physical properties. Changes in soil properties could result from direct contact with contaminants or indirectly via runoff from contaminated areas which could impair water quality, and affect the soil's ability to support plant and animal species and their habitat.
WATER RESOURCES
Off-road vehicle use; removal or modification of vegetation; and surface disturbance associated with the construction, maintenance and use of roads, wellpads, production facilities, flowlines and pipelines could increase soil erosion and sedimentation in surface waters. These activities could also alter surface and subsurface drainage patterns in the vicinity of operations which could change the overall amount and timing of stream flows – directly affecting stream channel structure or form, rate of meandering or migration, sedimentation, water quality, and the amount and type of aquatic habitat.
The release of hydrocarbons, or other contaminating and hazardous substances from vehicles and equipment used for exploration and production operations, or from flowlines and pipelines could impair water quality. Impaired water quality could affect the growth and survival of vegetation, cause declines in fish and wildlife populations, affect recreational uses, and harm human health and safety.
Reclamation of oil and gas sites could adversely affect water quality and quantity over the short-term. However, long-term benefits could occur when native vegetation communities and surface and subsurface water flow are re-established.
FLOODPLAINS
Floodplains comprise approximately 50 percent of the Preserve, and in some cases there may be no practicable alternative to locating roads, wellpads, production facilities, and flowlines and pipelines in or

across floodplains. These activities could potentially harm (from the hydraulic and erosive forces of flooding) life, property, and floodplain resources, functions, values and uses.
The siting, maintenance, and use of roads, wellpads, production facilities, and flowlines and pipelines in floodplains, or the release of hydrocarbons or other contaminating and hazardous substances from these operations, could adversely affect floodplain functions, values and uses, including: the natural moderation of floods; water quality; sediment control; groundwater recharge or discharge; fish and wildlife habitat; maintenance of biodiversity; recreational opportunities; and natural beauty.
Reclamation activities such as re-establishing the contour of the area, surface and subsurface water flow; controlling non-native vegetation; and reestablishing native vegetation communities could restore natural and beneficial floodplain functions, values, and uses.
VEGETATION
Vegetation could be cut along survey and seismic lines, routinely cut along flowlines and pipelines or totally removed in areas for the construction of roads, wellpads, production facilities, and flowlines and pipelines. Vegetation removal could change the structure and composition of vegetation communities; alter wildlife habitat and species composition; increase storm runoff; and increase soil erosion and sedimentation in adjacent streams.
Roads, wellpads, production facilities, and flowlines and pipelines could disrupt surface and subsurface water flow, which may adversely affect the localized water budget necessary to maintain vegetation communities. There could be greater adverse impacts on upland vegetation communities such as the Sandhill Pine Forest, Upland Pine Forest, and Wetland Pine Savanna.
Ecological research and monitoring plots contribute to a better understanding of park resources and their use and management. Surface disturbance within plots may alter the accuracy of the study results.
The release of hydrocarbons, or other contaminating and hazardous substances could damage or kill vegetation via direct contact with contaminants, or indirectly via pathways from contaminated areas.
Reclamation of oil and gas sites could re-establish native vegetation communities and surface and subsurface drainage patterns, and provide for the safe movement of wildlife.
WETLANDS
Wetlands comprise approximately 40 percent of the Preserve, and there may be no practicable alternative to locating roads, wellpads, production facilities, and flowlines and pipelines in or across wetlands. Their use and maintenance could adversely affect wetland functions and values including: wetland processes; natural moderation of floods; sediment control; maintenance of water quality; groundwater recharge or discharge; habitat for fish and wildlife (including habitat for species of special concern); maintenance of biodiversity; recreational opportunities; and natural beauty.
The release of hydrocarbons, or other contaminating and hazardous substances in or near wetlands could adversely affect wetlands (i.e., wetland vegetation, soils and water), and the diverse assemblage of aquatic and terrestrial life supported by wetlands.
Reclamation of oil and gas sites could restore wetland functions and values. These activities could include re-establishing natural contours, surface and subsurface water flow, and natural vegetation communities and controlling non-native vegetation.
FISH AND WILDLIFE
Oil and gas activities including off-road vehicle use; shothole drilling and detonation; and construction, maintenance, and use of roads, wellpads, production facilities, and flowlines and pipelines, could adversely affect fish and wildlife. These activities could increase predation in open areas; directly harm or kill fish and wildlife; and disrupt wildlife feeding, denning, nesting, and spawning/reproduction. These activities could also result in avoidance of the area by wildlife due to increased noise and human presence.
Loss or modification of fish and wildlife habitat could occur from the construction of roads, wellpads, production facilities, and flowlines and pipelines. These activities could increase edge effects, increase human access, and alter wildlife species and composition.
The release of hydrocarbons or other hazardous and contaminating substances from vehicles, drilling and production equipment, leaks or rupture of flowlines and pipelines could injure or kill fish and wildlife. The adverse effects could become worse over time if fish and wildlife species ingest the contaminants and are consumed by other fish and wildlife species.
Heavy equipment used for reclamation operations could injure or kill fish and wildlife, and degrade water quality over the short-term. However, reclamation of oil and gas sites over the long-term could re-establish native vegetation communities and surface and subsurface water quality and quantity that support fish and wildlife populations.

SPECIES OF SPECIAL CONCERN
There are 48 species listed as threatened, endangered, or species of concern in the seven counties containing units of the Preserve. Approximately 28 of these species have been documented or have the potential to occur in the Preserve. Where there is the potential for adverse effects on a species or their habitat, mitigation would be required by the NPS, in consultation with the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department. Even with these protective measures in place, there is the potential for an incidental take of a threatened, endangered, or species of concern.
Reclamation of oil and gas sites could re-establish native vegetation communities and surface and subsurface drainage patterns that support threatened, endangered, or species of special concern.
CULTURAL RESOURCES
Seismic lines, roads, flowlines, and pipeline rights-of-way could increase access to cultural resources, and result in illegal activities such as vandalism, artifact collection, and excavation.
Detonation of seismic explosives; the construction and use of roads, wellpads, production facilities, and flowlines and pipelines; and containment or cleanup of leaks and spills could alter the distribution, disturb or destroy surface or buried archeological materials, and alter the condition of ethnographic resources, historic structures, and cultural landscapes.
Leaks and spills of hydrocarbons or other hazardous and contaminating substances from vehicles and equipment along access roads or from wellsites, production sites, or flowlines and pipelines could damage or destroy cultural resources.
VISITOR USE AND EXPERIENCE
Oil and gas operations could pose a threat to human health and safety from a number of sources, including, the use of roads by commercial vehicles (particularly vehicles with less maneuverability and visibility); moving equipment at wells and production facilities; improper well control; and flowline or pipeline failure. The spill or release of hydrocarbons or other contaminating and hazardous substances could be inhaled, absorbed, or ingested by human beings.
Oil and gas operations could adversely affect air quality; alter scenic resources; increase background sound levels; and impair water quality. These effects could adversely affect or preclude visitor uses and experiences in certain areas of the Preserve such as hunting, fishing, boating, swimming, picnicking, camping, participating in NPS programs, bird watching, nature study, and solitude.
ADJACENT LAND USES AND RESOURCES
Big Thicket National Preserve is made up of 15 separate units, 12 of which are analyzed in this Plan/EIS. Most of the Preserve is surrounded by public and private lands. Operators may decide to explore for and develop nonfederal oil and gas from underlying the Preserve from locations outside the Preserve. The siting of operations outside the Preserve could result in adverse impacts on adjacent landowners, resources and uses. Beneficial effects of siting nonfederal oil and gas operations outside the Preserve could include the construction or improvement of roads and bridges on adjacent lands.

Resources and Concerns Evaluated and Dropped from Detailed Analysis

For the following two resources and concerns, the interdisciplinary team concluded that, with application of all required mitigation under the required Current Legal and Policy Requirements, that the anticipated impacts would be negligible, so they were dropped from further analysis.

Details on these resources/issues are provided below.

- Local and Regional Economies
- Park Operations for Fire and Facility Management

In addition to the resources/concerns listed above, the following topics were dropped from further analysis. The basis for dismissing these topics is provided below.

- Possible Conflicts Between the Proposed Action and Land Use Plans, Policies, or Controls
- Sustainability and Long-term Management, and Energy Requirements and Conservation Potential
- Environmental Justice
- Prime and Unique Farmlands

The following discussion provides a brief summary of these topics and includes the specific reasons why these were eliminated from detailed evaluation.

Local and Regional Economies: Big Thicket National Preserve contributes to the local economy by adding sales, taxes, and employment related to the acquisition of services, supplies and materials needed to administer the Preserve. In addition, tourism-related expenditures contribute to the local economy and also create jobs to support tourism. The Preserve's impact on the local economy in fiscal year 2001, has been calculated by using the Money Generation Model, developed by the National Park Service's Office of Social Science. The Money Generation Model was originally developed by Dr. Ken Hornback (USDI, NPS, 1995). The purpose of the Money Generation Model is to estimate the impacts of NPS visitor spending on the local economy. Economic impacts are summarized in terms of sales, income, employment, and value added. The Money Generation Model focuses primarily on the economic impacts of visitor spending and uses an Excel workbook to carry out these calculations. Big Thicket National Preserve hosted 100,000 recreation visits in 2001. In 2001, visitors to Big Thicket National Preserve spent $5.89 million dollars which supported a total of $7.26 million in sales, $2.60 million in personal income, 155 jobs, and $4.10 million in value added.

In the event of a serious oil spill, release of hydrogen sulfide gas, accident involving serious personal injury or death, or fire, the public could perceive that the Preserve is not a desirable place to visit. Tourism could fall, resulting in reduced revenues to the local economy. However, the likelihood of this happening is relatively small, and nonfederal oil and gas operators are required to take technologically feasible precautions to prevent accidents and fires (36 CFR § 9.46).

During the period from January 2004 through January 2005, 1,272 drilling permits were issued by the Railroad Commission of Texas in the 29 counties comprising District 3. For the seven-county area encompassing the Preserve (Hardin, Jasper, Jefferson, Liberty, Orange, Polk, and Tyler Counties), 356 drilling permits were issued, comprising 28 percent of the District-wide total. Production for 2004 in District 3 totaled 40,929,218 bbls of oil and condensate, and 647,023,981 mcf natural gas from gas wells and casingheads. In the 7-county area encompassing the Preserve, production of oil from all sources totaled 12,164,350 bbls (30 percent of the District total), and 177,198,300 mcf natural gas from all sources (27 percent of the District total) (RRC 2004).

From 1998 through 2000, no wells were drilled in or outside the Preserve to develop the underlying hydrocarbons. From 2001 through June 2005, 19 directional wells were drilled from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve. During 2004 and up to June 1, 2005, applicants received § 9.32(e) exemption determinations for 15 additional directional wells. The historic drilling activity in the Preserve is further described in the Nonfederal Oil and Gas Operations section in Chapter 3.

Hydrocarbon exploration, drilling, or production inside Big Thicket National Preserve would not be precluded under any of the alternatives presented in this Plan/EIS. Oil and gas targets that could not be drilled from surface locations within the Preserve could still be directionally developed by directional and/or horizontal drilling. In some cases, surface use restrictions may be exempted (see

Chapter 2, Exemptions from This Plan). Any changes in the level of oil and gas exploration and production resulting from this plan would be minor compared to the overall activity in the region.

Discernible changes in revenue flow, salaries, unemployment rates, utilization of local goods and services, or conflicts with existing ways of life are not expected. Since the impact to the local and regional economies from implementing any of the alternatives in this plan would likely be negligible, this impact topic was eliminated from further detailed analysis.

Park Operations for Fire and Facility Management: "The Preserve's General Management Plan identifies three management zones: natural, development and special use zones. This zoning system, common to most natural parks, recognizes differences in resources and focuses future management on particular types of activities and developments appropriate for each zone. Management zoning specifies how the Preserve is to be managed at full plan [GMP] implementation, not merely how the area is currently managed (GMP 1980)."

Most of the Preserve is included in the natural zone, which places management emphasis on conservation of natural resources and processes while providing for uses that do not adversely affect these resources and processes. The development zone defines and limits areas in the Preserve that may be used for certain types of development to serve the needs of park management and the public. Design and environmental factors are fully considered before development plans are implemented. Present development includes the maintenance and meeting facility, Big Thicket Information Station, Big Thicket Visitor Center, Turkey Creek Ranch House, and day-use areas. For all operations in the natural zone, appropriate mitigation measures under Current Legal and Policy Requirements would require remediation of any environmental damage and reclamation of the disturbed area. Also, Current Legal and Policy Requirements, specifically 36 CFR § 9.41(a), provide that "surface operations shall at no time be conducted within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for the administration of the unit, unless specifically authorized by an approved plan of operations." Application of this requirement is expected to avoid or minimize impacts on most Preserve operations.

The purpose of the Preserve's Fire Management program is to restore vegetation structure and distribution through the natural interaction of fire in the landscape. Land use practices prior to establishment of the Preserve (especially fire suppression) have promoted an overabundance of Loblolly pine and brush in upland vegetation types and caused significant loss of upland grass/forb groundcover. Wildfire control and the protection of structures within the Preserve, and on adjoining lands, utilize tactics appropriate to the values at risk, fire intensity, and resource damage. Preserve fire staff would need to plan prescribed fire burns with consideration of existing oil and gas operations and pipelines. Fires that occur within oil and gas operations areas and within pipeline corridors would continue to be the responsibility of the operator, and response activities would generally follow the prescribed methods addressed in the operator's plan of operations.

The facilities management program of the Preserve maintains the Preserve's built structures (e.g., maintenance facility, Information Station), roads and trails, picnic areas, restrooms, and the infrastructure that supports these facilities and developments, which include water wells and electrical power. New oil and gas operations could result in increased use of Preserve roads that could likewise require increasing the frequency of road maintenance by the Preserve. In the event that road maintenance increases to a level beyond the Preserve's current routine maintenance program, the Preserve could charge a fee for registration of commercial vehicles and use of roads pursuant to 36 CFR § 9.50.

In general, Preserve operations are not expected to be adversely affected more than negligibly by the proposed oil and gas development under any of the alternatives. Preserve operations that might be adversely affected are addressed in other topics that include the specific operation or area in question. Current Legal and Policy Requirements provide minimum standard protection, such as

provided by offsetting oil and gas operations a minimum 500 feet from park developments and visitor use areas, thereby avoiding conflicts between Preserve facility management activities and oil and gas operations. These requirements also provide adequate mechanisms to ensure wells are properly drilled and plugged to protect ground water quality and quantity. For these reasons, Preserve Operations, including Fire Management and Facilities Management were eliminated from further detailed analysis. Preserve management of nonfederal oil and gas activities, and pipeline right-of-ways, are discussed in Chapters 3 and 4.

Possible Conflicts between the Proposed Action and Land Use Plans, Policies, or Controls: This Plan/EIS is consistent with the NPS Organic Act, park enabling legislation, the General Management Plan for Big Thicket National Preserve, and all applicable policies and controls.

Sustainability and Long-term Management, and Energy Requirements and Conservation Potential: This Plan/EIS is not concerned with construction and maintenance of dwellings or structures for public use; therefore, this topic is not evaluated.

Environmental Justice: Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities. None of the alternatives considered would result in disproportionate direct or indirect negative or adverse effects on any minority or low-income population or community. The impacts on the natural and physical environment that occur from any of the alternatives would not significantly and adversely affect any minority or low-income population of community. Therefore environmental justice was dismissed as an impact topic.

Prime and Unique Farmlands: As a result of a substantial decrease in the amount of open farmland, Congress enacted the Farmland Protection Policy Act (Public Law 97-98). In August 1980, the Council on Environmental Quality directed that federal agencies must assess the effects of their actions on prime or unique farmland soils classified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). Prime or unique farmland is defined as a soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland is defined as soil that produces specialty crops such as fruits, vegetables and nuts. Prime and unique farmland soils are those that are actively being developed and could be converted from existing agricultural uses to nonagricultural purposes, as described above. None of the soils in the project area are classified as prime or unique farmland soils. Therefore, the topic of prime and unique farmland soils was dismissed as an impact topic in this document.

Generating and Evaluating Alternatives

The issue statements, and SMAs, were used in developing and evaluating alternatives. The plan alternatives are described in Chapter 2. In addition to the No Action/Current Management Alternative, two plan alternatives are described and evaluated in this Plan/EIS. The history of nonfederal oil and gas development in the Preserve, and Preserve resources and values are described under Affected Environment, Chapter 3; and the impacts anticipated from the alternatives are described in detail in Chapter 4. A comparative summary of impacts is included in Tables S.2 and 2.17.

PART I
PLAN ALTERNATIVES

CHAPTER 2



CHAPTER 2
PART I - PLAN ALTERNATIVES

INTRODUCTION

This chapter describes a reasonable[1] range of alternatives selected for analysis in this Oil and Gas Management Plan/Environmental Impact Statement (Plan/EIS). The Interdisciplinary planning team considered every alternative that was identified during internal and public scoping, and those that were considered reasonable were selected for further analysis. A discussion of the alternatives that were eliminated from further consideration, including the reasons why they were eliminated, is presented at the end of Part I of this chapter. This is a programmatic management plan that establishes a general framework for managing oil and gas operations. By itself, it does not authorize any on-the-ground activities. The National Park Service will authorize specific projects by reviewing and approving operator-submitted plans of operations or special use permit applications. Before doing so, the NPS will conduct further analysis in accordance with the National Environmental Policy Act of 1969, the National Historic Preservation Act of 1966, the Endangered Species Act of 1973, and other applicable federal laws.

Background material that is necessary to understand the alternatives is presented at the beginning of this chapter. A Reasonably Foreseeable Development (RFD) Scenario has been formulated that projects the extent of operations that could occur to develop the projected nonfederal oil and gas resources in the Preserve. This scenario is used to assess the impacts of each alternative presented in this Plan/EIS. Special Management Areas proposed under Alternatives B and C of this Plan to protect specific resources are also described in this section.

All of the alternatives presented in this Plan/EIS are subject to Current Legal and Policy Requirements (CLPR) and the NPS requirement to not impair park resources. Table 1.1 lists the legal and policy mandates that apply to nonfederal oil and gas operations in the Preserve. Part II of this chapter describes these legal and policy mandates, NPS management policies, and performance standards for each resource that could be adversely affected by oil and gas development in the Preserve. Part III lists the operating stipulations and mitigation measures that can be used to avoid or minimize impacts on natural and cultural resources, to protect visitor uses and experiences, and to provide for human health and safety.

Operating stipulations and mitigation measures have specific meaning in this Plan/EIS. Operating stipulations are mandatory resource protection methods founded in law, regulation, and/or policy that the operator must use during operations to protect Preserve resources and values. An example would be the operating standards listed in 36 CFR § 9.41. In contrast, mitigation measures are voluntary resource protection methods that an oil and gas operator may use while conducting oil and gas operations to avoid, minimize, or reduce adverse impacts on Preserve resources and values. “Voluntary” implies that the mitigation measures are designed by the operator, not the NPS. The NPS defines specific resource protection objectives and determines whether an operator’s proposed mitigation measures meet those objectives. Baseline mitigation would be required under all of the alternatives, but in most cases, the specific methods are up to the discretion of the operator, as long as

[1] Alternatives must be reasonable to be included in an EIS (40 CFR – CEQ 40 Most Asked Questions). Reasonable alternatives are economically and technically feasible, and show evidence of common sense. If an alternative could not be implemented if chosen, or does not resolve the need for action, and fulfill the stated purposes to a large degree, it must be eliminated from further consideration. If an alternative is feasible and reasonable to the NPS but unreasonable to an outside applicant, it still must be included in the range of alternatives considered in the EIS.

they are “least damaging methods” pursuant to 36 CFR 9B § 9.37(a)(1), and comply with other applicable laws and regulations.

Further information on the regulatory framework that governs nonfederal oil and gas operations can be found in Appendix A – Public Law 93-439, Big Thicket National Preserve Enabling Act, Appendix B – NPS Nonfederal Oil and Gas Rights Regulations, 36 CFR Part 9B, and Appendix C – Federal Laws, Regulations, Executive Orders, Policies and Guidelines that Apply to Nonfederal Oil and Gas Operations.

The alternatives in this Plan/EIS represent three reasonable strategies for managing exploration, drilling, production, and transportation of nonfederal oil and gas resources in the Preserve. Each alternative differs in the amount of surface use that would be permitted for these operations.

- Alternative A, the No Action alternative, is required under the National Environmental Policy Act (NEPA) and establishes a baseline for comparison with the two action alternatives, B and C. The No Action alternative is based on Current Legal and Policy Requirements and is a continuation of current oil and gas management direction in the Preserve. Protected Areas have been designated to protect research and monitoring plots and visitor use, administrative, and other use areas. There has been no formalized Preserve-wide oil and gas management plan and specific resource protection goals (called performance standards) and operating stipulations would continue to be applied on a case-by-case basis. Geophysical exploration may be permitted on 91 percent of the Preserve (80,670 acres) year-round while 59 percent (52,272 acres) would have timing stipulations (Hunting Areas and Birding Hot Spots); and drilling and production operations may be permitted on 91 percent of the Preserve (80,639 acres). No operations would be permitted within 500 feet of waterways (unless specifically authorized in an approved plan of operations).

- Alternative B, the agency Preferred Alternative, defines Preserve-wide resource-specific performance standards that would be applied to all existing and new oil and gas operations. Specific resource areas, called Special Management Areas (SMAs), in this Plan/EIS would be formally designated for areas where park resources and values are particularly susceptible to adverse impacts from oil and gas development. Operating stipulations would be applied in these SMAs to protect Preserve resources and values. Nonfederal oil and gas operations could be permitted under CLPR in all other areas of the Preserve that are not designated as SMAs. Geophysical exploration operations may be permitted on 87 percent of the Preserve (76,620 acres) year-round while 59 percent (52,272 acres) would have timing stipulations (Hunting Areas and Birding Hot Spots); and drilling and production operations may be permitted on approximately 47 percent of the Preserve (41,859 acres). No operations would be permitted within 500 feet of waterways (unless specifically authorized in an approved plan of operations).

- Alternative C, the Environmentally Preferred Alternative, also defines park-wide resource-specific performance standards that would be applied to all existing and new oil and gas operations. Similar to Alternative B, SMAs would be designated with specific operating stipulations for oil and gas operations. However, oil and gas operations would be prohibited in most of the designated SMAs. Geophysical exploration may be permitted on 55 percent of the Preserve (48,475 acres) year-round, while 59 percent (52,272 acres) would have timing stipulations (Hunting Areas and Birding Hot Spots); and drilling and production operations may be permitted on 47 percent of the Preserve (41,859 acres). No operations would be permitted within 500 feet of waterways (unless specifically authorized in an approved plan of operations).

FUTURE MODIFICATIONS TO THE OIL AND GAS MANAGEMENT PLAN

New or revised regulations, policies, and approved planning documents may be implemented in the future to protect park resources and values; avoid conflicts with visitor use and enjoyment; and provide for human health and safety. These changes may require updating and supplementing the information presented in this plan. Significant changes in the content or direction of this plan would require a supplemental EIS or the preparation of a new Oil and Gas Management Plan/EIS.

APPLICABILITY OF THIS PLAN IF THE BOUNDARIES OF THE PRESERVE ARE MODIFIED, PARK FACILITIES ARE CONSTRUCTED, OR AREAS CHANGE IN RESPONSE TO DYNAMIC ENVIRONMENTAL PROCESSES

If additional lands or waters are added to Big Thicket National Preserve in the future, or new facilities are constructed within the Preserve, management of these areas would be guided by all applicable legal and policy requirements, resource-specific performance standards, operating stipulations in the Special Management Areas, and mitigation measures described in this plan.

Three units in the Preserve – Canyonlands Unit, Big Sandy Creek Corridor Unit, and Village Creek Corridor Unit lie within the legislated boundary of the Preserve, but currently none of these lands are under federal ownership. The 36 CFR 9B regulations are predicated on access on, across or through federal lands or waters, so oil and gas operations in these units currently lie outside the reach of the regulations. The 36 CFR 9B regulations will be applicable once the federal government acquires lands in these units.

Big Thicket National Preserve is subject to dynamic changes from environmental and geologic processes. Storm events such as hurricanes and flooding could change the configuration of the resources in the designated Special Management Areas. River migration could alter the location and configuration of the stream network and associated riparian vegetation. If these or other changes were to occur, the resource and Special Management Area maps would be revised to reflect the current conditions and the provisions in this plan.

APPLICABILITY OF THIS PLAN TO CURRENT NONFEDERAL OIL AND GAS OPERATIONS

Current Legal and Policy Requirements, performance standards, operating stipulations, and mitigation measures presented in this plan would also apply to previously-approved nonfederal oil and gas operations in the Preserve. Where these operations are not in compliance with the requirements approved in this plan, modifications to the operations would be necessary. In addition, all ongoing nonfederal oil and gas operations in SMAs would be evaluated to ensure the protection of the resources and values in these areas.

EXEMPTIONS FROM THIS PLAN

The designation of Protected Areas, which is a component of all three alternatives, and the proposal in Alternatives B and C to designate Special Management Areas and apply operating stipulations are not intended to result in a taking of private property rights. Regulations at 36 CFR Part 9, Subpart B (9B regulations), were written to encourage technological innovation (§ 9.37(a)(1)). If an operator can demonstrate that a particular technology could reduce the potential for impact on resources in the

Preserve, the operator may be exempted from specific operating stipulations described in this plan. All requests for an exemption must be presented in a Plan of Operations and must describe how replacing the plan requirements with a technological innovation would protect park resources and values. Approval of an exemption would be documented in the accompanying NEPA document (Environmental Assessment/Finding of No Significant Impact or Environmental Impact Statement/Record of Decision) for a proposed Plan of Operations. Therefore, in the event that an operator cannot explore for or develop nonfederal oil and gas from a surface location outside of an SMA with the "No Surface Use" stipulation, the National Park Service will work with the operator, and in consultation with other state and federal agencies as required under applicable laws and regulations, to develop reasonable mitigation measures so as to allow the proposed operations surface use within the SMA. However, as noted on page 2-64, if the Service determines that the proposed mineral development would impair park resources, values, or purposes, or does not meet approval standards under applicable NPS regulations and cannot be sufficiently modified to meet those standards, the Service will seek to extinguish the associated mineral right through acquisition, unless otherwise directed by Congress.

TYPES OF OIL AND GAS OPERATIONS

This section provides a brief description of geophysical exploration, and drilling and production activities in and adjacent to the Preserve. This description was used to estimate the surface disturbance that could occur to develop the oil and gas resources underlying the Preserve, presented in the next section titled "Reasonably Foreseeable Development Scenario." For more information on the types of oil and gas operations that may occur in the Preserve, the reader is referred to Appendix D, Types of Oil and Gas Operations. The historic drilling activity in the Preserve is further described in the Nonfederal Oil and Gas Operations section in Chapter 3.

Geophysical Exploration

Since the 1940s, numerous 2-D and 3-D seismic surveys have been conducted within and adjacent to the Preserve to help delineate oil and gas drilling prospects (see Figure 3.1). Previous survey methods included operations where only seismic receivers (recording devices) were placed in the Preserve and the seismic source points (shotholes) were located outside its boundaries. Within the last decade, 3-D "mini-hole" seismic surveys have been conducted in the Jack Gore Baygall, Neches Bottom, Lower Neches River Corridor, Beaumont, and Lance Rosier Units. These previous 3-D surveys used the mini-hole pattern and were satisfactory in imaging the shallow plays (i.e., the Yegua and Wilcox). More recent 3-D seismic surveys focused on imaging the deeper Woodbine and Jurassic plays. The latest 3-D seismic survey conducted in 2004 by Seismic Assistants, Ltd., covered over 17,000 acres within the Big Sandy Creek, Menard Creek Corridor, and Hickory Creek Savannah Units of the Preserve used single 80-foot deep shotholes loaded with 5.5 pound explosive charges. This single shothole configuration was used to derive better imaging of the deeper hydrocarbon plays up to depths of 23,000 feet, while also providing a more accurate image of shallower objectives. The NPS has recently received proposals to conduct seismic surveys in the Upper and Lower Neches River Corridor Units of the Preserve. It is anticipated that over the next five to ten years, 3-D seismic surveys will be conducted throughout the Preserve. Since many seismic surveys are proprietary data, it is possible that more than one survey may be conducted in the same area of the Preserve.

Three-dimensional seismic surveys typically include selectively cutting vegetation up to a width of 3 to 6 feet along source and receiver lines, drilling shotholes in increments of 110 to 440 feet, placing explosives in the bottom of each shothole, and then detonating the explosives and recording the seismic waves generated from the detonation. The pattern (grid) for the seismic survey is designed to optimize

imaging geologic information in the subsurface. Source lines are usually placed perpendicular (or at an angle) to the receiver lines. In many cases, there may be up to 2,000 feet between source lines, and 660 to 2,400 feet between receiver lines. In order to image shallow hydrocarbon plays, oil and gas operators typically drill 5 to 10 "mini-holes" up to 10 feet deep at a single shotpoint and load each shothole with approximately ½-pound of explosives. Where an operator wants to image deeper drilling targets, single shotholes are drilled 80 to 100 feet deep and are loaded with 5 pounds or more of explosives.

Three-dimensional seismic surveys are the primary exploratory tool that is expected to be used during the life of this Plan/EIS. Nevertheless, new technologies may be developed in the future to delineate drilling locations and characterize oil and gas reservoirs. Surface disturbances and potential impacts from these techniques cannot be determined in this planning effort and therefore have not been assessed in this Plan/EIS.

Drilling and Production Operations

Surface disturbances for drilling and production operations included in the next section, Reasonably Foreseeable Development (RFD) Scenario, have been estimated using information derived from wells that have been drilled primarily from surface locations outside of the Preserve. In most cases, wellpad and access road dimensions would be smaller in the Preserve because the NPS directs operators to minimize surface disturbance (and impacts) on Preserve resources. Because of this, the RFD scenario represents an upper estimate of activities and surface disturbance, most of which are likely to occur on lands outside of the Preserve.

In the RFD scenario, a drilling pad for a single well would measure 300 feet by 350 feet (2.4 acres). If there is no access road to the wellsite, a road up to one mile in length may be built to the wellsite. Construction of a wellpad typically consists of clearing vegetation, constructing a ring ditch and levee around the perimeter of the wellpad, leveling the site, and installing an impermeable liner to collect spills or releases during drilling. Once drilling is completed, there is the potential for partial reclamation of the wellsite because of reduced area needs for production operations.

REASONABLY FORESEEABLE DEVELOPMENT SCENARIO

The United States Geological Survey (USGS) and the National Park Service (NPS) collaborated during the EIS planning process to estimate the undiscovered hydrocarbon resources in the Preserve and to develop a projection of the type and extent of operations that could occur to develop these resources. Utilizing available drilling, production, and other geologic data for the area surrounding the Preserve, the USGS estimated the remaining hydrocarbon potential beneath Big Thicket National Preserve. The USGS assessment resulted in a range of probabilities of discovering oil and gas in the Preserve. USGS estimated a high probability (95 percent) of discovering approximately 400,000 barrels of oil and 20 billion cubic feet of gas. The USGS estimated that there is a low probability (5 percent) that up to 2 million barrels of oil and 150 billion cubic feet of gas could be discovered. Appendix E – Remaining Oil and Gas Resources Beneath Big Thicket National Preserve Assessment Methodology, summarizes USGS' assessment methodology, geologic framework, target formations (plays), traps, seals, and a range of probabilities of discovering hydrocarbons within the Preserve.

Based on the USGS assessment, the NPS prepared a reasonably foreseeable development (RFD) scenario that projects the types of activities and the amount of surface disturbance that could occur to explore for and produce the remaining oil and gas resources underlying the Preserve.

The purpose of the RFD scenario is to provide a reasonable basis for analyzing the potential effects of oil and gas related operations within and outside the Preserve for the alternatives presented in this Plan/EIS. The number of wells and the acres of disturbance projected in the RFD scenario do not represent a benchmark or decision point for acceptable level of activity that could occur to develop the oil and gas underlying the Preserve. Rather, they are meant to provide the interdisciplinary team, public, and NPS decision-makers with an understanding of the types and extent of oil and gas exploration and production operations expected under this Plan/EIS. The NPS will track the number of wells and the acres of disturbance for nonfederal oil and gas operations in the Preserve. If the number of wells or the acres of disturbance presented in the RFD scenario, or the impacts (context, intensity, and duration) from future oil and gas projects exceed those anticipated in this Plan/EIS, then the NPS will re-examine whether to supplement the Plan/EIS as required by the NEPA and NPS Director's Order and Handbook – Conservation Planning, Environmental Impact Analysis and Decision-Making.

When preparing the RFD scenario for the Draft Plan/EIS, the NPS used USGS's mean probability (average) of undiscovered oil and gas resources of approximately 3 million barrels oil and natural gas liquids and 70 billion cubic feet of gas. In the Draft Plan/EIS, it was estimated that over the next 15 to 20 years, 29 wells could be drilled which could disturb up to 153 acres within and outside of the Preserve. Since the NPS prepared the RFD scenario in 1999, 19 wells have been drilled to explore for and produce the hydrocarbons underlying the Preserve. Even though 29 wells have not been drilled to-date, it is possible that these estimates could be attained in the near future. Conversely, it is possible that drilling may slow down and the RFD scenario in the Draft Plan/EIS may still be valid for the life of the Plan/EIS.

Due to the public comments received on the Draft Plan/EIS and the current increase in drilling activity, the NPS has decided to develop a revised RFD scenario for the Final Plan/EIS. Since it is unlikely that USGS's upper estimate (5 percent probability) would be discovered over the life of this Plan/EIS, the NPS has decided to use the 25 percent probability estimate in the revised RFD scenario. The NPS contacted oil and gas operators who have recently drilled wells in and adjacent to the Preserve to verify the assumptions used in the RFD scenario. Information collected from these operators included drilling success rates, well status, and area of surface disturbance for access roads and wellpads. This information was used in conjunction with the USGS 25 percent probability distribution to develop a revised estimate of the oil and gas activities and surface disturbances that could occur to develop the hydrocarbons underlying the Preserve.

The Revised Reasonably Foreseeable Development Scenario is based on the following assumptions:

- Using USGS's 25 percent probability distribution, approximately 4 million barrels of oil and natural gas liquids and 94 billion cubic feet of natural gas could be discovered over the next 15 – 20 years from Tertiary and Upper Cretaceous-age reservoirs under the Preserve. The USGS assessment includes all oil and gas reservoirs that are currently producing or have the potential to produce hydrocarbons in the Preserve.

- In order to delineate drilling prospects, 3-D seismic surveys would be conducted throughout the Preserve and would reduce the number of dry holes (unproductive) wells drilled.

- Information obtained from 3-D seismic surveys would result in an exploratory drilling success rate of approximately 50 percent (1 hydrocarbon discovery for every 2 wells drilled). The probability of success of encountering hydrocarbons in subsequent development (production) wells would be approximately 75 percent.

- The demand, price, and availability of domestically produced hydrocarbons would support the oil and gas development presented in the RFD scenario.

- Because of the complex nature of the subsurface geology in the Preserve, oil and gas production from the Tertiary and Upper Cretaceous formations (plays) is not likely in the same wells. This would require drilling of separate exploratory and production wells to produce hydrocarbons from the different geologic plays.

The RFD drilling scenario in the Preserve includes:

- Approximately 40 wells would be drilled over the next 15 – 20 years to produce the estimated hydrocarbons in Big Thicket National Preserve.

- Twenty-seven of the wells would be commercially successful oil and gas wells, and thirteen wells would be dry holes. Upon completion of drilling, the 13 dry holes would be plugged and the disturbed area reclaimed within 6 months.

There is a reasonable expectation that surface disturbances in the Preserve associated with drilling and production operations would be substantially reduced or eliminated with the following mitigation measures:

- Most of the potential bottomhole locations inside the Preserve could be reached by directionally drilling from a surface location outside the boundaries of the Preserve. Directional drilling is technologically feasible in the narrow corridor units and at the perimeters of the larger nonlinear units. Operators will likely continue to favor drilling wells outside of the Preserve in upland areas due to the logistical constraints of drilling wells in flood-prone areas and reduced regulatory requirements outside of the Preserve. However, it may be necessary to drill in the interior of larger units such as Big Sandy, Beech Creek, Jack Gore Baygall/Neches Bottom, Turkey Creek, Lance Rosier and Beaumont Units. The last well drilled inside of the Preserve was drilled in 1997, and all subsequent oil and gas wells have been directionally drilled from surface locations outside of the Preserve;

- Drilling and producing multiple wells from a single wellpad;

- Utilizing existing abandoned drilling sites or other previously disturbed areas for drilling and production operations;

- Re-entering and redrilling lateral extensions from existing wellbores; and

- Directionally drilling flowlines and gathering lines under designated areas/proposed Special Management Areas.

Table 2.1 summarizes the amount of surface disturbance associated with nonfederal oil and gas operations in the Preserve that is anticipated over the next 15 – 20 years.

Table 2.1. Projected Surface Disturbance Associated with the Reasonably Foreseeable Development Scenario

TYPE OF OPERATION	SURFACE DISTURBANCE[1]
Geophysical Exploration[1] -Survey and selectively cut vegetation along source and receiver lines. -Drill up to 6 shotholes per shotpoint, with 210' spacing between shotpoints).	 465 acres 9072 square feet =.2 acres Total = 465 acres
Drilling and Production Operations [2] -Construct up to 40 new access road extensions from existing roadways (30' wide x 1 mile long). -Construct up to 40 drilling pads (300' x 350' or 2.4 acres / wellpad). -Gathering lines and flowlines would be placed within road corridor or within previously disturbed areas.	 145 acres 96 acres Total = 241 acres

[1] These estimates assume that 3-D seismic surveys would be conducted Preserve-wide, all surveys would be done using conventional land survey equipment, vegetation would be selectively cut by hand, and up to 6 shotholes may be drilled at each shotpoint location. Even though future surveys may utilize a single shothole at each shotpoint, this RFD scenario would represent the maximum amount of surface disturbance that could occur from either a mini-hole or single shothole configuration. The source and receiver line spacing is based on a 3-D seismic survey conducted in the Preserve in 2004 by Seismic Assistants, Ltd., and includes; 1760 feet between source and receiver lines and selectively cutting vegetation along all source lines to a width of up to 6 feet and up to a width of 3.5 feet on receiver lines. It is also possible that surface disturbance could occur from the use of tracked drilling equipment in certain areas of the Preserve and from the detonation of underground explosives.

[2] Surface disturbances in the Preserve from drilling and production operations could range from no surface disturbance (all wells directionally drilled from outside the Preserve or drilled on previously disturbed lands), to an intermediate estimate where multiple wells are drilled from a common pad or are drilled from outside the Preserve, to the maximum acreage presented above where all wells are drilled from surface locations inside the Preserve.

In summary, if all of the activities in the RFD scenario occur in the Preserve, there could be up to 465 acres of vegetation selectively cut to conduct 3-D seismic operations, less than one acre of surface disturbance from drilling shotholes, and up to 241 acres of new surface disturbance to construct access roads and wellpads. Drilling operations could occur over the next 15 to 20 years but are expected to closely follow completion of 3-D seismic surveys. Of the 40 wells drilled, 27 would produce commercial quantities of hydrocarbons. After wells are drilled, the wellpads would be reduced in size to the minimum area necessary to support the production operations. Reclamation of up to 13 wellpads and 13 miles of access roads (comprising 78 acres), would begin within 6 months of plugging the dry holes. If Preserve management determines that some of the access roads constructed in the Preserve are necessary for administrative purposes, they would not be removed and reclaimed. Flowlines would be placed within road corridors or other disturbed areas to transport the hydrocarbons. Production operations would have a life expectancy of 20 to 30 years. The total amount of new surface disturbance would not occur at the same time because as some operations are being proposed, others would be plugged, abandoned, and reclaimed.

The RFD drilling scenario presented in this Plan/EIS is based on the collaborative work of the USGS and the NPS. Seismic and other proprietary data available only to oil and gas companies was not used in the preparation of the Reasonably Foreseeable Development Scenario. An assessment of the growth potential of existing oil and gas fields is not included in this RFD scenario. It is possible that the drilling success rate may deviate from the NPS projection, oil and gas prices may continue to climb resulting in accelerated drilling activity, and it may take fewer or more wells to develop the oil and gas resources underlying the Preserve. Any of these or other factors could result in a different RFD scenario than is presented in this Plan/EIS.

SPECIAL MANAGEMENT AREAS

During internal and public scoping and subsequent analyses, the interdisciplinary planning team identified those resources and values that are particularly susceptible to adverse impacts from oil and gas operations or are essential to maintain the ecological integrity of the Preserve. Certain areas of the Preserve, called Special Management Areas (SMAs) in this Plan/EIS, have been proposed under Alternatives B and C to protect these resources and values. Specific operating stipulations have been developed for each of these SMAs to protect park resources and values from adverse impacts from oil and gas operations.

Another objective for designating SMAs and identifying operating stipulations is to give the operator more complete information to assist them through the planning and development phases of their operations. Through the plan of operations or permit process, the National Park Service may attach additional operating stipulations to address specific circumstances not identified through this planning process.

The designation of Special Management Areas would protect park resources and values through the application of operating stipulations for nonfederal oil and gas operations. There are two categories of Special Management Areas proposed in this plan. In some areas of the Preserve, oil and gas operations may be permitted, with specific operating stipulations to protect park resources and values. In other areas, no surface uses (NSU) for new operations would be permitted. In some cases where the NSU requirement would apply, there are distance setbacks from the boundary of the SMA. For example, No Surface Use with a 500- to 1,500-foot setback in the Visitor Use, Administrative and Other Use Areas SMAs means that surface uses associated with nonfederal oil and gas operations would not be permitted within 500 – 1,500 feet of the perimeter of the designated SMA. In these SMAs, the setback is variable, and is dependant upon the mitigation measures employed to protect natural soundscapes, visual quality, and human health and safety. Timing stipulations would be applied to some operations during the hunting season (October 1st through January 15th) and during periods of bird nesting and migration (March 1st through May 30th and from September 1st through November 30th) and other wildlife (such as threatened and endangered species and other species of special concern). Operators may conduct geophysical exploration operations when the timing stipulations are not in effect, and drilling and production operations may occur year-round in the hunting areas. If, however, an operator can demonstrate a compelling reason why it must conduct geophysical operations in a hunting area when the timing stipulations are in effect, the right of the oil and gas operator to access the federally-owned surface will take precedence over the hunting privilege.

Prior to the development of this Plan/EIS, Special Management Areas were not formally designated, and operating stipulations and mitigation measures were applied in the Preserve on a case-by-case basis. Areas of the Preserve protected under current Legal and Policy Requirements are called “Protected Areas” under Alternative A, No Action; and would continue to receive the same protection under Alternatives B and C. As an example, these include areas of the Preserve where a 500 foot offset from waterways and visitor use, administrative and other use areas are required pursuant to 36 CFR § 9.41(a), unless specifically authorized in an approved plan of operations, and areas where surface use and timing stipulations would apply (Royal Fern Bog, hunting areas, and birding hot spots) that have been delineated prior to this planning effort. Table 2.2 describes the justification for the Special Management Areas that are proposed under Alternative B and C. A description of the resources that comprise the SMAs is included in Chapter 3 – Affected Environment.

Table 2.2. Basis for Proposed Designation of Special Management Areas in Big Thicket National Preserve under Alternatives B and C.

NOTE: A description of the proposed operating stipulations for the SMAs proposed under Alternatives B and C are presented in Table 2.4 – Summary of Alternatives. In addition to the overall protection of biodiversity in the Preserve, the protection of specific resources and values in designated SMAs is mandated under federal statutes, regulations, executive orders, and NPS policies shown in Table 1.1.

RESOURCE/ VALUE	PROPOSED SPECIAL MANAGEMENT AREAS (SMA)	BASIS FOR SMA DESIGNATION
Floodplains	• **Riparian Corridors SMA** includes: -Floodplain Hardwood Forests -Floodplain Hardwood Pine Forests -SMA consists of complexes of these vegetation types, and up to 300' from banks of major streams where not defined by the above vegetation types	Riparian corridors are critical in maintaining the ecological integrity of the Preserve. Integral to preserving riparian corridors is the protection of floodplain functions and uses, plant and animal species diversity and composition, water quality, and other park resources and values in riparian areas which could be adversely impacted from oil and gas operations.
Vegetation	• **Ecological Research and Monitoring Plots SMA** includes: -fire monitoring plots -long-term monitoring plots • **Rare Vegetation Communities SMA** includes: -Upland Pine Forests -Beech-Magnolia-Loblolly Pine Forests -Sandhill Pine Forests -Old Growth Trees	Ecological research and monitoring plots have been established in the Preserve and are protected from potential impacts so that researchers can gain an understanding of the effects of fire suppression, wind throw, insect infestations, and other disturbances; to determine the nature and extent of global climatic change; to understand the effects of invasive exotic plant species; and to enable researchers to learn more about the trends in forest ecology such as recruitment and succession. Vegetation communities in the Preserve that are proposed for SMA designation are rare, are necessary to maintain the biodiversity in the Preserve, contain habitat for species of special concern, and could be adversely affected by oil and gas operations.
Wetlands	• **Rare Forested Wetland Communities SMA** includes: -Wetland Baygall Shrub Thickets -Swamp Cypress-Tupelo Forests -Wetland Pine Savannas -Old Growth Trees **Ecological Research and Monitoring Plots SMA** includes: -Royal Fern Bog Research Plot	Forested wetland communities are rare and/or unique in the Preserve and their integrity could be adversely affected by oil and gas operations. Public access in the Royal Fern Bog Research Plot is limited to NPS staff and researchers due to its unique character, rare occurrences of the regal fern, and long-term monitoring efforts occurring in the plot.
Visitor Use, Administrative and Other Use Areas	• **Visitor Use, Administrative and other Use Areas SMA** includes: **-Day Use Areas** (26 areas: boat ramps, picnic areas, parking areas) **-Hiking Trails** (9 trails) **-Canoe Routes** (Village Creek, Turkey Creek from Gore Store Road to Village Creek, Franklin Lake to Johns Lake, and Cook's Lake to Scatterman Lake Loop) **-Administrative Areas** (Big Thicket Visitor Information Station, Big Thicket Visitor Center, Maintenance and Meeting Facility, and Turkey Creek Ranch House) **-Cemeteries** (3) **-Private residential home sites with use and occupancy terms** (2 sites)	Visitor experiences and values (enjoyment of plant and animal biodiversity, visual quality, natural quiet, night sky etc.) occurring in limited visitor use areas of the Preserve must be protected from all potential impacts, including oil and gas operations. Preserve facilities and private in-holdings within the Preserve, and human health and safety of park visitors and staff must also be protected from all activities occurring in the Preserve, including nonfederal oil and gas operations.

RESOURCE/ VALUE	PROPOSED SPECIAL MANAGEMENT AREAS (SMA)	BASIS FOR SMA DESIGNATION
	• **Birding Hot Spots SMA** (8 areas) • **Hunting Areas SMA** (5 units) includes designated lands in: -Big Sandy Creek Unit -Beech Creek Unit -Lance Rosier Unit -Beaumont Unit -Neches Bottom and Jack Gore Baygall Unit	

In recognition of the broad-scale information used in this document, and the surface and subsurface complexities of the Preserve, a modification of any SMA operating stipulation may be considered by the NPS if site-specific information (such as engineering, geological, biological, or other studies) warrant the change, or if an operator can demonstrate that their proposed operation would meet the goals of protecting resources and values in the SMA.

DESCRIPTION OF THE ALTERNATIVES

The three alternatives presented below describe strategies for the long-term management of nonfederal oil and gas operations in Big Thicket National Preserve. These alternatives were developed because they meet the stated objectives of this plan to a large degree and provide a reasonable range of options to manage exploration, drilling, production and transportation of nonfederal oil and gas within the Preserve. Alternative A – No Action is required by the National Environmental Policy Act (NEPA) and describes the continued management of oil and gas operations in the Preserve under Current Legal and Policy Requirements (CLPR). Alternatives B and C were developed using Special Management Areas, performance standards, and mitigation measures to protect specific resources and values in the Preserve, consistent with the purposes and values of the Preserve and state and federal resource protection mandates. Alternatives B and C have been developed to formalize and improve upon current oil and gas management practices in the Preserve, which are described in Alternative A, No Action. Alternatives B and C, if implemented, would provide consistent guidance to oil and gas operators and help to ensure the long-term protection of Preserve resources and values by formalizing the Protected Areas identified under Alternative A, identifying and designating additional sensitive resources areas as Special Management Areas, and clearly articulating legal and policy requirements, operating standards, operating stipulations and mitigation measures for oil and gas development. Alternative B is the NPS's preferred alternative. Alternative C is the environmentally preferred alternative.

All of the proposed alternatives are subject to Current Legal and Policy Requirements (CLPR), including operating standards (called operating stipulations in this Plan/EIS) required under 36 CFR § 9.41. When applicable, oil and gas operators in the Preserve must employ mitigation measures to fulfill the resource protection requirements of the NPS's Nonfederal Oil and Gas Rights Regulations at 36 CFR Part 9 Subpart B. These requirements are included in Plans of Operations and Directional Drilling Applications, or attached as Conditions of Approval during the review and approval process for a Plan or Application. The Current Legal and Policy Requirements are listed in Table 1.1 and Chapter 2, Part II, and are described in Appendix B – National Park Service Nonfederal Oil and Gas Rights Regulations at 36 CFR Part 9B, and Appendix C – Federal Laws, Regulations, Executive Orders, Policies and Guidelines that Apply to Nonfederal Oil and Gas Operations.

The three alternatives are described on the following pages. Table 2.3 describes how well each alternative meets the planning objectives presented in this Plan/EIS. Table 2.4, Summary of Alternatives, lists each of the topics evaluated in this Plan/EIS, the Protected Areas and Special

Management Areas, and the operating stipulations that would apply in each area for geophysical operations and drilling and production operations. Table 2.5, Summary of Operating Stipulations under Each Alternative, lists the operating stipulations and acreages for Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C. Table 2.17 is a summary of environmental impacts. Tables 2.6 through 2.16 list the acreage for Protected Areas under Alternative A, and SMAs under Alternatives B and C, for each Unit in the Preserve. These tables provide the total acreages for Protected Areas and SMAs in each Unit without overlap. Figures 2.7 through 2.17 are maps depicting protected areas and SMAs for Alternatives A, B, and C, for each Unit in the Preserve. There is no table or figure for the Loblolly Unit because it has no Protected Areas or Special Management Areas.

Some of the Special Management Areas shown in Figures 2.7 through 2.17 overlap with each other. As an example, portions of the Ecological Research and Monitoring SMA covers portions of the Rare Vegetation Communities SMA. Where SMAs overlap, the SMA with the most restrictive stipulation(s) would apply. For example, if an operation is proposed in a Hunting Area SMA (where timing stipulations would apply) overlaps with the Rare Forested Wetland Communities SMA (where No Surface Use would be permitted), the NSU stipulation would apply.

The boundaries of the proposed "vegetation" SMAs (Riparian Corridors, Rare Vegetation Communities, and Rare Forested Wetland Communities SMAs) are based on broad-scale reconnaissance information. Therefore, it is possible that the site-specific vegetation may differ (or may be absent) from what is depicted on the vegetation maps.

Alternative A, No-Action/Current Management

- All nonfederal oil and gas operations are subject to Current Legal and Policy Requirements,
- Operating stipulations are applied on a case-by-case basis,
- Protected Areas have been designated in limited areas of the Preserve, and
- All other areas of the Preserve may be available for nonfederal oil and gas operations.
- Geophysical exploration could be permitted on 91 percent (80,670 acres) and drilling and production operations on 91 percent (80,639 acres) of the Preserve.

Alternative A provides the baseline for analysis and describes current management strategies for oil and gas management in the Preserve. In the past, there has been no formalized, comprehensive Preserve-wide management plan to guide nonfederal oil and gas operations. Instead, oil and gas operations have been managed on a case-by-case basis, with operating stipulations applied during Plan of Operations development and through the NPS permitting process.

Special Management Areas have not been formally designated under Alternative A. However, limited areas of the Preserve have been designated "Protected Areas" and surface use and timing stipulations to protect resources and values in these areas have been implemented for different types of nonfederal oil and gas operations. A 500' offset (unless specifically authorized in an approved plan of operations) from visitor use and administrative areas; and perennial, intermittent, or ephemeral watercourses required under 36 CFR § 9.41(a) would apply to all phases of nonfederal oil and gas operations.

Geophysical exploration (3-D seismic surveys) could be allowed in all areas of the Preserve, with the exception of Ecological Research, and Long-term Monitoring Plots, and Visitor Use, Administrative and Other Uses Protected Areas. Timing Stipulations for geophysical exploration would apply in the Hunting and Birding Hot Spots Protected Areas. Exploration operations would not be permitted under Current Legal and Policy Requirements on 7,462 acres and on 52,272 acres during specified times.

Drilling and production operations could be permitted throughout the Preserve with the exception of the Ecological Research and Long-term Monitoring Plots, and Visitor Use, Administrative, and Other Uses Protected Areas. Drilling and production operations would not be permitted under Current Legal and Policy Requirements on 7,493 acres in the designated Protected Areas.

Currently there is no formal protection provided for rare vegetation communities (including Sandhill Pine Forest, Upland Pine Forest, American Beech-Southern Magnolia-Loblolly Pine Forest, and old growth trees) during nonfederal oil and gas development in the Preserve. Variations in protection of these resources may occur under Alternative A, resulting in different interpretations and applications of policy. In addition, the interpretation and application of Current Legal and Policy Requirements to protect floodplains, wetlands, riparian corridors, fish and wildlife, and cultural resources could also result in variations in how, where, and to what extent resource protection is applied.

Threatened and endangered species habitat and National Register-eligible or listed cultural resource areas have not been formally designated as SMAs in this plan. Based on Current Legal and Policy Requirements and in consultation with the appropriate regulatory authority, timing or surface use stipulations would be imposed on nonfederal oil and gas operations to avoid adverse impacts to these resources.

The Reasonably Foreseeable Development scenario presented in this Plan/EIS would apply to Alternative A. Geophysical exploration (3-D seismic surveys) could be conducted throughout the Preserve and up to 40 wells (13 dry holes, 27 productive wells) could be drilled in the Preserve over the next 15 – 20 years. New surface disturbances in the Preserve can be minimized by using directional drilling techniques and utilizing previously-disturbed areas.

Alternative B, Preferred Alternative

- All nonfederal oil and gas operations are subject to Current Legal and Policy Requirements;
- Performance Standards are developed and applied Preserve-wide to protect resources and values;
- Special Management Areas are formally designated and include timing and surface use stipulations; and
- All other areas of the Preserve may be available for nonfederal oil and gas operations.
- Geophysical exploration could be permitted on up to 87 percent (76,620 acres) and drilling and production operations on approximately 47 percent (41,859 acres) of the Preserve.

Under Alternative B, an oil and gas management plan that clearly articulates the Current Legal and Policy Requirements applicable to the exploration, production, and transportation of nonfederal oil and gas resources in the Preserve to help ensure the long-term protection of Preserve resources and values would be implemented. Performance standards, mitigation measures, and operating stipulations articulated in this Plan/EIS would provide information, and consistent direction to operators during project planning and compliance with federal, state, and local resource protection mandates.

Special Management Areas would be formally designated for areas of the Preserve where park resources and values would be particularly susceptible to adverse impacts from oil and gas operations or in areas where certain resources are critical to maintaining the ecological integrity of the Preserve. Under this alternative, surface use and timing stipulations would be developed in the SMAs for different types of nonfederal oil and gas operations.

Geophysical exploration (3-D seismic surveys) with specified surface use stipulations could be allowed in all of the SMAs except for Ecological and Research Monitoring Plots, and Visitor Use, Administrative and Other Use Areas SMAs. Timing Stipulations for geophysical exploration would apply in the Hunting Area and Birding Hot Spots SMAs. Exploration operations would not be permitted during any time of the year on 11,512 acres and during specified times on 52,272 acres.

Drilling and production operations would not be permitted in SMAs, with the exception of the Hunting Areas and Riparian Corridors SMAs. The No Surface Use stipulation would apply for drilling and production operations in all Ecological Research and Monitoring Plots, Rare Vegetation and Wetland Communities, and Visitor Use and Administrative Areas SMAs. Within the Riparian Corridors SMA, no new roads could be constructed, and subject to NPS floodplain management guidelines, surface uses for drilling and production operations could only be permitted adjacent to existing roadways and within previously disturbed areas. Drilling and production operations would not be permitted during any time of the year on up to 46,273 acres. All other areas of the Preserve could be available for drilling and production operations, including the placement of associated access roads and flowlines.

Threatened and endangered species habitat and National Register-eligible or listed cultural resource areas have not been formally designated as SMAs in this Plan/EIS. Based on Current Legal and Policy Requirements and in consultation with the appropriate regulatory authority, timing or surface use stipulations would be imposed on nonfederal oil and gas operations to avoid adverse impacts to these resources.

The Reasonably Foreseeable Development scenario presented in this Plan/EIS would apply to Alternative B – Preferred Alternative. Geophysical exploration (3-D seismic surveys) could be conducted throughout the Preserve and up to 40 wells (13 dry holes, 27 productive wells) could be drilled in all areas of the Preserve (except in certain designated SMAs) over the next 15 – 20 years. New surface disturbances in the Preserve can be minimized by using directional drilling techniques and utilizing previously-disturbed areas.

Alternative B was chosen as the preferred alternative over Alternative C, the environmentally preferred alternative, because it would meet the planning objectives better than Alternative C (shown on Table 2.3, Description of the Extent that Each Alternative Meets the Planning Objectives Presented in this Plan/EIS). The NPS believes Alternative B would fulfill its park protection mandates while allowing nonfederal oil and gas operators to exercise their property interests.

Alternative C, Maximum Resource Protection

- All nonfederal oil and gas operations are subject to Current Legal and Policy Requirements;
- Performance Standards are developed and applied Preserve-wide to protect Preserve resources and values;
- Special Management Areas are formally designated and surface use is not permitted for any type of oil and gas operation, with the exception of the Birding Hotspots and Hunting Area SMAs during designated times; and
- All other areas of the Preserve may be available for nonfederal oil and gas operations.
- Geophysical exploration could be permitted on 55 percent (48,475 acres) and drilling and production operations on 47 percent (41,859 acres) of the Preserve.

The same as Alternative B, an oil and gas management plan would be implemented that clearly articulates the Current Legal and Policy Requirements applicable to the exploration, production, and transportation of nonfederal oil and gas resources in the Preserve. Performance standards, mitigation

measures, and operating stipulations described in this Plan would provide information, and consistent direction for operators during project planning and compliance with federal, state, and local resource protection mandates.

This alternative emphasizes widespread resource protection in areas of the Preserve where resources are susceptible to adverse impacts from oil and gas operations or where certain resources and values are essential to maintain the ecological integrity of the Preserve. Special Management Areas designated under this alternative with the "No Surface Use" stipulation are more widespread than for Alternatives A and B.

Geophysical exploration would not be permitted in SMAs with the exception of the Birding Hot Spots and Hunting Areas SMAs during specified times. Where geophysical exploration would not be permitted in the SMAs, the modification of project designs could concentrate these operations outside of the SMAs. Exploration operations would not be permitted during any time of the year on 39,657 acres and during specified times on 52,272 acres.

Drilling and production operations would not be permitted in SMAs, with the exception of the Hunting Areas SMA. Drilling and production operations would not be permitted during any time of the year on 46,273 acres. Under most, if not all of the SMAs, nonfederal oil and gas could be developed using directional drilling methods. All other areas of the Preserve not designated as a SMA could be available for drilling and production operations, including associated access roads and flowlines.

Threatened and endangered species habitat and National Register-eligible or listed cultural resource areas have not been formally designated as SMAs in this plan. Based on Current Legal and Policy Requirements and in consultation with the appropriate regulatory authority, timing or surface use stipulations would be imposed on nonfederal oil and gas operations to avoid adverse impacts to these resources.

The Reasonably Foreseeable Development scenario presented in this Plan/EIS would apply to Alternative C. Geophysical exploration (3-D seismic surveys) could be conducted throughout the Preserve and up to 40 wells (13 dry holes, 27 productive wells) could be drilled in the Preserve over the next 15 – 20 years. Drilling and production operations would not be permitted in any of the SMAs (with the exception of the Hunting Areas SMA), and directional drilling techniques would be required to develop nonfederal oil and gas reserves underlying these areas. New surface disturbances in the Preserve can be minimized by using directional drilling techniques and utilizing previously-disturbed areas.

ENVIRONMENTALLY PREFERRED ALTERNATIVE

Based on the analyses presented in this document, the planning team has determined that Alternative C is the environmentally preferred alternative in this Plan/EIS. Alternative C would result in the least damage to the biological and physical environment and best protects, preserves, and enhances the historic, cultural, and natural resources in Big Thicket National Preserve.

Of the three alternatives presented in this Plan/EIS, Alternative C would best promote the following policies that are expressed in the National Environmental Policy Act (42 U.S.C. §§ 4321 *et seq.* section 101 (b)):

1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.

2) Ensure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings.
3) Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
4) Preserve important historic, cultural, and natural aspects of our natural heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
5) Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Under all of the alternatives, nonfederal oil and gas operations may be permitted in areas throughout the Preserve, based on Current Legal and Policy Requirements and operating stipulations described in this Plan/EIS. The total anticipated surface disturbance would be the same for all alternatives. There could be up to 465 acres of selective vegetation removal to conduct 3-D seismic operations, less than one acre of surface disturbance from drilling shotholes, and up to 241 acres of new surface disturbance to construct access roads and wellpads. The development of Special Management Areas for Alternatives B and C (see Tables 2.6 through 2.16) would ensure that Preserve resources and values would be better protected than under the No Action Alternative (Alternative A). Alternative A would be less likely to meet these policies because each operation is evaluated on a case by case basis with less overall consistency for protection of resources, values and human health and safety. Alternative C is most likely to meet these criteria because more of the Preserve is protected with the No Surface Use stipulation than the other two alternatives presented in this Plan/EIS.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

In developing alternatives for this Plan/EIS, nine alternatives were initially considered by the planning team. Six of the alternatives were eliminated from further detailed evaluation because they did not meet the stated objectives of the plan to a large degree, could not be implemented for technical or logistical reasons, did not meet park mandates, or were outside the scope of this planning effort. The alternatives and the reasons why they were dismissed are described below.

Nonfederal Oil and Gas Exploration, Drilling and Production Would Not be Allowed in Big Thicket National Preserve

The proposal to eliminate all nonfederal oil and gas operations at Big Thicket National Preserve was considered by the interdisciplinary planning team and eliminated from further consideration. Under this alternative, exploration, production, and transportation of nonfederal oil and gas resources would not be permitted within the Preserve. Alternatives that are carried forward for analysis must meet all of the planning goals and objectives that were developed for this Plan/EIS to a large degree. This alternative would protect, preserve, and interpret resources and values and avoid conflicts with visitor use, enjoyment, and human health and safety, but would create significant conflicts with private property rights. It would also not meet the goal of permitting access for geophysical exploration, drilling, and production/transportation of nonfederal oil and gas resources, to the extent it does not compromise the ecological integrity of the Preserve. NPS regulations at 36 CFR Part 9B provide for reasonable controls on nonfederal oil and gas exploration, production, and transportation to assure park resource and visitor protection. A blanket elimination of those activities is inconsistent with the regulations and is outside the scope of this Plan/EIS.

Nonfederal Oil and Gas Drilling and Production Operations Would Not be Allowed in Big Thicket National Preserve

An alternative was proposed during project scoping that would allow nonfederal oil and gas operations to occur from outside the Preserve, while applying "No Surface Use" stipulations inside the Preserve. Under this scenario, operators could obtain geophysical data in the Preserve through application of least damaging methods, however siting of roads, drilling or production facilities, flowlines and other facilities associated with drilling or production activities would not be permitted inside the Preserve. This alternative meets the planning goals to protect, preserve, and interpret resources and values and avoid conflicts with visitor use, enjoyment, and safety. However, for the same reasons described above, this alternative would fall short of the planning goal to permit reasonable access for exploratory drilling, production, and transportation of nonfederal oil and gas resources. If this alternative were implemented, certain areas of Big Thicket National Preserve, particularly the larger nonlinear units may not be accessible via directional drilling techniques from outside of the Preserve, thereby precluding the extraction of some nonfederal oil and gas resources.

Amending NPS Nonfederal Oil and Gas Regulations - 36 CFR Part 9B

A scenario that included Alternative B, the Preferred Alternative, and a second phase that included revising the NPS Nonfederal Oil and Gas Regulations at 36 CFR Part 9B was considered by the interdisciplinary team. The public suggested revising the regulations to simplify the process for preparing and approving Plans of Operations and to expand the types of situations where a waiver from Plan of Operations requirements would be permissible. Revising the 36 CFR Part 9B regulations is outside the scope of this planning effort because it is not a part of the stated management goals and objectives of this plan and is a function of the rulemaking process under the Administrative Procedures Act. In addition, the 9B regulations apply to oil and gas operations throughout the National Park System and should be revised as a coordinated effort with all of the parks that would be affected by the changes. Through a separate rulemaking process, the NPS would provide the public an opportunity to review and comment on proposed changes. The NPS must also comply with the National Environmental Policy Act as part of any effort to revise the 9B regulations. For these reasons, this alternative was eliminated from further detailed analysis.

Oil and Gas Operations would be Subject Only to State Regulation

An alternative was suggested where oil and gas operations would be subject solely to state regulation. The oil and gas operations covered in this plan are located on federal lands and are bound by all applicable federal, state, and local laws and regulations, including NPS oil and gas rights regulations at 36 CFR 9B. This alternative would not comply with these legal and policy mandates and would not meet the objectives of the plan to ensure protection of park resources and values and human health and safety. Therefore, this alternative was eliminated from further consideration.

Purchase the Nonfederal Mineral Rights in the Preserve

Two alternatives were proposed to acquire a portion of or all of the nonfederal mineral rights in the Preserve. One proposal was to purchase mineral rights in specific areas of the Preserve. The criteria for selecting where mineral rights would be purchased would depend on the sensitivity of Preserve resources to adverse impacts from oil and gas operations. Big Thicket National Preserve's enabling legislation (Public Law 93-439 § 2(a)) states that "The Secretary [of the Interior] shall, immediately after

the publication of the boundaries of the preserve, commence negotiations for the acquisition of the lands located therein: *Provided*, that he shall not acquire the mineral estate in any property or existing easements for public utilities, pipelines or railroads without the consent of the owner unless, in his judgment, he first determines that such property or estate is subject to, or threatened with, uses which are, or would be, detrimental to the purposes and objectives of this Act…" The planning team determined that this proposal is a component of all of the alternatives and eliminated it from further consideration. The NPS currently has the authority to acquire the nonfederal mineral rights on a case-by-case basis if it determines that an oil and gas operation poses a significant threat to park resources and values, and the operation cannot be modified to ensure the protection of park resources and values.

Another alternative proposed eliminating all oil and gas operations at the Preserve and purchasing the nonfederal mineral rights Preserve-wide. After a preliminary analysis by the planning team, this alternative was eliminated from further consideration. This alternative would protect park resources and values and avoid conflicts with visitor use, enjoyment, and human health and safety, but would create significant conflicts with private property rights. It would also not meet the objective of permitting reasonable access for exploration and development of nonfederal oil and gas resources. NPS regulations at 36 CFR Part 9B governing nonfederal oil and gas operations in parks provide for reasonable controls on nonfederal oil and gas exploration, production, and transportation to assure park resource and visitor protection. As described above, the NPS has the authority to purchase the nonfederal mineral rights on a case-case basis. It would be unnecessary and cost prohibitive to purchase all of the mineral rights throughout the Preserve; therefore, this alternative was eliminated from further detailed analysis.

Table 2.3. Description of the Extent that Each Alternative Meets the Planning Objectives Presented in this Plan/EIS

PLANNING OBJECTIVE	ALTERNATIVE A – NO ACTION/CURRENT MANAGEMENT	ALTERNATIVE B – PREFERRED ALTERNATIVE	ALTERNATIVE C – MAXIMUM RESOURCE PROTECTION
1. Identify Preserve resources and values susceptible to adverse impacts from oil and gas operations.	**Meets objective? NO** Resource protection has been applied on a case-by-case basis for oil and gas operations. Resources susceptible to adverse impacts from oil and gas operations have not been identified throughout the Preserve.	**Meets objective? YES** Specific Preserve resources susceptible to adverse impacts from oil and gas operations have been identified in this Plan/EIS and would be protected in designated SMAs throughout the parks.	**Meets objective? YES** Same as Alternative B.
2. Establish performance standards and impact mitigation measures for oil and gas operations to protect and prevent impairment to Preserve resources and values from adverse impacts from oil and gas operations.	**Meets objective? PARTIALLY** Resource protection has been applied on a case-by-case basis for oil and gas operations. Resources susceptible to adverse impacts from oil and gas operations have not been identified throughout the Preserve.	**Meets objective? YES** Specific Preserve resources susceptible to adverse impacts from oil and gas operations have been identified in this Plan/EIS and would be protected in designated SMAs throughout the Preserve.	**Meets Objective? YES** Same as Alternative B.
3. Establish performance standards and impact mitigation measures for oil and gas operations to avoid or minimize impacts from oil and gas operations on visitor use and enjoyment, and human health and safety.	**Meets objective? PARTIALLY** In accordance with CLPR, oil and gas operations have for the most part avoided visitor use areas, but variability in protection is possible by applying CLPR on a case-by-case basis. Visitor use and enjoyment may be affected by noise, visual intrusions, resource degradation, and damage to resources and values from accidental leaks and spills of hazardous and contaminating substances during oil and gas operations. Resource degradation and the potential for spills of hazardous and contaminating substances would continue to pose a threat	**Meets objective? YES** In accordance with CLPR, oil and gas operations would avoid visitor use areas. The designation of SMAs, and the application of performance goals, and operating stipulations developed in this Plan/EIS would protect visitor use and enjoyment, and human health and safety while minimizing adverse impacts on Preserve resources and values. Performance goals and specific operating stipulations would be required in this Plan/EIS to protect human health and safety in the Preserve.	**Meets objective? YES** Same as Alternative B. In addition, applying the No Surface use stipulation in more SMAs would minimize future damage to Preserve resources and values in those areas susceptible to adverse impacts from oil and gas operations, and reduce conflicts with visitor use and enjoyment. Same as Alternative B, performance goals and specific operating stipulations that would be required in this Plan/EIS would protect human health and safety in the Preserve.

PLANNING OBJECTIVE	ALTERNATIVE A – NO ACTION/CURRENT MANAGEMENT	ALTERNATIVE B – PREFERRED ALTERNATIVE	ALTERNATIVE C – MAXIMUM RESOURCE PROTECTION
	to human health and safety in the Preserve.		
4. Provide holders of oil and gas rights reasonable access for exploration and development.	**Meets objective? YES** In accordance with CLPR, oil and gas operators may conduct operations throughout the Preserve.	**Meets objective? YES** In accordance with CLPR and operating stipulations in Special Management Areas, operators may conduct operations throughout the Preserve.	**Meets objective? PARTIALLY** Increasing the No Surface Use stipulation in SMAs may limit an operator's ability to conduct operations in the Preserve.
5. Provide pertinent information to oil and gas operators to facilitate planning and compliance with NPS and other applicable regulations.	**Meets objective? PARTIALLY** There is no comprehensive plan describing CLPR, performance standards, SMAs, and operating stipulations that would guide oil and gas operations in the parks. Project development has been done on a case-by-case basis.	**Meets objective? YES** This Plan/EIS would provide the operator consistent guidance prior to project planning and would describe CLPR, performance standards, SMAs, operating stipulations, and recommended mitigation measures.	**Meets objective? YES** Same as Alternative B.

Table 2.4. Summary of Alternatives

Note: For definitions and additional information, see footnotes at the end of this table. Also note that the acreage numbers provided are total acres for each Protected Area or SMA. Because these areas overlap, if the acreages were add together, they would exceed the total area of the Preserve.

IMPACT TOPICS	ALTERNATIVE A NO ACTION/CURRENT MANAGEMENT	ALTERNATIVE B PREFERRED ALTERNATIVE	ALTERNATIVE C MAXIMUM RESOURCE PROTECTION
BIG THICKET NATIONAL PRESERVE – 88,132 Acres[1]			
OVERVIEW: Current Legal and Policy Requirements (CLPR[2]) are summarized for the 12 impact topics presented in this Plan/EIS. Special Management Areas (SMAs[3]) are formally designated under Alternatives B and C, and specific protection measures would be applied.	-Special Management Areas (SMAs) are not formally designated. Some areas of the Preserve called Protected Areas in this Plan/EIS have specific resource protection measures applied under Current Legal and Policy Requirements (CLPR). For other areas of the Preserve, resource protection measures are applied on a case-by-case basis by applying other CLPR. - Current Legal and Policy Requirements (CLPR) would apply in all areas of the Preserve and gas operations would be evaluated on a case-by-case basis. -CLPR could result in applying "No Surface Use" (NSU) or "No Surface Use with Timing Stipulations" in areas where cultural resources, threatened and endangered species and their habitat, and floodplains or wetlands are identified during plan of operations development. -In all areas of the Preserve, nonfederal oil and gas operations would be evaluated on a case-by-case basis, using Current Legal and Policy Requirements (CLPR).	-Special Management Areas (SMAs) would be formally designated, and applying "No Surface Use" (NSU[3]) or "No Surface Use with Timing Stipulations" for nonfederal oil and gas operations would provide specific resource protection. -Current Legal and Policy Requirements (CLPR) would apply in all areas of the Preserve. -"No Surface Use" (NSU) or "NSU with Timing Stipulations" would be applied in all designated SMAs. -In all other areas of the Preserve not designated as a SMA, nonfederal oil and gas operations would be evaluated on a case-by-case basis, using Current Legal and Policy Requirements (CLPR).	-Special Management Areas (SMAs) would be formally designated, and "No Surface Use" (NSU) would be applied to all geophysical exploration, drilling, and production operations, except in the Hunting Areas SMA. Directional drilling from surface locations outside SMAs to reach bottomhole locations under SMAs, and for placement of flowlines and gathering lines, could be permitted. - Current Legal and Policy Requirements (CLPR) would apply in all areas of the Preserve. -"No Surface Use" would be applied in all designated SMAs, except in the Hunting Areas SMA. -Same as Alternative B.
1. NONFEDERAL OIL AND GAS DEVELOPMENT	-Nonfederal oil and gas operations could be permitted, based on CLPR.	-CLPR would apply throughout the Preserve with additional stipulations in all designated SMAs.	- CLPR would apply throughout the Preserve with NSU in all designated SMAs, except the Hunting Area SMA.
2. AIR QUALITY	-CLPR would result in applying mitigation measures to protect local and regional air quality and related values.	-Same as Alternative A.	-Same as Alternative A.
3. GEOLOGIC RESOURCES	-Nonfederal oil and gas operations could be permitted, based on CLPR.	-Same as Alternative A.	- Same as Alternative A .
4. WATER RESOURCES	-CLPR with 500' foot offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations (36 CFR § 9.41(a)).	-Same as Alternative A.	-Same as Alternative A.

IMPACT TOPICS	ALTERNATIVE A NO ACTION/CURRENT MANAGEMENT	ALTERNATIVE B PREFERRED ALTERNATIVE	ALTERNATIVE C MAXIMUM RESOURCE PROTECTION
5. FLOODPLAINS, Including Riparian Corridors SMA[7]	-Geophysical exploration could be permitted within the 100-year floodplain with 500' foot offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations (36 CFR § 9.41(a)). Staging areas would not be permitted unless there is no practicable alternative, and vehicle use would not be permitted on or across saturated or flooded soils in hydrologic soil classes[8] "C" and "D" (DO-77-2).	-Same as Alternative A.	-Same as Alternative A with NSU in the Riparian Corridors SMA.
	-Drilling and production pads would not be permitted within the 500-year floodplain unless there is no practicable alternative (documented in Statement of Findings (SOF) (DO 77-2)).	-Same as Alternative A. NSU in Riparian Corridors SMA with exceptions.	-Same as Alternative A, with NSU in the Riparian Corridors SMA.
	-Drilling and production access roads, pads, flowlines, and gathering lines would not be permitted in the 100-year floodplain unless there is no practicable alternative (DO 77-2).	-Same as Alternative A. NSU in Riparian Corridors SMA with exceptions.	-Same as Alternative A, with NSU in the Riparian Corridors SMA.
Riparian Corridors SMA includes: -Floodplain Hardwood Forests -Floodplain Hardwood Pine Forests -complexes of these vegetation types, and up to 300' from banks of major streams where not defined by the above vegetation types	**Area:** No formal SMA designation **Geophysical Exploration[5]:** CLPR, as described above. **Drilling & Production:** CLPR as described above.	**Area:** 25,539 acres/30% of analysis area **Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** NSU, except drilling and production operations could be permitted adjacent to existing roadways, within previously disturbed areas, subject to CLPR. No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas.	**Area:** 25,539 acres/30% of analysis area **Geophysical Exploration:** NSU. **Drilling & Production:** NSU.
6. VEGETATION, including Ecological Research and Monitoring Plots and Rare Vegetation Communities SMAs	-Nonfederal oil and gas operations could be permitted, based on CLPR.	-Same as Alternative A, with additional stipulations in designated SMAs.	-Same as Alternative A, with NSU in designated SMAs.
Ecological Research and Monitoring Plots SMA includes: -fire monitoring plots	**Area:** 1.38 acres/.002% of analysis area **Geophysical Exploration:** NSU.	**Area:** 3.6 acres/.004% of analysis area **Geophysical Exploration:** NSU with 50' offset for seismic shotholes.	**Area:** 3.6 acres/.004% of analysis area **Geophysical Exploration:** Same as Alternative B.

IMPACT TOPICS	ALTERNATIVE A NO ACTION/CURRENT MANAGEMENT	ALTERNATIVE B PREFERRED ALTERNATIVE	ALTERNATIVE C MAXIMUM RESOURCE PROTECTION
-long-term monitoring plots	**Area:** 55 acres/1% of analysis area -NSU.	**Area:** 55 acres/1% of analysis area -NSU with 150' offset for seismic shotholes.	**Area:** 55 acres/1% of analysis area -Same as Alternative B.
All monitoring plots:	**Area:** 74 acres/1% of analysis area **Drilling & Production:** NSU.	**Area:** 74 acres/1% of analysis area **Drilling & Production:** NSU with 150' offset.	**Area:** 74 acres/1% of analysis area **Drilling & Production:** Same as Alternative B.
Rare Vegetation Communities SMA includes: -Upland Pine Forests -Beech-Magnolia-Loblolly Pine Forests -Sandhill Pine Forests -Old Growth Trees	**Area:** No formal SMA designation **Geophysical Exploration:** CLPR. **Drilling & Production:** CLPR.	**Area:** 2,948 acres/3.4% of analysis area **Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** NSU.	**Area:** 2,948 acres/3.4% of analysis area **Geophysical Exploration:** NSU. **Drilling & Production:** Same as Alternative B.
7. WETLANDS, including Rare Forested Wetland Communities and Ecological Research and Monitoring Plots SMAs	-Geophysical exploration could be permitted under CLPR (DO 77-1); with no vehicle use permitted on or across saturated or flooded soils in hydrologic soil classes[8] "C" and "D". -Drilling and production operations (including access roads and placement of flowlines and gathering lines) would not be permitted in wetlands unless there is no practicable alternative (DO 77-1).	-Same as Alternative A. -Same as Alternative A., with NSU in designated SMAs.	-Same as Alternative A, with NSU in designated SMAs. -Same as Alternative B, with NSU in designated SMAs.
Rare Forested Wetland Communities SMA includes: -Wetland Baygall Shrub Thickets -Swamp Cypress-Tupelo Forests -Wetland Pine Savannas -Old Growth Trees	**Area:** No formal SMA designation **Geophysical Exploration:** CLPR, as described above. **Drilling & Production:** CLPR, as described above.	**Area:** 5,087 acres/6% of analysis area **Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** NSU.	**Area:** 5,087 acres/6% of analysis area **Geophysical Exploration:** NSU. **Drilling & Production:** Same as Alternative B.
Ecological Research and Monitoring Plots SMA includes: -Royal Fern Bog Research Plot	**Area:** 168 acres/.2% of analysis area **Geophysical Exploration:** NSU. **Drilling & Production:** NSU.	**Area:** 191 acres/.2% of analysis area **Geophysical Exploration:** NSU with 150' offset. **Drilling & Production:** NSU with 150' offset.	**Area:** 191 acres/.2% of analysis area **Geophysical Exploration:** Same as Alternative B. **Drilling & Production:** Same as Alternative B.
8. FISH AND WILDLIFE	-CLPR would result in applying mitigation measures to protect fish and wildlife and their habitat.	-Same as Alternative A.	-Same as Alternative A.

IMPACT TOPICS	ALTERNATIVE A NO ACTION/CURRENT MANAGEMENT	ALTERNATIVE B PREFERRED ALTERNATIVE	ALTERNATIVE C MAXIMUM RESOURCE PROTECTION
9. THREATENED AND ENDANGERED SPECIES	-CLPR would result in applying surface use and Timing Stipulations to protect threatened, endangered, and sensitive species and their habitat (ESA).	-Same as Alternative A.	-Same as Alternative A.
10. CULTURAL RESOURCES	-CLPR would result in applying operating stipulations in areas where cultural resources are identified during plan of operations development (NHPA and DO-28).	-Same as Alternative A.	-Same as Alternative A.
11. VISITOR USE, ADMINISTRATIVE & OTHER USE AREAS, Including designated visitor use and administrative areas SMAs.	CLPR would result in NSU with 500' offset for all geophysical exploration, drilling, and production operations from any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations (36 CFR § 9.41(a)).	-Same as Alternative A.	-Same as Alternative A.
Visitor Use, Administrative, and other Use Areas SMA includes: -Day Use Areas (27 areas) includes: boat ramps, picnic areas, and parking areas	**Geophysical Exploration:** NSU with 500' offset, unless specifically authorized by an approved plan of operations. **Drilling & Production:** NSU with 500' offset, unless specifically authorized in an approved plan of operations. **Area:** 509 acres/.6% of analysis area	**Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** NSU with 1500' offset. **Area:** 3,092 acres/4% of analysis area	**Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** Same as Alternative B. **Area:** 3,092 acres/4% of analysis area
-Hiking Trails (9 trails)	**Area:** 5,357 acres/6% of analysis area	**Area:** 13,681 acres/16% of analysis area	**Area:** 13,681 acres/16% of analysis area
-Canoe Routes includes: Village Creek, Turkey Creek from Gore Store Road to Village Creek, Franklin Lake to Johns Lake, and Cook's Lake to Scatterman Lake Loop	**Area:** 2,323 acres/3% of analysis area	**Area:** 5,528 acres/6% of analysis area	**Area:** 5,528 acres/6% of analysis area
-Administrative Areas includes: Visitor Information Station, Big Thicket Maintenance and Meeting Facility, and Turkey Creek Ranch House	**Area:** 54 acres/.06% of analysis area	**Area:** 313 acres/.4% of analysis area	**Area:** 313 acres/.4% of analysis area
-Cemeteries (3 sites)	**Area:** 73 acres/.08% of analysis area	**Area:** 482 acres/.6% of analysis area	**Area:** 482 acres/.6% of analysis area
-Private Residences includes: 2 residential homesites with use and occupancy terms	**Area:** 56 acres/.06% of analysis area	**Area:** 255 acres/.3% of analysis area	**Area:** 255 acres/.3% of analysis area

IMPACT TOPICS	ALTERNATIVE A NO ACTION/CURRENT MANAGEMENT	ALTERNATIVE B PREFERRED ALTERNATIVE	ALTERNATIVE C MAXIMUM RESOURCE PROTECTION
Birding Hot Spots SMA (8 areas)	**Area:** 135 acres/.2% of analysis area **Geophysical Exploration:** NSU from 3/1–5/30 & 9/1–11/30 with 500' offset, unless specifically authorized by an approved plan of operations. **Drilling & Production:** NSU with 500' offset, unless specifically authorized by an approved plan of operations.	**Area**: 993 acres/1.1% of analysis area **Geophysical Exploration**: Same as Alternative A. **Drilling & Production:** NSU with 1,500' offset.	**Area:** 993 acres/1.1% of analysis area **Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** Same as Alternative B.
Hunting Areas SMA (5 units) includes designated lands in : -Big Sandy Creek Unit -Beech Creek Unit -Lance Rosier Unit -Beaumont Unit -Neches Bottom and Jack Gore Baygall Unit	**Area:** 52,272 acres/61% of analysis area **Geophysical Exploration:** NSU from 10/1-1/15. **Drilling & Production:** CLPR.	**Area:** 52,272 acres/61% of analysis area **Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** Same as Alternative A.	**Area:** 52,272 acres/61% of analysis area **Geophysical Exploration:** Same as Alternative A. **Drilling & Production:** Same as Alternative A.
12. ADJACENT LAND USES AND RESOURCES	-Nonfederal oil and gas operations could be permitted outside the Preserve, based on CLPR (36 CFR §9.32(e)).	Same as Alternative A.	Same as Alternative A.

[1]**88,132 acres** – The total acreage within the legislated boundary of the Preserve is 98,735 acres. However, 88,132 acres is used for the analysis in this Plan/EIS because the NPS has not acquired 10,602 acres within the boundary of the Preserve. All percentage calculations in this table (and document) are based on the 88,132 acre figure.

[2]**CLPR** = "Current Legal and Policy Requirements" – Nonfederal oil and gas operations could be permitted under "Current Legal and Policy Requirements" which include federal and state laws, regulations, federal executive orders, NPS policies, and applicable direction provided in park planning documents.

[3]**Modification of any SMA stipulation** may be considered if an operator can demonstrate that new technology or site-specific information (such as engineering, geological, biological, or other information or studies) would meet the goals of protecting resources, values, and uses in the SMA. Some of the SMAs overlap so the total SMA acreage will be greater than the total area of the Preserve. For example, overlap occurs between the Ecological Research and Monitoring Plots SMA and the Rare Vegetation Communities SMA, since some plots are located within the rare vegetation communities. A breakdown of SMAs by Preserve Unit is presented along with the SMA maps in Tables 2.6 through 2.16, and Figures 2.7 through 2.17.

[4]**NSU** = "No Surface Use" – Access across the surface or use of the surface for nonfederal oil and gas operations would be limited or not permitted in SMAs. Operations include, but are not limited to: gathering information for development of a plan of operations; geophysical exploration; construction or use of roads or other means of access; construction or use of drilling pads and well pads, well completion and production; use of production equipment and facilities; well servicing and workover operations, construction or use of flowlines and gathering lines; transport or processing of petroleum products; and inspection, monitoring or maintenance of wells and equipment. Under this constraint, operators may produce and develop the oil and gas resources beneath the Preserve by directionally drilling from sites outside the NSU area. NSU is also used with an offset or distance stipulation, or timing stipulation. For example, the "NSU with 150' offset," as applied to the Royal Fern Bog Research Plot, means to completely avoid (i.e., no surface access and No Surface Use) the plot itself, and offset operations 150 feet from the perimeter of the plot. Similarly, the "NSU from 10/1-1/15" stipulation for hunting areas means that geophysical exploration would not be permitted (i.e., no surface access and No Surface Use) in designated hunting areas during the Preserve's hunting season, typically from October 1 through January 15, inclusive.

[5]**Geophysical Exploration** primarily consists of 3-D seismic operations and typically involves selective cutting of vegetation along source and receiver lines, drilling shot holes along source lines, placing explosives at the bottom of each shot hole, placing cables and other recording equipment along receiver lines, and detonating explosives.

[6]**Drilling & Production** includes construction or use of roads or other means of access; construction or use of drilling pads and well pads; drilling for oil and gas; well completion; use of production equipment and facilities; well servicing and workover operations, construction or use of flowlines and gathering lines; transport or processing of petroleum products; and inspection, monitoring or maintenance of wells and equipment.

[7]**Riparian Corridors SMA** is defined as consisting of two distinct biological communities: the bottomland hardwood forest community located on the floodplain terrace adjacent to major streams; and the aquatic community present within the stream. Two vegetation types, Floodplain Hardwood Forests and Floodplain Hardwood Pine Forests, best represent bottomland hardwood forests located on floodplain terraces adjacent to major streams. In addition, complexes (or extensive intermingling) of these vegetation types define the riparian corridor. Where the riparian corridor is not defined by these vegetation types, or complexes of these types, the corridor width is defined as up to 300 feet from the banks of major streams, whichever area is greater. Where operations are permitted in this SMA, appropriate mitigation measures must be taken to floodproof or elevate the site to minimize structural and environmental risks associated with flooding.

[8]**Hydrologic soil classes** – In general, soils in hydrologic soil classes "C" and "D" are clayey textured, are found in floodplains and wetlands, have a high water table, and over 50 percent of these soils are occasionally to frequently flooded.

Table 2.5. Summary of Operating Stipulations under Each Alternative

(Acreage totals exclude overlapping areas for each Protected Area/SMA.)

Big Thicket National Preserve		**Total Area: 88,132 Acres**	
ALTERNATIVES	**PROTECTED AREAS under ALTERNATIVE A**	**SMAs under ALTERNATIVE B**	**SMAs under ALTERNATIVE C**
Total Area with Operating Stipulations[1]	56,538 acres[2]	<75,293 acres[3]	75,293 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	7,462 acres[2]	11,512 acres	39,657 acres
Designated Areas	Fire Monitoring Plots with no offset Long-term Monitoring Plots with no offset Royal Fern Bog Research Plot w/no offset Visitor Use, Administrative and Other Use Areas with 500'offset[1] Waterways with 500' offset[1]	Fire Monitoring Plots with 50' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with150' offset Visitor Use, Administrative and Other Use Areas with 500' offset[1] Waterways with 500' offset[1]	Fire Monitoring Plots with 50' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with 150' offset Visitor Use, Administrative and Other Use Areas with 500'offset[1] Waterways with 500' offset[1] Riparian Corridors Rare Vegetation Communities Rare Forested Wetland Communities
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	52,272 acres[2]	52,272 acres	52,272 acres
Designated Areas	Birding Hot Spots with 500' offset[1] (3/1-5/30 and 9/1-11/30) Hunting Areas (10/1-1/15)	Birding Hot Spots with 500' offset[1] (3/1-5/30 and 9/1-11/30) Hunting Areas (10/1-1/15)	Birding Hot Spots with 500' offset[1] (3/1-5/30 and 9/1-11/30) Hunting Areas (10/1-1/15)
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	7,493 acres[2]	<46,273[3]	46,273 acres
Designated Areas	Fire Monitoring Plots with no offset Long-term Monitoring Plots with no offset Royal Fern Bog Research Plot with no offset Visitor Use, Administrative and Other Use Areas with 500' offset[1] Birding Hot Spots with 500' offset[1] Waterways with 500' offset[1]	Fire Monitoring Plots with 150' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with 150' offset Visitor use, Administrative and Other Use Areas with 1500' offset Birding Hot Spots with 1500' offset Waterways with 500' offset[1] Riparian Corridors[3] Rare Vegetation Communities Rare Forested Wetland Communities	Fire Monitoring Plots with 150' offset Long-term Monitoring Plots with 150' offset Royal Fern Bog Research Plot with 150' offset Visitor Use, Administrative and Other Use Areas with 1500' offset Birding Hot Spots with 1500' offset Waterways with 500' offset[1] Riparian Corridors Rare Vegetation Communities Rare Forested Wetland Communities

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The area covered by this operating stipulation from waterways has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.1. Map of Protected Areas Preservewide under Alternative A, for Geophysical Exploration

Figure 2.2. Map of Protected Areas Preservewide under Alternative A, for Drilling and Production

Figure 2.3. Map of Special Management Areas Preservewide under Alternative B, for Geophysical Exploration

Figure 2.4. Map of Special Management Areas Preservewide under Alternative B, for Drilling and Production

Figure 2.5. Map of Special Management Areas Preservewide under Alternative C, for Geophysical Exploration

Figure 2.6. Map of Special Management Areas Preservewide under Alternative C, for Drilling and Production

Table 2.6. Summary of Operating Stipulations, Beaumont Unit

Beaumont Unit		Total Unit Acres: 6,289 acres	
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	4,258 acres[2]	<5,547 acres[3]	5,547 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	226 acres[2]	239 acres	3,112 acres
Designated Areas	Royal Fern Bog Research Plot SMA Day Use Areas	Royal Fern Bog Research Plot SMA Day Use Areas SMA	Royal Fern Bog Research Plot SMA Day Use Areas SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	4,038 acres[2]	4,038 acres	4,038 acres
	Hunting Areas Birding Hot Spots	Hunting Areas SMA Birding Hot Spots SMA	Hunting Areas SMA Birding Hot Spots SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	244 acres[2]	<3,258 acres[3]	3,258 acres
Designated Areas	Royal Fern Bog Research Plot Day Use Areas Birding Hot Spots	Royal Fern Bog Research Plot SMA Day Use Areas SMA Birding Hot Spots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA[3]	Royal Fern Bog Research Plot SMA Day Use Areas SMA Birding Hot Spots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.7. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Beaumont Unit

Table 2.7. Summary of Operating Stipulations, Beech Creek Unit

Beech Creek Unit		Total Unit Acres: 5,097 acres	
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	4,210 acres[2]	<4,753 acres[3]	4,753 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	1,058 acres[2]	1,058 acres	2,412 acres
Designated Areas	Day Use Areas Hiking Trails	Day Use Areas SMA Hiking Trails SMA	Day Use Areas SMA Hiking Trails SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	3,930 acres[2]	3,930 acres	3,930 acres
Designated Areas	Hunting Areas	Hunting Areas SMA	Hunting Areas SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	1,058 acres[2]	<3,561 acres[3]	3,561 acres
Designated Areas	Day Use Areas Hiking Trails	Day Use Areas SMA Hiking Trails SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA[3]	Day Use Areas SMA Hiking Trails SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.8. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Beech Creek Unit

Table 2.8. Summary of Operating Stipulations, Big Sandy Creek Unit

Big Sandy Creek Unit		Total Unit Acres: 14,227 acres	
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	11,392 acres[2]	<12,608 acres[3]	12,608 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	2,284 acres[2]	2,284.43 acres	6,118 acres
Designated Areas	Day Use Areas Hiking Trails Cemeteries Private Residence Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Hiking Trails SMA Cemeteries SMA Private Residential SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA	Day Use Areas SMA Hiking Trails SMA Cemeteries SMA Private Residential SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Pine Forests Rare Forested Wetland Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	10,990 acres[2]	10,990 acres	10,990 acres
Designated Areas	Hunting Areas Birding Hot Spots	Hunting Areas SMA Birding Hot Spots SMA	Hunting Areas SMA Birding Hot Spots SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	2,286 acres[2]	<8,552 acres[3]	8,552 acres
Designated Areas	Day Use Areas Hiking Trails Birding Hotspots Cemeteries Private Residence Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Hiking Trails SMA Birding Hot Spots SMA Cemeteries SMA Private Residential SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors[3]	Day Use Areas SMA Hiking Trails SMA Birding Hot Spots SMA Cemeteries SMA Private Residential SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	10,768 acres
Designated Areas	None	None	Hunting Areas SMA

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.9. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Big Sandy Creek Unit

Table 2.9. Summary of Operating Stipulations, Hickory Creek Savannah Unit

Hickory Creek Savannah Unit	Total Unit Acres: 705 acres		
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	85 acres[2]	<395 acres[3]	395 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	85 acres[2]	104 acres	394 acres
Designated Areas	Day Use Areas Hiking Trails Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Hiking Trails SMAs Fire Monitoring Plots SMA Long-term Monitoring Plots SMA	Day Use Areas SMA Hiking Trails SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	18 acres[2]	18 acres	18 acres
Designated Areas	Birding Hot Spots	Birding Hot Spots SMA	Birding Hot Spots SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	85 acres[2]	<395 acres[3]	395 acres
Designated Areas	Day Use Areas Hiking Trails Birding Hotspots Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Hiking Trails SMA Birding Hot Spots SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA[3]	Day Use Areas SMA Hiking Trails SMA Birding Hot Spots SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.10. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Hickory Creek Savannah Unit

Table 2.10. Summary of Operating Stipulations, Lance Rosier Unit

Lance Rosier Unit	Total Area 24,752 acres		
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	23,110 acres[2]	<23,515 acres[3]	23,515 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	131 acres[2]	138 acres	3,618 acres
Designated Areas	Day Use Areas Cemeteries Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Cemeteries SMA, Fire Monitoring Plots SMA Long-term Monitoring Plots SMA	Day Use Areas SMA Cemeteries SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	23,110 acres[2]	23,110 acres	23,110 acres
Designated Areas	Hunting Areas Birding Hot Spots	Hunting Areas SMA Birding Hot Spots SMA	Hunting Areas SMA Birding Hot Spots SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	142 acres[2]	<4,212 acres[3]	4,212 acres
Designated Areas	Day Use Areas Birding Hot Spots Cemeteries Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Birding Hot Spots SMA Cemeteries SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA[3]	Day Use Areas SMA Birding Hot Spots SMA Cemeteries SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	23,079 acres
Designated Areas	None	None	Hunting Areas SMA

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.11. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Lance Rosier Unit

Table 2.11. Summary of Operating Stipulations, Lower Neches River Corridor Unit

Lower Neches River Corridor Unit	Total Unit Acres: 3,291 acres		
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	30 acres[2]	<2,544 acres[3]	2,544 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	30 acres[2]	30 acres	2,510 acres
Designated Areas	Day Use Areas	Day Use Areas SMA	Day Use Areas SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres[2]	0 acres	0 acres
Designated Areas	None	None	None
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	30 acres[2]	<2,544 acres[3]	2,544 acres
Designated Areas	Day Use Areas	Day Use Areas SMA Riparian Corridors SMA[3]	Day Use Areas SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.12. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Lower Neches River Corridor Unit

Table 2.12. Summary of Operating Stipulations, Menard Creek Corridor Unit

Menard Creek Corridor Unit		Total Unit Acres: 3,999 acres	
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	98 acres[2]	<2,025 acres[3]	2,025 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	98 acres[2]	92 acres	1,797 acres
Designated Areas	Day Use Areas	Day Use Areas SMA	Day Use Areas SMA Rare Vegetation Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	18 acres[2]	18 acres	18 acres
Designated Areas	Birding Hot Spots	Birding Hot Spots SMA	Birding Hot Spots SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	98 acres[2]	<2,023 acres[3]	2,023 acres
Designated Areas	Day Use Areas Birding Hot Spots	Day Use Areas SMA Birding Hot Spots SMA Rare Vegetation Communities SMA Riparian Corridors SMA[3]	Day Use Areas SMA Birding Hot Spots SMA Rare Vegetation Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.13. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, Menard Creek Corridor Unit

Table 2.13. Summary of Operating Stipulations, Neches Bottom/Jack Gore Baygall Unit

Neches Bottom and Jack Gore Baygall Unit	Total Unit Acres: 13,712 acres		
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	10,115 acres[2]	<11,981 acres[3]	11,981 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	310 acres[2]	315 acres	5,354 acres
Designated Areas	Day Use Areas Canoe Routes Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Canoe Routes SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA	Day Use Areas SMA Canoe Routes SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	10,115 acres[2]	10,115 acres	10,115 acres
Designated Areas	Hunting Areas	Hunting Areas SMA	Hunting Areas SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	310 acres[2]	<5,803 acres[3]	5,803 acres
Designated Areas	Day Use Areas Canoe Routes Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Canoe Routes Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA[3]	Day Use Areas SMA Canoe Routes Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.14. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Neches Bottom/Jack Gore Baygall Unit

Table 2.14. Summary of Operating Stipulations, Pine Island – Little Pine Island Bayou Corridor Unit

Deleted:

Pine Island-Little Pine Island Bayou Corridor Unit	Total Unit Acres: 2,209.21 acres		
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	0 acres[2]	<1528 acres[3]	1,528 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	0 acres[2]	0 acres	1,528 acres
Designated Areas	None	None	Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres[2]	0 acres	0 acres
Designated Areas	None	None	None
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	0 acres[2]	<1,528 acres[3]	1,528 acres
Designated Areas		Riparian Corridors SMA	Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.15. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Pine Island–Little Pine Island Bayou Corridor Unit

Table 2.15. Summary of Operating Stipulations, Turkey Creek Unit

Turkey Creek Unit		Total Unit Acres: 7,978 acres	
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	3,219 acres[2]	<6,439 acres[3]	6,439 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	3,219 acres[2]	3,231 acres	4,881 acres
Designated Areas	Day Use Areas Hiking Trails Canoe Routes Administrative Areas Cemeteries Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Hiking Trails SMAs Canoe Routes SMAs Administrative Areas SMA Cemeteries SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA	Day Use Areas SMA Hiking Trails SMA Canoe Routes SMA Administrative Areas SMA Cemeteries SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	36 acres[2]	36 acres	36 acres
Designated Areas	Birding Hot Spots	Birding Hot Spots SMA	Birding Hot Spots SMA
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	3,219 acres[2]	<6,439 acres[3]	6,439 acres
Designated Areas	Day Use Areas Hiking Trails Birding Hot Spots Canoe Routes Administrative Areas Cemeteries Fire Monitoring Plots Long-term Monitoring Plots	Day Use Areas SMA Hiking Trails SMA Birding Hot Spots SMA Canoe Routes SMA Administrative Areas SMA Cemeteries SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA[3]	Day Use Areas SMA Hiking Trails SMA Birding Hot Spots SMA Canoe Routes SMA Administrative Areas SMA Cemeteries SMA Fire Monitoring Plots SMA Long-term Monitoring Plots SMA Rare Vegetation Communities SMA Rare Forested Wetland Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.16. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Turkey Creek Unit

Table 2.16. Summary of Operating Stipulations, Upper Neches River Corridor Unit

Upper Neches River Corridor Unit		Total Unit Acres: 5,902 acres	
Acreage totals exclude overlapping areas for each Protected Area/SMA.			
ALTERNATIVES	**ALTERNATIVE A**	**ALTERNATIVE B**	**ALTERNATIVE C**
Total Area with Operating Stipulations[1]	21 acres[2]	<3,958 acres[3]	3,958 acres
GEOPHYSICAL EXPLORATION OPERATIONS – NO SURFACE USE			
Total area	21 acres[2]	21 acres	3,939 acres
Designated Areas	Day Use Areas	Day Use Areas SMA	Day Use Areas SMA Rare Vegetation Communities SMA Riparian Corridors SMA
GEOPHYSICAL EXPLORATION OPERATIONS – TIMING STIPULATIONS			
Total area	17 acres[2]	17 acres	17 acres
Designated Areas	Birding Hot Spots	Birding Hot Spots SMA (1)	Birding Hot Spots SMA (1)
DRILLING AND PRODUCTION OPERATIONS – NO SURFACE USE			
Total area	21 acres[2]	<3,958 acres[3]	3,958 acres
Designated Areas	Day Use Areas	Day Use Areas SMA Rare Vegetation Communities SMA Riparian Corridors SMA[3]	Day Use Areas SMA Birding Hot Spots SMA Rare Vegetation Communities SMA Riparian Corridors SMA
DRILLING AND PRODUCTION OPERATIONS – TIMING STIPULATIONS			
Total area	0 acres	0 acres	0 acres
Designated Areas	None	None	None

[1]Nonfederal oil and gas operations may not be conducted within 500 feet from perennial, intermittent, or ephemeral watercourses, or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations, as per CLPR at 36 CFR § 9.41(a). The 500' area from waterways covered by this operating stipulation has not been mapped and will be determined on a case-by-case basis during project scoping and the preparation of a Plan of Operations.

[2]The Protected Areas denoted under Alternative A are not formally designated as SMAs, but the "No Surface Use" and "Timing Stipulations" have been applied on a case-by-case basis.

[3]The Riparian Corridor SMA under Alternative B would be NSU, except drilling and production could be permitted adjacent to existing roadways and within previously disturbed areas, subject to CLPR (including NPS Floodplain Management Guidelines and 36 CFR § 9.41(a)). No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas, with a minimum 500' offset from perennial, intermittent, or ephemeral watercourses, unless specifically authorized by an approved plan of operations.

Figure 2.17. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Upper Neches River Corridor Unit

Table 2.17. Summary of Impacts

The following terms are used in this impact summary chart:

Short-term – up to 3 years duration **Long-Term** – up to 20 years or more **CLPR** – Current Legal and Policy Requirements **NSU** – No Surface Use

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
SUMMARY OF ALTERNATIVES		
Geophysical Exploration would not occur in Protected Areas where CLPR would not permit operations on 7,462 acres; or within 500 feet of waterways. In addition to the areas where the NSU stipulation would apply year-round, surface uses for geophysical exploration operations would not be permitted in hunting areas (52,272 acres) or within 500 feet of birding hot spots (135 acres) during specified times. In all other areas of the Preserve, exploration operations could be permitted on up to 465 acres.	**Geophysical Exploration** would not occur in SMAs where the No Surface Use stipulation would be applied on 11,512 acres, or within 500 feet of waterways. In addition to the areas where the NSU stipulation would apply year-round, surface uses for geophysical exploration operations would not be permitted in the Hunting Areas SMA (52,272 acres) or within 500 feet of Birding Hot Spots (135 acres) during specified times. In all other areas of the Preserve, exploration operations could be permitted on up to 465 acres.	**Geophysical Exploration** would not occur in SMAs where the No Surface Use stipulation would be applied on 39,657 acres, or within 500 feet of waterways. In addition to the areas where the NSU stipulation would apply year-round, surface uses for geophysical exploration operations would not be permitted in the Hunting Areas SMA (52,272 acres) or within 500 feet of Birding Hot Spots (135 acres) during specified times. In all other areas of the Preserve, exploration operations could be permitted on up to 465 acres.
Drilling and production operations would not occur in Protected Areas where operations would not be permitted under Current Legal and Policy Requirements on 7,493 acres; or within 500 feet of waterways. Operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) would continue to adversely impact geologic resources in the Preserve. In all other areas of the Preserve, up to 40 new wells could be located on up to 241 acres.	**Drilling and Production** would not occur in designated SMAs where the No Surface Use stipulation is applied on up to 46,273 acres, or within 500 feet of waterways. Drilling and production operations may be permitted in the Hunting Areas SMA (52,272 acres). Operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) would continue to adversely impact geologic resources in the Preserve. In all other areas of the Preserve, up to 40 new wells could be located on up to 241 acres.	**Drilling and Production** would not occur in designated SMAs where the No Surface Use stipulation is applied on 46,273 acres, or within 500 feet of waterways. Drilling and production operations may be permitted in the Hunting Areas SMA (52,272 acres). Operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) would continue to adversely impact geologic resources in the Preserve. In all other areas of the Preserve, up to 40 new wells could be located on up to 241 acres.
Plugging/Abandonment/Reclamation: There would be no new operations to plug, abandon or reclaim in areas where exploration, drilling and production would not be permitted in Protected Areas. In all other areas of the Preserve where exploration, drilling and production operations could be permitted, there is a potential for up to 465 acres to be reclaimed in association with exploration operations, and up to 241 acres to be reclaimed in association with new drilling and production operations. In addition, there are operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) located throughout the Preserve that would be reclaimed in the future, some of which are in Protected Areas.	**Plugging/Abandonment/Reclamation:** There would be no new operations to plug, abandon or reclaim in areas where exploration, drilling and production would not be permitted in SMAs. In all other areas of the Preserve where exploration, drilling and production operations could be permitted, there is a potential for up to 465 acres to be reclaimed in association with exploration operations, and up to 241 acres to be reclaimed in association with new drilling and production operations. In addition, there are operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) located throughout the Preserve that would be reclaimed in the future, some of which are in SMAs.	**Plugging/Abandonment/Reclamation:** There would be no new operations to plug, abandon or reclaim in areas where exploration, drilling and production would not be permitted in SMAs. In all other areas of the Preserve where exploration, drilling and production operations could be permitted, there is a potential for up to 465 acres to be reclaimed in association with exploration operations, and up to 241 acres to be reclaimed in association with new drilling and production operations. In addition, there are operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) located throughout the Preserve that would be reclaimed in the future, some of which are in SMAs.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
1. IMPACTS ON NONFEDERAL OIL AND GAS DEVELOPMENT		
Project Planning – minor, beneficial impacts. **Geophysical Exploration** – minor to moderate, adverse impacts. **Drilling and Production** – minor to moderate, adverse impacts. **Plugging/Abandonment/Reclamation** – minor to moderate, adverse impacts. **Cumulative Impacts** – negligible, adverse impacts.	**Project Planning** – minor to moderate, beneficial impacts. **Geophysical Exploration** – similar to Alternative A. **Drilling and Production** – similar to Alternative A. **Plugging/Abandonment/Reclamation** – minor, adverse impacts. **Cumulative Impacts** – negligible, adverse impacts.	**Project Planning** – same as Alternative B. **Geophysical Exploration** – minor to major, adverse impacts. **Drilling and Production** – minor to major, adverse impacts. **Plugging/Abandonment/Reclamation** – same as Alternative B. **Cumulative Impacts** – negligible, adverse impacts.
2. IMPACTS ON AIR QUALITY		
Impacts could be localized, as well as contribute to regional air quality impacts. **Geophysical Exploration** – short-term, negligible, adverse impacts. **Drilling and Production** – short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – short-term, negligible, adverse impacts from operations in the Preserve; and ranging from no affect to short-term, negligible, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – moderate adverse impacts on the regional airsheds. But, with adherence to state and Federal standards and requirements, regional airsheds are expected to be maintained or improved. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that air quality in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that air quality in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that air quality in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of air quality in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that air quality in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that air quality in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation SMAs over a larger area with the NSU stipulation would ensure widespread protection of air quality in these areas of the Preserve. **Impairment Analysis** – no impairment.
3. IMPACTS ON GEOLOGIC RESOURCES		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to	**Geophysical Exploration** – similar to Alternative A, except that geologic resources in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that geologic resources in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that geologic resources in designated SMAs would be better protected.	**Geophysical Exploration** – similar to Alternative B, except that geologic resources in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that geologic resources in designated SMAs would be better protected.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
indirect, localized to widespread, short-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and negligible to minor, adverse impacts on geologic resources in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of geologic resources in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternative A and B, except that NSU designation in all SMAs except the Hunting Areas SMA would ensure widespread protection of geologic resources in the Preserve. **Impairment Analysis** – no impairment.
4. IMPACTS ON WATER RESOURCES		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that water resources in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that water resources in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that water resources in designated SMAs would be better protected. Indirect effects from wells directionally drilled and produced from outside the Preserve would range from no affect to localized to widespread, short- to long-term, moderate, adverse impacts. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of water resources in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that water resources in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that water resources in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of water resources in the Preserve. **Impairment Analysis** – no impairment.
5. IMPACTS ON FLOODPLAINS		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve.	**Geophysical Exploration** – similar to Alternative A, except that floodplains in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that floodplains in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that floodplains in designated SMAs would be better protected.	**Geophysical Exploration** – localized, short-term, negligible adverse impacts. **Drilling and Production** – indirect, short - to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the. **Plugging/Abandonment/Reclamation** – same as Alternatives A and B.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
Cumulative Impacts – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of floodplains in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of floodplains in the Preserve. **Impairment Analysis** – no impairment.
6. IMPACTS ON VEGETATION		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, minor to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that vegetation in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that vegetation in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that vegetation in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of vegetation in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – localized, short-term, negligible to moderate, adverse impacts. **Drilling and Production** – localized, short- to long-term, minor to moderate, adverse impacts from operations in the Preserve, and ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that vegetation in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of vegetation in the Preserve. **Impairment Analysis** – no impairment.
7. IMPACTS ON WETLANDS		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, negligible to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible beneficial impacts in the Preserve; and moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that wetlands in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that wetlands in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that wetlands in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of wetlands in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that wetlands in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that wetlands in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of wetlands in the Preserve. **Impairment Analysis** – no impairment.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
8. IMPACTS ON FISH AND WILDLIFE		
Geophysical Exploration – localized, short-term, negligible to minor, adverse impacts. **Drilling and Production** – localized, short- to long-term, minor to moderate, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – localized, short- to long-term, negligible to minor, adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and negligible to minor, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that fish and wildlife in designated SMAs would be better protected. **Drilling and Production** – similar to Alternative A, except that fish and wildlife in designated SMAs would be better protected. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that fish and wildlife in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of fish and wildlife in these areas of the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that fish and wildlife in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that fish and wildlife in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of fish and wildlife in the Preserve. **Impairment Analysis** – no impairment.
9. IMPACTS ON SPECIES OF SPECIAL CONCERN		
Geophysical Exploration – no adverse impacts. **Drilling and Production** – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Plugging/Abandonment/Reclamation** – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve. **Cumulative Impacts** – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative A, except that species of special concern in designated SMAs would be better protected. **Drilling and Production** – same as Alternative A. **Plugging/Abandonment/Reclamation** – similar to Alternative A, except that species of special concern in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of species of special concern and perpetuate habitat for species in the Preserve. **Impairment Analysis** – no impairment.	**Geophysical Exploration** – similar to Alternative B, except that species of special concern in designated SMAs would be better protected. **Drilling and Production** – same as Alternative B. **Plugging/Abandonment/Reclamation** – similar to Alternative B, except that species of special concern in designated SMAs would be better protected. **Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of species of special concern and perpetuate habitat for species in the Preserve. **Impairment Analysis** – no impairment.
10. IMPACTS ON CULTURAL RESOURCES		
Geophysical Exploration – no adverse impacts.	**Geophysical Exploration** – similar to Alternative A, except that cultural resources in designated SMAs would be better protected.	**Geophysical Exploration** – similar to Alternative B, except that cultural resources in designated SMAs would be better protected.

Alternative A No Action/Current Management	Alternative B Preferred Alternative	Alternative C Maximum Resource Protection
Drilling and Production – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, moderate, adverse impacts from wells directionally drilled and produced from outside the Preserve.	**Drilling and Production** – similar to Alternative A, except that cultural resources in designated SMAs would be better protected.	**Drilling and Production** – same as Alternative B.
Plugging/Abandonment/Reclamation – no adverse impacts from operations in the Preserve; and ranging from no affect to indirect, localized to widespread, short- to long-term, minor, adverse impacts from wells directionally drilled and produced from outside the Preserve.	**Plugging/Abandonment/Reclamation** – similar to Alternative A, except that cultural resources in designated SMAs would be better protected.	**Plugging/Abandonment/Reclamation** – same as Alternative B.
Cumulative Impacts – negligible, beneficial impacts in the Preserve; and minor to moderate, adverse impacts in the Lower Neches River Watershed.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of cultural resources in these areas of the Preserve.	**Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs over a larger area with the NSU stipulation would ensure widespread protection of cultural resources in the Preserve.
Impairment Analysis – no impairment.	**Impairment Analysis** – no impairment.	**Impairment Analysis** – no impairment.
11. IMPACTS ON VISITOR USE AND EXPERIENCE AND ADMINISTRATIVE AREAS		
Visitor Use and Experience – exploration, drilling and production operations in the Preserve would result in localized, short- to long-term, negligible to moderate, adverse impacts, and reclamation operations would result in localized, long-term, moderate, beneficial impacts. Wells directionally drilled from outside the Preserve would result in impacts ranging from no affect to indirect, localized, short- to long-term, moderate, adverse impacts; and reclamation would result in indirect, localized moderate, adverse and beneficial impacts.	**Visitor Use and Experience** – similar to Alternative A, except that visitor use and experience and administrative areas in designated SMAs would be better protected.	**Visitor Use and Experience** – exploration, drilling and production operations in the Preserve would result in localized, negligible to minor, adverse impacts, and reclamation operations would result in localized, moderate, beneficial impacts. Drilling and production of wells directionally drilled from outside the Preserve would result in impacts ranging from no affect to short- to long-term, moderate, adverse impacts; and reclamation would result in localized moderate, adverse and beneficial impacts.
Human Health and Safety – negligible, adverse impacts.	**Human Health and Safety** – similar to Alternative A, except that visitor use and experience and administrative areas in designated SMAs would be better protected.	**Human Health and Safety** – similar to Alternative B, except that visitor use and experience and administrative areas in designated SMAs would be better protected.
Cumulative Impacts – negligible, adverse impacts.	**Cumulative Impacts** – same as Alternative A, except that designation of SMAs with the NSU stipulation would provide consistent protection of visitor use and experience and human health and safety in these areas of the Preserve.	**Cumulative Impacts** – same as Alternatives A and B, except that designation of SMAs with the NSU stipulation would ensure more widespread protection of visitor use and experience and human health and safety in these areas of the Preserve.
12. IMPACTS ON SOCIOECONOMICS – ADJACENT LAND USES AND RESOURCES		
Geophysical Exploration – localized, short-term, negligible to moderate, adverse impacts.	**Geophysical Exploration** – localized, short-term, minor to major, adverse impacts.	**Geophysical Exploration** – similar to Alternative B.
Drilling and Production – short- to long-term, minor to major, adverse impacts, depending on the resource protection measures employed.	**Drilling and Production** – similar to Alternative A.	**Drilling and Production** – similar to Alternative B.
Plugging/Abandonment/Reclamation – localized, negligible to major, adverse impacts, depending on the amount of reclamation performed.	**Plugging/Abandonment/Reclamation** – localized, negligible to major, adverse impacts, depending on the amount of reclamation performed.	**Plugging/Abandonment/Reclamation** – similar to Alternative B.
Cumulative Impacts – minor to major, adverse impacts.	**Cumulative Impacts** – similar to Alternative A.	**Cumulative Impacts** – similar to Alternative B.

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WOODVILLE

190

Beech Creek Unit

POLK

Big Sandy Creek Unit

TYLER

69
287

JASPER

Upper Neches River Corridor Unit

Hickory Creek Savannah Unit

Turkey Creek Unit

Menard Creek Corridor Unit

Neches Bottom/Jack Gore Baygall Unit

LIBERTY

HARDIN

KOUNTZE

69
287

SILSBEE

Lance Rosier Unit

Loblolly Unit

Lower Neches River Corridor Unit

LUMBERTON

ORANGE

Pine Island-Little Pine Island Bayou Corridor Unit

Beaumont Unit

BEAUMONT

SOUR LAKE

BEVIL OAKS

DAISETTA

VIDOR

Legend

- No Surface Use Year-round
- No Surface Use Seasonally
- Unit Boundaries
- Highways
- Counties

N

0 2.5 5 10 Miles

Figure 2.1. Map of Protected Areas Preservewide under Alternative A, for Geophysical Exploration

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Sept 2004 | BTH

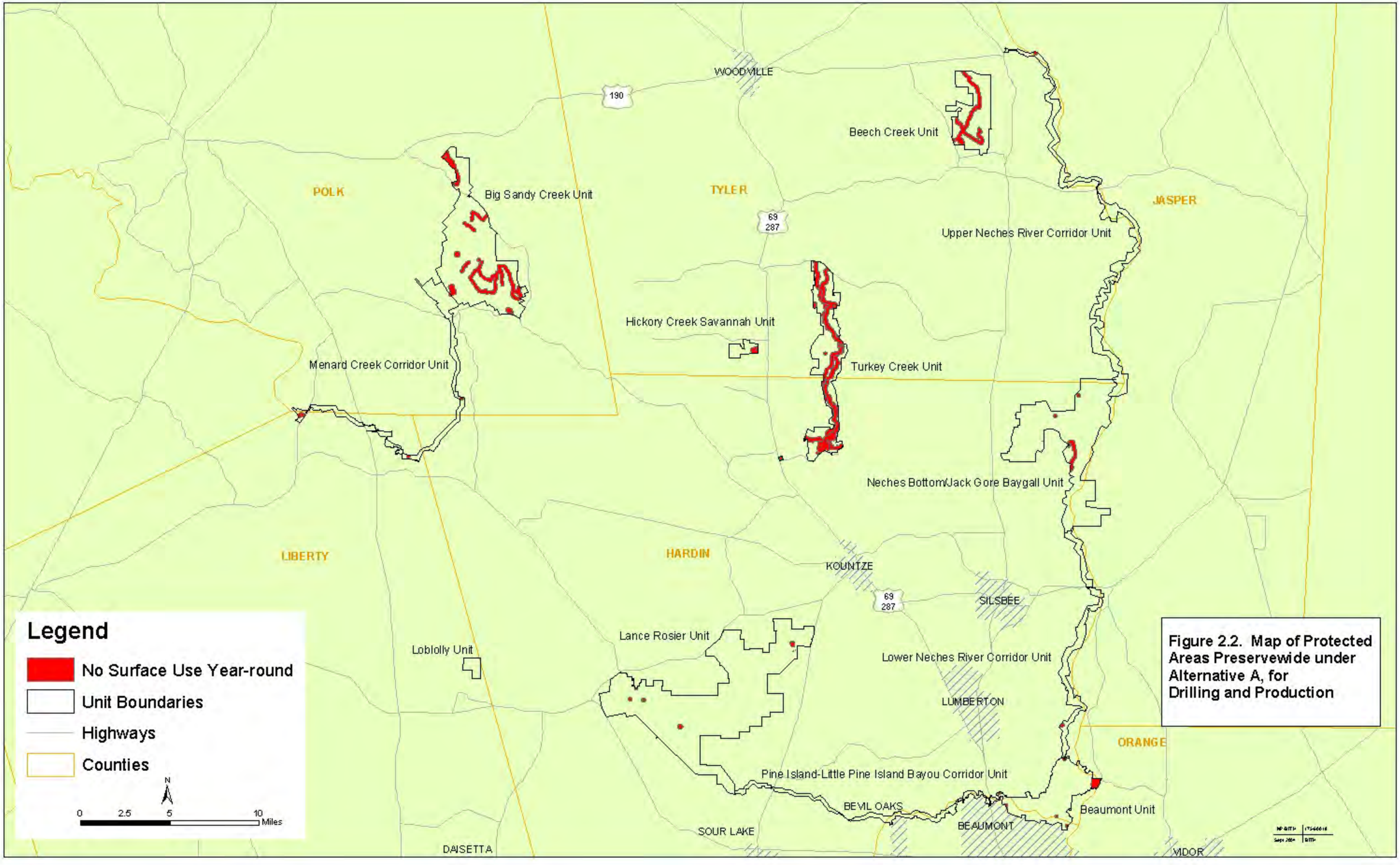


Figure 2.2. Map of Protected Areas Preservewide under Alternative A, for Drilling and Production

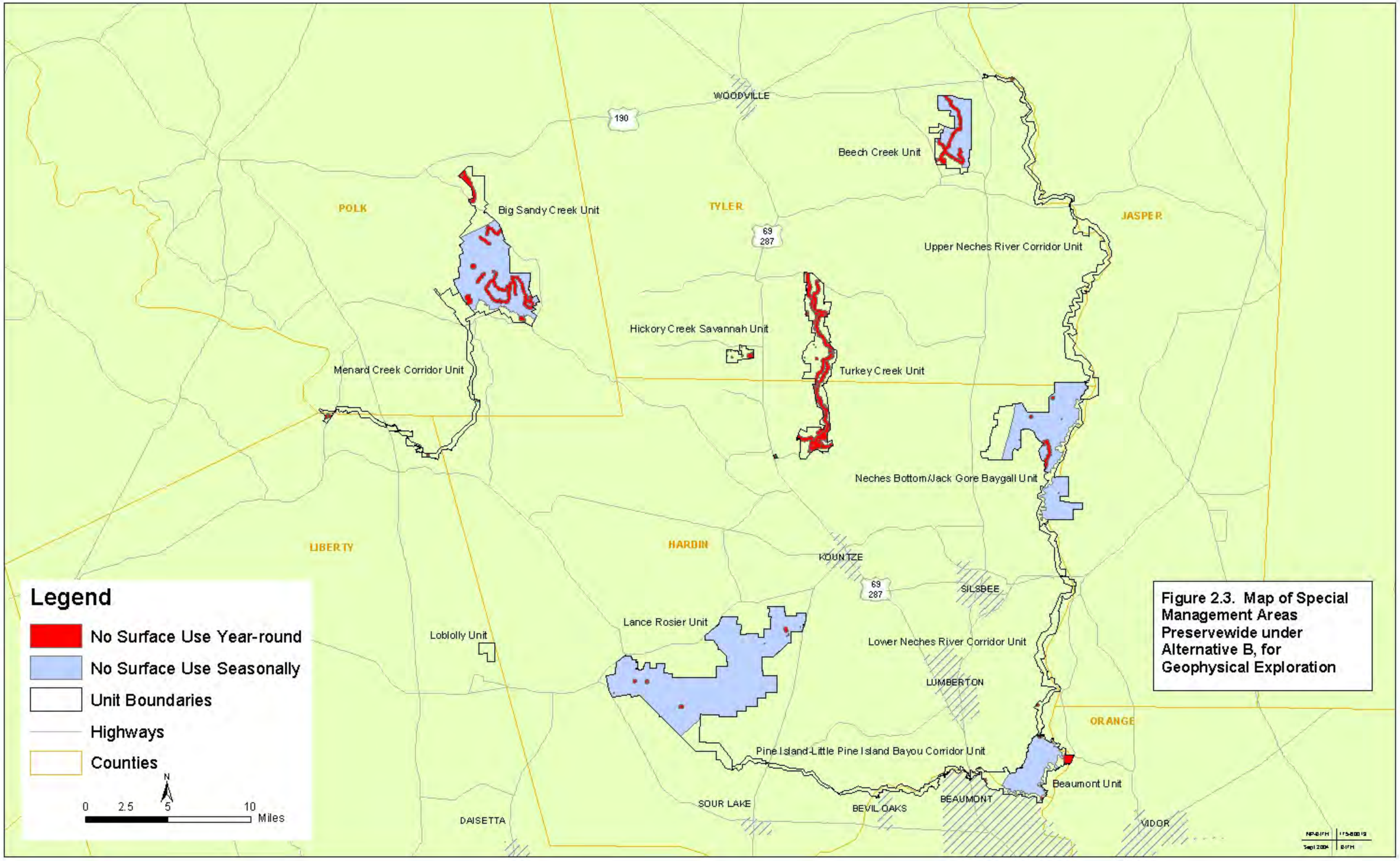


Figure 2.3. Map of Special Management Areas Preservewide under Alternative B, for Geophysical Exploration

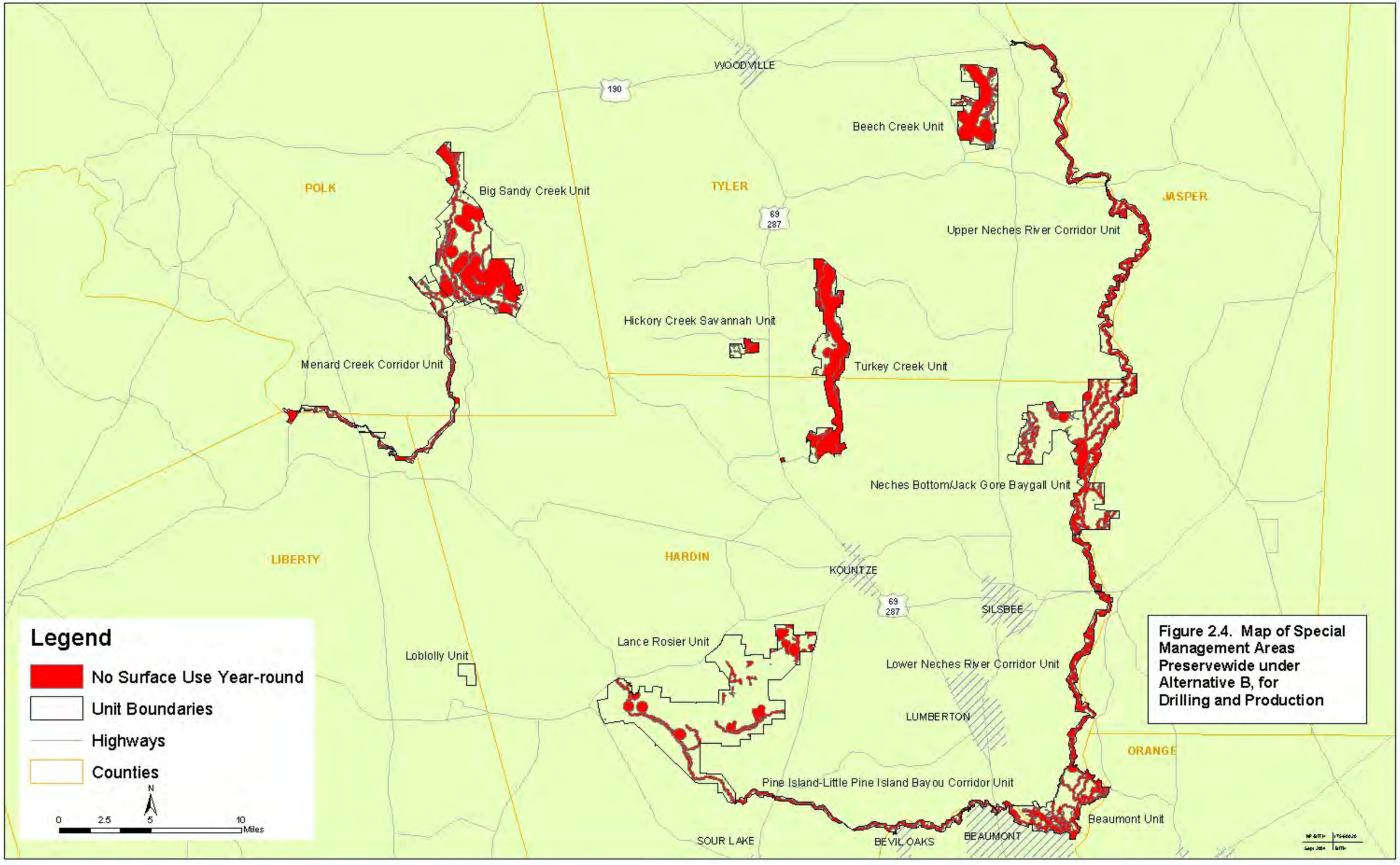


Figure 2.4. Map of Special Management Areas Preservewide under Alternative B, for Drilling and Production

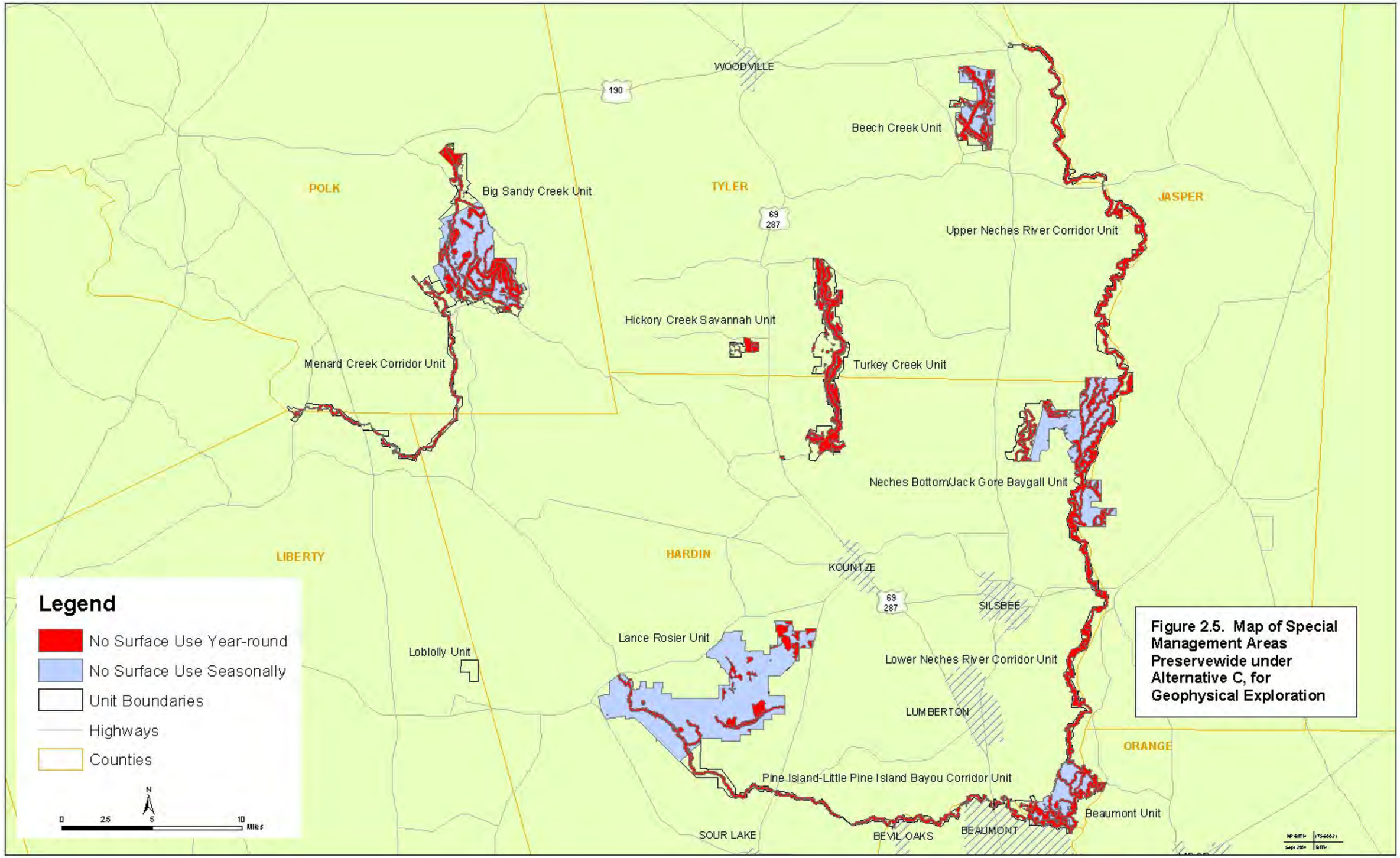


Figure 2.5. Map of Special Management Areas Preservewide under Alternative C, for Geophysical Exploration

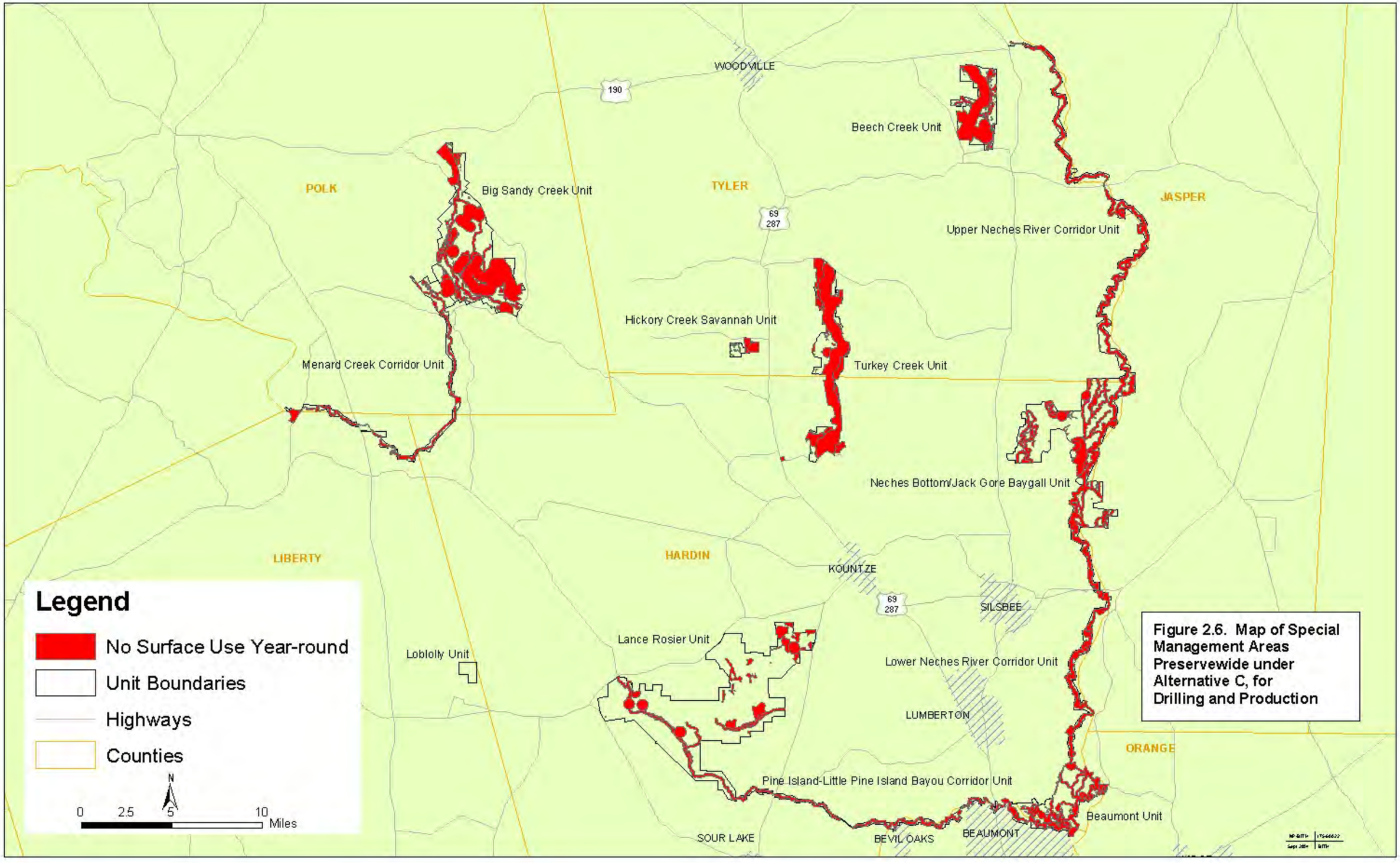


Figure 2.6. Map of Special Management Areas Preservewide under Alternative C, for Drilling and Production

Figure 2.7. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Beaumont Unit

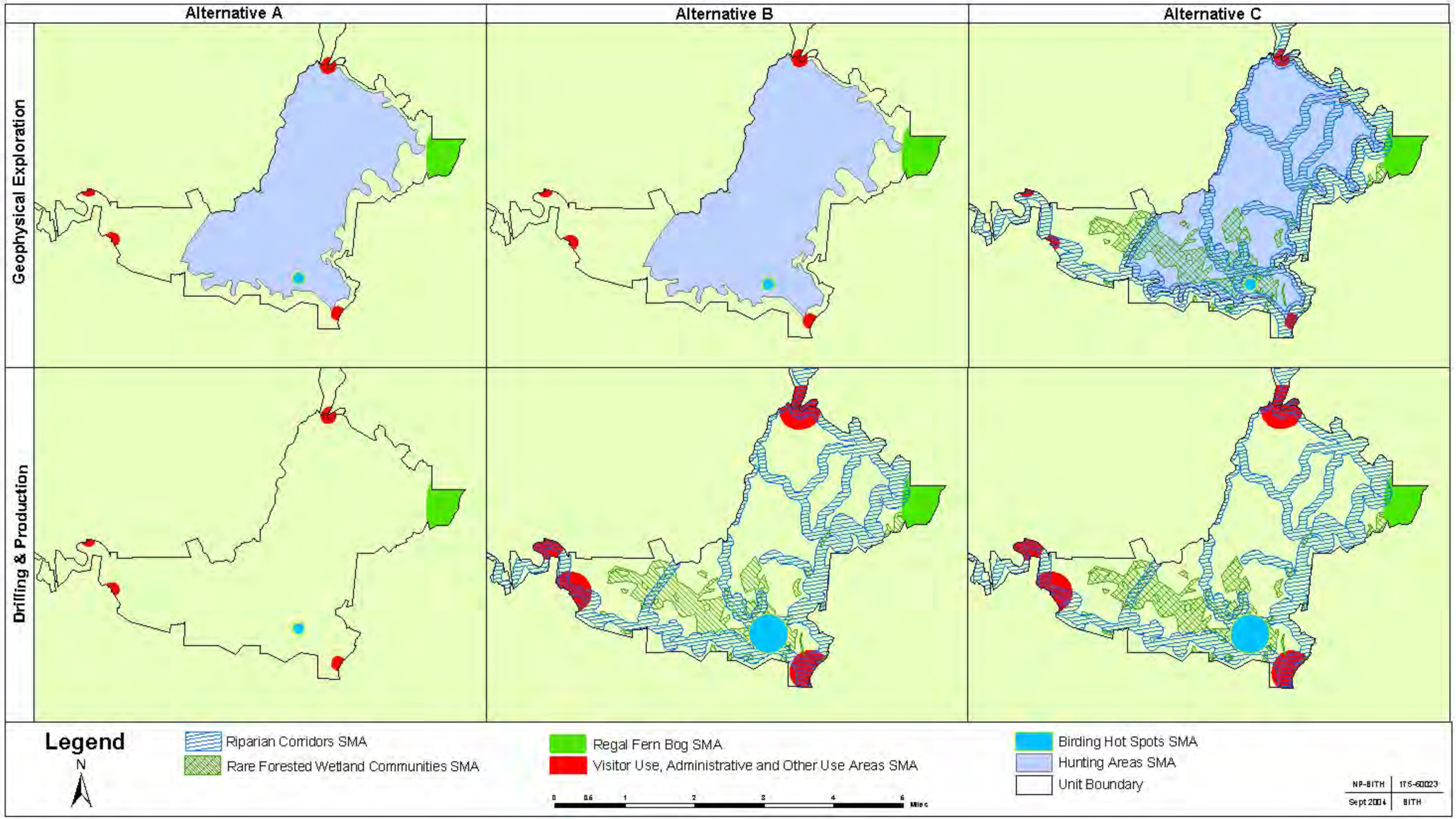


Figure 2.8. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Beech Creek Unit

	Alternative A	Alternative B	Alternative C
Geophysical Exploration			
Drilling & Production			

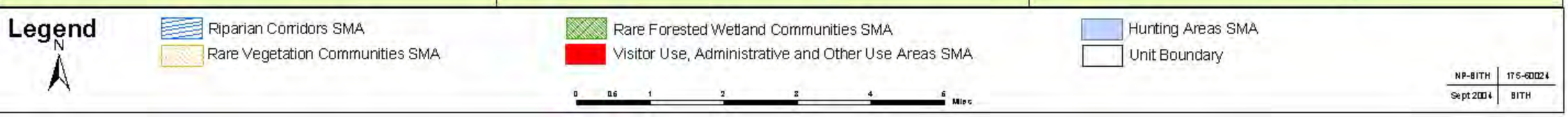


Figure 2.9. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Big Sandy Creek Unit

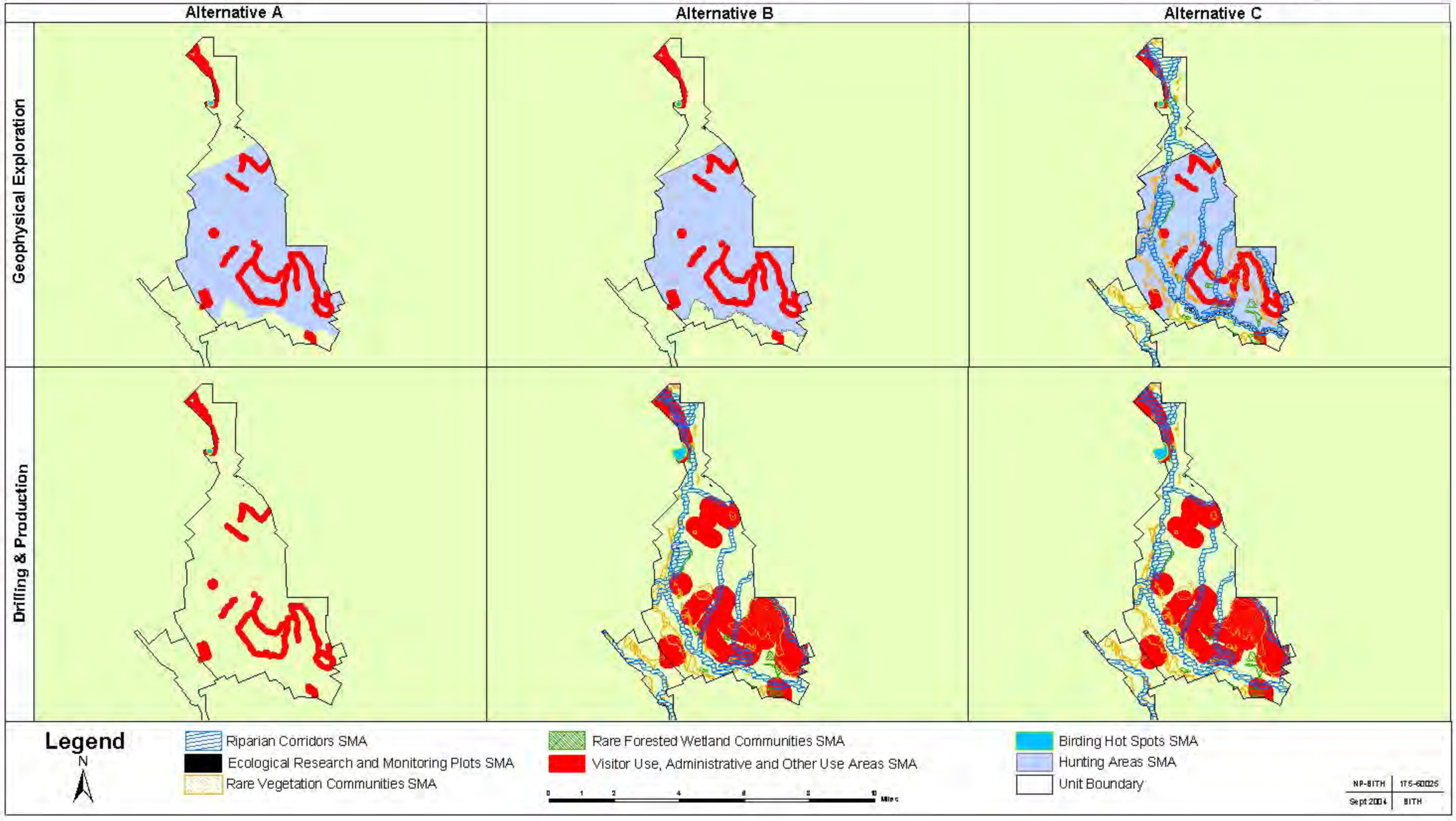


Figure 2.10. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Hickory Creek Savannah Unit

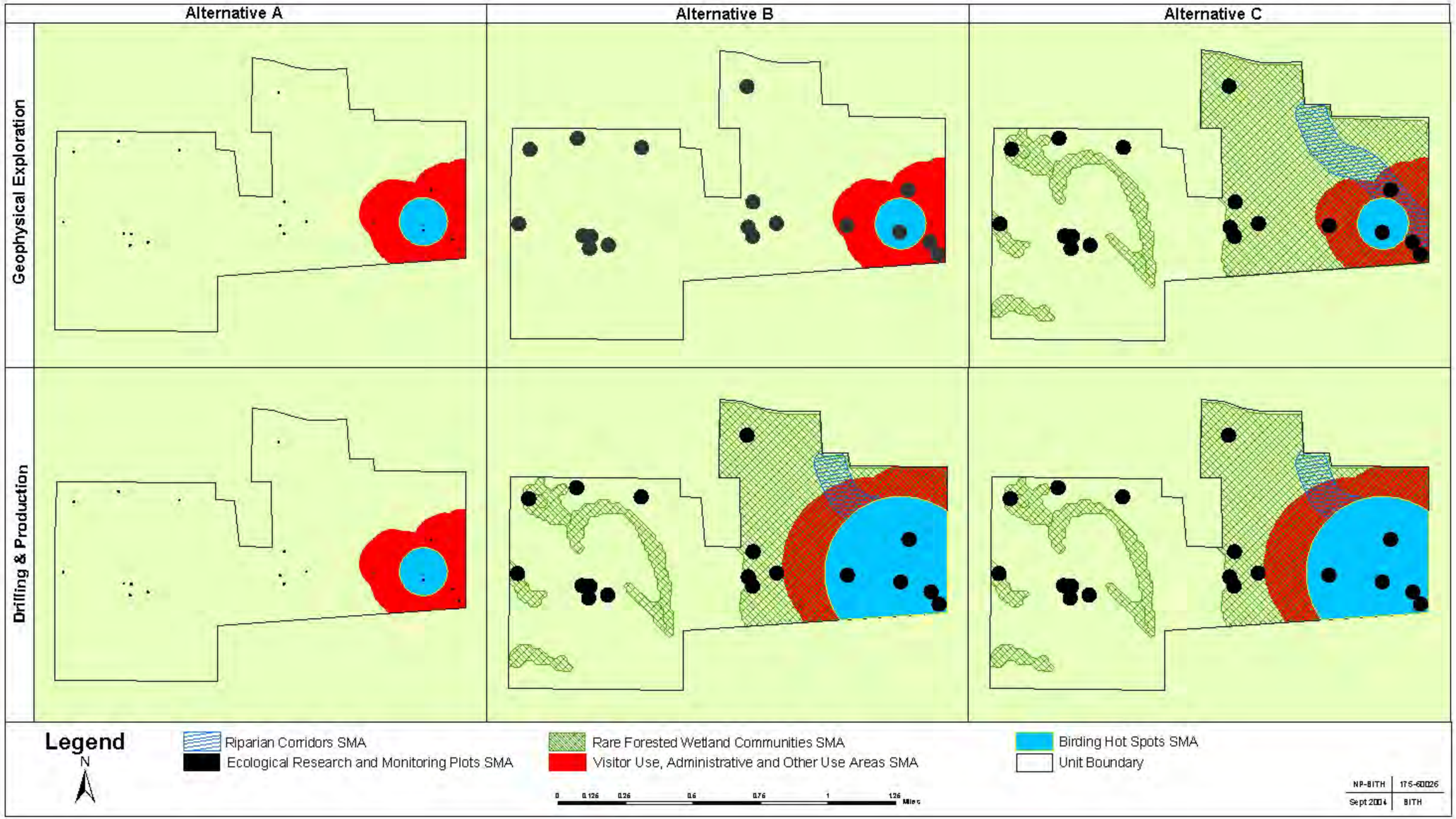


Figure 2.11. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Lance Rosier Unit

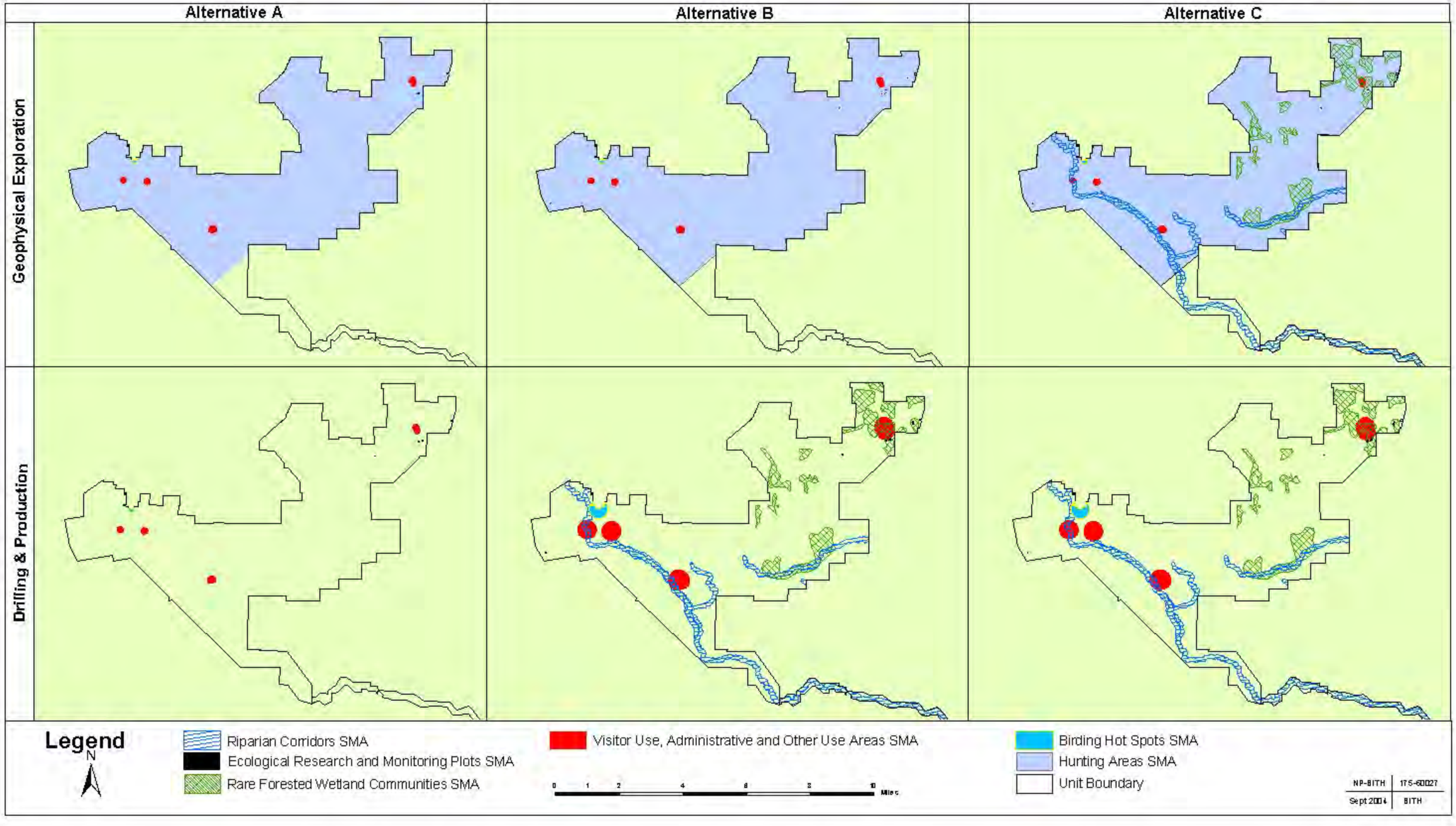


Figure 2.12. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Lower Neches River Corridor Unit

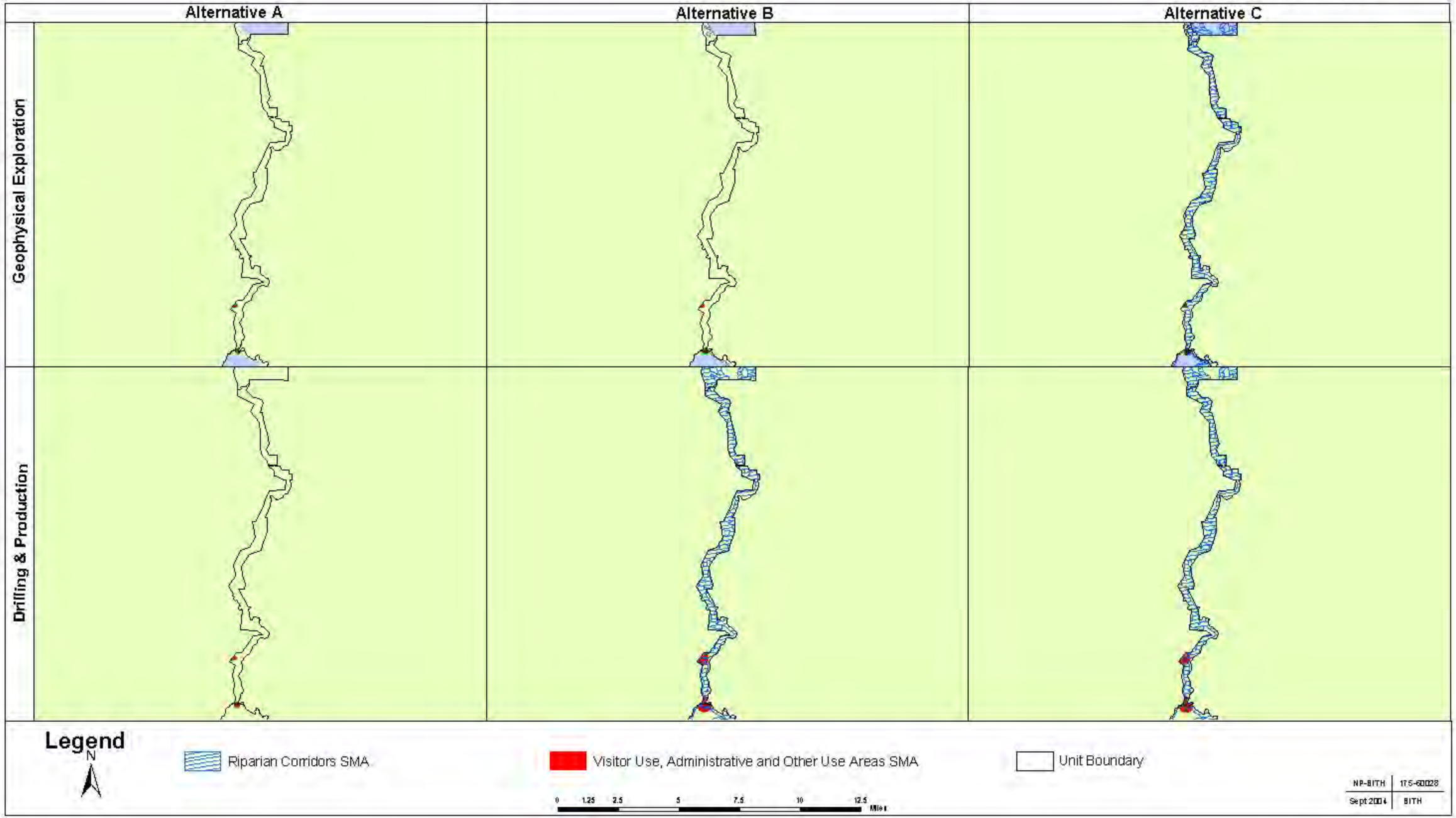


Figure 2.13. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Menard Creek Corridor Unit

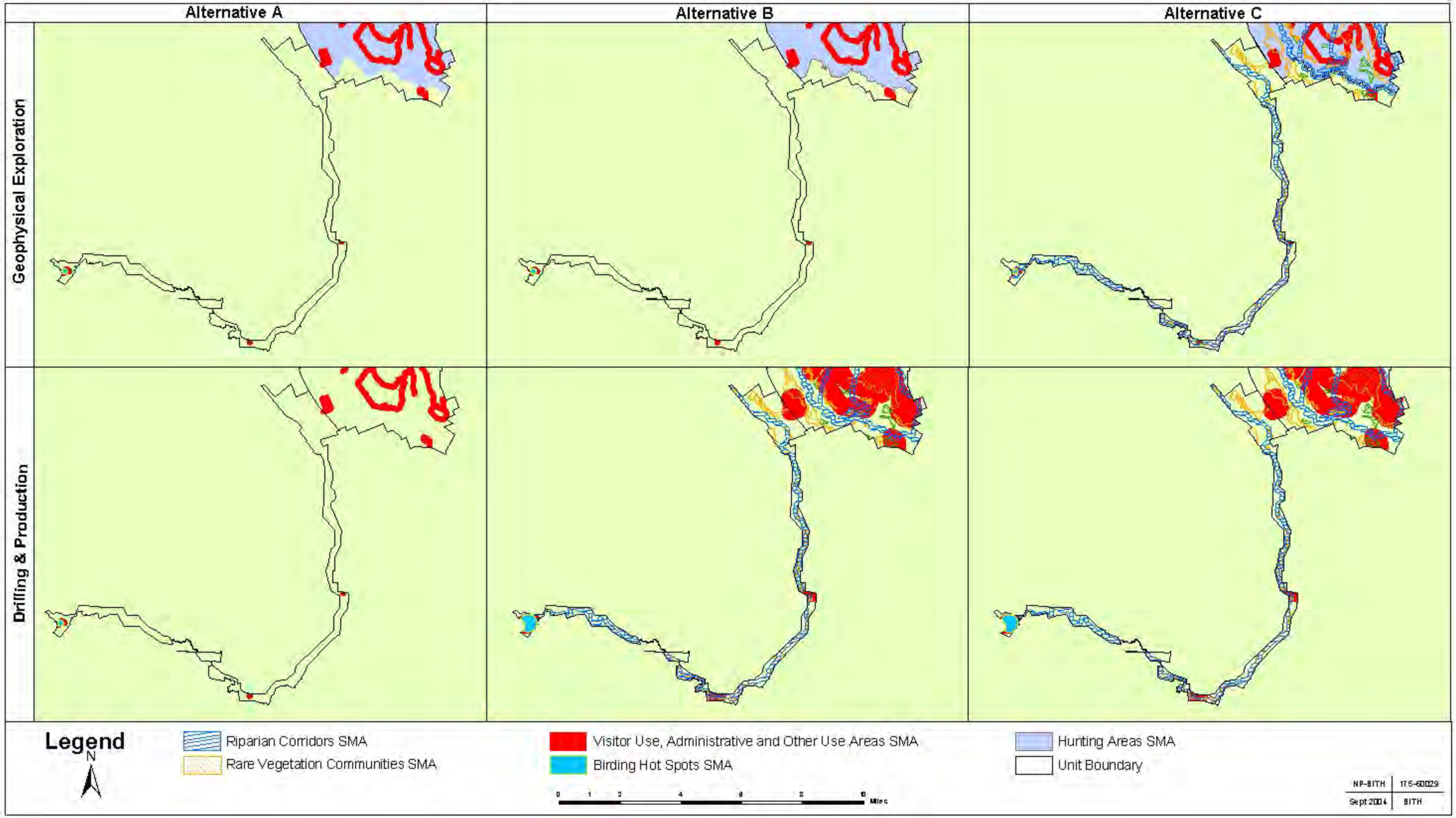


Figure 2.14. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Neches Bottom/Jack Gore Baygall Unit

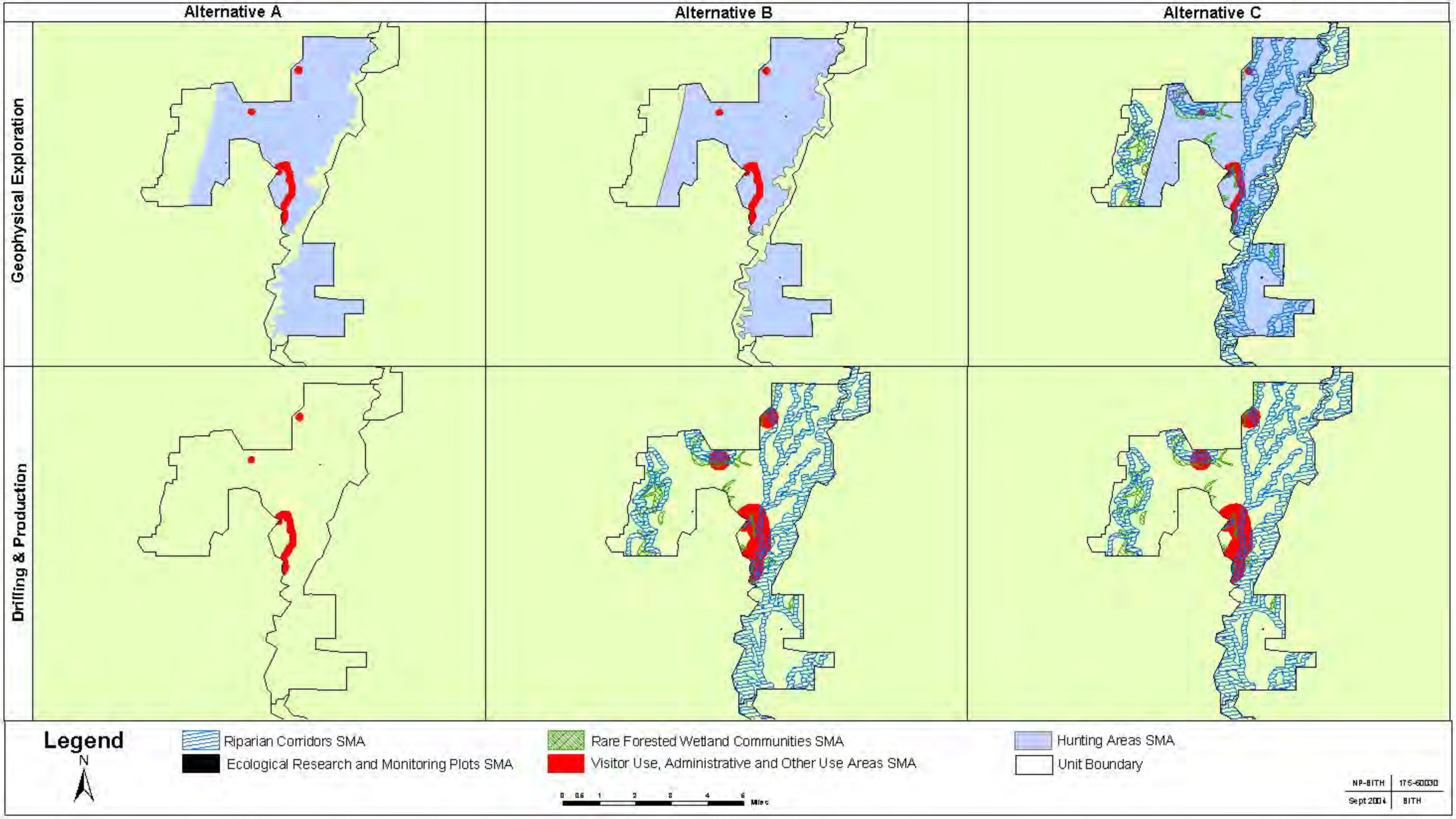


Figure 2.15. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Pine Is.-Little Pine Is. Bayou Corridor Unit

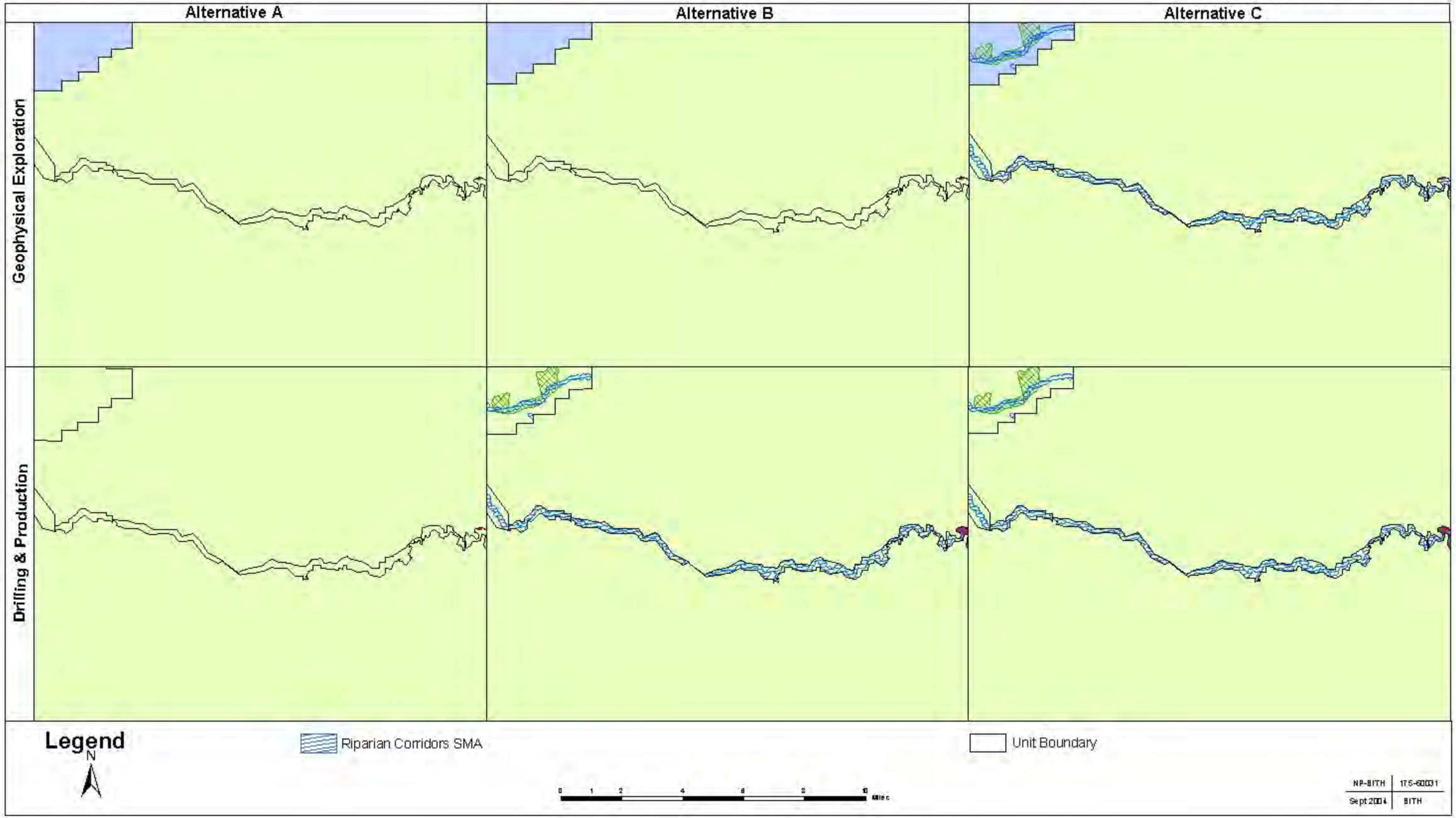
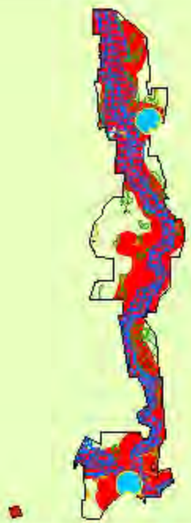
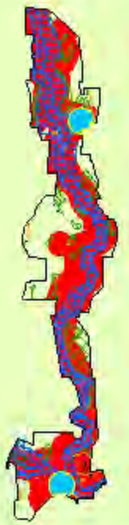


Figure 2.16. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Turkey Creek Unit

	Alternative A	Alternative B	Alternative C
Geophysical Exploration			
Drilling & Production			

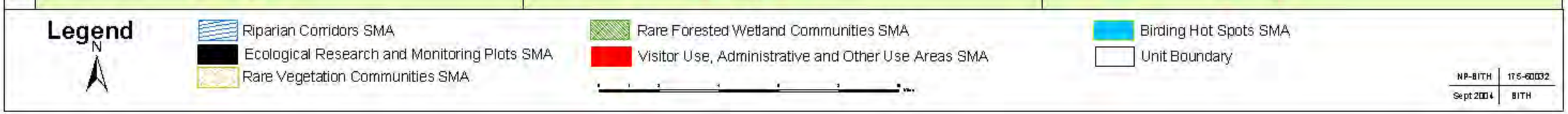
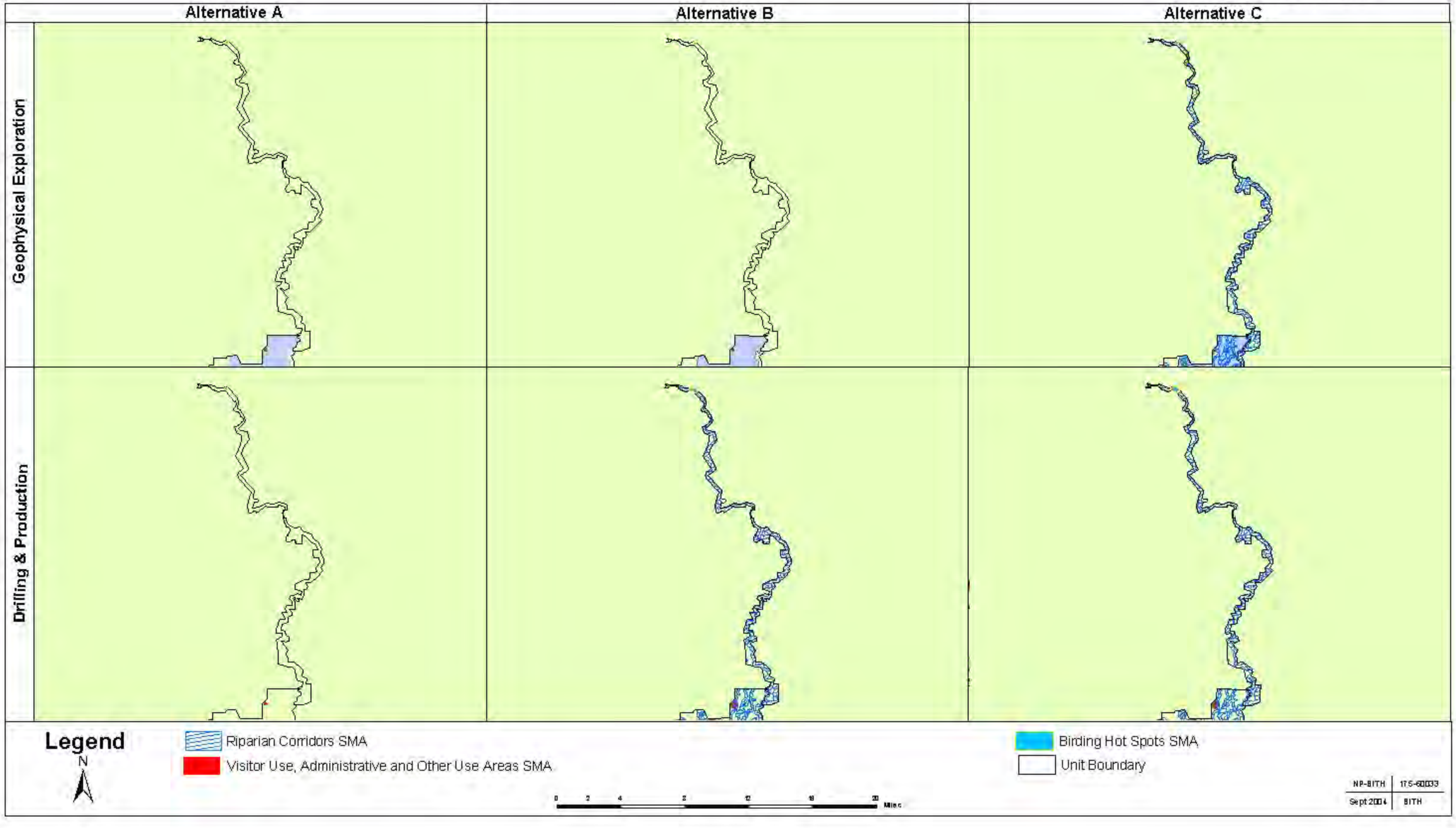


Figure 2.17. Map of Protected Areas under Alternative A, and Special Management Areas under Alternatives B and C, in the Upper Neches River Corridor Unit



PART II
CURRENT LEGAL AND POLICY REQUIREMENTS

CHAPTER 2



PART II - CURRENT LEGAL AND POLICY REQUIREMENTS

The information in this section focuses on Current Legal and Policy Requirements (CLPR) pertaining to 36 CFR 9B operations. All nonfederal oil and gas operations in National Park Service units are subject to CLPR that are based on federal and state laws, regulations, federal executive orders, NPS policies, and applicable direction provided in NPS planning documents. The following section provides an overview of the NPS 36 CFR 9B regulatory process for plans of operations and § 9.32(e) applications, and lists the applicable NPS management policies, legal requirements, and performance standards (resource protection goals) for each resource topic described in this Plan/EIS. The topics in this section are presented in the same order as in Chapter 3 – Affected Environment and Chapter 4 – Environmental Consequences.

Part III of Chapter 2 describes specific legal and policy requirements (called operating stipulations in this Plan/EIS), and recommended mitigation measures for each phase of nonfederal oil and gas development. Descriptions of the legal and policy requirements applicable to nonfederal oil and gas activities on NPS lands are included in Appendix C – Federal Laws, Regulations, Executive Orders, Policies, and Guidelines that Apply to Nonfederal Oil and Gas Operations.

The performance standards described in this section apply to all current and future nonfederal oil and gas operations in the parks. Where a current operation does not comply with these standards, the operation would be modified or mitigation measures implemented to comply with these standards and all applicable legal and policy requirements.

The laws, regulations, executive orders, NPS policies, and applicable planning direction listed in the following section are intended to provide the reader with an inventory of the most relevant legal and policy requirements for conducting nonfederal oil and gas operations in NPS units, including Big Thicket National Preserve. Congress may change or enact new statutes and agencies may change their regulations and policies. During project planning, operators are responsible for ensuring they have up-to-date and complete information on legal and policy requirements for nonfederal oil and gas operations on NPS lands.

Additional information on NPS requirements for nonfederal oil and gas operations on NPS lands can be found in the "Operator's Handbook for Nonfederal Oil and Gas Development in Units of the National Park System" at: http://www2.nature.nps.gov/geology/oil_and_gas/op_handbook.htm.

NPS NONFEDERAL OIL AND GAS RIGHTS REGULATIONS

The NPS has the primary responsibility for managing mineral activity in National Park System units in conjunction with nonfederally owned oil and gas to ensure that these oil and gas activities do not damage the environment and other resource values or impair unit resources or values. NPS regulations governing nonfederal oil and gas rights are published at Title 36 of the Code of Federal Regulations, Part 9, Subpart B (36 CFR Part 9B). The regulations have been promulgated under the authority of the NPS Organic Act of 1916, as amended (16 U.S.C. § 3) and several individual park enabling acts, including that of Big Thicket National Preserve. The final rulemaking on the regulations was published in the *Federal Register*, Volume 43, Number 237, page 57,822 (43 Fed. Reg. 57,822) on December 8, 1978, with an effective date of January 8, 1979. A reference copy of the 36 CFR Part 9B regulations is presented in Appendix B.

The NPS implements its protective responsibilities under its general authorities (e.g., National Park Service Organic Act, General Authorities Act of 1970, etc.) and the regulations at 36 CFR Part 9B, by:

- evaluating proposed Plans of Operations and § 9.32(e) Applications and approving such plans/applications if they meet standards that protect park resources and values,
- enforcing the regulations, and
- considering acquisition of the nonfederal oil and gas interest.

If the National Park Service determines that the proposed oil and gas operation within a park unit would conflict with preservation, management, or use of the parks, or would impair park resources or values, the 36 CFR 9B regulations and NEPA process would result in identifying measures to mitigate impacts. Mitigation measures may be applied to the Plan of Operations as conditions of approval, subject to the operator's acceptance of specific provisions and operating stipulations (36 CFR § 9.37(b)(2)). However, if the Service determines that the proposed mineral development would impair park resources, values, or purposes, or does not meet approval standards under applicable NPS regulations and cannot be sufficiently modified to meet those standards, the Service will seek to extinguish the associated mineral right through acquisition, unless otherwise directed by Congress.

In applying the NPS's Nonfederal Oil and Gas Rights Regulations, the NPS respects the constitutionally guaranteed property rights of mineral owners. As set forth in the Fifth Amendment to the Constitution, "...no person shall be deprived of property without due process of law; nor shall private property be taken for public use without just compensation." In two places, §§ 9.30(a) and 9.37(a)(3), the 9B regulations emphasize that they are not intended to result in the taking of a property interest, but rather are designed to impose reasonable regulations on activities that involve and affect federally-owned lands. Furthermore, the NPS has complied fully, and will continue to comply fully, with Exec. Order No. 12,630, 3 C.F.R. 554 (1989), "Governmental Actions and Interference with Constitutionally Protected Property Rights." Any alternative selected and applied to oil and gas activities in the park as a result of this planning process would be subject to the NPS's statutory mandates, regulatory provisions, policies, and Executive Orders, including the above described limitations regarding the taking of private property interests.

Overview of the 36 CFR 9B Plan of Operations Process

Under the NPS's 36 CFR 9B regulations, each operator requiring access on, across, or through NPS lands or water may conduct activities only under a Plan of Operations approved by the NPS. Once a Plan of Operations is approved, it serves as the operator's permit to operate in the park. Through the plan, the operator must show that the "…operations will be conducted in a manner which utilizes technologically feasible methods least damaging to the federally owned or controlled lands, waters and resources of the unit while assuring the protection of public health and safety" (36 CFR § 9.37(a)(1)).

Some nonfederal oil and gas operations in NPS units may qualify for an exemption to the Plan of Operations requirement. The exemption applies if: (1) the operation was being conducted on or before January 8, 1979, or (2) the operation predates establishment of the area as a unit of the National Park System, or (3) the operation was incorporated into the unit as a result of a boundary expansion; and the operation is being conducted pursuant to a valid state or federal permit. A state or federal permit is considered valid if the permit was issued to the current operator on or before January 8, 1979, the term of the permit has not expired, and the operations have not undergone any change requiring a new permit since January 8, 1979. See 36 CFR § 9.33. Exempt operations are, however, subject to suspension if they pose an immediate threat of significant injury to federally owned or controlled lands or waters. (See 36 CFR § 9.33(c))

Another category of nonfederal oil and gas operations that may qualify for an exemption from the 36 CFR 9B Plan of Operations requirement are wells that are directionally drilled from a surface location outside park boundaries to a location under federally-owned or controlled lands or waters within park boundaries. These operations are regulated under 36 CFR § 9.32(e) and are described in the next section.

A key component of preparing the Plan of Operations is a detailed description of the environment that will be affected by the proposed activities. Operators first conduct plant, animal, cultural, hydrological, and topographic surveys as needed to adequately describe the resources in the areas in which they plan to work. Once the environmental conditions are known, operators must plan the use of methods and equipment that are least damaging to park resources. The surveys also provide a basis for designing reclamation activities.

Based on the scale of operations, the Plan of Operations preparation can be in the range of $1,000 and up to and exceeding $45,000. The wide range in costs to prepare a Plan of Operations demonstrates the differences in a plan's scope and content, variations in the number and types of environmental surveys needed, and the company's approach to planning (in-house or contracted).

Next, operators may need to modify operations from their standard methods to minimize environmental impacts. For example, to avoid harming certain resources, an operator may need to construct a longer access road or use directional drilling techniques. Sometimes avoidance of areas (i.e., wetlands or sensitive vegetation communities) is necessary to protect park resources. Disposing of wastes and contaminants at an approved disposal facility outside of the park is another method used to protect park resources. These and other modifications can add to the overall project cost.

Some upfront project costs may prevent the need for operators to do costly clean-up and remediation activities in future. For example, the NPS requires dikes or berms around drilling and production operations and impermeable barriers underneath these operations to provide secondary containment in the event of a spill. An uncontained spill or unnoticed leaks from a tank can contaminate large areas, flow into nearby surface waters, and seep into the groundwater. Clean-up and restoration of the damaged area to meet federal and State of Texas requirements could cost the operator hundreds of thousands of dollars.

Next, the NPS commonly requires operators to take a more active role in reclamation of the site compared with areas outside of the park. Following proper plugging of wells and removal of surface equipment, operators must clean up contaminated soil, remove debris and non-native materials used in operations, re-establish natural contours and vegetation, and monitor the results of the reclamation operations.

Maintaining a performance bond to guarantee compliance with the Plan of Operations is an annual cost to the operator. The 36 CFR 9B regulations limit the maximum bond amount to $200,000 for a single operation or multiple operations by the same operator in a given park. Annual costs to maintain bonds through a surety company range from 1 to 3 percent of face value, or up to 70 percent, depending on the operator. Operators typically file a corporate surety bond but may elect to file other types of acceptable securities such as an irrevocable letter of credit, cash, certified check, certificates of deposit, or government bonds. The bond or security required by the NPS is in addition to and not in lieu of any bond or security deposit required by other regulatory authorities.

Another issue facing operators in NPS units is the length of time it takes to obtain a permit. Table 2.18 provides an explanation of the Plan of Operations permitting process and associated timeframes. Under current management practices, the NPS looks at each individual oil and gas

proposal under the 36 CFR 9B regulations. The NPS processing time is typically 3 to 4 months. Currently, there is no comprehensive oil and gas management plan to help operators interpret the

Table 2.18. NPS Processing Time for a 36 CFR 9B Plan of Operations

Action	NPS Response Time	Limiting Factor
Operator contacts park regarding interest in conducting oil and gas operations. Operator provides the NPS with written documentation demonstrating right to conduct operations.	Same day	Subject to park staff availability
Park provides operator copies of 36 CFR 9B regulations, performance standards, plan of operations requirements, and other information as necessary.	Same day	Subject to park staff availability
Operator meets with park staff to discuss proposed operation, scope resource issues relevant to the proposed operation, determine resources that could be affected by the operation; identify environmental planning and compliance requirements; and determine affected local, state and federal agencies.	Variable – NPS provides assistance as needed. Scoping meeting typically lasts one day.	Subject to park staff and operator availability
Operator meets with park staff and affected federal, state, and local agencies to identify resource issues, permitting requirements, and impact mitigation strategies.	Variable – NPS provides assistance as needed.	Subject to park staff, other agency staff, and operator availability
Operator submits written request for temporary access to gather basic information needed to complete the plan of operations.	Variable - NPS provides assistance as needed.	Subject to operator response
Park issues 60-day data collection permit with park resource/visitor protection requirements; and publishes a notice in the local newspaper pursuant to 36 CFR § 9.52(a).	1 - 2 days	Subject to park staff availability
Operator conducts necessary surveys, including natural and cultural surveys, as applicable and surveys/stakes the operations area.	Variable - NPS provides assistance as needed.	Subject to operator response or timing requirements
Operator submits draft plan of operations to park.	Variable - NPS provides assistance as needed.	Subject to operator response
NPS performs a completeness and technical review of the plan of operations. Park accepts plan of operations as complete or returns the plan to the operator with specific directions on how to revise the plan.	30 days	NPS policy from NPS procedures governing nonfederal oil and gas rights, 1992; and 36 CFR § 9.36(c)
Operator revises plan of operations, as necessary.	Variable - NPS provides assistance as needed.	Subject to operator response
Park staff prepares NEPA document (EA or EIS) or adopts operator's (or consultant-prepared) NEPA document, incorporates other environmental compliance (ESA, NHPA, wetlands, floodplains, CZM etc.), and initiates mandated consultations with other agencies. Park completes public review process, finalizes decision documents, and notifies the operator if the plan has been approved, conditionally approved, or rejected.	60 days (includes 30-day public review of EA)	36 CFR § 9.37, 36 CFR § 9.52(b), NPS DO-77.1 for wetlands compliance, NPS DO 77.2, and DO-12 for NEPA compliance. Operator notified if additional time is needed per 36 CFR § 9.37(b)(6)
Operator agrees to any conditions of approval (if any), submits applicable state and federal permits, and files suitable performance bond with the NPS.	Variable	Subject to operator response
TOTAL NPS RESPONSE TIME	Minimum of 3 to 4 months	Dependent on compliance requirements

regulations and apply them specifically to the parks in which they intend to operate. At times, this has caused confusion and added to permitting delays. When this oil and gas management plan is completed, operators will have more information on which to design and implement a proposed operation which should help to reduce the overall time of obtain a permit to conduct nonfederal oil and gas operations.

Taken altogether, the NPS permitting process, regulatory requirements, and the application of operating stipulations and mitigation measures generally increase the cost of operations, compared to conducting nonfederal oil and gas operations on non-NPS lands.

Under the NPS 36 CFR 9B regulations, the NPS has jurisdiction to regulate nonfederal oil and gas operations occurring within park boundaries. Activities located outside park boundaries but connected to operations occurring within a park are beyond the jurisdiction of the NPS. This means that the NPS cannot assert regulatory control over them. Nonetheless, the NPS can work cooperatively with the operator and permitting agencies with jurisdiction to get park protection concerns addressed. In the event that activities outside park boundaries damage or destroy park resources or values, Congress has given the NPS a means for recovering monetary damages under 16 USC § 19jj as discussed on page C-2.

Overview of 36 CFR 9.32(e) Application Process

Section 9.32(e) of the 9B regulations governs operators that propose to develop their nonfederal oil and gas rights in a park by directionally drilling a well from a surface location outside unit boundaries to a location under federally-owned or controlled lands or waters within park boundaries. It is limited in scope to those aspects of the directional drilling operation occurring within park boundaries. Due to the linear configuration and resources contained in the corridor units of the Preserve, it is likely that directional drilling will be utilized more often than vertically drilling from surface locations within the park.

Per § 9.32(e), an operator may obtain an exemption from the 9B regulations if a Regional Director is able to determine from available data that a proposed drilling operation under the park poses “no significant threat of damage to park resources, both surface and subsurface, resulting from surface subsidence, fracture of geological formations with resultant fresh water acquifer [sic] contamination or natural gas escape or the like." The regulations define operations as "all functions, work and activities within a unit in connection with exploration for and development of oil and gas resources, the right to which is not owned by the United States..." (36 CFR § 9.31(c), underlining added). The potential impacts considered in the § 9.32(e) exemption process relate only to effects on park resources from downhole activities occurring within the boundary of the park, not threats to park resources associated with the operation outside park boundaries.

Under the regulations, the NPS may determine that an operator: (1) qualifies for an exemption from the regulations with no needed mitigation to protect park resources from activities occurring within park boundaries, (2) qualifies for an exemption from the regulations with needed mitigation to protect subsurface park resources from activities occurring within park boundaries, or (3) must submit a proposed plan of operations and a bond to the NPS for approval. Each one of these legally permissible options is briefly described below:

1) **Exemption with No Mitigation:** (*no approval or permit issued)***:** The NPS determines that the proposed operation inside the park qualifies for an exemption under § 9.32(e) without any mitigation or conditions required by the NPS on the downhole activities. This option will arise when there is no potential for surface or subsurface impacts in the park from the downhole

activities (e.g., the wellbore does not intercept an aquifer within the park). Under this option, the NPS is not granting an approval or issuing a permit.

2) **Exemption with Mitigation:** *(no approval or permit issued)***:** The NPS determines that the proposed operation inside the park qualifies for an exemption under § 9.32(e) if there is no potential for surface impacts to park resources from downhole operations in the park and the operator adopts mitigation measures or conditions that reduce potential impacts on subsurface resources (e.g., an aquifer) to "no measurable effect." As in option #1 above, the NPS is not granting an approval or issuing a permit.

3) **Plan of Operations:** *(approval and "permit" issued)***:** This regulatory option would apply if NPS determines that it cannot make the requisite finding for a § 9.32(e) exemption because (1) impacts to surface resources are involved, or (2) impacts to subsurface resources cannot be adequately mitigated to yield "no measurable effect." This option would also apply if an operator does not apply for an exemption and the NPS does not consider granting an exemption on its own initiative. In these cases a prospective operator must submit and obtain NPS approval of a proposed plan of operations and file a bond before commencing directional drilling activities inside a park. The required plan and bond will be limited in scope to those aspects of the directional drilling operation that occur within park boundaries. As a result, many of the general plan information requirements set forth under § 9.36 will not apply. Mitigation measures and/or conditions of approval would be integral to this option. Mitigation measures would protect cultural resources, cave/karst resources, aquifers, floodplains, wetlands and other surface resources from operations occurring inside the park. Under this option, an operator must have NPS approval of a proposed plan before commencing any activity in the boundaries of the park. The approved plan constitutes the operator's "permit".

Applicability of NEPA. For purposes of public disclosure and education, NPS prepares NEPA documents on all directional drilling proposals submitted to the NPS. Through its NEPA analysis, the NPS assesses impacts both in and outside of the park associated with the downhole operations in addition to the connected actions outside of the park. The downhole activities occurring in the park are analyzed to determine if there is a significant threat to park resources and if a § 9.32(e) exemption should be granted. As required by NEPA, the analysis of the impacts from the connected actions occurring outside of the park are presented in addition to the downhole operations both inside and outside of the park to disclose to the public all of the potential impacts on the human environment. Cumulative impacts are presented for the analysis area which includes areas inside and outside of the park.

Collection of Resource Information by Prospective Operators. The NPS may only require a prospective operator of a directional drilling operation to conduct resource surveys inside a park when there is a correlation between downhole operations within the park and potential impacts on park resources and values. In contrast, the NPS may request, but cannot require, operators to conduct resource surveys inside a park associated with operations outside the park but connected to the downhole activities in the park or to conduct resource surveys outside the park. Overall costs and timeframes for the operator to prepare a § 9.32(e) application and timeframes for NPS review and approval should be less than for a Plan of Operations, in part because less data will be collected and used in the NEPA analysis.

When the NPS is the "lead" federal agency responsible for Endangered Species Act (ESA) § 7 consultation, the NPS may require biological surveys both inside and outside the park if, during consultation, it is determined that these surveys are needed. The ability to require biological surveys stems from authority under the ESA, not the 9B regulations.

Table 2.19 summarizes the applicability of the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), National Historic Preservation Act (NHPA), Executive Order 11988 – Floodplain Management, Executive Order 11990 – Protection of Wetlands, and mitigation measures to directional drilling applications.

Access to Surface Location Outside Park Boundaries. If the United States does not own the surface estate where operations are located outside the park, NPS access to these operations must be coordinated with the operator, including obtaining the operator's permission to be on location. NPS access also must relate to obtaining information to complete the needed compliance work or to ensuring compliance with mitigation measures related to downhole operations inside the park. The 9B regulations provide no authority for requiring an operator to grant the NPS access for the purpose of observing compliance with terms unrelated to the downhole activities in the park.

Monitoring. The NPS's ability to monitor and inspect directional drilling operations is limited to downhole operations within the park (e.g., surface casing, cementing, plugging operations, etc.). As a practical matter, monitoring of downhole activities inside the park can only be accomplished from the surface location outside the park. As a result, the NPS may need to access the surface location and should make such access a condition of an exemption under option #2 or a condition of approval under option #3. The NPS must coordinate the timing of such access with the operator. The 9B regulations provide no authority to require an operator to grant the NPS access for the purpose of observing compliance with terms unrelated to the downhole activities inside the park. When the NPS has made an upfront determination that a directional drilling operation is exempt without conditions from the regulations because of the lack of impacts, there is no 9B regulatory reason to access the surface location outside the park.

To ensure that directional drilling operations inside a park are being conducted in accordance with an exemption determination or an approved plan, the NPS has two monitoring options. The Service can have a qualified individual (NPS employee or a mutually agreed upon third-party contractor hired by the operator) on location to witness the well casing, cementing and well plugging programs within the park, or the NPS can require the operator to submit drilling records that demonstrate that the well casing, cementing program, and plugging program were completed as proposed. Selection of the appropriate option or combination of options should be worked out with the operator.

Applicability of the 9B Regulations to Transpark Pipelines

Existing transpark oil and gas pipelines and their rights-of-way lie outside the scope of the 9B regulations. Transpark oil and gas pipelines have their point of origin and end point outside national parks, and, for the most part are not supporting nonfederal oil and gas operations in parks. As a result, they are not subject to the existing 9B regulations. However, if a nonfederal oil and gas operation in a park connects to such a pipeline via a flowline or a gathering line, that portion of the flowline or gathering line crossing the park would be subject to the 9B regulations, including the Plan of Operations requirement.

While most transpark oil and gas pipelines are not subject to the 9B regulations, they are either subject to federal Department of Transportation (DOT) regulations at 49 CFR Parts 190-199 or State of Texas requirements, and all other applicable federal and state laws. The DOT regulations govern safety and environmental protection considerations affiliated with interstate pipelines. Specifically, the DOT regulations cover testing, reporting, inspection, maintenance, corrosion control, and spill contingency plans of these pipelines. State regulations often mirror the federal requirements and govern intrastate pipelines. The Railroad Commission of Texas administers state requirements on all oil and gas pipelines under Texas law (see TX. Rev. Stat. S81.011(a) *et seq.*). Transpark

pipeline operators should note that if park system resources are damaged from the operation of their pipeline in a park unit, the NPS can exercise its authority under the Act of July 27, 1990, Pub. L. No. 101-337, 104 Stat. 379, codified as amended at 16 U.S.C. §§ 19jj through 19jj-4 (2000), to undertake all necessary actions to protect park system resources. Operators will be held liable to the United States for its response costs as well as for any damages to park system resources. (See id. at § 19jj-1.)

The NPS management policies, legal requirements, and performance standards and suggested mitigation measures to protect park resources and values presented in Parts II and Part III respectively may be useful to transpark pipeline owners in planning and conducting their operations.

Table 2.19. Summary of Compliance Requirements for Directional Drilling Proposals from Surface Locations Outside a Park.

Option	Scope of NEPA Analysis	Endangered Species Act	National Historic Preservation Act	Floodplains Executive Order	Wetlands Executive Order	Mitigation Measures
Exemption with No Mitigation	The NEPA analysis (most likely an EA) would focus on environmental effects from the downhole operations in the park. The potential impacts of the connected actions on park resources and values would also be disclosed. Impacts outside the park would be qualitatively assessed.	Granting an exemption is non-discretionary under this option. ESA § 7 consultation for activities occurring in the park is not required because there would be no effect on federally listed threatened and endangered species and/or critical habitat. In the event that connected operations outside the park could affect a T&E species or critical habitat in or outside the park, consultation and mitigation under the ESA would be required. The NPS would be the lead federal agency carrying out the ESA consultations outside of the park if there is no other federal entity with broader regulatory involvement.	There is no potential for impact on cultural resources in the park from the downhole operations in the park. The NPS has no Section 106 responsibility with respect to the National Historic Preservation Act of 1966, as amended, for wells that originate on non-federal lands located outside the Unit, for which the wellbores would cross through the Unit to extract non-federally owned hydrocarbons from beneath the Unit. The Advisory Council on Historic Preservation concurred with this finding on September 13, 2004.	There is no potential for impact to federally-owned or controlled floodplains in the park from the downhole operations in the park. No action is required by the NPS under the Executive Order. Other federal agencies having broader permitting authority for the proposal would need to comply with the Executive Order if floodplains would be affected by the operation.	There is no potential for impact to federally-owned or controlled wetlands in the park from the downhole operations in the park. No action is required by the NPS under the Executive Order. Other federal agencies having broader permitting authority for the proposal would need to comply with the Executive Order if wetlands would be affected by the operation.	- NPS mitigation measures/ conditions would not be applied to the exemption. - The operator can voluntarily apply mitigation measures to reduce indirect impacts on park resources and values from connected actions outside the park. - The NPS will work cooperatively with other agencies during their permitting processes to identify potential impacts on park resources and values and recommend mitigation measures/conditions of approval. - If NPS is “lead” federal agency following ESA § 7 consultation, the Service may require mitigation measures/ conditions to protect threatened and endangered species and habitat both inside and outside the park.

Option	Scope of NEPA Analysis	Endangered Species Act	National Historic Preservation Act	Floodplains Executive Order	Wetlands Executive Order	Mitigation Measures
Exemption with Mitigation	Same as Option #1	Granting an exemption is discretionary under this option. NPS is required to determine if federally listed threatened and endangered species and/or critical habitat may be affected inside the park from in-park operations. The NPS would be the lead federal agency carrying out the consultations both inside and outside of the park if there is no other federal entity with broader regulatory involvement.	Same as Option #1	Mitigation/conditions applied to ensure the integrity of downhole operations in the park reduces the likelihood of impacts to floodplains in the park; no action is required by the NPS under the Floodplains Executive Order.	Mitigation/conditions applied to ensure the integrity of downhole operations in the park reduces the likelihood of impacts to wetlands in the park; no action is required by the NPS under the Wetlands Executive Order.	The compliance responsibilities are the same as Option # 1, except: NPS may require mitigation measures/conditions to reduce impacts to subsurface park resources associated with downhole operations inside the park.
Plan of Operations	Same as Option #1	Same as Option #2.	If potential impacts to cultural resources could not be mitigated, the NPS would follow its standard procedures for conducting consultations with the SHPO/THPO but focus its consultation on the downhole operations inside the park.	Same as Option #2. If potential impacts to floodplains could not be mitigated, the NPS must follow its standard procedures in the NPS Director's Order/ Procedures Manual and prepare a *Floodplains Statement of Finding*s pertaining to the downhole operations within the park.	Same as Option #2. If potential impacts to wetlands could not be mitigated, the NPS must follow its standard procedures in the NPS Director's Order/ Procedures Manual and prepare a *Wetlands Statement of Finding*s pertaining to the downhole operations within the park.	Same as Option #2.

NPS MANAGEMENT POLICIES, LEGAL REQUIREMENTS, AND PERFORMANCE STANDARDS

Air Quality

NPS Management Policy: The Service "will seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas. Vegetation, visibility, water quality, wildlife, historic and prehistoric structures and objects, cultural landscapes, and most other elements of a park environment are sensitive to air pollution…The Park Service will assume an aggressive role in promoting and pursuing measures to protect these values from the adverse impacts of air pollution." (NPS 2001, § 4.7.1)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.)*; 36 CFR § 9.37(a)(1); Clean Air Act, as amended (42 U.S.C. §§ 7401-7671q*)*; 40 CFR Parts 23, 50, 51, 52, 58, 60, 61, 82, and 93; 48 CFR Part 23; NPS new source review policies for air pollution sources; RM-77 Natural Resources Management; TEX. ADMIN. CODE tit. 16, §§ 3.36, and 3.94.

Performance Standard: Design and conduct operations in a manner that minimizes air pollution emissions and impacts.

Soils

NPS Management Policy: "The Service will actively seek to understand and preserve the soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources." (NPS 2001, § 4.8.2.4)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq*.); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.37(a)(1), 9.39, and 9.45; Resource Conservation and Recovery Act (42 U.S.C. §§ 6901 *et seq.*); 40 CFR Parts 240-280; 49 CFR Parts 171-179; Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. §§ 9601-9675); 40 CFR Parts 279, 300, 302, 355, and 373; 36 CFR Part 6; Department of the Interior's Onshore Oil and Gas Order Number 2, Section III, Drilling Abandonment Requirements; TEX. ADMIN. CODE tit. 16, §§ 3.8, 3.13, 3.20, 3.21, 3.24, 3.46, 3.57, 3.70, 3.91, 3.93, 3.94, 3.99, and 3.10.

Performance Standards:

1) Avoid or minimize soil compaction.
2) Avoid or minimize soil loss or removal.
3) Avoid or minimize soil erosion.
4) Prevent soil contamination.
5) Re-establish contours and soil chemistry to support and sustain native vegetative communities that existed prior to the initiation of operations.

Water Resources

NPS Management Policy: "The National Park Service will perpetuate surface waters and groundwaters as integral components of park aquatic and terrestrial ecosystems. Park waters – either surface waters or groundwaters – will be withdrawn for consumptive use only when such withdrawal is absolutely necessary for the use and management of the park. The Service will determine the quality of park surface and groundwater resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside of parks." (NPS 2001, §§ 4.6.1, 4.6.2, and 4.6.3)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.35, 9.39, 9.41(a), and 9.45; Safe Drinking Water Act of 1974 (42 U.S.C. §§ 300f *et seq.*); 40 CFR Parts 141-148; Federal Water Pollution Control Act of 1972 (33 U.S.C. §§ 1251 *et seq.*); 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328; Rivers and Harbors Act of 1899, as amended (33 U.S.C. §§ 401 *et seq.*); 33 CFR Parts 114, 115, 116, 321, 322, and 333; Oil Pollution Act (33 U.S.C. §§ 2701-2761); 15 CFR Part 990; 33 CFR Parts 135, 137, and 150; 40 CFR Part 112; 49 CFR Part 106; Wilderness Act (16 U.S.C. §§ 1131 *et seq.*); Resource Conservation and Recovery Act (42 U.S.C. §§ 6901 *et seq.*); 40 CFR Parts 240-280, 49 CFR Parts 171-179; Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 U.S.C. §§ 9601-9675); 40 CFR Parts 279, 300, 302, 355, and 373; Spill Prevention Control and Countermeasure Plan (40 CFR Part 112); Department of the Interior's Onshore Oil and Gas Order Number 2, Section III, Drilling Abandonment Requirements; TEX. ADMIN. CODE tit. 16, §§ 3.8, 3.9, 3.13, 3.14, 3.20, 3.21, 3.24, 3.46, 3.57, 3.70, 3.91, 3.93, 3.94, 3.99, and 3.100.

Surface Water Performance Standards:
1) Maintain existing quality of all surface waters.
2) Avoid diminishing the quantity of surface waters.
3) Avoid altering drainage characteristics of the area or hydrology of the soils.

Groundwater Performance Standards:
1) Maintain the existing quality of groundwater.
2) Avoid diminishing the quantity of groundwater.
3) Avoid altering the natural movement of groundwater.

Floodplains

NPS Management Policy: "In managing floodplains on park lands, the National Park Service will (1) manage for the preservation of floodplain values; (2) minimize potentially hazardous conditions associated with flooding; and (3) comply with the NPS Organic Act of 1916, as amended and all other federal laws and Executive Orders related to the management of activities in flood-prone areas, including Executive Order 11988 (Floodplain Management), NEPA, applicable provisions of the Clean Water Act, and the Rivers and Harbors Appropriation Act of 1899." (NPS 2001, § 4.6.4)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.37(a)(1), 9.39, and 9.41(a); Executive Order 11988 (Floodplain Management); Spill Prevention Control and Countermeasure Plan (40 CFR Part 112); NPS Director's Order and Reference Manual 77-2, Floodplain Management; National Environmental Policy Act of 1969 (42 U.S.C. §§ 4321 *et seq.*), 40 CFR Parts 1500-1508; National Flood Insurance Act of 1968; Flood

Disaster Prevention Act of 1973; TEX. ADMIN. CODE tit. 16, §§ 3.8, 3.9, 3.13, 3.14, 3.20, 3.21, 3.24, 3.46, 3.57, 3.70, 3.91, 3.93, 3.94, 3.99, and 3.100.

Performance Standards:

1) Restore and preserve natural floodplain values.
2) Avoid the long and short-term environmental impacts associated with the occupancy and modification of floodplains.
3) Avoid direct and indirect support of floodplain development wherever there is a practical alternative. When no practical alternative exists avoid adverse environmental impacts as well as risk to life and property through appropriate mitigation utilizing nonstructural methods when possible.

Vegetation

NPS Management Policy: "The National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals." The Service will achieve this maintenance by:

- "Preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and their communities and ecosystems in which they occur;
- Restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and
- Minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them." (NPS 2001, §§ 4.1.5, and 4.4)
- (Also refer to the Threatened and Endangered Species section.)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.37(a)(1), 9.39, 9.41(b), and 9.45; Spill Prevention Control and Countermeasure Plan (40 CFR Part 112); Executive Order 13112 (Control of Invasive Species); Department of the Interior's Onshore Oil and Gas Order Number 2, Section III, Drilling Abandonment Requirements; TEX. ADMIN. CODE tit. 16, §§ 3.13, 3.20, 3.21, 3.70, and 3.91.

Performance Standards:

1) Avoid or minimize damage to or removal of vegetation communities, particularly rare or imperiled plants communities identified by the State of Texas Parks and Wildlife Department.
2) Reclaim all disturbed areas to a condition that will be approximately equivalent to the pre-disturbance condition in terms of sustained support of functional physical processes, biological productivity, biological organisms, and land uses.
3) Prevent establishment of non-native (exotic) vegetation in all disturbed areas.

Wetlands

NPS Management Policy: "The Service will (1) provide leadership and take action to prevent the destruction, loss, or degradation of wetlands; (2) preserve and enhance the natural and beneficial values of wetlands; and (3) avoid direct and indirect support of new construction in wetlands unless there are no practicable alternatives and the proposed action includes all practicable measures to minimize harm to wetlands. The Service will implement a "no net loss of wetlands" policy." (NPS 2001, § 4.6.5)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.35, 9.36(a)(16)(iv), 9.37(a)(1), 9.39(b), 9.41(a), and 9.45; Rivers and Harbors Act of 1899, as amended (33 U.S.C. §§ 401 *et seq.*); 33 CFR Parts 114, 115, 116, 321, 322, and 333; Federal Water Pollution Control Act of 1972 (33 U.S.C. §§ 1251 *et seq.);* 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328; Spill Prevention Control and Countermeasure Plan (40 CFR Part 112); Executive Order 11990 (Protection of Wetlands); NPS Director's Order and Procedural Manual 77-1, Wetland Protection; TEX. ADMIN. CODE tit. 16, §§ 3.8, 3.9, 3.13, 3.14, 3.20, 3.21, 3.24, 3.46, 3.57, 3.70, 3.91, 3.93, 3.94, 3.99, and 3.100.

Performance Standards:

1) Avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands.
2) Avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.
3) Preserve the natural and beneficial values of wetlands.

Fish and Wildlife

NPS Management Policies: "The National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals." The Service will achieve this maintenance by:

- "Preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and their communities and ecosystems in which they occur;
- Restoring native plant and animal populations in parks when they have been extirpated by past human-caused actions; and
- Minimizing human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them." (NPS 2001, §§ 4.1.5, and 4.4)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.37(a)(1), 9.39, 9.41(e), and 9.45; Migratory Bird Treaty Act, as amended (16 U.S.C. §§ 703-712); 50 CFR Parts 10, 12, 20, and 21; Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds); Lacey Act, as amended (16 U.S.C. §§ 3371 *et seq.*); 15 CFR Parts 10, 11, 12, 14, 300, and 904; TEX. ADMIN. CODE tit. 16, §§ 3.20, 3.22, and 3.70.

Performance Standards:

1) Avoid or minimize disturbances to native fish and wildlife habitat.
2) Prevent fish and wildlife exposure to contaminants.
3) Avoid or minimize injury or death to fish and wildlife.
4) Reclaim disturbed fish and wildlife habitat to provide for their survival.

Species of Special Concern

NPS Management Policy: "The Service will survey for, protect, and strive to recover all species native to national park system units that are listed under the Endangered Species Act. The National Park Service will inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species, to the greatest extent possible. In addition, the Service

will inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and will manage them to maintain their natural distribution and abundance. The Service will determine all management actions for the protection and perpetuation of federally, state, or locally listed species through the park management planning process, and will include consultation with lead federal and state agencies as appropriate" (NPS 2001, § 4.4.2.3).

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.36(i), 9.37(a)(1), and 9.39; Endangered Species Act of 1973 (16 U.S.C. §§ 1531-1544); 36 CFR Part 13; 50 CFR Parts 10, 17, 23, 81, 217, 222, 225, 402, and 450; Spill Prevention Control and Countermeasure Plan (40 CFR Part 112); Migratory Bird Treaty Act (16 U.S.C. §§ 703-712); 50 CFR Parts 10, 12, 20, and 21; Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds); Lacey Act, as amended (16 U.S.C. §§ 3371 *et seq.*); 15 CFR Parts 10, 11, 12, 14, 300, and 904; TEX. ADMIN. CODE tit. 16, §§ 3.20, 3.22, and 3.70.

Performance Standards:

1) Avoid adverse impacts on state and federally listed threatened, endangered, rare, declining, sensitive, and candidate plant and animal species and their habitats.
2) Ensure the continued existence of state and federally listed threatened, endangered, rare, declining, sensitive, and candidate plant and animal species and their habitats.
3) Ensure that permitted operations aid in the recovery of state and federally listed threatened, endangered, rare, declining, sensitive, and candidate plant and animal species and their habitats.

The NPS cooperates with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, the lead agencies in matters pertaining to federally listed threatened and endangered animals. The NPS also cooperates with the Texas Parks and Wildlife Department, responsible for state-listed species, on a project-specific basis, to evaluate potential impacts on state-listed species and determine appropriate mitigation measures.

The NPS shall identify all federal and state listed threatened, endangered, rare, declining, sensitive, or candidate species that are native to and present in the parks, and their critical habitats. These species and their critical habitats will be considered in NPS permitting of nonfederal oil and gas operations. Based on an analysis of the status of state and locally listed species throughout their native ranges and through the National Park System, the NPS may choose to control access to critical habitats or to conduct active management programs similar to activities conducted to perpetuate the natural distribution and abundance of federally-listed species.

Cultural Resources

NPS Management Policies: "The National Park Service is the steward of many of America's most important cultural resources. These resources are categorized as archeological resources, cultural landscapes, ethnographic resources, historic and prehistoric structures, and museum collections. The Service's cultural resource management program involves:

- Research to identify, evaluate, document, register, and establish basic information about cultural resources and traditionally associated peoples;
- Planning to ensure that management processes for making decisions and setting priorities integrate information about cultural resources, and provide for consultation and collaboration with outside entities; and

- Stewardship to ensure that cultural resources are preserved and protected, receive appropriate treatments (including maintenance), and are made available for public understanding and enjoyment.

The cultural resource management policies of the National Park Service are derived from a suite of historic preservation, environmental, and other laws, proclamations, Executive Orders, and regulations. A comprehensive list can be found in the Cultural Resource Management Handbook issued pursuant to Director's Order #28. Taken collectively, they provide the Service with the authority and responsibility for managing cultural resources in every unit of the national park system so that those resources may be preserved "unimpaired for future generations." (NPS 2001, Chapter 5)

Archeological Resource. "Any material remains or physical evidence of past human life or activities which are of archeological interest, including the record of the effects of human activities on the environment. An archeological resource is capable of revealing scientific or humanistic information through archeological research."

Cultural Landscape. "A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or esthetic values. There are four non-mutually exclusive types of cultural landscapes: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes."

Ethnographic Resources. "Objects and places, including sites, structures, landscapes, and natural resources, with traditional cultural meaning and value to associated peoples. Research and consultation with associated people identifies and explains the places and things they find culturally meaningful. Ethnographic resources eligible for the National Register of Historic Places are called traditional cultural properties."

Historic Property. "A district, site, building, structure, or object significant in the historic of American archeology, architecture, culture, engineering, or politics at the national, state, or local level."

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq*.); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.37, 9.37(e), 9.39, and 9.47; National Historic Preservation Act of 1966, as amended (16 U.S.C. §§ 470-470x-6); 36 CFR Parts 60, 63, 78, 79, 800, 801, and 810; Antiquities Act of 1906 (16 U.S.C. §§ 431-433); 43 CFR Part 3; American Indian Religious Freedom Act, as amended (42 U.S.C. §§ 1996-1996a); 43 CFR Part 7; Historic Sites, Buildings and Antiquities Act (Historic Sites Act of 1935) (16 U.S.C. §§ 461-467); 18 CFR Part 6, 36 CFR Parts 1, 62, 63, and 65; Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa-470mm); 18 CFR Part 1312; 32 CFR Part 229; 36 CFR Part 296; 43 CFR Part 7; Native American Graves Protection and Repatriation Act (25 U.S.C. §§ 3001-3013); 43 CFR Part 10; National Environmental Policy Act of 1969 (42 U.S.C. §§ 4321 *et seq.*); 40 CFR Parts 1500-1508; the Advisory Council on Historic Preservation's regulations regarding "Protection of Historic Properties" (36 CFR Part 800), the Secretary of the Interior's "Standards and Guidelines for Archeology and Historic Preservation" (FR 48:44716), Executive Order 11593 (Protection and Enhancement of the Cultural Environment); Executive Order 13007 (Indian Sacred Sites); Mining in the Parks Act of 1976 (P.L. 94-429).

Performance Standards:

1) Provide for the protection of all cultural resources by preventing the destruction, alteration, or impairment of all or part of the cultural property.
2) Prevent the isolation from or alteration to cultural resources with its surrounding environment.

3) Prevent the alteration or introduction of visual, audible or atmospheric elements that are out of character with the cultural resources property or its setting.

Archeological Surveys

The NPS has developed the following approach for archeological surveys to identify, evaluate, and protect historic properties in compliance with the NHPA, other statutes, and NPS policy and be feasible for the operators in NPS units:

- Any activities that do not qualify as ground disturbing (i.e., hand-held drilling of shot holes of 3-inch diameter or less, and non-rutting vehicles) will not require an archeological survey.

- Wells and related facilities will not be allowed on any historic properties within an appropriate distance of these properties to avoid direct or indirect impacts to the integrity of such resources.

- Archeological surveys (including shovel testing) will be conducted prior to any ground-disturbing activities. Ground disturbance is defined as earth moving activities (blading, rutting, etc.) below 2 inches of the present ground surface. Particular care should be taken in areas where there is a high probability of archeological sites occurring. Areas of ground disturbance typically include access roads, storage areas, heavy equipment parking areas, well and production pads, and other related use areas including areas where fill has been removed or brought in to create roads or wellpads. Areas of disturbance should be restricted to an absolute minimum required for safe operation and construction of facilities.

  When a cultural resource survey is required, the operator shall provide to the NPS the necessary cultural resources survey of the project area or area of effect. The cultural resource surveys may include identification and evaluation of archeological sites, historic structures, cultural landscapes, and traditional cultural properties, and must be conducted by professionally qualified cultural resource experts who have knowledge of the specific resource type in question. The NPS will provide operators with existing site-specific cultural resource information, where available.

  Operator surveys will result in a final report that allows the NPS to determine National Register eligibility and effect. All newly discovered archeological sites will be recorded both on State of Texas computerized site forms and NPS Archeological Sites Management Information System (ASMIS) forms. GPS locations (requested in NAD 83) and site location maps will also be required.

- Operators shall employ a qualified archeologist to monitor all ground-disturbing activities. Qualified archeologists are those who meet the Secretary of Interior Standards and Guidelines for Archeology and Historic Preservation.

Unanticipated Discovery

The NPS is responsible, under 36 CFR § 800.11, for providing a plan of action to address properties discovered during project implementation.

If any unknown cultural resource is discovered during the conduct of approved operations, and such resource might be altered or destroyed by the operations, the operator must immediately cease operations in the immediate area and notify the superintendent. The operator must leave the discovery intact until the superintendent grants permission to proceed with the operations (36 CFR § 9.47(b)). Before any further activities occur, a qualified cultural resource expert will assess the cultural resources, evaluate their National Register eligibility, and consult with the State Historic

Preservation Officer. Minor recordation, stabilization, or data recovery may be necessary during this action and will be conducted at the operator's expense. Until eligibility of the discovered historic properties can be determined, no further disturbance to the cultural resources may occur. Any plans for mitigating the negative impacts on historic properties will be subject to approval of the NPS, and it is the operator's responsibility to provide for any necessary mitigation measures.

Damage to Previously Identified Sites

This stipulation applies to situations where operations have damaged a previously identified cultural resource that was visible on the ground surface. If, in its operations, a nonfederal oil and gas operator damages, or is found to have damaged, any historic or prehistoric ruin, monument, or site, or any object of antiquity subject to the Antiquities Act of 1906 or the Archaeological Resources Protection Act of 1979 (16 U.S.C. § 470) and the National Historic Preservation Act, as amended, the operator will prepare and implement a data recovery plan at his/her expense. The operator will obtain at his/her expense, a qualified permitted archeologist to carry out the specific NPS requirements.

A qualified cultural resource monitor may be required during operations or reclamation activities if the work is located in a particularly sensitive area and/or reclamation was not done immediately following operations. Additionally, the NPS may require an archeologist to inspect reroutes to determine if cultural sites were successfully avoided. If required, this information shall be included in a monitoring report submitted to the NPS, along with an assessment of the damage, if any, to the cultural resources that were to be avoided.

The operator's employees and subcontractors must be made aware that any collection of artifacts is punishable by law and that the company is liable under trespass regulations, the Antiquities Act, and the Archaeological Resources Protection Act for fines and possible costs for any cultural resources damaged by vehicular traffic or collection.

Visitor Use and Experience

Lightscape Management

NPS Management Policy: "The Service will preserve, to the greatest extent possible, the natural lightscapes of parks, which are natural resources and values that exist in the absence of human-caused light. Recognizing the roles that light and dark periods and darkness play in natural resource processes and the evolution of species, the Service will protect natural darkness and other components of the natural lightscape in parks." (NPS 2001, § 4.10)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act, 16 U.S.C. § 19jj; 36 CFR §§ 9.37(a)(1)and 9.39.

Performance Standard:

1) Minimize the visibility of operations from public use areas, including information stations, day and overnight use areas, public access roads, hiking trails, and administrative use areas.

Soundscape Management

NPS Management Policy: "The National Park Service will preserve, to the greatest extent possible, the natural soundscapes of parks. Natural soundscapes exist in the absence of human-caused sound. The natural soundscape is the aggregate of all the natural sounds that occur in parks, together with the physical capacity for transmitting natural sounds. The Service will restore degraded soundscapes to the natural condition wherever possible, and will protect natural soundscapes from degradation due to noise (undesirable human-caused sound)" (NPS 2001, § 4.9).

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); 36 CFR § 9.37(a)(1), Noise Control Act of 1972 (42 U.S.C. §§ 4901-4918); 40 CFR Part 211; Occupational Safety and Health Administration regulations.

Performance Standard:

1) Preserve the natural quiet and natural sounds associated with Big Thicket National Preserve.

Human Health and Safety

NPS Management Policy: "The saving of human life will take precedence over all other management actions as the Park Service strives to protect human life and provide for injury-free visits. While recognizing that there are limitations on its capability to totally eliminate all hazards, the Service and its concessioners, contractors, and cooperators will seek to provide a safe and healthful environment for visitors and employees. The Service will strive to identify recognizable threats to the safety and health of persons and to the protection of property by applying nationally accepted codes, standards, engineering principles, and the guidance contained in Director's Orders #50, #58, and #83 and their associated reference manuals. When practicable, and consistent with congressionally designated purposes and mandates, the Service will reduce or remove known hazards and apply other appropriate measures, including closures, guarding, signing, or other forms of education. In doing so, the Service's preferred actions will be those that have the least impact on park resources and values." (NPS 2001, § 8.2.5.1)

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.36(a)(14), 9.37(a)(1), 9.39, 9.41(e, f), 9.43-9.46, and 9.45; National Environmental Policy Act of 1969 (42 U.S.C. §§ 4321 *et seq.*); 40 CFR Parts 1500-1508; Resource Conservation and Recovery Act (42 U.S.C. §§ 6901 *et seq.*); 40 CFR Parts 240-280, 49 CFR Parts 171-179; Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 U.S.C. §§ 9601-9675); 40 CFR Parts 279, 300, 302, 355, and 373; Spill Prevention Control and Countermeasure Plan (40 CFR Part 112); 36 CFR Part 6; Pipeline Safety Act of 1992 (49 U.S.C. §§ 60101 *et seq.*); 49 CFR Subtitle B, Ch 1, Parts 190-199; Federal Water Pollution Control Act of 1972 (33 U.S.C. § 1251 *et seq.*); 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328; Executive Order 12088 – Federal Compliance with Pollution Control Standards (3 CFR 1978 Comp. p. 243), amended by Executive Order 12580 (3 CFR 1987 Comp. p. 193).

Performance Standard:

1) Operator shall take all necessary precautions to prevent human exposure to hazards (physical, chemical, and fire).

High Pressure Precautions

NPS Management Policy: Same NPS Management Policy as is cited under Human Health and Safety (NPS 2001, § 8.2.5.1).

Supporting laws, regulations, policies, and executive orders: 36 CFR §9.43; Resource Conservation and Recovery Act (42 U.S.C. §§ 6901 *et seq.*); 40 CFR Parts 240-280; 49 CFR Parts 171-179; Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. §§ 960-9675); 40 CFR Parts 279, 300, 302, 355, and 373; Spill Prevention Control and Countermeasure Plan (40 CFR Part 112).

Performance Standard:

1) Operator must ensure that all equipment, methods, and materials will ensure proper pressure control of the well.

Open Flow/Control of Wild Wells

NPS Management Policy: Same NPS Management Policy as is cited under Human Health and Safety (NPS 2001, § 8.2.5.1).

Supporting laws, regulations, policies, and executive orders: 36 CFR § 9.44; Resource Conservation and Recovery Act (42 U.S.C. §§ 6901 *et seq.*); 40 CFR Parts 240-280; 49 CFR Parts 171-179; Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. §§ 9601-9675); 40 CFR Parts 279, 300, 302, 355, and 373; Executive Order 12088 – Federal Compliance with Pollution Control Standards (3 CFR 1978 Comp. p. 243), amended by Executive Order 12580 (3 CFR 1987 Comp. p. 193); Spill Prevention Control and Countermeasure Plan (40 CFR Part 112).

Performance Standard:

1) Operator must ensure that all equipment, methods, and materials will ensure proper control of the well.

Control of Contaminating and Hazardous Substances

NPS Management Policy: "The Service will make every reasonable effort to prevent or minimize the release of contaminants on, or that will affect, NPS lands or resources, and will take all necessary actions to control or minimize such releases when they occur. The Service will take affirmative and aggressive action to ensure that all NPS costs and damages associated with the release of contaminants are borne by those responsible for the contamination of NPS property." (NPS 2001, § 9.1.6.2)

Contaminating substances is defined at 36 CFR § 9.31(n) as "those substances, including but not limited to, salt water, or any other injurious or toxic chemical, waste oil or waste emulsified oil, basic sediment, mud [drilling fluid] with injurious or toxic additives, or injurious or toxic substances produced or used in the drilling, development, production, transportation, or on-site storage, refining, and processing of oil and gas."

Supporting laws, regulations, policies, and executive orders: 36 CFR §§ 9.31(n) and 9.45; Park System Resource Protection Act (16 U.S.C. § 19jj); Resource Conservation and

Recovery Act (42 U.S.C. §§ 6901 *et seq.*); 40 CFR Parts 240-280; 49 CFR Parts 171-179; Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. §§ 9601-9675); 40 CFR Parts 279, 300, 302, 355, and 373; Executive Order 12088 – Federal Compliance with Pollution Control Standards (3 CFR 1978 Comp. p. 243), amended by Executive Order 12580 – Superfund Implementation (3 CFR 1987 Comp. p. 193); Oil Pollution Act (33 U.S.C. §§ 2701-2761; Pipeline Safety Act of 1992 (49 U.S.C. § 60101 *et seq.*); 49 CFR Subtitle B, Ch 1, Parts 190-199; Federal Water Pollution Control Act of 1972 (33 U.S.C. §§ 1251 *et seq.*); 33 CFR Parts 320-330; 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328; Spill Prevention Control and Countermeasure Plan (40 CFR Part 112).

Performance Standards:

1) Operator shall take all necessary precautions to prevent the release of contaminating and hazardous substances into the environment.
2) Operator shall respond quickly and effectively to contain and clean up spills and restore damaged resources.

Operators conducting oil and gas drilling and production operations will often use or generate substances that meet this definition, and are therefore required to fully comply with the provisions of 36 CFR § 9.45 during the conduct of operations. Operators must include a "Contaminating or Toxic Substance Spill Control Plan" in their Plan of Operations (36 CFR § 9.36(a)(10)(vi)). The Spill Control Plan will:

- list the types and amounts of contaminating substances proposed for use in operations;
- describe potential hazards to humans and the environment and respective mitigation measures;
- describe actions to be taken to handle, store, clean up, and dispose of such substances;
- describe the equipment and methods for containment and clean up of contaminating substances, including a description of the equipment available on-site versus those available from local contractors; and
- include an emergency spill response plan in the event of accidents, fires, or spills, prepared by a qualified spill specialist.

If determined to be adequate by the superintendent, a Spill Prevention Control and Countermeasure Plan, required under 40 CFR Part 112, may be used to satisfy the oil spill contingency plan requirements under 36 CFR § 9.36(a)(10)(vi).

- Confine brine water and all other waste and contaminating substances to the smallest practicable area, and prevent escape of such substances due to percolation, rain, high water, or other causes. Properly store and promptly remove all wastes and contaminating substances to prevent contamination, pollution, damage, and injury to unit resources and values (36 CFR § 9.45).
- The operator will immediately stop work if contamination is found in the operating area and notify the park superintendent or his/her designated representative.
- The operator will be liable for pollution or other damages, as a result of their operations, to government-owned lands and property.
- Operators shall make efforts to use the least hazardous and/or contaminating substances necessary in the conduct of operations if those choices are available; and to store the minimum quantity on site needed to maintain operations.
- Hazardous and contaminating substances shall be properly stored in secondary containment systems.
- The operator shall indemnify the United States against any liability for damage to life or property arising from the occupancy or use of public lands under an approved Plan of Operations. This shall include liability arising from the occupancy or use of public lands under an approved Plan of Operations. This shall include liability arising from the release of any hazardous substance or

hazardous waste (as these terms are defined in the Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C. §§ 9601, *et seq.*, or the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901, *et seq.*) on this approved surface use (unless the release or threatened release is wholly unrelated to operator's activity in this approved surface use), or resulting from the activity of operator on this approved surface use. This applies without regard to whether a release is caused by the operator, their agent, or unrelated third parties.

Any collection and laboratory analyses of soil sediment, surface or groundwater samples conducted before or after well drilling, production, or a change of ownership or lease rights, shall follow the NPS's "Guideline for the Detection and Quantification of Contamination at Oil and Gas Operations," contained in Appendix F.

Hurricane Preparedness

NPS Management Policy: Same NPS Management Policy as is cited under Human Health and Safety (NPS 2001, § 8.2.5.1).

Supporting laws, regulations, policies, and executive orders: 36 CFR § 9.31(n), 9.37(a)(1), 9.41(a), 9.45; Park System Resource Protection Act (16 USC 19jj); Executive Order 11988 (Floodplain Management); NPS Director's Order and Procedural Manual 77-2, Floodplain Management; Executive Order 12777, Implementation of Federal Water Pollution Control Act § 311 and the Oil Pollution Act; Spill Prevention Control and Countermeasure Plan (40 CFR 112); National Flood Insurance Act of 1968; Flood Disaster Prevention Act of 1973; Resource Conservation and Recovery Act (42 USC §§ 6901 et. seq.); 40 CFR 240-280; 49 CFR 171-179; Comprehensive Environmental Response, Compensation and Liability Act (42 USC § 9601 et. seq.); 40 CFR Parts 300, 302, 355, 373; Oil Pollution Act (33 USC § 2701-2761); 40 CFR Part 112; 33 CFR Parts 135, 137, 150; 49 CFR Part 106; 15 CFR Part 990; 33 CFR Part 135; 33 CFR Part 137; National Flood Insurance Act of 1968; Flood Disaster Prevention Act of 1973; National Environmental Policy Act of 1969 (42 USC § 4231); 40 CFR 1500-1508; Big Thicket National Preserve Emergency Preparedness Plan.

Performance Standard:

1) Minimize the potential harm to life, property, and park resources in the event of a hurricane.

Integrated Pest Management

NPS Management Policy: "All park employees, concessioners, contractors, permittees, licensees, and visitors on all lands managed or regulated by the National Park Service will comply with NPS pest management policies. Integrated pest management (IPM) is a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment. Proposed pest management activities must be conducted according to the IPM process prescribed in NPS Reference Manual #77-7: Integrated Pest Management. Pest issues will be reviewed on a case-by-case basis. Controversial issues, or those that have potential to negatively impact the environment, must be addressed through established planning procedures and be included in an approved park management or IPM plan. IPM procedures will be used to determine when to implement pest management actions, and which combination of strategies will be most effective for each pest situation. Under the Service's IPM

program, all pesticide use on lands managed or regulated by the Service, whether that use was authorized or unauthorized, must be reported annually" (NPS 2001, § 4.4.5).

Supporting laws, regulations, policies, and executive orders: Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. §§ 136 *et seq.*); as amended by the Federal Environmental Pesticide Control Act and FIFRA amendments of 1975, 1978, 1980, 1982, and 1996; 40 CFR Parts 152-180, except Part 157; USDI Policies and Procedures (DM 517); Occupational Safety and Health Administration regulations, Executive Order 13112 – Control of Invasive Species (1999).

Performance Standard:

1) Avoid or minimize adverse impacts of pesticide use to nontarget species or resources.

Protection of Park Development and Survey Monuments

NPS Management Policy: There is no applicable NPS Management Policy for this topic.

Supporting laws, regulations, policies, and executive orders: NPS Organic Act of 1916, as amended (16 U.S.C. §§ 1 *et seq.*); Park System Resource Protection Act (16 U.S.C. § 19jj); 36 CFR §§ 9.41(a, b).

Performance Standards:

1) Avoid impacts on existing or future park structures, development, and survey markers.
2) If impacts occur, restore, replace, or compensate for damages.
3) Reduce fire hazards to acceptable levels.

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PART III
OPERATING STIPULATIONS AND MITIGATION MEASURES FOR NONFEDERAL OIL AND GAS OPERATIONS

CHAPTER 2



PART III - OPERATING STIPULATIONS AND MITIGATION MEASURES FOR NONFEDERAL OIL AND GAS OPERATIONS

The following section lists required operating stipulations and suggested mitigation measures for each type of oil and gas operation that could occur in Big Thicket National Preserve. This section is organized by geophysical exploration (Table 2.20), drilling and production, including roads, drilling, production, and flowlines and pipelines (Table 2.21), and plugging, abandonment, and reclamation operations (Table 2.22). Operating stipulations that are required by law or regulation are listed at the beginning of each table with the appropriate citation shown in parentheses after the stipulation. Recommended mitigation measures follow the operating stipulations. The tables also specify which resource(s) would be protected by the particular operating stipulation or mitigation measure.

The following tables focus on the National Park Service's Nonfederal Oil and Gas regulations at 36 CFR Part 9 Subpart B. Many, but not all of the operating stipulations required under other federal and state laws and regulations are also listed in this table. To ensure compliance with all applicable legal and policy mandates, it is the operator's responsibility to consult with the appropriate federal, state, and local agencies prior to conducting operations in the Preserve.

Many of the mitigation measures are derived from environmental guidelines and publications developed by the oil and gas industry and environmental professionals. These measures may not address every environmental topic or risk that may be encountered during oil and gas operations.

Table 2.20. Operating Stipulations and Mitigation Measures for Nonfederal Oil and Gas Geophysical Exploration Operations

GEOPHYSICAL EXPLORATION OPERATIONS **REQUIRED OPERATING STIPULATIONS** **AND** **RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	**RESOURCES**	**Air Quality**	**Geologic Resources**	**Water (Surface and G.W.)**	**Floodplains**	**Vegetation**	**Wetlands**	**Fish and Wildlife**	**Species of Special Concern**	**Cultural Resources**	**Visitor Use and Experience**	**Human Health and Safety**
REQUIRED OPERATING STIPULATIONS - The applicable legal citation is noted in [parenthesis] after the stipulation.												
In order to use surface or subsurface water from inside the park, the operator must demonstrate in the plan of operations that his water rights are superior to any claim of the U.S. to use the water, and where the use is subordinate to that of the U.S., that use of the water will not damage park resources. Since any use of park water has the potential to negatively affect water quality, quantity, and flow patterns, the operator should note what resources would benefit from the in-park water use and how they would benefit the resources. [36 CFR § 9.35]			+	√	+	+	+	+	+		+	
Prepare an Emergency Response Plan to ensure safe operating procedures in the event of a reportable quantity spill; damage to wells, pipelines, or other structures; fire; explosion; medical evacuation; or other emergencies such as strong winds, heavy rainfall, swift currents, and flooding. [36 CFR 9.36(a)(10)(vi), 40 CFR § 112]		+	+	+	+	+	+	+	+	+	+	√
Prior to beginning operations, in consultation with the U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department and NPS, identify all species of special concern (threatened, endangered, and sensitive species) that may be present in the project area. Based on the species and the proposed operation, operators may be required to conduct biological surveys in the project area. [36 CFR § 9.36(a)(16)(i); Endangered Species Act of 1973 -16 USC 1531 *et. seq*.]						+	+	+	√			
Conduct cultural resource surveys to document the location and significance of any cultural resource (includes various components of archeological, ethnographic, historic architectural, and historic landscape resources) that might be affected by operations. [36 CFR §9.36 (a)(16)(I), 36 CFR § 63, 36 CFR § 800.4]										√	+	
Conduct a pre-operational analysis to adequately describe the natural, social and economic environments that would be affected by the operations (including air quality, geology, topography, soils, surface and subsurface hydrology, vegetation, wetlands, fish and wildlife, threatened and endangered species, cultural resources, and all water and oil and gas wells within a 2-mile radius of proposed operation). [36 CFR 9.36(a)(16)(i)]		√	√	√	√	√	√	√	√	√		
For geophysical operations using underground explosives, conduct a risk assessment of proposed operating methods (depth, size, pattern, and array of explosives) with respect to site conditions (landscape features and physical properties of soils, including depth and thickness of aquitards or water-retardant layers). [36 CFR § 9.37(a)(1)]			√	√				+	+	+		
Discharge explosives at safe distances from pipelines, telephone lines, railroad tracks, roads, power lines, water wells, oil and gas wells, oil and gas production facilities, buildings, etc. Use accepted industry minimum safe offset distances, unless otherwise specified. [36 CFR § 9.37(a)(1)]												√
Surface operations shall at no time be conducted within 500 feet of the banks of perennial, intermittent or ephemeral watercourses; or within 500 feet of the high pool shoreline of any natural or man-made impoundments…unless specifically authorized by an approved plan of operations. If necessary, the operator must specifically request exemptions from this standard in the plan of operations and demonstrate that the exemptions are necessary for acceptable data quality, can be conducted with insignificant effects on park waters or manmade infrastructure, and result in overall resource impact reduction. [36 CFR §9.41(a)]			+	√	√	+	+	+	+		+	

GEOPHYSICAL EXPLORATION OPERATIONS
REQUIRED OPERATING STIPULATIONS
AND
RECOMMENDED MITIGATION MEASURES

The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.

RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
Protect all survey monuments, witness corners, reference monuments and bearing trees against destruction, obliteration, or damage from operations. Operator shall be responsible for the reestablishment, restoration, or referencing of any monuments, corners, or bearing trees which are destroyed, obliterated, or damaged by such operations. [36 CFR § 9.41(b)]					√					+	
The operator shall take technologically feasible precautions to prevent accidents and fires. [36 CFR § 9.46]	+	+	+	+	+	+	+	+	+	+	√
Operations shall not injure, alter, destroy, or collect any object, structure, or site of historical, archeological, or cultural value, without the written authorization of the NPS. [36 CFR § 9.47(a); 43 CFR § 3]									√	+	
Ensure that a qualified monitor is present during appropriate operational phase(s). Once operations have commenced, the operator shall immediately bring to the attention of the Superintendent any cultural or scientific resource, or species of special concern encountered that might be altered, harmed or destroyed by the operation and shall leave such discovery intact until told to proceed by the Superintendent. The Superintendent will evaluate the discoveries brought to his/her attention, and will determine within ten (10) days what action will be taken with respect to such discoveries. [36 CFR § 9.47(b)]						+		√	√	+	
Include stop work provisions in the event of a cultural or scientific discovery in operator's contracts. [36 CFR § 9.47(b); 36 CFR § 800.11]									√	+	
Use of park roads must be in accordance with procedures outlined in an approved plan of operations. [36 CFR 9.50]		√	+				+	+		√	+
Firearms are prohibited in the Preserve, except as permitted under Big Thicket National Preserve Hunting Regulations. [36 CFR § 7.85]							√	√		√	√
Do not locate staging areas within the 100-year floodplain unless there is no practicable alternative. Avoid the use of fill in the 100-year floodplain. [EO 11988 Sec 3 (b)]		+	+	√	+	+	+	+			√
Develop an adequate flood warning system which monitors one or more physical parameters (e.g., rainfall, runoff, streamflow) and provides warning of an impending flood to the operator, operator's contractors and subcontractors, visitors and Preserve personnel with adequate time to permit evacuation; and use signs, high-water indicators, and other information indicating that a site is floodprone and suggesting appropriate actions in the event of flooding. [NPS Procedures Manual 77-2]											√
Wetlands (both Cowardin classification system and jurisdictional wetlands) must be delineated where proposed operations would directly or indirectly adversely impact wetlands. Wetland delineations shall be approved by the U.S. Army Corps of Engineers and the Water Resources Division of the National Park Service and incorporated in the Statement of Findings and Plan of Operations. [Executive Order 11990, NPS Procedural Manual 77-1 § 5.1]		+	+		+	√					
Plan work to avoid known cultural resources. If work cannot avoid known cultural resources, assess and mitigate effects on National Register eligible or listed properties in consultation with State Historic Preservation Office and Advisory Council on Historic Preservation. [36 CFR § 800.3-800.9]									√	+	
An incidental take of a federally listed species must be immediately reported to the NPS and USFWS, all other protected species would be reported to the NPS. [Endangered Species Act, 16 USC §§ 1531 – 1544, 50 CFR Parts 402, 450]								√			

GEOPHYSICAL EXPLORATION OPERATIONS
REQUIRED OPERATING STIPULATIONS
AND
RECOMMENDED MITIGATION MEASURES

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RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
RECOMMENDED MITIGATION MEASURES											
Hold daily safety and environmental meetings with crews to reinforce crew and public safety, environmental concerns, and operating procedures.	+	+	+	+	+	+	+	+	+	+	√
Minimize conflicts with visitors by avoiding designated visitor use areas. If operations are needed in or around designated visitor use areas for successful completion of the project, then schedule work during low visitor use times and/or implement strategies to minimize the sights, sounds, and duration of operations in and around these areas.										√	√
Use minimum number of vehicles, boats, or aircraft necessary to provide efficient and safe access for personnel and equipment.	√	√	√	√	√	√	√	√	√	√	√
Perform conformity demonstration during project planning to quantify level of expected air emissions.	√										
Reduce vehicle speeds on roads to minimize dust. Consider spraying roads and access routes with freshwater to reduce dust.	√		√		√		+				+
Use properly designed, maintained and operated equipment to reduce emissions such as proper engine fuel mixtures, regularly serviced exhaust systems, and proper engine tuning.	√										
Use designated access routes, designated roads, and natural routes (e.g., bayous and other waterways) whenever possible during operations and during travel to and from the project area. Minimize multiple passes along roads to reduce resource impacts.		√	√	+	+	+	+	+	+	√	√
Locate primary staging areas outside the Preserve. Confine refueling, lubrication, and maintenance of vehicles and equipment to areas outside the Preserve where feasible.		√	√	+	+	+	+	+	+	+	+
Where feasible, use global positioning systems (GPS) technology to minimize the amount of vegetation cut to survey source and receiver lines.		+	+	+	√	+	+	+	+	+	
Selectively cut vegetation along source and receiver lines, offsets, and designated access routes as necessary to accommodate safe passage of personnel and equipment.		+	+		√	+	+	+		+	√
Leave small vegetation in place, (low shrubs, and herbaceous vegetation) consistent with safe passage of personnel and equipment.		+	+	+	√	+	+	+		+	
Leave topsoil, rootstock, and seeds on lines and designated access routes to encourage natural regeneration.		√	+	+	√	+	+	+		+	
Cut vegetation by hand, supplementing as necessary with chain saws or other motorized cutting equipment.										√	√
When vegetation cutting is done, ensure that branches and brush lie in contact with the ground to enhance vegetative decay.		+			√					√	√
Cut vegetation in accordance with the Preserve's current management practices for geophysical exploration operations which are as follows: Other than Chinese tallow (*Sapium sebiferum*), the cutting of live or dead vegetation larger than three (3) inches in diameter, measured one (1) foot above ground level, is strictly prohibited. All cuts must be made flush with the ground and the remaining stump shall be no higher than one (1) inch above the ground. No limb larger than three (3) inches in diameter, measured at the branch collar or branch bark ridges, shall be cut. The remaining limb shall not extend more than one (1) inch beyond the main trunk. No cypress knees will be cut. Use of motorized cutting equipment is permitted.		+	+	+	√	+	+	+		x	
Secure flagging, other markers, cables, or other equipment without cutting or slicing vegetation.					√	+					

GEOPHYSICAL EXPLORATION OPERATIONS
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RECOMMENDED MITIGATION MEASURES

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Do not permanently mark any tree in the Preserve.										√	
Select means of access other than land vehicles when soils are saturated to minimize compaction, displacement, and rutting of clayey soils.		√	+	+	+	√					
Conduct operations during dry seasons when certain soils are less susceptible to compaction, displacement and rutting.		√	+	+	+	√					
Conduct operations during plant dormancy seasons.					x	+					
Use vehicles with low ground pressure to minimize surface impacts. In lieu of using large mechanized drilling equipment, use lightweight, walk behind tracked drills or hand augers as appropriate in the Preserve.		√	+	+	+	+				+	
Plan efficient refueling of vehicles and equipment to minimize travel and chances for spills.		√	√	+	+	+	+				+
Refuel or lubricate equipment over secondary containment such as drip pans, drip basins, or impenetrable polyvinyl covered by absorbent materials.		√	√	+	+	+	+				+
Periodically check for leaks under all operating vehicles and equipment; contain and remove contaminated soil for proper disposal.		√	√	+	+	+	+	+			+
Replace all cuttings in shotholes or boreholes, including proper tamping of cuttings during shothole plugging. Avoid backfilling shotholes too quickly to avoid bridging. Spread any remaining cuttings on the surface into a thin layer at each hole. Note: Plugging materials may be required for shotholes less than 20 feet below the land surface.		√								√	
Use existing stream crossings whenever practicable.			√	+	+	√	+	+		+	
Cross streams at right angles to the stream, and minimize stream crossings by good project planning.		+	√	+	+	√	+	+			
Ensure that approaches to stream crossings do not alter natural drainage into the stream. Temporary runoff diversion and/or erosion control may be appropriate to minimize erosion and vegetation loss.		+	√	+	√	√	+	+			
Wherever possible, cross streams or watercourses where the water is shallow and the streambed or bottom is firm.		+	√			√	√	√			
Minimize width of survey lines and designated access routes, particularly at water crossings to minimize sediment input and brush in watercourses.		+	√	+	+	+	+	+			
Avoid blocking or filling any natural drainage path.			√	+	+	√	+	+			
When traveling in water, slow vehicle and boat speeds to minimize wake.			√			√	√	√		+	
When using boats, ensure adequate water depth to minimize bank erosion and adverse effects on aquatic life.		√	√	+	+	√	√	√			
Secure portable fuel tanks to the boat for safety and to prevent loss.			√		+	+	+	+			√
Use biodegradable lubricants.			√	+	+	+	+	+			
Use biodegradable charges during seismic operations.		√	+			+					
Avoid disturbing rare vegetation such as magnolia, beech and old growth cypress trees. If this is not possible, drill shotholes outside the crown of the tree.					√	+		√			
Do not load charges into flowing holes.			√			+					

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Use loading poles or tamping poles to ensure charges are placed and seated at the proper depth, and shotholes are properly plugged with cuttings and/or other authorized materials. Use plugging materials that meet International Association of Geophysical Contractors (IAGC) standards.		√	√								√
Use plugging materials in tubes or casing which will expand appropriately. Recommended tube diameter is 75 percent of shothole diameter.		√	√								
Plugs should be set at least 24 hours before detonation of charges.		√	√								√
If fluid flows in a shothole (groundwater that is under artesian conditions), attempt to plug it immediately. If the flow is too great, use expansive plugging material to backfill the hole above the aquifer to the surface.		√	√								
Clean vehicles and equipment prior to entering the project area to avoid introducing foreign plant materials.					√						
For vehicles, clear the undercarriage of brush to prevent fires when driving over dry areas. Use spark arresters and spark suppression accessories on equipment.				+	√	+	+	+			√
Avoid species of special concern (threatened, endangered and sensitive species) and their habitats during project design.						+		√			
Use USFWS "Conservation Guidance for Plant and Animal Candidate Species" or other pertinent information provided by the USFWS, TWPD, or NPS to minimize disturbances to species of special concern and their habitat.						+		√			
Use qualified monitors with expertise in identifying threatened, endangered and sensitive plant and wildlife species and their habitats to accompany field crews, especially land survey crews.					√	+	√	√			
Provide field personnel and monitors with training in identification and habits of wildlife (including species of special concern) in the project area.						+	√	√			
If using helicopters, locate helipads as far apart as practical in existing clearings.							√	√		√	
Consistent with safety, minimize the number of helicopter flyways.							√	√		√	
Use long sling lines, consistent with safety, to minimize the effects of down draft from the rotor.							√	√		√	
Avoid or bypass wildlife areas marked on the project map and/or in the field to minimize disruption to wildlife, especially in areas of active denning, nesting, spawning, migration, and feeding. Where interaction with wildlife is unavoidable, minimize the sights, sounds, and duration of operations to the maximum extent feasible.							√	√		+	
Report any sighting of threatened, endangered, or sensitive species to the NPS.								√			
Inform visitors, area residents, and others during project planning and while conducting an operation. During geophysical exploration operations, post warning and informational signs in visible locations (such as intersections), notices in visitor centers, notices in local newspapers and publications, etc., to inform them of the timing and types of operations that will occur.										√	√
Conduct operations during low visitor use periods.										√	√
Provide trash bags and trash receptacles for cans, bottles, paper, and other trash generated daily by crews.										√	
Do not burn vegetation, survey stakes, flagging, refuse, or other debris or waste incidental to maintenance or operation.	√				+					√	√

GEOPHYSICAL EXPLORATION OPERATIONS
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Remove survey stakes, flagging, trash or other debris or waste from the project area.						+	+	+		√	
Bury and/or secure capwire from undetonated or live charges to reduce risk to human health and safety.											√
Take appropriate measures to ensure all charges are fired. Disable misfired charges by breaking or cutting the capwire as deep below ground as practical.											√
When working in dry vegetation, prohibit smoking, or only allow smoking at designated times and locations.					√						√
Ensure fire-fighting equipment and personnel are available while operating in dry vegetation. Consider both fire danger and fire danger rating during planning and conduct of operations.					√						√
Use seed, mulch, or other authorized materials or structures to mitigate the potential for erosion.		√	√	+	+	+	+	+		+	

Table 2.21. Operating Stipulations and Mitigation Measures for Nonfederal Oil and Gas Drilling and Production Operations. This table lists required operating stipulations and recommended mitigation measures for constructing roads and wellpads, drilling operations, production operations, and flowlines and pipelines. The 36 CFR 9B operating stipulations shown in the following table are required for all nonfederal oil and gas operations under a Plan of Operations and are recommended for directional drilling operations originating outside of the Preserve. Mitigation measures are recommended for all oil and gas operations regardless of whether the surface operation is sited within or outside of the Preserve.

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	**DRILLING AND PRODUCTION OPERATIONS REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
REQUIRED OPERATING STIPULATIONS - The applicable legal citation is noted in [parenthesis] after the stipulation.																
√	√			In order to use surface or subsurface water from inside the park, the operator must demonstrate in the plan of operations that his water rights are superior to any claim of the U.S. to use the water, and where the use is subordinate to that of the U.S., that use of the water will not damage park resources. Since any use of park water has the potential to negatively affect water quality, quantity, and flow patterns, the operator should note what resources would benefit from the in-park water use and how they would benefit. [36 CFR § 9.35]			+	√	+	+	+	+	+		+	
	√	√	√	Prepare an Emergency Response Plan to ensure safe operating procedures in the event of a reportable quantity spill; damage to wells, pipelines, or other structures; fire; explosion; medical evacuation; or other emergencies such as strong winds, heavy rainfall, swift currents, and flooding and secure storage tanks and other production equipment to reduce structural and environmental risks. [36 CFR 9.36(a)(10)(vi), 40 CFR § 112]		+	+	+	+	+	+	+	+	+	+	√
√	√		√	Prior to beginning operations, in consultation with the U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department and NPS, threatened, endangered, and sensitive species that may be present in the project area must be identified. Based on the species and the proposed operation, operators may be required to conduct biological surveys in the project area. [36 CFR § 9.36(a)(16)(i); Endangered Species Act of 1973 -16 USC 1531 *et. seq*.]						+	+	+	√			
√	√		√	Conduct cultural resource surveys to document the location and significance of any cultural resource (includes various components of archeological, ethnographic, historic architectural, and historic landscape resources) that might be affected by operations. [36 CFR §9.36 (a)(16)(i), 36 CFR § 63, 36 CFR § 800.4]									√	+	
√	√		√	Conduct a pre-operational analysis to adequately describe the natural, social and economic environments that would be affected by the operations (including air quality, geology, topography, soils, surface and subsurface hydrology, vegetation, wetlands, fish and wildlife, threatened and endangered species, cultural resources, and all water and oil and gas wells within a 2-mile radius of proposed operation. [36 CFR § 9.36(a)(16)(i)]		√	√	√	√	√	√	√	√	√		
√	√	√	√	Surface operations shall at no time be conducted within 500 feet of the banks of perennial, intermittent or ephemeral watercourses; or within 500 feet of the high pool shoreline of any natural or man-made impoundments…unless specifically authorized by an approved plan of operations. If necessary, the operator must specifically request exemptions from this standard in the plan of operations and demonstrate that the exemptions are necessary for acceptable data quality, can be conducted with insignificant affects on park waters or manmade infrastructure, and result			+	√	√	+	+	+	+		+	

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	**DRILLING AND PRODUCTION OPERATIONS REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
				in overall resource impact reduction. [36 CFR § 9.41(a)]												
√	√	√	√	Protect all survey monuments, witness corners, reference monuments and bearing trees against destruction, obliteration, or damage from operations. Operator shall be responsible for the reestablishment, restoration, or referencing of any monuments, corners, or bearing trees which are destroyed, obliterated, or damaged by such operations. [36 CFR § 9.41(b)]						√					√	
	√	√		Whenever drilling or production operations are suspended for 24 hours, but less than 30 days, the wells shall be shut-in by closing wellhead valves or blowout prevention equipment. When production operations are suspended for 30 days or more, a suitable plug or other fittings acceptable to the Preserve Superintendent shall be used to close the well. [36 CFR § 9.41(c)]			+	+	+	+	+	+	+		√	√
	√	√		Clearly sign every operation or well in a conspicuous place with the name of the operator or owner, well number, lease number, location (i.e., surface owner), phone number, and take all necessary precautions to preserve these markings. [36 CFR § 9.41(d)]											√	√
		√		Secure production operation sites with acceptable fencing around wells, storage tanks, all high pressure equipment, and storage tanks, unless otherwise authorized by the park superintendent. [36 CFR § 9.41(e)]							+	+			√	√
	√	√	√	Operators shall remove from the Preserve or store in an orderly manner, all scrap materials or other materials that are not in use or other materials deemed to be fire hazards from the vicinity of well locations and lease tanks. [36 CFR § 9.41(f)]			+	+	+	+	+	+	+	+	√	√
	√	√		Operators must use procedures and equipment of sufficient pressure rating to keep the well under control at all times. Surface casing must be cemented to surface unless otherwise permitted. All other casing strings must be adequately cemented in place to ensure control of the well. [36 CFR § 9.43]		+	+	+	+	+	+	+	+	+	+	√
	√	√		Operators must use procedures and equipment of sufficient pressure rating to prevent uncontrolled discharges of oil, gas, or brine. Operators must act quickly to control blowouts or burning wells. [36 CFR § 9.44]		+	+	+	+	+	+	+	+	+	+	√
	√	√		Oilfield brine, and all other waste and contaminating substances must be kept in the smallest practicable area, must be confined so as to prevent escape as a result of percolation, rain, high water or other causes, and such wastes must be stored and disposed of or removed from the area as quickly as practicable in such a manner as to prevent contamination, pollution, damage or injury to the lands, water (surface and subsurface), facilities, cultural resources, wildlife, and vegetation of or visitors to the unit. [36 CFR § 9.45]			√	√	+	√	+	√	√	√	+	√
	√	√		The operator shall take technologically feasible precautions to prevent accidents and fires. [36 CFR § 9.46]		+	+	+	+	+	+	+	+	+	+	√
√	√	√	√	Operators shall not injure, alter, destroy, or collect any object, structure, or site of historical, archeological, or cultural value, without the written authorization from the NPS. [36 CFR § 9.47(a); 43 CFR Part 3]										√	+	
√	√		√	Include stop work provisions in the event of a cultural or scientific resource discovery in operator's contracts. [36 CFR § 9.47(b); 36 CFR § 800.11]										√	+	

DRILLING AND PRODUCTION OPERATIONS
REQUIRED OPERATING STIPULATIONS
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ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol. RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
				Use of park roads must be in accordance with procedures outlined in an approved plan of operations. [36 CFR § 9.50]		√	+				+	+		√	+
√	√	√	√	Firearms are prohibited in the Preserve, except as permitted under Big Thicket National Preserve Hunting Regulations. [36 CFR §7.85]							√	√		√	√
√	√	√	√	Dispose of stormwater in accordance with federal and state laws. [33 USC 1251 et. seq. § 402]		+	√	+	+	+	+	+		+	√
	√	√		If required by the park superintendent, provide analyses of soils, surface water, groundwater, and sediments before and after well drilling or production operations (or change of ownership or leasing rights). [See NPS "Guideline for the Detection and Quantification of Contamination at Oil and Gas Operations" found in Appendix H of this document.]		√	+	+	+	+				+	
	√	√		Cover or place netting on storage tanks to minimize the likelihood of accidental deaths of migratory birds. [Migratory Bird Treaty Act -16 U.S.C. § 703-712, Executive Order 13186]							√	√			
√	√	√		Do not locate oil and gas well access roads and flowlines in the 100-year floodplain unless no practical alternative exists. Where such operations must be located in the 100-year floodplain, appropriate mitigation measures must be taken to floodproof or elevate the road or flowline to minimize structural and environmental risks associated with flooding, including debris flows. [EO 11988 § 3 (b), NPS Procedural Manual 77-2 § (VI) (G)] These activities would be permitted in the 500-year floodplain if appropriate mitigation measures are taken to floodproof or elevate the site to minimize environmental risks associated with flooding.		+	+	√	+	+	+	+			√
√	√	√	√	Do not locate oil and gas well access roads, drill and production pads, flowlines, gathering lines or oil and gas processing and storage facilities and equipment, including heater treaters, separators, oil storage tanks, produced water storage tanks, etc., in the 500-year floodplain unless there is no practicable alternative. Where such operations must be located in the 500-year floodplain, appropriate mitigation measures must be taken to floodproof or elevate the structures to minimize the environmental risks associated with flooding. [EO 11988 § 3(b), NPS Procedural Manual 77-2 § (VI) (G)]		+	+	√	+	+	+	+			√
	√	√	√	Develop an adequate flood warning system which monitors one or more physical parameters (e.g., rainfall, runoff, streamflow) and provides warning of an impending flood to the operator, operator's contractors and subcontractors, visitors and Preserve personnel with adequate warning of an impending flood with time to permit evacuation; and signs, highwater indicators, and other information indicating that a site is floodprone and suggesting appropriate actions in the event of flooding. [NPS Procedural Manual 77-2]		+	+	√	+	+	+	+			√
√	√		√	Wetlands (both Cowardin classification system and jurisdictional wetlands) must be delineated where proposed operations would directly or indirectly adversely impact wetlands. The wetland delineations shall be approved by the U.S. Army Corps of Engineers and the National Park Service, Water Resources Division, and be incorporated in the Statement of Findings and operator's proposed plan of operations. [Executive Order 11990, NPS Procedural Manual 77-1 § 5.1]		+	+		+	√					
√	√		√	When proposed operations cannot avoid direct and/or indirect impacts on wetlands, the operator shall compensate for direct and indirect impacts on to wetlands by restoring degraded or former wetland habitats. Wetland restoration must, at a minimum, provide for one-for-one (1:1) wetland function replacement (i.e., focus on no net loss of wetland functions,		+	+		+	√	+	+			

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				not just wetland acreage). Compensation shall be performed prior to or at the same time impacts associated with approved oil and gas operations occur. [Executive Order 11990, NPS Procedural Manual 77-1 § 5.2 (C)]												
√	√		√	Plan work to avoid known cultural resources. If work cannot avoid known cultural resources, assess and mitigate effects on National Register eligible or listed properties in consultation with State Historic Preservation Office and Advisory Council on Historic Preservation. [36 CFR § 800.3-800.9]									√	+	
		√		Firewalls constructed around storage tanks or tank batteries must be of sufficient size to contain at least 1.5 times the storage capacity of the largest enclosed tank. Firewalls must be properly constructed and maintained. [40 CFR § 112.7(e)(5)(B)]			+	+	+	+	+	+	+		+	√
√	√	√	√	An incidental take of a federally listed species will be immediately reported to the NPS and the USFWS and all other protected species would be reported immediately to the NPS. [Endangered Species Act, 16 USC §§ 1531 – 1544, 50 CFR Parts 402, 450].									√			
RECOMMENDED MITIGATION MEASURES																
√	√	√	√	Avoid direct impacts to unit resources and values by siting surface operations outside the boundaries of the Preserve (applies to directionally drilled wells, and siting of production facilities).		√	√	√	√	√	√	√	√	√	√	√
√	√	√	√	Confine all activities, including personal and company vehicles, to right-of-way, existing roads, disturbed areas, or other designated areas.			+	+	+	+	+	+	+	+	√	√
√	√	√	√	Avoid or bypass wildlife areas, especially in areas of active denning, nesting, spawning, migration, or feeding. Where interaction with wildlife is unavoidable, minimize the sights, sounds and duration of operations to the maximum extent feasible.							+	√	√			
√	√	√	√	Schedule work for seasonal times least likely to affect threatened and endangered species.						√		√	√			
√	√	√	√	Before moving equipment on or off location, make sure machinery is plugged, drained, or otherwise secured to keep fluids from leaking during transport.			√	√	+	+	+	+	+			
√	√	√	√	Reduce vehicle speeds to reduce chances of injuring wildlife.								√	√			
√	√	√	√	Use seed, mulch, or other authorized materials or structures to mitigate the potential for erosion. Use certified weed-free mulch, native seed, or sterile cover crops that are not sources of undesirable nonnative plant species.			√	√	+	+	+	+	+		+	
√	√	√	√	Use mechanical or physical methods to control vegetation along roadways, adjacent to wellpads, at wellheads, valves, meter stations, production facilities, etc.											+	√
√	√	√	√	Use NPS-approved herbicides to control vegetation where mechanical or physical methods are ineffective.			+	+	+	+	+	+	+		+	√
√	√	√	√	Apply pesticides when visitors/public are not in area and post signs in areas that have been treated until they are dry.											√	√
√	√	√	√	Apply pesticides according to label directions, when applying outdoors (especially herbicides) and do not apply during windy conditions.		+			+	+	+	+	+		√	√

DRILLING AND PRODUCTION OPERATIONS
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ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol. RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
√	√	√	√	Ensure that individuals applying herbicides are certified by the state for herbicide applications.	+			+	+	+	+	+		+	√
√	√	√	√	As authorized under an approved plan of operations, annually report the types and amounts of pesticide use to the park Superintendent (by January 30) of each year.											√
√	√	√	√	Perform a conformity determination during project planning to quantify level of expected air emissions.	√										
√	√	√	√	Do not burn vegetation, refuse, or other debris or wastes incidental to maintenance activities or oil/gas operation.	√				+					+	√
√				Minimize new surface disturbance by utilizing existing roads, and properly maintain all oil and gas access roads.		√	+	+	+	+	+	+	+	+	+
√				Use alternative construction methods, such as board roads, for temporary access to exploratory well locations.		√	+	+	+	+	+	+		+	
√				Use the minimum road design standard sufficient to carry anticipated traffic and loads with reasonable safety and with minimum environmental impact.		√	+	+	+	+	+	+			√
√				When possible, construct roads in drainage divides.		√	+			+					
√				Avoid constructing roads on clayey soils. If not possible, roads should trend perpendicular to contours when crossing clayey soils. In permeable soils, plan roads to run parallel to contours and design to enhance recharge.		√	+		+						
√				Crown or outslope the road surface to dissipate surface runoff and minimize erosion of the roadbed.		√	+	+	+	+	+	+			
√				Install drainage structures (ditches, culverts, cross drains, wing ditches, etc.) and bridges on roads to maintain hydrology of the site and adjoining wetlands, to protect aquatic life, and to allow for safe passage of wildlife.		+	√	+	+	√	√	+			√
√				Minimize the number of stream crossings along oil and gas access roads. Crossings should be perpendicular to the stream, resulting in less vegetation clearing than oblique crossings.		+	√	+	+	√	√	+			
√				Post appropriate signs on access roads to indicate speed limits, animal crossings, turnouts, blind curves, etc.							√	√		√	√
√	√			When possible, adding fill is preferable to grading and excavation to construct roadways, wellpads, berms, secondary containment, etc. All reasonable attempts should be made not to disrupt the hydrology of the site and adjoining wetlands.		√	+	+	+	+					
√	√			Conduct drilling operations during the dry season to avoid soil disturbance and compaction and disruption of water drainages caused by temporary access roads.		√	√	+	+	+					
√	√			Whenever possible, place access roads and wellpads on soil classes in hydrologic soil groups “A” and “B” and avoid or minimize placement of access roads and wellpads on soil classes in hydrologic soil groups “C” and “D.”		√	+	+	+	+					
	√			Consistent with safe operations, plan and conduct operations to minimize site disturbance. Site operation on elevated areas outside of floodplain and wetland areas and use the minimum size wellpad necessary to drill and produce well.	√	√	√	√	√	√	√	√	√	√	√
	√			Design wellpads to conform to the natural topography and other surface features of the area.		√	√							√	
	√			If properly sited for operations, use a single wellpad to directionally drill multiple wells.		√	√	+	√	+	+	+	+	√	
	√			Use portable wellpads (e.g., board locations) and skid-mounted equipment to minimize surface disturbance.		√	+	+	√	+	+	+			
	√			Avoid locating drilling/production pads on slopes greater than 3 percent to minimize soil disturbances and disruption of		√	+	+	+	+					

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	**DRILLING AND PRODUCTION OPERATIONS REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
				natural drainage patterns. Locating operations within the Preserve on slopes greater than 3 percent would not be permitted unless operator uses methods least damaging to resources while assuring protection of human health and safety.												
	√			Wellpads should not be located within a minimum buffer zone from all first order streams that are defined by an observable channel or swale. Note: Minimum buffer zone is determined by site specific analysis.			+	√	+	+	+	+	+			
	√			Establish minimum buffer strip between wellpad and access road for protection of recharge, water quality, and aesthetics. Note: Minimum buffer strip is determined by site specific analyses.				√	+	+	+				√	
	√			Construct a berm or ring levee around the drilling location. Install impermeable liners underneath the drilling rig and associated equipment including fuel storage and transfer areas. Install the liner to direct fluids to a collection point(s) for recycling or disposal.			+	√	+	+	+	+	+		√
	√			Secure drilling site to restrict public access with appropriate fencing, gate, security guard, or signs.							+	+		+	√
	√			Use containerized drilling mud system to minimize drilling mud volumes, drilling fluid wastes, and site disturbance. Earthen pits will not be permitted for nonfederal oil and gas operations inside the Preserve.			√	√	+	+	+	+		+	+
	√			Manage traffic to and from operation using two-way communications or other procedure. For drilling operations that run continuously, hire qualified security personnel to monitor egress and ingress to the drill site.										√	√
	√			Use an inside-diameter wiping tool for drillpipe to reduce loss of drilling fluids.			√	√							
	√			Maintain ample materials to increase drilling fluid density in an emergency situation. Install and maintain equipment capable of efficient, even delivery and mixing of drilling fluid weighting material.		+	+	+	+	+	+	+	+	+	+	√
	√			For wells that may encounter hydrogen sulfide gas, prepare a contingency plan that provides an organized approach for alerting and protecting the public within an area of exposure prior to release, intentional or otherwise, of a potentially harmful volume of hydrogen sulfide.							+	+		+	√
	√			Install, test, and maintain toxic gas detection equipment prior to reaching any formations suspected of containing toxic gases.							+	+		+	√
	√	√		Design, operate, and monitor drilling and production equipment and vehicles to minimize air emissions.		√			+	+	+	+		+	+
	√	√		Use fuels and control technologies that minimize release of air emissions from compressors, turbines, and other equipment.		√			+	+	+	+		+	+
	√	√		Prevent leaks and spills by practicing regular inspection and maintenance, good housekeeping, and in design of the operations.			√	√	+	+	+	+			√
	√	√		Use dust control techniques (such as watering roads) which do not adversely impact human health and safety, soils, ground and surface water quality, or other park resources.		√	√	+	+	+					√
	√	√		Reduce vehicle speed to minimize dust.		√		√	+	√	+	+	+			
	√	√		Flaring of gas from wells should be minimized. Such gases should be utilized for energy production with appropriate		√				+				√	√

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	**DRILLING AND PRODUCTION OPERATIONS REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	RESOURCES Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
				process and pollution controls applied to minimize air pollutant emissions.											
	√	√		Install and maintain catalytic converters on engines.	√									+	
	√	√		Use natural gas engines or electric engines instead of engines fueled by diesel or other fuels.	√									+	
	√	√		Maintain thief hatch seals on storage tanks to minimize the release of volatile organic compounds.	√									+	+
	√	√		When possible, use bulk drilling fluids, additives, and chemicals provided in reuseable containers to reduce solid waste generation from empty sacks or buckets.		√	√	+	+	+	+	+			+
	√	√		Use less volatile solvents and chemicals during operations. Properly store and label containers to prevent degradation, overflow, or contamination. Keep containers covered when not in use to decrease loss due to vaporization.	√	+	+	+	+	+	+	+			√
	√	√		Use nonhazardous products or less toxic substitutes whenever possible.		+	+	+	+	+	+	+			√
	√	√		Properly calibrate and operate monitoring equipment for hydrogen sulfide gas detection and warning.	√										√
	√	√		Stabilize wellpads to avoid or minimize erosion.		√	+	+	+	+	+	+	+	+	
	√	√		Use secondary containment (impermeable liner) around fuel, crude, and brine tanks, vessels, and under tank battery load-line connections to collect leaks, drips, and spills. Recommended impermeable liner thickness is 30 mil. Design secondary containment to eliminate or minimize collection of precipitation.		√	√	+	√	+	+	+		+	
	√	√		For drilling or workover operations, use a multi-layered or specialized impermeable liner system beneath the rig and associated equipment (including fuel and transfer areas). Use cellar as collection point for drilling fluid waste, rigwash, other fluids, etc.		√	√	+	√	+	+	+		+	
	√	√		Contain garbage in animal-proof containers before disposal at approved facilities.							√	x		+	
	√	√		Store sanitary wastes in approved, above ground septic tank or system before disposal at approved facilities.		+	√	+	+	+	+	+			√
	√	√		Use biodegradable, lead-free pipe dope whenever possible; avoid excessive use.		√	√								
	√	√		Carefully plan well completions to minimize production of sand and produced water.		√	√	+	√	+	+	+		+	
	√	√		Collect and reuse rigwash for subsequent rig maintenance, for initial washing of equipment, or as make-up water in drilling and completion operations.		√	√	+	√	+	+	+			
	√	√		Segregate or avoid mixing hazardous and nonhazardous chemicals to reduce the amount of hazardous waste for subsequent management.		√	√		+						√
	√	√		Contour and/or ditch around chemical, fuel, lubricant, and waste storage areas to a collection point that is separate from other rig equipment and not into the cellar.		√	√		+						
	√	√		Improve work process and properly maintain facilities and equipment to minimize stormwater contamination. Note: "Contaminated stormwater runoff" includes, but is not limited to runoff which: (1) contains a hazardous substance in excess of reporting quantities established at 40 CFR § 117.3 or 40 CFR § 302.4, (2) contains oil in excess of the reporting quantity established at 40 CFR § 110.3 (e.g., causes a visible sheen), or (3) contributes to a violation of a water		√	√	+	√	+	+	+		+	√

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	**DRILLING AND PRODUCTION OPERATIONS** **REQUIRED OPERATING STIPULATIONS** **AND** **RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
				quality standard.												
	√	√		Keep lighting to the minimum needed for safe operations. Design/use wellpad lighting only where necessary e.g., use low pressure sodium lights, downward directed lighting, and shield lights to prevent offsite glare.								√	√		√	
	√	√		Use appropriate sound-absorbing or sound-muffling equipment or materials such as electric motors, quiet design exhaust mufflers and acoustic covers on vehicles and equipment, and acoustically insulated buildings. Direct noise away from visitor use areas, adjacent landowners, and developed areas.								√	√		√	
	√	√		Install, test, and maintain pressure control equipment in proper working condition. Perform weekly pressure tests of the blowout prevention system.								√	√			√
	√	√		Construct and maintain firelane or firebreak along the perimeter of wellpads or production facilities. Use erosion control measures during firelane or firebreak construction and maintenance to mitigate the potential for site erosion.			√	√		√	+	√	√			x
	√	√		Do not drill a water supply well deeper than the surface casing in areas where abnormal pressures might be encountered.				√			+					+
	√	√		Divert stormwater from the wellsite by contouring, grading, berming, or trenching.			√	√	+	√	+	+	+			
	√	√		Protect usable quality aquifers by designing/implementing a surface casing and cementing program to place a properly designed cement slurry around a centered casing in a borehole of adequate size from which mud and mud cake has been removed. Specific measures include: -Cure any lost circulation problems prior to cementing. -Design hole size and casing size to provide a minimum of 1 inch clearance around pipe, but no more than 2 inches of clearance. -Implement a centralizer design (type and quantity) appropriate for hole conditions to achieve good casing centralization. When available, use borehole caliper information to place centralizers in locations where hole is in gauge. -Base mud circulation and conditioning on achieving hole stability rather than a specified volume. Condition mud to lower gel strength and viscosity. Proper hole conditioning is shown by a clean shaker, stable pump pressure and strokes at a constant throttle, and stable drag trends. -Reciprocate casing during hole conditioning and cementing. -Pump a preflush (water or engineered system depending on well conditions) in turbulent flow with enough volume to achieve 10 minutes contact time. Use fluid-loss additives as necessary to prevent preflush loss to high permeability zones. -Use lightweight or ultra-lightweight lead cement slurries if necessary to avoid lost circulation. -Design a large excess cement volume to account for uncertain annular volume and to improve mud removal efficiency. -Displace cement at maximum rate compatible with equipment and bottom-hole allowable pressure. -Prior to drilling out the surface casing shoe, verify surface casing integrity by pressure testing the surface casing as			+	√	+	+	+	+	+			+

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	**DRILLING AND PRODUCTION OPERATIONS** **REQUIRED OPERATING STIPULATIONS** **AND** **RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
				required by most state regulations and NPS standards as taken from Department of Interior Order No. 2, Section III. B.h. -After drilling between 10 and 20 feet of new formation, verify casing shoe integrity by testing the casing shoe to a minimum of the mud weight equivalent anticipated to control formation pressures at total depth.												
		√		Set storage tanks and other equipment on elevated and aerated base to prevent corrosion.			√	√	+	√	+	+	+			+
		√		Whenever possible, place workover wastes into production stream.			√	√	+	√	+	+	+			
		√		Use excess well completion, treatment, and stimulation fluids in other wells.			√	√	+	√	+	+	+			
		√		To reduce leakage from common points of friction and wear (e.g., stuffing box packing rubbers, valve stems), consider using magnetic ion coating technology.			√	√	+	√	+	+	+			
		√		Treat production streams with biocide or inhibitor to reduce sulfide formation.			√	√	+	√	+	+	+			+
		√		Paint production equipment to blend in with the surrounding environment. For facilities within the Preserve, the NPS must approve the selection of colors prior to the operator painting equipment and facilities.											√	
		√		Reduce and control paint overspray; use a brush for small painting jobs.			+	√		+						
		√		Replace mercury manometers or other instruments with mercury-free instruments.			√	√	+	√	+	+	+			√
		√		Use alternative methods to reduce sandblasting such as paint that does not require sandblast preparation, cathodic protection, or materials that do not need to be painted.			√	√		√						
		√		Design and maintain operation to reduce locations in the production system prone to NORM (Naturally Occurring Radioactive Materials) scale formation.			√	√		√						√
		√		Periodically monitor for accumulations of NORM or NORM-containing materials to minimize volume of NORM-contaminated waste requiring disposal.			√	√		√						√
		√		Store NORM-contaminated waste in aboveground tanks for proper disposal.			√	√		√						√
		√		Provide NORM management training for appropriate personnel of NORM-affected production facilities.												√
		√		Replace electrical equipment containing PCBs (polychlorinated biphenyls) with non-PCB containing equipment.			√	√		√						√
		√		Cover the top of all open vent stacks with a screen or cage to prevent injury to birds and wildlife.								√	√			
		√		Empty storage tanks and fill with water in preparation for a flood or hurricane.			√	√	+	√	+	+	+			√
		√	√	Install surface controlled subsurface safety valves on wells capable of natural flow.			√	√	+	√	+	+	+			√
		√	√	Provide for automatic shut-in of wells in response to pressure changes on the flowline to reduce spill volumes.			√	√	+	√	+	+	+			√
			√	Use only metal pipe for above-ground flowlines, gathering lines, and pipelines.			+	√	√	√	√	√	√			√
			√	Wherever possible, avoid or minimize flowlines, gathering lines, and pipelines crossing waterways, floodplains, and wetlands.			+	√	√	√	√	+	+		√	√

DRILLING AND PRODUCTION OPERATIONS
REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol. RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
			√	Where appropriate (i.e., based on site analysis), install flowlines or gathering lines via directional drilling underneath waterways, floodplains, wetlands, and Special Management Areas.		√	√	+	√	+	+	+		√	√
			√	Install flowlines, gathering lines, and pipelines adjacent to access roads to minimize surface disturbance. This strategy also provides easy access for pipeline maintenance or spill response.		√	√	+	√	+	+	+		√	√
			√	When possible, flowlines and gathering lines should parallel drainage divides. When pipelines must deviate from drainage divides, pipelines should trend perpendicular to contour lines.		√	√	+	√	+	+	+		√	√
			√	During placement of flowlines, gathering lines, and pipelines, avoid blocking or filling any natural drainage path.		+	√	+	+	+	+	+			
			√	Where pipelines are proposed to cross streams, assess the potential for site degradation (erosion) and stream migration and design and install pipeline to prevent exposure of the pipeline.		√	√	+	√	+				√	+
			√	Place impermeable plugs in soils where pipelines intersect waterways. Also place impermeable plugs in soils approximately every 1,000 feet across long, straight segments of pipelines to prevent water flow along the pipeline route.		√	√	+	√	+	+	+		√	
			√	Design, operate, and maintain leak detection monitoring and immediate remote shutdown of pipelines in the event of a leak or spill.		√	√	+	√	+	+	+			√
			√	To minimize spills, use block and check valves on pipeline segments that cross waterways, floodplains, and wetlands. Ensure integrity of pipeline joints, especially pipelines crossing these areas.		√	√	√	√	√	+	+			+
			√	Routinely maintain vegetation (trimming, cutting) along pipeline rights-of-way and routes to allow monitoring of pipelines and rapid access in the event of a leak or spill.		√	√	+	√	+	+	+			√
			√	At least annually, check thickness of pipeline to determine extent of internal corrosion.		√	√	+	√	+	+	+			√
			√	Maintain a program of regular visual, electric, magnetic, and/or acoustic inspections of pipelines to assess its integrity under worst case operating conditions of pressure and temperature. If warranted based on the inspection program, conduct mechanical integrity pressure tests in accordance with standard practices.		√	√	+	√	+	+	+			√
			√	Use “smart pig” or other devices to test pipe wall thickness or integrity to determine the need for further pressure testing or pipeline replacement.		√	√	+	√	+	+	+			√
			√	“Pig” and pre-clean pipelines prior to hydrotesting to reduce the toxicity of hydrotest water.		√	√	+	√	+	+	+			√
			√	For aboveground pipelines, partially rotate the lines to extend the life of the line from support contact wear and exposure of the upper half of the line.		√	√	+	√	+	+	+			√
			√	For aboveground lines, provide supports that minimize contact with the pipeline. Supports should not restrict thermal expansion and contraction of the line, be close enough to eliminate sag, and designed for maximum loading conditions.		√	√	+	√	+	+	+			√
			√	Before placing a new line in service or after replacing sections of an existing line, conduct hydrostatic test at pressure 1.5 times the maximum designed working pressure for the system. Pressure should be maintained for at least 8 hours.		√	√	+	√	+	+	+			√
			√	Minimize internal corrosion by keeping both product and pipeline free of water.		√	√	+	√	+	+	+			√

ROADS	DRILLING	PRODUCTION	FLOWLINES/PIPELINES	**DRILLING AND PRODUCTION OPERATIONS REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
			√	Maintain a good protective coating on pipe and joints at all times (both above and underground).			√	√	+	√	+	+	+			√
			√	For underground pipelines, use resistivity testing of soils to forecast external corrosion problems.			√	√	+	√	+	+	+			√
			√	Use cathodic protection for underground or submerged pipelines. Note: A typical cathodic protection system involves connecting the pipeline and a sacrificial anode to a direct current rectifier, thereby corroding the anode instead of the pipeline metal.			√	√	+	√	+	+	+			√
			√	Place and maintain warning signs at each public road crossing, railroad crossing, and trail; and in sufficient number along the remainder of each pipeline so that its location is accurately known. Post warning signs at intersections with roads and trails.											√	√

Table 2.22. Operating Stipulations and Mitigation Measures for Nonfederal Oil and Gas Well Plugging, Abandonment, and Site Reclamation

WELL PLUGGING, ABANDONMENT, AND SITE RECLAMATION **REQUIRED OPERATING STIPULATIONS** **AND** **RECOMMENDED MITIGATION MEASURES** The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.	**RESOURCES**	**Air Quality**	**Geologic Resources**	**Water (Surface and G.W.)**	**Floodplains**	**Vegetation**	**Wetlands**	**Fish and Wildlife**	**Species of Special Concern**	**Cultural Resources**	**Visitor Use and Experience**	**Human Health and Safety**
REQUIRED OPERATING STIPULATIONS - The applicable legal citation is noted in [parenthesis] after the stipulation.												
Reclamation actions must begin as soon as possible, and no later than 6 months following completion of operations, unless a longer period of time is authorized in writing by the Regional Director. [36 CFR § 9.39(a)]		√	√	√	√	√	√	√	√	√	√	√
Remove from the unit all aboveground structures, equipment, and roads used for operations, except for structures, equipment and roads that are to be used for continuing operations which are the subject of another approved plan of operations or of a plan which has been submitted for approval, or unless otherwise authorized by the Regional Director. [36 CFR § 9.39(a)(2)(i)]			+	+	+	+	+	+	+		√	
Remove all debris resulting from the operations. [36 CFR § 9.39(a)(2)(ii)]											√	
Remove or neutralize any contaminating substances. [36 CFR § 9.39(a)(2)(iii)]			√	√	+	+	+	+	+			
Plug and cap all nonproductive wells and fill dump holes, ditches and other excavations. [36 CFR § 9.39(a)(2)(iv)]											√	√
Restore topographic contours to reasonably conform to the contours that existed prior to initiation of operations. [36 CFR § 9.39(a)(2)(v)]			√	+	+	+	+	+	+		√	
Replace natural topsoil necessary for vegetative restoration. [36 CFR § 9.39(a)(2)(vi)] Topsoil brought in from outside of the Preserve shall be clean of non-native propagules.			+	+	+	√	+	+	+		+	
Re-establish native vegetative communities. [36 CFR § 9.39(a)(2)(vii)]			+	+	+	√	+	+	+		+	
Reclamation must provide for the safe movement of native wildlife, must re-establish native vegetative communities, the normal flow of surface and reasonable flow of subsurface waters, and must return the area to a condition that does not jeopardize visitor safety or public use of the unit. [36 CFR § 9.39(b)]			+	√	+	√	+	√	√		√	
When proposed operations cannot avoid direct and/or indirect impacts on wetlands, the operator shall compensate for direct and indirect impacts on to wetlands by restoring degraded or former wetland habitats. Wetland restoration must, at a minimum, provide for one-for-one (1:1) wetland function replacement (i.e., focus on no net loss of wetland functions, not just wetland acreage). Compensation shall be performed prior to or at the same time impacts associated with approved oil and gas operations occur. [EO 11990, NPS Procedural Manual 77-1 § 5.2 (C)]			+	+	+	+	√	+	+		+	
Plug wells to meet the requirements described in the "NPS well Plugging Guide for Nonfederal Oil and Gas Operations in the State of Texas" (see Appendix I).		√	√	√	√	√	√	√	√	√	√	√

WELL PLUGGING, ABANDONMENT, AND SITE RECLAMATION
REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES

The primary resource(s) that would be protected by the operating stipulation or mitigation measure are denoted by a √ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.

RESOURCES	Air Quality	Geologic Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	Species of Special Concern	Cultural Resources	Visitor Use and Experience	Human Health and Safety
Reclamation activities must re-establish natural functions of wetlands and floodplains. [NPS Procedural Manuals 77-1, 77-2]		+	+	√	√	√	+	+		+	
RECOMMENDED MITIGATION MEASURES											
When plugging wells within geomorphically active zones (e.g., the active meander belt of a river), set adequate surface plugs and cut casing below the expected lateral migration and water level changes of the stream channel to avoid future exposure of the surface plug.			+	+				+	+	+	√
Take necessary precautions to prevent oil, brine, chemicals, and other materials from reaching the ground during well plugging operations. Precautions include the use of plastic liners beneath the rig, pipe racks, and other equipment as necessary.		√	√	+	√	+	+	+			+
Collect all fluids and solids returned to the surface from the wellbore in metal tanks and dispose of them in an approved disposal facility outside of the Preserve.		√	√	+	+	+	+	+			+
Remove all fill material and recontour to natural grade. Soil surveys for the area can assure that the soil profile is re-established after the excavation is completed.		√	+	+	√	+	+	+	+	+	
Repair compacted soils by disking.		√	+	+	+	+	+	+		+	
Restore disturbed soils to original contours.		√	√	+	+	+	+	+		+	
Revegetate cut-and-fill slopes and use good civil engineering practices to maintain disturbed areas in a stable condition to avoid erosion and sedimentation.		√	√	+	√	+	+	+	+	+	
Compost or chip vegetation and use as soil supplement or mulch.		√	+	+	√	+	+	+		+	
Provide for natural succession of vegetative species (herbaceous species, then woody species) and to reduce chance of introduction of exotic plant species by seeding areas with native seed materials.				+	√	+	+	+			
Consider active revegetation and erosion control measures (i.e., reestablishing contours, seedbed preparation, planting seeds, planting or transplanting seedlings, adding mulch or other authorized materials to reduce the potential for erosion, etc.) if natural growth is unacceptable.		√	√	+	√	+	+	+		+	
Optimize survival of vegetation by planting during the fall and winter.		+	+	+	√	+	+	+			
Determine target percent cover for vegetation based on site (pre-operational) analysis. Reclamation of vegetation is acceptable if the canopy cover of native vegetation communities is at least 70 percent and sustained over at least 3 complete growing seasons. Canopy cover is defined as the vegetative cover above the soil surface that intercepts raindrops but does not contact the soil. For example, if the majority of the canopy is composed of grasses and forbs, then that would be the type of canopy used in estimating canopy cover.		+	+	+	√	+	+	+		+	

AFFECTED ENVIRONMENT

CHAPTER 3



CHAPTER 3
AFFECTED ENVIRONMENT

INTRODUCTION

The purpose of this chapter is to describe the resources in the Preserve that may be affected by the alternatives under consideration, and serve as the baseline environment by which to compare the potential effects of the alternatives. The resources or topics covered in this chapter, and Chapter 4, Environmental Consequences, are those that would potentially be affected by the implementation of any alternative considered in this Plan/EIS. These topics are:

- Nonfederal Oil and Gas Development
- Air Quality
- Geologic Resources
- Water Resources
- Floodplains
- Vegetation
- Wetlands
- Fish and Wildlife
- Species of Special Concern
- Cultural Resources
- Visitor Use and Experience
- Adjacent Land Uses and Resources

As described in the last portion of Chapter 1, the following topics were considered and evaluated, but not carried forward for more detailed analysis:

- Local and Regional Economies
- Park Operations for Fire and Facility Management
- Possible Conflicts Between the Proposed Action and Land Use Plans, Policies, or Controls
- Sustainability and Long-term Management, and Energy Requirements and Conservation Potential
- Environmental Justice
- Prime and Unique Farmlands

The description of resources in this chapter also provides a basis for developing the Performance Standards and Mitigation Measures described in Chapter 2, Parts II and III, which are common to all alternatives.

DESCRIPTION OF THE STUDY AREA

The Big Thicket area of East Texas originally covered approximately 3-½ million acres and is characterized by the diversity and beauty of its vegetation. Variations in geology, climate, soils, elevation and drainage have resulted in the biological diversity of the area. Land uses in the region, though benefiting the area economy, have reduced the Big Thicket to mere remnants of its former extent. The Preserve was established to assure the preservation, conservation, and protection of a portion of this once great forest complex.

The Big Thicket, often referred to as a “biological crossroads,” is a transition zone where southeastern swamps, eastern deciduous forest, central plains, pine savannas, and xeric (dry)

sandhills intersect. The area provides habitat for rare species and favors unusual combinations of plants and animals.

In recognition of this diversity, the Preserve was designated a Biosphere Reserve in 1978 by the United Nations Educational, Scientific, and Cultural Organization (UNESCO). It shares this distinction among 337 biosphere reserves in 85 countries worldwide. The biosphere reserve program (Man and the Biosphere Program) is based on the concept that it is possible to achieve a sustainable balance between the conservation of biological diversity, economic development, and maintenance of associated cultural values. The validity of this concept is tested, refined, demonstrated, and implemented in the Biosphere Reserves (United States Man and the Biosphere Program, 1994).

The study area includes Big Thicket National Preserve and extends approximately ½-mile outside of the Preserve boundaries to include directional wells sited outside Preserve boundaries. The Preserve contains 15 separate units, comprising 98,735 acres. Approximately 11percent of the total acreage (10,602 acres) is comprised of three units added to the Preserve in 1993. This Plan/EIS does not address the three units included in the Addition Act lands because these areas have not been acquired by the Federal Government and nonfederal oil and gas operations in these units are outside the scope of the 36 CFR 9B regulations. The 9B regulations are triggered when an operator accesses nonfederal minerals on or across federally-owned or controlled lands or waters in a park. When an operator or mineral owner can reach his/her private oil and gas right in a park without such access, the 36 CFR 9B regulations do not apply.

The 12 units of the Preserve covered in this Plan/EIS, lie in East Texas, north of Beaumont and northeast of Houston, and occupy portions of Hardin, Liberty, Orange, Jasper, Polk, Tyler and Jefferson Counties. A Region/Vicinity Map for Big Thicket National Preserve is provided in the Summary chapter, Figure S.1. The following table lists the acreage for each unit.

Table 3.1. Big Thicket National Preserve, Unit Acreages

Preserve Unit	Counties	Acreage
Beaumont Unit	Orange, Hardin, and Jefferson Counties	6,289.00 acres
Beech Creek Unit	Tyler County	5,097.00 acres
Big Sandy Creek Unit	Polk County	14,227.00 acres
Hickory Creek Savannah Unit	Tyler County	705.00 acres
Lance Rosier Unit	Hardin County	24,752.00 acres
Loblolly Unit	Liberty County	551.85 acres
Lower Neches River Corridor Unit	Hardin, Jasper, and Orange Counties	3,291.00 acres
Menard Creek Corridor Unit	Polk, Hardin, and Liberty Counties	3,999.00 acres
Neches Bottom and Jack Gore Baygall Unit	Hardin and Jasper Counties	13,712.00 acres
Pine Island-Little Pine Island Bayou Corridor Unit	Hardin and Jefferson Counties	2,209.21 acres
Turkey Creek Unit Administrative/Visitor Headquarters	Tyler and Hardin Counties	7,949.90 acres 28.10 acres
Upper Neches River Corridor Unit	Jasper, Tyler, and Hardin Counties	5,902.00 acres
Total Acquired Acreage for 12 units		88,132.21 acres
Units authorized by Public Law 103-46 (July 1, 1993). Surface estate has not been acquired.		
Big Sandy Corridor Unit	Hardin, Polk, and Tyler Counties	4,788.10 acres
Canyonlands Unit	Tyler County	1,704.06 acres
Village Creek Corridor Unit	Hardin County	4,109.36 acres
Additional Acreage Authorized		10,601.52 acres
Total Authorized Acreage		98,734.73 acres

Historically, the Big Thicket area was wilderness and remained undeveloped until the early 1800's, when the area gradually was opened to pioneer settlement. Evidence of some of this pioneer way of life still exists today. Logging and the railroad were evident in the 1880's and 1890's. Nearly all of the Big Thicket has been logged at least once over the last two centuries. Much of the land formerly in natural forests is managed today as productive timberland.

NONFEDERAL OIL AND GAS DEVELOPMENT

History of Oil and Gas Development in the Region

In 1866, Lynis T. Barrett of the Melrose Petroleum Company drilled the first productive oil and gas well in Texas. Early development of this field, the Nacogdoches Field, followed in 1887 and 1889 under B. F. Hitchcock of the Petroleum Prospecting Company. Development of the Nacogdoches Field contributed towards establishing many of the petroleum industry's firsts: the auger principle, later employed in the rotary rig; the first cable-tool rig; first lease; oil pipe line; wooden and iron storage tanks; iron drums for transporting crude oil; and the first refinery (Rister, 1949). In 1889, Pattilo Higgins, a young Beaumont man and self-taught geologist, postulated that an abundance of cheap fuel was available just south of Beaumont at Spindletop Hill. Convinced they would become wealthy, Higgins and partners formed the Gladys City Oil, Gas and Manufacturing Company to find oil and to use it to develop a model industrial city – Gladys City. The company started drilling on Spindletop in 1893, but with no success. They continued to look for hydrocarbons in 1895 and 1896, each time failing because of inadequate oilfield equipment.

During 1899, Captain Anthony B. Lucas, a mining engineer and salt dome prospector in Louisiana, leased land in southeast Texas from the Gladys City Oil, Gas and Manufacturing Company. Also convinced there was oil at Spindletop, he began drilling for oil. Lucas' first attempt failed, but on January 10, 1901, while drilling his second well at Spindletop, the famous Lucas gusher blew in. Oil sprayed over 100 feet above the derrick for nine days before the well was capped. As news of the discovery spread, thousands of sightseers, speculators, promoters, fortune seekers and "boomers" poured into the area.

By 1902, 285 active wells were operating at Spindletop and over 600 oil companies had been formed. Companies such as the Texas Company (Texaco), J.M. Guffey Petroleum Company (Gulf), Magnolia Petroleum Company (Mobil), and Sun Oil Company went on to become giants in the oil and gas industry. Although the first commercial oil well is located in Pennsylvania, and Russia could claim the first gushers, the vast quantities of oil at Spindletop made it possible to use oil as an inexpensive, lightweight and efficient fuel to propel the world into the twentieth century.

Spindletop boomed again in 1926 when oil was discovered through deeper drilling on the flanks of the salt dome. The Spindletop Field led others to search for similar oil traps in southeast Texas. Salt domes with vast oil reservoirs were discovered at Saratoga, Sour Lake, and Batson. Salt domes are formed by underground movement of salt at depths of several tens of thousands of feet. Hydrocarbons accumulate above and on the flanks of these subsurface salt structures. Approximately 60 percent of the Preserve lies within the Upper Gulf Coast Salt Basin. Ending near Houston, the basin generally encompasses the counties of Walker, San Jacinto, Polk, Tyler, Newton, Liberty, Hardin, Orange and Chambers (James W. Jones, pers. comm.).

Nonfederal Oil and Gas Development within the Preserve

Within the Preserve, all of the underlying oil and gas resources are non-federally owned. Most of the oil and gas resources are owned by private individuals or companies; but the oil and gas resources beneath the Neches River and navigable reaches of Pine Island Bayou are owned by the State of Texas. Leasing State-owned oil and gas is administered by the Texas General Land Office.

According to Preserve records, between 125 and 155 wells have been drilled within the boundaries of the Preserve. Most had been plugged and abandoned before the Preserve was established in 1974. During the period from 1982 to 1985, the NPS contracted a site inventory of these wells, wellpads and associated access roads and pipeline corridors. The inventory identified and described direct surface disturbance by area and type of operation and includes 125 wellpads, 15 miles of access roads, and 64 miles of pipelines.

Active Oil and Gas Operations. Currently, there are 9 nonfederal oil and gas surface operations in the Preserve with a total direct surface disturbance of 11 acres. These operations consist of 6 wells and associated production facilities, 1 saltwater disposal well, a flowline and tank battery associated with a well located outside the Preserve, and an access road associated with directional wells located outside the Preserve. Eight wells inside the Preserve have been plugged, with ongoing reclamation on 13.2 acres. In addition, 47 directional wells from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve have been issued 36 CFR § 9.32(e) exemption determinations. Of these, 33 wells have been drilled (as of 6/1/2005). In addition, 6 wells were directionally drilled from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve under an approved plan of operations. Current operations are shown below in Table 3.2. Figure 3.1 is a map showing nonfederal oil and gas development. Active, inactive, and abandoned yet unreclaimed nonfederal oil and gas sites in the Preserve, previous seismic surveys; and surface locations outside the Preserve for active directional wells are shown on this map.

Preserve resources, primarily soils, vegetation and water quality, have been affected by leaks and spills of oil and gas, and contaminating and hazardous substances. By utilizing secondary containment, good well maintenance programs, employing conscientious oil and gas employees, and thorough monitoring and enforcement by Preserve staff, the occurrence of leaks and spills at oil and gas sites has been greatly reduced. The primary resource concerns for seismic operations include rutting and compaction of soils, damage to vegetation from off-road vehicle use, and possible cratering and blowouts from the detonation of explosives in seismic shotholes. By utilizing narrow, light-weight vehicles or hand-held drilling equipment, and planning for proper charge size in shotholes, these concerns can be substantially reduced or avoided.

Table 3.2. Nonfederal Oil and Gas Operations

(Operations are organized by Unit and Completion Date.)

No.	Operator	Well Name	Completion Date	36 CFR 9B Compliance Date	Remarks
Beaumont					
1.	Ballard Exploration Co., Inc.	Vastar #1-A	1996	6/5/96	Directional well and production operation located outside Preserve
2.	Ballard Exploration Co., Inc.	Exxon #1	1996	9/9/96	Directional well located outside Preserve on common pad with Vastar #1-A well
3.	Ballard Exploration Co., Inc.	Vastar #2-A	1996	10/17/96	Directional well located outside Preserve on common pad with production facilities for Vastar #1-A well

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No.	Operator	Well Name	Completion Date	36 CFR 9B Compliance Date	Remarks
Big Sandy Creek					
4.	Burton Exploration Co.	Kirby #3	1986	09/12/86	Directional well and production operation located outside Preserve
5.	Comstock Oil and Gas, Inc.	Hamman #1	2002	9/5/01	Directional well and production operation located outside Preserve
6.	Comstock Oil and Gas, Inc.	Hamman #2	2003	5/2/03	Directional well and production operation located outside Preserve
7.	Comstock Oil and Gas, Inc.	Collins #2	2004	6/23/03	Directional well and production operation located outside Preserve on common pad with Collins #1 well
8.	Comstock Oil and Gas, Inc.	Collins #3	2004	9/16/04	Directional well and production operation located outside Preserve
9.	Comstock Oil and Gas, Inc.	BSMC Unit D #1	Proposed 2004/2005	11/8/04	Proposed directional well and production operation located outside Preserve
Jack Gore Baygall					
10.	Murphy Exploration and Production Co.	L.L. Williams #2	1952	8/6/91, revised 5/31/95	Well plugged 11/18/1995; reclamation of 1.5 acres ongoing
11.	Merit Energy Co.	James Rafferty Fee #1	1954	9/22/03	Well plugged 5/1/01; reclamation of 2.1 acres ongoing
12.	Premium Exploration Co.	James Rafferty Fee #3	1954	Not in compliance	Transfer on 9/1/98 of existing operations on 1.1 acres inside Preserve. Oil well converted to saltwater injection well in 1977.
13.	Merit Energy Co.	James Rafferty Fee #1-N	1954	9/22/03	Well plugged 4/21/01; reclamation of 1.4 acres ongoing
14.	Merit Energy Co.	James Rafferty Fee #7	1955	9/22/03	Well plugged 4/19/01; reclamation of 1.9 acres ongoing
15.	Buford Curtis, Inc.	James Rafferty Fee #1	1956	10/23/02	Well plugged 12/2/02. Plan of operations required for reclamation on 1.5 acres
16.	Premium Exploration Co.	ARCO Rafferty #1A	1976	Not in compliance	Transfer on 9/1/98 of existing well and production operations on 1.9 acres inside Preserve
17.	Merit Energy Co.	M. J. Cunningham #5	1976	9/22/03	Well plugged 4/10/01; reclamation of 1.2 acres ongoing
18.	Richman Petroleum Corp.	Doty-Jackson Unit #A-1	1985	7/24/03	Well and production operation located inside Preserve on common pad with Omega Energy Corp. Tanton #1 well and production site on 1.5 acres
19.	Omega Energy Corp.	Tanton #1	1997	6/12/02	Directional well and production operation located inside Preserve on common pad with Richman Petroleum Corp. well and production site on 1.5 acres
20.	Davis Bros. Oil Producers, Inc.	Vastar-Johnson #1	2002	5/28/02	Directional well and production operation located outside Preserve
21.	Davis Bros. Oil	Kiamu-Johnson #1	2003	10/4/02	Directional well located outside Preserve on common pad with Vastar-Johnson #1

No.	Operator	Well Name	Completion Date	36 CFR 9B Compliance Date	Remarks
	Producers, Inc.				well
22.	Davis Bros. Oil Producers, Inc.	Cowden-Johnson #1	2003	6/2/03	Directional well located outside Preserve on common pad with Vastar-Johnson #1 well
23.	Davis Bros. Oil Producers, Inc.	Johnson-Elene #1	2004	4/16/04	Directional well located outside Preserve on common pad with Vastar-Johnson #1 well
24.	Davis Bros. Oil Producers, Inc.	Nelson-Allie #1	2005	4/16/04	Directional well and production operation located outside Preserve
25.	Davis Bros. Oil Producers, Inc.	Nelson-Kate STK #1	2005	4/16/04	Directional well located outside Preserve on common pad with Nelson-Allie #1
26.	Union Gas Operating Co.	BP Rafferty A-45 #1	2005	6/1/05	Directional well and production operation located outside Preserve
27.	Davis Bros. Oil Producers, Inc.	Johnson-Hayden #1	Proposed 2004/2005	4/16/04	Proposed directional well and production operation located outside Preserve
28.	Davis Bros. Oil Producers, Inc.	Johnson-Reese #1	Proposed 2004/2005	4/16/04	Proposed directional well located outside Preserve on common pad with Johnson-Hayden #1 well
29.	Davis Bros. Oil Producers, Inc.	Johnson-Whitman #1	Proposed 2004/2005	4/16/04	Proposed directional well located outside Preserve on common pad with Johnson-Hayden #1 well
30.	Davis Bros. Oil Producers, Inc.	Nelson-Emmie #1	Proposed 2004/2005	4/16/04	Proposed directional well located outside Preserve on common pad with Nelson-Allie #1 well
31.	Davis Bros. Oil Producers, Inc.	Nelson-Lynn #1	Proposed 2004/2005	4/16/04	Proposed directional well located outside Preserve on common pad with Nelson-Allie #1 well
32.	Davis Bros. Oil Producers, Inc.	Nelson-Lance #1	Proposed 2004/2005	4/16/04	Proposed directional well located outside Preserve on common pad with Nelson-Allie #1 well
33.	Davis Bros. Oil Producers, Inc.	Nelson-Pidgeon #1	Proposed 2004/2005	4/16/04	Proposed directional well located outside Preserve on common pad with Nelson-Allie #1 well
34.	Union Gas Operating Co.	Bertrand-Nelson #1	Proposed 2005	6/1/05	Proposed directional well and production operation located outside Preserve
35.	Union Gas Operating Co.	BP Rafferty A-45 #2	Proposed 2005	6/1/05	Proposed directional well located outside Preserve on common pad with Union's BP Rafferty A-45 #1
36.	Union Gas Operating Co.	BP Rafferty A-45 #3	Proposed 2005	6/1/05	Proposed directional well located outside Preserve on common pad with Union's BP Rafferty A-45 #1
Lance Rosier					
37.	Caskids Operating	W.R. Carr #1	1983	9/20/94	Well plugged 12/19/95; reclamation of 1.5 acres ongoing

No.	Operator	Well Name	Completion Date	36 CFR 9B Compliance Date	Remarks
	Co.				
38.	COBRA Oil and Gas Corporation	Quinn 2-84 #2	2001	03/12/01	Directional well and production operation located outside Preserve. Well plugged 4/10/2003. Re-drilled in June 2003 and in production since.
Lower Neches River Corridor					
39.	Davis Southern Operating Co.	P.C. Bernal #1	2004	7/14/2004	Directional well located outside Preserve drilled as re-entry into the Duncan Energy Company's P.C. #1 Bernal well. To be P&A'd.
40.	Davis Southern Operating Co.	P.C. Bernal #2	Proposed 2004/2005	7/14/04	Proposed directional well located outside Preserve to be drilled on common pad with P.C. Bernal #1 well
41.	Davis Southern Operating Co.	P.C. Bernal #3	Proposed 2004/2005	7/14/04	Proposed directional well located outside Preserve to be drilled on common pad with P.C. Bernal #2 well
42.	Davis Southern Operating Co.	P.C. Bernal #4	Proposed 2004/2005	7/14/04	Proposed directional well located outside Preserve to be drilled on common pad with P.C. Bernal #3 well
Neches Bottom					
43.	Westport Oil and Gas Co.	Hankamer #1-A	1985	5/7/03	Directional well and production operation that includes the Hankamer #1-B saltwater injection well located outside Preserve. Access road through Preserve on 1.2 acres
44.	Westport Oil and Gas Co.	Hankamer #2	1985	5/7/03	Directional well on common pad with Hankamer #1-A outside Preserve
45.	Westport Oil and Gas Co.	Hankamer #3	1985	5/7/03	Directional well located outside Preserve on common pad with Hankamer #1-A well
46.	Westport Oil and Gas Co.	Hankamer #4	1987	5/7/03	Directional well located outside Preserve on common pad with Hankamer #1-A well
47.	C&E Operating, Inc.	Hankammer Well #1	Proposed 2005	5/10/05	Proposed directional well and production operation located outside Preserve
Pine Island-Little Pine Island Bayou Water Corridor					
48.	Penwell Energy, Inc.	Vastar Fee #2	1996	9/26/96	Directional well and production operation located outside Preserve
49.	Penwell Energy, Inc.	Vastar-Pica Unit #1	2002	11/29/01	Directional well and production operation located outside Preserve on common pad with Vastar Fee #3 well
50.	Century Resources Land, LLC	Black Stone Minerals #3	2003	1/14/03	Directional well outside Preserve located on common pad with Black Stone Minerals #1 well
Turkey Creek					
51.	Milestone Operating, Inc.	William M. Rice Institute B-5	1953	10/9/90	Active well on 1.4 acres
52.	Austral Oil Company, Inc.	Campbell #2	1958	5/26/05	Well located outside Preserve. Produced fluids to flowline and tank battery located inside Preserve.
53.	Austral Oil Company, Inc.	Campbell #3	1959	5/26/05	Suspended well inside Preserve on 0.7 acres
54.	Austral Oil Company, Inc.	Campbell #4	1959	5/26/05	Inactive well inside Preserve on 3.2 acres.

No.	Operator	Well Name	Completion Date	36 CFR 9B Compliance Date	Remarks
55.	Hanson Production Co.	Vastar Fee #307-2	1995	12/20/94	Directional well and production operation located outside Preserve on common pad with Vastar #307-1 well
56.	Hanson Production Co.	Mann Fee #307-1	1997	12/13/95	Dry hole/well plugged on 3/17/97; reclamation of 2.1 acres ongoing

Plugged and Abandoned Oil and Gas Wells. There are approximately 110 plugged and abandoned wells in the Preserve. The acreage directly affected by these well sites or pads totals 211 acres; associated access roads directly disturb another 164.7 acres. Most of the disturbance is located in the Lance Rosier (75 wells), Neches Bottom/Jack Gore Baygall (33 wells), and Turkey Creek (15 wells) Units. Nearly all of these operations were undertaken prior to establishment of the Preserve.

The nature and extent of impacts identified at these sites is limited to the information collected during the 1980's inventory. In general, the NPS documented debris, fill, pits or evidence of pits, and berms. Debris was observed on 60 wellpads and pits or evidence of pits on 71 pads. Debris, found on both wellpads and access roads, included pipe, cable, drums, drilling equipment, pipe racks, fence, and household garbage. Pits, used for a variety of purposes, may have contained saltwater, drilling fluid, cuttings, hydrocarbons, wash water for cleaning drill pipe and other equipment, and other oil and gas wastes. At two of the well sites, the NPS has documented contamination by saltwater, heavy metals, and hydrocarbons.

An estimated 20 of the plugged and abandoned wells are located within the 100-year floodplain and the active meander belt of the Neches River, and could become exposed due to river meandering or migration. Presently, two of the wells are located in the Neches River, approximately 40 feet from the eastern bank. Removal of the well casings in these wells and setting the surface plug to a depth of 50 feet below the surface to meet NPS requirements remains problematic due to engineering, logistical, and financial constraints. Both wells are marked with solar powered warning lights.

On nearly all of these sites, soil and water contamination has not been assessed to determine if any contaminants pose an unacceptable risk to human health and the environment. In fiscal year 2002, the Preserve received funding to investigate soil contamination on 4 abandoned sites. Preliminary review of these data indicates that these sites need to be delineated and characterized before mitigation requirements can be determined. At 3 of the sites, total petroleum hydrocarbon (TPH) levels exceeded State of Texas standards. Metals were detected, and lead concentrations exceeded State standards at all 4 sites. Antimony, chromium, and cadmium exceeded State standards at 2 sites. The Preserve has requested funding to further delineate and characterize contamination on these and additional sites.

Figure 3.1. Nonfederal Oil and Gas Development

Historic Saltwater Disposal Area. Historically, saltwater or brine and other oil and gas wastes from the salt dome area near Saratoga were transported and impounded near Little Pine Island Bayou. Today, the lower end of the impoundment area and containment levees occupies approximately 80 acres within the Lance Rosier Unit. Although most of the impoundment area is outside the Preserve, surface and subsurface water flows across and through the Unit. Elevated chloride levels in the bayou and Pine Island Bayou watershed are partially attributed to oil field brine.

Deleted: exceeded State standards at all 4 sites. Antimony, chromium, and cadmium exceeded State standards at 2 sites. The Preserve has requested funding to further delineate and characterize contamination on these and additional sites. ¶
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Geophysical Exploration. Geophysical exploration has been conducted within the Preserve since the early 1940's (Peyton Weems, pers. comm.). Three methods of exploration have occurred: cable-only seismic surveys; traditional two-dimensional (2-D) and three-dimensional (3-D) shot-hole seismic surveys; and mini-hole 2-D and 3-D seismic surveys. At least 85 cable-only seismic surveys have been conducted in the Preserve. Cable-only surveys within the Preserve are conducted on foot and involve cutting a minimal amount of vegetation for line-of-sight survey and placement of cables or receivers. Within the Preserve, survey lines have varied in length from a few hundred feet to 8,000 feet.

Traditional 2-D shot-hole operations and 3-D mini-hole operations have been conducted in 6 units since June 1981 (Table 3.3). The traditional shot-hole method involves drilling a single hole per shot-hole location, placing an explosive charge at the bottom of each hole, refilling the hole with cuttings, and detonating each charge to create sound waves. Traditional 2-D shot-hole operations were drilled using tandem buggy mounted equipment. Drill and water buggies are high clearance, four-wheel drive vehicles, and typically weigh 12,000 to 18,000 lbs. Between 1981 and 1987, approximately 46 miles of seismic lines were drilled using this type of equipment.

Since 1984, 2-D and 3-D mini-hole seismic operations have been conducted within the Preserve using all-terrain vehicle mounted equipment, portable "rickshaw" drills, hand portable drills, and boats. Most 2-D mini-hole operations have involved drilling holes 5 to 10 feet deep in a straight line or star-shaped pattern. The number of shotholes per source point or shot-hole location was typically 5 to 7. Shot points were generally spaced 220 to 440 feet apart. Explosive charges placed in each shothole averaged ½-pound (range: 5 oz. to 1 pound). Both shotholes and cables were placed along the same line. Average line width was 3.5 feet.

Two-dimensional (2-D) seismic surveys create an image of the subsurface along a vertical plane, directly below the seismic line. If the subsurface beds dip at an angle to the orientation of the 2-D line, then the image obtained may be inaccurate and not directly below the surface of the line. The end result may be a targeted area actually several hundred feet away from the location identified on the image. The 2-D image also requires that the interpreter determine the subsurface geology between 2-D lines with limited indirect data. Such data limitations may result in the need for additional 2-D programs to fill any data gaps. Approximately 13 miles of 2-D (mini-holes) lines crossed the Preserve from 1984 to 1991.

In contrast, 3-D seismic surveys cover a larger surface area and generate a three-dimensional image of the subsurface. Three-dimensional seismic data help the oil and gas industry to more accurately locate subsurface structures that may contain oil and gas accumulations. Four 3-D mini-hole operations, covering approximately 50 square miles or 40 percent of the Preserve, have been conducted from July 1998 to September 1999. Operations were conducted primarily on foot and by boat using portable drills. On average, ½-pound charges were used in holes from 5 to 10 feet deep. Shothole spacing ranged from 110 to 440 feet between points. Distances between source and receiver lines ranged from 880 to 2400 feet for both lines. Width line averaged 3.5 feet.

In 2004, one 3-D seismic survey was conducted in the Big Sandy Creek, Menard Creek Corridor and Hickory Creek Savannah Units using both shot-hole and cable-only methods. Shotholes were generally spaced 220 feet apart; spacing between both shot lines and receiver lines was 1,760 feet. Using lightweight drilling equipment, shotholes were drilled to 80 feet and 5.5-pound explosives were placed at the bottom of each hole. Shotholes were primarily located in the Big Sandy Unit.

Table 3.3. Two-and Three-Dimensional Seismic Surveys
(Operations are organized by Unit and Permit Date.)

Operator	Line ID	Type	No. of Shothole Locations	Avg. Depth (Feet)	Permit Date	Total Line Length (Feet)	Area of Survey (mi^2)
Beaumont Unit							
Minerals Search, Inc.	1	2-D	205	120	09/23/83	6,600	N/A*
Western Geophysical	83-13	2-D	70	10	06/18/84	7,000	N/A
Western Geophysical	83-14	2-D	55	10	06/18/84	5,400	N/A
Inland Geophysical Services	I/W #3	2-D	126	5	04/08/91	27,710	N/A
Inland Geophysical Services	I/W #21	2-D	57	5	04/08/91	12,430	N/A
Continental Geophysical	N/A	3-D	588	10	07/15/98	N/A	9 mi^2
Spirit Energy	N/A	3-D	470	5	07/30/98	N/A	6 mi^2
Big Sandy Creek Unit							
Arco	1	2-D	144	100	12/08/81	32,000	N/A
Arco	2	2-D	135	100	12/08/81	30,000	N/A
Arco	1	2-D	122	100	06/23/83	15,000	N/A
Seismic Assistants, Ltd.	N/A	3-D	1,860	80	01/23/04	N/A	22 mi^2
Lance Rosier Unit							
Ladd	1	2-D	50	80	06/03/81	30,000	N/A
Seis Pros Inc	2	2-D	78	120	06/09/82	10,700	N/A
Seis Pros Inc	3	2-D	107	120	06/09/82	19,500	N/A
Seis Pros Inc	5	2-D	111	120	06/09/82	21,120	N/A
Geo Seismic Services	2	2-D	29	100	06/14/82	6,300	N/A
Geo Seismic Services	5	2-D	82	100	06/14/82	10,700	N/A
Amoco	A	2-D	35	150	12/16/87	15,400	N/A
Amoco	B	2-D	7	150	12/16/87	2,800	N/A
Amoco	C	2-D	14	150	12/16/87	5,600	N/A
Frontier Geophysical	659312	2-D	227	5	03/03/89	8,000	N/A
Frontier Geophysical	658313	2-D	235	5	03/03/89	8,300	N/A
Cobra Exploration Company	N/A	3-D	1,303	10	6/1/99	N/A	18 mi^2
Menard Creek Unit							
Texaco, Inc	24	2-D	2	Unknown	11/08/78	1,500	N/A
Neches Bottom and Jack Gore Baygall Unit and Lower Neches River Corridor Units							
Arco	1	2-D	65	120-160	06/09/83	14,000	N/A
Shell Oil Company	1	2-D	145	120	06/17/83	22,000	N/A
Seismic Exchange, Inc.	N/A	3-D	1,083	6	01/15/99	N/A	22 mi^2

* N/A - Not Applicable

Existing Transpark Oil and Gas Pipelines and Associated Rights-of-Way. There are 71 oil and gas pipeline segments crossing units of the Preserve within rights-of-way totaling 101 miles of pipelines, and occupying approximately 589 acres. These rights-of-way existed prior to establishment of the Preserve, and acquisition of the surface estate was made subject to these encumbrances. Rights-of-way widths are variable and range from 30 to 150 feet.

Pipelines are used to transport saltwater, crude oil, natural gas, liquid petroleum gas and natural gas liquids within or through the Preserve, and may or may not be associated with nonfederal oil and gas rights within the Preserve. New rights-of-way for a limited number of purposes, such as public

utilities, may be permitted under NPS regulations at 36 CFR Part 14. However, pipeline rights-of-way in any park unit may be granted only under specific legislative authority from Congress. At present, no statutory authority exists for granting new trans-park oil and gas rights-of-way within the Preserve. Table 3.4 lists the pipelines crossing units of the Preserve. Several pipelines cross more than one unit. There are no pipelines crossing the Loblolly or Beach Creek Units.

Table 3.4. Existing Transpark Oil and Gas Pipelines within Big Thicket National Preserve

(Pipelines are organized by Unit and Preserve Identifier.)

No.	Operator	Product	Preserve Identifier[1]	Size of Pipeline (Inches)	Date Constructed
Beaumont					
1.	Centana Intrastate Pipeline LLC	Natural Gas	B-2	1-6”	1959
2.	Houston Pipe Line Company	Not in Service	B-3	1-6”	1961
Big Sandy Creek					
3. 4. 5.	Tennessee Gas Pipeline Company	Natural Gas	BS-1	1-24” 1-31” 1-30”	1944 1949 1952
6. 7.	El Paso Field Service LP	Natural Gas	BS-2	1-4” 1-3”	1983-1984 1996
Hickory Creek Savannah					
8.	El Paso Field Services	Natural Gas	HC-1	1-8”	1949
9.	Houston Pipe Line Company	Not in Service	HC-4	1-6”	1949
10.	Energy Transfer Company	Natural Gas	HC-5	1-10”	1929-1930
11.	Tennessee Gas Pipeline Company	Not in Service	HC-6	N/A	
Jack Gore Baygall/Neches Bottom					
12.	El Paso Field Services	Natural Gas	JG-1	1-4”	1945
13.	El Paso Field Services	Natural Gas	JG-2	1-4”	1949
14.	Lion Oil Company	Crude Oil	JG-3	1-10”	1932
15.	El Paso Field Services	Natural Gas	JG-4	1-8”	1961
16.	Oxy Petroleum Company	Not in Service	JG-5	1-2 1/2	1954
17.	Black Lake Pipeline	NGL	JG-6	1-8”	1967
18.	El Paso Field Services	Natural Gas	JG-7	1-6”	Unknown
19.	El Paso Field Services	Natural Gas	JG-8	1-8”	Unknown
Lance Rosier					
20.	Black Lake Pipeline	NGL	LR-1	1-8”	1967
21.	Sunoco Pipeline LP	Crude Oil	LR-2	1-6”	1950
22.	Black Hills Operating Co., LLC	Crude Oil	LR-3	1-12”	1930s
23.	Chevron Pipe Line Company	Empty	LR-4	1-12”	1931
24.	Sunoco Pipeline LP	Crude Oil	LR-5	1-10”	1931
25.	Mobil Pipe Line Company	Crude Oil	LR-6	1-20”	1954
26. 27.	Kinder Morgan Texas Pipeline, LP	Natural Gas	LR-7	1-18” 1-20”	1954
27.	Sunoco Pipeline LP	Crude Oil	LR-8	1-6”	1950
28.	Chevron Pipe Line Company	Not in Service	LR-9	1-12”	Late 1920s
29.	Sunoco Pipeline LP	Crude Oil	LR-10	1-26”	1953
30.	Sunoco Pipeline LP	Not in Service	LR-11	1-6”	1952
31.	SETEX Oil and Gas Company	Not in Service	LR-12	1-4”	1952
33.	Big Thicket Pipe Line LLC	Natural Gas	LR-13	1-6”	2000
Lower Neches River Corridor					
34. 35.	Trunkline Gas Company	Natural Gas	LN-1	2-24”	1950 & 1966
36.	Gulf State Pipe Line Co., Inc.	Naptha	LN-2	1-8”	1974
37.	Transcontinental Gas Pipe Line Corporation	Natural Gas	LN-3	1-30”	1949
38.	Houston Pipe Line Company	Natural Gas	LN-4	1-8”	1961
39.	Lion Oil Company	Crude Oil	LN-5	1-10”	1932

No.	Operator	Product	Preserve Identifier[1]	Size of Pipeline (Inches)	Date Constructed
40.	Houston Pipe Line Company	Natural Gas	LN-6	1-30”	1974
Menard Creek Corridor					
41.	Mobil Pipe Line Company	Crude Oil	MC-1	1-20”	1954
42. 43.	Kinder Morgan Texas Pipeline, LP	Natural Gas	MC-2	1-18” 1-20”	1954
44.	Sunoco Pipeline LP	Crude Oil	MC-3	1-26”	1953
45. 46 47. 48.	Chevron Pipeline Company	Not in Service LPG	MC-4	2-14” 2-10”	1957 1970
49.	Louis Dreyfus Pipeline LP	NGL	MC -5	1-12”	1971
50.	TE Products Pipeline Co LP	NGL	MC-6	1-10”	1993
51.	Mustang Pipeline Company	HVL	MC-7	1-10”	1995
Pine Island Bayou-Little Pine Island Bayou Corridor					
52.	Unocal Corporation	Crude Oil	PI-1	1-10”	1929-1930
53. 54.	Kinder Morgan Texas Pipeline, LP	Natural Gas	PI-2	1-18” 1-20”	1954
55.	Mobil Pipe Line Company	Crude Oil	PI-3	1-20”	1954
56.	Link Energy Texas LLC	Crude Oil	PI-4	1-8”	1930’s
57.	Transcontinental Gas Pipe Line Corporation	Natural Gas	PI-5	1-30”	1949
58.	Houston Pipe Line Company	Natural Gas	PI-6	1-12”	1959
59.	Transcontinental Gas Pipe Line Corporation	Natural Gas	PI-7	1-10”	1949-1950
60.	Houston Pipe Line Company	Natural Gas	PI-8	1-4”	1981
61.	El Paso Field Services	Natural Gas	PI-9	1-8”	Unknown
62.	Kinder Morgan Texas Pipeline, LP	Natural Gas	PI-10	1-4”	1929
Turkey Creek					
63.	Houston Pipe Line Company	Natural Gas	TC-1	1-4”	1968
64.	Houston Pipe Line Company	Natural Gas	TC-2	1-10”	1952
65. 66.	Enterprise Products Operating LP	Natural Gas Not in Service	TC-3	1-6” 1-6”	1956
67. 68.	El Paso Field Services	Not in Service	TC-4	2-4”	1956
69.	Driscoll	Natural Gas	TC-5	1-2”	1977
70.	El Paso Field Services	Natural Gas	TC-6	1-8”	1978
Upper Neches River Corridor					
71.	Black Lake Pipeline	NGL	JG-6	1-8”	1967

[1]**Preserve Identifier:**

B	= Beaumont Unit	LR	= Lance Rosier Unit
BS	= Big Sandy Creek Unit	MC	= Menard Creek Corridor Unit
HC	= Hickory Creek Savannah Unit	PI	= Pine Island Bayou-Little Pine Island Corridor Unit
JG	= Jack Gore Baygall Unit	TC	= Turkey Creek Unit
LN	= Lower Neches River Corridor Unit	UN	= Upper Neches River Corridor Unit

Natural gas, crude oil, liquid petroleum gas (LPG), natural gas liquids (NGL), and refined products (gasolines, diesels, heating oil, and jet fuels) are transported in pipelines. Natural gas is composed mostly of methane, with lesser portions of ethane and propane. Although nearly odorless as it comes from the well or production facility, its characteristics depend on the reservoir from which it is produced. As described in this document, “gas” means natural gas, flammable gas, or gas which is toxic or corrosive. Crude oil is a black or dark brown mixture of hydrocarbons, with relatively small quantities of oxygen, nitrogen, sulfur, salt, water, and trace amounts of certain metals. Similarly, the characteristics of crude oil are dependent on the reservoir. LPG and NGL are referred to as liquefied hydrocarbons and considered highly volatile. They are gases under atmospheric conditions and liquids under pressure (The Pipeline Group, 1995). All categories of hydrocarbons except refined products are transported through the Preserve.

Transpark pipeline rights-of-way are maintained by their owners/operators. Routine maintenance consists of trimming and pruning overhanging tree limbs and mowing within the right-of-way. Removal and maintenance of vegetation is necessary for initial construction of the pipeline, for long-term access to conduct routine maintenance and monitoring, and for rapid response in the event of a rupture or spill.

Hunters commonly use right-of-way corridors during the Preserve's hunting season. Given the rural nature of the area and adjacent land uses, these open corridors may be conduits for unauthorized access on or across Preserve lands. Similarly, these corridors have resulted in the loss of wildlife habitat for some wildlife species, while improving habitat for others.

Pipelines may pose a significant threat to park resources and values if not properly managed and maintained. Given the water-dominated nature of the Preserve, pipeline leaks and spills could considerably harm water quality, aquatic habitat, aquatic life, and adversely impact public use of the Preserve. Although any of the Preserve's water corridors could be affected, the Neches River, because of its size, may represent the greatest flood hazard to oil and gas facilities and be most at risk of pipeline spill or fire catastrophe (Harcombe and Callaway, 1997).

It should be noted that the entire Preserve is a sensitive area, as defined by the Railroad Commission of Texas (Statewide Rule 91). Factors that are characteristic of sensitive areas include the presence of shallow ground water or pathways for communication with deeper groundwater, and proximity to surface water, including lakes, rivers, streams, dry or flowing creeks, irrigation canals, stock tanks, and wetlands. A preliminary assessment of the vulnerability of groundwater to pollution within the Preserve indicates the entire Preserve would be moderately to very vulnerable to pollution from both agricultural and industrial sources (Allen 1999).

Pipeline Incidents. Both the petroleum industry and the regulatory community are aware of the potential for pipeline failures from outside forces, corrosion, operator error, failed pipe, equipment malfunction, failed weld, and other causes of pipeline failure. Despite these problems, industry and federal safety officials believe that underground pipelines are the safest mode of transportation. Accidents are relatively few, given that half of the nation's hazardous liquids move through them (Houston Chronicle, 1997). Natural forces, including excavation activity, are the leading cause of hazardous liquid pipeline failures. Outside forces account for the following incidents.

In 1993, pipeline LN-3 became exposed due to migration of the Neches River. A new segment was installed via directional drilling in 1994, and the abandoned segment was subsequently removed. Reclamation of the easement (approximately 3 acres) continues and has remained difficult due to drought, flooding, herbivory, site disturbance, and the presence of the invasive Chinese tallowtree.

Adjacent to the Menard Creek Unit, an active 10-inch NGL line was damaged during installation of another pipeline within the same right-of-way in March of 1997. This event caused the contents to volatilize, creating dangerously low oxygen conditions that initially delayed emergency responses. Over 250 people were evacuated from a 50-acre area near the Polk/Liberty County line. Evacuation was further complicated by flooding in a nearby subdivision, requiring evacuation of residents by boat. Approximately 80 gallons of oil combined with soil, drilling mud and road materials flowed approximately 1,000 feet down Menard Creek. As a result of aggressive cleanup efforts by the responsible party, surface water samples taken within the Preserve showed contaminant levels were well below all aquatic life standards and below almost all aquatic life and wildlife criteria. However, soil and groundwater sampling and testing continue for benzene. Benzene is carcinogenic and can persist in groundwater longer than in surface water.

In 2000, pipeline segment JG-4 was taken out of service by the operator due to a natural gas leak. No camping permits were issued by the Preserve or burning was permitted in the Neches Bottom/Jack Gore Baygall Unit until the leak was remedied.

Administration of Nonfederal Oil and Gas Program. Management of the oil and gas program in the Preserve is accomplished by staff in the Preserve, with technical support from resource and program specialists in the Regional Office (Santa Fe and Denver) and the Washington Office's National Resource Program Center (Denver and Fort Collins). The majority of fieldwork and coordination with operators is performed by the Preserve's single staff specialist, who typically has other program responsibilities and tasks to perform. When there are multiple new proposals in development, the Preserve's specialist has been unable to address all program needs. Additionally, the Preserve's geographic configuration, wet nature, and relative inaccessibility generally constrain travel and access to project areas. The Preserve recognizes that due to these factors and increased oil and gas activity, additional staff support for the program is needed to ensure timely processing of plans of operations, and to protect Preserve resources and visitor experience.

The NPS has no regulatory authority to accrue fees for the management of its Nonfederal Oil and Gas Rights Regulations (36 CFR 9B), nor for the use of parklands under this regulatory program. The NPS encourages operators to adaptively use disturbed areas for siting new operations where appropriate. Prospective operators would not want to site operations where they may assume liability for cleanup and remediation of contaminated soils if it exists, and the NPS cannot require operators to do so. Where there are valid operators still in existence, the NPS would request the operator's voluntary return to reclaim their previous operations areas. In most cases, the sites were plugged and abandoned prior to the implementation of the 36 CFR 9B regulations, and the NPS lacks the regulatory authority to require further reclamation by the operator. Where reclamation activities were not successful, the NPS would request the operators to return to complete the necessary reclamation requirements. The NPS has funding available to remediate contaminated sites. Where there are no valid operators in existence, or operators do not voluntarily return to reclaim these sites, the Preserve would need to compete with other park units for NPS funds dedicated to disturbed lands and abandoned mine lands reclamation.

AIR QUALITY

The Preserve is located north of the Beaumont/Port Arthur/Orange airshed and northeast of the Houston/Galveston airshed. These are two of the most polluted airsheds in the State, and represent two of five Nonattainment Areas in Texas that exceed National Ambient Air Quality Standards (NAAQs) established by the Environmental Protection Agency (EPA). The Preserve may also be influenced by air pollutants transported from the Lake Charles, Louisiana, petrochemical complex. The primary pollutants transported from airsheds affecting the Preserve are volatile organic compounds (VOCs), and nitrogen oxides (NO_x). Other air pollutants that could affect the Preserve and public health and welfare include carbon monoxide, sulfur dioxide (SO_2), and particulate matter (including heavy metals and lead).

During most of the year, prevailing air flow is from the southeast and Gulf of Mexico, shifting to flow from the northwest during passages of major continental air masses (cold fronts) that generally occur in late fall, winter, and early spring. The airshed of the southern portions of the Preserve is also affected by air currents (inshore/offshore flows) from the Gulf of Mexico with daily heating and cooling. These flow patterns are considered important because they transport various air pollutants from the nearby industrial and urban areas.

The Preserve is designated a Class II area under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act (CAA). As such, the Preserve's air quality is protected by allowing limited increases (i.e., allowable increments) over baseline concentrations of pollution for the

pollutants sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulate matter (PM). The PSD permitting program is administered by the Texas Commission on Environmental Quality (TCEQ) and applies to defined categories of new or modified sources of air pollution with emissions greater than 100 tons per year and all other sources greater than 250 tons per year. Based on level of emissions, oil and gas operations may or may not be subject to the PSD permitting program. Emissions from these and other pollution sources affecting the Preserve will be considered on a project-by-project basis in the assessment of air quality impacts allowed under the PSD increment system. Emission limitations under CAA New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants may apply to certain production facilities.

The Preserve lies within the Nonattainment Area for the 8-hour ozone National Ambient Air Quality Standard (NAAQS) in Hardin, Liberty, Orange, and Jefferson Counties. Ozone can be both phytotoxic (having damaging effects on some vegetation) and injurious to humans and wildlife. Existing ozone levels may be increased by additional emissions of NO_x and VOCs, the primary precursors to ozone formation. Emission limits for ozone precursors must conform with the State Implementation Plan (SIP) to attain the ozone NAAQS in these counties, and more stringent emission controls may be imposed by TCEQ than those required under the PSD program.

In the fall of 1996, particulate matter (PM) was monitored in the Preserve as part of a special study by the TCEQ, NPS, and Mexico to increase understanding of the transport of pollution to the Big Bend area of Texas. The fine fraction of PM (i.e., particles less than 2.5 microns, or $PM_{2.5}$) was measured due to the interest in the dramatic effect this particle size has on visibility. Of the 18 sites monitored on both sides of the U. S. – Mexico border, the Preserve measured the highest levels of $PM_{2.5}$ during a two-month period. Preliminary study findings indicate that fine sulfate particles comprised a significant portion of the $PM_{2.5}$ measured at the Preserve, and that air masses arriving at Big Bend National Park from the Big Thicket area contained some of the highest levels of $PM_{2.5}$ and sulfur compounds.

It is likely that additional industrial activity associated with oil and gas production will contribute to $PM_{2.5}$ formation through emissions of SO_2, NO_x, and VOCs that are transformed in the atmosphere to fine particulate matter. Mean $PM_{2.5}$ 24-hour average levels (16.5 micrograms per cubic meter) measured in the Preserve during 1996 indicate ambient concentrations that exceed the recently promulgated annual average NAAQS for the pollutant (15 micrograms per cubic meter). If these levels are sustained, the Preserve would also be classified as a Nonattainment Area for fine particle NAAQS under EPA's proposed new standard.

The Preserve's fire management program and nonfederal oil and gas operations could locally affect air quality in the Preserve and surrounding area. Industrialization (primarily petrochemical and public utility industries) and urbanization contribute more appreciably to air quality in the vicinity of the Preserve.

GEOLOGIC RESOURCES

Overview

The Preserve lies within the Flatwoods and Lower Coastal Plain geographic areas of southeast Texas. The topography is nearly level in the southern part to gently rolling in the northern part of the Preserve. Slopes in the Flatwoods Area (Beaumont and Lance Rosier Units) are generally less than one percent. Slopes in the Lower Coastal Plain Area (Jack Gore Baygall/Neches Bottom, Turkey Creek, Big Sandy Creek and Beech Creek Units) are generally one to three percent, and range from 0.5 to 12 percent (Table 3.5). Elevation generally rises to the north and west from 5 feet (above mean sea level) in the Beaumont Unit to 365 feet at the northern tip of the Big Sandy Creek Unit and 215 feet at the northern edge of the Beech Creek Unit. Although the units of the Preserve vary widely in topography, soils, and size, most are situated along water corridors or in upland settings, or a combination of both.

Table 3.5. Acreage and Proportion of Slope Classes by Preserve Unit

	Total Acres Per Unit	0-3% slopes (acres)	0-3% slopes (%)	3-5% slopes (acres)	3-5% slopes (%)	5-12% slopes (acres)	5-12% slopes (%)	>12% slopes (acres)	>12% slopes (%)
Beaumont	6,289	5,753	91.5	107	1.7	89	1.4	6	0.1
Beech Creek	5,097	3,103	60.9	1,062	20.8	927	18.2	114	2.2
Big Sandy Creek	14,227	5,810	40.8	2511	17.6	5,107	35.9	918	6.5
Hickory Creek	705	565	80.1	134	19.0	4	0.6	0	0
Lance Rosier	24,752	23,759	96.0	848	3.4	349	1.4	0	0
Little Pine Island – Pine Island Bayou Corridor	2,209	1,420	64.3	429	19.4	356	16.1	4	0.2
Loblolly	552	552	100.0	0	0	0	0	0	0
Lower Neches River Corridor	3,291	1,738	52.8	408	12.4	442	13.4	10	0.3
Menard Creek	3,999	1,537	38.4	666	16.7	1,248	31.2	354	8.9
Neches Bottom/ Jack Gore Baygall	13,712	9,413	68.6	1,757	12.8	2024	14.8	120	0.9
Turkey Creek Administration /Visitor Headquarters	7,950 28	5,698 27	71.7 96.0	1,098 1	13.8 4.0	833 0	10.5 0.0	156 0	2.0 0.0
Upper Neches River Corridor	5,902	2,301	39.5	664	11.3	1,295	21.9	484	8.2
Total	88,132	61,676	70.0	9,685	11.0	12,674	14.4	2,166	2.5

Subsurface Geology

The geology in the area of the Preserve primarily consists of Pleistocene and Holocene-aged sedimentary deposits. These thick nonmarine fluvial, deltaic, and nearshore marine deposits are exposed at the surface in a series of linear “bands” that run parallel to the coast, decreasing in age seaward. Structurally, these sediments dip towards the Gulf of Mexico at approximately 20 – 30 feet per mile. The thicknesses of the individual formations increase towards the Gulf of Mexico (Teas, 1935). The varied depositional environments resulted in a complex interbedding of lithologies; generally the coarser grained deposits have higher permeability than the finer grained deposits (Williamson et al., 1990).

The youngest and most seaward geologic unit of the Gulf Coastal Plain is the Pleistocene age Beaumont Formation, deposited less than 125,000 years ago. The Beaumont Formation was deposited by deltaic and fluvial (river) processes and consists of predominantly fine-grained deposits, with a reported lithology of roughly 60 percent clay and the remainder composed of silts and sands (Boylan, 1986). Due to the high percentage of clay, the Beaumont Formation acts principally as an aquitard, or geologic unit that inhibits the flow of water. However, sand lenses within the clay beds are likely to act as local aquifers (Enprotec, Inc., 1998).

Moving northward, the older Pleistocene age formations, deposited between 125,000 to 2,500,000 years ago, are the Montgomery and Bentley Formations (also mapped as Upper and Lower Lissie Formations, respectively). These units consist of clay, silt, and sand with minor amounts of gravel. The thickness of each of these units ranges from 75 to 125 feet. The southern part of the Preserve is underlain by the Montgomery and Beaumont Formations.

The oldest Pleistocene (possibly Pliocene) deposit in this area is the Willis Formation. Although composed of somewhat coarser sands and gravels, its lithologies are similar to the Montgomery and Bentley Formations. This deposit reaches a maximum thickness of 75 feet (Geologic Atlas of Texas, 1968). The Willis Formation underlies the Big Sandy Creek and Beech Creek Units of the Preserve.

Structural processes such as faulting, uplift, subsurface salt movement, and subsidence have modified the sedimentary layers throughout the Gulf Coast region. The Sabine Arch and the Houston Embayment are surface expressions of uplift and subsidence, respectively. Movement of salt layers in the subsurface has deformed subsurface sedimentary layers throughout the Gulf Coast region. Salt domes are commonly composed of thick halite (sodium chloride) and sylvite (potassium chloride) beds that deform subsurface sedimentary layers; structures formed as a result of salt movement strongly influence the location of oil and gas reservoirs in the Gulf Coast area. Where salt domes occur near the surface, there may be some surface expression. High Island (Galveston County) and Spindletop (Jefferson County) are two areas that exhibit surface features indicative of salt domes. Fourteen salt domes have been documented within the seven-county area of the Preserve.

Table 3.6. Generalized Stratigraphic Formations in the Vicinity of the Big Thicket National Preserve (revised from Renfro *et. al*, 1973)

Era	System	Series	Time (millions of years ago)	Formation	Group	Approx. Depth
Cenozoic	Quaternary Q	Holocene	0	Deweyville (Qd)		
		Pleistocene	3	Beaumont (Qbc/Qbs) Montgomery Lissie (Ql) Bentley Willis		0-300′
	Tertiary	Pliocene	11	Citronelle Goliad		
		Miocene	25	Legarto Fleming Oakville	Fleming	~1,200′
				Anahuac Catahoula Frio	Catahoula	~1,800′
		Oligocene	40	Vicksburg (subsurface only)	Vicksburg	
		Eocene		Whitsett Manning McElroy Wellborn	Jackson	
				Cadell-Moody's Ranch Yegua-Cockfield Cook Mountain Stone City Sparta Weches Queen City Reklaw	Claiborne	6,500′ 8,500′ 9,900′
				Carrizo		10,000′
			60	Wilcox: Calvert Bluff-Sabinetown Simsboro-Rockdale-Pendleton	Wilcox	
		Paleocene	70	Midway: Hooper-Seguin Wills Point Kincaid	Midway	14,000′ 23,000′
Mesozoic	Cretaceous KI	Upper Gulfian KU		Navarro: Kemp Corsicana Nacatoch	Navarro	
				Taylor: Marlbrook Pecan Gap Annona Wolfe City Ozan	Taylor	
				Austin: Gober Brownstown Tokio/Blossom Bonham	Austin	
				South Bosque Eagle Ford Lake Waco	Eagle Ford	

Soils

Soils developed on the Pleistocene age Willis, Bentley and Montgomery Formations and Pleistocene to Holocene age (late Pleistocene to less than 10,000 years ago) Deweyville Formation and Quaternary Alluvium. Quaternary Alluvium is thickest within the major active drainages: the Neches and Trinity Rivers. The Deweyville Formation, underlying the Alluvium, is also associated with river and stream drainages. Most soils in the Preserve developed on the Bentley and Montgomery Formations. These formations are exposed at the surface in approximately 70 percent of the Preserve (Saul Aronow, pers. comm.).

Soils formed in floodplains range from loamy to clayey, and occur on old oxbows to moderately well-drained natural levees adjacent to stream channels. Upland soils are generally loamy to sandy in texture and are found on a wide variety of landscapes. Immediately above the floodplains are sandy point bar deposits and low, mounded terraces. Deshotels (1978) described 46 soils (mapping units) in the Preserve.

For purposes of describing the hydrologic characteristics of the soil and evaluating the potential impacts of oil and gas operations, soils have been combined into four major classes based on their infiltration/runoff potential or Hydrologic Group (see Table 3.7 for characteristics of the soil classes described in this Plan/EIS). Hydrologic Group refers to a group of soils having similar runoff potential under similar storm and cover conditions. Secondary characteristics of the soils that are described in the following section, but are not directly attributable to the Hydrologic Group, include water storage capacity, water table, and flooding frequency. Hydrologic soil classes are based on the soil Hydrologic Groups as assigned by the Natural Resources Conservation Service (formerly Soil Conservation Service).

The soils within the Preserve are characteristic of those developed under a mild climate, with abundant rainfall, in a mixed conifer-deciduous forest. Two broad categories of soils are found: a highly leached, acidic, sandy to loamy textured soil with a lower less-permeable zone of clay accumulation; and a more clayey textured, less permeable soil that is subject to either high water tables or periods of extensive flooding. The latter soils shrink and swell with changes in seasonal moisture. In general, the sandier soils tend to occur in uplands, and clayey textured soils are found in swales, lowlands, floodplains, and wetlands. The sandier textured soils typically belong to hydrologic soil classes “A” and “B”, and the more clayey textured soils to classes “C” and “D”.

Over 60 percent of the soils in the Beech Creek, Big Sandy Creek, and Hickory Creek Savannah Units belong to classes “A” and “B”, while Turkey Creek and Lance Rosier have between 40-60 percent. The water corridor units typically have less than 30 percent of classes “A” and “B”, and the majority of soils are within class “D”.

Described below, soil characteristics that are important in assessing the potential impacts of oil and gas operations are: soil erodibility, soil compaction, shrink-swell potential, flooding frequency, recharge potential, and water conditions.

Soil Erodibility. Most of the soils in classes “A” and “B” are low to moderately erodible, while soils in classes “C” and “D” are moderately to highly erodible. Erosion also depends on the rainfall energy, slope, slope length, vegetative cover, and site conservation or management practices. Even though most slopes within the Preserve are relatively flat (less than two percent), soil erosion control is necessary whenever vegetative cover is removed or when water is concentrated and flow velocities are high.

Soil Compaction. Typically, soils with a high clay content are most subject to compaction. Soil compaction resulting from foot travel or vehicle use reduces the pore spaces in the soil and impedes the penetration of rainfall and plant roots (Meek et al., 1992). Even though drying and shrinking of

the soils and subsequent wetting and expansion will tend to negate some of the adverse impacts over time, clayey soils should not be traversed when saturated. Vehicular travel on clayey soils under saturated conditions will form compacted tracks. These tracks will have the effect in flat topography of changing surface drainage patterns by forming small drainage channels which can locally modify the hydroperiod (frequency and duration of saturation) of a site. Compaction will also tend to severely reduce the permeability of the soil. Soils within class "D" are most prone to compaction.

Shrink-Swell Potential. Clayey soils that are composed of expansive clays will tend to expand and contract with seasonal moisture variations. Due to the water budget of the area, flat topography, and high seasonal water tables, the depth of shrinkage cracks produced in clayey soils will probably not exceed one to two feet. Soils below the seasonal water table will be saturated and thus swollen. The combined effects of shrink-swell and compaction make road construction difficult in areas where there are clayey soils. Typically, soils in class "D" are more prone to shrink and swell.

Flooding Frequency. Soil maps assign flooding frequencies generally based on soils and vegetation. In the Preserve, flooding frequencies typically range from occasional to frequent in classes "C" and "D", and from none to rare in classes "A" and "B".

Frequent flooding infers that flooding is likely to occur often under usual weather conditions; more than a 50 percent chance of flooding in any year, but less than a 50 percent chance of flooding in all months of any year. Soils are covered by flowing water for long durations, generally ranging from seven to 30 days. Soils will typically occur on level or depressional landscapes with restricted surface drainage or restricted permeability. Usually only water tolerant plants will be present.

Occasional flooding infers that flooding is expected infrequently under usual weather conditions, and there is a five to 50 percent chance of flooding in any year or flooding occurs five to 50 times in 100 years. Soils are covered by flowing water for shorter durations, generally ranging from two to seven days. Such soils are typically relatively permeable and occur on level or depressional landscapes, or are soils with restricted permeability on low sloping or swampy terrain. For flooding frequencies from none to rare, the percent chance of flooding in any year ranges from five percent to near zero, respectively.

Recharge Potential and Water Conditions. Recharge is a complex process that is dependent upon many factors such as rainfall amount and duration, soil texture, soil structure, vegetative cover, and soil moisture. As mentioned at the beginning of this section, a simplified index of infiltration and runoff is the soil Hydrologic Group. The infiltration rate is the rate at which water enters the soil at the surface and is controlled by the surface conditions. The Hydrologic Group also indicates the rate at which water moves in the soil. The rate that water moves through the soil is controlled by the composition, textures and structure of the soil.

Soils in Cass "A" have low runoff potential and high infiltration rates even when thoroughly wetted. Typically these soils consist of deep, well to excessively drained sands, loamy sands or sandy loams. Class "B" soils have moderate infiltration rates when thoroughly wetted and consist of moderately deep, well to excessively drained soils with fine to moderately coarse textures such as silt loams or loams. Class "C" soils have low infiltration rates when thoroughly wetted and consist of soils with a water-retardant layer and moderately fine to fine textures such as sandy clay loams. Class "D" soils have high runoff potential and low infiltration rates when thoroughly wetted. Such soils primarily consist of clay soils with high shrink-swell potential, soils with a permanent high water table, soils with a claypan, or clay layer near the surface, and shallow soils over nearly impervious material. Impermeable structures, pads, or roads placed over the more permeable soils will have larger impacts on the water budget than those placed over the less permeable soils.

In relation to recharge, flooding, and water table conditions, Classes “A” and “B” generally have high recharge potential, lower flooding frequencies, and a highly variable water table. Classes “C” and “D” all have a high water table, with over 50 percent of the soils having frequent to occasional flooding frequencies.

The water budget, its components, and their interaction must be known or inferred in order to properly assess the impacts of surface uses. Surface uses and the characteristics of the soils dictate the rainfall runoff relationships of the system. Rainfall of a certain magnitude and duration, soil permeability, and water holding capacity with depth all determine how much water the soil will hold before runoff occurs. The slope and roughness of the land surface and soil will control the general speed of both overland flow and shallow subsurface or lateral flow. Surface uses, soils, and slope will also determine the erodibility of the soil and potential for sediment input into streams. The balance of all of the above will ultimately determine the flow in streams and recharge into aquifers.

Table 3.7. Characteristics of the Soil Classes Described in this Plan/EIS

Hydrologic Soil Class[1]	“A” Soils	“B” Soils	“C” Soils	“D” Soils
Composition	Thick, well to excessively drained, moderately coarse textured (sands, loamy sands, and sandy loams)	Moderately thick, well to excessively drained, moderately fine to moderately coarse textured (silt loams and loams)	High clay content, water retardant layer, moderately fine to fine textured (sandy clay loams)	Fine textured, thin clayey soils with claypan or clay layer near surface
Location	Generally found in upland areas	Generally found in upland areas	Generally found in wetlands and floodplains	Generally found in wetlands and floodplains
Permeability	High	Moderate	Low	Very low
Erodibility	Low to moderate	Low to moderate	Moderate to high	Moderate to high
Compaction	Low	Low	Moderate	High
Shrink / Swell Potential	Low	Low	Moderate	High
Flooding Frequency	None to very rare	rare	Occasional to frequent	Frequent
Run-off Potential	Low	Low	Moderate	High
Infiltration Rate	High	Moderate	Low	Low
Recharge Potential	High	High	Low	Low

[1] Hydrologic soil classes are based on the soil Hydrologic Groups as assigned by the Natural Resources Conservation Service. Other parameters, e.g., flooding frequency and recharge potential, are not directly attributable to soil Hydrologic Group.

Distinctive Landforms

Sand Mounds. Located primarily within the Lance Rosier and Jack Gore Baygall Units, sand mounds (referred to elsewhere as “mima” or “prairie” mounds) are landforms found throughout the gulf coast of Texas and Louisiana. Sand mounds are typically located on low-relief slopes of silts and sands comprising relict meander ridges and barrier islands (Aten and Bollich, 1981). These mounds are largely found on the Montgomery and Bentley formations, and to a lesser extent on the beaumont formation. Based on the 1997 provisional soil survey conducted by the natural resources conservation service, sand mounds occur on approximately 4,000 acres, predominately in the lance rosier unit.

Individual mounds range in height from 6 inches (15 cm) to 60 inches (150 cm), are circular to elliptical in shape, and vary in diameter from 6 feet (2 m) to 180 feet (55 m). Several hypotheses for the formation of these mounds include erosional remnants left after sheetflood erosion or wind deflation, wind-blown sand accumulations around vegetation, and mounds formed by the burrowing of rodents (Louisiana Geological Survey 2001).

The origin of sand mounds has been debated since the mid-19th century, but most experts agree that sand mounds were principally formed in the late Pleistocene and early Holocene epochs; each mound takes 300 to 500 years to form; mounds within the same area did not form simultaneously; and mound terrain has archeological potential. See the section on Cultural Resources in this chapter for a description of temple mounds.

During project planning, if sand mounds are found to contain cultural artifacts or human remains, operations would have to be sited to avoid or mitigate impacts on the cultural resources.

WATER RESOURCES

Water is one of the pervasive resources in the Preserve. Most of the Preserve units either contain or are adjacent to high-order, perennial streams. In fact, four of the existing 12 management units are river/stream corridor units. In addition to these major river/stream reaches, the Preserve contains a wide variety of minor hydrologic features: floodplains, sloughs, oxbows, baygalls, acid bogs, and low-order tributary streams. The origin and occurrence of practically all of these features is strongly affected by the surface and subsurface geology. Furthermore, the occurrence and movement of groundwater within the Big Thicket area is heavily influenced by both the structure and the lithology of the local bedrock. Wetlands, which provide a physical link between the ground and surface water systems, are covered in the following Wetlands section. Soils are covered in the preceding Geologic Resources section, but some information on soils is essential due to the influence different soil types have on the shallow groundwater system. Accordingly, where a mention of soil types is necessary, it has been made.

The surface and subsurface geology are closely interrelated and greatly influence the water resources of the Preserve. The sedimentary formations exposed at the surface also tend to be separated by low cuestas, or scarps, which strongly affect drainage. One of these features (scarps) is visible as an abrupt rise or “break” in topography along U.S. Highways 69 and 287, about 4 miles southeast of Kountze. This “break” represents the change from the Bentley Formation to the Montgomery Formation in this area. Similarly, the contact zone between the Montgomery and Beaumont Formations bisects the Beaumont Unit. Water seepage from the higher sands of the Montgomery Formation discharge over the Beaumont Formation, providing an additional source of water to the system (Blanton & Associates, Inc., 1998).

Climate

The Preserve is located on the western edge of the humid subtropical climatic region. This region is characterized by long, warm to hot humid summers and fairly short, mild winters. Onshore winds from the Gulf of Mexico provide maritime influence during the spring, summer, and fall. Arctic, Rocky Mountain, and Pacific storms occur frequently in the winter months and result in depressed temperatures; however, warming periods usually occur between fronts. Sub-zero temperatures are rare with typically less than a dozen freezing nights per year.

Precipitation is reasonably well distributed throughout the year, ranging from 50 to 55 inches and increasing from west to east. Thunderstorms occur about 60 days each year, and while sustained rainfall and flooding often take place in the winter and spring, the most intense events are associated with tropical storms and hurricanes in the summer and fall (NPS, 1996).

In an area of relatively poor drainage, rains from a tropical storm have the potential to create "catastrophes." In October of 1994, the remnants of Tropical Storm Rosa caused flood waters to rise to a record of 12.5 feet above flood stage on Pine Island Bayou. This flood caused 26 counties to be declared Federal Disaster Areas and, regionally, took 20 lives, forced the evacuation of 14,000 people from their homes, caused over 700 million dollars in damages, closed Interstate 10 between Beaumont and Houston, closed the Port of Houston, and contaminated several areas by dispersing pollutants, fresh water, and mud (Lamar University, 1996).

Major Drainages

All units of the Preserve are located within the watershed or basin of the Neches River, except for the Menard Creek Corridor Unit which is in the Trinity River basin. Both of these drainage basins trend from northwest to southeast and have gentle slopes with channels that meander from their headwaters to the Gulf of Mexico. The Neches and Angelina Rivers constitute the two major rivers within the Neches River basin. The mainstem Neches River headwaters are located in northeast Texas, in Van Zandt, Smith and Henderson Counties. The Angelina River originates in Smith and Rusk Counties.

The Neches River basin is roughly 200 miles long by 50 miles wide, and drains an area of approximately 10,000 square miles. The Angelina River drains the northern one-third of the basin, while the Neches drains the remaining two-thirds before reaching the Gulf of Mexico through Sabine Lake. Major tributaries to the Neches within the Preserve are Big Sandy Creek/Village Creek, Turkey Creek, Pine Island and Little Pine Island Bayous, Hickory Creek, and Beech Creek. The drainages generally follow dendritic patterns which are indicative of horizontal or near horizontal bedrock and gentle sloping topography.

Within the Menard Creek Corridor Unit, Menard Creek is a tributary to the Trinity River. Its headwaters are north of the Dallas-Fort Worth metroplex, in the northwest part of the basin. The Trinity River basin drains approximately 18,000 square miles, encompassing parts of 34 counties before entering the Gulf of Mexico through Trinity Bay and Galveston Bay (TNRCC, 1996).

Minor Hydrologic Features

In addition to these major drainages, the surface water network in all units of the Preserve is composed of numerous unnamed creeks, sloughs, acid bogs, and baygalls that greatly affect both the hydrology and hydrochemistry of the surface and near-surface groundwater environments. The

occurrence and function of these hydrologic features are strongly influenced by the local surface and subsurface geology.

Baygalls (named for sweet bay and gallberry holly) occur in depressions formed by abandoned channels on terraces. In the Preserve, baygalls frequently occur in relatively lower depressional areas, where water stands for much of the year (e.g., Lance Rosier Unit). Additionally, baygalls may form at the contact of two geologic formations with differing hydraulic properties. Baygalls accumulate a large amount of organic debris which results in water that is high in organic acids, low in dissolved oxygen and exhibit low pH values.

Similar to baygalls, sloughs channel and capture water. Sloughs however, are located within the active floodplain – and therefore subject to a greater degree of hydrologic exchange with mainstem drainages. In addition to the periodic input of floodwaters, sloughs may receive sediments during floods. Water quality in sloughs can vary from that observed in the mainstem watercourse to that of baygalls depending on the elapsed time between flood events.

Acid bogs generally form at locations where terrace-level tributary streams enter a main drainage. The loss in gradient from terrace to active floodplain results in sediment deposition, long-term aggradation, and shifting channels. Acid bogs are subject to the same water quality controls as baygalls and consequently exhibit low pH waters with organic acid turbidity and low dissolved oxygen. Additionally, acid bogs may be subject to flooding due to their location in floodplains. Acid bogs are similar to baygalls in plant species composition.

Flow: Quantity, Timing, Floodplains, Diversions

The majority of the streams within the Preserve are perennial, free-flowing and non-channelized watercourses. Intense storms result in large magnitude runoff events; however, flood peaks are attenuated by broad flat valleys that produce slow-moving, long-duration floods.

Both the U. S. Geological Survey (USGS) and the U. S. National Weather Service (USNWS) operate a number of stream gages within the Neches River and Trinity River basins. Within the Preserve, USGS operates two gages on the Neches River, one on Pine Island Bayou, and one on Menard Creek. Similarly, USNWS operates two gages on the Neches and one on Pine Island Bayou. Analysis of the 71 year flow record from the USGS gage on the Neches River at Evadale, the gage most central to the Preserve, indicates that peak flows generally occur between February and June, and that 90 percent of these peaks are below 22500 cubic feet per second (NPS, 1995). This summary was derived from flow records that both pre- and post-date dam construction (described below) upstream of this gage.

Within the Neches River basin, two major impoundments are located within 30 river miles upstream of the Preserve. The larger of the two, Sam Rayburn Reservoir, is located on the Angelina River about 25 miles above the confluence of the Neches and Angelina Rivers. It includes parts of five counties and occupies 114,500 surface acres (at normal level). Sam Rayburn provides flood control, sediment control, habitat for fish and wildlife, recreation, and hydropower for generating electricity.

B. A. Steinhagen Reservoir is located upstream of the Upper Neches River Corridor Unit. Situated immediately downstream from the confluence of the Neches and Angelina Rivers, it normally occupies 16,800 surface acres. At Steinhagen, Town Bluff Dam (Dam “B”) functions as a regulatory structure for the Sam Rayburn Reservoir, i.e., it serves to control the release of water from Rayburn – since Rayburn is a flood control reservoir and has no real storage capacity (Ed Shirley, pers. comm.). When operated in conjunction with the dam at Rayburn, Steinhagen’s surface acreage normally ranges between 11,000 and 14,000 acres. Both dams are operated by the Fort Worth

District of the Army Corps of Engineers. Additional impoundments located above these reservoirs are Athens, Palestine, and Jacksonville reservoirs in the Neches River basin, and Tyler, Striker, Nacogdoches, Kurth, and Pinkston reservoirs in the Angelina basin.

The construction and subsequent operation of Sam Rayburn and B.A. Steinhagen reservoirs have altered the flow characteristics of the Neches River by reducing the frequency and duration of both high and low flows (Gooch, 1996; Hall, 1996). Changes in the duration and frequency of floods have also resulted in changes in species composition and distribution of floodplain forest communities (Hall, 1996).

In addition to the control of these reservoirs, water diversion may also alter the natural flow and behavior of a river or stream. A number of water diversions exist within the Neches River basin. However, an analysis of basin diversions concluded that the amount of water currently diverted annually is relatively small compared to annual flux.

Water Quality

Monitoring Programs/Studies. A relatively large amount of water quality data exists for the major drainages in the Preserve. These data are essentially of two types: (a) studies that were either very limited geographically and/or temporally, or (b) more comprehensive monitoring programs where the period of data collection spanned months or years, and included numerous stations. Separate monitoring programs have been undertaken by both the USGS and NPS.

The USGS has six established water quality stations within the area of the Preserve. Three stations are located on the Neches River and singly on Menard Creek, Village Creek, and Pine Island Bayou. Operation of these stations spans different time intervals with the earliest data beginning about 1967. Presently, only the Evadale station along the Neches River is in operation.

The NPS has established 15 water quality monitoring stations within six Preserve watersheds or subwatersheds: Beech Creek, Mill Creek, Big Sandy Creek/Village Creek, Black Creek, Menard Creek, and Pine Island Bayou. Additionally, there are 5 water quality stations established on the mainstream of the Neches River. Between 1984 and 1994, nearly monthly measurements were made at 14 of the 20 stations resulting in 1,781 records of field parameters and 678 records of lab parameters (Hall and Bruce, 1996).

General Water Quality/Hydrochemical Regime. General conclusions drawn from these studies are that the quality of water resources of the Preserve was fair to excellent, although in some areas water quality has degraded with respect to particular parameters (Harrel, 1985; Flora, 1984; Flora, 1985; Hughes, 1987; Hall and Bruce, 1996). Compared to other rivers in Texas, the Neches River generally has lower values for ion concentrations (especially bicarbonate and calcium), hardness, specific conductance, pH, and total dissolved solids (TDS).

It is apparent that some impacts are related to human activities such as residential development, agricultural activities, logging operations, and oil and gas development. In contrast, previous studies have suggested that reductions in salinity at locations in the Preserve may be the result of improved oil field brine management and reduced disposal within the watershed (Kaiser et al., 1994); or perhaps the reduction in oil and gas activities over the same period may have also contributed to lowering salinity (particularly chloride) concentrations. Parameters of concern have included fecal coliform, low dissolved oxygen (DO) levels, high concentrations of metals, increased salinity, and in at least one case, a dioxin advisory. In addition to these concerns, a number of state water quality standards violations have been recorded within the Preserve. The watercourses where these concerns and violations were observed are described in the Individual Watersheds section below.

Regulatory Framework. Discharges into Texas waterways are regulated through two types of permits: those issued through the Texas Commission on Environmental Quality (TCEQ) as authorized under Sections 5.103 and 26.032 of the Texas Water Code; and those issued through the Environmental Protection Agency (EPA) as authorized by the National Pollutant Discharge Elimination System (NPDES) provisions under Section 402 of the Clean Water Act. Although EPA continues to monitor the NPDES program, EPA delegated this program to the TCEQ during fiscal year 1999. TCEQ now issues and monitors these permits under the Texas Pollutant Discharge Elimination System (TPDES) program, under EPA oversight.

In addition to these discharge permits, the Railroad Commission of Texas (RRC) is the lead agency for spills and discharges from all activities associated with the development of oil and gas resources under Section 401 of the Clean Water Act and Sections 85.042, 91.101, and 91.601 of the Texas Natural Resources Code. Permits issued for oil and gas operations generally prohibit the discharge of any material that would in any way alter the quality of surface or subsurface waters, or contribute to a violation of a water quality standard. However, within the RRC's Statewide Rules, there are provisions for disposal of certain wastes.

The State Soil and Water Conservation Board (SSWCB) oversees a voluntary program for reduction of agricultural and silvicultural (forestry) nonpoint source pollution through the identification of problem areas by the state board or local soil and water conservation districts. Under this program, the SSWCB reviews and certifies water quality management plans – typically prepared by the Board, local soil and water conservation districts, or private entities. Approximately ten percent of these plans are checked for voluntary compliance each year (Larry Gibbs, pers. comm.). Within the area of the Preserve, there are seven soil and water conservation districts.

NPS Stream Categories. The major water resources of the Preserve have been divided into three classes by the NPS based on a combination of ambient water quality and monitoring status. Category 1 waters are those streams whose water quality presently ranges from very good to excellent. Streams in the Preserve included in Category 1 are: Big Sandy Creek, Beech Creek, Turkey Creek, and Black Creek (within the Jack Gore Baygall Unit). Category 2 waters are those already exhibiting water quality degradation for one or more parameters, often due to non-point source pollution and/or legally permitted point-source discharges. Streams in the Preserve included in Category 2 are Little Pine Island Bayou and Menard Creek. Category 3 waters are those major stream segments within the Preserve which are included in the Texas Surface Water Quality Standards (1980) and are routinely monitored by the USGS. Category 3 stream segments that flow through the Preserve are the Neches River, from Town Bluff Dam to the tidal zone (Beaumont Unit area), and Pine Island Bayou (Flora, 1984).

State Designated Stream Segments and Uses. In accordance with EPA guidelines, the TCEQ has classified major stream segments within the State according to designated uses. In order to support or achieve the designated uses of these stream segments, the TCEQ has promulgated specific numerical standards for each use and each segment (Kaiser et al., 1993). The Preserve contains three State-designated stream segments; all other streams are classified as off-segment and are subject to the same controls as the mainstem segment. Designated uses for stream segments of the Preserve are primarily for contact recreation (e.g., swimming, boating), medium-to-high-quality aquatic habitat for protection of aquatic life and riparian vegetation, and for public water supply. In addition to designated uses, each stream segment has a water quality designation indicating the applicable regulatory framework. This may be either "effluent limited" which indicates that the segment is meeting its designated uses, or "water quality limited" which indicates failure to meet designated uses.

Anti-Degradation Policy. The State-established Anti-degradation Policy is designed to protect water quality at existing levels and prevent a deterioration of water quality below achievable uses for a given stream segment. The policy has three levels of protection: 1) existing uses will be

maintained and protected, 2) for in-stream segments whose quality exceeds designated uses, degradation may only be allowed for important social and economic development, and 3) no degradation will be allowed for outstanding natural resource waters (ONRW). Presently, no waters in the State are designated as ONRW.

Groundwater

The Preserve is located in the Gulf Coastal Plain, an area characterized by marine and non-marine fluvial and deltaic sedimentary deposits that are highly variable in lithology and hydraulic properties. These geologic deposits, generally consisting of alternating layers of clays, silts, sands and gravels, are hydrologically connected and compose the aquifers in the vicinity of the Preserve. Water from precipitation migrates downward until it reaches a zone of saturation. Groundwater is defined as subsurface water occupying interstices (spaces or voids in rock or soil) in a zone of saturation, and groundwater systems that are economically viable are called aquifers.

The geologic units (further described in the Geology section) composing the aquifers range in age from Miocene to Holocene. Because of the difficulty in differentiating the formations of the subsurface (i.e., aquifers generally consist of parts of more than one geologic formation), the sediment deposits are commonly grouped together and referred to as the Gulf Coast aquifer or Gulf Coast Aquifer System. The Gulf Coast aquifer forms a wide belt along the Gulf of Mexico, extending from Florida to Mexico, and is a major aquifer in the State of Texas.

The Gulf Coast aquifer has been subdivided into three separate aquifers. The following paragraphs focus on the uppermost aquifers because water in the lower Jasper aquifer is generally not used in the area of the Preserve. The two main types of aquifers, water table and artesian, are also discussed.

The Evangeline aquifer, which underlies the Chicot aquifer, is within the upper sands of the Fleming Formation and the lower sands of the Willis Formation. It contains fresh to moderately saline water, and supplies a moderate amount of fresh water for municipal uses in Hardin and Liberty Counties, and for parts of Newton, Jasper and Tyler Counties. Its thickness varies from county to county, but generally increases toward the Gulf.

Overlying the Evangeline aquifer, the Chicot aquifer is a series of sand and clay beds within the Willis, Bentley, Montgomery, and Deweyville Formations, and Quaternary Alluvium. Separated by clay beds approximately 200 feet thick, the Chicot aquifer has been subdivided into upper and lower levels. The total thickness of the Chicot is roughly 425 feet, and both the thinner upper and thicker lower Chicot yield fresh to slightly saline water. The Chicot is the main source of groundwater in Orange County, although small to large quantities of fresh water are recovered in southern Liberty County. Most of the water used is drawn from the lower Chicot.

Aquifers at surface pressures are referred to as water table aquifers or unconfined aquifers, and usually occur at or near the source of recharge (Lamar University, 1996). Both the Evangeline and Chicot are water table aquifers near their recharge areas, but become artesian aquifers as the water migrates downdip toward the coast. Water table conditions exist in recharge areas where surface deposits are permeable enough to allow infiltration of precipitation. Here, water levels in the aquifer fluctuate in response to the volume in storage and oftentimes are very close to the ground surface. Recharge to both aquifers occurs primarily from precipitation, and may also occur through streams, lakes, and lateral flow. More locally, recharge may occur as vertical flow between aquifers – where sands of one aquifer are in contact with sands of another aquifer (Blanton & Associates, Inc., 1998). Conversely, discharge occurs in topographically low areas such as springs, seeps, and streams, and in Hardin County, it represents a major loss of groundwater (Baker, 1964).

In both the Evangeline and lower Chicot aquifers, water occurs under artesian conditions (Williamson et al., 1990; Blanton & Associates, 1998). This does not mean that water will flow to the surface, but rather that groundwater is under sufficient pressure to rise above the top of the aquifer when provided with a conduit. The presence of artesian conditions indicates that the hydraulic gradient in the area increases with depth. Consequently, the preferred direction of flow is from deeper zones to the surface. As mentioned above, these aquifers become artesian aquifers as water migrates downdip toward the coast.

This natural gradient can, and has been reversed in areas of extreme groundwater withdrawals. Overpumping water wells causes cones of depression to form, lowering the effective water level and may cause saltwater contamination. Cones of depression have been observed in the lower Chicot aquifer in the vicinity of Houston, Baton Rouge, and to a lesser extent, Beaumont (Williamson et al., 1990). Similarly, between 1941 and 1963, the industrial use of water in Orange County from the lower Chicot lowered the level of the water table approximately 45 feet (Thorkildsen, 1990). However, during a 10 year period beginning in 1977, decreased water use by industries in Orange County showed a water level increase of approximately 5 to 10 feet (Thorkildsen, 1990). However, in spite of this reverse in gradient, there is no reference to impacts on the water table which is supported by the upper Chicot aquifer. This is likely because of the thick clay layer that separates the upper and lower Chicot aquifers, and the large recharge from precipitation on the surficial aquifer.

Wells. The Gulf Coast aquifer has been utilized extensively for groundwater development. The first wells were drilled to relatively shallow depths, while subsequent wells have been drilled to hundreds of feet and provide water for today's municipal, industrial, and agricultural uses. Approximately half of the water used by the City of Beaumont is drawn from the Neches River, while the remainder is supplied by three wells at Loeb (Hardin County). The cities of Silsbee, Kountze, and Sour Lake also use groundwater from wells in Hardin County.

Domestic water wells in the area support a much smaller number of users. Presumably, most of these wells draw water from the Evangeline or Chicot aquifers. The zones of influence associated with shallow domestic wells are minor compared to municipal and industrial uses.

As mentioned above, water table levels can be depleted when water is withdrawn at a rate that exceeds the recharge rate. Continued overuse by pumping, past the capacity of the system to transmit water, may lower the water table to a point where water can no longer be removed economically. In the past, extensive municipal production from the lower Chicot and the Evangeline aquifers has resulted in extreme drawdowns, gradient reversals, and even land subsidence in some local areas.

Groundwater Quality. Due to the composition and varying depths of the water-bearing formations, a wide range of water quality regimes may be encountered. Total dissolved solids values may vary from near fresh to saline and hypersaline at depth. In general, the freshest water is close to the surface and is likely encountered in the Quaternary Alluvium, near the water table present in the Bentley Formation, or in the sand lenses present in the Beaumont Formation. Water in the aquifers is generally of good quality, and only receives chlorination before use.

Groundwater can be severely impacted by both natural and human causes. Natural contaminants in southeast Texas include salt from salt domes, sulfur and associated mineral deposits, naturally radioactive materials, and the chemicals associated with petroleum deposits (Lamar University, 1996). Human impacts on groundwater include: improper handling, storage, or transport of toxic, hazardous, or other contaminating substances; leaching from septic systems, sewage; agricultural runoff from fertilizer use; and contamination of water supplies by pathogenic (disease-causing) microorganisms.

In summary, the quality and quantity of groundwater in the Gulf Coast aquifer represent an important resource in southeast Texas that can continue to be used for an extended period of time.

Individual Watersheds

This section subdivides the Neches River basin into three primary drainages or individual watersheds within the Preserve: the Neches River, Big Sandy Creek/Village Creek, and Pine Island Bayou. Menard Creek, which occupies its own corridor unit, is part of the Trinity River basin and described last.

The Neches River. The Neches River is the primary drainage, capturing the majority of water from precipitation and overland flow, for most units of the Preserve. The Neches is a large, low gradient river with regulated flow. It also shares certain similarities with blackwater rivers, a subset of coastal plain rivers of the southeastern U. S. Four units of the Preserve are located between the 88-mile segment from Town Bluff Dam (Dam "B") to its confluence with Pine Island Bayou in the Beaumont Unit. Additionally, all three primary drainages join within or near the Beaumont Unit.



Neches River

The tidal portion of the watershed extends from the confluence with Sabine Lake upstream into the southeast portion of the Beaumont Unit. Flows in the Neches River downstream of this area are also influenced by tides, water quality of the ocean, and discharges from the upper watershed. The tidal segment is highly developed, industrialized, and is dredged to maintain a navigation channel. There is a permanent saltwater barrier on the Neches River just south of the Preserve.

Groundwater: The uppermost aquifer underlying the Neches River corridor is the Chicot aquifer. This aquifer includes all of the Quaternary formations including the Quaternary Alluvium. The total thickness of the Chicot aquifer is roughly 425 feet, however it is likely that only the upper Chicot aquifer influences groundwater in this area. Surface deposits, areas likely in the upper reaches of the river where the exposed bedrock is the Bentley Formation, are permeable enough to allow infiltration of precipitation into the upper Chicot aquifer. Additionally, alluvial aquifers associated with the drainages probably serve as freshwater aquifers (Ryder, 1988). The Beaumont Formation, which is exposed in the southern portions of the watershed, generally serves as an aquitard; however, sand lenses that exist within the clay beds may serve as local freshwater aquifers.

Hydrochemical Regime: Previous evaluations of baseline chemistry for the Neches River have concluded that total dissolved solid (TDS) concentrations were relatively low (less than

132 mg/L in 50 percent of samples), dissolved oxygen (DO) was generally close to saturation with a median of over 8 mg/L, and nutrient concentrations were relatively low (total nitrogen and total phosphorus were less than 1.8 mg/L and less than 0.2 mg/L, respectively). There were small declining trends in alkalinity and calcium, and a small increasing trend in sulfate concentration (Wells & Bourdon, 1985). Additionally, data compiled by the NPS (1995) for the Preserve indicate that specific conductance and chlorides appear to have decreased, and pH may have experienced a slight increase since the study began in the early 1960's.

Seasonally, specific conductance, suspended sediment, and to some extent chloride concentrations alternately increased and decreased over the seasons, with high values in the fall and spring. Dissolved oxygen concentrations were highest in the winter; alkalinity appeared to peak in the fall; and sulfate and manganese concentrations seemed to reach the highest levels in the spring (NPS, 1995).

Stream Segments, Uses, And Permits: Texas Surface Water Quality Standards define Segment 602 from a point 7.0 miles upstream of Interstate Highway 10 in Jefferson/Orange Counties to Town Bluff Dam in Jasper/Tyler Counties. The segment is 88 miles long and situated in a broad, low-lying, low gradient valley fed by small streams and sloughs. Village Creek and Pine Island Bayou are major tributaries to this segment. Segment 601 extends from the confluence with Sabine Lake in Jefferson/Orange Counties upstream to the confluence with Pine Island Bayou. Major tributaries to Segment 601 include Ten Mile Creek, Tiger Creek, and Anderson Gully. Water quality of the tidal segment has historically been poor, but improved treatment processes at major domestic and industrial wastewater treatment facilities in the early 1980's have improved water quality in this segment.

Designated uses for Segment 602 are contact recreation, high quality aquatic habitat, and public water supply. Designated uses for Segment 601 are contact recreation and intermediate aquatic habitat.

There are three permitted discharges along segment 602: two domestic outfalls, and one industrial outfall. Along segment 601, accidental spills of oil and other contaminants from riverside industries or ships have occurred and continue to threaten water quality on an acute as well as chronic basis (TNRCC, 1996).

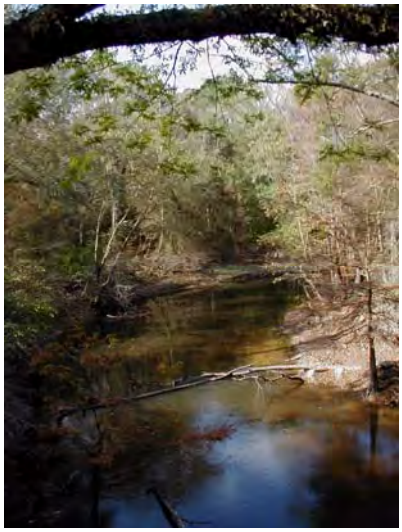
Violations/Exceedances/Problems: EPA water quality criteria levels for zinc, cadmium, copper, and lead have been exceeded in some locations along Segment 602. Specifically, mean cadmium concentrations exceeded the chronic criterion in the river near Silsbee, causing nonsupport of the aquatic life designated use in that area of the river. Lead (both total and dissolved) also exceeded EPA water quality criteria for drinking water in 12% and 56% of the samples, respectively. Additionally, sediments have been shown to be high in arsenic, manganese, mercury, nickel, selenium, and methylene chloride (TRNCC, 1996). In the Neches River, downstream of the Preserve (segment 601), EPA water quality criteria for turbidity, pH, dissolved oxygen, chlorides, and sulfates have been exceeded. Fecal coliform counts occasionally exceeded the water quality criterion level of 400/100 ml in this segment.

Big Sandy/Village Creek Watershed. Big Sandy/Village Creek is a naturally flowing creek with base flow supported by the alluvial aquifer and peak flows occurring in response to rainfall events. No water diversions exist within the watershed or on the mainstem of the creek, and therefore, flows are more representative of natural conditions. The upper reaches of the creek is named Big Sandy Creek, but renamed Village Creek upon passing the Hardin/Polk County line.

Preserve units within the watershed are: Turkey Creek, Hickory Creek, Big Sandy Creek, and Beech Creek. The Turkey Creek Unit encompasses 7,784 acres in southern Tyler and northern Hardin Counties. This unit is located on the Bentley Formation just south of the Hockley Scarp,

within the recharge zone of the Lissie Sands, a portion of the Chicot aquifer. Three major streams are partially contained within the Turkey Creek Unit: Turkey Creek, Hickory Creek, and Big Sandy/Village Creek. Turkey Creek flows in a southerly direction for about 18 miles before confluencing with Village Creek in the southern portion of the Unit (Flora et al., 1985).

The Big Sandy Creek Unit, the most upstream in the watershed, encompasses 14,346 acres within Polk County. The Big Sandy Creek flows through this unit. The headwaters of both of these streams originate outside of the Preserve. Big Sandy Creek originates in northern Polk County and flows in a southeasterly direction for about 4 miles before entering the Unit. Within the Unit, Big Sandy Creek meanders for about 21.5 miles. The average gradient of Big Sandy/Village Creek through the Unit is 1.1 feet/mile. Reported bed material varies from silt to course sand (Flora et al., 1985). In addition to the main drainages within the Unit, numerous sloughs, baygalls, springs, tributaries and acid bogs exist.



Village Creek

The Beech Creek Unit in Tyler County encompasses 5,206 acres, in the upper Preserve area. The major stream in this unit is Beech Creek which headwaters in eastern Tyler County and flows 32.5 miles before reaching Village Creek. The Beech Creek Unit contains about 6.4 miles of Beech Creek and about 2.5 miles of Little Beech Creek which is tributary to Beech Creek. The gradient of Beech Creek and Little Beech Creek are 10.8 feet/mile and 8.6 feet/mile, respectively (Flora et al., 1985).

Groundwater: In general, the watershed contains two broad categories of soils: upland soils and floodplain soils (see Geologic Resources section). Upland soils are not usually flooded, due largely to higher elevations relative to watercourses. Water table elevations are generally greater than six feet below the surface (Deshotels, 1978). Soils associated with the floodplains are more subject to flooding. Water table elevations are close to the surface, especially in winter months when it occurs within about two feet of the surface (Deshotels, 1978). The bedrock formation underlying the Big Sandy Creek Unit is the Bentley Formation. Many of the Bentley outcrops, especially those containing the Lissie Sands, likely serve as recharge zones for the lower Chicot aquifer. As with all Preserve units that contain a more developed drainage system, there exists a prism of Quaternary Alluvium deposited in river valleys cut through the bedrock. These alluvial deposits generally serve as local freshwater aquifers.

Hydrochemical Regime: In 1981, surface water quality in the Big Sandy/Village Creek watershed was reported as very good. Combined, oxygen and temperature regimes would support a diverse and healthy warm-water aquatic life population. Dissolved oxygen concentrations were consistently above State standards, indicating no substantial organic pollution. Total dissolved solids, specific conductance and chloride concentrations – all indicators of contamination from oil operations – were within a range typical of southeastern Texas streams (Flora et al., 1985). Fecal coliform bacteria concentrations ranged from slight to moderate with only a few violations of State water quality standards for contact recreation, with all of these occurring in the upper portion of the watershed.

The fish and macroinvertebrate populations indicated that Big Sandy/Village Creek was a healthy and unstressed environment, and as of 1981, there was no evidence that human activities were adversely affecting water quality. The nutrients ammonium, orthophosphate, and nitrate were all below levels of concern.

Preliminary screening of TCEQ and USGS data as of 1996 suggested both pH and dissolved oxygen as potential problem parameters within the watershed, and a 1994 basinwide assessment added fecal coliform as a potential problem (Lower Neches Valley Authority, 1994; Hall and Bruce, 1996). Data from 1978 identify nearly 3,800 residents in the Village Creek Watershed as utilizing individual septic systems. Areas of concentrated use are north of Lumberton, north of Silsbee, Honey Island, Village Mills, Hillister, and Doucette. The cities of Silsbee, Kountze and Woodville utilize wastewater treatment facilities (Hall and Bruce, 1996).

Stream Segments, Uses, And Permits: Texas Surface Water Quality Standards define Segment 608 from the confluence with the Neches River upstream approximately 53 miles to Lake Kimball Dam in Hardin County. This segment classification is “effluent limited”, indicating good water quality.

Designated uses for Segment 608 are contact recreation, high quality aquatic habitat, and public water supply. As of 1993, this segment contained 17 permitted NPDES wastewater discharges: 10 municipal outfalls at 2.02 million gallons per day (MGD) and seven industrial outfalls at 0.60 MGD. No information was found regarding the number of water supply intakes present along the drainage. No official swimming beaches exist within the unit and there was no information regarding unofficial swimming (TRNCC, 1996).

Violations/Exceedances/Problems: Exceedances for EPA water quality criteria include total phosphorus (20 percent of the samples), and a sediment sample exceeded acute criteria for aluminum. Overall, indications are that regional water quality has declined somewhat, with the exception of improvements in turbidity and chlorides.

Pine Island Bayou Watershed. Pine Island Bayou watershed drains about 657 square miles before confluencing with the Neches River just upstream of the city of Beaumont. The watershed is largely wooded but also contains substantial industrial and residential development. Three units of the Preserve are contained within the Pine Island Bayou watershed: the Loblolly Unit, Lance Rosier Unit, Little Pine Island-Pine Island Bayou Corridor Unit, and additionally, part of the Beaumont Unit. The watershed slopes in a southeasterly direction and varies in elevation from about 2 feet (above mean sea level) at the confluence to about 160 feet at the watershed divide (ACOE, 1985).

A large number of structures within the watershed are floodprone due to the presence of substantial residential development on the fringes of some of the bayous and creeks. The threshold of flood damages for both Pine Island and Little Pine Island Bayous is the 5-year flood which has been estimated at 8000 and 4000 cfs, respectively (ACOE, 1985). Several flood mitigation plans have been proposed although none at this time have been accepted.

Little Pine Island Bayou and Pine Island Bayou comprise the water corridor unit between the Lance Rosier Unit upstream, and the Beaumont Unit downstream. Little Pine Island Bayou is a tributary to Pine Island Bayou, and the two join upstream or west of the Beaumont Unit near Bevil Oaks. Black Creek, another major tributary to the water corridor unit, joins Pine Island Bayou downstream of Bevil Oaks.

The Lance Rosier Unit, located upstream (west) of the Little Pine Island-Pine Island Bayou Corridor Unit, includes the upper end of the Little Pine Island Bayou. It is the largest unit of the Preserve. Changes in geology, elevation, vegetation, and other transitions across the Lance Rosier Unit influence the type and quality of water resources. As in the water corridor unit, seepage springs

form cypress brakes, acid bogs, and baygalls, where the water is typically low in dissolved oxygen concentrations and pH, and decay of organic material creates clear, dark water.

Groundwater: Geologic formations exposed within the Pine Island Bayou Watershed are the Montgomery and Beaumont Formations. In general terms, both of these formations likely serve as aquitards impeding the flow of subsurface water. However, sand lenses likely exist in both of these formations and serve as local freshwater aquifers. Additionally, Quaternary Alluvium deposited along the river corridor probably provides freshwater baseflow to the perennial streams and likely serves as an aquifer.

Hydrochemical Regime: Generally speaking, streams flowing through the Pine Island Bayou watershed are similar to other surface waters in Southeastern Texas in that seasonal flows are variable and total dissolved solids (TDS) concentrations are relatively low (Flora et al., 1984). In addition to natural factors, land use practices in the watershed have influenced area water quality, generally contributing to its degradation.

Hughes and others (1986) summarized water quality monitoring results from 1975 to 1983, and showed that water quality in Little Pine Island-Pine Island Bayou Corridor Unit was moderately degraded with respect to specific conductance and chloride concentrations. An additional observation regarding water quality is that turbidity in Little Pine Island Bayou varied with discharge, from a low during low flows, to a high during high flows (Harrel et al., 1978). Turbidity was lowest at the station near Sour Lake, attributed to contamination with oil field brine (saltwater) which precipitates suspended particles. Dissolved oxygen concentrations were frequently low in Little Pine Island Bayou (minimum of 0.3 mg/L); and were lowest in the summer and highest in the winter.

Stream Segments, Uses, And Permits: Segment 607 is described in Texas Surface Water Quality Standards from the confluence with the Neches River in Hardin/Jefferson Counties to FM 787 in Hardin County. This segment is "water quality" limited due to violations of existing water quality standards (TNRCC, 1996). Designated uses for segment 607 are contact recreation, high quality aquatic habitat, and public water supply. Since Little Pine Island Bayou is an unclassified tributary to Pine Island, it is an off-segment stretch of Pine Island Bayou with the same designated uses. The classification for segment 607 is "water quality limited" due to previous water quality standards violations.

There are three National Pollutant Discharge Elimination System (NPDES) permitted discharges in the water corridor unit for sewage treatment plant effluent from Pinewood Estates, Bevil Oaks and Lumberton. In 1992, eight NPDES municipal wastewater discharge permits were recorded for Pine Island Bayou for a total flow of 3.17 MGD. There are also 11 domestic outfalls into the bayou for a total of 4.94 MGD

Violations/Exceedances/Problems: The Texas Water Commission (1985) identified dissolved oxygen, pH, and fecal coliform as potential problem areas for water quality. Depressed dissolved oxygen concentrations and elevated fecal coliform counts, which occur primarily during summer conditions when streamflows are low and the water is warmer, have resulted in non-support designated uses. Specifically, the middle 26 miles of the segment 607, located downstream of Sour Lake wastewater discharge, has not supported high quality aquatic habitat or contact recreation due to depressed dissolved oxygen and fecal coliform (Adsit and Hagen, 1978). Sediment samples collected during an intensive survey by the Texas Water Commission (TWC) at two sites, one in Pine Island Bayou, and the other in Little Pine Island Bayou, were analyzed for pesticides and metals at both sites, and also for PCBs at Little Pine Island Bayou. Survey results indicated elevated levels of arsenic, manganese, and mercury, but no state or federal standards were exceeded.

Water quality of Little Pine Island Bayou was considered the worst in the region throughout its length (Hall and Bruce, 1996). Little Pine Island Bayou water quality has long been impacted by saltwater

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(brine) in the Saratoga and Sour Lake area. An influx of brine into Little Pine Island Bayou, either from existing or abandoned oil field operations, increased specific conductance, chloride concentrations, pH, and TDS, and decreased turbidity and color (Kaiser et al., 1993). In July 1985, a pipeline rupture released brine which resulted in exceedingly high specific conductance readings (16,241 mmhos/cm) and a maximum chloride concentration that reached at least 1,400 mg/L in Little Pine Island Bayou. Effects of the spill were studied for 26 months, but persisted beyond that time. Eventually, the brine settled to the bottom of the channel, reducing the specific conductance at the surface to about 2,000 mmhos/cm (Hughes et al., 1987).

In 1978, a study determined that Pine Island Bayou complied with the fecal coliform standard of 200 organisms/100 mL less than 50% of the time during the sampling period during high and low flow conditions (Commander, 1978). Fecal coliform ranged between 0 to 5,880/100 ml, with spikes observed after heavy rains (Harrel and Darville, 1978).

Menard Creek Watershed. Menard Creek originates in central Polk County and flows approximately 48 miles before entering the Trinity River. Menard Creek is an off-stream component of Segment 802 of the Trinity River Basin. Designated uses for this segment are contact recreation, high aquatic life, and public water supply. Two unofficial swimming beaches exist along Menard Creek: Holly Grove and Whoop-N-Holler. These sites have been traditionally used for baptisms in addition to swimming.

Hydrochemical Regime: Menard Creek is among a number of creeks in the Preserve that exhibit low alkalinity and turbidity (Lower Neches Valley Authority, 1992). Additionally, TDS tended to increase on Menard Creek in the downstream direction. Periods of elevated chloride concentrations at Menard Creek have been attributed to contamination by waste brines from the Schwab oil field (Hughes et al., 1987).

Seasonal discharge and stream temperatures were similar to those of Little Pine Island Bayou. Dissolved oxygen concentrations tend to be greater than 5 mg/L, but occasionally drop below 4 mg/L which may be a natural occurrence in streams as influenced by high seasonal water temperatures, concurrent low flows, combined with natural organic loading (e.g., decaying vegetation) (LNVA, 1992). Bacterial counts were not excessive (i.e., mean of 200 fecal coliform/100 mL), but were somewhat elevated.

Data are not available for Menard Creek from water quality assessment reports published by the Trinity River Authority.

FLOODPLAINS

Area topography, soils, and climate all combine to produce a unique flood regime in southeast Texas. The most notable of these factors being its proximity to the Gulf of Mexico moisture source, as well as the effects of tropical storms and easterly waves (Patton and Baker, 1977). Intense storms result in large magnitude runoff events; however, flood peaks are attenuated by broad flat valleys that produce slow-moving, long-duration floods.

In the southern part of the Preserve, the land surface is nearly level and slopes are generally less than one percent. In addition, the high clay and silt content of soils in the area is a major factor contributing to the accumulation of surface runoff. The problems of poor drainage on flatlands cannot be separated from flooding problems.

Floodplains comprise roughly 50 percent of the Preserve, and most of the Preserve's wetlands are located in floodplains. Similarly, the water corridor units and riparian corridors are located in floodplains and consist primarily of floodplain forests. A generalized list of floodplain resources, functions, values and uses includes: food chain production; fish and wildlife habitat; research, educational, and recreational opportunities; hydrologic and sediment modification; groundwater recharge or discharge; water quality; and maintenance of biodiversity.

Floodplains may also benefit agricultural lands, manufacturing, and transportation activities. The scenic qualities of floodplains may be desirable for residential developments. However, when considering floods and floodplain locations there are three important points which should be addressed: (1) flooding in the United States is the most destructive of natural hazards, bringing more loss of life and property damage than any other hazard; (2) approaches for controlling and mitigating losses due to floods have not fully succeeded; and (3) these losses continue to increase (Lamar University, 1996).

Flood Insurance Rate Maps (FIRM), produced by the Federal Emergency Management Agency (FEMA), show several areas of flood hazards. One of these areas is the Special Flood Hazard Area – also referred to as the 100-year floodplain. Areas of 500-year flood are also identified. Figure 3.2 shows the 100-year and 500-year floodplains in the seven-county area of the Preserve. Please note that these maps do not necessarily identify all areas subject to flooding, particularly from local drainage sources, or all surface features outside Special Flood Hazard Areas.

In interpreting the Director's Order 77-2, the construction and operation of flowlines and gathering lines, and roads used exclusively to access oil and gas operations, fall into the Class I Actions category, and the associated regulatory floodplain is the 100-year floodplain. Alternately, actions that would create an added disastrous dimension to the flood event (called critical actions) are Class II Actions, and the associated regulatory floodplain is the 500-year floodplain. Examples of critical actions include well drilling, construction and operation of treatment and storage facilities, and storage of toxic, hazardous and/or water-reactive materials. Most oil and gas operations are classified as critical actions (Class II).

Before an operator is permitted to undertake an action, it will be determined if the proposed action is to occur within a regulatory floodplain. This determination will be made based on the best available hydraulic information, with the FIRM considered the minimal level of information. In the absence of FIRM, the operator will complete an appropriate hydrologic and hydraulic analysis to determine the location of the 100-year and 500-year floodplains within their operations area.

Riparian Corridors

Most riparian corridors in the Preserve lie within the 100-year floodplain. These areas are also referred to as riparian wetlands, bottomland hardwood forests, and floodplain forests. The riparian areas are ecologically important because they:

- Reduce floods by slowing water flow through riparian vegetation including trees.
- Improve water quality when floodwater overflows the banks of the stream or river. Riparian vegetation slows the floodwater so that it can no longer carry its load of sediment that then settles out. The vegetation grows quickly through the sediment, stabilizing it with roots and covering it with plants that utilize the nutrients that could otherwise harm downstream water quality.
- Provide a vital groundwater recharge area when riparian soils absorb excess water during spring snowmelt and other flood events.
- Provide shade that keeps water temperatures cool for fish and vegetative cover for animals looking for food, shelter, and reduced temperatures along the riverbanks.
- Provide key resources that support biological diversity both in the riparian area and nearby uplands.

The Preserve's water corridor units and riparian corridors are composed primarily of floodplain forests. According to Harcombe et al. (1996), floodplains include the broad, flat terraces between the bluffs of the Neches River and along some of the major streams. Floodplain Hardwood Forest occurs on low terraces along the Neches River and in strips along Little Pine Island Bayou, Village Creek and its tributaries, and Menard Creek. Smaller stream floodplains support Floodplain Hardwood Pine Forest.

Riparian corridors in the Preserve consist of two distinct biological communities: the bottomland hardwood forest community located on the floodplain terrace adjacent to major streams; and the aquatic community present within the stream. Two vegetation types, Floodplain Hardwood Forests and Floodplain Hardwood Pine Forests, best represent bottomland hardwood forests located on floodplain terraces adjacent to major streams. In addition, complexes (or extensive intermingling) of these vegetation types define the riparian corridor.

In addition, riparian areas exist throughout the Preserve wherever creeks, rivers, or sloughs are found. These areas are best defined as "interfaces between terrestrial and aquatic ecosystems. As ecosystems they encompass sharp gradients of environmental factors, ecological processes and plant communities. Riparian areas or zones are not easily delineated but are composed of mosaics of landforms, communities, and environments within the larger landscape." (Gregory et al., 1991)

Riparian corridors are important in maintaining the ecological integrity of the Preserve. These areas are formally designated as a Special Management Area under Alternatives B and C, and specific protection is provided. The two vegetation classes – floodplain hardwood forests and floodplain hardwood pine forests – can be seen on the vegetation map (Figure 3.3), and the Riparian Corridors Special Management Area are shown on maps provided in Chapter 2, Part I. Where the riparian corridor is not defined by these vegetation types, or complexes of these types, the corridor width is defined as up to 300 feet from the banks of major streams, whichever area is greater.

Figure 3.2. Floodplains Map

VEGETATION

Vegetation is a fundamental component of the biological diversity of the Preserve. Roughly 1,300 species of trees, shrubs, forbs, and grasses are believed to grow in the Preserve.

A variety of environmental factors including geography, climate, and soil contribute to the botanical diversity of the Preserve. Big Thicket lies at an ecotone between forests to the east and prairies to the west. Moderated by warm Gulf breezes, the climate of the region is sub-tropical with relatively high levels of rainfall that are evenly distributed throughout the year. Just a short distance west, rainfall begins to drop off quickly, and this sudden transition partly explains why Big Thicket is the farthest western extent of many eastern plant species. Edaphic (soil) conditions ranging from relatively impermeable clays to coarse sands also contribute significantly to the floristic diversity of the Preserve. Taken together, the interplay of geography, climate and soils causes abrupt transitions in vegetation: upland pine savannas and sandhills with yucca and cacti often lie just a stone's throw from bottomland hardwood forests and cypress swamps and sloughs.

Numerous vegetation classification systems, descriptive treatments, and maps have been published on forest communities throughout the southeastern United States, including the Big Thicket. Two of the most common broad-based classifications that encompass the Big Thicket region include *The Deciduous Forests of Eastern North America* (Braun, 1950), and *Forest Atlas of the South* (USFS, 1969). Although these classifications have their own unique variations, each includes the Big Thicket Region as a complex of forests dominated by hardwoods on floodplains and pine forests and mixed oak-pine forests on uplands.

Several vegetation classifications specific to the Big Thicket Region have also been published. These include *The Big Thicket Forest of East Texas* (McLeod, 1971), *Big Thicket Plant Ecology: An Introduction* (Watson, 1975), *Wild Flowers of the Big Thicket, East Texas and Western Louisiana* (Ajilvsgi, 1979), and *Forest Vegetation of the Big Thicket, Southeast Texas* (Marks and Harcombe, 1981). Each of these classifications describes vegetation communities in the Big Thicket area by focusing on either dominant vegetation, plant associations, physiognomy (structure or outward appearance), or a combination of these.

The Preserve has relied most frequently on the vegetation classification of Marks and Harcombe (1981) to identify and describe plant communities and to relate the patterns of distribution of species and communities with major environmental gradients. This classification defines and names vegetation on the basis of physiographic position (upland, slope, floodplain, and flatland) and community physiognomy or structure (forest, savanna, or shrub thicket), normally combined with important trees (pine, oak, hardwood). It also emphasizes potential natural vegetation (PNV) rather than existing or actual vegetation, although potential or actual vegetation may be the same in some types. Potential vegetation refers to the structure that would become established if all successional sequences were completed without interference by humans under present climatic and edaphic conditions (including those created by humans) (The Nature Conservancy and Environmental Systems Research Institute, 1994). This classification is applicable to the Preserve because most of the vegetation has been removed in the past. Table 3.8 shows these vegetation types and the approximate acreages found in the Preserve. Figure 3.3 is a Map of Potential Natural Vegetation of Big Thicket National Preserve.

Table 3.8. Potential Natural Vegetation of Big Thicket National Preserve

Physiographic Position	Vegetation Type			
Upland	Sandhill Pine Forest 132 acres	Upland Pine Forest 1,137 acres	Wetland Pine Savanna 1,813 acres	
Slope	Upper Slope Pine Oak Forest 10,342 acres	Mid Slope Oak Pine Forest 4,927 acres	Lower Slope Hardwood Pine Forest 29,522 acres	
Floodplain	Floodplain Hardwood Pine Forest 2,683 acres	Floodplain Hardwood Forest 23,251 acres	Wetland Baygall Shrub Thicket 3,399 acres	Swamp Cypress Tupelo Forest 1,295 acres
Flatland	Flatland Hardwood Forest 8,165 acres			

Upland Vegetation Community

The three upland vegetation types (Upland Pine Forest, Sandhill Pine Forest, and Wetland Pine Savanna) are all strongly influenced by fire and edaphic (soil) conditions. Historically the dominant pine species in the Upland Pine Forest was longleaf pine. In many of these communities, longleaf pine is no longer dominant, however, due to factors such as aggressive fire suppression and logging, and subsequent replanting with faster growing species such as shortleaf pine and loblolly pine. Many Upland Pine stands have converted from longleaf pine to a mixed pine-oak type (Upper Slope Pine Oak) due to the impact of reduced fire frequency.

The Sandhill Pine Forest differs from the Upland Pine Forest in that it is found on very well drained, sandy soils. The term “Sandhill” was borrowed from a similar vegetation type found in the sandhills of the Carolinas. The term is topographically misleading, however, because these communities are actually located on sandy, riverine bluffs and terraces, not hills. In spite of high precipitation, rapid infiltration limits soil moisture, and these areas support a wide variety of plants such as yucca and cacti that are adapted to xeric (dry) conditions and frequent fire. Dominant tree species include post oak (*Quercus stellata*) and bluejack oak (*Quercus incana*). Three types of native pines are also found widely scattered and include longleaf pine (*Pinus palustris*), shortleaf pine (*Pinus echinata*), and loblolly pine (*Pinus taeda*). The past impacts of logging and subsequent fire suppression in these areas may explain why longleaf pine is not the dominant pine species in these communities. The shrub layer, while present, is indistinct in these communities.

Sandhill Pine Forest is the rarest plant community in the Preserve and surrounding Big Thicket region. This community best exemplifies the “Desert Southwest” component of the “Biological Crossroads” paradigm that is often used to describe the ecological setting of Big Thicket. According to Harcombe and Marks (1979), only 132 acres exist in the Preserve; of which 110 acres are found on the Sandhill Loop (trail) in the Turkey Creek Unit, and 22 acres are found in the Big Sandy Creek Unit. Historically, the federally endangered Texas Trailing Phlox was documented in this vegetation community.

Figure 3.3. Map of Potential Natural Vegetation of Big Thicket National Preserve

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Phlox was recently reintroduced to the Sandhills in an attempt to restore this endangered endemic plant. **Given the rarity of this vegetation community and its importance for restoring Texas trailing phlox, Sandhill Pine Forest is designated as a Special Management Area under Alternatives B and C. Sandhill Pine Forest can be seen on the vegetation map (Figure 3.3) and Special Management Areas maps provided in Chapter 2, Part I.**



Texas Trailing Phlox



Sandhill Pine Forest

In contrast to well-drained, sandy soils of the Sandhill Pine Forest type, Wetland Pine Savannas are found on poorly drained soils, with seasonal ponding. The interplay of wetland conditions and frequent fires in these systems is believed to inhibit the invasion of trees. Wetland Pine Savannas are among the rarest plant communities in the southeast and in the Preserve. Over the past two centuries, these communities have been significantly degraded due to human settlement and fire suppression; less than 3 percent of these communities remain. Compared with all other plant communities in the Preserve, wetland pine savannas contain the richest botanical diversity; roughly 100 species of forbs per acre can be found.

Fire plays a critical role in preventing fire-intolerant trees and plants. Unfortunately, the effects of 75 years of aggressive fire suppression in the Big Thicket region has made these plant communities among the rarest in the Preserve, due to invasion by shrubs and trees. The Preserve is using prescribed fire and mechanical thinning as a tool to restore and to maintain these botanically rich communities.

Due to their rarity, Wetland Pine Savanna is designated as a Special Management Area under Alternatives B and C. Wetland Pine Savannas can be seen on the vegetation map (Figure 3.3) and Special Management Areas maps provided in Chapter 2, Part 1.



Wetland Pine Savannah

The third type of upland plant community is



Upland Pine Forest. These pyric (fire-dependent) communities are found on dry uplands and interdistributary ridges. Soil type and past disturbances such as logging and fire are important factors in determining the age and abundance of tree species in these forests. A prototypical stand of Upland Pine Forest is dominated by longleaf pine, and to a lesser extent by loblolly pine and shortleaf pine. Several species of oaks are commonly associated with this community including post oak, bluejack oak, and blackjack oak (*Quercus marilandica*). In stands where fire has burned at frequent intervals, the woody understory is largely absent, and the forest is open and park-like with a rich herbaceous layer of grasses and forbs. Absent frequent fire, the woody understory quickly encroaches and is dominated by species such as flowering dogwood (*Cornus florida*), flame-leaf sumac (*Rhus copallina*), American beautyberry (*Callicarpa americana*), wax-myrtle (*Myrica cerifera*), and yaupon (*Ilex vomitoria*). **Upland Pine Forest is designated as a Special Management Area under Alternatives B and C. Upland Pine Forests can be seen on the vegetation map (Figure 3.3) and Special Management Areas maps provided in Chapter 2, Part 1.**

Upland Pine Forest

Slope Vegetation Community

The slope community contains three distinct vegetation types: Upper Slope Pine Oak Forest, Middle Slope Oak-Pine Forest, and Lower Slope Hardwood Pine Forest. The transition from dry to mesic (moist) soil conditions generally results in a shift from upland forest communities to slope communities. This increase in soil moisture is reflected in the shift from longleaf pine to loblolly pine and shortleaf pine. The species composition of oaks also shifts, with Southern red oak dominating on the upper slopes and white oak (*Quercus alba*) in high abundance on the wetter, lower slopes. Other significant hardwood species include Southern magnolia (*Magnolia grandiflora*) and American Beech (*Fagus grandiflora*). Given the abundance of these three species, the slope forests are often referred to alternatively as Beech-Magnolia-Loblolly forests. Of all vegetation types in the Preserve, many visitors to the Preserve consider these open forests to be the most beautiful and stately. Aside from their aesthetic qualities, the American Beech-Southern Magnolia Series (as designated by the Texas Natural Heritage Program) is considered imperiled because of its rarity both statewide and globally. **Due to its rarity, the American Beech-Southern Magnolia-Loblolly Forest is designated a Special Management Area under Alternatives B and C. This community can be seen on the Special Management Areas maps provided in Chapter 2, Part I.**



American Beech-Southern Magnolia-Loblolly Forest

Floodplain Vegetation Community

Floodplain vegetation communities generally occur along river and creek floodplains throughout the Preserve. Four vegetation types are included within the floodplain position: Floodplain Hardwood Pine Forest, Floodplain Hardwood Forest, Wetland Baygall Shrub Thicket, and Swamp Cypress Tupelo Forest. The Floodplain Hardwood Pine Forest type generally grows along smaller floodplains, where the transition from terrestrial to aquatic environments occurs over a relatively short distance. Dominant pine and hardwood species in this vegetation type are loblolly pine and American beech. American hornbeam (*Carpinus caroliniana*) is an abundant understory species.

Moving from lower order to higher order streams, the floodplains increase in size and Floodplain Hardwood Pine Forest is replaced by Floodplain Hardwood Forest community. This vegetation type is often generally referred to as bottomland hardwood forest. Extensive examples of these forests are found along the Neches River floodplain, especially in the Jack Gore Baygall and Neches Bottom Unit. Dominant tree species in this type include sweetgum (*Liquidambar styraciflua*) and water oak (*Quercus nigra*).

Swamp Cypress Tupelo Forest is found in secondary river and creek channels and along the fringe of oxbow lakes and sloughs throughout the floodplain forests of the Preserve. As the name implies, the dominant tree species are baldcypress (*Taxodium distichum*) and tupelo (*Nyssa aquatica*).

Swamp Cypress Tupelo Forest



Over the past 100 years, most of the old growth forest in the region has been removed. Longleaf pine forests were generally logged first, followed by loblolly forests and eventually the bottomland hardwood forests. Accessibility to timber was a major problem in the bottomlands due to periodic flooding and wet conditions. While the Swamp Cypress Tupelo Forest type was logged extensively for cypress, a few of these relic stands (often just a few individuals) escaped harvest. They now represent perhaps the only example of old-growth left in the Preserve. The cypress loop on the Kirby Nature Trail provides an excellent example of some of the remaining old-growth cypress left in the Preserve. These stands are a rare reminder of the extensive primordial forested swamps that once blanketed the Big Thicket region. Very little information on the locations of old-growth cypress stands exists in the Preserve, so mapping all of these areas is not currently possible. However, remaining old-growth stands or individuals are expected to occur in Special Management Areas. **Swamp Cypress Tupelo Forest is designated as a Special Management Area under Alternatives B and C. This vegetation type can be seen on the vegetation map (Figure 3.3) and Special Management Areas maps provided in Chapter 2, Part 1.**

The fourth floodplain community is the Wetland Baygall Shrub Thicket. The term "baygall" is descriptive of the two dominant tree species that are commonly found in these communities: sweetbay magnolia (*Magnolia virginiana*) and gallberry holly (*Ilex glabra*). Baygalls occur most extensively along the broad floodplain of the Neches River in the Jack Gore Baygall. However, they are not restricted solely to floodplains, and can occur out of the floodplain in association with seeps and springs and ponded areas on uplands and on slopes. Patches of baygalls are occasionally found in wetland pine savannas, and some have suggested that their presence is the result of fire suppression. **Due to their rarity, Wetland Baygall Shrub Thicket is designated as a Special Management Area under Alternatives B and C. Wetland Baygall Shrub Thickets can be seen on the vegetation map (Figure 3.3) and Special Management Areas maps provided in Chapter 2, Part 1.**

The Flatland Hardwood Forest type occurs in the Preserve on flat, low elevation areas where drainage patterns are poorly developed and precipitation remains ponded for long periods of time. Of all the vegetation communities in the Preserve, this particular community appears to be endemic to the Big Thicket. Dominant deciduous tree species include swamp chestnut oak (*Quercus prinus*), willow oak (*Quercus phellos*) and laurel oak (*Quercus laurifolia*). An interesting geomorphic feature known as sand mounds are abundant in this community, and the drier microsites on these mounds frequently support loblolly pine. Jungle-like thickets of dwarf palmetto often dominate the understory in flatland forests. Along with baygalls, these dense palmetto thickets perhaps best exemplify the original and seemingly impenetrable "Big Thicket."

Ecological Research and Monitoring Areas

Certain areas of the Preserve serve as ecological research and monitoring areas. Ecological research and monitoring are important for a number of reasons, including:

- To increase the Preserve's understanding of the importance and effects of disturbances such as fire suppression, wind throw and insect infestations,
- To determine the nature and extent of global climate change,
- To understand the effects of invasive exotic species of plants such as Chinese tallowtree, and
- To learn more about the trends in forest ecology such as recruitment and succession.

Under NPS administration, ecological research and monitoring activities have taken place in the Preserve since the mid-1970's. To support these activities, permanent research and monitoring plots are established throughout the Preserve in a variety of vegetation communities and habitats. The knowledge and insight gained from monitoring these areas over time are critical to better understanding, interpreting, and managing the biodiversity and ecology of Big Thicket. These areas provide long-term research opportunities to study and determine how resources are responding to ecosystem processes and management actions. **Ecological Research and Monitoring Plots are designated as a Special Management Area under Alternatives B and C. These plots can be seen on the Special Management Areas maps provided in Chapter 2, Part 1.** There are over 240 ecological research and monitoring plots located within the Preserve. Many have not been mapped using global position system (GPS) coordinates, but are annotated on maps maintained at the Preserve. Only the 59 plots that have been mapped using GPS coordinates are represented on maps and tables in the Plan/EIS.

Fire Monitoring Plots. The Preserve consists of approximately 13,000 acres of land containing vegetation communities that are highly adapted to periodic fire. Aggressive fire suppression in the region for the past 75 years has impacted these fire-adapted communities by favoring the invasion of fire-intolerant plants and trees. To mitigate the impacts of fire suppression, the Preserve is using prescribed fire to restore fire as a dynamic natural process. A number of fire-effects monitoring plots are located in various fire management units to monitor and gauge the effects of prescribed fire.

Long-term Monitoring Plots. Aside from monitoring for the effects of fire, many other monitoring plots are located throughout the Preserve. These plots are used for studying how Big Thicket vegetation responds to a variety of ecological processes such as forest succession, non-native species invasion and response to disturbances such as tornadoes and global climate change.

The Royal Fern Bog Research Plot. Located in the east corner of the Beaumont Unit, the Royal Fern Bog is a fascinating area both botanically and geomorphically. According to Watson (1982), the Royal Fern Bog area is unique in all of Big Thicket National Preserve. It is a true acid bog, but of much more extensive proportions than the small ones found in other units. Common arrowhead (*Sagittaria latifolia*) and royal fern (*Osmunda regalis*) found rarely and sparsely in other areas, grow here in dominant profusion. As the bog nears the vicinity of the river, it grades from acid bog into slough rather than into baygall as is the case on higher terraces. In recognition of the bog's unique character, the NPS designated the bog as a Research Natural Area (NPS, 1980). Under this management zone, management emphasis is placed on non-manipulative research within undisturbed ecological communities. Access to the bog is limited to NPS personnel and researchers only.

WETLANDS

> "Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year." (Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al., 1979)).

Wetlands are significant in that they produce a large amount of primary production and provide important habitat for the wildlife of the Preserve. All types of wetlands act as a nutrient source, sink, or transformer, and their role may change for different nutrients or for the same nutrient during different seasons (National Research Council, 1995). In general, wetlands function as nutrient cycles and various wetland types maintain different cycle rates. Floodplain wetlands tend to be high-nutrient and bogs are usually low-nutrient. The availability of nutrients in the system, in turn, affects the productivity and biodiversity of the wetland (National Research Council, 1995). Some functions of wetlands are interdependent with the surrounding landscape. For example, wetlands dampen the effects of storms by reducing flood crests and flow rates, thereby reducing flooding in surrounding areas. A variety of amphibians, reptiles, birds, and mammals require wetlands during substantial parts of their lives, and depend on wetlands spaced throughout the landscape. Other creatures have adapted to wetlands that maintain standing water for only a few weeks to a month during the year, and remain dry the rest of the year (National Research Council, 1995). Wetlands also provide essential habitat for 60 percent of all threatened and 40 percent of all endangered species (Feierabend, 1992). Overall, each type of wetland may provide similar functions but for different organisms.

At least 40 percent of the Preserve is comprised of wetlands that can be classified in three systems: palustrine, riverine, and lacustrine wetlands. Table 3.9 lists the acreage of Cowardin classification wetlands by wetland type. Wetland types are combined in Figure 3.4.

Table 3.9. Cowardin Classification System Wetlands in the Big Thicket National Preserve[1]

Wetland Type	Area (Acres)
Palustrine System	31,530
Palustrine System *with two classes (complex)*	180
Riverine System	3,125
Lacustrine System	60
Total	34,895

[1] Based on National Wetlands Inventory maps published in 1987 by the U. S. Fish and Wildlife Service.

Overall, the wetlands currently mapped under the National Wetlands Inventory (NWI) program in the Preserve appear to underestimate the total wetlands acreage. Based on fieldwork during January and February 1999, multiple localities determined to be wetlands in the field were not mapped by the NWI. Additionally, topographic maps (USGS 7.5 minute quadrangle; scale: 1:24000) of the Preserve indicate depressions that are not entirely mapped as wetlands by the NWI. Other studies have also shown wetlands in forested regions to be undermapped (Tiner, 1997; National Resource Council, 1995; and Stolt and Baker, 1995). NWI wetland mapping is difficult in large areas with mineral soils, facultative vegetation, and minor topographic relief (National Resource Council, 1995), conditions similar to those found in the Preserve. The wetland boundaries on the NWI maps are also estimates because the area of the Preserve was mapped from a single air photo for each topographic map; whereas photos taken during each of the seasons may produce different wetland boundaries. Although not all of the existing wetlands of the Preserve are mapped, each of the Cowardin wetland types found illustrates the different habitats and wetlands that occur within the various units of the Preserve. Wetlands are part of the mosaic of plant and animal communities and support a diverse assemblage of life in the Preserve.

The majority of wetlands in the Preserve fall within the palustrine system (nontidal wetlands dominated by trees, shrubs, or persistent emergents). Non-vegetated wetlands smaller than 20 acres, less than 6 feet deep, lacking a wave-formed or bedrock shoreline, and with low salinity (less than 0.5 ppt from ocean-derived salts), also fall under the palustrine system (Cowardin et al., 1979). The palustrine classes found in the Preserve are forested, scrub-shrub, emergent, unconsolidated bottom (also called open water), or mixtures of classes (i.e., complexes). The open water class was combined with the unconsolidated bottom class in the 1979 publication of the Cowardin classification system (Pipken, pers. comm.), and is now only referred to as “unconsolidated bottom.”

The palustrine emergent wetlands of the Preserve contain nonwoody aquatic plants such as rushes (*Juncus* spp.), arrowheads (*Sagittaria* spp.), sedges (*Carex* spp.), grasses, vines, pitcherplants (*Sarracenia alata*), and other plants. Organisms found in emergent wetlands include aquatic invertebrates (e.g., insects, snails, crayfish), aquatic vertebrates (e.g., fish), amphibians (e.g., salamanders, frogs, toads), reptiles (e.g., snakes, turtles, alligators), birds, and mammals (e.g., beaver, muskrat). Emergent wetlands are generally considered to have high productivity rates and act as nutrient pumps as plants take in ions and then release some back to the water and soil when they die (Mitsch and Gosselink, 1993).

The palustrine forested and scrub-shrub wetlands are also referred to as riparian wetlands, bottomland hardwood forests, and floodplain forests. These wetlands tend to be linear in shape as they form in floodplains (Mitsch and Gosselink, 1993). The forested and scrub-shrub wetlands are characterized by a dominance of woody vegetation including baldcypress, tupelo gum (*Nyssa aquatica*), black gum (*Nyssa sylvatica*), oaks (*Quercus* spp.), river birch (*Betula nigra*), sweetgum,

Figure 3.4. Wetlands Map

sweetbay (*Magnolia virginiana*), sycamore (*Plantanus occidentalis*), American hornbeam, baygall holly (*Ilex coriacea*), red maple (*Acer rubrum*), and red bay (*Persea borbonia*). They also contain some nonwoody vegetation such as various grasses, vines, mosses, and other hydrophytes. They have high biodiversity, and more substances flow through these riparian wetlands than other types (Mitsch and Gosselink, 1993). The hydrology of these wetlands is sustained by a high water table and flooding. Additionally, the functioning of these areas is connected to the physical, chemical, and biological processes of the nearby streams (National Resource Council, 1995).

The palustrine unconsolidated bottom wetlands consist of less than 30 percent vegetative cover (Cowardin et al., 1979). The types of vegetation, if any, at these sites is similar to vegetation found in forested, scrub-shrub, and emergent wetlands. These wetlands are essentially small, shallow ponds that provide water and nutrients to organisms. While some of these sites in the Preserve qualify under the Cowardin definition of wetlands used by the NPS, they do not qualify as U.S. Army Corps of Engineers wetlands under the Corps' wetlands definition, because of the lack of vegetation and/or the water is too deep. The Corps does, however, consider these areas to be "waters of the U.S." and jurisdictional (33 CFR 328.3). The ponded sites that are isolated from streams often offer crucial habitat for migrating waterfowl (National Resource Council, 1995). The unconsolidated bottom wetlands also provide habitat for aquatic invertebrates and vertebrates, reptiles, amphibians, birds, and mammals.

The riverine system consists of wetlands and deepwater habitats within stream channels. The riverine classes found in the Preserve are unconsolidated bottom and unconsolidated shore. The majority of the riverine wetlands lie within the Neches River corridor, including the Jack Gore Baygall and Neches Bottom Unit. Besides the river and some other channels, additional riverine wetlands are pointbars and sites located immediately along the Neches, Little Pine Island Bayou, and Pine Island Bayou. While the Neches River qualifies under the Cowardin definition of wetlands used by the NPS, it does not qualify as U.S. Army Corps of Engineers wetlands under Section 404 of the Clean Water Act – because of the lack of vegetation and/or the water is too deep. However, the Corps does consider it a "water of the U.S." and jurisdictional (33 CFR 328.3).

Wetlands larger than 20 acres, situated in topographic depressions or a dammed river channel, and with vegetation covering less than 30 percent, are classified as lacustrine wetlands (Cowardin et al., 1979). Only two localities in the Preserve are currently categorized as lacustrine, with classes of unconsolidated bottom or unconsolidated shore. These sites provide habitat for various organisms, hunting opportunities, and the possibility for nature trails.

The following rare vegetation communities are found in wetlands areas and are designated as Special Management Areas: Wetland Baygall Shrub Thicket, Wetland Pine Savanna, Swamp Cypress Tupelo Forest, and Royal Fern Bog.

FISH AND WILDLIFE

Introduction

The Big Thicket region has long been recognized for possessing a diverse array of fauna and flora. This area provides habitat for plant and animal species of the southeast swamps, pineywood forest, post-oak belt, Great Plains, southwest deserts, and the coastal prairie.

The abundant and diverse vegetation of the Preserve supports aquatic and terrestrial habitats for a variety of fish and wildlife. Many studies of specific types of wildlife, such as inventories of mammals, have been performed in the Big Thicket region over the past century. Some of the most thorough inventories were conducted shortly after the Preserve's establishment in 1974. The

following section summarizes these studies, literature reviews, and wildlife observations to describe fauna believed to inhabit the Preserve. Rare, threatened, and endangered species of plants and animals are discussed under the Species of Special Concern section.

Mammals

Of the 181 mammals listed for Texas, 60 are either documented or believed to inhabit the Preserve. Several large species are now extirpated in Big Thicket due to a variety of factors including habitat destruction and overhunting. These include the jaguar, ocelot, red wolf and the Louisiana subspecies of the American black bear. Although occasional sightings of black bears have been reported near the Preserve, no populations are believed to be reproducing in East Texas.

Birds

Birds are the most visible and diverse group of vertebrate fauna found in the Preserve. Currently 176 species have been documented. This figure is thought to be low, because no comprehensive inventory of birds has ever been performed. The Preserve lies on a major migratory flyway, and many species of birds are transient during spring and fall migrations. Birds found in Big Thicket predominantly consist of three categories: passerines (including many neotropical songbirds), raptors and waterfowl. The abundance and variety of birds in the Big Thicket contribute to one of the favorite visitor activities, bird watching.

Reptiles and Amphibians

Approximately 85 species of reptiles and amphibians are believed to inhabit the Preserve (Harcombe et al., 1996). This figure represents roughly 33 percent of the 235 species of reptiles and amphibians in Texas. The most diverse group of reptiles in Big Thicket is snakes. Texas has 68 species of snakes, and half of these inhabit Big Thicket. Other types of reptiles include skinks, lizards, turtles, and the American alligator. Three types of amphibians including frogs, toads, and salamanders inhabit Big Thicket.

Fish

Of all faunal groups in the Preserve, fish are perhaps the most thoroughly inventoried: 92 species are believed to inhabit Preserve waters. In small tributaries, the most abundant species of fish include minnows, darters, bass, and bullhead catfish. This pattern shifts in larger tributaries, which are dominated by channel, blue and flathead catfish; sunfish; largemouth and spotted bass; and crappie.

Invertebrates

A recent inventory of lepidoptera (butterflies, moths, and skippers) has documented over 1,800 species (Bordelon and Knudson, 1999); this is believed to be the greatest species diversity in the contiguous United States. In aquatic environments, insects and mussels are the most thoroughly documented species. Comprehensive inventories in the Village Creek drainage have documented 249 species of common macroinvertebrates including dragonflies, caddisflies, mayflies and stoneflies. Three species of aquatic insects are endemic to the Big Thicket region (Abbott and

Stewart, 1997), and two are candidates for federal listing (see Table 3.10). Thirty-four species of mussels, including the Texas heelsplitter (*Potamilus amphichaenus*) live in the Lower Neches River watershed (Howells, 1996). This portion of the watershed includes most of the units of the Preserve.

Habitat Fragmentation

The Preserve consists of eight discrete land units connected by four narrow water corridor units. The water corridor units, varying in width from 1,000 to 1,500 feet, were established in part to offset the effects of fragmentation by providing ecological connectivity between otherwise isolated units. However, the degree to which these habitat corridors serve as migration routes or enhance the persistence of fish and wildlife species has not been adequately tested.

With few exceptions, the Preserve's land and corridor units are crossed by roads, trails, pipeline and power line corridors, oil and gas operations, and one railway. Therefore, the geographic configuration of the units, along with the further contributions of human-induced developments, result in fragmentation of wildlife habitat. In general, habitat fragmentation has two major interrelated consequences for biological diversity: (1) population isolation and decrease in effective population size, and (2) creation of edge habitat and its effects (Harcombe and Callaway, 1997).

Population Isolation. Habitat fragmentation can result in demographic isolation of populations and/or subpopulations, resulting in inadequate exchange between populations or subpopulations to maintain demographic and genetic viability. Isolated populations are at greater risk of decline due to effects of random events such as storms, drought and reduced food availability. The effects of habitat fragmentation may explain why most of the original predators of the Big Thicket (jaguars, black bears, red wolves, and ocelots) are now extirpated.

Edge Habitat. Another potential effect associated with habitat fragmentation is the creation of "edge" habitat. Edge habitat is produced whenever there is an abrupt discontinuity between vegetative cover (Harris, 1988). Pipeline rights-of-way are a good example of edge habitats, and the Preserve's water corridor units are a long continuous edge zone. Impacts of edge habitats, often referred to as "edge effects" include the movement of exotic species into interior habitats, and increased predation and mortality (e.g., road kill) as animals cross edges between habitats (Harris and Gallagher, 1989). While the impacts of edge effects are known to be ecologically significant, there is no generally accepted threshold of significance. Rather, it is generally accepted that increased edge habitat, often described quantitatively as the edge-to-interior ratio, has a greater ecological impact as the ratio increases.

SPECIES OF SPECIAL CONCERN

Overview of Species

Under the Endangered Species Act of 1973 (ESA), the NPS has responsibility to address impacts to federally-listed threatened, endangered, candidate and species proposed for listing. Also, NPS policy requires that State-listed species, and others identified as species of management concern by the park, are to be managed in parks in a manner similar to those that are federally-listed. Big Thicket National Preserve does not have any species of management concern identified. Thus, federal and State-listed species will be addressed in this Plan/EIS following federal law and NPS policy.

The terms “threatened” and “endangered” describe the official federal status of certain species in the Preserve as defined by the ESA. The term “candidate” is used officially by the U.S. Fish and Wildlife Service (FWS) when describing those species for which the Service has on file sufficient information on biological vulnerability and threats to support issuance of a “proposed rule to list,” but issuance of the proposed rule is precluded. No candidate species are currently believed to inhabit the Preserve. The term “proposed” describes species for which a “proposed rule to list” has been published in the Federal Register, however, a finalized rule has not yet been issued. Texas has enacted regulations similar to the ESA that confer threatened and endangered status to certain species that inhabit areas in the state. NPS policies dictate that federal candidate species, proposed species and State-listed threatened and endangered species are to be managed to the greatest extent possible as federally-listed threatened and endangered species (NPS, 1991). Therefore, these species are included in this discussion. See Appendix G, “U.S. Fish and Wildlife Service County-by-County Listing of Threatened and Endangered Species and Species of Concern,” and Appendix H, “Texas Parks and Wildlife Department Special Species List” for species that occur in the counties where the Preserve is located.

A listing of species of proposed, candidate, threatened and endangered species specific to Big Thicket is problematic to compile because listed species are rare by default, and current, comprehensive inventories of flora and fauna in the Preserve are incomplete. Moreover, the FWS publishes lists by county, and political boundaries do not coincide with natural boundaries such as habitats or ecoregions. Since the Preserve is located in parts of seven east Texas counties, not all of the species listed for these counties (such as marine species) have suitable habitat. Nonetheless, all federally-listed and State-listed species believed to occur permanently or transiently (such as migrating birds) in the Preserve based on past inventories, existing and potential habitat, documented sightings, and professional judgement are listed in Table 3.10.

Table 3.10. State and Federally Listed Candidate, Threatened and Endangered Species Believed To Occur in Big Thicket National Preserve

Status: E=Endangered, T= Threatened, C=Candidate, PDL=Prpoposed for Delisting, N/L=Not Listed.

Common Name	Latin Name (names in italics)	Type	Federal Status	State Status
American Swallow-tailed Kite	*Elanoides forficatus*	Bird	N/L	T
Bachman's Sparrow	*Aimophila aestivalis*	Bird	N/L	T
Bald eagle	*Haliaeetus leucocephalus*	Bird	T/PDL	T
Interior Least Tern	*Sterna antillarum athalassos*	Bird	E	E
American Peregrine Falcon	*Falco peregrinus anatum*	Bird	N/L	E
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	Bird	N/L	T
Brown Pelican	*Pelicanus occidentalis*	Bird	E	E
Piping Plover	*Charadrius melodus*	Bird	T	T
Red-cockaded Woodpecker	*Picoides borealis*	Bird	E	E
White-faced Ibis	*Plegadis chihi*	Bird	N/L	T
Wood Stork	*Mycteria americana*	Bird	N/L	T
Blue Sucker	*Cycleptus elongatus*	Fish	N/L	T
Creek Chubsucker	*Erimyzon oblongus*	Fish	N/L	T
Paddlefish	*Polyodon spathula*	Fish	N/L	T
Louisiana Black Bear	*Ursus americanus luteolus*	Mammal	T	T
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*	Mammal	N/L	T
Navasota Ladies'-Tresses	*Spiranthes parksii*	Plant	E	E
Texas Trailing Phlox	*Phlox nivalis var. texensis*	Plant	E	E
Alligator Snapping Turtle	*Macroclemys temminckii*	Reptile	N/L	T
Loiusiana Pine Snake	*Pituophis melanoleucus ruthveni*	Reptile	C	T
Northern Scarlet Snake	*Cemophora coccinea copei*	Reptile	N/L	T

Status: E=Endangered, T= Threatened, C=Candidate, PDL=Prpoposed for Delisting, N/L=Not Listed.				
Common Name	**Latin Name (names in italics)**	**Type**	**Federal Status**	**State Status**
Canebrake Rattlesnake	*Crotalus horridus atricaudatus*	Reptile	N/L	T

Birds

American Swallow-Tailed Kites (*Elanoides forficatus*): American Swallow-tailed kites (State threatened) are migratory raptors that inhabit bottomland hardwood forests along major river bottoms in the southeastern United States and winter in South America. Kites historically bred throughout the southeastern United States, however, populations have declined throughout the southeast in recent years. According to Rappole and Blacklock (1994), kite populations are now considered rare and local in Louisiana, South Carolina, and Georgia; good populations of kites are now only found in Florida. A recent survey of Swallow-tailed kites in East Texas (Shackelford and Simmons, 1999) documented 277 sightings and only one nest. Most sightings of kites in the Preserve have been reported in spring and summer months along the mid- and upper-portions of the Neches River. Although no kite nests have been found, the routine sightings of this species along the Neches strongly suggest that it may be nesting in mature bottomland forests in or near the Preserve.

Bachman's Sparrow (*Aimophila aestivalis*): Bachman's Sparrow (State threatened) is an uncommon, endemic resident of east Texas. Preferred habitat for Bachman's sparrow includes mature longleaf pine savannas, open pine woods and brushy overgrown fields (Rappole and Blacklock, 1994). The sparrow is a documented nesting resident of the Preserve; however, it is rare and secretive – and therefore, nesting and foraging locations are likely to be underreported. The most common sightings of Bachman's sparrow have been along Gore Store road in, or near, the Turkey Creek Unit.

Bald Eagle (*Haliaeetus leucocephalus*): Although formerly common, Bald eagles (federally threatened; State threatened) are rare residents in East Texas. They prefer large lakes and rivers with tall trees along the shoreline. Bald eagles have been sighted most frequently near McQueen's landing in the Upper Neches River Corridor Unit of the Preserve, and at the confluence of Menard Creek and the Trinity River in the Menard Creek Corridor unit.

Interior Least Tern (*Sterna antillarum*): Least Terns are only afforded protection under the ESA for those populations at least 50 miles inland from the coast. They nest on sparsely vegetated sandbars along major river systems. Migratory individuals may occur in the area of the preserve enroute to and from their wintering grounds in central and South America.

Peregrine Falcon (*Falco peregrinus*): Two subspecies of Peregrine Falcon are found in Texas: the American Peregrine (*Falco peregrinus anatum*) and the Arctic Peregrine (*Falco peregrinus tundrius*). Both species were delisted on August, 25, 1999, but remain State listed as endangered and threatened, respectively. The American Peregrine is a resident of the Trans-Pecos region, including Big Bend National Park, and the Chisos, Davis, and Guadalupe mountain ranges. Arctic Peregrines migrate through Texas twice a year to and from their wintering areas in South America. They stop on the Texas Coast to feed before continuing their migration. In Big Thicket, peregrines (most likely the arctic subspecies) have been documented along the Neches River and in or near the Turkey Creek and Hickory Creek Units during spring and fall migrations.

Brown Pelican (*Pelicanus occidentalis*): The Brown pelican (State and federally listed as endangered) is an uncommon permanent resident of the Texas coast. Preserve staff have observed pelicans near the terminus of the Neches River at Sabine Lake and at High Island southeast of Port Arthur; however, no pelicans have been documented in the Preserve. Pelicans might venture up the Neches River into the Beaumont Unit of the Preserve, but this would be a rare occurrence.

Piping Plover (*Charadius melodius*): Piping Plovers (federally threatened and State threatened) are uncommon winter residents along the Texas coast and are considered rare to casual winter transients in the eastern third of the state. Habitat includes sand and gravel shorelines, river sandbars and islands. No piping plovers have been documented in the Preserve; however, the lower Neches River provides a corridor for movement of plovers inland from their coastal habitat. The large sandbars along the Neches River could also provide nesting habitat.

Red-cockaded Woodpecker (*Picoides borealis*): Red-cockaded Woodpeckers (federally endangered, State endangered) are year-round inhabitants of the Pineywoods of East Texas. Red-cockaded woodpeckers prefer open, park-like stands of mature pine maintained by frequent fire. Little of this habitat remains in the Preserve due to the lasting impacts of logging and fire suppression. In time, however, pine forest regeneration and periodic prescribed fire should create more favorable habitat in uplands throughout the Preserve. Until recently, active colonies were documented in upland pine forests in the Big Sandy Unit. These colonies became inactive in the mid-1990's, but the cavity trees and associated habitat remain and could be recolonized in the future.

White Faced Ibis (*Plegadis chihi*): The white-faced ibis (State threatened) is predominately a coastal species that inhabits a wide variety of freshwater and estuarine environments. The south Texas coast appears to be the northern limit of the ibis's breeding range. This species is considered a rare transient in the eastern third of Texas during spring and fall migration (Rappole and Blacklock, 1994), and could be found in the Preserve. To date, no sightings of white faced ibis in the Preserve have been documented.

Wood Stork (*Mycteria americana*): Wood storks (State threatened) have been seen in a variety of wetland and riverine locations throughout the Preserve, including along the Little Pine Island Bayou in the Lance Rosier Unit, the Beaumont Unit, and the Lower Neches River Corridor Unit. Storks in the Preserve are believed to be post breeding transients from populations in southern Mexico. While these populations are considered stable, storks from separate breeding populations in Florida are listed as federally endangered due to habitat loss and low numbers. Storks may have bred historically in Texas, but no breeding populations are currently believed to exist. Preferred inland habitat includes large lakes and forested wetlands (Rappole and Blacklock, 1994).

Fish

Blue Sucker (*Cycleptus elongatus*) and Creek Chubsucker (*Erimyzon oblongus*): No federally-listed fish species are believed to inhabit the Preserve. However, three State-listed species have been documented during past fish inventories and research projects: the blue sucker (Cycleptus elongatus), creek chubsucker (Erimyzon oblongus), and the paddlefish (Polyodon spathula). The blue sucker and creek chubsucker are both listed as State threatened. Creek chubsuckers have been found in relatively high abundances in the upper portions of Big Sandy Creek in the Big Sandy Unit and in Beech Creek in the Beech Creek Unit. Both of these creeks are clean, low-order (i.e., small, low flow) black water systems. In contrast to the abundance of creek

chubsuckers, only one blue sucker has been documented in the Preserve. It was found in the Neches River near Highway 1013 (Suttkus and Clemmerer, 1979; Evans, 1977).

Paddlefish (*Polyodon spathula*): Paddlefish (State threatened) generally inhabit large rivers in the Mississippi river drainage and adjacent Gulf coastal plain. Paddlefish have been documented in the Lower Neches River and at the confluence of the Neches River and Little Pine Island Bayou (Seidensticker, 1994). Unlike most large riverine fish, paddlefish are planktivorous as opposed to piscivorous. Paddlefish require cool temperatures, large flows, and gravel bottoms for spawning (Rosen and Hales, 1981). The lower Neches River does not typically have flows of sufficient magnitude, and gravel substrate is uncommon, so spawning habitat is considered marginal. Nonetheless, the backwaters of the Neches could provide important feeding areas for paddlefish during the summer months. The Texas Parks and Wildlife Department recently developed a recovery plan for paddlefish in the Neches River that included annual stocking of paddlefish below Dam "B" on the Upper Neches River corridor. The Texas Parks and Wildlife Department is not doing stocking of paddlefish in the lower Neches River. The effectiveness of paddlefish recovery has yet to be documented.

Mammals

Only two listed mammals are believed to occur in or near to the Preserve. Since the turn of the century, several species of predatory mammals have been extirpated due to a variety of factors including predator control, overhunting and poaching, habitat loss and population isolation. These species include the jaguar, red wolf and ocelot.

Black Bear (*Ursus americanus ssp. luteolus*): The Louisiana black bear is federally listed as threatened and State listed as threatened. The closest known reproducing populations of Louisiana black bears are in the Atchafalaya basin in Louisiana. Occasional sightings of bears have been reported in East Texas, so occurrences of bears in the Preserve (especially wandering males) are possible. Two separate studies aimed at identifying potential habitat for black bear reintroduction have identified suitable habitat in the Neches Bottom/Jack Gore Baygall Unit of the Preserve (Garner, 1996; Epps, 1997). This area could serve as core habitat for bears in the future, through reintroduction efforts or expansion of existing populations in Louisiana. However, any reintroduction effort would require the active participation and support of a number of public and private land management agencies and the public to ensure the provision of sufficient habitat and to prevent poaching and other bear-human conflicts. Continued fragmentation of habitat in the Big Thicket and surrounding region could preclude the possibility of black bear reintroduction.

Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*): Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) is State listed as threatened. This bat is easily distinguished from other bats by its immense ears. East Texas is considered the western distributional limit of this species. Preferred habitat for this species includes hollow trees, crevices behind bark, and dry leaves, although it is most frequently found in occupied and abandoned buildings (Davis, 1974). A temporary roost of Rafinesque's big-eared bats was documented in the Little Pine Island Bayou Unit in 1995 (Horner and Maxey, 1998), and occurrences elsewhere in the Preserve are likely (Schmidly et al., 1979).

Plants

Navasota Ladies'-Tresses (*Spiranthes parksii*): Navasota Ladies'-Tresses (Spiranthes parksii) is a federally-endangered and State-endangered species of orchid that is endemic to southeast Texas. Navasota ladies'-tresses grows in moist, sandy soils in small openings on gentle

slopes and along intermittent tributaries of the Brazos, Navasota and Neches Rivers. The species has a limited range and low population numbers. Reasons for endangerment include habitat loss and degradation due to development and road construction (Fish and Wildlife Service, 1992). Most populations of Navasota Ladies'-Tresses have been documented in post oak savannah vegetation community types west of Big Thicket; however, a separate population exists in northwestern Jasper County just east of the Upper Neches River Corridor Unit. Although this plant has not been documented in the Preserve, it could occur given the close proximity of the Preserve to the Jasper population and the existence of favorable habitat along upper Neches River.

Texas Trailing Phlox (*Phlox nivalis var. texensis*): Texas trailing phlox (*Phlox nivalis var. texensis*) is a federally-endangered and State endangered plant species that is endemic to southeast Texas. Populations of phlox are only currently found in three counties: Hardin, Polk and Tyler. Texas trailing phlox is a fire-adapted plant species that grows in fire-maintained openings in upland longleaf pine savannas or post oak-bluejack oak woodlands on deep sandy soils. Considered very rare and imperiled less than a decade ago, its numbers have increased at some sites during the last few years. This trend may indicate that prescribed burning of its habitat, which allows more light to reach the ground and possibly influences nutrient availability, is essential to its continued survival and recovery (Texas Parks and Wildlife, 1997; Ajilvsgi, 1979). Phlox currently grows in two locations in the Big Sandy Unit and in two locations in the Turkey Creek Unit. The population in the Turkey Creek Unit was established from cuttings taken from plants in Roy E. Larsen Sandylands sanctuary, owned and managed by the Nature Conservancy of Texas.

Reptiles

Alligator Snapping Turtle (*Macroclemys temminckii*): The alligator snapping turtle (*Macroclemys temminckii*) is listed as State threatened. Considered one of the largest freshwater turtles in the world, it lives in deep, fresh waters with muddy bottoms (such as rivers, lakes, oxbows, and sloughs) and occasionally enters brackish water. The species is rare mainly due to international and domestic demand for its meat, although it has also declined as a result of habitat loss from reservoir construction, channelization of streams and rivers, placement of dredge spoil on riverbanks, recreational use of riverbanks and sandbars, removal of snags and water pollution (FWS, 1994; Ernst and Barbour, 1972). Almost all of the units of the Preserve provide habitat for alligator snapping turtles. Alligator snappers have been documented in Turkey Creek, the Neches River and most recently (May, 1999) in Menard Creek. The Menard Creek specimen weighed 116 pounds and had a 26 inch diameter shell.

Louisiana Pine Snake (*Pituophis melanoleucus ruthveni*): The Louisiana pine snake (*Pituophis melanoleucus ruthveni*) is a federal candidate species and State listed as threatened. The Louisiana pine snake mainly uses small mammal (especially pocket gopher) burrows as shelter (Craig Rudolph, pers. comm.), and feeds chiefly on small mammals. The snake is limited to sandy soils in hardwood-conifer forests of western Louisiana and East Texas. Within this broad ecoregion, upland longleaf pine savanna habitat appears to be preferred (Conant, 1975). To date only one Louisiana pine snake has been found in the Lance Rosier Unit of the Preserve, although favorable habitat exists as well in both the Big Sandy and Turkey Creek Units.

Northern Scarlet Snake (*Cemophora coccinea copei*): The northern scarlet snake is listed as threatened by the State of Texas. The northern scarlet snake is considered by the Texas Parks and Wildlife Department as rare or uncommon in the State. Preferred habitat for this species is sandy soil in both pine and hardwood forests. It will avoid wet areas, but can be found along dry sandy ridges in close proximity to baygalls and floodplains (Tennant, 1984). This species has not been documented in the Preserve to date, but potential habitat exists in most of the units.

Timber Rattlesnake (*Crotalus horridus*): The timber rattlesnake (*Crotalus horridus*) is listed as threatened by the State of Texas. In the past, two subspecies of timber rattlesnake were believed to be in East Texas: the canebrake rattlesnake and the timber rattlesnake (Conant, 1975). However, recent research suggests that the canebrake rattlesnake is simply a color variant and not a separate subspecies (Craig Rudolph, pers. comm.). Timber rattlesnakes have been documented in the Lance Rosier Unit, Turkey Creek Unit and Big Sandy Unit of the Preserve.

CULTURAL RESOURCES

Archeological Resources

Archeological resources consist of "any material remains or physical evidence of past human life or activities which are of archeological interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research" (NPS 1997:177). A complete inventory of archeological resources within Big Thicket National Preserve has not been conducted, although several surveys have been conducted in recent years ahead of 3-D seismic surveys in the Beaumont, Jack Gore Baygall and Neches Bottom, and Lance Rosier Units. Approximately 30 archeological sites are known within the 151-square-mile Preserve, but none have been evaluated for eligibility to the National Register of Historic Places. Known archeological resources are divided into two categories, as discussed below.

Prehistoric sites, although not numerous, do occur within the Preserve. Based on what is known about the general East Texas regional archeology, prehistoric sites are subdivided into three temporal periods: Paleoindian sites that date to ca. 8,000-6,000 BC; Archaic sites that date between ca. 6,000 BC and AD 100; and Late Prehistoric sites that date to AD 100-1500. Paleoindian and much of the Archaic period sites are known only from the coastal area south of Beaumont with shell middens being the typical early-to-middle Archaic site type. The latter part of the Archaic (ca. 1500 BC to AD 100) was a period of more widespread utilization of areas beyond the coastal zone, including the Neches River and its tributaries. This change is also characterized by the introduction of ceramics, the bow and arrow, and maize agriculture, along with the retention of plant food gathering and shellfish collecting. These new innovations were introduced by the Hopewell Culture of the Lower Mississippi Valley who greatly influenced the local East Texas populations. By the time of European contact, the local populations would be identified as various tribes of the Caddo and Atakapa. Within the Preserve, archeological sites of the prehistoric period are typically buried, with stone flakes and, occasionally, ceramic shards exposed. Such sites often occur on slightly elevated ridges near the watercourses.

In the Pipkin Marsh area of southwest Jefferson County, test excavations at three archeological sites near Big Hill Salt Dome uncovered evidence of human habitation stratified within naturally-formed sand mounds. Datable artifact assemblages indicate the mounds were created between 100 B.C. and A.D. 1300 (Aten and Bollich, 1981). Due to the slightly higher elevation of sand mounds, these features were selected over lower-relief areas for human occupancy and, therefore, have a high potential for the discovery of archeological sites.

Large temple mounds, smaller burial mounds and agricultural villages built by the Caddo Indians and dating from late prehistoric times (A.D. 500–1500) are located in the piney woods of East Texas (http://www.thc.state.tx.us/archeologyaware/aaphsites.html). Located approximately 130 miles northwest of Beaumont, TX is the Caddoan Mounds State Historical Site. Built between A.D. 750 and A.D. 1250, the ceremonial center contains a major village containing ceremonial temple mounds and a burial mound. Arrowheads, axes, copper and quartz pieces, clay pipes, other sacred items,

and human remains have been found beneath the mounds at the State Historic Site. (http://www.tpwd.state.tx.us/park/pom/200406.phtml)

If oil and gas operations are permitted on temple mounds or sand mounds in the Preserve, cultural artifacts would be protected by the National Historic Preservation Act, Native American Graves Protection and Repatriation Act and all other applicable laws and regulations.

Historical sites occur throughout the Preserve and consist of material remains of Euroamerican occupation of the Big Thicket from the early 1800's through the mid-20th century. The area was under varying degrees of influence from Spain, France, and England until 1802 when the United States acquired it from France as part of the Louisiana Purchase. No archeological sites from these early historic periods are known, but many remains from the latter half of the 19th and first half of the 20th century can be found throughout the park. Although few have been formally recorded as archeological sites, they include remnants of homesteads; logging camps and mills; hunting camps; river craft; roads, trails, and traces; ferry crossings; steamboat landings; abandoned communities; and early oil and gas production sites. The water transportation sites occur along the Neches River and its tributaries (particularly Little Pine Island Bayou), while other historical archeology sites are scattered throughout the Preserve and reflect economic ventures associated with early homesteading and agriculture/ranching pursuits of the early 19th century, through the timber industry boom of the late 19th century, and the oil and gas boom of the early 20th century. Other sites of the historic period may be related to the immigration of the Alabama and Coushatta tribes whose move into southeast Texas both geographically and temporally paralleled that of early settlers from the United States. Former village sites, hunting camps and other localities of cultural importance undoubtedly occur within the Preserve boundaries, but have not yet been identified.

Historic Structures

Historic structures in the Preserve are those elements of the built environment that have survived relatively intact and which illustrate some historical aspect or association with the region's or Preserve's past. No structure in the Preserve is currently listed in the National Register of Historic Places. The State Historic Preservation Officer (SHPO) deemed the Saratoga School gymnasium eligible for the National Register in 1994. However, the building was deteriorated and declared unsafe and in 1995 the NPS completed the required site documentation and the building was demolished.

The only historic structure potentially significant under the National Register criteria is the Brammer House, immediately adjacent to the Saratoga school property. A rectangular wood frame residence, the building is characterized by wood clapboard siding, a front gabled porch, exposed rafter ends, and double-hung wood windows. It has been included in the List of Classified Structures, and is being considered for listing in the National Register pending SHPO concurrence.

Ethnographic Resources

Ethnographic resources are sites, structures, objects, landscapes, or natural resource features assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it. The decision to call resources "ethnographic" depends on whether associated peoples perceive them as traditionally meaningful to their identity as a group and the survival of their lifeways (NPS 1997:181, 160).

The abundance of game and other foodstuffs in the Big Thicket made it a long-time hunting, fishing and gathering ground for generations of indigenous peoples, early and recent immigrants, and

longtime settlers. The region, however, was also impenetrable and downright hostile, and forays into its center and swamps were infrequent and seasonal. Not only was settlement limited into the 20th century, but so was exploitation of its resources.

When Big Thicket National Preserve was established, acquisition procedures, coordinated with local interest groups, generally excluded settlements and farmsteads and, thus, ethnographic resources were mostly avoided. Nonetheless, specific efforts were made to determine the association between the Preserve and traditionally associated communities for the purposes of this Plan/EIS. Historical associations between the Preserve and various communities were researched and reported (Moss, 1998). Subsequent field visits were made in a preliminary effort to identify specific resources that might retain cultural significance to park-associated communities. Additionally, a meeting between park staff and the Alabama and Coushatta tribes was held to determine if the tribes had particular concerns about potential effects of oil and gas development on ethnographic resources. Through the background research, field visits, and meetings, the following park-associated groups were identified:

American Indian Tribes. The Federal Government has specially mandated responsibilities toward American Indian interests, including but not limited to those required by the NHPA. For purposes of this Plan/EIS, it was crucial to determine if there are American Indian tribes that retain customary associations with park land and, if so, if there are places in the Preserve to which they may ascribe cultural significance and which require special management considerations. Further, American Indian tribal identities are often rooted in the landscapes from which their origins derived and are intricately linked with tribal traditional history. These histories are common to the cultural group as a whole and are passed from generation to generation, making the physical places themselves an integral component of cultural continuity. Five tribal groups have historic associations with the Big Thicket and with various units of the Preserve. These include:

Atakapa. Although anthropologists commonly consider descendents of this group to be fully absorbed into other tribes, an effort should be made to determine any continuing affiliations and associations that other American Indian groups may have with the earlier Atakapas and any affiliations they may have with the Preserve.

Caddo. The Caddo Confederacy formed one of the most important and influential groups of Texas Indians and were probably the most complex collection of related groups to occupy the general East Texas region. Although they had linguistic ties to tribes to the north and west, they had stronger cultural affiliation with the Creeks and other tribes to the east, particularly the Natchez of Louisiana. Historically, the Caddo lived on the northern boundaries of the Big Thicket, occupying the "piney woods", while the Atakapa occupied the coastal strip just to the south of the Caddo homeland (Newcomb 1975:279-284). Following years of reduction by disease and warfare with European and Euroamerican groups moving into their homeland, the remnant groups of the Caddo were settled on reservations in Oklahoma in 1859.

Creek. The Creek Confederacy, originally located in Georgia, consisted of various tribes of Muskogean speakers as well as a few non-Muskogean tribes that stretched from Georgia to Texas. In 1826, the core tribes were moved from Georgia to Alabama and, six years later, to land in Oklahoma. The few Creeks that historically lived on the boundaries of the Big Thicket are, today, part of the Alabama and Coushatta tribes or the Creek Tribe in Oklahoma.

Alabama and Coushatta. Both of these groups were members of the Upper Creek Nation and speak a common Muskogean language. After immigrating into East Texas around 1800, both tribes lived in settled groups on the north and west edges of the Big Thicket. Today they occupy the Alabama-Coushatta Indian Reservation, which adjoins the north boundary of the Big Sandy Unit. Because of the tribes' long association with Big Thicket, and their statements about having deep

traditional association with park lands, a thorough investigation should be undertaken of the continuing affiliations and associations that the Alabama and Coushatta tribes have with the various units of the Preserve. In particular, they expressed interest in preserving the Coushatta Trace, which bisects the Big Sandy Unit, and pre-contact archeological sites.

Non-Indian Associated Groups. Most other users of the Big Thicket are descendants of Euroamerican settlers who immigrated to the area during the early 19th to early 20th centuries. Small farmers and stockraisers from the Upper South established scattered agricultural homesteads and defined their communities with a church, school and cemetery. While the schools have been consolidated, the churches and cemeteries are still active, although none currently exist within the boundaries of the Preserve. The Big Thicket provided hunting, fishing and gathering grounds for these people, as well as other uses. Examples of such places are the Blue Hole in the Jack Gore Baygall, and Hook's Bear Camp and the Lance Rosier birthplace, both in the Lance Rosier Unit; and other examples may exist (Maxine Johnston, pers. comm.).

Park User/Affinity Groups. A major force behind the dedication of portions of the Big Thicket as a national preserve was the Big Thicket Association, a group with strong continuing associations with the Preserve. Other significant affinity groups that support park programs include the Jack Gore Baygall Association and former Big Thicket Conservation Association. These organizations also serve as a link to knowledgeable local residents who can share the history and ethnographic concerns associated with the Preserve. Other groups with associations to the Preserve include a wide variety of recreational users.

Preliminary research of historical literature, field visits, and meetings have not confirmed specific ethnographic resources that might be affected by oil and gas development; however, this does not conclude that such resources do not exist within the Preserve. As oil and gas operations progress, efforts need to be made to identify ethnographic resources and associated community concerns, including consultations with the Alabama and Coushatta tribes and other park-affiliated communities.

Cultural Landscapes

Cultural landscapes are geographic areas, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historical event, activity, or person or exhibiting other cultural or aesthetic values. The four general kinds of cultural landscapes, not mutually exclusive, are Historic Designed Landscapes, Historic Vernacular Landscapes, Ethnographic Landscapes, and Historic Sites (NPS, 1997:179).

Considering the variety of cultural meanings given to the Big Thicket, and the dispersion of subsistence and commercial land uses throughout the Preserve over time, the entire Preserve can be considered a cultural landscape. This landscape is made up of more than individual historic sites. It also includes systems of land use; circulation connections such as trails, wagon and lumber roads, the Old Spanish Trail and Coushatta Trace corridors, ferry routes, and tram roads; and vegetation patterns that, for example, indicate previous farming activities and pine plantations.

Although there have been several historical and ethnographic studies of various aspects of the Big Thicket, no detailed examination of the land use history with the Preserve has been completed; nor has a historic context analysis been done. In general, the region has been lightly settled through the historic period. The dense vegetation for which the area is named discouraged extensive farming practices, the mainstay of Texas settlers in the 19th century. Much of the Preserve is in low-lying areas that were inhospitable and unproductive for farming. Additionally, the acquisition of land for the Preserve strove to avoid settlements and unwilling landowners, limiting the presence of cultural landscape elements. Nevertheless, Big Thicket may contain cultural landscapes that are potentially

eligible for the National Register of Historic Places and, as described above, associations with several contemporary groups exist.

Association with Native Americans. At least three contemporary American Indian tribes may have direct cultural affiliation with the Preserve. The pre-contact Caddo and Atakapa groups probably occupied seasonal hamlets or camps within the Big Thicket as they hunted, fished and foraged for food stuffs during seasonal rounds. Year-round occupation of the Thicket probably did not occur as the core areas for these groups were to the north and south. The Alabama and Coushatta tribes, having been in Texas since the 1780's and on their reservation adjacent to the Preserve since 1853, have used the Big Thicket for generations and in a manner similar to previous tribes. Although hunting, fishing and foraging have been a part of their livelihood in the Thicket, they have been more permanent residents and can point to such affiliated landscape features as the Coushatta Trace and, perhaps, abandoned village sites within the Preserve. The Creeks may have an affiliation with the Preserve by way of their association with the Alabama and Coushatta.

Association with Euroamericans. Because of the dense vegetation and low-lying areas, the Big Thicket was generally avoided by immigrants during the Spanish and Mexican colonization eras. A few settlers in the Texas Republic and early Statehood periods found their way into the thicket, particularly along major waterways such as the Neches River, and small settlements grew at ferry crossings and, later, steamboat landings. Early settlement additions to the cultural landscape included small, dispersed communities and small isolated farmsteads. Cultural landscape elements characteristic of these patterns include ferry crossing ramps, small community or farmstead structures, outbuildings, field areas, cemeteries, and circulation systems. Ferry landing sites associated with the Preserve include Sheffield Ferry, Town Bluff, Yellow Bluff, Richardson's Ferry and Weiss Bluff. Later transportation elements include the still-active railroad and the old, abandoned highway bridge at Evadale. Specialized settlement sites including hunting sites, particularly bear-hunting camps and grounds, occur in the park. Early settlement/subsistence farming landscapes are associated with the Lilly and Kennedy farmsteads in the Big Sandy Unit; the Rosier, Teel, and Cotton complexes in the Lance Rosier Unit; the King, Richardson, and Sternburg Bluff localities in the Turkey Creek Unit; and the Blue Hole water source and wagon road associated with the Holyfield family in the Jack Gore Baygall Unit.

Association with Transportation Avenues: Waterways and Railroads. With very few exceptions, overland transportation corridors avoided the Big Thicket until the mid-1800's. Waterways were the natural avenues of transportation from pre-contact times through the 1800's. The Antebellum period saw the establishment of several steamboat landings along the Neches River. Goods of all kinds were transported up and down river throughout this period and later. As early trails, and eventually roads, were established through the region, ferry crossings were established to facilitate movement of people and goods across the Thicket. Such access, however, encouraged people to move into the region and their effects on a cultural landscape were generally localized and isolated. Railroads in the Big Thicket region, and smaller rail lines (including tram routes) leading into the Preserve were inspired by the growing demand for timber and resulted in the first major assault on more remote areas of the Thicket. The impacts were directly related to the level of technology. Timber was cut along the routes to provide ties, crude railroad camps were established, and water-stops and towns were built along the way to supply water and fuel. Invariably, roads sprang up along the rail line, which encouraged immigration into the inner parts of the Thicket not previously accessible. All of these features contributed to the evolution of a cultural landscape throughout the Preserve.

Association with 19th and 20th Century Timber Industry. The Big Thicket has been a primary source for timber in Texas since the late 1880's. This industry brought major changes in the cultural landscape. As sawmill towns grew up along the railroad lines, small landholders sold their timber and surface interests, and the cut-over land provided opportunities for additional agricultural development. No unit of the Preserve was untouched by the massive timbering efforts. Most of the

virgin hardwood and pine forest was cut, and the population of the region increased to accommodate the industry. When the sawmill towns moved on after the local resources were depleted, much of the new population left, leaving the earlier residents to revert to the subsistence lifestyle and some pick-up work from the reduced timber industry. Locations within the Preserve associated with the timber industry include the sawmill town site of Hicksbaugh and its tram line; the sawmill site at Sternburg Bluff and the Keith/Kirby mill at Voth. Associated landscape features include tram routes (wood and iron rail lines), berms, drainage ditches, and bridges.

Association with 20th Century Petroleum Industry. One of the first oil fields in Texas came in at Saratoga in 1901. Early oil exploration initially concentrated at the southern edge of Big Thicket, pushed north and east in the 1930's, and, by the 1950's most units of the Preserve were home to some level of oil and gas activity. Like the timber industry, oil and gas brought increases in population numbers, but this population was even more ephemeral. The boomtowns of Saratoga, Batson, and Sour Lake faded as quickly as they had boomed as most of the boomers left when the exploration phase waned. The production end of the oil and gas industry, as with the timber industry, provided some work for those left behind. Oil industry-related sites with the Preserve include abandoned well sites in the Saratoga field, the Saratoga School complex, and the Brammer house.

Association with Big Thicket National Preserve. Federal ownership has halted private ownership of surface resources and timber is in recovery. The oil and gas industry still has producing interests within the Preserve. Subsistence aspects of prior cultural use of fish and game have been expanded to be largely recreational with visitors drawn from nearby urban and suburban communities and the State as a whole. Educational, scientific, and recreational uses of the Preserve have increased and include: nature study, research and monitoring, hunting, trapping, fishing, boating, hiking, swimming, picnicking, camping, bird watching, horseback riding, bicycle riding, canoeing, and solitude. While uses of the Big Thicket lands have changed since their inclusion in the national preserve, a number of places still have significant associations for contemporary communities, as described above.

As discussed previously, the various categories of cultural resources vary in type and density across the Preserve. Individually, they all have their particular character, integrity, and information base. The archeological sites, the historic structure, and the ethnographic associations are unique in and of themselves. But they also form individual elements that combine to create the more encompassing cultural landscape of the Preserve, and one category of cultural resource cannot be taken into account without consideration for the others.

VISITOR USE AND EXPERIENCE

Congress provided direction in Section 4 (b) of the enabling legislation, to limit the construction of roads, vehicular campgrounds, employee housing, and other public and administrative facilities in the interest of maintaining the ecological integrity of the Preserve. Therefore, development has followed a conservative approach, with careful siting and sustainable design being applied when development is warranted, to retain natural qualities and processes.



Visitor Use Areas

Each unit of the Preserve is unique and harbors noticeable differences when compared and contrasted. These differences range from floodplain forests to cypress sloughs to savannas to mixed hardwood and pine forests. The trails that have been developed in the units take advantage of this uniqueness and expose trail users to these different environments. The following section lists the recreational attributes found in each unit of the Preserve. These areas include day use areas, hiking trails, canoe routes, and birding hot-spots. **These visitor use areas, in addition to park administrative areas (3), hunting areas, and other use areas (cemeteries (3) and residential homesites (2)) are designated as Protected Areas under Alternative A, and as Special Management Areas under Alternatives B and C. These areas are shown on Figure 3.5; and the Protected Areas/Special Management Areas are shown on maps provided in Chapter 2, Part 1.**

Day Use Areas. There are 26 day use areas located in the following 9 Units:

- Beaumont Unit
- Beech Creek Unit
- Big Sandy Creek Unit
- Hickory Creek Savannah Unit
- Lance Rosier Unit
- Menard Creek Corridor Unit
- Neches Bottom/Jack Gore Baygall Unit
- Turkey Creek Unit
- Upper Neches River Corridor Unit

Hiking Trails. There are 9 hiking trails located in the following 5 Units:

- **Beech Creek Unit.** One trail: Beech Woods Trail is a 1-mile loop.
- **Big Sandy Creek Unit.** Three trails: Woodland Trail has three distance options of 3.3, 4.5 and 5.4 miles; the Beaver Slide Trail is 1.5 miles long; and Big Sandy Trail is a "multi-mode" loop trail, 18 miles long for horseback riding, hiking, and off-road bicycle riding.
- **Hickory Creek Savannah Unit.** One trail: Sundew Trail has an inner loop 0.5 miles and an outer loop of 1 mile. The inner loop is designed for full accessibility.
- **Menard Creek Unit.** One trail: Birdwatcher's Trail is at the confluence of Menard Creek and the Trinity River.
- **Turkey Creek Unit.** Three trails: Turkey Creek Trail is 15 miles long with three trailheads; Pitcher Plant Trail is a short spur connecting with Turkey Creek; and the Kirby Nature Trail, which is a two loop trail, with an inner loop 1.7 miles long and an outer loop 2.4 miles long. Fishing and canoeing occurs on Turkey and Village Creeks.

Figure 3.5. Visitor Use, Administrative and Other Use Areas

Canoe Routes. There are four canoe routes:

- Village Creek,
- Turkey Creek from Gore Store Road to Village Creek,
- Franklin Lake to Johns Lake, and
- Cook's Lake to Scatterman Lake Loop.



Marked canoe routes include: Franklin Lake to Johns Lake, and the Cook's Lake to Scatterman Lake Loop. Most of the creeks and rivers flowing through the Preserve are navigable either year-round, seasonally, or after a significant rainfall. Other canoeable waterways include:

- Some sections of waterways, such as the 40-mile stretch of the Neches River through the Jack Gore Baygall Unit, are nationally publicized for their wild character.
- Aside from the Neches River, Village Creek is also widely publicized as one of the finest canoeing streams in East Texas.
- The lesser known Turkey Creek through the Turkey Creek Unit offers an outstanding experience for those seeking to paddle through riparian forests of hardwood and pine.
- Little Pine Island Bayou through the Lance Rosier Unit is normally unnavigable, but after intense rainfall, it floods the surrounding forest and becomes canoeable.
- For the most intrepid canoeists, the Little Pine Island Bayou offers a challenging two-day journey through one of the least traveled sections of the Preserve.
- The loop from Cook's Lake to Scatterman Lake follows a slough in the Beaumont Unit, and is one of the few loops in the Preserve.

Many other canoeing and boating possibilities exist in secondary channels, sloughs, and oxbow lakes throughout the Preserve.

Birding Hot Spots. Bird migrations through the Preserve peak between late March and early May, and again in October and November. The more sought after birds for bird watchers are the Red-cockaded Woodpecker, the Brown-headed Nuthatch, and the Bachman's Sparrow. The last reported sighting of an Ivory-billed Woodpecker in the Preserve was in May 1971. Dense vegetation can make birding for migratory songbirds difficult in much of the Preserve. The eight (8) birding hot-spots located in the Preserve are listed below.



- **Collin's Pond.** Collin's Pond, located at the head of the Woodlands Trail in the Big Sandy Creek Unit, is good habitat for a variety of song birds and waterfowl: thrushes, warblers, herons, and egrets. The trailhead is located on FM 1276, 3.3 miles south of U.S. 190, or 5.9 miles north of Dallardsville.

- **Birdwatcher's Trail.** Panoramic views of expansive sandbars from high bluffs on the east bank of the Trinity River offer good birding opportunities for shorebirds, raptors and

migrant song birds. It is located at the confluence of Menard Creek and the Trinity River, 3.1 miles north of Romayor off of FM 2610 on Oak Hill Drive.

- **Teel House Road.** This road runs through Lower Slope Hardwood Pine Forest in the Lance Rosier Unit. Access is via dirt road that runs south through the Saratoga Oil Field – just east of Saratoga off Highway 770.

- **Pitcher Plant Trail.** This loop trail runs through wetland pine savanna and upland pine habitats, and has good access to floodplain communities. To get there, take FM 1943 4.3 miles east of Warren, turn right and go south 1.9 miles on Pineville Church Road (eastern boundary road of Turkey Creek).

- **Sundew Trail.** This is an open and park-like wetland savanna, and it is good habitat for Pine Warblers and Brown-headed Nuthatches. It is located just off of a dirt road leading to the Sundew Trailhead, off of FM 2827 0.5 mile west of US 69.

- **Kirby Nature Trail.** This is a group of loop trails that go through slope forest, baygall, floodplain, cypress slough and stream bank communities with good access to arid sandhill communities, too. This trail is good for warblers, vireos, woodpeckers and resident song birds. The Kirby Nature Trailhead and information station are located at the southern end of the Turkey Creek Unit on FM 420, 2.5 miles east of the junction of US 69 and FM 420.

- **McQueen's Landing.** This is a canoe and boat launch ramp below the dam at Steinhagen Reservoir. It is a viewing area for bald eagles in the winter. To get there, take FM 777 south to Beech Grove (just east of Martin Dies Jr. State Park). At Beech Grove, take the dirt road toward East End Park until it ends at McQueen's Landing on the Neches River.

- **Cook's Lake.** This is a backwater area off of Pine Island Bayou, not far from its confluence with the Neches River. It is a very scenic area to go birding by canoe. The swamp forest and floodplain forest communities in Cook's Lake provide good habitat for herons, egrets, raptors, and swallows. It is accessible from Interstate 10 and US 69. From there, exit on Highway 105, and continue east 8.2 miles through Vidor. After Vidor, go north on 105 for 4.0 miles to FM 1131. Then go west on FM 1131 for 3.3 miles. Turn left onto a paved road. Go 3.7 miles (pavement ends after 2.7 miles) to a parking area on the right (Confluence Boat Ramp).

Roads. The Preserve maintains 9.5 miles of dirt and gravel roadways. By virtue of the Preserve's configuration, visitors must travel over a road and highway system consisting of farm-to-market roads, county roads (both improved and unimproved), and State and U.S. Highways. For visitors from outside the region seeking the location of a specific Unit, or a specific attraction in a Unit, the effort can easily become a navigational challenge.

Hunting and Trapping. The enabling legislation for Big Thicket National Preserve, while mandating that the Preserve be administered in a manner that will assure in perpetuity the natural and ecology integrity, also directed the NPS to provide for continued traditional recreational uses of the Preserve, including hunting and trapping. The Act further directed that these activities would be "conducted in accordance with applicable laws of the United States and the State of Texas." The NPS was allowed to "designate zones where and periods when, no hunting, fishing, trapping or entry may be permitted for reasons of public safety, administration, floral and faunal protection, and management, or public use and enjoyment." The Act also directed that, "except in emergencies, any regulations prescribing such restrictions relating to hunting, fishing, or trapping shall be put into effect only after consultation with the appropriate State agency having jurisdiction over hunting, fishing, and trapping activities."

The general regulations governing the management and use of NPS-administered areas generally prohibit the consumptive use of resources such as hunting and trapping. In order to implement and guide the consumptive uses authorized in the enabling legislation, the NPS determined that it was necessary to develop special regulations. In 1979, special regulations were developed and implemented in 36 CFR 7.85 to address hunting and trapping activities.

Since 1979, approximately 2,000 permits have been issued each year for hunting. An average of 12 permits for trapping have been issued each year.

Hunters are presently issued permits, on a first-come, first-served basis at annual sign-ups held during July and August. Permitted hunters may hunt in only one of the following open units: Big Sandy Unit, Beech Creek Unit, Lance Rosier Unit, Beaumont Unit, and areas in the Neches Bottom and Jack Gore Baygall Unit. A total of 47,400 acres in these units are open to hunting. Hunting season generally begins October 1 and continues through January 15 each year. Texas State seasons and bag limits are followed during this period. While applying general Texas hunting regulations, the Superintendent applies additional restrictions to hunters in order to protect Preserve resources and provide for additional hunter and visitor safety. Hunting areas are not generally closed to public use during hunting season, except backcountry camping is not permitted in areas open to hunting during hunting season. During the 1997-1998 season, October 1, 1997, to January 15, 1998, 9,896 trips were made by hunters into hunting areas. Hunters harvested 282 deer, 13,851 squirrels, 247 hogs, 285 rabbits, and 291 waterfowl.

Seismic surveys have not been permitted in hunting areas during the Preserve's hunting season, but have been permitted in non-hunting areas during this period. Seismic surveys have been restricted during this period in order to avoid conflicts and protect visitor safety. Occurring at the same time, both activities could unnecessarily increase the hazards for both hunters and seismic crews.

Trapping is permitted in the Lance Rosier Unit, Beaumont Unit, and areas in the Jack Gore Baygall/Neches Bottom Unit, a total of 35,000 acres. As with hunters, Texas State trapping regulations apply and the Superintendent has implemented additional restrictions to protect Preserve resources and provide for visitor safety. During the 1997-1998 season, December 1, 1998 to January 31, 1999, 126 trips were made into open units with 352 raccoon, 18 opossum, 2 nutria, 5 mink, 2 otter, and one bobcat harvested.

Park Administrative Areas

Park administrative developments include:

- Maintenance and Meeting Facility,
- Turkey Creek Ranch House,
- Big Thicket Information Station, and
- Big Thicket Visitor Center.



The Big Thicket Visitor Center, shown on the right, serves as the primary contact point for all Preserve visitors and is open seven days per week, year-round. The station grounds are the focal point for most environmental educational programs conducted by Preserve staff due to the proximity of the Big Thicket National Preserve Visitor Center Kirby Nature Trail (Turkey Creek Unit). A small book sales area, brochures, limited exhibits, video tape viewing, orientation, outside restrooms, picnic tables and nearby Kirby Nature and Turkey Creek trailheads are found at this location. Average visitation at the Information Station for 1990 – 2000 is 10,843 persons.

Other Use Areas

Cemeteries. There are three cemeteries within the Preserve. They are designated as Special Management Areas under Alternatives B and C.

Inholdings. There are two residential homesites in the Preserve. Both homesites have use and occupancy terms. They are designated as Special Management Areas under Alternatives B and C.

Visitor Use Statistics

Yearly visitation to the Preserve during the period from 1978 to 1996 was approximately 65,000, but generally increased during the period from 1987 to 1996. An average of 87,000 visitors come to the Preserve each year (Table 3.11). Since visitation counts are limited and are largely based on Visitor Information Station counts, the data shown in Table 3.11 may underestimate the number of annual visitors to the Preserve.

The majority of visitor use is regional in nature. Yet, looking at the visitor registration log found at the Information Station, all 50 states and at least 20 countries are represented annually. It is felt that Big Thicket's Biosphere Reserve designation interests international visitors.

Backcountry camping is generally light in the Preserve and must be conducted in designated areas. There are no developed drive-in campgrounds.

Table 3.11. Annual Visitation at Big Thicket National Preserve

Year	Annual Visitation
1990	77,930
1991	64,076
1992	72,269
1993	82,854
1994	127,313
1995	115,466
1996	111,626
1997	77,633
1998	60,087
1999	60,193
2000	62,009
2001	98,526
2002	101,830
2003	101,580
2004	107,782

Data derived from NPS internet website, Public Use Statistics Office.

Seasonal Visitor Use Patterns

Visitor use patterns are not complicated and are predictable during the spring and fall seasons.

Spring is the busiest visitor use period. Early spring travelers, mostly bird watchers from a majority of states and several countries, converge on the general area and Preserve. School groups participating in Preserve educational programs arrive daily in late spring in groups of 100 for several weeks. Weekend use increases as visitors from the region use trails, and go fishing and boating.

Summer use is light because of high temperatures and humidity. Users are families from outside the region on traditional summer family vacations visiting several attractions in a two- or three-week period. Local limited visitation continues with fishing and boating activities.

Fall visitor use is moderate to high consisting of late seasonal travelers and school groups. Depending on weather conditions, regional visitor use can be high as people are enjoying outdoor recreation during cooler temperatures and humidities.

Winter use is light, with seasonal travelers consisting of retirees and some regional visitor use. During hunting season, from October through early January, up to 2,300 permits are issued for hunting in select units. Hunting limits other visitor uses, such as hiking, horseback riding and off-road bicycling, due to safety issues and concerns.

Visual Quality, including Night Sky, as a Component of Visitor Experience

Although the presence of humans is evident in the Preserve and region, the dominant visual elements are water and vegetation on a predominantly flat landscape. While man-made developments are apparent, the relatively flat topography and dense vegetation also reduce these influences within a short distance.

However, only 30 years ago people clearly viewed the night sky from most residential areas. Now the night sky is being obscured by artificial light. In many parts of Southeast Texas, only the moon and brighter planets are visible during the nighttime (David Deming, pers. comm.). The spectacular view of the night sky that our ancestors had on clear nights no longer exists (International Dark-Sky Association, 1996).

Referred to as light pollution, urban sky glow brightens the night sky for everyone, including amateur and professional astronomers. Many advances at the frontiers of astronomy require observations of very faint objects that can be studied only with large telescopes located at prime observing sites, well away from sources of air pollution and urban sky glow (International Dark-Sky Association 1996). The nearest observation sites to the Preserve are the George Observatory at Brazos Bend State Park, and a site regularly used by the Astronomical Society of Southeast Texas near Kirbyville.

The increasing number of people living in nearby Houston and Southeast Texas, particularly the Golden Triangle (Beaumont-Port Arthur-Orange), are expected to continue to decrease the visibility of the night sky. However, light pollution can be minimized without compromising nighttime safety, security, or utility by using night lighting only when necessary, using well designed lighting to direct light where it is needed, and using low pressure sodium light sources whenever possible.

Natural Quiet as a Component of Visitor Experience

Part of the Preserve's resources include the sounds associated with its natural resources, often referred to as "natural sounds" or "natural quiet." Natural quiet generally includes the naturally occurring sounds of winds aloft in the trees, calling birds, as well as the quiet associated with still nights. As with all Preserve resources, natural quiet is part of the visitor experience. The natural sounds of the Preserve contribute to a positive visitor experience and is a component of why many people visit the Preserve. Therefore, noise was evaluated as a component of visitor experience.

During 1998, ambient sounds were monitored and recorded at 11 locations in the Preserve to provide a rationale for protecting natural sounds and natural quiet (Table 3.12). Background sound levels in most of the Preserve are due to wind aloft in the trees (Foch, 1999). A useful measure of background sound level is L90, defined as the sound level that is exceeded 90 percent of the time for the time period under consideration (Canter, 1996). Comparisons of Preserve sound levels to other natural and human-induced sounds, including certain oil and gas operations, are shown in Figure 3.6.

"Noise" can be defined as unwanted sound, and noise levels are most commonly expressed in decibels. Unless otherwise stated, most noise levels are rated using the A-weighting network (dBA). Sources of noise within the Preserve and surrounding areas include automobiles, boat motors, motorcycles, all-terrain vehicles, various types of equipment (e.g., tractors, log skidders, chainsaws, lawn mowers, etc.), power lines and transformers, and firearms. Automobile traffic occurs primarily on the highways and county roads within the Preserve and surrounding areas; however, some vehicular traffic does occur within the Preserve on existing roads. Single automobiles produce noise levels in the range of 70 dBA near the vehicle, while moderately heavy traffic may produce noise levels in the range of 85-90 dBA near the roadway. Boat traffic along the Neches River is another primary source of noise within the Preserve.

Sources of noise within the Preserve are generally localized or seasonal in duration. Examples include the use of all-terrain vehicles, chainsaws, firearms and vehicles and equipment for oil and gas exploration and production. Although short-lived, gunfire produces considerable noise in the range of 130-160 dBA near the weapon (depending on the caliber of the weapon).

Table 3.12. Ambient L90 Sound Levels at Various Locations within Big Thicket National Preserve

Location	DBA
Turkey Creek Unit – Near Sandhill Loop on the Turkey Creek Trail within Sandhill Pine Forest	37
Jack Gore Baygall Unit – within Upper Slope Pine Oak Forest	41
Lance Rosier Unit – At the end of Church House Road within Lower Slope Hardwood Pine Forest	39
Beech Creek Unit – Along Beech Woods Trail 0.8 miles from the parking/picnic area within Lower Slope Hardwood Pine Forest	35
Big Sandy Creek Unit – Along the Big Sandy Horse Trail within Lower Slope Hardwood Pine Forest, 2.9 miles from parking area	41
Turkey Creek Unit – NPS Ranch House within Upper Slope Pine Oak Forest/Wetland Baygall Shrub Thicket	36

The potential effects of noise on visitor experience in visitor use, administrative, and other use areas (e.g., hiking trails, picnic areas, cemeteries, and residential homesites), was one of the main reasons for establishing a 1,500-foot offset for drilling and production operations under Alternatives B and C. The offset distance was determined using sound levels presented in Figure 3.6, and

Figure 3.6. Sound Level Comparison Chart[1]

How it Feels	Equivalent Sounds	Decibels	Sound Levels at Various Locations in Big Thicket National Preserve
Near permanent damage level from short exposure	Large caliber rifles (e.g., .243, 30-06)	140-160	
Pain to ears	.22 caliber weapon	130-140	
Very loud	Air compressor @ 20 ft. Garbage trucks and city buses	100	
Conversation Stops	Power Lawnmower		
	Diesel truck @ 25 ft.		
Intolerable for phone use	Steady flow of freeway traffic 10 HP outboard motor Garbage disposal	90	
	Near drilling rig Automatic dishwasher Muffled jet ski @ 50 ft. Vacuum cleaner	80	
	Drilling rig @ 200 ft. Window air conditioner outside @ 2 ft.	70	
Quiet	Window air conditioner in room Drilling rig @ 800 ft. Normal conversation	60	
Sleep interference		50	
	Quiet home in evening		
	Bird calls Drilling rig @ 1500 ft. Library	40	Big Sandy Creek along Big Sandy Horse Trail Jack Gore Baygall Unit Lance Rosier Unit – at end of Church House Rd. Turkey Creek Unit on Turkey Creek Trail and at NPS Ranch House Beech Creek Unit along Beech Woods Trail
	Soft whisper	30	
	In a quiet house at midnight Leaves rustling	20	

[1]Modified from Final Environmental Impact Statement, Miccosukee 3-1 Exploratory Well, Broward County, Florida (U.S. Department of the Interior).

assuming noise in visitor use, administrative, and other use Special Management Areas should be kept as close as possible to ambient sound levels in the Preserve.

Visitor Perception of Oil and Gas Operations

There is no specific survey information available regarding visitor expectations about the oil and gas operations. Based on limited sampling during 1992, visitors to the Preserve's Visitor Information Station were from Texas (85 percent), and 76 percent were visiting the Preserve for the first time. Similarly, Gulley (1999) found the typical Preserve visitor was a Texas resident (78 percent), and that most visitors (58 percent) lived within a 2.5-hour drive from the Visitor Information Station. Overall, past and current levels of public use do not appear to have adversely affected Preserve resources, and conflict between public uses or between public uses and nonfederal oil and gas operations has been minimal. Since oil and gas operations have been present in the area since the 1900's, the surrounding public supports these activities to promote the economy of the area. Regarding noise impacts, there have been few complaints registered at the Preserve about oil and gas operations. However, noise from oil and gas operations is an important consideration and can be reduced in visitor use areas.

Human Health and Safety

The NPS policy regarding public health and safety is that the saving of human life will take precedence over all other management actions. The NPS and its concessionaires, contractors, and cooperators will seek to provide a safe and healthful environment for visitors and employees. The NPS works cooperatively with other federal, state, and local agencies, organizations, and individuals to carry out this responsibility. However, Preserve visitors assume a certain degree of risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments (NPS, 2001). Proper siting of nonfederal oil and gas operations and the application of current legal and policy requirements will guide the NPS and nonfederal oil and gas operators to avoid visitor use conflicts, protect the health and safety of visitors, and to protect visitor use and enjoyment of Preserve resources.

Wild Character – Solitude

As required by the Wilderness Act and the Preserve's enabling legislation, the Preserve was evaluated for its suitability as wilderness in 1979.

Wilderness is defined as:

> "…an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of Wilderness is further defined to mean…an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." (Public Law 88577, of September 3, 1964, establishing a National Wilderness Preservation System)

The Wilderness Recommendation (December 1980) for the Preserve concluded:

> The national preserve was established in order to ensure the preservation, conservation, and protection of the natural, scenic, and recreational values of a significant portion of the Big Thicket area. This statement by Congress makes it clear that natural values are to be preserved. However, Congress also provided that the mineral estate or existing easements for public utilities, pipelines, or railroads may not be acquired without the consent of the owner, unless the property is subject to uses that would be detrimental to the purpose of the Preserve.
>
> Because of the existing oil and gas operations and the continual development of the mineral estate in the Preserve, management of a specific area as wilderness cannot be ensured. However, the long-range concept is to work toward the restoration of natural conditions as existing operations end. For historically impacted areas, mitigating impacts would be the goal for any future designated wilderness.
>
> Under the long-range concept, it is believed that lands within 6 of the 12 Preserve units may qualify for wilderness at some future time. The lands that may qualify as wilderness have been identified as wilderness objective areas, and total nearly 60,000 acres. The wilderness objective areas identified in the 1979 study included the Beaumont, Lance Rosier, Big Sandy Creek, Beech Creek, and Jack Gore Baygall/Neches Bottom Units. It should be noted that some of the wilderness objective areas include roads, and pipeline and power line rights-of-way. All of these elements are incompatible with wilderness.
>
> While the need for some of these incompatible elements may change or cease, others may continue indefinitely. *Therefore, specific wilderness area adjustments could and should be made, as necessary, in any future studies.*
>
> The remaining six units of the Preserve will be managed to emphasize natural conditions. However, because of their small size or configuration, presence of roads and utility lines, and existing and potential oil and gas development, these units do not have the potential for wilderness designation.
>
> Therefore, after careful evaluation of the wilderness study document; the comments and suggestions received from individuals, groups, and public agencies; the mandates outlined in the establishing legislation; and the definition of wilderness contained in the wilderness act; it has been determined that none of the units within Big Thicket National Preserve are currently suitable for designation as wilderness.

ADJACENT LAND USES AND RESOURCES

The physical configuration of the Preserve, and particularly the narrow water corridor units, are affected by a number of adjacent land uses. Such land uses include residential development, commercial and private forestry, industrial development (oil and gas; forest products), agriculture, and publicly-owned facilities (e.g., Town Bluff Dam, water diversion, and sewage treatment facilities). The existing condition of resources in the Preserve that are described in this chapter in many cases would be similar on adjacent lands.

Residential development in the seven-county area of the Preserve is generally rural; however, there are residential developments adjacent to: Big Sandy Creek (e.g., Alabama-Coushatta Indian Reservation); Hickory Creek Savannah (e.g., Wildwood subdivision); Pine Island Bayou-Little Pine Island Bayou Corridor (e.g., Pinewood Estates and Bevil Oaks subdivisions); and the Beaumont Unit (Cook's Lake Road residents). Oil and gas exploration and development may conflict with

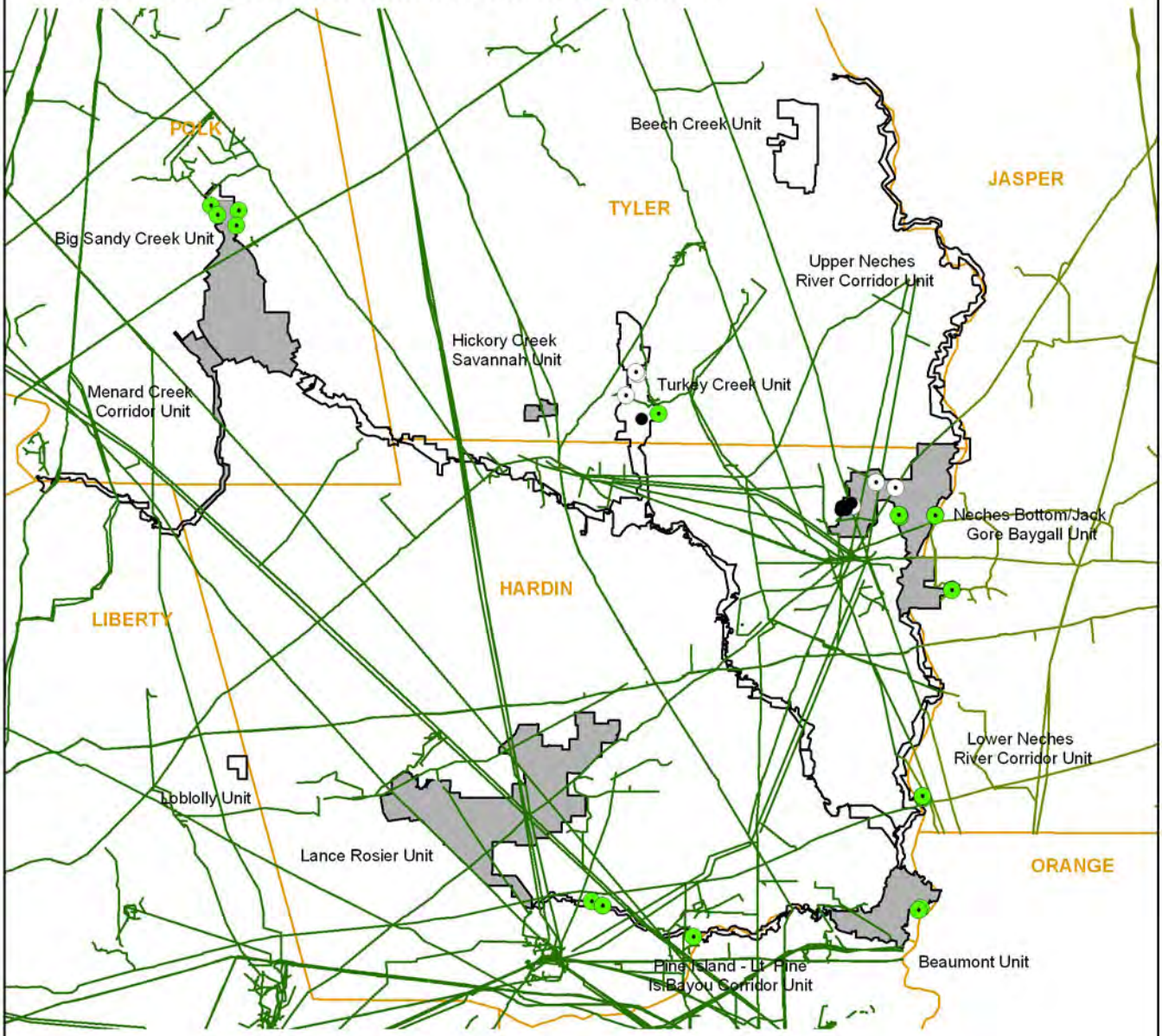
homeowners and raise homeowner concerns about regulation, control, and safety of oil and gas activities.

Of land uses immediately adjacent to the Preserve, commercial and private forestry account for approximately 95 percent of the land area (Harcombe and Callaway, 1997). For units of the Preserve along the Neches River, commercial timber and commercial timber with oil account for approximately 90 percent of land uses within a one mile buffer from the center of the Neches River.

Additional issues related to timberlands include encroachment onto Preserve lands, public safety concerns regarding hunting clubs on adjacent timberlands, and public use of timber company roads to access the Preserve (Harcombe and Callaway, 1997).

The industrial base in the area is mostly concentrated to the south and east of the Preserve. Some industrial development, mostly related to forest products, is adjacent to the Preserve.

Figure 3.1. Nonfederal Oil and Gas Development



Legend

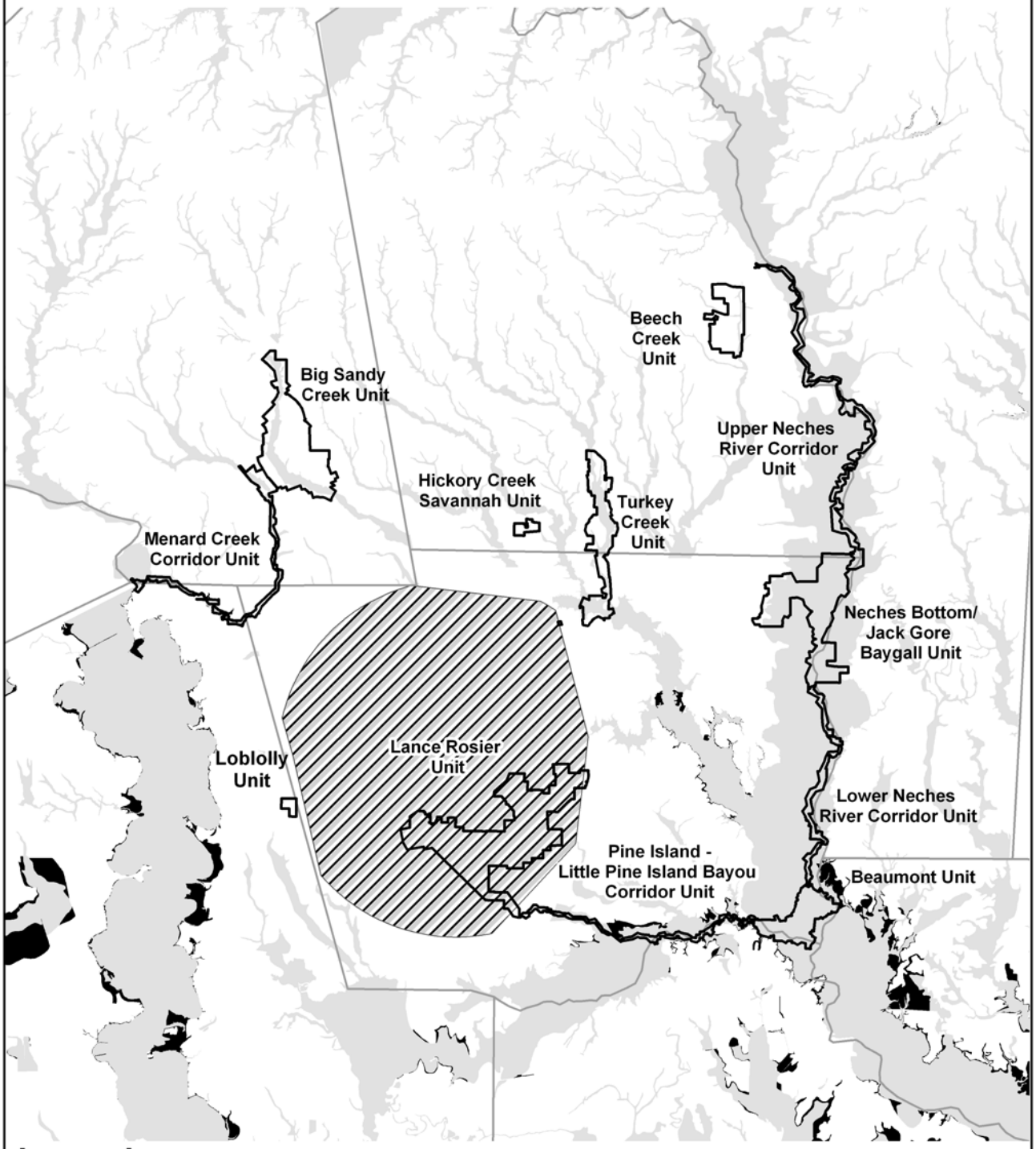
- Oil and Gas Pipelines
- 3D Seismic
- Unit Boundaries
- Counties
- Wells Inside Preserve
- Plugged Wells Inside Preserve
- Directional Wells

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Figure 3.2. Floodplains Map



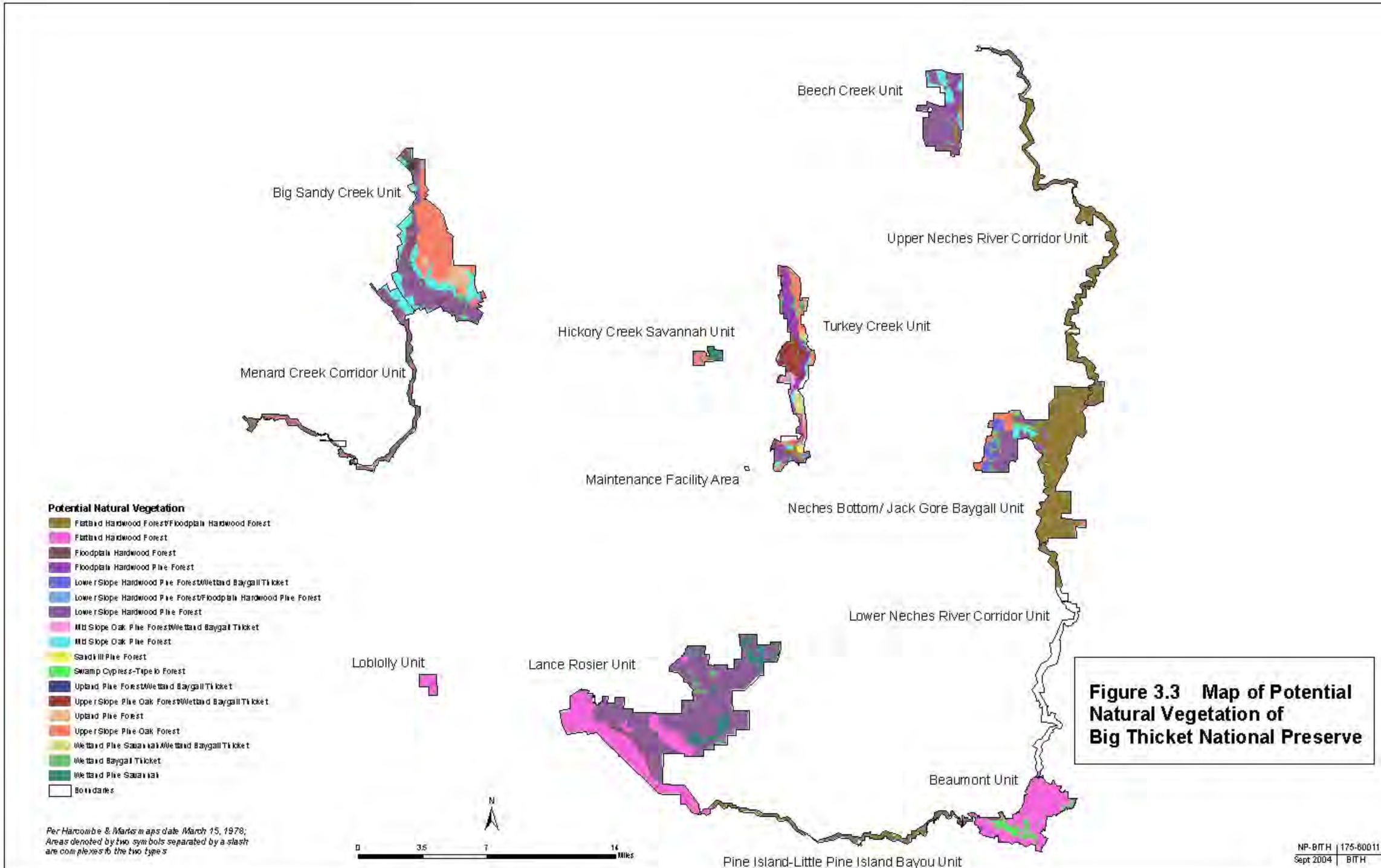


Figure 3.3 Map of Potential Natural Vegetation of Big Thicket National Preserve

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Figure 3.4. Wetlands Map

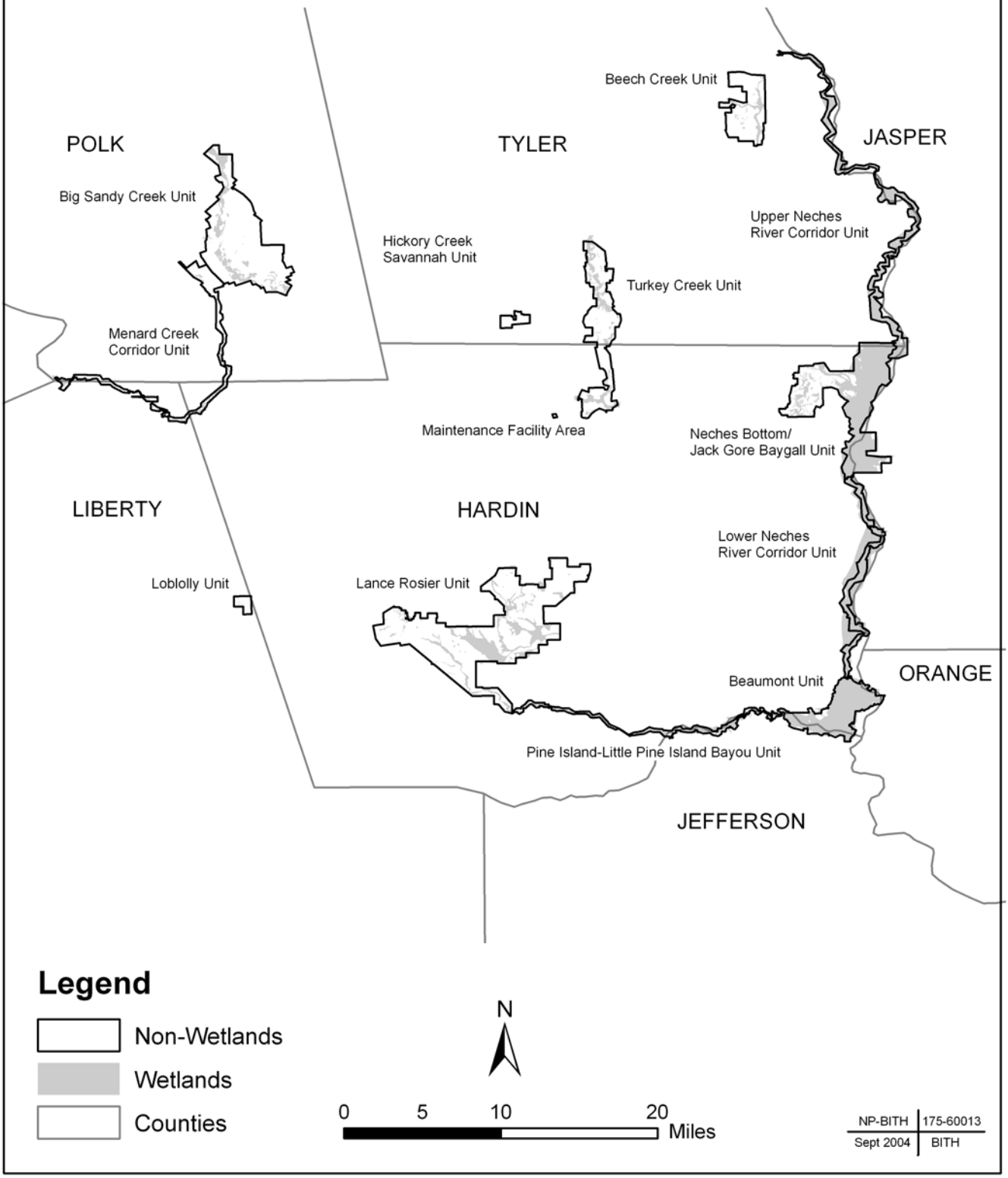
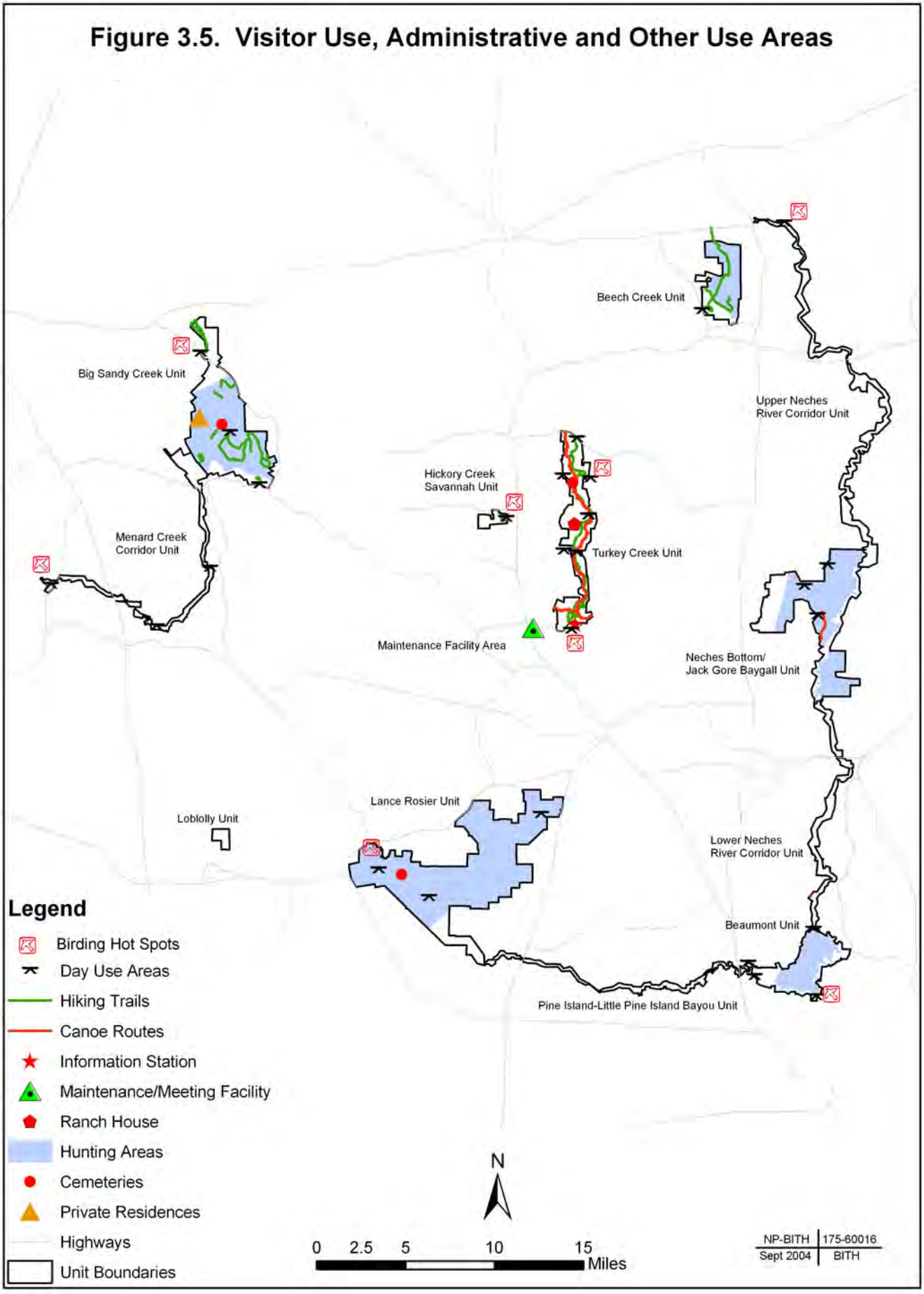


Figure 3.5. Visitor Use, Administrative and Other Use Areas



ENVIRONMENTAL CONSEQUENCES

CHAPTER 4



CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter analyzes on a programmatic level, the potential impacts on the socioeconomic, physical, biological, and cultural environment from implementation of the alternatives considered in this Oil and Gas Management Plan/Environmental Impact Statement (Plan/EIS). This is a programmatic management plan that establishes a general framework for managing oil and gas operations. By itself, it does not authorize any on-the-ground activities. The National Park Service will authorize specific projects by reviewing and approving operator-submitted plans of operations or special use permit applications. Before doing so, the NPS will conduct further analysis in accordance with the National Environmental Policy Act of 1969, the National Historic Preservation Act of 1966 (NHPA), the Endangered Species Act of 1973, and other applicable federal laws. The following topics analyzed in this chapter are the same as those addressed in Chapter 3:

- Nonfederal Oil and Gas Development
- Air Quality
- Geologic Resources
- Water Resources
- Floodplains
- Vegetation
- Wetlands
- Fish and Wildlife
- Species of Special Concern
- Cultural Resources
- Visitor Use and Experience
- Adjacent Land Uses and Resources

Other resources or issues that were considered and evaluated, but not carried forward for more detailed analysis in the Plan/EIS, are described at the end of Chapter 1.

Impact Intensity Thresholds

The NPS describes the severity of impacts using four intensity levels: negligible, minor, moderate, and major. Impact intensity thresholds are defined in this section for each impact topic to establish the threshold or magnitude at which an impact could be considered negligible, minor, moderate or major. The NPS defines “measurable effects” as moderate or greater effects. “No measurable effects” equates to minor or less effects. “No measurable effect” is used by the NPS in determining the appropriate level of NEPA compliance documentation.

Future nonfederal oil and gas operations that meet or exceed the impact intensity threshold defined for a major impact as defined in this chapter for a particular impact topic would trigger the requirement to prepare an EIS, rather than an EA, to accompany the Plan of Operations, unless mitigation measures are employed to reduce the intensity of the adverse impact. The impact intensity thresholds that are presented are derived from government regulatory standards, available scientific documentation, previously prepared environmental documents, and the professional judgment of National Park Service (NPS) resource specialists.

The impact intensity thresholds presented in this chapter were developed specifically for this Oil and Gas Management Plan/Environmental Impact Statement, and specifically for Big Thicket National Preserve. These impact intensity thresholds are used in all NEPA analyses for all types of proposals in the Preserve. Over time, as new information becomes available about the resources in the Preserve, or as NPS policies or government regulatory standards change, these impact intensity threshold definitions may be revised.

Organization of Impact Discussions

This chapter is organized by impact topic. The format of the impact analyses may vary among impact topics, but generally includes the following sections: (1) an "Introduction" that provides an overview of the resource; (2) a "Methodology for Assessing Impacts" that summarizes data analysis methods used in evaluating impacts and includes impact intensity threshold definitions; and (3) separate discussions of the impacts attributable to nonfederal oil and gas operations for Alternatives A, B, and C. Within the discussion of impacts for each alternative, the analysis is organized by type of oil and gas operation and includes "Geophysical Exploration," "Drilling and Production" (including the placement of flowlines and gathering lines; and the construction of transpark oil and gas pipelines, and access and other surface activities within their associated right-of-way corridors), and "Plugging/Abandonment/Reclamation." For a description of types of oil and gas operations, refer to Appendix D. The NPS follows the plugging procedures as discussed in Appendix I. In some cases, these operations are combined, if the analysis is applicable to more than one operation. For the most part, the impact analyses are qualitative and not site specific. Quantitative, site specific, detailed information will be provided in environmental assessments/environmental impact statements that will be tiered off of this EIS for a proposed plan of operations or directional drilling application.

Operating stipulations and mitigation measures are an integral part of all alternatives and are intended to avoid or minimize adverse impacts on Preserve resources and values. These measures are presented by type of oil and gas operation in Chapter 2, Parts I and III.

Impacts are described in terms of context, duration, and intensity. The context or extent of the impact may be localized or widespread. "Localized" impacts would affect the operations area, but would generally not extend beyond 1,500 feet from a well/production pad or 100 feet from an access road or flowline. "Widespread" or regional impacts would extend beyond the area of localized effects. The duration of impacts could be short-term ranging from weeks to three years in duration, or long-term extending up to 20 years or longer. Generally, short-term impacts would apply to data-gathering (i.e., non-manipulative surveys required to collect site-specific physical, biological, and cultural resource information performed prior to selecting the least-damaging location to site operations and to design and mitigate potential impacts), construction activities and geophysical exploration operations; and long-term impacts would apply to roads, production operations, and flowlines and pipelines. The intensity of an impact is described as negligible, minor, moderate or major. Impacts are either beneficial or adverse. A beneficial impact describes a positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition; whereas, an adverse impact describes a change that moves the resource away from a desired condition or detracts from its appearance or condition. Where the intensity of an impact can be described quantitatively, the numerical data are presented.

The following types of impacts are also evaluated:

- Direct and Indirect Impacts – Direct impacts are caused by the action and occur at the same time and place. Indirect impacts are caused by the action and are later in time or farther removed in distance.

- Cumulative Impacts – A cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions (in the NPS, major actions are synonymous with significant actions) actions taking place over a period of time (see 40 CFR Part 1508.7). The cumulative impact analysis area for each resource topic may cover a different geographic area, depending on the specific resource being evaluated.

A conclusion statement is provided for each impact topic, and under each alternative. The conclusion statement includes an impairment analysis. Impairment analysis is performed for Preserve resources and values only; therefore, there is no impairment analysis for nonfederal oil and gas development, visitor use and experience, or adjacent land uses and resources. Impairment is described on pages 1-2 and 1-3, under the heading "NPS Organic Act and General Authorities Act."

This chapter ends with a comparative analysis of the alternatives pertaining to the following topics:

- Relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity;
- Irreversible or irretrievable commitments of resources; and,
- Unavoidable adverse impacts that cannot be avoided should the action be implemented.

Directional Drilling from Outside the Preserve

The focus of the analysis under all of the resource topics (with the exception of Adjacent Land Uses and Resources) is on operations inside the Preserve because Preserve resources would more likely be impacted by operations that are sited inside of the Preserve. After presenting a description of impacts from drilling and production operations inside the Preserve, the analysis expands to describe potential impacts from directional drilling from outside the Preserve. Currently, most of the wells producing hydrocarbons underlying the Preserve are directional wells whose surface locations are outside the Preserve (see Table 3.2). The NPS's regulatory authority under the 9B regulations, and for issuing directional drilling exemptions under § 9.32(e), is limited in scope to only that portion of the operations occurring inside the Preserve (see Chapter 1, and Chapter 2, Part II). Depending on the proximity of the well to the Preserve boundary, site-specific environmental conditions, and mitigation measures employed, impacts from directional drilling on Preserve resources and values could vary widely, from no adverse impacts, to moderate, adverse impacts. Generally, directional drilling is not anticipated to result in major adverse impacts because directional drilling proposals would need to meet minimum state and federal requirements. The NPS conducts a NEPA analysis for each directional drilling proposal. In the event that there could be major, adverse impacts, the NPS would need to prepare an environmental impact statement (EIS) prior to making a decision on the proposed operation. An operator is likely to preclude the requirement for an EIS by applying the necessary mitigation measures. Impacts on Preserve resources and values would likely be substantially less than predicted in this Plan/EIS because it is anticipated that most wells would be directionally drilled from outside the Preserve to develop oil and gas resources underlying the Preserve.

IMPACTS ON NONFEDERAL OIL AND GAS DEVELOPMENT

Introduction

The impacts on nonfederal oil and gas development have been assessed because provisions in the Plan/EIS could affect how, where, and to what extent an operator could conduct nonfederal oil and gas operations in the Preserve. The application of Current Legal and Policy Requirements and operating stipulations in certain areas of the Preserve (described as Protected Areas under Alternative A, and SMAs under Alternatives B and C) have been analyzed to differentiate between the impacts of the alternatives presented in this plan.

The terminology used in this section is derived from the National Park Service's 36 CFR 9B regulations. Mineral owners who have title to the subsurface mineral estate in the Preserve may include individuals and the State of Texas. Lessees are individuals or corporations that lease oil and gas rights from the mineral owner. An operator is authorized to conduct operations in the Preserve and may include the mineral owner or lessee, or an individual or corporation designated by such to conduct operations.

This section does not discuss transpark pipeline rights-of-way in detail. Currently, the operator's right to access their pipeline rights-of-way is regulated by the issuance of a Special Use Permit by the National Park Service. All other aspects of pipeline operations in the Preserve are regulated by the U.S. Department of Transportation (49 CFR Parts 190-195) and State regulations, rather than by the National Park Service's regulations governing nonfederal oil and gas operations at 36 CFR 9B. Rights-of-way pipelines would be regulated by the NPS 36 CFR 9B regulations if hydrocarbons produced from within the Preserve are transported through these pipelines.

Methodology for Assessing Impacts

Impacts were qualitatively assessed by comparing where surface uses would be permitted for oil and gas development in the Preserve and determining whether this could affect a mineral owner's, lessee's, or operator's ability to conduct operations. The RFD scenario presented in Chapter 2 projects the number of wells that are anticipated to develop the hydrocarbons underlying the Preserve over the next 15 – 20 years. Specific locations of hydrocarbon accumulations in the Preserve are unknown, and the NPS cannot speculate where operators would conduct their operations. Because of the uncertainties of the petroleum industry and the financial considerations inherent in each operation, it is not possible to quantify the impacts on oil and gas development. Therefore, the estimates of the intensity of impact (negligible, minor, moderate, and major) presented in the following section are qualitative. This Plan/EIS describes programmatically, the impacts that could occur on nonfederal oil and gas development. As individual projects are proposed, site specific impact analyses would be conducted (as required under the National Environmental Policy Act), which would further refine the assessment of environmental effects. This assessment of impacts is based on best professional judgement and has been developed through review of relevant literature and through discussions with National Park Service staff and project consultants.

Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are defined as follows:

Negligible: The impact on operators' rights of access to their mineral estates, and the impact on nonfederal oil and gas development would be so slight that it would not be of any measurable or perceptible consequence.

Minor: The impact on operators' rights of access to their mineral estates, and the impact on nonfederal oil and gas development would be small and of little consequence.

Moderate: The impact on operators' rights of access to their mineral estates, and the impact on nonfederal oil and gas development would be measurable and of consequence.

Major: The impact on operators' right of access to their mineral estates, and the impact on nonfederal oil and gas development would be measurable and of substantial consequence.

Impacts on Nonfederal Oil and Gas Development under Alternative A (No Action/Current Management)

Project Planning: In the past, there has been no comprehensive plan guiding nonfederal oil and gas operations in the Preserve. Current Legal and Policy Requirements, mitigation measures and operating stipulations have previously been communicated to the operator on a case-by-case basis during project scoping and have been incorporated into project plans during plan development and review. Resource specific performance standards pertaining to nonfederal oil and gas operations have not been prepared prior to this planning effort. Without a comprehensive plan, it has been difficult to consistently apply Current Legal and Policy Requirements to operations throughout the Preserve. This has made project oversight by Preserve staff difficult and limits the operator's ability to efficiently plan nonfederal oil and gas operations in the Preserve. A comprehensive oil and gas management plan that describes Protected Areas and Current Legal and Policy Requirements would provide minimum protection to Preserve resources and values. However, other resources and values most susceptible to potential impacts from nonfederal oil and gas operations would not be formally designated as Special Management Areas under this alternative. Resources and values, and applicable performance standards, operating stipulations and mitigation measures would need to be defined on a case-by-case basis while preparing plans of operations or directional drilling applications. This could result in project delays. Nevertheless, a comprehensive management plan that defines Protected Areas and Current Legal and Policy Requirements would provide a minimum level of operator certainty about areas that should be avoided during nonfederal oil and gas operations, resulting in a minor beneficial impact.

Geophysical Exploration: The acquisition of 3-D seismic data could be permitted outside of protected areas, provided that all Current Legal and Policy Requirements are met and surface disturbances are either avoided or minimized (see Table 2.4). There would be increased costs for operators to comply with all current legal and policy requirements and to conduct operations that are least damaging to Preserve resources and values compared to operating outside the Preserve, and could result in a minor to moderate adverse impact on operators.

Drilling and Production: Drilling proposals would be evaluated on a case-by-case basis to determine the effect on Preserve resources. In addition to the protected areas described above, where the no surface use or timing stipulations would be applied, the application of Current and Legal Policy Requirements could result in the identification of additional areas where the no surface use or timing stipulations, and other mitigation measures would be applied (see Chapter 2, Part III).

Where it is determined that Preserve resources and values would be adversely impacted from drilling and production operations, operators may be required to directionally drill prospects from an alternate surface location to develop oil and gas resources underlying the Preserve. Directionally drilling a well would increase operating costs and the duration of operations but should not prevent commercial development of nonfederal hydrocarbons in the Preserve. Depending on the ability of the operator to conduct operations within the specified constraints, there could be minor to moderate, adverse impacts on nonfederal oil and gas development.

Due to the geographic nature of the Preserve comprising 12 distinct units, many which are narrow riparian corridors, the trend for developing the nonfederal oil and gas underlying the Preserve in

recent years has been to drill directional wells from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve. If a drilling operation were conducted outside the Preserve to access nonfederal oil and gas underlying the Preserve, there would be operational costs associated with using lands adjacent to the Preserve (including surface use agreements and loss-of-use payments). The cost of conducting operations outside the Preserve may be offset if the operator is granted an exemption under § 9.32(e) from all or a portion of the NPS 36 CFR 9B Plan of Operations requirements. The operator's costs could be reduced outside of the Preserve, because fewer resource protection measures may be required, and costs to construct access roads and drilling pads may be reduced if operations are conducted in previously disturbed areas. If flowlines and gathering lines are installed along existing road corridors, they may not be as costly to maintain as inside of the Preserve.

Plugging/Abandonment/Reclamation: Under Current Legal and Policy Requirements, an operator is required to provide a description, schedule, and cost estimate for reclamation of an operations site inside of the Preserve. For a directional drilling exemption with mitigation under § 9.32(e), operators would submit an abbreviated Application. The NPS requires specific plugging requirements (see Appendix I) for directional wells only if the proposed wellbore would intersect usable quality groundwater zones beneath the Preserve. NPS review and approval of plans and applications (for exemptions with mitigation), and subsequent monitoring of well abandonment and site reclamation is expected to ensure that Preserve resources are returned to approximate pre-disturbance conditions, and that natural conditions and processes are restored. In the event that an operator does not comply with the conditions of the approved Plan of Operations, the NPS has the option of retaining all or a portion of the operator's performance bond to ensure that plugging and abandonment operations are completed by a contractor.

Site reclamation would be more costly in the Preserve compared to non-parklands due to the regulatory requirements imposed on nonfederal oil and gas operations. Added costs that may be associated with NPS requirements for plugging and reclamation may result in a minor to moderate, adverse impact if operators decide not to proceed with development plans.

Cumulative Impacts: The cumulative impact analysis area for oil and gas development consists of the Railroad Commission of Texas District 3. District 3 includes 29 counties in East Texas and the 7 counties surrounding the Preserve. District 3 is representative of the types of hydrocarbon development and geologic plays as those found in the Preserve.

Since the discovery of Spindletop in 1901, the economy of the area has been heavily dependent upon the oil and gas industry. Much of the employment in the area surrounding the Preserve is associated with the oil and gas industry, as well as support industries (retail/wholesale trade, health and education services, construction). The cities of Beaumont, Port Arthur and Orange, known as the Golden Triangle area, make up one of the largest petrochemical and refining complexes in the world. Eleven natural gas production and transportation companies serve the Golden Triangle's power needs of industry and homes along the upper Texas and Louisiana Gulf Coast (Beaumont Chamber of Commerce, 1999).

Most oil and gas activity and pipeline construction occurred between the late 1920's and early 1970's in East Texas. Within the Preserve, there are 71 transpark pipeline segments, between 125 and 155 wells (most had been plugged and abandoned prior to the Preserve's establishment), and 15 miles of oil and gas access roads. Currently, there are 9 nonfederal oil and gas surface operations in the Preserve, comprising 6 wells, 1 saltwater disposal well, a flowline and tank battery associated with a well located outside the Preserve, and an access road associated with directional wells located outside the Preserve. Eight wells inside the Preserve have been plugged and reclamation is ongoing on 13.2 acres. In addition, there are 39 directional wells that have been drilled from outside the Preserve to bottomhole locations beneath the Preserve (as of June 1, 2005).

During the period from January 2004 through January 2005, 1,272 drilling permits were issued by the Railroad Commission of Texas in the 29 counties comprising District 3. For the seven-county area encompassing the Preserve (Hardin, Jasper, Jefferson, Liberty, Orange, Polk, and Tyler Counties), 356 drilling permits were issued, comprising 28 percent of the District-wide total. Production for 2004 in District 3 totaled 40,929,218 bbls of oil and condensate, and 647,023,981 mcf natural gas and casinghead gas. In the 7-county area encompassing the Preserve, production of oil from all sources totaled 12,164,350 bbls (30 percent of the District total), and 177,198,300 mcf natural gas from all sources (27 percent of the District total) (RRC 2004).

From 1998 through 2000, no wells were drilled in or outside the Preserve to develop the underlying hydrocarbons. From 2001 through June 2005, 19 directional wells were drilled from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve. During 2004 and up until June 1, 2005, applicants received § 9.32(e) exemption determinations for 15 additional directional wells. The historic drilling activity in the Preserve is further described in the Nonfederal Oil and Gas Operations section in Chapter 3.

The RFD scenario developed for this Plan/EIS projects that up to 40 additional wells could be drilled over the next 15 to 20 years to develop hydrocarbons underlying the Preserve. During 1998 to 2004, companies acquired 3-D seismic data over 5 units of the Preserve. Availability of the 3-D data may stimulate near-term exploratory drilling, development, and/or additional geophysical exploration in and around the Preserve. Therefore, much of the activity projected under the RFD scenario could occur over the next five to ten years (pers. comm., Peppiatt, Pathfinder 2/17/00).

Advances in geophysical exploration technology (3-D seismic) and increases in oil and gas prices have contributed to increased exploratory drilling in the region. Given the degree of exploration maturity of the area, the potential for undiscovered hydrocarbons is considered good, but the chance for discovering a large field is small (USGS 1999). Except for the short-term increase in exploration and drilling activity, an overall decline in oil and gas drilling and production is expected over the long-term. As new oil and gas discoveries occur and are developed, older operations would be abandoned and reclaimed. Cumulatively, the increased exploratory drilling activity and new field development resulting from 3-D seismic in the region, would essentially be offset by the overall decline of drilling activity (and production) in the region, resulting in negligible cumulative, adverse impacts on oil and gas development.

Conclusions under Alternative A (No Action/Current Management)

Project Planning: Implementation of a comprehensive management plan to guide nonfederal oil and gas operations in the Preserve that describes Current Legal and Policy Requirements, performance standards, mitigation measures, and operating standards would facilitate project oversight by Preserve staff, and project planning and implementation by oil and gas operators. This information would result in fewer project uncertainties, unnecessary expenditures, or time delays during the permitting process, resulting in a minor beneficial impact on oil and gas development.

Geophysical Exploration: There would be increased costs for operators to comply with Current Legal and Policy Requirements in the Preserve, which could result in minor to moderate, adverse impacts.

Drilling and Production: Drilling targets could be reached through directionally drilling wells from outside Protected Areas, which would increase the operator's drilling costs and duration of operations. Depending on the geographical extent of the area where drilling and production would not be permitted, and the ability of the operator to conduct operations within the specified

constraints, could result in a minor to moderate, adverse impact on nonfederal oil and gas development.

Plugging/Abandonment/Reclamation: Nonfederal oil and gas operations would be more costly in the Preserve, and may result in minor to moderate, adverse impacts on oil and gas operators.

Cumulative Impacts: The level of oil and gas activity in and around the Preserve would not be expected to change appreciably from current levels, and overall, there should be negligible cumulative, adverse impacts on oil and gas development.

Impacts on Nonfederal Oil and Gas Development under Alternative B (Preferred Alternative)

Project Planning: An oil and gas management plan would be prepared that would include the formal designation and protection of certain areas of the Preserve called SMAs where resources are particularly susceptible to adverse impacts from oil and gas operations or where the resources are essential to maintain the ecological integrity of the Preserve. The oil and gas management plan would clearly articulate Current Legal and Policy Requirements, performance standards, mitigation measures and SMA stipulations that are relevant to nonfederal oil and gas operations in the Preserve. The development of an oil and gas management plan would facilitate project oversight by Preserve staff, and project planning and implementation by oil and gas operators. This information would result in fewer project uncertainties, unnecessary expenditures, or time delays during the permitting process, resulting in a minor to moderate beneficial impact on oil and gas development. Implementation of Alternative B would also allow comprehensive and consistent management of nonfederal oil and gas operations by Preserve staff to meet the objectives of avoiding and minimizing damage, and preventing impairment, to resources and values in the Preserve.

Geophysical Exploration: Where operations are not permitted, geophysical surveys would need to be designed to acquire high quality data while avoiding the No Surface Use areas. Timing stipulations in the Birding Hot Spots and Hunting Areas SMAs would require scheduling operations so that they would avoid adverse impacts on specific resources. These operating stipulations could result in a minor to moderate adverse impact on geophysical exploration operations. Throughout the rest of the Preserve, there should be no adverse impacts on exploratory operations resulting from actions proposed under Alternative B.

Drilling and Production: Oil and gas underlying SMAs with the No Surface Use stipulation could be accessed through directional drilling from outside SMA boundaries, or, in the case of the Riparian Corridor SMA, from sites already disturbed and accessible within the SMA where approved under the floodplain guidelines. Directional drilling would be more likely to occur under Alternative B than under Alternative A, because of the designation of SMAs in this alternative. Directional drilling techniques would be feasible in the linear corridor units using standard drilling technology. More expensive and higher risk drilling methods may be needed to reach some interior portions of the larger SMAs. Increased drilling costs and operational risks may reach a point where operators decide not to drill certain wells. If an operator decides not to directionally drill a well to reach the hydrocarbons underlying a SMA, nonfederal oil and gas operations may slightly decline inside the Preserve and the RFD scenario presented in Chapter 2 may not be attainable. Depending on the geographical extent of the SMA and the ability of the operator to conduct operations within the specified constraints, could result in minor to moderate, adverse impacts on nonfederal oil and gas development.

If a drilling operation were conducted outside the Preserve to access nonfederal oil and gas underlying the Preserve, there would be costs associated with using lands adjacent to the Preserve (including surface use agreements and loss-of-use payments). The cost of conducting operations outside the Preserve may be offset if the operator is granted an exemption under § 9.32(e) from all or a portion of the NPS Plan of Operations requirements. The operator's costs could also be reduced outside of the Preserve because fewer resource protection measures may be required. Costs to construct access roads and drilling pads may also be reduced if operations are conducted in previously disturbed areas.

Plugging/Abandonment/Reclamation: The same as Alternative A, site reclamation would be more costly in the Preserve, due to the regulatory requirements imposed on nonfederal oil and gas operations. However, consistent, guidance on reclamation requirements would be provided to operators through the oil and gas management plan and could reduce plugging and reclamation costs resulting in minor, adverse impacts.

Cumulative Impacts: The same as Alternative A, there are anticipated to be negligible cumulative, adverse impacts on oil and gas development. With the advances in geophysical exploration technology (3-D seismic) there has been a recent increase in exploratory drilling in the region. Except for the short-term increase in activity, the overall decline in oil and gas drilling and production is expected to continue over the long-term. As new oil and gas discoveries are made and are developed, older operations would be abandoned and reclaimed.

Conclusions under Alternative B (Preferred Alternative)

Project Planning: The development of an oil and gas management plan that clearly articulates Current Legal and Policy Requirements, performance standards, mitigation measures, and SMA stipulations would facilitate project planning, resulting in minor to moderate, beneficial impacts.

Geophysical Exploration: There would be increased costs for operators to comply with Current Legal and Policy Requirements in the Preserve, which could result in minor to moderate, adverse impacts.

Drilling and Production: Drilling targets could be reached through directionally drilling wells from outside the SMAs, which would increase the operator's drilling costs and duration of operations. Depending on the geographical extent of the SMA, and the ability of the operator to conduct operations within the specified constraints, could result in minor to moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Guidance provided to operators during project planning and implementation should reduce plugging and reclamation costs. In addition, where operations are conducted outside the Preserve, reclamation may be less costly, depending on the extent of reclamation, resulting in minor, adverse impacts.

Cumulative Impacts: Same as Alternative A, the level of oil and gas activity in and around the Preserve would not be expected to change appreciably from current levels, and overall, there should be negligible cumulative, adverse impacts on oil and gas development.

Impacts on Nonfederal Oil and Gas Development under Alternative C (Maximum Resource Protection)

Project Planning: The same as Alternative B, an oil and gas management plan would be prepared that would include the formal designation and protection of certain areas of the Preserve where resources are particularly susceptible to adverse impacts from oil and gas operations or where the resources are essential to maintain the ecological integrity of the Preserve. The plan would clearly articulate Current Legal and Policy Requirements, performance standards, mitigation measures and SMA stipulations for nonfederal oil and gas operations in the Preserve. The development of an Oil and Gas Management Plan would facilitate project oversight by Preserve staff, and project planning and implementation by oil and gas operators. This information would result in fewer project uncertainties and unnecessary expenditures or time delays during the permitting process, resulting in a minor to moderate, beneficial impact on oil and gas development. Implementation of Alternative C would also allow comprehensive and consistent management of nonfederal oil and gas operations by Preserve staff to meet the NPS mandate to protect Preserve resources and values from impairment.

Geophysical Exploration: Operators could use existing seismic and well data to develop prospects beneath these areas, but could not acquire new data within the SMAs. If there is no existing data to image the subsurface within a SMA, there could be a minor to major adverse impact where operators are attempting to develop prospects in these areas. Throughout the rest of the Preserve, there should be no adverse impacts on exploratory operations resulting from actions described under Alternative C.

Drilling and Production: Drilling targets within the SMAs could only be reached through directionally drilling wells from outside the SMA, which would increase the operator's drilling costs, risk, and duration of operations. Directional drilling techniques would be feasible in the linear corridor units using proven drilling technology. More expensive and higher risk drilling methods may be needed to reach some interior portions of the larger SMAs (i.e., Riparian Corridors, and Rare Forested Wetland Communities SMAs). Increased drilling costs and operational risks may reach a point where operators decide not to drill certain wells. If an operator chooses to not directionally drill a well to reach oil and gas underlying a SMA, nonfederal oil and gas operations may slightly decline inside the Preserve and the RFD scenario presented in Chapter 2 may not be attainable. Depending on the geographical extent of the SMA and the ability of the operator to conduct operations within the specified constraints, could result in minor to major, adverse impacts on nonfederal oil and gas development.

If it is determined that the area considered for nonfederal oil and gas operations is "…subject to, or threatened with, uses which are, or would be, detrimental to the purposes and objectives of this Act" (Big Thicket National Preserve enabling legislation - P.L. 93-439), the NPS would notify Congress of its intent to begin acquisition of the mineral interest and would seek appropriations for the acquisition of the mineral rights.

If a drilling operation is conducted outside the Preserve to access nonfederal oil and gas underlying the Preserve, there would be costs associated with using lands adjacent to the Preserve (including surface use agreements and loss-of-use payments). The cost of conducting operations outside the Preserve may be offset if the operator is granted an exemption under § 9.32(e) from the NPS Plan of Operations requirements. The operator's costs could also be reduced outside of the Preserve, because costs to construct access roads and drilling pads may be reduced if operations are conducted in previously disturbed areas and if pipelines are installed along existing road corridors, so that maintenance costs may be reduced.

Plugging/Abandonment/Reclamation: The same as Alternatives A and B, site reclamation would be more costly for operations occurring inside the Preserve, due to the regulatory requirements imposed on nonfederal oil and gas operations. However, consistent, guidance on

reclamation requirements would be provided to operators through the oil and gas management plan and could reduce plugging and reclamation costs resulting in minor, adverse impacts.

Cumulative Impacts: The same as Alternatives A and B, there are anticipated to be negligible cumulative, adverse impacts on oil and gas development. With the advances in geophysical exploration technology (3-D seismic) there has been a recent increase in exploratory drilling in the region, but except for the short-term increases in activity, the overall decline in oil and gas drilling and production is expected to continue over the long-term. As new oil and gas discoveries are made and are developed, older operations would be abandoned and reclaimed. Within the Preserve, the level of oil and gas activity may decrease from current levels, because of the No Surface Use stipulation in SMAs.

Conclusions under Alternative C (Maximum Resource Protection)

Project Planning: Same as Alternative B, the development of an oil and gas management plan that clearly articulates Current Legal and Policy Requirements, performance standards, mitigation measures, and SMA stipulations would facilitate project planning, resulting in minor to moderate, beneficial impacts.

Geophysical Exploration: Exploration operations would not be permitted in the SMAs where the No Surface Use stipulation would be applied on 37,088 acres or in SMAs during specified times (52,307 acres), or within 500 feet of waterways (unless specifically authorized in an approved plan of operations).

Exploration operations may decline inside the Preserve. If there is not adequate data to image the subsurface, there could be minor to major, adverse impacts.

Drilling and Production: Drilling targets within the SMAs could only be reached through directionally drilling wells from outside the SMA, which would increase the operator's drilling costs and duration of operations. Nonfederal oil and gas drilling operations may decline inside the Preserve. Depending on the geographical extent of the SMA and the ability of the operator to conduct operations within the specified constraints, could result in a minor to major, adverse impact.

Plugging/Abandonment/Reclamation: Same as Alternative B, guidance provided to operators during project planning and implementation should reduce plugging and reclamation costs. In addition, where operations are conducted outside the Preserve, reclamation may be less costly, depending on the extent of reclamation, resulting in minor, adverse impacts.

Cumulative Impacts: Same as Alternatives A and B, the level of oil and gas activity in and around the Preserve would not be expected to change appreciably from current levels, and overall, there should be negligible cumulative, adverse impacts on oil and gas development.

IMPACTS ON AIR QUALITY

Introduction

Big Thicket National Preserve is designated a Class II area under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act. The Preserve lies within several Texas counties that are not in compliance with the National Ambient Air Quality Standard for ground-level ozone.

Nonfederal oil and gas operations in and surrounding the Preserve could affect air quality in the Preserve and regional airsheds.

Methodology for Assessing Impacts

The RFD scenario and data available from the State's air quality management program were used to qualitatively assess the environmental impacts on air quality of the Preserve and region. Exact locations of future operations are unknown. It is assumed that activities would occur in a similar distribution as compared to locations of existing activities. The assessment of impacts is based on best professional judgement and has been developed through discussions with NPS staff and through review of relevant literature.

Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impacts would result in a change to air quality that would be slight and perceptible, but would not affect the Preserve's protected limits within the Class II air shed.

Minor: Impacts would result in a change to air quality, but the change would be small and of little consequence, and would not affect the Preserve's protected limits within the Class II air shed. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: Impacts would result in a perceptible and measurable change to air quality that would be long-term and localized, but would not affect the Preserve's protected limits within the Class II air shed. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.

Major: Impacts would result in a change to air quality that could be severely perceptible and measurable for long periods of time, and/or would affect the Preserve's protected limits within the Class II air shed. Extensive mitigation measures would be needed to offset any adverse effects, and their success would not be guaranteed.

The analysis of air quality impacts described in this section is based on potential changes from baseline conditions. If oil and gas operations anticipated under the RFD scenario could emit air pollutants, the impact is considered to be "adverse" under NEPA guidelines. It should be understood, however, that some increases in air pollution emissions within a given airshed may be allowed without being considered "adverse" under Clean Air Act programs.

Under all three alternatives, the exploration and production of oil and gas has the potential to impact air quality from the following sources:

- suspended particulate matter (dust) generated from construction of access roads, wellpads, production facilities, flowlines, gathering lines and pipelines, and site reclamation activities; combustion of diesel-powered equipment; the oil and gas itself; routine emission of noxious vapors from storage tanks; vehicle exhaust; and traffic on paved and unpaved roads;

- accidental spills of volatile petroleum products, resulting in emissions of hydrocarbons or volatile organic compounds, and other pollutants such as hydrogen sulfide (H_2S);

- emissions of carbon monoxide (CO), and oxides of nitrogen (NO_x) from vehicle and stationary gasoline and diesel engines (including electric generators from construction machinery and vehicles transporting equipment); and

- flaring of gas during well testing and production operations.

Under all alternatives, air quality in all areas of the Preserve would receive protection under Current Legal and Policy Requirements, particularly 36 CFR 9B regulations, which require utilization of least-damaging methods. Section 9.41(a) of the regulations require operations be sited a minimum 500 feet from visitor use, administrative and other use areas; and waterways, unless specifically authorized by an approved plan of operations. The effects from operations conducted inside the Preserve or from directional drilling and production from outside the Preserve on the Class II air quality are anticipated to range from negligible to minor, because of the limited extent of projected operations under the RFD scenario, and because all operations must comply with state and federal regulations. Operations conducted inside the Preserve would also have to comply with NPS requirements in order to receive approval for the Plan of Operations; therefore, operators inside the Preserve would be required to follow operating procedures to minimize emissions. These include use of blowout preventers; a prohibition on burning of vegetation, construction debris, or site-produced wastes; use of clean (i.e., low sulfur) fuels; proper maintenance of engines; use of pollution control devices on vehicles (e.g., catalytic converters); and inspection and maintenance of flares and treater facilities. However, the application of Current Legal and Policy Requirements, and project-specific operating stipulations, could result in variations in how, where, and to what extent resource protection is applied.

A description of impacts on air quality from specific types of oil and gas operations under each alternative follows.

Impacts on Air Quality under Alternative A (No Action/Current Management)

Geophysical Exploration: Air quality would be impacted primarily due to increased vehicle use to transport seismic work crews, and equipment to drill shotholes. Combustion engine emissions include volatile organic compounds, nitrogen oxides, carbon monoxide, and sulfur oxides. The primary pollutants of concern are nitrogen oxide compounds (NO_x) which are formed in the high temperature, pressure, and excess-air environment of combustion in diesel engines. Lesser amounts of carbon monoxide (CO) and hydrocarbons are also emitted. Some sulfur dioxide (SO_2) is emitted due to the burning of gasoline and diesel (which can contain minor amounts of sulfur). The amount of engine emissions depends on the number and type of gasoline or diesel-fueled vehicles and shothole drilling equipment used and the length of use. Due to the short-term nature that 3-D seismic surveys occur, these emissions would result in negligible, adverse impacts that would be short-term (weeks or months). For large-size particulates and CO emissions, impacts would be localized. However, for other pollutants, like VOCs and NO_X (or even SO_2 which transforms to SO_4 fine particles downwind), these impacts may be localized, as well as contribute to regional air quality impacts.

Drilling and Production: Vehicles and heavy equipment used for the construction and maintenance of access roads, wellpads, flowlines, and pipelines; and well drilling could introduce nitrogen oxides, volatile organic compounds, carbon monoxide, sulfur dioxide, and odors from operating large engines, pumps and auxiliary equipment, resulting in, short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), negligible to minor, adverse impacts on air quality.

Hydrocarbons and treatment chemicals could be released during drilling, production, or transport and could adversely impact air quality. Hydrocarbons could volatize and enter the atmosphere. In the vicinity of the leak or spill, concentrations of gas and other constituents could present health hazards to animal and plant life. In addition, this could provide a source for explosion or fire. These impacts could be serious on a very local level, with minor to major, adverse impacts; however, with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to minor, and be short-term. These impacts would be localized as well as contribute to regional air quality impacts.

Drilling would involve continuous operation of combustion engines over a 30 to 45-day drilling period. This would introduce emissions of nitrogen oxides (NO_x), carbon monoxide (CO), and sulfur dioxide (SO_2). Large diesel engines, which are used to power the drill, rigs, pumps, and auxiliary equipment emit nitrogen oxide compounds (NO_x) as primary pollutants of concern. These are formed in the high temperature, pressure, and excess-air environment of combustion diesel engines. Smaller amounts of carbon monoxide (CO) and hydrocarbons would also be emitted. Some sulfur dioxide (SO_2) would be emitted due to the burning of gasoline and diesel (which contain minor amounts of sulfur). The amount of engine emissions depends on the drilling rig size (horsepower), percent sulfur in the fuel burned, gallons of diesel fuel burned per hour, the hours per day, number of days the diesel rigs operate, and the use of any control devices.

Hydrogen sulfide (H_2S) presents a serious localized air quality concern because it is extremely toxic at very small concentrations. Hydrogen sulfide, if encountered, is extremely hazardous to normal oil field operations because of potential adverse health effects, and it contributes to metal fatigue in drilling equipment. Past drilling operations in the Preserve have not encountered hydrogen sulfide-bearing zones. However, if zones containing gas or fluids under pressure are encountered, the drilling mud system is adjusted to prevent the release of hydrogen sulfide. Drilling is discontinued until the pressure is stabilized and there is essentially no gas entering the hole. The small amount of gas that could reach the surface is vented from the system by use of a de-gasser unit and flared (burned). Drilling and producing of hydrocarbons containing toxic gases can be performed safely and without incident if the necessary precautions are taken and appropriate safety procedures are followed.

Odors from drilling and production operations could affect visitors and park employees. The possibility and extent for odor would depend on wind speed and direction and the nature of the drilling equipment and material encountered during drilling operations (particularly hydrogen sulfide-bearing zones). Odor would be more noticeable during light breezes and less evident during periods of stronger winds.

Particulate matter emissions would be greatest during construction of roads, pads, flowlines and transpark oil and gas pipelines, due to the higher number of vehicles and earthmoving activities. Greater use of motor vehicles during construction of access roads and pads, and during drilling, would increase particulate matter from vehicle exhaust and dust from paved and unpaved roads. Exhaust from machinery used during construction and drilling would also contribute to an increase in particulate matter. As a result of increased particulate matter emissions, visibility may be slightly impacted during construction and drilling in the localized area where these activities are undertaken. There could be some added impact on regional visibility due to transport of fine particulate matter and haze produced by secondary aerosols (i.e., particulate matter formed from gaseous emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and volatile organic compounds (VOC), in particular).

The amount of air pollution generated over the productive life of oil or gas wells depends on the characteristics of the product and the production practices used. Emissions associated with production are usually considerably less than the emissions from well drilling. However, over the life of some production operations, emissions could exceed those of drilling operations. Wells that do not produce hydrogen sulfide (H_2S) in the oil, natural gas, or associated gas products are less likely to cause air pollution than wells that do produce hydrogen sulfide. Oil and gas production operations would release gaseous pollutants such as carbon monoxide (CO), hydrocarbons, nitrogen oxides (NO_x), and sulfur

dioxide (SO_2). These air pollutants would be released by separation facilities, disposal of liquid waste and unwanted gas, burning of waste petroleum products, routine emission of objectionable odors, and venting of noxious vapors from storage tanks.

Photochemical reactions between hydrocarbons and nitrogen oxides (NO_x) produce ozone. While the concentration of all these pollutants would increase as the fields are developed, the levels are expected to be low and are required to comply with federal and State standards and conform to the Texas air quality State Implementation Plan (SIP). The extent of impacts caused by increases in pollutants may range from areas in close proximity to each well to longer ranges, low level contributions to regional impacts, like ozone and haze formation.

Proper maintenance of gasoline and diesel-fueled engines and use of low sulfur fuels are important in minimizing exhaust emissions. The use of pollution control devices on vehicles (e.g., catalytic converters) would reduce unnecessary emissions. Inspection and maintenance of production equipment such as flares and treater facilities is necessary to ensure that deteriorated components and equipment are detected and replaced or repaired.

Mitigation should reduce the intensity of impacts from drilling and production operations to localized, short-term (construction activities and drilling operations) to long-term (roads, production operations, flowlines, gathering lines, and pipelines), negligible to minor, adverse impacts on air quality.

Wells directionally drilled and produced from outside the Preserve to develop hydrocarbons beneath the Preserve could impact air quality in the Preserve. Directional wells in the past have been drilled within 100 to 1,500 feet from Unit boundaries. Depending on proximity to the Preserve boundary, prevailing winds, site-specific environmental factors, and mitigation measures employed, impacts on the Preserve could range from no impact to indirect, short- to long-term, minor, adverse impacts. Impacts could be localized, as well as contribute to regional air quality impacts

Plugging/Abandonment/Reclamation: Increased vehicle use and removal of roads, pads, flowlines and pipelines could increase particulate matter emissions. Leaks and spills of hydrocarbons could occur during well plugging, shutting down and abandoning/removing flowlines and pipelines and use of heavy equipment and vehicles during reclamation activities, resulting in emissions of gaseous pollutants and presenting a potential source for explosion or fire, but with mitigation, impacts would result in short-term, negligible, adverse impacts on air quality at sites throughout the Preserve. These impacts could be localized, as well as contribute to regional air quality impacts.

Impacts on air quality in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short-term, negligible, adverse impacts. Impacts could be localized as well as contribute to regional air quality impacts.

Cumulative Impacts: The cumulative impact analysis area for air quality includes the seven-county area encompassing the Preserve. Impacts on air quality in the Preserve from oil and gas operations could result from 41 existing wells located within and outside the Preserve, leaks or spills from 71 transpark oil and gas pipelines; and future operations including RFD-projected Preserve-wide geophysical exploration on up to 465 acres, and drilling of an estimated 40 wells with production of an estimated 27 wells from locations within or outside the Preserve. As some operations are developed, others would be plugged, abandoned, and reclaimed; therefore, impacts would be distributed over time. Other Preserve activities that could contribute to air quality impacts include prescribed fires and routine maintenance of Preserve unpaved roads.

Due to the fragmented nature of the Preserve's management units, the spectrum of adjacent land uses which would contribute more appreciably to the air quality in the region includes: nonfederal oil and gas

activities of a substantially greater number as compared to operations in the Preserve (from January 2004 – January 2005, 1,272 drilling permits were issued by the Railroad Commission of Texas in the 29 counties comprising District 3. For the seven-county area encompassing the Preserve, 356 drilling permits were issued, comprising 28 percent of the District-wide total. In contrast, from 1998 through 2000, no wells were drilled in or outside the Preserve to develop the underlying hydrocarbons, and from 2001 – 2005, there has been an average of five wells directionally drilled from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve); industrial sources including pulp mills, oil refineries, and petro-chemical manufacturing plants; public utilities; and urban sources. Odors associated with pulp mill operations in the region are periodically noticeable, and some air pollution may occur from burning associated with the preparation of sites by private timber companies.

Two emission source categories were considered in the cumulative impact analysis. The Preserve lies within several Texas counties that are classified as nonattainment for ozone (Hardin, Liberty, Orange, and Jefferson Counties). Additional emissions of NO_x and volatile organic compounds (VOCs), the primary precursors of ozone formation may exacerbate existing ozone levels. Both pollutants are common emissions of oil and gas exploration and production operations. Fine fraction particulate matter (PM) emissions are also a concern. The Big Thicket region has been found to comprise high levels of $PM_{2.5}$ measured during a 2-month special study period (1996) at 18 sites on both sides of the US-Mexico border. Air quality monitoring was performed at NPS and non-NPS locations in Texas, including Big Thicket National Preserve and Big Bend National Park, Texas. Fine sulfate particles comprised a significant portion of the $PM_{2.5}$ measured at the Preserve. It is likely that additional industrial activity associated with oil and gas production will contribute to $PM_{2.5}$ formation through emissions of SO_2, NO_x, and VOCs that are transformed in the atmosphere to fine particulate matter. If $PM_{2.5}$ levels are increased in the region, the Big Thicket region could be classified as a Nonattainment Area for the fine particle NAAQS.

While the NPS can exercise more stringent air quality mitigation standards than currently exist under State (TCEQ) and federal (EPA) requirements under the Clean Air Act, air quality in the region would be contingent on the state and federal ambient air quality standards, air pollution control requirements, and air quality management programs of the appropriate state and federal authorities. Therefore, while existing and new oil and gas operations in the Preserve are expected to result in mostly localized, negligible to minor, adverse impacts on air quality in the Preserve, increased population growth and development outside the Preserve could result in cumulative, moderate to major adverse impacts on the regional airsheds. But, with adherence to State and federal ambient air quality standards, air pollution control requirements, and air quality management programs specified in State Implementation Plans, air quality in regional airsheds are expected to be maintained or improved.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: Use of vehicles to transport seismic work crews and equipment, and shothole drilling equipment could increase emissions of sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons in areas where geophysical exploration could be permitted on up to 465 acres of the Preserve, resulting in short-term, negligible, adverse impacts on air quality. These impacts could be localized, as well as contribute to regional air quality impacts.

Drilling and Production: The construction and maintenance of access roads, wellpads, flowlines, and pipelines could increase particulate matter emissions. Well drilling could introduce nitrogen oxides, volatile organic compounds, carbon oxides, sulfur oxides, and odors from operating large engines, pumps and auxiliary equipment. Emissions could continue during production at lower levels; but could exceed emissions from drilling over the life of production operations. Mitigation should reduce impacts to short-term (construction activities and drilling operations) to long-term (roads, production operations,

and flowlines and pipelines), negligible to minor, adverse impacts on air quality. Hydrocarbons or treatment chemicals could be released during drilling, production, or transport. Hydrocarbons could volatize and enter the atmosphere, and provide a source for explosion or fire, with minor to major, adverse impacts on air quality; but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to minor. Impacts on air quality in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short- to long-term, minor, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Plugging/Abandonment/Reclamation: Vehicle use and removal of roads, pads, flowlines and pipelines could increase particulate matter emissions. Leaks and spills of hydrocarbons could occur during well plugging, shutting down and abandoning/removing flowlines and pipelines, or from use of heavy equipment and vehicles during reclamation activities, resulting in emissions of gaseous pollutants and providing a source for explosion or fire; but with mitigation, impacts would result in short-term, negligible, adverse impacts on air quality at sites throughout the Preserve. Impacts on air quality in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Cumulative Impacts: Over time, protection provided to air quality in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of this resource, a cumulative, beneficial impact on air quality in the Preserve. Activities that contribute to air quality impacts outside the Preserve such as oil and gas operations, pulp mills, oil refineries, and petro-chemical manufacturing plants, public utilities, and urbanization could result in cumulative, moderate, adverse impacts on the regional airsheds. But, with adherence to State and federal ambient air quality standards, air pollution control requirements, and air quality management programs specified in State Implementation Plans, air quality in the regional airsheds are expected to be maintained or improved.

Impairment Analysis: Because there would be no major adverse impacts to air quality whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment to Preserve air quality.

Impacts on Air Quality under Alternative B (Preferred Alternative)

SMAs would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. In addition to SMA operating stipulations, by applying applicable Current Legal and Policy Requirements, including 36 CFR 9B regulations, which have been described in Chapter 2, Parts II and III, and under Alternative A, impacts on air quality should be substantially reduced throughout the Preserve.

Geophysical Exploration: Similar to Alternative A, use of vehicles to transport seismic work crews and equipment, and shothole drilling equipment could increase emissions of sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons, resulting in short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Drilling and Production: Due to the designation of SMAs, it is possible that some wells may be directionally drilled from outside the SMAs, and from outside the Preserve, to develop hydrocarbons underlying the SMAs. As a result, new drilling and production operations would be distanced from SMAs and would have less effect on air quality in SMAs, especially for larger-sized particulates and

odors that could settle out or dissipate close to the sources outside the SMAs. Emissions of more regional pollutants like fine particulates and ozone/haze precursors could still have effects as described under Alternative A.

Similar to Alternative A, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could increase particulate matter emissions. Well drilling could introduce nitrogen oxides, volatile organic compounds, carbon monoxide, sulfur dioxide, and odors from operating large engines, pumps and auxiliary equipment. Emissions could continue during production at lower levels; but could exceed emissions from drilling over the life of production operations. Mitigation should reduce impacts to short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), negligible to minor, adverse impacts on air quality within areas where drilling and production could occur in or directionally from outside the Preserve. Hydrocarbons or treatment chemicals could be released during drilling, production, or transport. Hydrocarbons could volatize and enter the atmosphere, and provide a source for explosion or fire, with minor to major, adverse impacts on air quality; but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to minor. Air quality in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short- to long-term, minor, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Existing operations (24.2 acres) and transpark pipelines (589 acres) would continue to adversely impact air quality in the Preserve.

Plugging/Abandonment/Reclamation: Similar to Alternative A, increased vehicle use and removal of roads, pads, flowlines and pipelines could increase particulate matter emissions. Leaks and spills of hydrocarbons could occur during well plugging, shutting down and abandoning/removing flowlines and pipelines, or from use of heavy equipment and vehicles during reclamation activities, resulting in emissions of gaseous pollutants and providing a source for explosion or fire; but with mitigation, impacts would result in short-term, negligible, adverse impacts on air quality at sites throughout the Preserve. Impacts on air quality in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Cumulative Impacts: Similar to Alternative A, existing and future oil and gas operations, and other activities in the Preserve, in combination with increased population growth and development surrounding the Preserve could result in cumulative, moderate to major, adverse impacts on the regional airsheds. But, with adherence to State and federal ambient air quality standards, air pollution control requirements, and air quality management programs specified in State Implementation Plans, air quality in regional airsheds are expected to be maintained or improved. Designation of SMAs with operating stipulations under Alternative B would better ensure that air quality in the Preserve is protected.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, exploration operations would result in short-term, negligible, adverse impacts on air quality within the areas of operation on up to 465 acres in the Preserve. These impacts could be localized, as well as contribute to regional quality impacts.

Drilling and Production: Similar to Alternative A, construction and maintenance of drilling and production operations in the Preserve would result in short to long-term, negligible to minor, adverse

impacts on air quality. Impacts on air quality in the Preserve from directional wells drilled from outside the Preserve to bottomohles beneath the Preserve could range from no impact to indirect, short- to long-term, minor, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Plugging/Abandonment/Reclamation: Similar to Alternative A, plugging, abandonment, and reclamation of new operations located outside SMAs; and for existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in short-term, negligible, adverse impacts on air quality. Impacts on air quality in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Cumulative Impacts: Similar to Alternative A, with cumulative, moderate, adverse impacts on the regional airsheds; but air quality in the Regional airsheds are expected to be maintained or improved. The designation of SMAs with the No Surface Use stipulations would better ensure that air quality in these areas of the Preserve are protected.

Impairment Analysis: Because there would be no major adverse impacts to air quality whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment to Preserve air quality.

Impacts on Air Quality under Alternative C (Maximum Resource Protection)

SMAs would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to geophysical exploration in all SMAs, except for the Hunting Areas and Birding Hot Spots SMAs that would have timing restrictions. The No Surface Use stipulation would be applied to drilling and production operations in all SMAs, except for the Hunting Areas SMA. In the remaining areas of the Preserve where operations could be permitted, the application of Current Legal and Policy Requirements, including 36 CFR 9B regulations (which have been described in Chapter 2, Parts II and III, and under Alternative A), should substantially reduce impacts on air quality throughout the Preserve.

Geophysical Exploration: Similar to Alternatives A and B, vehicle use to transport seismic work crews and equipment, and to drill shotholes could increase emissions of sulfur dioxide, nitrogen oxides, carbon monoxide, and hydrocarbons, resulting in short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

The No Surface Use stipulation year-round in SMAs covering 37,088 acres may result in the modification of project designs for 3-D seismic surveys. As a result, it may be necessary to increase the density or intensity of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. As a result, impacts could occur inside or outside of the Preserve, and are dependant upon the location and layout of the seismic grid. Despite the greater number of vehicles and equipment for concentrated operations, impacts would be similar to Alternatives A and B, with short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Drilling and Production: Due to the designation of SMAs covering 46,273 acres, where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. As a result, new drilling and production operations would be distanced from SMAs and would have less effect on air quality in SMAs, especially for larger-sized particulates and odors that could settle out or dissipate close to the sources outside the SMAs. Emissions of more regional pollutants like fine particulates and ozone/haze precursors could still have effects as described under Alternatives A and B.

Similar to Alternatives A and B, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could increase particulate matter emissions. Well drilling could introduce nitrogen oxides, volatile organic compounds, carbon monoxide, sulfur dioxide, and odors from operating large engines, pumps and auxiliary equipment. Emissions could continue during production at lower levels; but could exceed emissions from drilling over the life of production operations. Mitigation should reduce impacts to short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), negligible to minor, adverse impacts on air quality. Hydrocarbons or treatment chemicals could be released during drilling, production, or transport. Hydrocarbons could volatize and enter the atmosphere, and provide a source for explosion or fire, with minor to major, adverse impacts on air quality; but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to minor. Impacts on air quality in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short- to long-term, minor, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Existing operations on 613 acres (including 9 existing oil and gas operations on 11 acres and 8 plugged wells with ongoing reclamation on 13.2 acres, and 71 transpark pipelines and activities in their associated rights-of-way on 589 acres) could contribute to air quality degradation if hydrocarbons or treatment chemicals are leaked or spilled, or during routine maintenance operations if transported oil and gas products are exposed and volatized to the atmosphere.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, increased vehicle use and removal of roads, pads, flowlines and pipelines could increase particulate matter emissions. Leaks and spills of hydrocarbons could occur during well plugging, shutting down and abandoning/removing flowlines and pipelines, or from use of heavy equipment and vehicles during reclamation activities, resulting in emissions of gaseous pollutants and providing a source for explosion or fire; but with mitigation, impacts would result in short-term, negligible, adverse impacts on air quality at sites throughout the Preserve. Impacts on air quality in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Cumulative Impacts: Similar to Alternatives A and B, with cumulative, moderate to major, adverse impacts on the regional airsheds; but, with adherence to State and federal ambient air quality standards, air pollution control requirements, and air quality management programs specified in State Implementation Plans, air quality in the regional airsheds are expected to be maintained or improved. The designation of SMAs over a larger area with the No Surface Use stipulation would better ensure that air quality in these areas of the Preserve are protected.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Where geophysical exploration could be permitted, impacts would be similar to Alternatives A and B, with short-term, negligible, adverse impacts on air quality near areas on

up to 465 acres of the Preserve. These impacts could be localized, as well as contribute to regional air quality impacts.

Drilling and Production: Similar to Alternatives A and B, with short to long-term, negligible to minor, adverse impacts on air quality localized around operations on up to 241 acres of the Preserve. Due to the designation of SMAs over a larger area where operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons beneath the Preserve. Impacts on air quality in the Preserve from directional wells drilled from outside the Preserve to bottomohles beneath the Preserve could range from no impact to indirect, short- to long-term, minor, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, with short-term, negligible, adverse impacts on air quality. Impacts on air quality in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, short-term, negligible, adverse impacts. These impacts could be localized, as well as contribute to regional air quality impacts.

Cumulative Impacts: Similar to Alternatives A and B, with cumulative, moderate, adverse impacts on the regional airsheds; but, air quality in the regional airsheds are expected to be maintained or improved. The designation of SMAs over a larger area with the No Surface Use stipulation would provide greater assurance that air quality in these areas of the Preserve are protected.

Impairment Analysis: Because there would be no major adverse impacts to air quality whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment to Preserve air quality.

IMPACTS ON GEOLOGIC RESOURCES

Introduction

Nearly half of the Preserve is located within floodplains and wetlands containing soils that are particularly susceptible to impacts from oil and gas operations. Disturbance to slopes would accelerate erosion, made easier by the heavy and sustained rainfall typical of the region, which averages 55 inches annually.

Methodology for Assessing Impacts

Actions projected under the RFD scenario were analyzed against mapped landcover classifications, which have been entered in the Preserve's geographic information system (GIS) database. Mapping involved delineating soils by Hydrologic Soil Group; mapping the 100 and 500-year floodplains, slopes, and defining the general location of sand mounds. The assessment of impacts is based on best professional judgement and was developed through discussion with NPS staff, consultants, and a review of relevant literature.

Impact Intensity Thresholds. Impacts on geologic resources could include:

- construction of roads, well pads, and/or flowlines could result in disturbance to poorly-drained soils that support riparian or wetland vegetation, the loss of long-term productivity, and reduced potential for successful reclamation;
- project construction could disturb slopes, which would result in long-term erosion;
- release of oil and gas or other contaminating and hazardous substances into the environment would impact soils;
- increased erosion rates or reduction in soil productivity and stability could prevent successful reclamation with native species and composition; and
- following project completion, more than two years could be required to reestablish ground cover needed to stabilize the site and minimize erosion of soils.

The thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impacts would result in a change to geologic resources, but the change would be so slight that it would not be of any measurable or perceptible consequence.

Minor: Impacts would result in a change to geologic resources, but the change would be small and of little consequence and would be expected to be short-term and localized. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: Impacts would result in a change to geologic resources that would be measurable, long-term, and localized. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major: Impacts would result in a change to geologic resources that would be measurable and result in substantial consequences on a regional scale for long periods of time or to be permanent. Extensive mitigation measures would be needed to offset any adverse effects, and their success would not be guaranteed.

Impacts on Geologic Resources under Alternative A (No Action/Current Management)

Under Alternative A, geologic resources throughout the Preserve would receive protection under Current Legal and Policy Requirements, including the 36 CFR 9B regulations, which require utilization of least-damaging methods. Through the application of Current Legal and Policy Requirements, impacts on geologic resources should be substantially reduced throughout the Preserve. However, there could be variations in how, where, and to what extent resource protection is applied. At this time, operational issues related to the protection of geologic resources are done on a case-by-case basis.

Geophysical Exploration: Off-road vehicle use, and shothole drilling and detonation could result in soil erosion, compaction, rutting, contamination, and blow-outs with localized, short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve.

The primary impacts from geophysical exploration on geologic resources, including disturbance to sand mounds, would result from the use of overland vehicles to transport equipment and personnel. Vehicles are typically used in seismic operations to transport survey crews, water for drilling shotholes, shothole drilling equipment, geophones and cables. Vehicles could damage and kill plants, increasing the potential for soil erosion. Soil Hydrologic Groups "C" and "D" typically found in lowland areas (wetlands and floodplains) are very susceptible to adverse impacts from oil and gas operations. The NPS study, "Impact of Oil/Gas Development on Vegetation and Soils of Big Thicket National Preserve" (Fountain and Rayburn, 1987), found that upland soils allow deeper root penetration than seasonally wet (hydrologic) soils. Sloped sites and wet soils with shallow-rooted vegetation (typically found in wetlands and floodplains) were found to be the most susceptible to disturbance. Vegetation with shallow roots tends to be uprooted when run over by vehicles, while deeper-rooted plants would bend but later resume normal appearance. Also, loose alluvial soils and moist clays have low bearing capacities and are very susceptible to vehicle use.

Vehicles could also cause soil compaction, and reduce the soil's water-holding and infiltration capacities. Soil compaction would reduce vegetation's root-penetration capabilities and hinder plant growth and soil formation. Compacted soils increase runoff of surface waters and accelerate soil erosion. Vehicles could also cause deep rutting of soils if operations are conducted when soils are saturated, which would also contribute to erosion and increased runoff along ruts made by vehicles.

In most areas of the Preserve, the use of overland vehicles for geophysical exploration operations would not be permitted, thereby eliminating many of the adverse impacts associated with their use. Drilling shotholes with a hand-held auger could be done in areas where vehicle access would cause damage and unnecessary loss of vegetation, or where wet or saturated soils would be damaged by vehicle use. Since 1998, the 3-D seismic mini-shot hole technique has been used in the Preserve to minimize resource impacts. This method involves drilling shallow shotholes in a cluster or tight linear pattern with a hand-held portable-drilling tool. With this technique, equipment can be carried on foot or transported via helicopter, thereby reducing adverse impacts from overland vehicle use. During the initial application of this technique, detonation of a large number of the shotholes resulted in craters and blowouts, indicating that explosive charge size may have been too large for the shothole depth. While the mini-shothole technique may increase the chances of blowouts and craters, the risk of this occurring has been substantially reduced with improved project designs. If craters or blowouts were to occur, they would be reclaimed following completion of the 3-D seismic survey.

Several other mitigation measures provided for under Current Legal and Policy Requirements would help to minimize impacts on soils from exploration operations. The NPS's Nonfederal Oil and Gas Rights Regulations, at 36 CFR § 9.41(a), require that "Surface operations shall at no time be conducted within 500 feet of the banks of perennial, intermittent or ephemeral watercourses; or within 500 feet of the high pool shoreline of natural or man-made impoundment; or within 500 feet of the mean high tideline; or within 500 feet of any structure of facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit, unless specifically authorized by an approved plan of operations." This operating requirement would eliminate direct impacts on soil resources within these areas. Nonfederal oil and gas operations could be exempt from this requirement as long as the operations utilize least-damaging methods to avoid or minimize adverse impacts on Preserve resources and values.

Also, no new roads would be allowed for geophysical exploration under Current Legal and Policy Requirements. Vehicle use would be prohibited on Preserve roads when they are wet enough to cause damage to the roadbed. Off-road vehicle travel would not be permitted on saturated soils to prevent soil compaction or rutting (particularly on Soil Hydrologic Groups "C" and "D" commonly found in floodplains and wetlands).

Explosive charges must be positioned where they would not cause soil damage. Shotholes would not be placed on slopes greater than 3 percent or on small terraces where there is a high probability for lateral blowouts. This mitigation measure should result in avoid directly impacting soils.

Drilling and Production: Where new wells could be located, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could erode, compact and rut soils, introduce non-native construction materials, and reduce soil permeability, resulting in localized, short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), moderate, adverse impacts. Hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to minor.

Impacts on soils from construction of roads and drill pads would result from clearing of vegetation, exposing soils to erosion, and then compacting and introducing non-native fill materials to construct elevated access roads and pads. If there are no existing roads into the area, access roads would have to be constructed. A 30-foot-wide road, including shoulders and turnouts, one mile in length, would disturb approximately 3.63 acres of soil. Elevated pads for exploratory drilling and production operations may disturb as much as 2.4 acres of soil per site.

Soil erosion can be caused by raindrop splash, surface water movement, and by mass wasting. Raindrops loosen and dislodge soil particles as they strike the soil surface. Sheet erosion affects large areas with unconcentrated waterflows. Concentration of surface waters forms small, shallow channels (rills) that are up to a few inches deep. The convergence of rills forms gullies that can be several feet wide and deep. Large volumes of water and sediment can be transported downslope through gullies. Mass wasting is the loss of rocks and sediment and is caused by collapsing or headcutting of gully walls, gully bottoms, and stream banks. The loss is usually measured in cubic yards. The extent to which these erosional features (sheetwash, rills, and gullies) are present on a landscape indicates the severity of the erosion problem.

Slopes are particularly susceptible to erosion caused from road and wellpad construction. Avoidance of steep slopes and sensitive soils is required under Current Legal and Policy Requirements and is the most cost-effective and sensible approach that would avoid adverse impacts. Soil displacement and losses cannot be predicted with any degree of accuracy until soil studies have been done for a Plan of Operations. If there are no other practicable alternatives to constructing roads and pads on slopes, construction would be permitted if least-damaging methods are utilized. In all areas of the Preserve, and particularly for operations constructed on slopes greater than 3 percent, establishment of 70 percent native grass cover would be required within 3 months of initiating reclamation to minimize soil erosion.

Soil compaction related to road and wellpad construction reduces porosity and increases the soil's bulk density. Soil compaction occurs on roads and wellpads when vehicles or other heavy objects cross or are placed on the soil surface. A decrease in soil porosity causes a reduction of available water and oxygen for plant growth (Alexander and McLaughlin, 1990). In extreme cases, compaction can extend to a depth of 2 feet (the majority of the root zone). This may be an irreversible impact if compaction happens when the soil profile is wet. Soil Hydrologic Groups "C" and "D" are most common in wetlands and floodplains and have a relatively higher clay content, compact more easily, and have a lower bearing capacity (approximate bearing capacity: 2.8 lb/in^2 to 57.0 lb/in^2) than sandy soils (approximate bearing capacity: 7.1 lb/in^2 to 85.0 lb/in^2). To protect soils, the use of vehicles when soils are wet or saturated would not be permitted except on access roads and wellpads. The use of fill materials for the construction of access roads, wellpads and berms around wellpads is required to protect soils in the Preserve. Use of fill materials would protect the soils from erosion and would maintain the soil structure that is essential for re-establishment of vegetation following the completion of operations. Once drilling

and production operations are completed, the fill would be removed, exposing the underlying, undisturbed soils.

In addition to construction-related impacts associated with development of the access roads and wellpads, another primary impact to soils is the potential for releases of hazardous or contaminating substances during drilling or production operations. In most cases, primary and secondary containment on a wellpad should prevent the release of drilling muds, diesel fuel, oil and gas, and other substances beyond the drilling pad. But if a blow-out were to occur during drilling, standard containment may not prevent the release of contaminants into the surrounding environment.

The composition of the drilling mud depends on the types of formations being drilled, project economics, water availability, subsurface temperatures and pressures, and other factors. Mud can be composed of freshwater, or a mixture of water, oil, chemicals, clays, and weighting materials. Chemical additives such as alkalis, bactericides, soluble chromates, and corrosion inhibitors are often used to optimize well drilling. Weighting materials are often added to prevent formation fluids from flowing into the well as it is being drilled. Drilling mud can be highly toxic or relatively benign. The drilling mud and cuttings from the well account for the largest volume of waste generated at the wellsite. According to Current Legal and Policy Requirements, the drilling mud (including drill cuttings and waste fluids) at operations in the Preserve must be completely containerized in tanks for offsite disposal at a state approved facility.

Drilling operations in the Preserve should not encounter formations with hydrogen sulfide (H_2S), or high pressures and associated uncontrolled flows of oil, gas, brine, or fresh water. Safety precautions such as the use of properly weighted drilling muds and blow-out preventers are expected to ensure safe drilling operations that would prevent blowouts and the release of contaminants.

Since production operations could last for 20 years or longer, the potential for leaks and spills of hazardous or contaminating substances from production operations (including flowlines and pipelines) is greater than for any other type of oil and gas operation. Impacts on soils may occur from accidental discharge of drilling fluids during workovers, hazardous waste spills including diesel fuel, well blowouts, and rupture of flowlines and pipelines. Chronic small leaks and spills, could spread through various pathways, and over an extended period of time, could become significant and costly to remediate. The intensity of the impact would depend on the type of substance spilled, (hydrocarbons, produced waters, chemicals, solvents, and fuels), and the size of area impacted, and could be a minor to major adverse impact on geologic resources, but with mitigation, there should be negligible to minor adverse impacts on geologic resources. Releases of contaminating or hazardous substances normally require in-situ treatment or the removal of all of the contaminated soil and replacement with soil brought in from outside the Preserve.

Under Current Legal and Policy Requirements, risks associated with accidental releases of hazardous and contaminating substances are reduced to negligible by a variety of operating stipulations. Careful siting of operations would avoid moderate or steep slopes, reducing the potential for downslope contamination with oil, gas or other hazardous substances. Other considerations for locating a production site would include avoiding close proximity to wetlands, floodplains, or waterways. Other mitigation techniques include the use of less toxic or hazardous substances, storing the minimum quantity of contaminating and hazardous substances at operations locations, storing barrels or smaller containers of chemicals with secondary containment, using automatic shut-off valves on wells and on flowlines on each side of crossings of waterways and other sensitive resource areas, constructing berms and installing liners at production tank facilities and increasing their capacity to accommodate high precipitation events, and including a Spill Notification and Response Plan in the Plan of Operations.

In the event of a release of contaminating or hazardous substances into the environment, the NPS promptly notifies the National Response Center. In the event an operator does not respond promptly or

effectively to clean up a release, the NPS proceeds through the National Contingency Plan for cleanup, for which the operator is financially responsible. Cleanup attainment levels are to the baseline soil and surface/ground water chemistry, which is determined prior to beginning operations. When a release occurs, the NPS requires the operator to collect samples for lab analyses according to the NPS Guideline for the Detection and Quantification of Contamination at Oil and Gas Operations (Appendix F). In the event that contaminating or hazardous substances are not removed or reduced to predisturbance levels, the NPS may utilize the Park System Resource Protection Act to recover costs associated with the residual damages to park resources.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact geologic resources in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions such as steepness of slope and direction, and surface hydrology; and mitigation measures being employed. Based on these factors, indirect impacts on geologic resources in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Surface subsidence caused by fluid withdrawals from beneath Big Thicket National Preserve is not expected because of the properties (depth, porosity, compaction, hydropressure, etc.) of the target reservoirs and adjacent overlying sediments. There is no evidence that past production has contributed to any subsidence in the Preserve. While subsidence related to oil and gas withdrawals is possible, conditions conducive to it occurring (very shallow, high porosity reservoirs combined with high fluid withdrawal volumes, or fractures extending from reservoir depths to the surface) are not known to exist in or near the Preserve.

Plugging/Abandonment/Reclamation: Well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, disturb and contaminate soils, but with mitigation, would result in localized, short- to long-term, negligible to minor, adverse impacts at sites throughout the Preserve. Incorrectly removing fill materials could result in exposing and eroding the underlying soils and disrupting surface water hydrology. Contamination from hydrocarbons and produced water still persists at several of these inactive and abandoned oil and gas operations. Until cleanup is successfully completed, there would be adverse impacts on geologic resources.

Contamination from hydrocarbons and produced water still persists at several of the inactive and abandoned oil and gas operations. Until cleanup is successfully completed, there would be adverse impacts on geologic resources.

Current Legal and Policy Requirements require the operator to conduct baseline soil chemical analyses so that if there is a release of hazardous or contaminating substances, the operator can remove or remediate the contaminants to acceptable levels and reclaim the site to pre-disturbance conditions.

Indirect impacts on geologic resources from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed. Therefore, impacts could range from no impact to indirect, localized short-term, minor, adverse impacts.

Cumulative Impacts: The cumulative impact analysis area for geologic resources covers the Lower Neches River Watershed which extends from the B.A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area is the same as what has been defined for all natural resources. The analysis area has

been selected because it includes the major rivers and tributaries that flow through the Preserve, and activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact natural resources, including soils in the region.

Abandoned, ongoing and future oil and gas operations within and outside of the Preserve could adversely affect geologic resources. Existing (24.2 acres) and abandoned operations (unreclaimed sites comprising 376 acres), and transpark pipelines (589 acres) totaling 989 acres in the Preserve would continue to adversely affect geologic resources until the sites are reclaimed. Future oil and gas operations that are projected to occur on up to 465 acres for exploration operations and on up to 241 acres for drilling and production operations may also adversely affect geologic resources. Short-term impacts (1 to 3 years) could result from geophysical exploration (3-D seismic surveys) and short and long-term impacts could occur from the construction, maintenance and use of access roads, wellpads, flowlines or transpark oil and gas pipelines. While the total direct surface disturbance from oil and gas operations could be as high as 1,695 acres in the Preserve, it is expected that as some operations are being developed, others would be reclaimed to pre-disturbance conditions. Reclamation of existing access roads and wellpads within and outside of the Preserve would be a beneficial impact on soils. The removal of fill materials such as gravel and oyster shell, and recontouring and revegetating disturbed areas should reduce soil erosion and re-establish surface drainage flows.

Geologic resources (primarily soils) under all alternatives could be adversely affected by agricultural and forestry operations; urban and residential development; road construction, publicly owned facilities (water impoundments, water diversion structures, and sewage treatment), and oil and gas operations in and outside of the Preserve. Agricultural, forestry, and construction activities may cause compaction and rutting, reduce permeability, and increase erosion and deposition of sediments that could alter the topography, increase turbidity in streams, modify surface water flows and indirectly adversely affect vegetation, and fish and wildlife. Urban, residential, and agricultural run-off (such as fertilizers and oil; and leachate from septic systems); and accidental leaks and spills of oil, produced water, or other contaminating substances from oil and gas operations could contaminate sediments and soils. Water impoundments (i.e., Steinhagen Reservoir) and water diversion canals can increase or decrease water levels and alter the duration and frequency of stream flows, which indirectly affects the extent of flooded or saturated soils. Water impoundment structures (dams) also reduce sediment movement throughout the river system which can affect a variety of downstream natural resources.

The information provided by geologic resource surveys of proposed operations in the Preserve would increase the NPS's knowledge of the resource in the Preserve, a cumulative, negligible, beneficial impact. Over time, protection provided to geologic resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed, adversely impacting geologic resources. Overall, past, present, and future oil and gas development, along with other types of ground disturbing activities inside and outside the Preserve, should have cumulative, negligible to minor, adverse impacts on geologic resources.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: Off-road vehicle use, and shothole drilling and detonation could result in soil erosion, compaction, rutting, contamination, and blow-outs with localized, short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve.

Drilling and Production: The construction and maintenance of access roads, wellpads, flowlines, and pipelines could erode, compact and rut soils, introduce non-native construction materials, and reduce soil permeability, resulting in localized, short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), moderate, adverse impacts on

up to 241 acres of the Preserve. Hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to minor. Indirect impacts on geologic resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, disturb and contaminate soils, but with mitigation, would result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Indirect impacts on geologic resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short-term, minor, adverse impacts.

Cumulative Impacts: Over time, protection provided to geologic resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed adversely impacting geologic resources. The cumulative impact of nonfederal oil and gas operations within and outside the Preserve; oil and gas sites that are not reclaimed to predisturbance conditions; and other ground disturbing activities outside the Preserve could increase soil compaction, erosion and contamination, and alter soil chemistry resulting in cumulative, negligible to minor, adverse impacts on geologic resources.

Impairment Analysis: Because there would be no major adverse impacts to geologic resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve geologic resources.

Impacts on Geologic Resources under Alternative B (Preferred Alternative)

SMAs would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. By applying applicable Current and Legal Policy Requirements, including 36 CFR Part 9B regulations (which have been described in Chapter 2, Parts II and III), impacts on soils and other geologic resources should be substantially reduced throughout the Preserve.

Geophysical Exploration: Similar to Alternative A, in all other areas of the Preserve where exploration operations could be permitted, off-road vehicle use, and shothole drilling and detonation could result in soil erosion, compaction, rutting, contamination, and blow-outs with localized, short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve. Where geophysical operations would be permitted, mitigation measures required under Current Legal and Policy Requirements would protect geologic resources in these areas (which have been described in Chapter 2, Parts II and III, and under Alternative A).

Drilling and Production: There would be no direct impacts on geologic resources in SMAs covered by the No Surface Use stipulation. New drilling or production operations (including the construction of roads and flowlines) would not be allowed in the riparian corridor unless the operation complies with the floodplain guidelines. If permitted, these operations would have to be sited adjacent to existing roads or within previously disturbed areas. Limiting drilling and production operations on 25,539 acres in the Riparian Corridors SMA would substantially reduce adverse impacts on Soil Hydrologic Groups "C" and

"D" that are very susceptible to adverse impacts from oil and gas operations. Drilling and production operations would also not be permitted in all Ecological Research and Monitoring SMAs. Soils and other geologic features in these areas would also be protected by the No Surface Use stipulation.

Similar to Alternative A, in all other areas of the Preserve where drilling and production operations could be permitted, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could erode, compact and rut soils, introduce non-native construction materials, and reduce soil permeability, resulting in localized, short- to long-term, moderate, adverse impacts on up to 241 acres of the Preserve. Impacts on geologic resources would be short-term for construction activities and drilling operations and long-term, extending up to 20 years or more, for roads, production operations, and flowlines and pipelines. Leaks and spills during construction activities or drilling or production operations, and blowouts during drilling operations could adversely impact geologic resources in the Preserve. The intensity of the impact would depend on the type of substance spilled, (hydrocarbons, produced waters, chemicals, solvents, and fuels), and the size of area impacted, and could result in minor to major, adverse impacts on soils. But, with the application of mitigation measures, and prompt response in the event of a spill, these impacts could be negligible to minor. Nonfederal oil and gas operations that predate this planning effort on 989 acres, including existing operations on 24.2 acres, abandoned and unreclaimed sites comprising 376 acres, and transpark pipelines on 589 acres and their associated rights-of-way would continue to adversely impact geologic resources in the Preserve.

It is anticipated, under Alternative B, that some wells may be directionally drilled from outside the SMAs to develop hydrocarbons underlying the SMAs. The intensity of impacts on soils is dependant upon where the operation is located with respect to soil type, whether the operation is sited inside or outside of the Preserve, and on the resource protection measures that are employed. Indirect impacts on geologic resources in the Preserve from drilling and production of directional wells from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within the 500-year floodplain (including the Riparian Corridors SMA) unless there is no practicable alternative. Generally, the soils in upland areas are composed of Soil Hydrologic Groups "A" and "B" that are well to excessively drained, with a high silt and sand content, and moderate to high permeabilities. In comparison to bottomland soils, a spill in higher permeability upland soils could result in a greater chance for deeper penetration into the soils. Conversely, Soil Hydrologic Groups "C" and "D" typically found in lowland areas (wetlands and floodplains) are poorly drained, clayey soils with low permeabilities. There should be less adverse impacts from drilling and production operations on soils in upland areas than on soils found in wetlands and floodplains. However, if leaks and spills were to occur, the fluids could be transported downslope into surface waters and/or infiltrate into the groundwater, with minor to major, adverse impacts on water quality. But, with mitigation and quick response in the event of a spill, these adverse impacts should be negligible to moderate.

Where drilling and production operations would be permitted under Alternative B, mitigation measures should minimize adverse impacts on geologic resources. These include using fill materials to construct access roads and wellpads, not allowing the construction of access roads and wellpads on steep slopes, using containerized mud systems, constructing a berm around the wellpad, storing the minimum quantity of contaminating and hazardous substances at operations locations, storing barrels or smaller containers of chemicals with secondary containment, using automatic shut-off valves for disposal wells and on flowlines on each side of crossings of waterways and other sensitive resource areas, constructing berms and installing liners at production tank facilities and increasing capacity to accommodate high precipitation events, and including a Spill Notification and Response Plan in the Plan of Operations.

Surface subsidence caused by fluid withdrawals from beneath Big Thicket National Preserve is not expected because of the properties (depth, porosity, compaction, hydropressure, etc.) of the target reservoirs and adjacent overlying sediments. There is no evidence that past production has contributed

to any subsidence in the Preserve. While subsidence related to oil and gas withdrawals is possible, conditions conducive to it occurring (very shallow, high porosity reservoirs combined with high fluid withdrawal volumes, or fractures extending from reservoir depths to the surface) are not known to exist in or near the Preserve.

Plugging/Abandonment/Reclamation: Similar to Alternative A, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, disturb and contaminate soils, but with mitigation, would result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Indirect impacts on geologic resources in the Preserve from reclaiming of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative B would be the same as described for Alternative A, except that formal designation of SMAs, and application of specific protection measures, would provide consistent protection of geologic resources in the SMAs. Over time the additional protection afforded the Riparian Corridors SMA would protect soils that are particularly susceptible to adverse impacts from oil and gas operations or are essential to maintain the ecological integrity of the Preserve. Mitigation measures such as prohibiting vehicle use on wet or flooded soils would further protect soils in the Preserve. Land uses that could adversely affect geologic resources include; agricultural and forestry operations; urban and residential development; road construction, publicly owned facilities (water impoundments, water diversion structures, and sewage treatment plants), and oil and gas operations in and outside of the Preserve. Over time, protection provided to geologic resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed adversely impacting geologic resources resulting in cumulative, negligible to minor adverse impacts.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, exploration operations would result in localized, short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternative A, the construction and maintenance of drilling and production operations would result in localized, short- to long-term, moderate, adverse impacts on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be negligible to minor. Indirect impacts on geologic resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Similar to Alternative A, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to minor, adverse impacts on geologic resources. Indirect impacts on geologic resources in the Preserve from reclamation directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short-term, minor, adverse impacts.

Cumulative Impacts: The impacts would be the same as Alternative A, except that formal designation of SMAs, and application of specific protection measures, would provide consistent protection of geologic resources in the SMAs. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, negligible to minor, adverse impacts on geologic resources.

Impairment Analysis: Because there would be no major adverse impacts to geologic resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve geologic resources.

Impacts on Geologic Resources under Alternative C (Maximum Resource Protection)

SMAs would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to geophysical exploration in all SMAs, except for the Hunting Areas and Birding Hot Spots SMAs that would have timing stipulations. The No Surface Use stipulation would be applied to drilling and production operations in all SMAs, except for the Hunting Areas SMA. Many of the SMAs designated under Alternative C where the No Surface Use stipulation would apply contain geologic resources that are highly susceptible to adverse impacts from oil and gas operations (i.e., sand mounds, and Soil Hydrologic Groups "C" and "D" commonly located in wetlands and floodplains). In the remaining areas of the Preserve, where operations could be permitted, the application of Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations (which have been described in Chapter 2, Parts II and III, and under Alternative A), should substantially reduce impacts on geologic resources throughout the Preserve.

Geophysical Exploration: Many of the SMAs under this alternative are situated in lowland areas containing Soil Hydrologic Groups "C" and "D" which are highly susceptible to adverse impacts from vehicle use during nonfederal oil and gas operations. The No Surface Use stipulation in these areas would protect the hydrologic soils from any adverse impacts from geophysical exploration operations.

In areas of the Preserve where exploration operations could be permitted, off-road vehicle use, and shothole drilling and detonation could result in soil erosion, compaction, rutting, contamination, and blow-outs. The No Surface Use designation in SMAs covering 39,088 acres may result in the modification of project designs for 3-D seismic surveys. It may be necessary to increase the density or intensity of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. The modification of project designs could result in impacts similar to Alternatives A and B, with short-term, negligible to minor, adverse impacts on geologic resources on up to 465 acres outside of the SMAs. These adverse impacts could occur inside or outside the Preserve, and the intensity of the impact is dependent upon the layout of the seismic grid.

Where geophysical operations would be permitted, mitigation measures required under Current Legal and Policy Requirements would protect geologic resources in these areas. Surface operations cannot be conducted within 500 feet of waterways, or visitor use and administrative areas unless specifically authorized by an approved plan of operations (3 CFR § 9.41(a)). New roads may not be constructed for geophysical exploration. Vehicle use would be prohibited on Preserve roads when they are wet enough to cause damage to the roadbed. Off-road vehicle travel would not be permitted on saturated soils to prevent soil compaction or rutting (particularly in floodplains and wetlands). Explosive charges

must be positioned where they would not cause soil damage. Shotholes would not be placed on slopes greater than 3 percent or on small terraces where there is a high probability for lateral blowouts.

Drilling and Production: The No Surface Use stipulation in SMAs would protect these soils from any adverse impacts from construction and maintenance activities that could cause erosion, compaction, rutting, or loss of permeability. Also, many of the designated SMAs are situated in areas of the Preserve (i.e., Riparian Corridors and Rare Forested Wetlands Communities SMAs) containing Soil Hydrologic Groups "C" and "D" which are highly susceptible to adverse impacts from overland vehicle use during nonfederal oil and gas operations.

Similar to Alternatives A and B, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could erode, compact and rut soils, introduce non-native construction materials, and reduce soil permeability, resulting in localized, short- to long-term, moderate, adverse impacts on up to 241 acres of the Preserve. Impacts on geologic resources would be short-term for construction activities and drilling operations and long-term, extending up to 20 years or more for roads, production operations, and flowlines and pipelines. Leaks and spills during construction activities or drilling or production operations, and blowouts during drilling operations could adversely impact geologic resources in the Preserve. The intensity of the impact would depend on the type of substance spilled, (hydrocarbons, produced waters, chemicals, solvents, and fuels), and the size of area impacted, and could result in minor to major, adverse impacts on soils. But, with the application of mitigation measures, and prompt response in the event of a spill, these impacts could be negligible to minor. Nonfederal oil and gas operations that predate this planning effort on 989 acres, including existing operations on 24.2 acres, abandoned and unreclaimed sites comprising 376 acres, and transpark pipelines on 589 acres and their associated rights-of-way would continue to adversely impact geologic resources in the Preserve.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of indirect impacts on geologic resources in the Preserve would depend on proximity to the Preserve, site-specific environmental conditions such as steepness of slope and direction, and surface hydrology; and mitigation measures being employed. Based on these factors, indirect impacts on geologic resources in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

If the operations are conducted inside the Preserve, by directionally drilling to avoid SMAs, they are likely to occur in upland areas since drilling and production operations would not be permitted within the 500-year floodplain unless there is no practicable alternative. Generally, the soils in upland areas are composed of Soil Hydrologic Groups "A" and "B" that are well to excessively drained, with a high silt and sand content, and moderate to high permeabilities. Conversely, "C" and "D" soils typically found in lowland areas (wetlands and floodplains) are poorly drained, clayey soils with low permeabilities. There should be less adverse impacts from drilling and production operations on soils in upland areas than on soils found in wetlands and floodplains. However, if leaks and spills were to occur, the fluids could be transported downslope into surface waters and/or infiltrate into the groundwater, with minor to major, adverse impacts on water quality. But, with mitigation and quick response in the event of a spill, these adverse impacts should be negligible to moderate.

Where drilling and production operations would be permitted under Alternative C, mitigation measures should minimize adverse impacts on geologic resources. These include: (1) using fill materials to construct access roads and wellpads, (2) not allowing the construction of access roads and wellpads on steep slopes, (3) using containerized mud systems, constructing a berm around the wellpad, (4) storing the minimum quantity of contaminating and hazardous substances at operations locations, (5) storing barrels or smaller containers of chemicals with secondary containment, (6) using automatic shut-off valves for disposal wells and on flowlines on each side of crossings of waterways and other

sensitive resource areas, (7) constructing berms and installing liners at production tank facilities and increasing the capacity of storage tanks to accommodate high precipitation events, (8) and including a Spill Notification and Response Plan in the Plan of Operations.

Surface subsidence caused by fluid withdrawals from beneath Big Thicket National Preserve is not expected because of the properties (depth, porosity, compaction, hydropressure, etc.) of the target reservoirs and adjacent overlying sediments. There is no evidence that past production has contributed to any subsidence in the Preserve. While subsidence related to oil and gas withdrawals is possible, conditions conducive to it occurring (very shallow, high porosity reservoirs combined with high fluid withdrawal volumes, or fractures extending from reservoir depths to the surface) are not known to exist in or near the Preserve.

Plugging/Abandonment/Reclamation: There would be more acreage designated as SMAs under Alternative C, where exploration, drilling and production would not be permitted; therefore, plugging, abandonment, and reclamation of new operations would not occur in these areas. Similar to Alternatives A and B, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, disturb and contaminate soils, but with mitigation, would result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Incorrectly removing road and pad fill could result in exposing and eroding the underlying soils and disrupting of surface water hydrology.

Indirect impacts on geologic resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to short-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative C would be the same as described for Alternatives A and B except that the No Surface Use stipulation would be applied in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development which would ensure widespread protection of geologic resources in the Preserve. Over time the protection afforded in the Sand Mounds, Riparian Corridors, and Rare Forested Wetland Communities SMAs would protect soils that are particularly susceptible to adverse impacts from oil and gas operations or are essential to maintain the ecological integrity of the Preserve. Mitigation measures such as prohibiting vehicle use on wet or flooded soils would further protect soils in the Preserve. Land uses that could adversely affect geologic resources include: agricultural and forestry operations; urban and residential development, road construction, publicly owned facilities (water impoundments, water diversion structures, and sewage treatment), and oil and gas operations in and outside of the Preserve. Over time, protection provided to geologic resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed adversely impacting geologic resources resulting in cumulative, negligible to minor adverse impacts.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Similar to Alternatives A and B, exploration operations would result in localized, short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternatives A and B, drilling and production could be permitted in other areas of the Preserve, with localized, short to long-term, negligible to moderate, adverse impacts on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a

spill these impacts could be negligible to minor. Indirect impacts on geologic resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: There would be more acreage designated as SMAs under Alternative C, where exploration, drilling and production would not be permitted; therefore, plugging, abandonment, and reclamation of new operations would not occur in these areas.

Similar to Alternatives A and B, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to minor, adverse impacts on geologic resources. Indirect impacts on geologic resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short-term, minor, adverse impacts.

Cumulative Impacts: The impacts would be the same as Alternatives A and B, except that the No Surface Use stipulation would be applied in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development which would ensure widespread protection of geologic resources in the Preserve. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, negligible to minor, adverse impacts on geologic resources.

Impairment Analysis: Because there would be no major adverse impacts to geologic resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve geologic resources.

IMPACTS ON WATER RESOURCES

Introduction

Water plays a dominant role in maintaining the ecological integrity of the Preserve, and protection of water resources is a very high management priority. Four of the twelve management units in the Preserve are riparian corridors. All 12 units are dominated by major waterways and surface water flow. Nearly half of the Preserve is floodplains, and over 40 percent is wetlands. Abundant rainfall, averaging 55 inches of precipitation annually, could contribute to erosion of soils and increase sediment load in rivers and streams caused by nonfederal oil and gas operations. Oil and gas operations have the potential to release pollutants into surface and ground waters, which can threaten Preserve resources.

Methodology for Assessing Impacts

Actions projected under the RFD scenario were analyzed against mapped land-type delineations, which have been entered in the Preserve's geographic information system database. Resources that have been mapped include wetlands, 100- and 500-year floodplains, and surface waters. The degree of potential impacts on water resources from oil and gas development would depend on the types and locations of operations and the mitigation measures used to reduce impacts. The assessment of

impacts is based on best professional judgement and was developed through discussions with NPS staff and consultants and a review of relevant literature.

Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are as follows:

Negligible: Impacts would result in a change to water resources and/or floodplains, but the change would be so slight that it would not be of any measurable or perceptible consequence.

Minor: Impacts would result in a change to water resources and/or floodplains, but the change would be small and of little consequence and would be expected to be short-term and localized. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: Impacts would result in a change to water resources and/or floodplains that would be measurable, long-term, and localized. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major: Impacts would result in a change to water resources and/or floodplains that would be measurable and have substantial consequences on a regional scale for long periods of time or to be permanent. Extensive mitigation measures would be needed to offset any adverse effects, and their success would not be guaranteed.

Impacts on Water Resources under Alternative A (No Action/Current Management)

Under Alternative A, SMAs would not be formally designated. Protected areas comprising 56,538 acres and other areas of the Preserve would be provided protection under Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations. Interpretation and application of Current Legal and Policy Requirements, and project-specific considerations, could result in variations in how, where, and to what extent resource protection is applied in the Preserve. If appropriate identification of water quality concerns is not made and avoidance or mitigation techniques are not applied, impacts on water resources could be the greatest under Alternative A.

Surface water quality can be directly affected by altering or disrupting surface flow (e.g., velocity, quantity or direction), increasing turbidity and sediment loads, or introducing hazardous and contaminating substances into stream systems. The following sections provide descriptions of impacts on water resources that could result from specific types of oil and gas operations.

Geophysical Exploration: Where exploration operations could be permitted, the loss or modification of vegetation, off-road vehicle use, and shothole drilling and detonation could increase turbidity and sedimentation, and degrade water quality in surface waters with localized, short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve. Shothole drilling and detonation are expected to have negligible, adverse impacts on groundwater quality and quantity in the Preserve.

The primary impacts from geophysical exploration on water resources would result from the use of overland vehicles to transport equipment and personnel. Vehicles are typically used in seismic operations to transport survey crews, water for drilling shotholes, shothole drilling equipment, and geophones and cables. Vehicles could damage and kill plants, increasing the potential for soil erosion,

turbidity, and sedimentation in waterways. However, in most areas of the Preserve, seismic operations could be done with smaller, lightweight vehicles or on foot, using the mini-shothole technique (see discussion under Impacts on Geologic Resources). This would minimize impacts on vegetation, soils, and subsequently on water resources from the use of vehicles.

Seismic operations are anticipated to have negligible effects on groundwater quantity or quality. Shothole detonation could dislodge or mobilize clays within an aquifer and cause a decrease in water quality, or a reduction in groundwater flow. These effects are very uncommon and usually of short duration, unless the aquifer has limited geographic extent such as a localized perched water table. Explosives that are occasionally left undetonated in shotholes could introduce small quantities of organic chemical compounds that are biodegradable within two to three years. The small quantity of explosives (usually ½-pound) spaced approximately 110 to 440 feet apart is not expected to appreciably impact groundwater chemistry. Soils such as fragipans that support surface waters in wetlands areas, are susceptible to adverse impacts from oil and gas operations and could conceivably be disturbed by shothole drilling, and possible fractured from the detonation of explosives in shotholes. However, through Current Legal and Policy Requirements, operators are required to conduct soil surveys in the proposed project area, and must avoid the remote possibility of fracturing or splitting aquitards by offsetting shotholes or using smaller explosive charges. Therefore, the NPS anticipates no more than negligible, adverse impacts from geophysical exploration on the Beaumont Clay Unit or other aquitards; or on the quantity or quality of the groundwater in the Preserve.

Where geophysical operations would be permitted, mitigation measures required under Current Legal and Policy Requirements would protect water resources in these areas. Surface operations cannot be conducted within 500 feet of waterways, or visitor use and administrative areas unless specifically authorized by an approved plan of operations (36 CFR § 9.41(a)). New roads may not be constructed for geophysical exploration. Vehicle use would be prohibited on Preserve roads when they are wet enough to cause damage to the roadbed. Off-road vehicle travel would not be permitted on saturated soils to prevent soil compaction or rutting (particularly in floodplains and wetlands). Explosive charges must be positioned where they would not cause soil damage. Shotholes would not be placed on slopes greater than 3 percent or on small terraces where there is a high probability for lateral blowouts.

Drilling and Production: In accordance with Current Legal and Policy Requirements (Director's Order 77-2 for Floodplain Management), drilling and production operations would not be permitted within the 500-year floodplain unless there is no practicable alternative. Where permitted, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could increase soil erosion, turbidity and sedimentation, and alter flow characteristics and hydrologic functions of surface waters with localized, short- to long-term, minor to moderate, adverse impacts on up to 241 acres of the Preserve. Impacts on water resources would be short-term for construction activities and drilling operations and long-term, extending up to 20 years or more for roads, production operations, and flowlines and pipelines. Surface and groundwater in the Preserve could be contaminated if drilling muds, hydrocarbons, produced waters, or treatment chemicals are released during drilling, production, or transport, with moderate to major, adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate.

Prior to conducting operations, the operator must collect site-specific water resources data such as stream discharge, precipitation, runoff, soils, slope, vegetation cover, current sediment loading, etc., for a quantitative impact assessment on water resources to be included in the Plan of Operations. If the incremental increase of sediment loads into surface and groundwater is small relative to the current load, the adverse impacts from drilling and production operations would likely be minor. If the incremental increase of sediment loads is large relative to the current loads, the resulting sedimentation could alter stream channel morphology, degrade water quality, and damage aquatic habitats. Assuming the successful implementation of mitigation measures, such as erosion and sediment

controls and other least-damaging methods, impacts on water quality and aquatic habitat would likely be minor.

Surface water quality could be impacted by the construction, use, and maintenance of access roads used for oil and gas operations. The potential for adverse impacts from roads would be greatest where extensive cut and fill was necessary to construct the roadway. Road construction and maintenance could expose soils to erosion, which could move downslope and fill in depressions and increase turbidity and sedimentation in surface waters. Compacted road fill could also reduce infiltration rates on road surfaces. Additional roads in the Preserve could increase access, which in turn could result in additional land disturbance and erosion. If roads are used during wet conditions, rutting could occur and may concentrate surface waterflows. However, proper siting, engineering design, construction, and maintenance of roads would substantially reduce impacts associated with road construction, use, and maintenance.

Access roads and pads could disrupt natural surface flow patterns and may result in an increase or decrease in the amount of water in some areas (including wetlands). The proper siting and alignment of roads and pads, and the placement of adequate culverts under access roads, and appropriate drainage on and around drilling and production pads, adverse impacts on water resources would be minimized.

NPS regulations under 36 CFR § 9.41(a) require a setback of 500 feet from waterways for all oil and gas operations, unless specifically authorized by an approved plan of operations. Therefore, increased erosion and sedimentation in surface waters from access roads, drilling and production pads is expected to be minor. Increased sediment loads would be more likely at stream crossings during the construction of bridges, and during the construction or replacement of flowlines and transpark oil and gas pipelines. Current Legal and Policy Requirements such as obtaining Clean Water Act Section 404 permits prior to undertaking any work in waterways would mitigate impacts at stream crossings.

Oil and gas drilling operations are not expected to impact surface and groundwater quantity from surface and groundwater withdrawals. According to 36 CFR § 9.35, water for nonfederal oil and gas operations may not be taken from within the Preserve unless approval is granted in a plan of operations. If an operator requests to use water within the Preserve, the NPS would evaluate the potential effects on in-stream flows of tributary channels and groundwater quantity prior to approval of the plan. If adverse effects are anticipated, the request would be denied and the operator would have to obtain water from outside the Preserve.

Water resources could become contaminated if hazardous or contaminating substances are released during drilling operations. Blowouts could occur and release hydrocarbons, water, and drilling mud, but the use of blow-out preventers should prevent an uncontrolled contaminant release during drilling operations. There could also be accidental spills of drilling mud, diesel fuel, and other chemicals during drilling operations. Primary and secondary containment systems such as containerized mud systems, impermeable wellpad liners, and berms around the perimeter of the wellpad should prevent the release of hazardous and contaminating substances into surface and groundwaters.

Drilling operations in the Preserve should not encounter formations with hydrogen sulfide (H_2S), or high pressures and associated uncontrolled flows of oil, gas, brine, or fresh water. Safety precautions such as the use of properly weighted drilling muds and blow-out preventers are expected to ensure safe drilling operations that would prevent blowouts and the release of contaminants.

It is possible that drilling and production operations could adversely impact groundwater quality if adequate mitigation measures are not employed. If drilling mud, fuels, or other chemicals are spilled on the ground and there is no impermeable liner on the wellpad, the fluids could infiltrate into shallow aquifers. During drilling operations and prior to casing the well, groundwater quality is protected because drilling muds form a “mud cake” on the walls of the wellbore which minimizes the loss of fluids

into the surrounding formations. Faulty installation or corrosion of production casing may go undetected for years and could adversely impact groundwater, if hydrocarbons and/or produced waters migrate into an aquifer and contaminate groundwater. However, proper placement and cementing of casing through all useable aquifers according to the minimum standards required by the Railroad Commission of Texas should adequately protect groundwater from contamination with hydrocarbons and produced waters.

Since production operations could last for 20 years or longer, the potential for leaks and spills of hazardous or contaminating substances from production operations (including flowlines and pipelines) is greater than for any other phase of oil and gas operation. Adverse impacts on water quality may occur from accidental leaks and spills of drilling fluids during workovers, hazardous waste spills including diesel fuel, well blowouts, rupture of flowlines and pipelines, and spills from tanker trucks. Chronic small leaks and spills, could spread through various pathways, and over an extended period of time, could become significant and costly to remediate. The intensity of the impact would depend on the type of substance spilled (hydrocarbons, produced waters, chemicals, solvents, and fuels), and the size of area impacted, and could be a minor to major, adverse impact on water resources. However, with mitigation there should be negligible to moderate adverse impacts on water resources. Releases of contaminating or hazardous substances normally require in-situ treatment of soils, surface and groundwater, or the removal of all of the contaminated soil and replacement with soil brought in from outside the Preserve.

The transport of hydrocarbons has the potential to adversely affect water quality. Production pipelines can rupture from corrosion of the pipe, or from failure of a flange, valve, or seal. Transpark oil and gas pipelines are generally larger in diameter and under more pressure than the smaller flowlines and pose the potential for a large volume release. The escaping fluids could contaminate surface and groundwater and could have major adverse impacts on water quality in and downstream from the Preserve. In lieu of transporting hydrocarbons via pipelines, the product could be transported by tanker truck. This method has a greater potential for leaks and spills during transfer of fluids to the tanker, in addition to the potential for vehicular accidents in which the tank contents could be spilled.

If there is an accidental release of a hazardous or contaminating substance, the NPS promptly notifies the National Response Center. In the event an operator does not respond promptly or effectively to clean up a release, the NPS proceeds through the National Contingency Plan for cleanup, for which the operator is financially responsible. Cleanup attainment levels are to the baseline surface/ground water chemistry, which is determined prior to beginning operations. When a contaminant release occurs, the NPS requires the operator to collect samples for lab analyses according to the NPS Guideline for the Detection and Quantification of Contamination at Oil and Gas Operations (Appendix F). If hazardous or contaminating substances are not removed or reduced to predisturbance levels, the NPS may utilize the Park System Resource Protection Act to recover costs associated with the residual damages to park resources.

Mitigation measures required under Current Legal and Policy Requirements are expected to prevent the contamination of surface and groundwater. Siting drilling and production operations 500 feet from waterways as required under at 36 CFR § 9.41(a), unless specifically authorized by an approved plan of operations, would reduce the likelihood of spills entering waterways. Also, careful siting of wellpads away from moderate or steep slopes would minimize the potential of contaminating or hazardous substances being transported down-slope and into streams. The use of automatic shut-off valves on flowlines and pipelines on each side of a stream crossing would reduce the volume of a hydrocarbon release. Additional mitigation measures that would protect water resources include: using least contaminating and hazardous substances, storing the minimum quantity of contaminating and hazardous substances at operations locations, storing barrels or smaller containers of chemicals in “coffins” or other secondary containment, constructing berms and installing liners at drilling operations and at production facilities and increasing capacity within the firewall to accommodate high precipitation events, and including a Spill Notification and Response Plan in the Plan of

Operations. Routine monitoring by operators and the NPS should promptly identify and correct potential problems and is expected to avoid or minimize adverse impacts from leaks and spills of hazardous and contaminating substances.

Twenty plugged and abandoned wells located within the active meander belt of the Neches River could potentially impact water resources. As described in Chapter 3 – Affected Environment, river migration has exposed two of these wells so that they are now located approximately 40 feet from the eastern bank of the Neches River. Even though these two exposed wells are marked with solar powered warning lights, the potential exists for collision from boats or flood debris, which could breach the well casing. If this occurs, remaining fluids in the wellbore could contaminate the Neches River, resulting in a major adverse impact. Eighteen other plugged and abandoned wells are located within the active meander belt of the Neches River and could be exposed when the river migrates.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact water resources in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions, particularly surface hydrology; and mitigation measures being employed. Based on these factors, indirect impacts on water resources in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, sedimentation in waterways, alter surface water flows, and contaminate surface and groundwater, but with mitigation, would result in localized, short-term, negligible to moderate, adverse impacts at sites throughout the Preserve.

Reclamation of drill pads, roads, and other disturbed areas under most conditions should reduce erosion rates to predisturbance levels within two to five years. Over time, these practices could eliminate the adverse impacts caused by drilling and production operations, if fill materials are completely removed, sites are properly prepared by ripping compacted areas, sites are recontoured to match original contours, and proper seed mixtures and revegetation techniques are utilized.

Indirect impacts on water resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: The cumulative impact analysis area for water resources covers the Lower Neches River Watershed which extends from the B. A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area is the same as what has been defined for all natural resources. The analysis area has been selected because it includes the major rivers and tributaries that flow through the Preserve, and activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact water resources in the area.

Abandoned, ongoing and future oil and gas operations within and outside of the Preserve could adversely affect water resources. Existing (24.2 acres) and abandoned operations (unreclaimed sites comprising 376 acres), and transpark pipelines (589 acres) totaling 989 acres in the Preserve may continue to adversely affect water resources until the sites are reclaimed. Future oil and gas operations

that are projected to occur on up to 465 acres for exploration operations and on up to 241 acres for drilling and production operations may also adversely affect water resources. Short-term impacts (1 to 3 years) could result from geophysical exploration (3-D seismic surveys) and short-term and long-term impacts could occur from the construction, use and maintenance of access roads, wellpads, flowlines, and transpark oil and gas pipelines. While the total direct surface disturbance from oil and gas operations could be as high as 1,695 acres in the Preserve, it is expected that as some operations are being developed, others would be reclaimed to pre-disturbance conditions. Indirect cumulative, adverse impacts on water resources could occur from these operations, and may include increased turbidity and sedimentation in waterways, and contamination from accidental leaks and spills of hazardous and other contaminating substances (oil, drilling mud, produced water, and treatment chemicals). Reclamation of existing oil and gas operations, including access roads and wellpads within and outside the Preserve would be a beneficial impact on water resources. Recontouring and revegetating disturbed areas should reduce soil erosion and re-establish surface drainage flows. For more detailed information, the reader is referred to the analysis of environmental impacts pertaining to oil and gas operations under each alternative.

Land uses that could potentially impact water quality in the region include: residential development, agricultural and forestry activities, oil and gas development, and publicly owned facilities (water impoundments, water diversion structures, and sewage treatment plants).

Water quality could be impacted by various activities in and around the Preserve. Water quality could be adversely impacted by contamination from surface runoff and from accidental leaks and spills of hydrocarbons, drilling muds, produced water, and treatment chemicals during oil and gas operations. Nutrient and organic enrichment caused by runoff from fertilizer use, leaching from septic systems, and sewage effluent may increase organic matter and subsequently reduce dissolved oxygen in sediments and the water column. The combustion of fossil fuels may increase the acidity of surface waters. The encroachment of saltwater in the lower Neches River and Pine Island Bayou from the Gulf of Mexico may locally increase the salinity in surface and groundwater. (A permanent saltwater barrier is on the Neches River just south of the Preserve. Temporary saltwater barriers on the Lower Neches and Pine Island Bayou have been installed to mitigate the encroachment of saltwater into the Preserve). Ground disturbances would expose sediments to erosion, which in turn can increase turbidity in surface waters. Excavation activities associated with construction, the installation of subsurface drainage, and extensive groundwater or surface water withdrawals for agricultural, industrial, or residential uses may disrupt surface and subsurface water flow, which could cause reductions in water levels and/or changes in frequency, duration, or extent of water distribution.

With the exception of reduced turbidity and chloride concentrations, water quality data show regional water quality has declined somewhat, with declines in dissolved oxygen and alkalinity, and increases in pH and sulfate concentrations (Hall and Bruce, 1996). Regional decline in dissolved oxygen may be related to increasing water temperature or increased organic loading (Hall and Bruce, 1996). Organic loading from agricultural run-off, sewage effluent, leaching from septic systems (e.g., fecal coliform bacteria, oxygen-demanding substances, and nutrients), and decaying vegetation exert a demand on dissolved oxygen. Increasing water temperature could result from changes in land use (such as conversion of forest to pasture or rural to urban), changes in the amount of shade along watercourses, forestry operations, or increasing air temperatures due to long-term climatic fluctuations or global warming (Hall and Bruce, 1996). Water quality data from 1975 to 1983 have identified produced water (brine or saltwater) from oil fields in Saratoga, Sour Lake, and Batson as recurring contributors to elevated chlorides in Pine Island Bayou. However, the Lower Neches River Valley Authority (LNVA 1994) found no exceedances for chloride since 1985. Overall, chloride concentrations have declined (improved) in the Lower Neches, Little Pine Island Bayou, Turkey Creek, and Menard Creek – partly attributed to declining releases of oil field brine and reduced saltwater (seawater) intrusion (Hall and Bruce, 1996).

While providing for flood and sediment control, habitat for fish and wildlife, recreation, and hydropower for general electricity, the construction and operation of Sam Rayburn and Steinhagen Reservoirs have changed the flow characteristics of the Neches River. These impoundments have reduced the frequency and duration of both high and low flows on the Neches River (Gooch, 1996 and Hall, 1996). In addition, changes in the overall amount and timing of stream flows may directly affect stream channel morphology (structure or form), rate of river migration, sedimentation, water quality, and the amount and type of aquatic habitat. Indirectly, these changes could affect the growth, mortality, and regeneration of vegetation along riparian corridors. Changes in species composition and distribution of floodplain forest communities in the Preserve (i.e., in the floodplain of the Jack Gore Baygall/Neches Bottom Unit) are mainly attributed to the Rayburn and Steinhagen reservoirs (Hall, 1996).

Water diversions such as the Lower Neches River Valley Authority Canal may affect flooding frequency and duration by reducing (or increasing) the amount of water flowing through stream channels (Pearlstine et al., 1985). A number of water diversions exist within the Neches River Basin, although most of the diversions are at the south end of the Preserve and do not substantially alter the volume of flows within the Preserve's water corridor units (Harcombe and Callaway, 1997). Due to projected water needs for central and south Texas, the "Trans-Texas Water Program" is considering, among other options, the transfer of water between the Sabine River Basin and the San Jacinto River Basin. Although avoiding impacts on the Preserve has been one factor for reviewing route alternatives, the possibility exists for disturbance to water corridor units from construction, fragmentation of habitat, and/or changes in water circulation or quantity (Harcombe and Callaway, 1997).

The quality and quantity of groundwater in the region represents an important resource for southeast Texas (for further information, see Chapter 3 – Water Resources). The Gulf Aquifer System has been used extensively for groundwater development, and in part continues to provide water for municipal, industrial, and agricultural uses in Beaumont, Silsbee, Kountze, and Sour Lake. The Texas Water Commission, as part of its Statewide groundwater assessment program, has used the DRASTIC methodology to evaluate the vulnerability of aquifers to pollution (Texas Water Commission, 1989). Using this methodology, the preliminary assessment indicates that the entire Preserve would be moderately to very vulnerable to groundwater contamination from both agricultural and industrial sources (Allen, 1999). Groundwater can be adversely impacted by both natural and human causes. Natural contaminants include salt from salt domes, sulfur and associated mineral deposits, naturally radioactive materials, and chemicals associated with petroleum deposits (Lamar University, 1996). Adverse impacts on groundwater could result from improper handling, storage, or transport of toxic, hazardous, or contaminating substances; sewage effluent; runoff from agricultural and forestry operations (e.g., fertilizer use); contamination of water supplies by pathogenic or disease-causing microorganisms; and extensive use. Past and present adverse impacts on groundwater have ranged from minor to major. If not properly managed and maintained, storage tanks, saltwater injection wells, and pipelines for oil and gas operations may threaten groundwater quality in the Preserve and region.

The information provided by water resource surveys of proposed operations in the Preserve would increase the NPS's knowledge of the resource in the Preserve, a cumulative, negligible, beneficial impact. Over time, protection provided to water resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed, adversely impacting water resources. Therefore, cumulative impacts on water resources are expected to be minor to moderate under Alternative A.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: The loss or modification of vegetation, off-road vehicle use, and shothole drilling and detonation could increase turbidity and sedimentation, and degrade water quality in

surface waters with short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve. Shothole drilling and detonation of explosives in shotholes are expected to have negligible, adverse effects on groundwater quality and quantity in the Preserve.

Drilling and Production: Under Current Legal and Policy Requirements, drilling and production operations would not be permitted within the 500-year floodplain unless there is no practicable alternative. Where permitted, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could increase soil erosion, turbidity and sedimentation, and alter flow characteristics and hydrologic functions of surface waters with short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), minor to moderate, adverse impacts on up to 241 acres of the Preserve. Surface and groundwater in the Preserve could be contaminated if drilling muds, hydrocarbons, produced waters, or treatment chemicals are released during drilling, production, or transport, with moderate to major, adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate. Indirect impacts on water resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, sedimentation in waterways, alter surface water flows, and contaminate surface and groundwater, but with mitigation, would result in localized, short-term, negligible to moderate, adverse impacts at sites throughout the Preserve. Indirect impacts on water resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short-term, minor, adverse impacts.

Cumulative Impacts: Over time, protection provided to water resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed, adversely impacting water resources. The cumulative impact of nonfederal oil and gas operations in and outside the Preserve; oil and gas sites that are not reclaimed to predisturbance conditions; ground disturbing activities; and water impoundments outside the Preserve could increase sediment loads in streams, alter surface water flows and stream morphology, and introduce hazardous and contaminating substances into surface and groundwaters, resulting in cumulative, minor to moderate, adverse impacts on water resources.

Impairment Analysis: Because there would be no major adverse impacts to water resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve water resources.

Impacts on Water Resources under Alternative B (Preferred Alternative)

Special Management Areas would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. By applying applicable Current and Legal Policy Requirements, including 36 CFR 9B regulations (which have been described in Chapter 2, Parts II and III, and under Alternative A), impacts on water resources should be substantially reduced throughout the Preserve.

Geophysical Exploration: The designation of the Riparian Corridors and the Rare Forested Wetlands Communities SMAs where vehicle use would not be permitted on or across saturated soils in

Soil Hydrologic Groups "C" and "D" soils would indirectly protect water quality. This operating stipulation would eliminate the potential for vegetation damage, increased soil erosion and increased turbidity and sedimentation in surface waters as a result of vehicle use. The No Surface Use stipulation for geophysical exploration in the Ecological Research and Monitoring Plots would also indirectly protect water quality because vehicles and shothole detonation would not be permitted in these areas.

Similar to Alternative A, in all other areas of the Preserve where exploration operations could be permitted, the loss or modification of vegetation, off-road vehicle use, and shothole drilling and detonation could increase turbidity and sedimentation, and degrade water quality in surface waters with short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve. Shothole drilling and detonation are expected to have negligible, adverse effects on groundwater quality and quantity in the Preserve.

The primary impacts from geophysical exploration on water resources would result from the use of overland vehicles to transport equipment and personnel. Vehicles are typically used in seismic operations to transport survey crews, water for drilling shotholes, shothole drilling equipment, and geophones and cables. Vehicles could damage and kill plants, increasing the potential for soil erosion, turbidity, and sedimentation in waterways. However, in most areas of the Preserve, seismic operations could be done with smaller, lightweight vehicles or on foot, using the mini-shothole technique. This would minimize impacts on vegetation, soils, and subsequently on water resources from the use of vehicles.

With mitigation, geophysical exploration should result in negligible adverse impacts on groundwater quality and quantity. Shothole detonation could dislodge or mobilize clays within an aquifer and cause a decrease in water quality, or a reduction in groundwater flow. These effects are very uncommon and usually short duration, unless the aquifer has limited geographic extent. Explosives that are occasionally left undetonated in shotholes could introduce small quantities of organic chemical compounds that are biodegradable within two to three years.

Where geophysical operations would be permitted, mitigation measures required under Current Legal and Policy Requirements would protect water resources in these areas. Surface operations cannot be conducted within 500 feet of waterways, or visitor use and administrative areas unless specifically authorized by an approved plan of operations (36 CFR § 9.41(a)). New roads may not be constructed for geophysical exploration. Vehicle use would be prohibited on Preserve roads when they are wet enough to cause damage to the roadbed. Off-road vehicle travel would not be permitted on saturated soils to prevent soil compaction or rutting (particularly in floodplains and wetlands). Explosive charges must be positioned where they would not cause soil damage. Shotholes would not be placed on slopes greater than 3 percent or on small terraces where there is a high probability for lateral blowouts.

Drilling and Production: Drilling and production operations would not be permitted within designated SMAs where the No Surface Use stipulation would be applied. The No Surface Use stipulation in the Riparian Corridors applies, except operations could be permitted adjacent to existing roadways and within previously disturbed areas, where operations would result in no new direct impacts on water resources in the Preserve.

The 500-foot offset required under 36 CFR § 9.41(a), unless specifically authorized by an approved plan of operations, would protect surface waters from direct impacts from drilling and production operations. Indirect impacts could occur in the designated SMAs as a result of drilling and production operations sited near the SMAs; however, these impacts would be expected to be minor and localized. However, operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) would continue to adversely impact water resources in the Preserve.

Similar to Alternative A, in all other areas of the Preserve where drilling and production operations could be permitted, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could increase soil erosion, turbidity and sedimentation, and alter flow characteristics and hydrologic functions of surface waters with short to long-term, minor to moderate, adverse impacts on up to 241 acres of the Preserve. Impacts on water resources would be short-term for construction activities and drilling operations and long-term, extending up to 20 years or more for roads, production operations, and flowlines and pipelines. Leaks and spills during construction activities or drilling or production operations, and blowouts during drilling operations could adversely impact water resources in the Preserve. The intensity of the impact would depend on the type of substance spilled, (hydrocarbons, produced waters, chemicals, solvents, and fuels), and the size of area impacted, and could result in moderate to major, adverse impacts on water resources. But, with the application of mitigation measures, and prompt response in the event of a spill, these impacts could be negligible to moderate.

It is possible under Alternative B that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. Similar to Alternative A, indirect impacts on water resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within the 500-year floodplain (including the Riparian Corridors SMA) unless there is no practicable alternative. Adverse impacts on water resources should be minor in these upland areas because the operations would not be sited near waterways. However, if there is an accidental leak or spill of a hazardous or contaminating substance, the fluids could be transported downslope into surface waters and/or infiltrate into the groundwater, with minor to major, adverse impacts on water quality. But, with mitigation and quick response in the event of a spill, these adverse impacts should be negligible to moderate.

Where drilling and production operations would be permitted, the following mitigation measures would avoid or minimize adverse impacts on water resources: proper siting, design, construction and maintenance of access roads and drilling pads, using containerized mud systems, lining the wellpad with impermeable materials, constructing a berm around the wellpad, storing the minimum quantity of contaminating and hazardous substances at operations locations, storing barrels or smaller containers of chemicals inside secondary containment, using automatic shut-off valves for disposal wells and on flowlines on each side of crossings of waterways and other sensitive resource areas, constructing berms and installing liners at production tank facilities and increasing the secondary containment capacity of storage tanks to accommodate high precipitation events, and including a Spill Notification and Response Plan in the Plan of Operations. Routine monitoring by operators and the NPS should promptly identify and correct potential problems and is expected to avoid or minimize adverse impacts from leaks and spills of hazardous and contaminating substances.

Plugging/Abandonment/Reclamation: The designation of SMAs would increase the acreage where the No Surface Use stipulation would be applied to exploration, drilling and production operations; therefore, plugging, abandonment, and reclamation of new operations would not occur in these areas. Similar to Alternative A, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities outside of the SMAs could cause soil erosion, sedimentation in waterways, alter surface water flows, and contaminate surface and groundwater, but with mitigation, would result in localized, short-term, negligible to moderate, adverse impacts at sites throughout the Preserve. Indirect impacts on water resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short-term, moderate, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative B would be the same as those described for Alternative A except that the formal designation of SMAs (such as the Riparian Corridors and Rare Forested Wetland Communities SMAs), and the application of specific protection measures in these SMAs, would provide consistent protection of water resources in the Preserve. Over time, protection provided to water resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed, adversely impacting water resources. The cumulative impact of nonfederal oil and gas operations within and outside the Preserve; oil and gas sites that are not reclaimed to predisturbance conditions; ground disturbing activities; and water impoundments upstream of the Preserve could increase sediment loads in streams, alter surface water flows and stream morphology, and introduce hazardous and contaminating substances into surface and groundwater, resulting in cumulative, minor to moderate, adverse impacts on water resources.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, exploration operations could be permitted in other areas of the Preserve, with short-term, negligible to minor, adverse impacts on surface and groundwater on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternative A, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, resulting in short- to long-term, minor to moderate, adverse impacts on water resources on up to 241 acres of the Preserve. However, leaks and spills could result in moderate to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be negligible to moderate. Indirect impacts on water resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Similar to Alternative A, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to moderate, adverse impacts on water resources. Indirect impacts on water resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short-term, moderate, adverse impacts.

Cumulative Impacts: The impacts would be the same as described for Alternative A, except that formal designation of SMAs, and application of specific protection measures, would provide consistent protection of water resources in and adjacent to the SMAs. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, minor to moderate, adverse impacts on water resources.

Impairment Analysis: Because there would be no major adverse impacts to water resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve water resources.

Impacts on Water Resources under Alternative C (Maximum Resource Protection)

Special Management Areas would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to all types of operations in all SMAs, except for the Hunting Area SMA, which has a timing stipulation for geophysical exploration. The total acreage of the Preserve in which operating stipulations would apply covers 75,293 acres. Many of the SMAs designated under Alternative C where the No Surface Use stipulation would apply are adjacent to the stream network in the Preserve (i.e., the Riparian Corridors SMA) or are dependant upon water resources to maintain their ecological integrity (i.e., Rare Forested Wetlands SMA, Ecological Research and Monitoring Plots SMA). By applying all applicable Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations (which have been described in Chapter 2, Parts II and III, and under Alternative A), impacts on water resources should be substantially reduced throughout the Preserve.

Geophysical Exploration: Where geophysical operations are permitted, the loss or modification of vegetation, off-road vehicle use, and shothole drilling and detonation could increase turbidity and sedimentation, and degrade water quality in surface waters.

Many of the SMAs under this alternative are situated in wetlands and floodplains containing soils which are highly susceptible to adverse impacts from vehicle use during geophysical exploration operations. The No Surface Use stipulation in these areas would protect Soil Hydrologic Groups "C" and "D" from any adverse impacts from these operations, and would indirectly protect water resources adjacent to these areas.

The No Surface Use designation in SMAs may result in the modification of project designs for 3-D seismic surveys. It may be necessary to increase the density or intensity of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. The modification of project designs could result in impacts similar to Alternatives A and B, with localized, short-term, negligible to minor, adverse impacts on surface water resources on up to 465 acres. These adverse impacts could occur inside or outside the Preserve, and the intensity of the impact is dependent upon the layout of the seismic grid, and the proximity of the operations to water resources.

Mitigation measures required under Current Legal and Policy Requirements would protect water resources in the areas where geophysical operations would be permitted. Surface operations cannot be conducted within 500 feet of waterways, or visitor use and administrative areas unless specifically authorized by an approved plan of operations (3 CFR § 9.41(a)). New roads may not be constructed for geophysical exploration. Vehicle use would be prohibited on Preserve roads when they are wet enough to cause damage to the roadbed. Off-road vehicle travel would not be permitted on saturated or flooded soils to prevent soil compaction or rutting (particularly in floodplains and wetlands). Explosive charges must be positioned where they would not cause soil damage. Shotholes would not be placed on slopes greater than 3 percent or on small terraces where there is a high probability for lateral blowouts.

Drilling and Production: The potential for direct impacts on water resources from accidental leaks and spills would be substantially reduced under Alternative C because operations would not be permitted in the Riparian Corridors SMA (25,539 acres), in the Ecological Research and Monitoring Areas (74 acres), in Rare Forest Wetland Communities (5,087 acres) or within 500 feet of waterways. Many of the SMAs under this alternative are situated in floodplains and wetlands containing soils which are highly susceptible to adverse impacts from vehicle use during nonfederal oil and gas operations. The No Surface Use stipulation in these SMAs would protect the Soil Hydrologic Groups "C" and "D" from any adverse impacts from construction and maintenance activities that could cause erosion,

compaction, rutting, or loss of permeability, and would indirectly protect water resources adjacent to these areas.

Similar to Alternatives A and B, where drilling and production operations are permitted, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could increase soil erosion, turbidity and sedimentation, and alter flow characteristics and hydrologic functions of surface waters with short- to long-term, minor to moderate, adverse impacts on up to 241 acres of the Preserve. Impacts on water resources would be short-term for construction activities and drilling operations and long-term, extending up to 20 years or more for roads, production operations, and flowlines and pipelines. Surface and groundwater in the Preserve could be contaminated if drilling muds, hydrocarbons, produced waters, or treatment chemicals are released during drilling, production, or transport, with moderate to major, adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate. However, operations on 989 acres (including transpark pipeline corridors, and existing and abandoned operations) would continue to adversely impact water resources in the Preserve.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of impacts on water resources is dependent upon where the operation is located (uplands vs. lowlands), if the operations are conducted inside or outside of the Preserve, on the resource protection measures that are employed. Similar to Alternative B, indirect impacts on water resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within the 500-year floodplain. Adverse impacts on water resources should be minor in these upland areas because the operations would not be sited near waterways. However, if there is an accidental leak or spill of a hazardous or contaminating substance, the fluids could be transported downslope into surface waters and/or infiltrate into the groundwater, with minor to major, adverse impacts on water quality. But, with mitigation and quick response in the event of a spill, these adverse impacts should be negligible to moderate.

Where drilling and production operations would be permitted, the following mitigation measures would avoid or minimize adverse impacts on water resources; proper siting, design, construction and maintenance of access roads and drilling pads, using containerized mud systems, lining the wellpad with impermeable materials, constructing a berm around the wellpad, storing the minimum quantity of contaminating or hazardous substances at operations locations, storing barrels or smaller containers of chemicals inside secondary containment, using automatic shut-off valves for disposal wells and on flowlines on each side of crossings of waterways and other sensitive resource areas, constructing berms and installing liners at production tank facilities and increasing the secondary containment capacity to accommodate high precipitation events, and including a Spill Notification and Response Plan in the Plan of Operations. Routine monitoring by operators and the NPS should promptly identify and correct potential problems and is expected to avoid or minimize adverse impacts from leaks and spills of hazardous and contaminating substances.

Plugging/Abandonment/Reclamation: There would be more acreage designated as SMAs than under Alternative B where exploration, drilling and production operations would not be permitted; therefore, plugging, abandonment, and reclamation of new operations would not occur in these areas. Similar to Alternatives A and B, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities outside of the SMAs could cause soil erosion, sedimentation in waterways, alter surface water flows, and contaminate surface and groundwater, but with mitigation, would result in localized, short-term, negligible to

moderate, adverse impacts at sites throughout the Preserve. Similar to Alternative B, indirect impacts on water resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative C would be the same as those described for Alternatives A and B except that the No Surface Use stipulation would be applied in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development which would ensure widespread protection of water resources in the Preserve. Over time, protection provided to water resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed, adversely impacting water resources. The cumulative impact of nonfederal oil and gas operations in and outside the Preserve; oil and gas sites that are not reclaimed to predisturbance conditions; ground disturbing activities; and water impoundments upstream of the Preserve could increase sediment loads in streams, alter surface water flows and stream morphology, and introduce hazardous and contaminating substances into surface and groundwater, resulting in cumulative, minor to moderate, adverse impacts on water resources.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Exploration operations would result in short-term, negligible to minor, adverse impacts on surface and groundwater on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternatives A and B, the construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, resulting in short to long-term, minor to moderate, adverse impacts on water resources on up to 241 acres of the Preserve. However, leaks and spills could result in moderate to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be negligible to moderate. Indirect impacts on water resources in the Preserve from drilling and production of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, plugging, abandonment, and reclamation of new operations located outside SMAs, and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to moderate, adverse impacts on water resources. Indirect impacts on water resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: The impacts would be the same as Alternatives A and B, except that the No Surface Use stipulation would be applied in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development which would ensure widespread protection of water resources in the Preserve. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, minor to moderate, adverse impacts on water resources.

Impairment Analysis: Because there would be no major adverse impacts to water resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as

a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve water resources.

IMPACTS ON FLOODPLAINS

Introduction

Floodplains comprise approximately one-half of the Preserve, and most of the Preserve's wetlands are located in floodplains. The regulatory floodplains (100-year and 500-year) in the Preserve have been mapped by the Federal Emergency Management Agency and are shown on Figure 3.3. As shown in Figure 3.2, the 500-year floodplain is not appreciably larger than the 100-year floodplain. The "riparian corridor" (designated as a SMA under Alternatives B and C) lies within the 100-year floodplain. The Riparian Corridor SMA is defined by the presence of the Floodplain Hardwood and Floodplain Hardwood Pine Forest, and where the surface waters are not bordered by these vegetation communities, the riparian corridor is delineated as an area extending 300 feet from streambanks. The riparian corridor is depicted on the SMA maps for each unit in the Preserve on Figures 2.7 to 2.17.

The beneficial values of floodplains and riparian corridors are described in Chapter 3. Impacts that could occur from oil and gas development in floodplains are summarized in the following section. The impacts on floodplains under each alternative would be similar to those described in the Impacts on Geologic Resources, Water Resources, and Vegetation sections. The reader is referred to these sections of Chapter 4 for a more detailed description of the activities and their associated impacts.

Methodology for Assessing Impacts

Actions under the RFD scenario were analyzed against mapped land-type delineations, which have been entered in the Preserve's geographic information system database. Mapping involved using the Federal Emergency Management Agency 100- and 500-year floodplain maps. Assessment of impacts was based on best professional judgement and was developed through discussions with NPS staff and consultants.

Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are as follows:

Negligible: Impacts would result in a change to water resources and/or floodplains, but the change would be so slight that it would not be of any measurable or perceptible consequence.

Minor: Impacts would result in a change to water resources and/or floodplains, but the change would be small and of little consequence and would be expected to be short-term and localized. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: Impacts would result in a change to water resources and/or floodplains that would be measurable, long-term, and localized. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major: Impacts would result in a change to water resources and/or floodplains that would be measurable and have substantial consequences on a regional scale for long periods of time or to be permanent. Extensive mitigation measures would be needed to offset any adverse effects, and their success would not be guaranteed.

Impacts on Floodplains under Alternative A (No Action/Current Management)

Under Alternative A, SMAs would not be formally designated. Protected areas comprising 56,538 acres and other areas of the Preserve would be provided protection under Current Legal and Policy Requirements (CLPR), including the NPS 36 CFR 9B regulations, and NPS Director's Order 77-2, Floodplain Management. Interpretation and application of CLPR, and project-specific considerations, could result in variations in how, where, and to what extent resource protection is applied.

Geophysical Exploration: The primary impacts from geophysical exploration on floodplains are similar to those described for geologic resources, vegetation, and water resources; and would be from the use of overland vehicles to transport equipment and personnel. Vehicles could damage and kill plants, reduce the soil's water-holding and infiltration capacities, compact and rut soils, reduce the vegetation's root-penetration capabilities, and hinder plant growth and soil formation. Soil Hydrologic Groups "C" and "D" typically found in lowland areas (wetlands and floodplains) are very susceptible to adverse impacts from oil and gas operations. In general, these soils have high clay contents, low permeabilities, are moderately to highly compactable, and have low infiltration rates and recharge potentials. Wet or saturated soils are the most sensitive to disturbance from overland vehicle use. Exposed, compacted soils increase runoff of surface waters and accelerate soil erosion. Erosion of floodplain soils could increase turbidity and sedimentation in surface waters. Leaks and spills from off-road vehicles could harm or kill vegetation, and contaminate soils and surface and groundwater. With required mitigation, there would be localized, short-term, negligible to minor, adverse impacts on floodplain resources, including soils, water, and vegetation from geophysical exploration on up to 465 acres in the Preserve.

In most areas of the Preserve, the use of overland vehicles for geophysical exploration operations would not be permitted, thereby eliminating the adverse impacts associated with their use. Drilling shotholes with a hand-held auger could be done in areas where vehicle access would cause damage and unnecessary loss of vegetation, or where soils would be damaged by vehicle use. Where overland vehicles would not be permitted, equipment can be carried on foot or transported via helicopter.

The drilling of seismic shotholes are expected to have localized, negligible, adverse impacts on floodplain resources. There could be small blow-outs measuring up to several feet in diameter from the detonation of explosives in seismic shotholes. Upon completion of operations any areas damaged from geophysical exploration would be reclaimed.

The NPS's Nonfederal Oil and Gas Rights Regulations, at 36 CFR § 9.41(a), require that operations shall at no time be conducted within 500 feet of waterways, unless specifically authorized by an approved plan of operations." This operating requirement should eliminate direct impacts on floodplains where this requirement would site operations outside of the floodplain, or where the floodplain is larger would substantially reduce the potential for adverse impacts. Nonfederal oil and gas operations could be exempted from the 500-foot offset requirement as long as the operations utilize least-damaging methods to avoid or minimize adverse impacts on Preserve resources and values.

Several additional mitigation measures provided for under Current Legal and Policy Requirements would help to minimize impacts on floodplain resources. The construction of new roads for geophysical exploration would not be permitted under Current Legal and Policy Requirements. Vehicle use would be prohibited on Preserve roads when they are wet enough to cause damage to the roadbed. Off-road vehicle travel would not be permitted on saturated soils to prevent soil compaction or rutting (particularly in floodplains and wetlands).

Drilling and Production: Where drilling and production operations are permitted in floodplains under Alternative A, the construction and maintenance of access roads, wellpads, flowlines, and

pipelines could remove vegetation, expose soils to erosion, compact and rut soils, and introduce non-native construction materials (i.e., gravel) and exotic vegetation, reduce soil permeability, and introduce sediments in waterways with localized, minor to moderate, adverse impacts on up to 241 acres of the Preserve. Impacts on floodplain resources would be short-term for construction activities and drilling operations and long-term, extending up to 20 years or more for roads, production operations, and flowlines and pipelines.

Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling and production operations, or during the transportation of hydrocarbons (via flowline, pipeline or tanker truck). The intensity of the impact would depend on the type of substance spilled, and the size of area impacted, and could result in minor to major, adverse impacts on floodplain resources. But with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate.

If there were an increase in flood hazards or a loss of beneficial floodplain values from drilling and production operations, it would be a major adverse impact, but should not occur due to required mitigation. Siting of drilling or production operations in a floodplain could also pose a safety hazard to oil and gas operator's workers and contractors, Preserve staff, and visitors. Flood warning systems should adequately notify the operator and Preserve staff of the approach of major storms, including hurricanes. This should allow sufficient time to take all necessary actions at oil and gas facilities to avoid or reduce the potential impacts of flooding or high winds. Mitigation measures that are required to "floodproof" drilling and production operations include; shutting-in the well, securing storage tanks, removing hydrocarbons from storage tanks and replacing them with water, and removing excess containers of contaminating and hazardous chemicals from the site.

Indirect effects on floodplains may result if sites are developed outside, but adjacent to, floodplains/riparian areas, when lateral drainage is interrupted by road or well-site construction or increased erosion impacts the water quality of stream systems.

There would be no direct impacts on floodplain resources and values where Current Legal and Policy Requirements would not permit drilling and production operations on 7,500 acres (includes the Royal Fern Bog Research Plot and visitor use and administrative areas) or within 500 feet of waterways. However, operations on 989 acres (including transpark pipeline corridors, and existing and abandoned operations) would continue to adversely impact floodplains in the Preserve.

The NPS's 36 CFR 9B regulations provide specific protection to waterways under § 9.41(a), described under geophysical operations. Even more specific floodplain protection is provided in the NPS Director's Order 77-2, Floodplain Management, which states that oil and gas operations must avoid floodplains or minimize the potential impacts. The intent of the directive is to recognize and protect beneficial floodplain/riparian values and to avoid long-term surface occupancy in floodplains, and to minimize impacts when there is no practicable alternative to locating operations in a regulatory floodplain. In interpreting the Director's Order 77-2, the NPS directive requires operators to avoid or minimize developments and activities that could result in increasing flood hazards and reducing the beneficial value of floodplains, including storage of hazardous or contaminating substances, within 100- and 500-year floodplains. However, surface occupancy is permitted for limited phases of operations, if there is no other practicable alternative, and if floodplain/riparian impacts are minimized.

The environmental analysis conducted during the Plan of Operations evaluation process would identify alternative locations for siting roads, flowlines, drill pads and production operations, and would identify the least damaging locations and methods. Examples of least-damaging methods for placement of flowlines and wellpads in a regulatory floodplain include precautionary measures such as automatic shut-off valves on flowlines that cross riparian and wetland sites, berm and liner installation at storage tank locations, and increasing tank battery berm capacity to reduce the risk of contaminants overflowing berms during high precipitation events. Current Legal and Policy Requirements, Chapter 2, Part II,

provides further discussion of preventative measures that pertain to protecting floodplain resources and values.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact floodplains in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions such as steepness of slope and direction, and surface hydrology; and mitigation measures being employed. Based on these factors, indirect impacts on floodplains in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could increase soil erosion, alter surface water flows, increase sedimentation in waterways, and contaminate soils, surface and groundwater. Abandonment and reclamation could require cutting and clearing of vegetation. Required mitigation measures should result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve.

Indirect impacts on floodplains in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: The cumulative impact analysis area for floodplain resources covers the Lower Neches River Watershed which extends from the B. A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area is the same as what has been defined for all natural resources. The analysis area for floodplain resources is determined primarily by waterflow through the Preserve; consequently, activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact floodplain resources (including soils, vegetation and water resources).

Abandoned, ongoing and future oil and gas operations within and outside of the Preserve could adversely affect floodplain resources. Existing (24.2 acres) and abandoned operations (unreclaimed sites comprising 376 acres), and transpark pipelines (589 acres) totaling 989 acres in the Preserve would continue to adversely affect floodplain resources (where they are sited in floodplains) until the sites are reclaimed. The RFD scenario developed for this Plan/EIS projects that future oil and gas operations may occur on up to 465 acres for exploration operations and on up to 241 acres for drilling and production operations may also adversely affect floodplain resources. Short-term impacts (1 to 3 years) could result from geophysical exploration (3-D seismic surveys) and short- and long-term impacts could occur from the construction, use and maintenance of access roads, wellpads, flowlines, and transpark oil and gas pipelines. New drilling and production operations are not likely to occur within floodplains because NPS Floodplain Guidelines do not permit drilling and production operations within the 500-year floodplain unless there is no practicable alternative. While the total direct surface disturbance from oil and gas operations could be as high as 1,695 acres in the Preserve, it is expected that as some operations are being developed, others would be reclaimed to pre-disturbance conditions.

Indirect cumulative, adverse impacts on floodplain resources may include increased turbidity and sedimentation in waterways, and contamination from accidental leaks and spills of hazardous and other contaminating substances (oil, drilling mud, produced water, treatment chemicals). Reclamation of existing oil and gas operations, including access roads and wellpads within and outside the Preserve

would be a beneficial impact on floodplain resources. Recontouring and revegetating disturbed areas should reduce soil erosion and re-establish surface drainage flows. For more detailed information, the reader is referred to the analysis of environmental impacts pertaining to oil and gas operations under each alternative.

Oil and gas operations within and outside of the Preserve in conjunction with other activities can adversely affect vegetation, soils, water resources, fish and wildlife habitat, research, educational, and recreational opportunities; groundwater recharge or discharge; water flows, and maintenance of biodiversity of vegetation and wildlife in the region.

Vegetation disturbance and/or removal can occur from residential and urban development, forestry activities, the construction or use of roads, well pads, and pipelines. Habitat fragmentation can occur where vegetation is removed for residential and urban development, and during the construction of pipelines, roads, and wellpads.

Adverse impacts on soils from numerous ground disturbing activities include compaction and rutting, reduced permeability, erosion, changes in soil composition, and soil contamination. Agricultural, forestry, and construction activities may increase erosion and deposition of sediments that could alter the topography, modify surface water flows and indirectly adversely affect vegetation, fish and wildlife. Water impoundments and water diversion canals can increase or decrease water levels and/or alter the duration and frequency of stream flows, which indirectly affects the extent of flooded or saturated soils.

Water quality and quantity could be impacted by various activities in and around the Preserve. Water quality could be adversely impacted by contamination from surface runoff and from accidental leaks and spills of hydrocarbons, drilling muds, produced water, and treatment chemicals during oil and gas operations. Nutrient and organic enrichment caused by runoff from fertilizer use, leaching from septic systems, and sewage effluent may increase organic matter and subsequently reduce dissolved oxygen in sediments and the water column. The combustion of fossil fuels may increase the acidity of surface waters. The encroachment of saltwater in the lower Neches River and Pine Island Bayou from the Gulf of Mexico, may locally increase the salinity in surface and groundwater. Temporary saltwater barriers on the Lower Neches and Pine Island Bayou are installed to mitigate the encroachment of saltwater into the Preserve. Ground disturbances would expose sediments to erosion, which in turn can increase turbidity in surface waters. Excavation activities associated with construction, the installation of subsurface drainage, and extensive groundwater or surface water withdrawals for agricultural, industrial, or residential uses may disrupt surface and subsurface water flow, which could cause reductions in water levels and/or changes in frequency, duration, or extent of water distribution.

While providing for flood and sediment control, habitat for fish and wildlife, recreation, and hydropower for general electricity, the construction and operation of the Sam Rayburn and Steinhagen Reservoirs have changed the flow characteristics of the Neches River. These impoundments have reduced the frequency and duration of both high and low flows on the Neches River (Gooch, 1996 and Hall, 1996). In addition, changes in the overall amount and timing of stream flows may directly impact stream channel morphology (structure or form), rate of river migration, sedimentation, water quality, and the amount and type of aquatic habitat. Indirectly, these changes could affect the growth, mortality, and regeneration of vegetation along riparian corridors. Changes in species composition and distribution of floodplain forest communities in the Preserve (i.e., in the floodplain of the Jack Gore Baygall/Neches Bottom Unit) are mainly attributed to the Rayburn and Steinhagen reservoirs (Hall, 1996).

Water diversions such as the Lower Neches River Valley Authority Canal may affect flooding frequency and duration by reducing (or increasing) the amount of water flowing through stream channels (Pearlstine et al., 1985). A number of water diversions exist within the Neches River Basin, although most of the diversions are at the south end of the Preserve and do not substantially alter the volume of flows within the Preserve's water corridor units (Harcombe and Callaway, 1997). Due to projected water needs for Central and South Texas, the "Trans-Texas Water Program" is considering, among

other options, the transfer of water between the Sabine River Basin and the San Jacinto River Basin. Although avoiding impacts on the Preserve has been one criterion for reviewing route alternatives, the possibility exists for disturbance to water corridor units from construction, fragmentation of habitat, and/or changes in water circulation or quantity (Harcombe and Callaway, 1997).

There are numerous federal, state and local laws, regulations, policies and guidelines in-place that control or limit development in floodplains. These resource protection measures, in conjunction with mitigation measures employed in the Preserve should result in cumulative, minor to moderate, adverse impacts on floodplain resources and values in the region. The information provided by floodplain assessments of proposed operations in the Preserve would increase the NPS's knowledge of the resource in the Preserve, a cumulative, negligible, beneficial impact.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: The loss or modification of vegetation, off-road vehicle use, and shothole drilling and detonation could result in soil erosion, compaction, and rutting; soil contamination; increased turbidity and sedimentation; and surface water degradation on up to 465 acres of the Preserve, a localized, short-term, negligible to minor, adverse impact.

Drilling and Production: The construction and maintenance of access roads, wellpads, flowlines, and pipelines could remove vegetation, expose soils to erosion, compact and rut soils, and introduce non-native construction materials and exotic vegetation, reduce soil permeability, and introduce sediments in waterways with localized, short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), minor to moderate, adverse impacts on up to 241 acres of the Preserve. Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with moderate to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate. If there were an increase in flood hazards or a loss of beneficial floodplain values, it would be a major adverse impact, but should not occur due to required mitigation. Indirect impacts on floodplains in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, alter surface water flows, increase sedimentation in waterways, and contaminate soil and surface and groundwater, but with mitigation, should result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Indirect impacts on floodplains in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: Over time, protection provided to floodplains in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while adjacent lands could continue to be developed adversely impacting floodplains. Overall, there would be cumulative, minor to moderate, adverse impacts given the protection afforded floodplains, under national regulations, NPS guidelines and policies.

Impairment Analysis: Because there would be no major adverse impacts to floodplains whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as

a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve floodplain resources or values.

Impacts on Floodplains under Alternative B (Preferred Alternative)

Special Management Areas would be formally designated under Alternative B with surface use and timing stipulations protecting up to up to 75,293 acres. By applying applicable Current and Legal Policy Requirements, including 36 CFR 9B regulations, and NPS Director's Order 77-2, Floodplain Management (which have been described in Chapter 2, Parts II and III, and under Alternative A), adverse impacts on floodplain resources and values should be substantially reduced throughout the Preserve.

Geophysical Exploration: Geophysical exploration would result in localized, short-term, negligible to minor, adverse impacts on floodplain resources, including soils, water, and vegetation on up to 465 acres of the Preserve. The primary impacts from geophysical exploration on geologic resources, vegetation, and water resources would be from the use of overland vehicles to transport equipment and personnel. Vehicles could damage and kill plants, reduce the soil's water-holding and infiltration capacities, compact and rut soils, reduce the vegetation's root-penetration capabilities, and hinder plant growth and soil formation. Soil Hydrologic Groups "C" and "D" typically found in lowland areas (wetlands and floodplains) are very susceptible to adverse impacts from oil and gas operations. In general, these soils have high clay contents, low permeabilities, are moderately to highly compactable, have low infiltration rates and recharge potentials. Wet or saturated soils are the most sensitive to disturbance from overland vehicle use. Exposed, compacted soils increase runoff of surface waters and accelerate soil erosion. Erosion of floodplain soils could increase turbidity and sedimentation in surface waters. Leaks and spills from off-road vehicles could harm or kill vegetation, and contaminate soils and surface and groundwater. In most areas of the Preserve, the use of overland vehicles for geophysical exploration operations would not be permitted, thereby eliminating the adverse impacts associated with their use.

The drilling of seismic shotholes are expected to have localized, negligible, adverse impacts on floodplain resources. There could be small blow-outs measuring up to several feet in diameter from the detonation of explosives in seismic shotholes. Upon completion of operations any areas damaged from geophysical exploration would be reclaimed.

The NPS's Nonfederal Oil and Gas Rights Regulations, at 36 CFR § 9.41(a), require that operations shall not be conducted within 500 feet of waterways, or visitor use and administrative areas, unless specifically authorized by an approved plan of operations. This operating requirement would eliminate direct impacts on floodplain resources within these areas. Nonfederal oil and gas operations could be exempt from this requirement as long as the operations utilize least-damaging methods to avoid or minimize adverse impacts on Preserve resources and values.

Several additional mitigation measures provided for under Current Legal and Policy Requirements would help to minimize impacts on floodplain resources. The construction of new roads for geophysical exploration would not be permitted under Current Legal and Policy Requirements. Vehicle use would be prohibited on Preserve roads when they are wet enough to cause damage to the roadbed. Off-road vehicle travel would not be permitted on saturated soils to prevent soil compaction or rutting (particularly in floodplains and wetlands).

Drilling and Production: The designation of the Riparian Corridors SMA where the No Surface Use stipulation would be applied would eliminate direct impacts on floodplain resources (including soils,

vegetation and water resources). Under NPS Director's Order 77-2, Floodplain Management, operations would not be permitted within the 500-year floodplain (which encompasses the riparian corridor) unless there is no practicable alternative. If operations are permitted within the Riparian Corridors SMA, they must be sited adjacent to existing roads or within previously disturbed areas. No new roads would be permitted in these areas. Indirect impacts such as accidental leaks and spills, and increased erosion could still occur from drilling and production operations that are sited outside of these areas, to develop hydrocarbons underlying the floodplain/riparian corridors.

The protection of resources in the Rare Forested Wetland Communities and Rare Vegetation Communities SMAs would also protect floodplain resources because some of these areas are located within in the floodplain/riparian corridors. Drilling and production operations would not be permitted in these areas, resulting in no new direct adverse impact on floodplain resources.

Similar to Alternative A, where operations are permitted within the floodplain, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could remove vegetation, expose soils to erosion, compact and rut soils, and introduce non-native construction materials (i.e., gravel) and exotic vegetation, reduce soil permeability, and introduce sediments in waterways with localized, minor to moderate, adverse impacts on up to 241 acres of the Preserve. Impacts on floodplain resources would be short-term for construction activities and drilling operations and long-term, extending up to 20 years or more for roads, production operations, and flowlines and pipelines. However, Current Legal and Policy Requirements should limit the intensity and geographic extent of adverse impacts in floodplains.

It is possible under Alternative B that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. Similar to Alternative A, indirect impacts on floodplains in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within the 500-year floodplain (including the Riparian Corridors SMA) unless there is no practicable alternative. Adverse impacts on water resources should be minor in these upland areas because the operations would not be sited near waterways. Uplands areas contain soils (Soil Hydrologic Groups "A'' and "B") that are typically less susceptible to adverse impacts from oil and gas operations than soils found in floodplains. However, if there is an accidental leak or spill of a hazardous or contaminating substance, the fluids could be transported downslope into surface waters and/or infiltrate into the groundwater, with minor to major, adverse impacts on floodplain resources. But, with mitigation and quick response in the event of a spill, these adverse impacts should be reduced to negligible to moderate.

The NPS's 36 CFR 9B regulations provide specific protection to waterways under § 9.41(a), described under Geophysical Exploration. Even more specific floodplain protection is provided in the NPS Director's Order 77-2, Floodplain Management, which states that oil and gas operations must avoid floodplains or minimize the potential impacts. The intent of the directive is to recognize and protect beneficial floodplain/riparian values and to avoid long-term surface occupancy in floodplains, and to minimize impacts when there is no practicable alternative to locating operations in a regulatory floodplain. In interpreting the Director's Order 77-2, the NPS directive requires operators to avoid or minimize developments and activities that could result in increasing flood hazards and reducing the beneficial value of floodplains, including storage of hazardous or contaminating substances, within 100- and 500-year floodplains. However, surface occupancy is permitted for limited phases of operations, if there is no other practicable alternative, and if floodplain/riparian values can be maintained.

The environmental analysis conducted during the Plan of Operations evaluation process would identify alternative locations for siting roads, flowlines, drill pads and production operations, and would identify the least damaging locations and methods. Examples of least-damaging methods for placement of

flowlines and wellpads in a regulatory floodplain include precautionary measures such as automatic shut-off valves on flowlines that cross riparian and wetland sites, berm and liner installation at storage tank locations, and increasing tank battery berm capacity to reduce the risk of contaminants overflowing berms during high precipitation events. Current Legal and Policy Requirements, Chapter 2, Part II, provides further discussion of preventative measures that pertain to protecting floodplain resources and values.

Plugging/Abandonment/Reclamation: The designation of SMAs would increase the acreage where the No Surface Use stipulation would be applied to exploration, drilling and production operations. If drilling and production operations are permitted in floodplains under Alternative B, there could be new operations to reclaim. Similar to Alternative A, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, alter surface water flows, sedimentation in waterways, and contaminate soil and surface and groundwater, but with mitigation, should be localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Indirect impacts on floodplains in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative B would be the same as described for Alternative A, except that formal designation of SMAs, and application of specific protection measures, would provide consistent protection of floodplain resources in the SMAs. The designation of SMAs in the Preserve, specifically the Riparian Corridors, and Rare Forested Wetland Communities SMAs would ensure widespread protection of floodplain resources that are particularly susceptible to adverse impacts from oil and gas operations or are essential to maintain the ecological integrity of the Preserve. Oil and gas operations within and outside of the Preserve in conjunction with other activities can adversely affect vegetation, soils, water resources, fish and wildlife habitat, research, educational, and recreational opportunities; groundwater recharge or discharge; water flows, and maintenance of biodiversity of vegetation and wildlife in the region. Land uses that could adversely affect floodplain resources include; agricultural, forestry and construction operations; urban and residential development; road construction, publicly owned facilities (water impoundments, water diversion structures, and sewage treatment facilities), and oil and gas operations within and outside of the Preserve. Over time, protection provided to floodplain resources in the Preserve under Current Legal and Policy Requirements is expected to improve the condition of these resources, while floodplains on adjacent lands could continue to be developed, resulting in cumulative, minor to moderate adverse impacts on floodplain resources and values in the region.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, exploration operations would result in localized, short-term, negligible to minor, adverse impacts on floodplain resources on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternative A, the construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, resulting in localized, short- to long-term, minor to moderate, adverse impacts on floodplain resources. However, leaks and spills could result in moderate to major, adverse impacts, but with the application of mitigation measures, the impacts could be negligible to moderate. Indirect impacts on floodplains in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Similar to Alternative A, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located in floodplains/riparian corridors could cause soil erosion, alter surface water flows, increase sedimentation in waterways, and contaminate soil and surface and groundwater resulting in localized, short-term, negligible to minor, adverse impacts on floodplains. Indirect impacts on floodplains in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: The impacts would be the same as described for Alternative A, except that formal designation of SMAs, and application of specific protection measures, would provide consistent protection of floodplains in and adjacent to the SMAs. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, minor to moderate, adverse impacts on floodplain resources.

Impairment Analysis: Because there would be no major adverse impacts to floodplains whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve floodplain resources or values.

Impacts on Floodplains under Alternative C (Maximum Resource Protection)

Special Management Areas would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to all types of operations in all SMAs, except for the Hunting Area SMA which has a timing stipulation for geophysical exploration. The total acreage of the Preserve in which operating stipulations would apply covers 75,293 acres. In the remaining areas of the Preserve where operations could be permitted, the application of Current Legal and Policy Requirements, including 36 CFR 9B regulations, and NPS Director's Order 77-2, Floodplain Management (which have been described in Chapter 2, Parts II and III, and under Alternative A), should substantially reduce impacts on floodplain resources.

Geophysical Exploration: The Preserve's riparian corridors would be formally designated as SMAs, and the No Surface Use stipulation would be applied. Floodplains within 500 feet of waterways would continue to be protected under Current Legal and Policy Requirements (36 CFR § 9.41(a)) that would not permit operations in these areas, unless specifically authorized by an approved plan of operations. Within the SMAs, there would be no direct adverse impacts from exploration operations; however, indirect impacts from operations in adjacent areas could result in impacts ranging from no impact to localized, short-term, negligible adverse impacts.

Due to the designation of large SMAs where geophysical exploration would not be permitted, the modification of project designs could concentrate operations outside of the SMAs. As a result, it may be necessary to increase the density or intensity of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. These adverse impacts could occur inside or outside the Preserve, and are dependent upon the location and layout of the seismic grid. As a consequence, the concentration of vehicles and equipment, and the footprint of exploration operations could be greater; and impacts on soils, vegetation and water resources could be greater on up to 465 acres that would include some floodplains. The intensity of the impact is

dependent upon the mitigation measures employed, the layout of the seismic grid, and the specific resources that area impacted by the operation, resulting in localized, short-term, negligible, adverse impacts.

Drilling and Production: Many of the SMAs under this alternative are situated in floodplains containing Soil Hydrologic Groups "C" and "D" which are susceptible to adverse impacts from vehicle use during nonfederal oil and gas operations. The No Surface Use stipulation in these SMAs would protect the hydrologic soils from any adverse impacts from construction and maintenance activities that could cause erosion, compaction, rutting, or loss of permeability, prevent the damage or loss of vegetation, and would indirectly protect water resources adjacent to these areas.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of indirect and direct impacts on floodplain resources and values is dependent upon where the operation is located (uplands vs. lowlands), if the operations are conducted inside or outside of the Preserve, on the resource protection measures that are employed. Similar to Alternatives A and B, indirect impacts on floodplains in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to short- to long-term, moderate, adverse impacts.

If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within the 500-year floodplain. Adverse impacts on floodplains should be minor because the operations would not be sited within floodplain areas. However, if there is an accidental leak or spill of a hazardous or contaminating substance, the fluids could be transported downslope, with minor to major, adverse impacts on floodplain resources. But, with mitigation and quick response in the event of a spill, these adverse impacts should be negligible to minor.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation of new operations located outside SMAs, and of existing and abandoned operations, and transpark pipelines located in floodplains/riparian corridors, could cause soil erosion, alter surface water flows, increase sedimentation in waterways, and contaminate soil and surface and groundwater resulting in localized, short-term, negligible to minor, adverse impacts on floodplains. Indirect impacts on floodplains in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to short-term, moderate, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative C would be the same as described for Alternatives A and B except that the No Surface Use stipulation would be applied in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development. The designation of SMAs in the Preserve, specifically the Riparian Corridors, and Rare Forested Wetland Communities SMAs would ensure widespread protection of floodplain resources that are particularly susceptible to adverse impacts from oil and gas operations or are essential to maintain the ecological integrity of the Preserve. Oil and gas operations within and outside of the Preserve in conjunction with other activities can adversely affect vegetation, soils, water resources, fish and wildlife habitat, research, educational, and recreational opportunities; groundwater recharge or discharge; water flows; and maintenance of biodiversity of vegetation and wildlife in the region. Land uses that could adversely affect floodplain resources include: agricultural, forestry and construction operations, urban and residential development, road construction, publicly owned facilities (water impoundments, water diversion structures, and sewage treatment facilities), and oil and gas operations in and outside of the Preserve. Over time, protection provided to floodplain resources in the Preserve under Current Legal and Policy

Requirements is expected to improve the condition of these resources, while floodplains on adjacent lands could continue to be developed, resulting in cumulative, minor to moderate adverse impacts on floodplains and values in the region.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Exploration operations would not be permitted in the Riparian Corridors SMA, or within 500 feet of waterways (unless specifically authorized in an approved plan of operations); therefore, there should be no direct adverse impacts on floodplain resources in the Preserve. Indirect impacts could range from no impact to localized, short-term, negligible and adverse.

Drilling and Production: Drilling and production operations would not be permitted in the Riparian Corridors SMA, or within 500 feet of waterways (unless specifically authorized in an approved plan of operations). Leaks and spills from existing operations in floodplains or from operations conducted outside of floodplains could result in indirect, moderate to major, adverse impacts on floodplains, but with the application of mitigation measures, the impacts could be negligible to minor. Similar to Alternatives A and B, indirect impacts on floodplains in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: There would be more acreage designated as SMAs under Alternative C, where exploration, drilling and production would not be permitted; therefore, plugging, abandonment, and reclamation of new operations would not occur in these areas.

Similar to Alternatives A and B, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to minor, adverse impacts on floodplains. Indirect impacts on floodplains in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: The impacts would be the same as Alternatives A and B, except that the No Surface Use stipulation in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development would ensure widespread protection of water resources in the Preserve. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, minor to moderate, adverse impacts on floodplain resources.

Impairment Analysis: Because there would be no major adverse impacts to floodplains whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve floodplain resources or values.

IMPACTS ON VEGETATION

Introduction

The vegetation of Big Thicket National Preserve is an essential contributor to its ecological value and diversity. As noted in Chapter 3, Big Thicket National Preserve is known for its biodiversity, with approximately 1,300 species of trees, shrubs, forbs, and grasses within its boundaries. Vegetation is important to the overall health of the Preserve and provides habitat for wildlife. It also prevents erosion and is a primary factor in the Preserve's high recreational value.

Methodology for Assessing Impacts

Actions under the RFD scenario were analyzed against the types of vegetation in Big Thicket National Preserve that could be impacted. The vegetation types were defined and described based on the sources cited in Chapter 3. Impacts on uplands vegetation are analyzed in this section; impacts on wetlands vegetation are analyzed in the next section. The assessment of impacts is based on best professional judgement and was developed through discussions with Preserve staff and EIS team members, and a review of relevant literature.

Impact Intensity Thresholds. The thresholds of change of an impact are defined as follows:

Negligible: Impacts would result in a change to native vegetation, their habitats, or the natural processes sustaining them, but the change would be so slight that it would not be of any measurable or perceptible consequence.

Minor: Impacts would result in a change to native vegetation, their habitats, or the natural processes sustaining them, but the change would be small and of little consequence and would be expected to be short-term and localized. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: Impacts would result in a change to native vegetation, their habitats, or the natural processes sustaining them, and the change would be measurable, long-term, and localized. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major: Impacts would result in a change to native vegetation, their habitats, or the natural processes sustaining them, and the change would be measurable and have substantial consequences on a regional scale for long periods of time or to be permanent. Extensive mitigation measures would be needed to offset any adverse effects, and their success would not be guaranteed.

Impacts on Vegetation under Alternative A (No Action/Current Management)

Under Alternative A, SMAs would not be formally designated. Protected areas comprising 56,538 acres and other areas of the Preserve would be provided protection under Current Legal and Policy Requirements, including the NPS 36 CFR 9B regulations. Vegetation that is particularly susceptible to adverse impacts from oil and gas operations or are essential to maintain the ecological integrity of the Preserve would need to be identified during the planning/development and review of Plans of Operations, so that avoidance or mitigation measures are applied to minimize impacts on vegetation.

The NPS's 36 CFR 9B regulations require utilization of least-damaging methods, reclamation of disturbed areas with the goal of reestablishing native vegetation communities and preventing invasion of non-native (exotic) species. The application of Current Legal and Policy Requirements, and project-specific operating stipulations, could result in variations in how, where, and to what extent resource protection is applied.

Currently, there is no formal protection provided for rare vegetation communities (includes Sandhill Pine Forest, Upland Pine Forest, American Beech- Southern Magnolia-Loblolly Pine Forest, and any old growth tree or trees within these or other community types). Adverse impacts on rare vegetation communities would be primarily from drilling and production operations. Therefore, impacts on vegetation are likely to be greatest under Alternative A because variations in protection may occur under different park administrations, resulting in different interpretations and applications of policy and different levels of protection. If these vegetation communities are disturbed or destroyed as a result of nonfederal oil and gas operations, it would be considered a major adverse impact.

Because of the extensive vegetation cover in Big Thicket National Preserve, any oil and gas activity would most likely result in some adverse impact to vegetation, since it would be almost impossible to avoid vegetated areas. Also, the avoidance of vegetated wetlands would tend to focus oil and gas operations to non-wetland, upland vegetation communities.

A description of impacts on vegetation from specific types of oil and gas operations is provided below.

Geophysical Exploration: Where exploration operations could be permitted, vegetation could be cut or trimmed along source and receiver lines; and could be crushed, damaged or uprooted by off-road vehicles. Compacted and rutted soils could reduce germination and root penetration. Leaks and spills could harm or kill vegetation. Mitigation could reduce the intensity of impacts to localized, short-term, negligible to minor, adverse impacts on vegetation on up to 465 acres of the Preserve.

The degree in which geophysical exploration could adversely impact vegetation would depend on the type of survey conducted, equipment and vehicles used, vegetation type, and site conditions where the survey is conducted. It is expected that all future surveys in the Preserve would utilize 3-D seismic technology and follow Current Legal and Policy Requirements in the planning and conduct of operations. Three-dimensional exploration involves a relatively extensive grid pattern of holes filled with explosive charges and receiver lines placed in and on the ground. These surveys typically require vegetative trimming, drilling of shotholes, and associated access clearing.

Current Legal and Policy Requirements provide for use of mitigation to limit the impacts on vegetation associated with seismic surveys. For example, trimming of vegetation for survey lines would be limited to a 3.5 foot width (understory vegetation only), and no tree limbs greater than 3 inches in diameter may be cut (see Chapter 2, Part II, for more information). The use of GPS could also be encouraged to reduce the need for line-of-sight surveys. Drilling of shotholes could involve use of off road vehicles of various types, which could result in damage to vegetation. However, there are smaller, light-weight, or other low-impact vehicles available for use. Also, there is the option of using portable hand drills to drill shallow shotholes, which would limit the need for vehicles to drill deep holes. The use of helicopters to bring in supplies and equipment would greatly limit the extent of vegetation trimming and disturbance and the amount of time spent on the ground. Other mitigation available to limit direct and indirect impacts on vegetation include locating staging and fueling areas out of sensitive vegetation communities, maintaining and inspecting vehicles and equipment to prevent leaks and spills and using drip pans during refueling, providing for prompt response in the event of spills, developing and implementing an exotic vegetation control plan, and using existing roads for access whenever possible.

Vegetation trimmed for survey lines or disturbed during shothole drilling would recover over the short-term. Different types of vegetation would be expected to recover at different rates, as noted in Fountain

and Rayburn (1987). This study of exploration operations (pre-3-D seismic) found that slope communities (and wetlands) were the most sensitive to disturbance, with the highest percent of damaged or killed vegetation. Upland soils allowed deeper root penetration than slope or wetland soils, and these deeper rooted plants would bend and recover when run over by a survey vehicle, while the shallow rooted stems tended to be uprooted. However, they found that vegetation recovery was rapid on most sites, with lines 3-4 years old very hard to even locate, indicating the short-term nature of seismic survey impacts on vegetation. It is important to note that old seismic survey lines investigated by Fountain and Rayburn involved the use of large articulating ORVs such as an Ardco buggy. The use of this type of large equipment would not be permitted in the Preserve today, due to the availability of alternative equipment and methods that would result in considerably fewer adverse surface impacts.

Under Alternative A, fire monitoring plots and long-term monitoring plots do not receive formal protection. These important research vegetation communities would have to be identified and protected during the planning and development of specific exploration Plans of Operations stipulations. With the implementation of the mitigation currently used for 3-D seismic work, especially mini-shotholes and helicopters, adverse impacts should be kept to less than major levels. However, if specific protective measures or offsets are not required, major adverse impacts could occur to these sites, since they are particularly susceptible to adverse impacts that would jeopardize their historical, ecological, and research attributes.

Drilling and Production: Where drilling and production operations could be permitted, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could result in vegetation being routinely maintained along flowlines and pipelines, or totally cleared for construction of roads, pads, flowlines and pipelines. Ground disturbance could promote the introduction of exotic species. These effects could result in localized, short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), moderate, adverse impacts on vegetation on up to 241 acres of the Preserve. Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be minor to moderate.

According to the RFD scenario, up to 40 wells could be drilled, with 27 placed in production. This level of development, along with associated access roads, could utilize up to 241 acres of the Preserve. Wellpads are estimated to be 2.4 acres in size, and could last 15 to 20 years, or longer. If a well is productive, the wellpad would be reduced in size to accommodate the production operation. Drilling and production of oil and gas would include direct loss of vegetation and habitat as a result of clearing, contouring, construction and maintenance of the pads, roads, flowlines, pipelines, and other ancillary facilities. Impacts on vegetation from constructing a wellpad and drilling a well would be considered short-term, lasting a few to 6 months, while a producing well may create long-term impacts for 20 years or longer, until the well is plugged and the pad and access road are reclaimed.

According to the studies conducted by Fountain and Rayburn (1987), there are differential responses to direct disturbance among the vegetation community types within Big Thicket. Upland sites that are primarily pine-dominated were deemed the least susceptible to adverse impacts from oil and gas operations, because the predicted time for recovery (based on achieving a species composition similar to that of the original site) was found to be less than for the other vegetative communities that were studied. This is because pines were the primary woody species invading both upland and slope sites, and a return of pines to uplands that were previously dominated by pines reflects a rapid recovery of the sites. Slope sites, on the average, possess the higher diversity and richness, and require a longer time frame to recover. Succession on the slope sites must pass through a pine-dominated seral stage before returning to the potential mixed hardwood pine climax vegetation.

Indirect effects to vegetation could also occur from drilling and production operations. There is a potential for leaks and spills of drilling muds, hydrocarbons, produced waters, or treatment chemicals during drilling, production, or transport, to impact site or off-site soil and groundwater and associated vegetation. Herbicides used to control site vegetation could drift or migrate off-site, causing damage to nontarget vegetation in nearby areas. Observation of areas with high soil chloride levels from spills of produced water suggest that these spills are lethal to forest vegetation and can persist for many years, if not remediated. Other indirect adverse impacts impacting off-site vegetation include the possibility of erosion and sedimentation if runoff from the site occurs. Ground disturbance could also facilitate the invasion of exotic vegetation.

Although drilling and production operations cannot avoid clearing of vegetation, there are mitigation measures under Current Legal and Policy Requirements that could minimize long-term effects. These include using already disturbed areas (including existing pads) for wellpad sites, using existing access roads, and using closed loop, drilling fluid systems and tanks to hold cuttings and fluid which are then disposed off site. In addition, indirect impacts from leaks and spills could be limited by using automatic shutdown, blowout preventers, drip pans, berms, liners, clean-up plans and equipment, and regular flowline testing. Exotic vegetation control plans should be part of every plan of operations, and use of herbicides to keep vegetation off the site should be limited and/or restricted to those that do not readily drift or migrate off site. Silt fences or barriers should be used to eliminate off-site sedimentation.

Under Alternative A, rare vegetation communities (including upland pine forests, beech-magnolia-loblolly pine forests, sandhill pine forests, and old growth trees) do not receive formal protection. These important vegetation communities would have to be identified and protected during the planning and development of specific drilling and production plans of operations stipulations. With the implementation of mitigation, adverse impacts should be kept to less than major levels. However, if specific protective measures or offsets are not required, major adverse impacts could occur to these vegetation communities, since they are particularly susceptible to adverse impacts that would jeopardize their historical, ecological, and research attributes.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact vegetation in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions such as steepness of slope and direction, and surface hydrology; and mitigation measures being employed. Based on these factors, indirect impacts on vegetation in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting-down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could release oil, and other contaminating and hazardous substances, which could harm or kill vegetation. Abandonment and reclamation could require cutting and clearing of vegetation. With mitigation, these effects would result in localized, short-term, negligible to minor, adverse impacts on vegetation at sites throughout the Preserve.

During reclamation operations, sites are reclaimed by removing any contaminated soil or materials, grading the site to natural contours, replacing topsoil, seeding with a selected mix of native herbaceous vegetation, and possibly planting trees and/or shrubs. Site recovery is monitored and success is determined by some measure of species composition and cover over a set period of time. Abandonment and reclamation could require minimal trimming and clearing vegetation along the periphery of roads and pads, or along flowlines and pipelines if lines are removed. Similar to other types of oil and gas operations, well plugging, shutting-down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could result in

accidental releases of oil, and other contaminating and hazardous substances, which could harm or kill vegetation.

Recovery of vegetation communities would be primarily dependent on location, edaphic (soil) conditions, and type of community desired. Except for rare vegetation communities that are susceptible to the adverse impacts of oil and gas operations, most vegetation communities in the Preserve, especially upland communities, can re-establish vegetation in a relatively short time period. However, many years may be needed to replace the pre-disturbance community with a similar community, especially for slope communities (Fountain and Rayburn, 1987). For most of Big Thicket National Preserve, vegetation communities have a relatively widespread distribution and occur with high frequency in the Preserve and the region, and will recover with time. If access roads are not reclaimed, but continue to be used for other administrative purposes, a long-term adverse impact to vegetation would occur.

Indirect impacts on vegetation in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: The cumulative impact analysis area for vegetation covers the Lower Neches River Watershed which extends from the B. A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area is the same as what has been defined for all natural resources. The analysis area has been selected because it includes the major rivers and tributaries that flow through the Preserve, and activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact natural resources, including vegetation in the region.

Land cover data show that approximately 50 percent of the acreage in the analysis area consists of slope forests, upland forests and clearcut cover classes. By comparison, the Preserve contains a larger number of vegetation types.

Cumulative impacts on vegetation in the Preserve include impacts from past, present and reasonably foreseeable future oil and gas operations located within and directionally drilled from locations outside the Preserve; activities in the Preserve that impact vegetation (e.g., Preserve developments including buildings, visitor use areas and roads; and management practices such as prescribed fire management) and other regional construction or development activities that result in removing vegetation or altering conditions that could impact native vegetation.

Using LANDSAT Thematic Mapper imagery taken February 10, 1991, Hall and Harcombe (1997) found distinct differences in land uses/landcover classes inside and outside the Preserve. Developed, urbanized, pasture, and clearcut cover classes comprise approximately 25 percent of the analysis area while accounting for less than one percent the Preserve.

Plugged and abandoned oil and gas wellpads and associated road segments that pre-date the establishment of the Preserve continue to adversely impact 376 acres. Existing oil and gas operations in the Preserve occupy 24.2 acres, and 71 existing transpark oil and gas pipelines utilize 589 acres within associated right-of-way corridors. Impacts have included direct loss of vegetation at oil and gas sites. These combined effects on 989 acres have caused long-term impacts on plant communities within Big Thicket National Preserve, resulting in removal of vegetation or a change (decrease) in site productivity and habitat value for as long as operations areas remain unreclaimed. Under the RFD scenario, a Preserve-wide 3-D seismic survey could utilize up to 465 acres of the Preserve, while

drilling up to 40 wells and production of up to 27 wells could occupy up to 241 acres of the Preserve. Over the long-term, up to 1,695 acres could be directly impacted by oil and gas operations in the Preserve; however, while new operations are occurring, others would be plugged, abandoned, and reclaimed. Any failed mitigation or adverse impacts on vegetation communities or plots under the No Action Alternative would add adverse impacts on these existing adverse impacts.

Existing and future oil and gas operations in the Preserve would be required to meet least-damaging methods and other requirements under Current Legal and Policy Requirements to protect native vegetation and ensure reclamation of disturbed areas. Vegetation that is particularly susceptible to adverse impacts from oil and gas operations or are essential to maintain the ecological integrity of the Preserve would need to be identified during the planning/development and review of Plans of Operations, so that avoidance or mitigation measures are applied to minimize impacts on vegetation. In addition, the Preserve's prescribed fire management program would provide long-term cumulative beneficial impacts on Preserve vegetation by restoring and maintaining vegetation communities and biodiversity. Therefore, cumulative impacts on the vegetation in the Preserve would be minimized and over time, vegetation resources would be improved; a cumulative beneficial impact for vegetation resources of the Preserve.

On lands surrounding the Preserve within the analysis area, population growth and continued development including the construction and operation of the Sam Rayburn and B. A. Steinhagen Reservoirs, pipelines, roads, commercial and private forestry, and residential developments, could result in the long-term incremental loss of natural vegetation communities. Since uplands would be more favorable for development, these vegetation communities would be more prone to incremental losses over time. Developments and activities could also disrupt surface and subsurface water flow necessary to support vegetation in the region and the Preserve, and could particularly affect bottomland forests and wetland hardwood classes in the Preserve. The NPS would ensure that wells directionally drilled from locations outside the Preserve to bottomhole targets underlying the Preserve "pose no significant threat of damage to park resources, both surface and subsurface" (36 CFR § 9.32(e)); however, wellpads outside the Preserve may not be reclaimed to pre-disturbance conditions. It is also likely that areas outside the Preserve would control wildfires and have no active prescribed fire management practices to restore and maintain vegetation communities and biodiversity. Over the long-term, these effects could result in cumulative, minor to moderate, adverse impacts on vegetation in the analysis area, particularly outside the Preserve. The information provided by vegetation surveys of proposed operations in the Preserve would increase the NPS's knowledge of the resource in the Preserve, a cumulative, negligible, beneficial impact.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: Where exploration operations could be permitted, vegetation could be trimmed along source and receiver lines; and crushed, damaged or uprooted by off-road vehicles. Compacted and rutted soils could reduce germination and root penetration. Leaks and spills could harm or kill vegetation. Mitigation could reduce the intensity of impacts to localized, short-term, negligible to minor, adverse impacts on vegetation on up to 465 acres of the Preserve. There is no formal protection provided for fire monitoring plots and long term monitoring plots; and if they are not adequately protected could result in major adverse impacts.

Drilling and Production: Where drilling and production operations could be permitted, the construction and maintenance of access roads, wellpads, flowlines, and pipelines could result in vegetation being routinely cut along flowlines and pipelines, or totally cleared for construction of roads, pads, flowlines and pipelines. Ground disturbance could promote the introduction of exotic species. These effects could result in localized, short-term (construction activities and drilling operations) to long-

term (roads, production operations, and flowlines and pipelines), moderate, adverse impacts on vegetation on up to 241 acres of the Preserve. Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be minor to moderate. Indirect impacts on vegetation in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

There is no formal protection provided for fire monitoring plots, long-term monitoring plots, and rare vegetation communities; and if they are not adequately protected could result in major adverse impacts.

Plugging/Abandonment/Reclamation: Future operations including RFD-projected Preservewide geophysical exploration on up to 465 acres; and drilling of an estimated 40 wells with production of an estimated 27 wells from locations within or outside the Preserve on up to 241 acres; in addition to existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) located throughout the Preserve (some of which are located in protected areas) would be reclaimed in the future.

Well plugging, shutting-down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could release oil, and other contaminating and hazardous substances, which could harm or kill vegetation. Abandonment and reclamation could require cutting and clearing of vegetation. With mitigation, these effects would result in localized, short-term, negligible to minor, adverse impacts on vegetation at sites throughout the Preserve. Indirect impacts on vegetation in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Over time, protection provided to vegetation of the Preserve under Current Legal and Policy Requirements is expected to result in the Preserve maintaining and improving vegetation, with cumulative, beneficial impacts on Preserve vegetation. Adjacent lands could continue to be developed, and native vegetation, particularly rare forested communities, could be incrementally lost. Also, reclamation of oil and gas operations inside or outside the Preserve may not return sites to pre-disturbance conditions. Therefore, Alternative A could result in cumulative, minor to moderate, adverse impacts on vegetation in the region.

Impairment Analysis: Because there would be no major adverse impacts to vegetation whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve vegetation.

Impacts on Vegetation under Alternative B (Preferred Alternative)

Special Management Areas would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. By applying applicable Current Legal and Policy Requirements, including 36 CFR 9B regulations, which have been discussed in Chapter 2, Parts II and III, and under Alternative A, impacts on vegetation should be substantially reduced throughout the Preserve.

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve, resulting in localized, short-term, negligible to minor, adverse impacts on vegetation on up to 465 acres of the Preserve associated with vegetation trimming along source and receiver lines; and from being crushed, damaged or uprooted by off-road vehicle use. Compacted and rutted soils could reduce germination and root penetration. Leaks and spills could harm or kill vegetation.

Drilling and Production: Rare and important vegetation communities receive formal protection under Alternative B by designation as SMAs and applying the No Surface Use stipulation. While SMAs receive specific protection from new drilling and production operations, existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres), and transpark pipelines (589 acres) would continue to adversely impact vegetation in the Preserve, some of which are located within SMAs.

It is possible under Alternative B that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. The intensity of impacts on vegetation would be dependant upon where the operation is located with respect to vegetation type, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Indirect impacts on vegetation in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including the Riparian Corridors SMA) unless there is no practicable alternative.

According to the studies conducted by Fountain and Rayburn (1987), there are differential responses to direct disturbance among the vegetation community types within Big Thicket. Upland sites that are primarily pine-dominated were deemed the least susceptible to adverse impacts from oil and gas operations, because the predicted time for recovery (based on achieving a species composition similar to that of the original site) was found to be less than for the other vegetative communities that were studied. This is because pines were the primary woody species invading both upland and slope sites, and a return of pines to uplands that were previously dominated by pines reflects a rapid recovery of the sites. Slope sites, on the average, possess the higher diversity and richness, and require a longer time frame to recover. Succession on the slope sites must pass through a pine-dominated seral stage before returning to the potential mixed hardwood pine climax vegetation.

Similar to Alternative A, the construction and maintenance of drilling and production operations sited in uplands would result in localized, short- to long-term, moderate, adverse impacts on vegetation.

Plugging/Abandonment/Reclamation: Similar to Alternative A, well plugging, shutting-down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could release oil, and other contaminating and hazardous substances, which could harm or kill vegetation. Abandonment and reclamation could require cutting and clearing of vegetation. With mitigation, these effects would result in localized, short-term, negligible to minor, adverse impacts on vegetation at sites throughout the Preserve, some of which are located within SMAs. Indirect impacts on vegetation in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative B would be similar to those described for Alternative A, but with more certainty of avoiding new adverse impacts on important and rare vegetation in the Preserve. The formal protection provided by designation of fire monitoring plots, long-term monitoring plots, and rare vegetation communities as SMAs and application of the No Surface Use stipulation would result in cumulative, beneficial impacts over time, as the vegetation in these areas

continued to be protected, adding to the amount of old growth and/or mature climax community acreage within the Preserve and the region. This would be especially important if forests outside the Preserve boundary are not similarly protected and are lost over time.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve, resulting in localized, short-term, negligible to minor, adverse impacts on vegetation on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternative A, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, moderate, adverse impacts on vegetation on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be minor to moderate. Indirect impacts on vegetation in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: The designation of SMAs would increase the acreage where the No Surface Use stipulation would be applied to exploration, drilling and production operations; therefore, plugging, abandonment, and reclamation of new operations would not located in these areas.

Similar to Alternative A, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to minor, adverse impacts on vegetation. Indirect impacts on vegetation in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Similar to Alternative A, with cumulative, minor to moderate, adverse impacts on vegetation in the region. However, protection of vegetation would be more readily attainable in the Preserve due to designation of SMAs where the No Surface Use stipulation would result in no new impacts on vegetation that is particularly susceptible to adverse impacts from oil and gas operations and important to maintaining the ecological integrity of the Preserve.

Impairment Analysis: Because there would be no major adverse impacts to vegetation whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve vegetation.

Impacts on Vegetation under Alternative C (Maximum Resource Protection)

Special Management Areas would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to all types of operations in all SMAs, except for the Hunting Area SMA which has a timing stipulation for geophysical exploration operations

only. The total acreage of the Preserve in which operating stipulations would apply covers 75,293 acres. In the remaining areas of the Preserve where operations could be permitted, the application of Current Legal and Policy Requirements, including 36 CFR 9B regulations, which have been described in Chapter 2, Parts II and III, and under Alternative A, should substantially reduce impacts on vegetation.

Geophysical Exploration: The Preserve's rare and important vegetation communities and monitoring plots would experience no direct adverse impacts from exploration operations because they are formally designated as SMAs, and the No Surface Use stipulation would be applied with protective offsets. Vegetation within 500 feet of waterways would continue to be protected under Current Legal and Policy Requirements that would not permit operations in these areas.

Due to the designation of large SMAs where geophysical exploration would not be permitted, the modification of project designs could concentrate operations outside of the SMAs. As a result, it may be necessary to increase the density or intensity of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. These adverse impacts could occur inside or outside the Preserve, and are dependent upon the location and layout of the seismic grid. As a consequence, the concentration of vehicles and equipment, and the footprint of exploration operations could be greater; and impacts on vegetation could also be greater, resulting in localized, short-term, negligible to moderate, adverse impacts on vegetation on up to 465 acres of the Preserve associated with vegetation trimming along source and receiver lines; and from being crushed, damaged or uprooted by off-road vehicle use. Compacted and rutted soils could reduce germination and root penetration. Leaks and spills could harm or kill vegetation.

Drilling and Production: Due to the designation of SMAs covering 46,273 acres where drilling and production would not be permitted, it is probable that some wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of impacts on vegetation would be dependant upon where the operation is located with respect to vegetation type, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted in wetlands or the 500-year floodplain.

According to the studies conducted by Fountain and Rayburn (1987), there are differential responses to direct disturbance among the vegetation community types within Big Thicket. Upland sites that are primarily pine-dominated were deemed the least susceptible to adverse impacts from oil and gas operations, because the predicted time for recovery (based on achieving a species composition similar to that of the original site) was found to be less than for the other vegetative communities that were studied. This is because pines were the primary woody species invading both upland and slope sites, and a return of pines to uplands that were previously dominated by pines reflects a rapid recovery of the sites. Slope sites, on the average, possess the higher diversity and richness, and require a longer time frame to recover. Succession on the slope sites must pass through a pine-dominated seral stage before returning to the potential mixed hardwood pine climax vegetation.

Similar to Alternatives A and B, impacts from the construction and maintenance of drilling and production operations sited in uplands would result in localized, short- to long-term, moderate, adverse impacts on vegetation. Indirect impacts on vegetation in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

While SMAs receive specific protection from new drilling and production operations, existing (24.2 acres) and abandoned (unreclaimed operations on 376 acres), and transpark pipelines (589 acres)

would continue to adversely impact vegetation in the Preserve. Some of these sites are located within SMAs.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, well plugging, shutting-down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could release oil, and other contaminating and hazardous substances, which could harm or kill vegetation. Abandonment and reclamation could require cutting and clearing of vegetation. With mitigation, these effects would result in localized, short-term, negligible to minor, adverse impacts on vegetation at sites throughout the Preserve. Indirect impacts on vegetation in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative C would be similar to those described for Alternatives A and B, but with greater certainty of avoiding new major adverse impacts on important and rare vegetation in the Preserve. The additional protection provided by formal designation of fire monitoring plots, long-term monitoring plots, and rare vegetation communities as SMAs and application of the No Surface Use stipulation would result in cumulative, beneficial impacts over time, as the vegetation in these areas continued to be protected, adding to the amount of old growth and/or mature climax community acreage within the Preserve and the region. This would be especially important if forests outside the Preserve boundary are not similarly protected and are lost over time.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Geophysical exploration would result in localized, short-term, negligible to moderate, adverse impacts on vegetation on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternatives A and B, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, moderate, adverse impacts on vegetation on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be minor to moderate. Indirect impacts on vegetation in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: There would be more acreage designated as SMAs under Alternative C, where exploration, drilling and production would not be permitted; therefore, plugging, abandonment, and reclamation of new operations would not occur in these areas.

Similar to Alternatives A and B, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to minor, adverse impacts on vegetation. Indirect impacts on vegetation in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Similar to Alternatives A and B, with cumulative, minor to moderate, adverse impacts on vegetation in the region. However, protection of vegetation within the Preserve would be more readily attainable due to more acreage designated as SMAs under Alternative C, with no new

impacts on vegetation that is particularly susceptible to adverse impacts from oil and gas operations and important to maintaining the ecological integrity of the Preserve.

Impairment Analysis: Because there would be no major adverse impacts to vegetation whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve vegetation.

IMPACTS ON WETLANDS

Introduction

As described in Chapter 3, wetlands are a predominant and important ecological component of Big Thicket National Preserve. More than 40 percent of the Preserve is comprised of wetlands, and these areas often coincide with other sensitive and ecologically important resources, such as Soil Hydrologic Groups "C" and "D," floodplains, and riparian corridors. Important wetland functions and values are provided protection under NPS regulations, orders, and policies, as well as Army Corps of Engineers regulations. In general, wetlands must first be avoided, and then, if no practicable alternatives exist, impacts must be mitigated, which usually involves compensation for wetland losses. In areas like Big Thicket, with large expanses of wetlands, avoidance may not always be possible, especially for larger scale seismic surveys. Therefore, Impacts on wetland functions and values could result from oil and gas operations, depending on the locations selected for the operations.

Methodology for Assessing Impacts

The RFD scenario was used to analyze against the types of wetlands in Big Thicket National Preserve that could be impacted by oil and gas operations. The wetland types were defined and described based on the sources cited in Chapter 3. Assessment of impacts is based on best professional judgment and was developed through discussions with Preserve staff and EIS team members, and a review of relevant literature.

Impact Intensity Thresholds. The thresholds of change for the intensity of impacts are defined as follows:

Negligible: Impacts would result in a change to wetlands values and functions, but the change would be so slight that it would not be of any measurable or perceptible consequence.

Minor: Impacts would result in a change to wetlands values and functions that would be small and of little consequence and would not be expected to have any long-term effects. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: Impacts would result in a change to wetlands values and functions that would be measurable, long-term, and localized. Mitigation measures, if needed to offset adverse effects, would be extensive and likely successful.

Major: Impacts would result in a change to wetlands values and functions that would be measurable and have substantial consequences on a regional scale for long

periods of time or to be permanent. Extensive mitigation measures would be needed to offset any adverse effects, and their success would not be guaranteed.

Impacts on Wetlands under Alternative A (No Action/Current Management)

All of Big Thicket's wetlands receive standard protection under Current Legal and Policy Requirements. However, the application of Current Legal and Policy Requirements, and project-specific operating stipulations, could result in variations in how, where, and to what extent resource protection is applied. Wetland areas would need to be identified during the planning/development and review of Plans of Operations, so that avoidance or mitigation measures are applied to minimize direct and indirect impacts on wetlands. The NPS's 36 CFR 9B regulations require utilization of least-damaging methods, reclamation of disturbed areas with the goal of reestablishing wetland functions and values and preventing invasion of non-native (exotic) species (e.g., Chinese Tallow tree). The NPS's DO 77-1, wetlands protection guidelines set goals to first avoid and then to minimize impacts on wetlands, followed by appropriate compensatory mitigation for any unavoidable adverse impacts. Where wetlands resources may potentially be directly or indirectly impacted, oil and gas operators are required to perform and submit wetlands delineation surveys in the Plan of Operations. NPS mitigation requirements for direct and indirect adverse impacts on wetlands also requires a minimum compensation to be performed prior to or at the time permitted operations commence. The minimum compensation ratio is 1:1; however, a higher ratio for compensation may be required if (1) the functional values of the site being impacted are determined to be high and the restored wetlands will be of lower value; (2) it will take a number of years for the restored site to become fully functional; (3) the likelihood of full restoration success is unclear. As soon as possible after completing a permitted operation, but no later than 6 months, reclamation of the disturbed wetlands site must begin which would result in restoring wetland functions and values.

There are several wetland communities in Big Thicket recognized as being particularly rare, or important for their long-term research purposes. One of the ecological research and monitoring areas, the Royal Fern Bog Research Plot, is currently provided formal protection under Current Legal and Policy Requirements. It is recognized as a Research Natural Area Subzone in the Preserve's General Management Plan (1980), and only non-manipulative research by NPS and research personnel may occur in this area. In addition to the Royal Fern Bog Research Plot, other areas that currently receive specific protection under Current Legal and Policy Requirements are visitor use and park administrative areas (with a 500-foot offset), and areas within 500 feet of waterways.

Currently, there is no formal protection provided for rare forested wetland communities (including wetland baygall shrub thickets, swamp cypress-tupelo forests, wetland pine savannas, and any old growth trees within these or other community types). Adverse impacts on these rare forested wetland communities would be primarily impacted by drilling and production operations. Therefore, impacts on wetlands are likely to be greatest under Alternative A because rare and other important wetland areas are not identified in advance of project planning and are not provided specific protection. As a result, variations in protection may occur under different park administrations, resulting in different interpretations and applications of policy and different levels of protection. If these wetland communities are disturbed or destroyed as a result of nonfederal oil and gas operations, it would be considered a major adverse impact. These important and rare wetland communities would be formally designated as SMAs under Alternatives B and C.

A description of impacts on wetlands from specific types of oil and gas operations is provided below.

Geophysical Exploration: Where exploration operations could be permitted, wetland vegetation could be trimmed along source and receiver lines, and crushed, damaged or uprooted by off-road vehicle use. Where soils are compacted or rutted, surface hydrology and plant growth could be altered. Leaks and spills could pollute soil and water, and harm or kill vegetation. Mitigation should reduce impacts to result in localized, short-term, negligible to minor, adverse impacts on wetlands on up to 465 acres of the Preserve.

Impacts on wetlands from seismic surveys would depend on the type of survey done, the equipment and vehicles used, the type of vegetation, and the season of the year. It is expected that all future surveys in the Preserve would utilize 3-D seismic technology and follow the Current Legal and Policy Requirements in their Plans of Operations. During such surveys, a grid pattern of source and receiver lines would require survey line cuts, drilling of shotholes, and associated access clearing. Such actions could result in direct and indirect adverse impacts on wetland vegetation and soils, and possibly local hydrology. Under the RFD scenario, up to 465 acres would be impacted by seismic survey line cuts, shothole drilling, and detonation of explosives in shotholes. The actual number of wetland acres impacted would depend on the location of the seismic surveys.

Current Legal and Policy Requirements provide for the use of least-damaging methods to limit the impacts associated with seismic surveys. For example, under current environmental requirements included in recent Plans of Operation for seismic work, cutting of vegetation for survey lines is limited to a 3.5 to 6-foot width (understory vegetation only), and no tree limbs greater than 3 inches in diameter may be cut. The use of GPS is encouraged to reduce the need for line-of-sight surveys.

Drilling of shotholes could involve use of off-road vehicles of various types, which could compact and rut soils and damage vegetation. However, adverse impacts could be minimized with the use of smaller, light-weight, or other low-impact vehicles. Wide-tired or light-weight vehicles would rut soils less, minimizing disturbance to the root zone for wetland vegetation. Floatation-type tires would lessen compaction of wetland soils, avoiding ruts that may alter wetland hydrology. Also, there is the option of using mini-shotholes, which would limit the need for vehicles to drill deep holes and allow the use of portable hand drills. The use of helicopters to bring in supplies and equipment would greatly limit the amount of time spent on the ground, as well as the extent of ground and vegetation disturbance (although increasing short-term noise impacts).

Other mitigation measures available to limit direct and indirect adverse Impacts on wetlands from seismic surveys include keeping staging and fueling areas out of sensitive vegetation, using leak protection methods, providing for rapid cleanup of spills, properly plugging shotholes, developing and implementing an exotic weed control plan, and using existing roads for access whenever possible. In addition, consideration could be given to conducting surveys during drier seasons, if possible. Finally, there is concern about drilling shotholes in wetlands that have developed over fragipans. If wetlands have formed due to perched water conditions over the fragipans, and the fragipan layers are penetrated or disrupted by drilling of shotholes, there may be drainage of the wetland and disruption to the community that would be difficult to restore. Site-specific surveys during the planning and development of Plans of Operations would be required, and avoidance would be used if fragipans are found.

Localized soil disturbance could indirectly impact wetland productivity and functioning, but recovery would be expected to occur within a short time if proper mitigation is followed. Vegetation cut for survey lines or disturbed during shothole placement and detonation of explosives in shotholes would also be expected to recover over the short-term. As noted in Fountain and Rayburn (1987), a study of seismic surveys (pre-3-D seismic) found that wetlands were one of the most sensitive to disturbance, with the highest percent of damaged or killed vegetation. Upland soils allowed deeper root penetration than slope or wetland soils, and these deeper rooted plants would bend and recover when run over by a survey vehicle, while the shallow rooted stems tended to be uprooted. However, they found that

vegetation recovery was relatively rapid on most sites, and that survey lines 3 – 4 years old were very hard to locate, indicating the short-term nature of impacts from seismic surveys.

Drilling and Production: In areas of the Preserve were drilling and production operations could be permitted, the construction and maintenance of roads, wellpads, flowlines, and pipelines in or adjacent to wetlands could require the placement of fill material, removal of vegetation, and disruption of soils and surface hydrology, which would alter beneficial wetland functions and values. In the rare event that direct and/or indirect impacts on wetlands cannot be avoided, mitigation to select a least-damaging site to locate operations and to minimize direct and indirect wetland impacts could result in localized, short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), minor to moderate, adverse impacts on Preserve vegetation on up to 241 acres of the Preserve, which could include wetland vegetation if wetlands are not avoided. Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate.

Impacts could be considered major if rare and highly productive wetland communities (rare forested wetland communities) meet the major impact threshold defined in this EIS. Under Alternative A, precautions included in case-by-case Plan of Operations/EAs would reduce most impacts to less than major levels.

Under any alternative, wetlands would be avoided as sites for drilling and production, and operators would have to show that there are no practicable alternatives for siting their operations in wetlands. In addition, operators are required to avoid floodplains, which would also result in the avoidance of many of the Preserve's wetlands. However, if wetlands cannot be avoided, drilling and production could occur within or near Preserve wetland communities. Drilling and production of oil and gas could involve clearing, contouring, and construction of the wellpad, roads, flowlines, and other ancillary facilities. All ground-disturbing activities have the potential to have adverse impacts on wetland vegetation, soils and/or hydrology. Oil and gas drilling and production would create similar but varying amounts of surface disturbance, depending on the size of the project and length of time involved. Under the RFD scenario, wellpads are estimated to be 2.4 acres in size, and up to 241 acres could be impacted. The actual number of wetland acres impacted would depend on the location of the well/production pads and access roads, and ancillary facilities, particularly flowlines and pipelines. Drilling operations and impacts would be considered short-term, lasting a few to 6 months, while a producing well may create long-term impacts for 20 years or longer, until the site is abandoned and reclaimed.

The types of impacts on wetlands associated with drilling and production would include not only the visible loss of vegetation and disruption to soils, but the effects on the functions and values of the wetland community. Typical functions and values of wetlands include high productivity, fish and wildlife support, erosion and sedimentation control, dampening storm effects and flood control, water purification, and nutrient cycling. Wetlands also play a major role in the biodiversity of Big Thicket National Preserve and add to its cultural and scientific value. Different wetland types have different levels of importance for these various functions, and site-specific functions and values would be assessed and included in the development of mitigation plans for any wetland disturbance that triggers NPS and Section 404 permitting.

Replacement time is also an issue for Preserve wetlands. Some of the wetlands are forested wetlands, such as the bottomland hardwoods and cypress-tupelo swamps, and are extremely difficult to successfully reclaim or restore, even over a very long period of time (Clewell and Lea, 1990).

Changes in wetland hydrology and drainage patterns could result from surface disturbance, and indirect impacts could occur to off-site wetlands, due to compaction of soils, rutting, use of fill that alters natural drainage patterns, and placement of flowlines or ditches. Flooding or draining of wetlands could occur due to these activities on the site or on nearby lands. Prohibiting vehicular traffic during periods when soils are saturated or flooded, and use of light-weight, large-tired vehicles could help to reduce adverse impacts on soils. Also, earthen pits for disposal of drilling muds and cuttings would not be permitted in the Preserve. A closed loop, containerized drilling mud system would be required for both drilling and workover operations, and tanks would be used to hold drill cuttings or fluids prior to off-site disposal.

As described under the geophysical exploration discussion, above, another issue related to Preserve wetlands is the potential for disturbance of fragipans and associated wetlands. In areas of the Preserve where such conditions are suspected, surveys should be done as part of the planning/development of Plan of Operations and permitting process to ensure that fragipans are not perforated by drilling or production operations.

Indirect impacts on off- and on-site wetlands could also occur due to sedimentation from ground disturbance and erosion. Proper erosion control devices and the proper placement of culverts along access roads would minimize these impacts. Oil and gas releases or accidental spills and leaks of hazardous chemicals could also threaten wetland communities, especially if the chemicals are transported to off-site targets. Produced water spills could be toxic to wetland vegetation and cause long-term soil sterilization, if not remediated. Noxious or exotic weeds could also spread into wetlands from oil and gas operations if proper precautions are not taken. Chinese tallow-tree is a particularly invasive exotic species in the Big Thicket region and has been problematic and costly to control in previous oil and gas operations in the Preserve.

Mitigation measures under Current Legal and Policy Requirements would apply to many of the above concerns. In addition to the mitigation already mentioned, additional measures would include using already disturbed areas (especially existing access roads and wellpads), using blowout prevention equipment on wells, providing adequate secondary containment (berms and liners), having spill contingency plans and equipment on site; and conducting regular flowline testing. Weed control plans, particularly for herbicide application, should also be included as part of any Plan of Operation.

In addition to impact minimization measures, compensation requirements would go into effect during site-specific permitting and Plan of Operations approval if wetlands cannot be practicably avoided. The NPS no-net loss policy and DO 77-1 require a minimum 1:1 compensation ratio for direct and indirect impacts on wetlands, to be performed prior to, or at the time of impacts. This is a functional replacement, and the required ratio may be increased to 2:1 or more if the compensation wetland would not provide the same functions as the impacted wetland, or the wetland type and function requires a very long period of time to develop. Section 404 permitting requirements would also need to be met, and these involve compensatory mitigation to be determined on a project-by-project basis, usually at a minimum of a 2:1 ratio.

In any case, if drilling and production operations are sited in wetlands, there would be a direct loss of wetland acreage for the well/production pad and any associated roads, which may or may not be totally mitigated, depending on the success of eventual reclamation of the operations area. As noted by Kentula (1996), it is difficult to make a definitive statement about the ability to replace wetland functions. The lack of information on ecologically mature mitigation projects limits the ability to predict whether or not the functions of project wetlands can replace the functions of natural wetlands, and replacing forested wetlands and bogs is most problematic. Both Kentula (1996) and Clewell and Lea (1990) note that forested wetlands are complex and require a long time for woody vegetation to mature. According to the case studies reviewed by Clewell and Lea, a wide variety of forest establishment techniques have been explored, some with initial success, but none of them

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proven. Forested wetland creation/restoration projects that are carefully planned and executed will be successful in terms of species establishment, but functional equivalency to natural forested wetlands has not been documented. Hydrology is the critical factor during wetland reclamation and creates much more variability and uncertainty than in the reclamation of non-wetland sites. Competent supervision and monitoring during restoration are also essential.

Contacts with several wetland scientists familiar with wetland mitigation in this region confirm that forested wetlands such as bottomland hardwoods and swamp communities are difficult to replace through restoration (pers. comm., Orr, Theriot, 1999). There have been no mitigation banks established in the area for bottomland forest (nearly all are for emergent marshes), and mitigation projects for shrub and forested wetlands have not been in existence long enough to really see if they are successful. Therefore, avoidance of these areas, especially rare and highly productive wetlands, is extremely important (pers. comm., Orr, 1999).

Given the uncertainty about forested wetland compensation and length of time to achieve functionality, there is the possibility that localized, major adverse impacts could result if wetlands cannot be avoided and are impacted by oil and gas drilling and production. If the restored wetlands do not replace the lost functions and values to the extent required by the mitigation plan, a major, long-term adverse impact would occur. Other potential impacts described above would be short-term and minor to moderate in nature.

Under Alternative A, impacts could occur in all wetland communities, with the exception of the fire and long-term monitoring plots, and the Royal Fern Bog Research Plot, based on the specific protection afforded these areas under Current Legal and Policy Requirements, through direction provided in the Preserve's General Management Plan (1980). However, indirect impacts could occur to these areas, since the GMP does not provide for protective offsets, but these impacts could be avoided by siting oil and gas facilities away from these areas.

Under Alternative A, rare forested wetlands (includes wetland baygall shrub thickets, swamp cypress-tupelo forests, wetland pine savannas, and any old growth trees within these or other community types) do not receive formal protection. These important wetland vegetation communities would have to be identified and protected during the planning and development of Plans of Operations. With the implementation of mitigation, adverse impacts should be kept to less than major levels. However, if specific protective measures or offsets are not required, major adverse impacts could occur to these vegetation communities, since they are particularly susceptible to adverse impacts that would jeopardize their ecological attributes.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact wetlands in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions such as steepness of slope and direction, and surface hydrology; and mitigation measures being employed. Based on these factors, indirect impacts on wetlands in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting-down, abandoning and removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, sedimentation in waterways, alter surface water flows, and result in leaks and spills of fuels, and other contaminating and hazardous substances, but with mitigation would result in localized, negligible to minor, adverse impacts at sites throughout the Preserve. Impacts could be short- or long-term, lasting until reclamation of impacted wetlands successfully restores wetland functions and values. Impacts could be considered major and adverse if reclamation does not successfully restore wetland functions and values.

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For impacts on wetlands, compensatory mitigation involves restoration as described above. Proper plugging of the wells would ensure that hydrocarbon contamination would not occur in the future. Success of compensatory mitigation would be dependant on the conditions of the site-specific mitigation plan. If the site is not properly recontoured and the natural hydrology is altered, or contamination remains, and the potential for restoration of the natural community is not possible, then a major, long-term impact would occur. With the implementation of a site-specific mitigation plan that requires site clean up, remediation of contaminated water or soils, restoration of hydrology, and planting of native vegetation, impacts should be reduced to negligible to minor, adverse impacts, unless rare or important wetlands (rare forested wetland communities) are involved and their integrity or value is jeopardized.

Indirect impacts on wetlands in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: The cumulative impact analysis area for wetlands covers the Lower Neches River Watershed which extends from the B. A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area is the same as what has been defined for all natural resources. The analysis area has been selected because it includes the major rivers and tributaries that flow through the Preserve, and activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact natural resources, including wetlands in the region.

Since the time of Colonial America, wetlands have been regarded as a hindrance to productive land use. Swamplands, bogs, sloughs, and other wetland areas were considered wastelands to be drained, filled, or manipulated to “produce” other than natural services or commodities. (Dahl, 1990). Over a period of 200 years, Texas has lost an estimated 52 percent of its wetlands (Dahl, 1990). Wetland losses are principally attributed to filling, draining, excavating, diverting, clearing, flooding, shading activities, and from adverse impacts from adjacent land uses, grazing, and farming (Texas Parks and Wildlife Department, 1995). Over a 200-year timespan, wetland acreage has diminished to the point where environmental and even socio-economic benefits (i.e., groundwater supply and water quality, shoreline erosion, floodwater storage and trapping of sediments, and climatic changes) are now seriously threatened (Dahl, 1990).

As described in the previous chapter, the Preserve comprises at least 40 percent wetlands, consisting primarily of palustrine wetlands (31,530 acres), but also includes a small acreage of riverine (3,125 acres) and lacustrine (60 acres) wetland systems. These wetland systems represent less than 20% of the analysis area. Loss of palustrine forested wetlands (bottomland hardwood and floodplain forests) in the analysis area are mainly attributed to upland agriculture and other upland land uses. Long-term viability of wetlands in the analysis area could be influenced by direct loss through developments or indirectly by alteration of surface or subsurface water supply.

Cumulative impacts of any alternative on wetlands within and immediately adjacent to the Preserve include unmitigated wetland losses of an undetermined acreage from oil and gas developments that pre-existed the establishment of the Preserve. Many of these sites have not been properly reclaimed, and it is anticipated that impacts have included direct loss of wetland vegetation and soils, and changes in hydrology around site structures and filled areas. These effects have caused long-term impacts on plant communities within and outside Big Thicket National Preserve, resulting in removal of wetland vegetation or a change (decrease) in site productivity and habitat value. These past unmitigated disturbances, especially those within the Preserve, constitute a cumulative adverse

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impact, but until site-specific analysis of each abandoned site (unreclaimed sites comprising 376 acres in the Preserve) is performed, it is difficult to gauge the level of impact. Any additional impacts resulting from operations permitted under the No Action Alternative would add to these cumulative adverse impacts within the Preserve. However, future wetland impacts would be reduced through the application of Current Legal and Policy Requirements, which require operators to avoid wetlands areas for development unless there are no practicable alternatives, requires a standard offset of a minimum 500 feet from waterways (unless specifically authorized by an approved plan of operations), requires Plans of Operations to address reclamation of disturbed wetlands to be performed at the completion of operations prior to undertaking a permitted operation, in addition to also describing in Plans of Operations how restoration of a disturbed wetlands site would be performed to meet the compensatory requirements of both the NPS wetlands protection guidelines and Corps of Engineers Section 404 permitting requirements. In addition, the Preserve's prescribed fire management program would provide long-term cumulative beneficial impacts on wetland pine savannas by restoring and maintaining the wetland vegetation community and biodiversity. Therefore, over time, cumulative impacts on wetlands in the Preserve would be improved, a cumulative beneficial impact for wetland resources of the Preserve.

Wetlands in the analysis area outside the Preseve could be lost by developing wetland areas, and indirectly influenced by any development or activity that causes sedimentation in wetlands or disrupts surface and subsurface water flow. Although these actions are subject to Army Corps of Engineers Section 404 requirements, wetland mitigation has not always been done or been done successfully. Land uses with potential to impact wetlands outside the Preserve, or influence water supply both within the analysis area and in the Preserve include: residential development; commercial and private forestry; oil and gas development; agriculture; and public-owned facilities (e.g., impoundments, water diversion, and sewage treatment). With expected population growth in the analysis area and increased development in the analysis area, it is inevitable that some wetlands could be developed or indirectly impacted by uplands developments; therefore, over the long-term, cumulative moderate adverse impacts on wetlands could occur in the analysis area. Since approximately 97 percent of the lands in Texas are privately-owned, the future of the State's wetlands is closely linked to land-use decisions made by private citizens. The information provided by wetlands delineation of proposed operations in the Preserve would increase the NPS's knowledge of the resource in the Preserve, a cumulative, negligible, beneficial impact.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: Where exploration operations could be permitted, vegetation could be trimmed along source and receiver lines; and crushed, damaged or uprooted by off-road vehicle use. Where soils are compacted or rutted, surface hydrology and plant growth could be altered. Leaks and spills could pollute soil and water, and harm or kill vegetation. Mitigation should reduce impacts to result in localized, short-term, negligible to minor, adverse impacts on wetlands on up to 465 acres of the Preserve.

There is no formal protection provided for fire monitoring plots and long term monitoring plots; and if they are not adequately protected could result in major adverse impacts.

Drilling and Production: Where drilling and production operations could be permitted, the construction and maintenance of roads, wellpads, flowlines, and pipelines in or adjacent to wetlands could require the placement of fill material, removal of wetland vegetation, and disruption of soils and surface hydrology, which would alter beneficial wetlands functions and values. In the rare event that direct and/or indirect impacts on wetlands cannot be avoided, mitigation to select a least-damaging site to locate operations and to minimize direct and indirect wetland impacts could result

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in localized, short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), minor to moderate, adverse impacts on wetlands on up to 465 acres of the Preserve. Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate. Indirect impacts on wetlands in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

There is no formal protection provided to rare forested wetland communities, and if they are not adequately protected could result in major adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting-down, abandoning and removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, sedimentation in waterways, alter surface water flows, and result in leaks and spills of oil, and other contaminating and hazardous substances, but with mitigation would result in localized, negligible to minor, adverse impacts at sites throughout the Preserve. Impacts could be short-term or long-term, lasting until reclamation of impacted wetlands successfully restores wetland functions and values. Impacts could be considered major and adverse if reclamation does not successfully restore wetland functions and values. Indirect impacts on wetlands in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Over time, protection provided to wetlands in the Preserve under Current Legal and Policy Requirements is expected to result in the Preserve maintaining and improving wetlands, with cumulative, beneficial impacts on Preserve wetlands; while adjacent lands could continue to be developed with wetlands incrementally being lost. Also, reclamation of wetlands inside or outside the Preserve may not return sites to pre-disturbance conditions. Therefore, Alternative A is expected to result in cumulative, moderate, adverse impacts on wetlands in the region.

Impairment Analysis: Because there would be no major adverse impacts to wetlands whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve wetlands.

Impacts on Wetlands under Alternative B (Preferred Alternative)

Special Management Areas would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. By applying applicable Current Legal and Policy Requirements, including 36 CFR 9B regulations and NPS Director's Order 77-1 wetlands protection guidelines, which have been described in Chapter 2, Parts II and III, and under Alternative A, impacts on wetlands should be substantially reduced throughout the Preserve.

Under Alternative B, the types of impacts that could occur to wetlands would be the same as described under Alternative A. However, because SMAs would be designated and provided with specific protection, these impacts would be lessened or eliminated in some SMA areas. Under

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Alternatives B (and C), rare forested wetlands are formally designated as SMAs; however, the operating stipulations required for geophysical exploration, and drilling and production operations varies for each alternative.

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve, resulting in localized, short-term, negligible to minor, adverse impacts on wetlands on up to 465 acres of the Preserve associated with wetland vegetation being trimmed along source and receiver lines; and crushed, damaged or uprooted by off-road vehicle use. Where soils are compacted or rutted, surface hydrology and plant growth could be altered. Leaks and spills could pollute soil and water, and harm or kill vegetation. Geophysical exploration would be permitted in the rare forested wetland communities SMA (which includes wetland baygall shrub thickets, swamp cypress-tupelo forests, wetland pine savannas, and old growth trees), and in all other wetland communities subject to Current Legal and Policy Requirements, including NPS and Corps of Engineers permitting and mitigation policies and requirements. The restriction of vehicle use on or across saturated or flooded soils in hydrologic soil classes "C" and "D," under Current Legal and Policy Requirements, would substantially lessen impacts on wetlands vegetation and soils.

Drilling and Production: Similar to Alternative A, construction and maintenance of drilling and production operations could be permitted in areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on wetlands on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be negligible to moderate. However, if reclamation of operations areas that required disturbance of wetlands, or compensatory mitigation is not successful in restoring wetland functions and values, there would be major adverse impacts that could potentially last for the long-term until the desired community type is restored.

It is possible under Alternative B that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. The intensity of impacts on wetlands would be dependant upon where the operation is located with respect to specific types of wetland communities, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Similar to Alternative A, indirect impacts on wetlands in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including the Riparian Corridors SMA) unless there is no practicable alternative. In the rare event that direct and/or indirect impacts on wetlands cannot be avoided, Current Legal and Policy Requirements would guide the selection of the least-damaging site to locate operations.

Plugging/Abandonment/Reclamation: Similar to Alternative A, well plugging, shutting-down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, sedimentation in waterways, alter surface water flows, and result in leaks and spills of oil, and other contaminating and hazardous substances, but with mitigation would result in localized, negligible to minor, adverse impacts at sites throughout the Preserve. Impacts could be short- to long-term, lasting until reclamation successfully restores wetland functions and values. Impacts could be considered major and adverse if reclamation does not successfully restore wetland functions and values. Indirect impacts on wetlands in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

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Cumulative Impacts: Cumulative impacts under Alternative B would be similar to those described for Alternative A, but with more certainty of avoiding adverse impacts on wetlands communities in the Preserve as a result of the additional protection provided by formally designating wetlands communities as SMAs, with offsets or increased offsets, where operating and timing stipulations would apply. Over time, the additional protection afforded the SMA wetland communities and old growth trees would result in a cumulative beneficial impact for Preserve wetlands, as the older trees in these areas continued to be protected, adding to the amount of old growth and/or mature wetland forest acreage within the Preserve. This is especially important, since the NPS's more stringent wetland protection policies are not in effect for privately-owned wetlands outside the Preserve boundary. These private wetlands could be lost over time, particularly if very small areas are developed and are exempt from Corps of Engineers review; and if they are not adequately replaced or restored, over the long-term the incremental small losses could result in cumulatively large acreage of wetland losses, resulting in cumulative, moderate, adverse impacts on wetlands in the region.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve, resulting in localized, short-term, negligible to minor, adverse impacts on wetlands on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternative A, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on wetlands on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be negligible to moderate. Indirect impacts on wetlands in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: The designation of SMAs would increase the acreage where the No Surface Use stipulation would be applied to exploration, drilling and production operations; therefore, plugging, abandonment, and reclamation of new operations would not occur in these areas.

Similar to Alternative A, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, negligible to minor, adverse impacts on wetlands. Impacts could be short-term or long-term, lasting until reclamation of impacted wetlands successful restores wetland functions and values; and could be considered major and adverse if reclamation does not successfully restore wetland functions and values. Indirect impacts on wetlands in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Similar to Alternative A, with cumulative, moderate, adverse impacts on wetlands in the region. However, protection of wetland resources would be more readily attainable in the Preserve due to designation of SMAs where the No Surface Use stipulation would result in no new impacts on wetlands that are particularly susceptible to adverse impacts from oil and gas operations and important to maintaining the ecological integrity of the Preserve.

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Impairment Analysis: Because there would be no major adverse impacts to wetlands whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve wetlands.

Impacts on Wetlands under Alternative C (Maximum Resource Protection)

SMAs would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to geophysical exploration in all SMAs, except for the Hunting Areas and Birding Hot Spots SMAs that would have timing restrictions. The No Surface Use stipulation would be applied to drilling and production operations in all SMAs, except for the Hunting Areas SMA. In the remaining areas of the Preserve where operations could be permitted, the application of Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations and the NPS's wetlands protection guidelines (Director's Order 77-1), which have been described in Chapter 2, Parts II and III, and under Alternative A, should substantially reduce impacts on wetlands throughout the Preserve.

Geophysical Exploration: The Preserve's rare forested wetland communities, fire and long-term monitoring plots, and Royal Fern Bog Research Plot would experience no direct adverse impacts from exploration operations because they are formally designated as SMAs, and the No Surface Use stipulation would be applied with protective offsets. SMAs formally designated to protect wetlands include Fire Monitoring Plots and Long-term Monitoring Plots (50-150 foot offset), the Royal Fern Bog Research Plot (150-foot offset), Rare Forested Wetland Communities (including Wetland Baygall Shrub Thickets, Swamp Cypress-Tupelo Forests, Wetland Pine Savannas, and Old Growth Trees), and Riparian Corridors. Wetland areas would also be protected in Visitor Use and Administrative Areas SMAs (500-foot offset), and where they occur within the Rare Vegetation Communities (including Upland Pine Forests, Beech-Magnolia-Loblolly Pine Forests, and Sandhill Pine Forests). Wetlands within 500 feet of waterways would continue to be protected because Current Legal and Policy Requirements would not permit operations in these areas.

In addition to the areas where the No Surface Use stipulation would apply year-round, surface uses for geophysical exploration operations would not be permitted in the Hunting Areas SMA from October 1st through January 15th, or in Birding Hot Spots SMAs from March 1st through May 30th and September 1st through November 30th. These areas comprise 52,272 acres. The timing stipulation would result in no direct impacts on wetlands in these areas during the specified times.

Geophysical exploration could be permitted in other areas of the Preserve. Due to the designation of large SMAs where geophysical exploration would not be permitted, the modification of project designs could concentrate operations outside of the SMAs. As a result, it may be necessary to increase the density of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. These adverse impacts could occur inside or outside the Preserve, and are dependant upon the location and layout of the seismic grid. Impacts would be similar to Alternatives A and B, with localized short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve, with some acreage associated with wetland vegetation being trimmed along source and receiver lines; and crushed, damaged or uprooted by off-road vehicle use. Where soils are compacted or rutted, surface hydrology and plant growth could be altered. Leaks and spills could pollute soil and water, and harm or kill vegetation.

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Drilling and Production: Protection is provided to certain wetland communities by formally designating these areas as SMAs and applying the No Surface Use stipulation. SMAs formally designated to protect wetlands include fire monitoring plots and long-term monitoring plots (with a 150-foot offset), the Royal Fern Bog Research Plot (with a 150-foot offset), rare forested wetland communities (wetland baygall shrub thickets, swamp cypress-tupelo forests, wetland pine savannas, and old growth trees), and riparian corridors. Wetland areas would also be protected in visitor use and administrative areas SMAs (with a 1,500-foot offset), and where they occur within the rare vegetation communities (upland pine forests, beech-magnolia, loblolly pine forests, and sandhill pine forests). Wetlands within 500 feet of waterways would continue to be protected because Current Legal and Policy Requirements would not permit operations in these areas. However, some existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) may be impacting, directly or indirectly, wetlands in the Preserve, some of which are located within SMAs.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of impacts on wetlands would be dependant upon where the operation is located with respect to specific types of wetland communities, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Similar to Alternatives A and B, indirect impacts on wetlands in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including the riparian corridors SMA). In the rare event that direct and/or indirect impacts on wetlands cannot be avoided, Current Legal and Policy Requirements would guide the selection of the least-damaging site to locate operations.

Similar to Alternatives A and B, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on wetlands on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be negligible to moderate. If reclamation of operations areas that required disturbance of wetlands, or compensatory mitigation are not successful in restoring wetland functions and values, the effects would be considered a major adverse impact, and could potentially last for the long-term until the desired community type is restored.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, well plugging, shutting-down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could cause soil erosion, sedimentation in waterways, alter surface water flows, and result in leaks and spills of oil, and other contaminating and hazardous substances, but with mitigation would result in localized, negligible to minor, adverse impacts at sites throughout the Preserve. Impacts could be short- to long-term, lasting until reclamation of impacted wetlands successfully restores wetland functions and values. Impacts could be considered major and adverse if reclamation does not successfully restore wetland functions and values. Indirect impacts on wetlands in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative C would be similar to those described for Alternatives A and B, but with even greater certainty of avoiding adverse impacts on

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wetlands communities in the Preserve as a result of the additional protection provided by formally designating wetlands communities as SMAs, with offsets or increased offsets, where operating and timing stipulations would apply. Over time, the additional protection afforded the SMA wetland communities and old growth trees would result in a cumulative beneficial impact for Preserve wetlands, as the older trees in these areas continued to be protected, adding to the amount of old growth and/or mature wetland forest acreage within the Preserve. This is especially important, since the NPS's more stringent wetland protection policies are not in effect for privately-owned wetlands outside the Preserve boundary. These private wetlands could be lost over time, particularly if very small areas are developed and are exempt from Corps of Engineers review; and if they are not adequately replaced or restored, over the long-term the incremental small losses could result in cumulatively large acreage of wetland losses, a cumulative, moderate, adverse impacts on wetlands in the region.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Where geophysical exploration would not be permitted, the modification of project designs could concentrate operations outside of the SMAs. Geophysical exploration could be permitted in other areas of the Preserve, resulting in impacts similar to Alternatives A and B, with localized, short-term, negligible to minor, adverse impacts on up to 465 acres of the Preserve, some of which may occur in wetlands.

Drilling and Production: Similar to Alternatives A and B, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on wetlands on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be negligible to moderate. Indirect impacts on wetlands in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, negligible to minor, adverse impacts on wetlands. Impacts could be short-term or long-term, lasting until reclamation of impacted wetlands successfully restores wetland functions and values; and could be considered major and adverse if reclamation does not successfully restore wetland functions and values. Indirect impacts on wetlands in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Similar to Alternatives A and B, with cumulative, moderate, adverse impacts on wetlands in the region. However, protection of wetland resources within the Preserve would be more readily attainable due to more acreage designated as SMAs under Alternative C, with no new impacts on wetlands that are particularly susceptible to adverse impacts from oil and gas operations and important to maintaining the ecological integrity of the Preserve.

Impairment Analysis: Because there would be no major adverse impacts to wetlands whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3)

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identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve wetlands.

IMPACTS ON FISH AND WILDLIFE

Introduction

The Big Thicket is a "biological crossroads" because it is a transition zone between four distinct vegetation types: the moist eastern hardwood forest, the arid southwestern desert, the tropical coastal marsh, and the central prairies. The variety of vegetation, climate, soils, and their interactions in these communities provide habitat for a diversity of fish and wildlife. The NPS perpetuates the native fish and wildlife as part of the natural ecosystem of the Preserve. The management emphasis is to preserve and restore the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and their communities and ecosystems in which they occur; restore native plant and animal populations in parks when they have been extirpated by past human-caused actions; and minimize human impacts on native plants, animals, populations, communities, and ecosystems, and the processes that sustain them. (NPS Management Policies, 2001).

Methodology for Assessing Impacts

Assessment of impacts is based on professional judgement and was developed through consultation with NPS staff and other experts in the field, and review of relevant literature.

Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impacts would result in a change to a population or individuals of a species or a resource, but the change would be short-term, and well within the range of natural fluctuations. The changes would be so slight that they would not be of any measurable or perceptible consequence to native fish and wildlife species, their habitats, or the natural processes sustaining them.

Minor: Impacts would result in a change to a population or individuals of a species or a resource that would not be measurable or expected to be outside the natural range of variability and would not be expected to have any long-term effects on native species, their habitats, or the natural processes sustaining them. Population numbers, population structure, genetic variability, and other demographic factors for species may have small, short-term changes, but long-term characteristics remain stable and viable. Occasional responses to disturbance by some individuals could be expected, but without interference to feeding, reproduction, or other factors impacting population levels. Key ecosystem processes may have short-term disruptions that would be within natural variation. Sufficient habitat would remain functional to maintain viability of all species. Impacts would be outside of critical reproduction periods for sensitive species. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: Impacts would result in a change to a population or individuals of a species or a resource that would be measurable, long-term, and localized, with

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consequences at the population level. Breeding animals of concern are present; animals are present during particularly vulnerable life-stages, such as migration or juvenile states; mortality or interference with activities necessary for survival can be expected on an occasional basis, but is not expected to threaten the continued existence of the species in the park unit. Impacts on native fish and wildlife species, their habitats, or the natural processes sustaining them would be measurable, and they could be outside the natural range of variability for short periods of time. Population numbers, population structure, genetic variability, and other demographic factors for species may have short-term changes, but would be expected to rebound to pre-impact numbers and to remain stable and viable in the long-term. Frequent response to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, or other factors impacting short-term population levels. Key ecosystem processes might have short-term disruptions that would be outside natural variation (but would soon return to natural conditions). Sufficient habitat would remain functional to maintain variability of all native fish and wildlife species. Some impacts might occur during critical periods of reproduction or in key habitat for sensitive native species. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major: Impacts on native fish and wildlife species, their habitats, or the natural processes sustaining them would be measurable, and they would be expected to be outside the natural range of variability for long periods of time or to be permanent. Population numbers, population structure, genetic variability, and other demographic factors for species might have large, short-term declines with long-term population numbers significantly depressed. Frequent responses to disturbance by some individuals would be expected, with negative impacts to feeding, reproduction, or other factors resulting in a long-term decrease in population levels. Breeding colonies of native species might relocate to other portions of the recreation area. Key ecosystem processes might be disrupted in the long-term or permanently. Loss of habitat may affect the viability of at least some native species. Extensive mitigation measures would be needed to offset any adverse effects and their success would not be guaranteed.

Impacts on Fish and Wildlife under Alternative A (No Action/Current Management)

All of Big Thicket's fish and wildlife is protected under Current Legal and Policy Requirements. However, the application of Current Legal and Policy Requirements, and project-specific operating stipulations, could result in variations in how, where, and to what extent resource protection is applied. The NPS's 36 CFR 9B regulations require a description of the natural environment to be impacted by operations be included in Plans of Operations, and that least-damaging methods are utilized. Reclamation of disturbed areas must reestablish native vegetative communities and provide for the safe movement of native wildlife and the normal flow of surface waters. Fish and wildlife habitat would need to be identified during the planning/development and review of Plans of Operations, so that avoidance or mitigation measures are applied to minimize impacts on fish and wildlife, and reclamation standards may be established prior to conducting operations (including documentation of the natural topographic contours, native vegetative communities, surface water flow patterns, natural topsoil characteristics, and biological survey of fish and wildlife in the project area). Fences shall be erected around existing or future installations, e.g., well, storage tanks, all

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high pressure facilities, to protect wildlife. Under Alternative A, SMAs would not be formally designated. Protected areas comprising 56,538 acres and other areas of the Preserve would be provided protection under Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations.

A description of impacts on fish and wildlife from specific types of oil and gas operations is provided below.

Geophysical Exploration: Where exploration operations could be permitted, fish and wildlife could be displaced and experience increased stress and mortality and decreased production while seismic work crews occupy large areas to lay receiver and source lines, drill shotholes, and detonate explosives placed in shotholes. Fish and burrowing wildlife would be susceptible to shock, concussion and mortality from detonation of explosives in shotholes. Elevated noise from intermittent shothole drilling and detonation of explosives in shotholes, vehicles and helicopters could contribute to displacing some fish and wildlife, increasing stress and reducing productivity. These effects could result in localized, short-term, negligible to minor, adverse impacts on fish and wildlife on up to 465 acres of the Preserve.

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The degree in which geophysical exploration could adversely impact fish and wildlife would depend on the type of survey conducted, equipment and vehicles used, the specific fish and wildlife habitats that are impacted, and when the survey is conducted (particularly in terms of the life cycle of fish and wildlife species that could be adversely impacted by the proposed exploration operation). It is expected that all future surveys in the Preserve would utilize 3-D seismic technology. Three-dimensional exploration involves the placement of a grid pattern of source lines with explosive charges placed in shotholes below the ground and receiver lines placed in and on the ground that can cover many square miles.

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Effects to fish and wildlife from conducting 3-D seismic surveys could include increased displacement, increased risk of mortality, decreased production, and increase in stress levels. These effects could be caused by multiple seismic crews occupying a large area to trim vegetation along 3.5-foot wide receiver and source lines, drill shotholes, detonate explosives, and use vehicles and helicopters.

Displaced wildlife may not be able to find suitable, unoccupied habitat in adjacent areas, and could potentially die of natural causes or displace other wildlife. Undisturbed wildlife normally exhibit patterns of activity and habitat selection that result in the optimization of energy expenditure. Disturbance of normal activity patterns and habitat use through oil and gas operations would have an adverse impact on the amount of available energy and, therefore, the welfare of an individual or a population could suffer. If the animal is unable to compensate for these increases in energy utilization, reproduction, growth, and survival are often greatly reduced.

Localized effects on burrowing wildlife (primarily reptiles, amphibians and small mammals), include shock, concussion, and possibly mortality, resulting from vehicle use, drilling of shotholes, and detonation of explosive charges in shotholes. Fish and wildlife could also be impacted by the noise associated with seismic survey work, particularly detonation of explosives in shotholes, and helicopter and vehicle noise. Impacts related to noise are usually temporary, with fish and wildlife avoiding or moving away from the source, but returning after noise is reduced or eliminated. Seismic survey noise is intermittent, and the loudness depends on the size of the explosive and depth of the shothole. Detonation of explosives in shotholes could be muffled but could be loud and startling due to the intermittent timing of explosive detonations. Helicopter noise is also localized and intermittent. Vibrations from explosive detonations could damage eggs so that they do not incubate.

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Under any alternative, protection of water quality and aquatic fish and wildlife would be provided by 36 CFR § 9.41(a), which requires operations to maintain a 500-foot offset from rivers, streams, and other waterbodies, unless specifically authorized by an approved plan of operations. The offset

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would avoid or substantially reduce sedimentation and turbidity. The 500-foot offset from waterbodies would protect fish and wildlife utilizing water and the immediate riparian areas within this protective zone. Protection of aquatic habitats would also be provided by the wetlands and floodplains permitting and compliance requirements. Vehicle use would not be permitted on or across saturated or flooded soils in hydrologic soil classes "C" and "D," which would reduce damage to vegetation and soils, but could result in lengthening the time seismic work crews and activities remain in an area.

The potential exists for leaks and spills of diesel fuel from refueling of vehicles and shothole drilling equipment that could pollute habitats, and injure and kill fish and wildlife that come into contact with or ingest hazardous or contaminating substances. However, stringent requirements under Current Legal and Policy Requirements, which include locating staging and fueling areas outside of sensitive environments such as wetlands and floodplains, utilizing drip pans, maintaining and inspecting vehicles and equipment to prevent leaks and spills and using drip pans during refueling, and providing for prompt response in the event of spills, would reduce the potential for spills and adverse impacts on fish and wildlife.

Drilling and Production: Where drilling and production operations could be permitted, the construction and maintenance of roads, wellpads and production pads could result in the direct loss of habitat and habitat fragmentation. Increased mortality could result from vehicles, construction activities, and increased access into previously inaccessible areas, resulting in localized, short-term (construction and well drilling) to long-term (roads, flowlines, pipelines, wells and production operations), minor to moderate, adverse impacts on up to 241 acres of the Preserve. Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be minor to moderate.

Many of the impacts on fish and wildlife from drilling and production are associated with construction activities. Fish and wildlife, particularly small mammals, invertebrates, and herpetofauna (reptiles and amphibians) that cannot escape an area during construction could be killed, and increased mortality for small mammals is also likely to occur along access roads.

Fish and other water-dependent species could experience habitat degradation from road construction and use, construction of wellpads, and pipelines in drainages where these species occur. These effects could decrease the long-term viability of populations as a result of increased sedimentation from construction activities and long-term uses, if appropriate mitigation measures are not applied. Some risk of direct mortality to fish and other aquatic species could occur if a pipeline ruptures at a stream crossing or toxic materials (such as diesel fuel) are spilled into streams. In some cases, improved human access to remote streams could result in greater fishing mortality or poaching, which would constitute an indirect effect. These effects would depend on where exploration and production ultimately occur, and careful siting of developments could avoid or minimize these impacts substantially. Because waterways are inherently a part of floodplains (riparian corridors) and wetland areas, they receive added protection under the Executive Orders and NPS implementing guidelines for protection of wetlands and floodplains, and are protected by a 500 foot offset under the NPS's Nonfederal Oil and Gas Rights Regulations, at 36 CFR § 9.41(a), unless specifically authorized by an approved plan of operations. These protective measures would ensure that water levels would be maintained and stream temperatures, and water quality and quantity would be protected. Careful siting of facilities when there are no practicable alternatives to locating an operation or activity in floodplains and wetlands is expected to result in stringent mitigation measures to minimize potential impacts. Therefore, the sediment increases are not expected to change channel processes or affect viability of the fish populations. Required compensatory mitigation for direct and indirect impacts on wetlands could be used to restore wetlands habitats and increase fish and wildlife habitat values.

Construction of oil and gas-related roads, wellpads or flowlines would result in direct loss of habitat. However, identification of fish and wildlife habitat through biological surveys would result in

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development of mitigation measures intended to avoid or minimize impacts. These surveys must be performed by biologists having sufficient technical knowledge and/or experience to appropriately time when and how surveys are performed and be qualified to identify species and habitat of the species that are present or may potentially use the area.

Reclamation of disturbed areas associated with access roads, pads, flowlines and pipelines would minimize impacts on fish and wildlife. Where disturbed areas are properly prepared and seeded with native species, reclamation would expedite the return of habitat and reduce the potential for invasion of non-native species. For production operations, these areas and their associated access roads would be unavailable as wildlife habitat for the long-term (i.e., 20 years or longer). Use of already-disturbed areas for siting new operations would minimize loss of fish and wildlife habitat.

Wildlife could also be adversely impacted when access is increased or human access becomes easier, especially in areas that were previously inaccessible. This increases the risk of fish and wildlife mortality, through legal or illegal means. The Preserve Superintendent can close or restrict motorized public access on roads that are to be used for oil and gas development if necessary. With this authority, the NPS can mitigate the effects of increased public access via oil and gas access roads.

Habitat fragmentation from this new access occurs when a timbered landscape is converted to early successional stages of grass/forb. Fragmentation also occurs due to the presence of roads bisecting the landscape. This fragmentation may inhibit some species of wildlife (generally small prey species, i.e., rodents, insects, etc.) to utilize their habitats effectively. The direct effect of modifying or removing vegetation would need to be analyzed on a project-specific basis, particularly if it occurs in a location of necessary habitat for a species group.

Alteration of fish and wildlife habitat and increased access and human intrusion can also allow for the introduction of non-native species. The most invasive non-native species of wildlife is the feral hog that was introduced by early settlers over a hundred years ago. Preferred habitat includes hardwood forests, swamps, and river bottoms (Singer, 1981). These habitats are abundant in the Preserve and none are expected to increase or decrease substantially as a result of oil and gas operations. Many hunting leases adjacent to the Preserve actively manage feral hogs for sport hunting, and it is likely that invasion of feral hogs from these leases will continue to ensure a viable population of feral hogs in the Preserve in perpetuity.

Ground-disturbing activities in wet soils, such as in floodplains and wetlands areas (including riparian corridors), could increase the possibility for introduction and invasion of non-native vegetation such as the Chinese tallow tree. A landscape invaded by Chinese tallow would not support native wildlife populations as fully as a landscape with native vegetation. The potential for introducing the Chinese tallow tree should be avoided or substantially reduced by not allowing vehicle use on or across saturated or flooded soils in hydrologic soil classes “C” and “D.”

All construction activities are likely to displace animals along access corridors and near the wellpad during construction, and through the exploration and production phase of the well. Displacement is the major effect to most wildlife species. Displacement of wildlife would continue from the initial wellpad construction phase into exploratory drilling, and if the well is placed in production, during the potentially long life of the producing well. Road and pad development and drilling operations would reduce the usable habitat for large carnivores as well as their prey species. Secure areas for large carnivores and prey species are reduced and the risk of legal and illegal mortality increases. The increase of and ease of access routes for public travel would serve to increase public motorized travel, or if the roads are closed to public motorized travel, they still serve as an access route by foot, horse and mountain bike. New access roads may even serve as travel corridors for large carnivores which may increase their risk of mortality, either legal or illegally. Increased access would also result in the same effects on smaller wildlife species, with increase in direct loss of wildlife through trapping and hunting. Low-speed

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roads are not expected to appreciably increase mortality from road kill or should not be barriers to movements of the small wildlife species.

Noise from drilling operations would also impact wildlife. Drilling operations introduce noise with the highest measurements in the 90 dBA range for a period of 30 to 90 days, with noise coming mostly from multiple diesel engines. Therefore, noise impacts could be major, but limited to a localized area and relatively short-term duration.

Also, in spite of careful best-management practices to minimize the release of oil and other contaminating and hazardous substances, in the worst case scenario, releases could potentially escape primary and secondary containment systems and species inhabiting the area could be harmed. If releases are transported into waterways, fish and other species occupying the water could be impacted. The severity of impacts would depend on the type and amount of pollutant released, physical and environmental factors of the site, the method and speed in which cleanup occurs, and the sensitivity of fish and wildlife to these impacts during different stages of their life cycle.

Some facilities associated with production operations (i.e., heater treater units/separator units) could kill bats, migratory birds and raptors through asphyxiation or incineration. To mitigate the residual impacts from these facilities, a cone device, placed on top of all vent stacks, would be required under Current Legal and Policy Requirements. The cones would be constructed in a manner that prevents perching on the vent stacks and subsequent asphyxiation, and eliminates all access into the vent stack pipes. Inaccessibility to the vent stacks would curtail any potential mortality to bats and birds.

Another protective measure requires that all open containers that collect stormwater be netted or covered. This requirement prevents bird and other wildlife species from accessing stormwater that have come in contact with and mixed with oil and gas, and contaminating and hazardous substances.

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Selection and use of herbicides and pesticides must be approved by the NPS Integrated Pest Management Coordinator. Therefore, major effects on native fish and wildlife would be avoided.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact fish and wildlife in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions such as steepness of slope and direction, and surface hydrology; and mitigation measures being employed. Based on these factors, indirect impacts on fish and wildlife in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, flushing and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for release of oil, and other contaminating and hazardous substances, which could harm or kill fish and wildlife, but with mitigation, would result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve.

Plugging and abandonment operations and site preparation during reclamation would introduce heavy equipment and people, along with increased noise levels for a short time; however, the long-term effect of these activities is to return the area to natural conditions, a beneficial impact to fish and wildlife. Wherever access roads have been built or are used for the primary purpose of allowing access for oil and gas operations, access roads would be reclaimed at the completion of operations. This would return the area to its natural conditions, thereby having a beneficial impact on the Preserve environment. Wherever possible, habitats would be improved to perpetuate the viability of habitats and increase the survivability of species.

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As oil and gas operations are plugged and abandoned, fish and wildlife habitat will be reclaimed. And, as new operations are planned, while they are likely to contribute to habitat fragmentation, it is expected to be to a much lesser degree than in the past. This is because Current Legal and Policy Requirements would be applied to avoid and minimize habitat fragmentation, and require operators to utilize least-damaging techniques, which would emphasize siting of new operations in already disturbed areas. Therefore, over the long-term, it is anticipated that fragmentation could be reduced and fish and wildlife habitat could be improved.

Indirect impacts on fish and wildlife in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: The cumulative impact analysis area for fish and wildlife covers the Lower Neches River Watershed which extends from the B. A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area is the same as what has been defined for all natural resources. The analysis area has been selected because it includes the major rivers and tributaries that flow through the Preserve, and activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact natural resources, including fish and wildlife in the region.

The long-term protection of fish and wildlife biodiversity in the Preserve depends on the ability of fish and wildlife populations to persist in the disparate configuration of the Preserve. A principal conservation strategy for the Preserve is that the water corridors should enhance the dispersal of fish and wildlife among otherwise isolated units. The degree to which these habitat corridors serve as migration routes or enhance the persistence of fish and wildlife species has not been adequately analyzed. Ultimately, the interplay between habitat characteristics at local sites and the dispersal abilities of species will determine which species persist in the Preserve (pers. comm., Lee Fitzgerald, 1999).

Assessment of fish and wildlife species diversity by Harcombe et al. (1996) suggest regional declines in fish and some stream invertebrate groups, partially attributed to regional modification of waterways. Modification of waterways may change the overall amount and timing of stream flows, directly impacting stream channel morphology (structure or form), rate of meandering or migration, sedimentation, water quality, and the amount and type of aquatic habitat. These changes may indirectly impact the growth, availability, and regeneration of bottomland hardwood forests. A majority of mammals, birds, reptiles, amphibians, fish, and invertebrates depend on bottomland hardwood forests for all or part of their life cycle.

Past and present oil and gas operations in and adjacent to the Preserve adversely impact fish and wildlife. Plugged and abandoned oil and gas wells and associated road segments that pre-date the establishment of the Preserve continue to adversely impact 376 acres inside the Preserve. Thirteen existing oil and gas operations in the Preserve occupy 24.2 acres, and 71 existing transpark oil and gas pipelines utilize 589 acres within associated right-of-way corridors. Impacts have included direct loss of terrestrial habitat at oil and gas sites. Also, construction of roads, flowlines and pipelines that cross rivers and streams increase erosion and sedimentation that adversely impact water quality and aquatic habitats. These combined effects on 989 acres have caused long-term impacts on fish and wildlife communities within the Preserve, resulting in removal of vegetation or a change (decrease) in site productivity and habitat value. These adverse impacts will remain until operations areas are reclaimed. Under the RFD scenario, future oil and gas operations may result in Preserve-wide 3-D seismic surveys that could utilize up to 465 acres of the Preserve, while drilling up to 40 wells and production of up to 27 could occupy up to 241 acres of the Preserve. Over the long-term, up to 1,695 acres could be directly impacted by oil and gas operations in the Preserve; however,

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while new operations are occurring, others would be plugged/abandoned/reclaimed. In addition to oil and gas operations within the Preserve, many operations adjacent to the Preserve may have indirect impacts on Preserve resources.

Other activities in the Preserve that could impact fish and wildlife included wildlife harvest (hunting and trapping), non-consumptive recreation in wildlife habitats, and the Preserve's prescribed fire management program. Bag limits are set by the State of Texas to ensure the continuing viability of populations; therefore, over the long-term, hunting and trapping could have beneficial impacts on wildlife populations. Recreational activities in the Preserve focused near developed visitor use areas, trails, canoe routes, and roads have a negligible to minor, adverse impact on fish and wildlife. The Preserve's prescribed fire management program could contribute to short-term habitat loss and result in adverse effects to wildlife including increased stress and mortality, and decreased productivity, but would provide long-term cumulative beneficial impacts on Preserve vegetation by restoring and maintaining wildlife habitats and biodiversity.

Over the long-term, the application of Current Legal and Policy Requirements to avoid or minimize adverse impacts on fish and wildlife in the Preserve, hunting, trapping, prescribed fire management practices, and the reclamation of abandoned operations sites (unreclaimed areas comprising 376 acres), would result in improving fish and wildlife habitat, a cumulative beneficial impact for fish and wildlife of the Preserve. While reclamation rarely succeeds in returning a disturbed area to pre-disturbance conditions, the removal of nonnative fill materials, recontouring and revegetation with native species would return these sites to a more productive habitat. Wherever possible, disturbed areas would be improved to perpetuate the viability of habitats and increase the survivability of species. The information provided by fish and wildlife surveys of proposed operations in the Preserve would increase the NPS's knowledge of the resource in the Preserve, a cumulative, negligible, beneficial impact.

On lands surrounding the Preserve, population growth and continued development including the construction and operation of the Sam Rayburn and B. A. Steinhagen Reservoirs, pipelines, roads, commercial and private forestry, and residential developments, in combination with natural events such as fire, flood and drought, could stress fish and wildlife species that reduce the resiliency of the local populations, resulting in the long-term incremental loss of fish and wildlife, and habitat decline through changes in water quality and quantity, particularly to bottomland hardwood forests. Because of the fragmented nature of the individual units of the Preserve, particularly the narrow riparian corridors, the influence of adjacent land-uses (particularly development activities) and introduction of non-native species that alter fish and wildlife habitat (Chinese tallow tree) or compete with available habitat (feral hog), could reduce the viability of fish and wildlife populations and habitat in the Preserve. Over the long-term, these effects would have cumulative, negligible to minor, adverse impacts on fish and wildlife resources in the region.

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Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: Where exploration operations could be permitted, fish and wildlife could be displaced and experience increased stress and mortality and decreased production while seismic work crews occupy large areas to lay receiver and source lines, drill shotholes, and detonate explosives placed in shotholes. Fish and burrowing wildlife would be susceptible to shock, concussion and mortality from detonation of explosives in shotholes. Elevated noise from intermittent shothole drilling and detonation of explosives in shotholes, vehicles and helicopters could contribute to displacing some fish and wildlife, increasing stress and reducing productivity. These effects could result in localized, short-term, negligible to minor, adverse impacts on fish and wildlife up to 465 acres of the Preserve.

Drilling and Production: Where drilling and production operations could be permitted, the construction and maintenance of roads, wellpads and production pads could result in the direct loss of habitat and habitat fragmentation. Increased mortality could result from vehicles, construction activities, and increased access into previously inaccessible areas, resulting in localized, short-term (construction and well drilling) to long-term (roads, flowlines, pipelines, wells and production operations), minor to moderate, adverse impacts on up to 241 acres of the Preserve. Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with minor to major adverse impacts, but with mitigation, and prompt response in the event of a spill, the intensity of adverse impacts could be negligible to moderate. Indirect impacts on fish and wildlife in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

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Plugging/Abandonment/Reclamation: Well plugging, flushing and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for release of oil, and other contaminating and hazardous substances, which could harm or kill fish and wildlife, but with mitigation, would result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Indirect impacts on fish and wildlife in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Over time, protection provided to fish and wildlife resources of the Preserve under Current Legal and Policy Requirements is expected to result in the Preserve protecting fish and wildlife populations, and maintaining and improving habitat, with cumulative beneficial impacts on Preserve fish and wildlife resources; while adjacent lands could continue to be developed with fish and wildlife populations and habitat values incrementally being lost, resulting in cumulative, negligible to minor, adverse impacts on fish and wildlife resources in the region.

Impairment Analysis: Because there would be no major adverse impacts to fish and wildlife whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve fish and wildlife.

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Impacts on Fish and Wildlife under Alternative B (Preferred Alternative)

Special Management Areas would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. By applying applicable Current Legal and Policy Requirements, including 36 CFR 9B regulations, which have been discussed in Chapter 2, Parts II and III, and under Alternative A, impacts on fish and wildlife should be substantially reduced throughout the Preserve.

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve, resulting in localized, short-term, negligible to minor, adverse impacts on fish and wildlife up to 465 acres of the Preserve. Fish and wildlife could be displaced and experience increased stress and mortality and decreased production while seismic work crews occupy large areas to lay receiver and source lines, drill shotholes, and detonate explosives placed in shotholes. Fish and burrowing wildlife would be susceptible to shock, concussion and mortality from detonation of explosives in shotholes. Elevated noise from intermittent shothole drilling and detonation of explosives in shotholes, vehicles and helicopters could contribute to displacing some fish and wildlife, increasing stress and reducing productivity.

Drilling and Production: It is possible under Alternative B that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. The intensity of impacts on fish and wildlife would be dependant upon where the operation is located with respect to specific fish and wildlife habitat, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Similar to Alternative A, indirect impacts on fish and wildlife in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including the Riparian Corridors SMA) unless there is no practicable alternative. In the rare event that direct and/or indirect impacts on wetlands cannot be avoided, Current Legal and Policy Requirements would guide the selection of the least-damaging site to locate operations.

In SMAs that are geographically small, the added protection would primarily be provided for small mammals and invertebrates that occupy these areas. In larger SMAs, such as rare vegetation communities and rare forested wetland communities, protection from additional fragmentation would benefit all fish and wildlife. The increased offset from visitor use and administrative areas, from a 500-foot offset to a 1,500-foot offset, would reduce the potential impacts of oil and gas operations and activities on riparian areas, providing added protection to fish and wildlife that rely on water and riparian areas for part or all of their life cycles. The 1,500-foot offset from birding hot spots would reduce the possibility of impacts on birds and other wildlife using these areas during nesting, breeding and migration.

While SMAs receive specific protection from new drilling and production operations, existing (24.2 acres) and abandoned (unreclaimed operations on 376 acres), and transpark pipelines (589 acres) would continue to adversely impact fish and wildlife and habitat in the Preserve. Some of these sites are located within SMAs.

Similar to Alternative A, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on fish and wildlife on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be minor to moderate.

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Plugging/Abandonment/Reclamation: Similar to Alternative A, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for release of oil, and other contaminating and hazardous substances, which could harm or kill fish and wildlife, but with mitigation, would result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Indirect impacts on fish and wildlife in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts would be similar to Alternative A. Over the long-term, the application of Current Legal and Policy Requirements that would be applied to oil and gas operations to avoid or minimize adverse impacts on fish and wildlife in the Preserve, reclamation of abandoned, unreclaimed sites (376 acres) occupied by new operations, in combination with hunting, trapping, and prescribed fire management practices, would result in improving fish and wildlife habitat, a cumulative beneficial impact for fish and wildlife of the Preserve. However, protection of fish and wildlife populations and improvement of habitat would be more readily attainable due to the designation of SMAs where the No Surface Use stipulation would be applied, resulting in no new impacts in these areas.

On lands surrounding the Preserve, population growth and continued development, in combination with natural events such as fire, flood and drought, could cause stress to fish and wildlife species that reduce the resiliency of the local populations, resulting in the long-term incremental loss of fish and wildlife, and habitat decline through changes in water quality and quantity, particularly to bottomland hardwood forests. Because of the fragmented nature of the individual units of the Preserve, particularly the narrow riparian corridors, the influence of adjacent development activities, the introduction of non-native species that alter fish and wildlife habitat or compete with available habitat, could reduce the viability of fish and wildlife populations and habitat in the Preserve. Over the long-term, these effects would have cumulative, negligible to minor, adverse impacts on fish and wildlife resources in the region.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve, resulting in localized, short-term, negligible to minor, adverse impacts on fish and wildlife on up to 465 acres of the Preserve.

Drilling and Production: Similar to Alternative A, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on fish and wildlife on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be minor to moderate. Indirect impacts on fish and wildlife in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Similar to Alternative A, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to minor, adverse impacts on fish and wildlife. Indirect impacts on fish and wildlife in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes

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beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Similar to Alternative A, with cumulative, negligible to minor, adverse impacts on fish and wildlife resources in the region; however, protection of fish and wildlife populations and improvement of habitat in the Preserve would be more readily attainable in SMAs where the No Surface Use stipulation would result in no new impacts in these areas, resulting in a cumulative, beneficial impact on fish and wildlife in the Preserve.

Impairment Analysis: Because there would be no major adverse impacts to fish and wildlife whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve fish and wildlife.

Impacts on Fish and Wildlife under Alternative C (Maximum Resource Protection)

SMAs would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to geophysical exploration in all SMAs, except for the Hunting Areas and Birding Hot Spots SMAs that would have timing restrictions. The No Surface Use stipulation would be applied to drilling and production operations in all SMAs, except for the Hunting Areas SMA. In the remaining areas of the Preserve where operations could be permitted, the application of Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations and the NPS's wetlands protection guidelines (Director's Order 77-1), which have been described in Chapter 2, Parts II and III, and under Alternative A, should substantially reduce impacts on fish and wildlife throughout the Preserve.

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve. The No Surface Use stipulation year-round in SMAs covering 37,088 acres may result in the modification of project designs for 3-D seismic surveys. As a result, it may be necessary to increase the density or intensity of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. These adverse impacts could occur inside or outside the Preserve, and are dependant upon the location and layout of the seismic grid. Despite the greater number of vehicles and equipment for concentrated operations, impacts would be similar to Alternatives A and B, with localized, short-term, negligible to minor, adverse impacts on fish and wildlife up to 465 acres of the Preserve.

Fish and wildlife could be displaced and experience increased stress and mortality and decreased production while seismic work crews occupy large areas to lay receiver and source lines, drill shotholes, and detonate explosives places in the shotholes. Fish and burrowing wildlife would be susceptible to shock, concussion and mortality from detonation of explosives in shotholes. Elevated noise from intermittent shothole drilling and detonation of explosives, vehicles and helicopters could contribute to displacing some fish and wildlife, increasing stress and reducing productivity.

Drilling and Production: Designation of riparian corridors and some larger vegetation and wetlands communities as SMAs would prevent further fragmentation of fish and wildlife habitat in these areas. Non-manipulative data-collection and surveys may be permitted in SMAs if oil and gas operations are proposed nearby and the influence of indirect impacts could extend into the

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boundaries of SMAs. Impacts on fish and wildlife could occur where biological, cultural, and other required resource surveys are conducted and would be short-term and negligible.

While SMAs receive specific protection from new drilling and production operations, existing (24.2 acres), and abandoned (unreclaimed sites on 376 acres) operations, and transpark pipelines (589 acres) would continue to adverse impact fish and wildlife and habitat in the Preserve. Some of these sites are located within SMAs.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of impacts on fish and wildlife would be dependant upon where the operation is located with respect to specific fish and wildlife habitat, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Similar to Alternatives A and B, indirect impacts on fish and wildlife in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain unless there is no practicable alternative.

Similar to Alternatives A and B, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on fish and wildlife on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be minor to moderate.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for release of oil, and other contaminating and hazardous substances, which could harm or kill fish and wildlife, but with mitigation, would result in localized, short-term, negligible to minor, adverse impacts at sites throughout the Preserve. Indirect impacts on fish and wildlife in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts would be similar to Alternatives A and B. Over the long-term, the application of Current Legal and Policy Requirements that would be applied to oil and gas operations to avoid or minimize adverse impacts on fish and wildlife in the Preserve, reclamation of abandoned, unreclaimed sites (376 acres) occupied by new operations, in combination with hunting, trapping, and prescribed fire management practices, would result in improving fish and wildlife habitat, a cumulative beneficial impact for fish and wildlife of the Preserve. However, protection of fish and wildlife populations and improvement of habitat would be more readily attainable due to the substantial acreage of SMAs designated where the No Surface Use stipulation would be applied, resulting in no new impacts in these areas.

On lands surrounding the Preserve, population growth and continued development, in combination with natural events such as fire, flood and drought, could cause stress to fish and wildlife species that reduce the resiliency of the local populations, resulting in the long-term incremental loss of fish and wildlife, and habitat decline through changes in water quality and quantity, particularly to bottomland hardwood forests. Because of the fragmented nature of the individual units of the Preserve, particularly the narrow riparian corridors, the influence of adjacent development activities, the introduction of non-native species that alter fish and wildlife habitat or compete with available habitat, could reduce the viability of fish and wildlife populations and habitat in the Preserve. Over

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the long-term, these effects would have cumulative, negligible to minor, adverse impacts on fish and wildlife resources in the region.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Similar to Alternatives A and B, geophysical exploration could be permitted in other areas of the Preserve, resulting in localized, short-term, negligible to minor, adverse impacts on fish and wildlife on up to 465 of the Preserve.

Drilling and Production: Similar to Alternatives A and B, construction and maintenance of drilling and production operations could be permitted in other areas of the Preserve, with localized, short- to long-term, minor to moderate, adverse impacts on fish and wildlife on up to 241 acres of the Preserve. However, leaks and spills could result in minor to major, adverse impacts, but with the application of mitigation measures, and prompt response in the event of a spill these impacts could be minor to moderate. Indirect impacts on fish and wildlife in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, plugging, abandonment, and reclamation of new operations located outside SMAs; and of existing and abandoned operations, and transpark pipelines located throughout the Preserve would result in localized, short-term, negligible to minor, adverse impacts on fish and wildlife. Indirect impacts on fish and wildlife in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Similar to Alternatives A and B, with cumulative, negligible to minor, adverse impacts on fish and wildlife resources in the region; however, protection of fish and wildlife populations and improvement of habitat in the Preserve would be more readily attainable in the substantial acreage of SMAs where the No Surface Use stipulation would result in no new impacts in these areas; resulting in a cumulative, beneficial impact in the Preserve.

Impairment Analysis: Because there would be no major adverse impacts to fish and wildlife whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve fish and wildlife.

IMPACTS ON SPECIES OF SPECIAL CONCERN

Introduction

As described in Chapter 3, 22 federally and State-listed species of special concern are believed to occur permanently or transiently in the Preserve. Appendices G and H include U.S. Fish and Wildlife Service (FWS, 8/04), and Texas Parks and Wildlife Department (TPWD, 11/03) listings of species of special concern that may occur in the counties encompassing the Preserve. The NPS policy is to identify and promote the conservation of federal, State, and locally protected threatened, endangered,

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rare, declining, sensitive, or candidate species (hereafter referred to as species of special concern) that are native to and present in the Preserve and their critical habitats.

Methodology for Assessing Impacts

Species of Special Concern are defined as those listed by either FWS as endangered, threatened, candidate, or special concern; or by TPWD as endangered, threatened, or a special concern or imperiled species.

For federally-listed species, the terms “threatened” and “endangered” describe the official federal status of vulnerable species as defined by the Endangered Species Act of 1973. The term “candidate” is used officially by the FWS when describing those species for which sufficient information on the biological vulnerability and threats is available to support issuance of a proposed rule to list, but rule issuance is precluded for some reason. Federal “species of concern” are those for which listing may be warranted, but further biological research and field study is needed to clarify their conservation status.

NPS policies dictate that federal candidate species, species of concern, and State-listed threatened, endangered, candidate, or sensitive species be managed to the greatest extent possible as federally listed threatened or endangered species (NPS 2001). Therefore, all of these special status species are included in this discussion.

The Endangered Species Act terminology used to assess impacts to listed species is as follows:

No effect: When a proposed action would not impact a listed species or designated critical habitat.

May affect/not likely to adversely affect: Effects on special status species or designated critical habitat are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or completely beneficial.

May affect/likely to adversely affect: When an adverse effect to a listed species or designated critical habitat may occur as a direct or indirect result of proposed actions and the effect is either not discountable or completely beneficial.

Is likely to jeopardize proposed species/adversely modify proposed critical habitat: The appropriate conclusion when the National Park Service or the U.S. Fish and Wildlife Service identify situations in which oil and gas operations could jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside park boundaries.

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The NPS has developed the following threshold definitions under the NEPA guidelines. Each definition corresponds to the FWS definitions used to assess impacts to federally listed species under the Endangered Species Act.

Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are defined as follows:

Negligible: No state and/or federally-listed species would be impacted or the alternative would impact an individual of a listed species or its critical habitat, but the change would be so slight that it would not be of any measurable or

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perceptible consequence to the protected individual or its population. A negligible effect would equate to a "no effect" determination by the FWS.

Minor: An individual or population of a listed species or its critical habitat would be impacted, but the change would be small and of little consequence and would be expected to be short-term and localized. A minor effect would equate to a "may affect" determination by the FWS and would be accompanied by a statement of either "not likely to adversely affect" the species. Mitigation measures, if needed to offset adverse effects, would be simple and successful.

Moderate: An individual or population of a listed species or its critical habitat would be noticeably impacted. The effect could have long-term consequences to the individual, population, or critical habitat. A moderate effect would equate to a "may affect" determination by the FWS and would be accompanied by either a statement of "likely to adversely affect" or "not likely to adversely affect" the species. Mitigation measures, if needed to offset adverse effects, could be extensive, but would likely be successful.

Major: An individual or population of a listed species, or its critical habitat, would be noticeably impacted with a long-term, substantial consequence to the individual, population, or habitat. A major effect would equate to a "may affect" determination by the FWS and would be accompanied by a statement of "likely to adversely affect" the species or critical habitat. Extensive mitigation measures would be needed to offset any adverse effects, and their success would not be guaranteed.

Impacts on Species of Special Concern under Alternative A (No Action/Current Management)

All of Big Thicket's species of special concern are protected under Current Legal and Policy Requirements. The application of Current Legal and Policy Requirements, and project-specific operating stipulations, could result in variations in how, where, and to what extent resource protection is applied. The occurrence of species of special concern and suitable habitat would need to be identified during the planning/development and review of Plans of Operations, so that adverse impacts would be avoided. Potential impacts on species of special concern from geophysical exploration, drilling, or production operations could range from no impacts to major impacts, depending on location, timing, and scope of operations proposed.

The NPS manages federally-listed species and their habitat within the Preserve as mandated under the Endangered Species Act of 1973 (ESA). The ESA, as amended, prohibits the NPS and other federal agencies from implementing any action that is likely to jeopardize the continued existence of a federally-listed species. Furthermore, the act requires that the NPS consult with the FWS on any action it authorizes, funds, or executes that could potentially impact a federally-listed species or its designated habitat.

Species of special concern, as discussed in this section, include federal threatened and endangered candidate species, in addition to State and locally protected threatened, endangered, rare, declining, sensitive, or candidate species that are native to the Preserve and their habitats. These species are afforded the same status as federally-listed species under the ESA. (Management Policies, USDI, NPS 2001)

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Oil and gas operations or activities would not be allowed to occur where there may be a potential for adversely impacting a species of special concern. The development, if it were allowed, would only occur after consultation with FWS under the Endangered Species Act was completed.

Under Current Legal and Policy Requirements, Plans of Operations must include a biological survey performed by a qualified biologist when this information is determined to be needed by the NPS, in consultation with FWS and TPWD to evaluate the potential impacts of the proposed operation on species of special concern. The biologist conducting the field survey(s) must have sufficient technical knowledge and/or experience to appropriately time when and how biological surveys shall be performed and be qualified to identify species and habitat of the species of special concern that may occur or be potentially impacted in and adjacent to the proposed operations area. If proposed operations have the potential to impact a species of special concern and/or their habitat, the NPS consults with FWS and TPWD on a project-by-project basis, as per Endangered Species Act requirements, and develops measures to avoid impacting species of special concern.

There is a remote possibility for the incidental take of an individual from a species of special concern as a result of any oil and gas operation or activity. During the course of oil and gas operations, it is possible that mortality to an individual of a population could result from vehicle use, construction activities, seismic operations, or in the rare event of a spill of contaminating or hazardous substances that escapes containment systems, enters the environment, and comes into contact with a species of special concern. Any incidental take of a federally-listed species will be reported to the NPS and the FWS and all other species of special concern would be reported immediately to the NPS. The potential for an incidental take of an individual of a species of special concern would be identified by the NPS during project planning and would require Section 7 consultation with FWS and issuance of an incidental take permit.

Geophysical Exploration: Where exploration operations could be permitted, exploration operations and their effects would be expected to avoid impacting species of special concern and their habitat which would be identified through biological surveys, when determined to be needed by the NPS through consultation with the FWS and TPWD. When species of special concern and their habitat are found to be within the project area, mitigation measures including avoidance of species of special concern (including sufficient distance offsets and/or timing restrictions to nesting and other sensitive periods in a given species' life cycle) would result in avoiding impacts.

Potential effects from exploration operations on protected fish and wildlife species could be increased displacement, increased risk of mortality, decreased production, and increased stress levels from seismic survey activities and associated noise. Potential effects on protected plants could be loss or damage from cutting or trimming vegetation along source and receiver lines; and being crushed, damaged or uprooted by off-road vehicles. Compacted and rutted soils could reduce germination and root penetration. Leaks and spills could harm or kill plants, fish and wildlife. These effects could be caused by seismic crews occupying a large area to trim vegetation along 3.5-foot wide receiver and shot lines, drilling shotholes, detonating explosives in shotholes, and using vehicles and helicopters.

Under any alternative, protection of water quality is provided by 36 CFR § 9.41(a), which requires operations to be offset 500 feet from rivers, streams, and other waterbodies, unless specifically authorized by an approved plan of operations, which would minimize erosion and sedimentation and other impacts on water quality and quantity that could adversely impact aquatic life. The standard 500-foot offset from water bodies would protect fish and wildlife utilizing water and the vegetation within this protective zone. Through project-specific consultation with the FWS and TPWD under the Endangered Species Act, the offset could be increased. The 500-foot standard offset would provide primary protection to blue sucker, creek chubsucker and paddlefish, the caddisfly and dragonfly, alligator snapping turtle, timber rattler, Navasota Ladies'-Tresses, and a variety of migratory birds that utilize stream and riparian areas. Additional protection to these habitats would be provided by the

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wetlands and floodplains Executive Orders, NPS Director's Orders and project specific permitting requirements.

Species of special concern that occupy mature pine forests, uplands longleaf pine and oak forests found in upland environments include Bachman's sparrow, red-cockaded woodpecker, Southeastern Myotis and Rafinesque's big-eared bats, smooth green snake and Louisiana pine snake; and plants including Slender gay feather, Texas trailing phlox, and white firewheel. These species would be protected under the required mandated in Endangered Species Act and other CLPR.

Surface disturbances caused by off-road vehicle use, drilling of shotholes, detonation of explosives in shotholes; and trimming of vegetation could reduce the amount of habitat available for use by species of special concern. However, at the completion of operations, reclamation of disturbed areas would be required, and recovery of vegetation is expected to occur over the short-term.

Through the Endangered Species Act, required biological surveys, and/or assessments and consultations with the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department would result in identification of potential impacts on species of special concern and their habitat, and the application of mitigation measures that should result in no adverse impacts on species of special concern.

Drilling and Production: Where drilling and production operations could be permitted, potential adverse impacts on species of special concern could occur from the construction and maintenance of roads, wellpads, flowlines and pipelines. The RFD scenario projects the drilling of 40 wells with production of up to 27 wells. Along with associated roads and facilities, new drilling and production operations could occupy up to 241 acres of the Preserve. Drilling and production operations could range in duration from short-term (weeks or months for construction of roads, wellpads, flowlines and pipelines; and well drilling) to long-term lasting 20 years or longer (roads, flowlines, pipelines, wells and production operations).

Construction and maintenance of roads, pads, flowlines and pipelines could require the clearing of vegetation and habitat loss. Potential effects on species of special concern would depend on where drilling and production operations are located. Careful siting of developments that is based on biological survey and/or assessment results could avoid or minimize these impacts substantially.

Through the Endangered Species Act, required biological surveys and/or assessments and consultations with FWS and TPWD would result in identification of potential impacts on federally-listed species and their habitat, and the application of mitigation measures that should result in no adverse impacts.

Water-dependent species (including paddlefish, blue sucker, creek chubsucker, Texas heelsplitter, caddisfly and dragonfly) could be impacted by the construction and long-term maintenance of roads, pads, flowlines and pipelines if stream crossings result in alteration of streamflow, water quality, or temperature; or if there is increased sedimentation. In some cases, increased access to remote streams could result in greater fishing mortality or poaching, which would constitute an indirect adverse effect. Under all alternatives, waterways are protected by a 500-foot offset under 36 CFR § 9.41(a), unless specifically authorized by an approved plan of operations; and because waterways are inherently a part of floodplains (riparian corridors) and wetland areas, and receive added protection under various regulatory and policy requirements, streamflows, water quality or temperature would be protected from disturbance and water levels would be maintained. Careful siting of facilities when there are no practicable alternatives to locating an operation or activity in floodplains and wetlands is expected to result in stringent mitigation measures to avoid potential adverse impacts. Required compensation for direct and indirect impacts on wetlands could be used to restore wetland habitats and increase species of special concern habitat values.

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Construction and maintenance of roads, wellpads, flowlines and pipelines could contribute to habitat fragmentation. Fragmentation occurs when a timbered landscape is converted to early successional stages of grass/forb and also occurs due to the presence of roads across the landscape. Habitat fragmentation may inhibit some species of wildlife (generally small prey species, i.e., rodents, insects, etc.) to utilize their habitats effectively. The direct effect of vegetation removal would need to be analyzed on a project-specific basis, particularly if it occurs in a location of critical importance to a species of special concern. In general, areas of the Preserve that have potential to be converted from forested vegetation to a grass/forb stage or bare soil condition are minimal, and this would not be considered a major adverse impact when analyzed in context of the larger landscape.

Displacement of wildlife would continue from initial wellpad construction into exploratory drilling, and if the well is placed in production, during the life of the producing well. Road and wellpad development and drilling operations would reduce the usable habitat for large carnivores as well as their prey species. Secure areas for large carnivores and prey species are reduced and the risk of mortality is increased. The increase of and ease of access routes for public travel would serve to increase public motorized travel or if the roads are closed to public motorized travel they still serve as an access route by foot, horse and mountain bike. New access roads may even serve as travel corridors for large carnivores which may increase the potential of mortality either legal or illegally.

Increased access would also result in the same effects on small carnivores, with an increase in direct loss of small carnivores resulting from mortality through trapping and hunting. Low-speed roads are not expected to appreciably increase mortality from road kill or to be barriers to movements of the small wildlife. The Preserve Superintendent can close or restrict motorized public access on roads that are to be used for oil and gas development if necessary. With this authority, the NPS can mitigate the effects of increased public access caused by road construction and long-term operation of production facilities.

Noise from drilling operations would also impact protected wildlife species. Drilling operations introduce noise with the highest measurements in the 90 dBA range for a period of 30 to 90 days, with noise coming mostly from multiple diesel engines. Therefore, noise impacts could be major concern, but limited to a localized area and relatively short-term duration.

Some facilities associated with production operations (i.e., heater treater units/separator units) could cause the mortality of bats, migratory birds and raptors through asphyxiation or incineration. To mitigate the residual impacts from these facilities, a cone device placed on top of all vent stacks, would be required under Current Legal and Policy Requirements. The cones would be constructed in a manner that prevents perching on the vent stacks and subsequent asphyxiation, and eliminates all access into the vent stack pipes. Inaccessibility to the vent stacks would curtail any potential mortality to species of special concern of bats and birds.

Another operating stipulation requires that all open containers that collect stormwater be netted or covered. This requirement prevents birds and other wildlife species from accessing stormwater that may have contacted and mixed with oil and gas, and other contaminating and hazardous substances.

Selection and use of herbicides and pesticides must be approved by the NPS Integrated Pest Management Coordinator, and is kept to a minimum. Therefore, effects on species of special concern would be avoided.

It is possible that some wells may be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of impacts on species of special concern is dependent upon where the operation is located with respect to species and their habitats, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. For wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve, the connected actions occurring outside the Preserve boundaries could

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Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly adversely impact federally-listed species or their critical habitats in the Preserve if project-specific action areas extend into the Preserve. The NPS would assume the "lead" role in carrying out Section 7 responsibilities under the Endangered Species Act if there are no other federal entities involved in permitting the directional drilling proposal, and it is proposing to issue an exemption with mitigation, or approve a plan of operations for the directional drilling proposal. In other cases, where there is no federal entity involved in issuing a permit (NPS proposes to issue an exemption with no mitigation for which it would not trigger any Section 7 responsibilities), the applicant would be responsible for satisfying responsibilities under the Endangered Species Act. The application of mitigation measures for private applicants may not be of the same standard that the FWS would require of the NPS on parklands. Further, private applicants are not required to survey for or protect State-listed species on private lands; therefore, there is the potential for State-listed species in the Preserve to be indirectly impacted by directional drilling proposals, depending on proximity to the Preserve, site-specific environmental conditions, and mitigation measures being employed, with indirect impacts on species of species of special concern ranging from no impact to indirect, localized to widespread, moderate, adverse impacts. ¶

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include constructing and maintaining access roads, well/production pads, and flowlines/pipelines; drilling the well; producing the well; plugging and abandoning the well; and site reclamation. The in-park operations associated with directional wells would consist of the wellbore crossing into the Preserve, usually several thousand feet or more below the surface. Therefore, for most directional wells drilled that are exempted under 36 CFR § 9.32(e), the NPS regulatory authority would be limited to applying mitigation to the in-park operations to ensure protection of groundwater resources beneath the park. Because the in-park operations would typically have no affect on species of special concern or their habitats on the surface, the NPS would have no Section 7 responsibilities under the Endangered Species Act. However, the NPS would assume the "lead" role in carrying out Section 7 responsibilities under the Endangered Species Act if there are no other federal entities with broader regulatory involvement for the connected actions proposed outside the park. The FWS may not require oil and gas operators outside the Preserve to apply the same degree of mitigation as the NPS applies on parklands. Further, oil and gas operators outside the Preserve are not required to survey for or protect Federally-listed plant species or State-listed species. Indirect impacts on species of special concern and their habitats in the Preserve from drilling and production of wells drilled from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in adverse impacts ranging from no impact to localized to widespread, short- to long-term, moderate adverse impacts.

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Plugging/Abandonment/Reclamation: Well plugging, shutting down, abandoning and removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for release of oil, and other contaminating and hazardous substances, which could harm or kill protected plants, fish and wildlife, but by applying the consultation requirements under the ESA; performing biological surveys of the area that could be potentially impacted by proposed plugging, abandonment, and reclamation operations; identifying species of special concern and applying appropriate mitigation, there should be no adverse impacts on species of special concern.

Plugging and abandonment operations and site preparation during reclamation would introduce heavy equipment and people, along with increased noise levels for a short time; however, the long-term effect of these activities is to return natural conditions to the operations area. Access roads that have been developed or allowed to remain open for the primary purpose of allowing access for oil and gas operations would be reclaimed at the completion of operations. This would return the area to its natural conditions. Wherever possible, habitats would be improved to perpetuate the viability of habitats and increase the survivability of species of special concern.

Similar to the discussion under the Drilling and Production section, indirect impacts on species of special concern and their habitats in the Preserve from plugging/abandonment/reclamation of directional wells drilled from outside the Preserve to reach bottomholes beneath the Preserve could result in adverse impacts. Impacts could range from no impact to indirect, short- to long-term, localized, minor, adverse impacts on species of special concern and their habitats in the Preserve.

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As discussed above under the Drilling and Production section, in the absence of a federal entity's involvement, reclamation of wells directionally drilled and produced from outside the Preserve could result in indirect impacts on species of special concern or their habitats in the Preserve, resulting in impacts ranging from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts. ¶
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Cumulative Impacts: The cumulative impact analysis area for species of special concern covers the Lower Neches River Watershed which extends from the B. A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area is the same as what has been defined for all natural resources. The analysis area has been selected because it includes the major rivers and tributaries that flow through the Preserve, and activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact natural resources, including species of special concern in the region.

Existing surface disturbances, including existing (24.2 acres) and abandoned (unreclaimed sites on 376 acres) operations, and 71 transpark oil and gas pipelines (589 acres); in combination with other Preserve developments and activities, including park roads, visitor use areas, recreational activities, hunting and trapping, and prescribed fire management practices, have reduced the amount of

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habitat available for use by species of special concern. It is difficult to accurately determine the types of habitat that were developed prior to the establishment of the Preserve. Since the establishment of the Preserve, however, development decisions have been applied under a well defined regulatory process that limited any additional impacts on species of special concern.

It is possible that some past developments have altered habitat utilized by species of special concern. Past impacts have included direct loss of terrestrial habitat at oil and gas sites. Also, the construction of roads, flowlines and pipelines that cross rivers and streams; or wellpads developed near rivers and streams, increased erosion and sedimentation that adversely impact water quality and aquatic habitats. These combined effects on 989 acres have caused long-term impacts on vegetation, fish and wildlife in the Preserve, resulting in removal of vegetation or a change (decrease) in site productivity and habitat value. These adverse impacts will remain until disturbed areas are reclaimed.

Under the RFD scenario, future oil and gas operations could involve 3-D seismic surveys that could utilize up to 465 acres of the Preserve; while drilling up to 40 wells and production of up to 27 wells could occupy up to 241 acres of the Preserve. Over the long-term, up to 1,695 acres could be directly impacted by oil and gas operations in the Preserve; however, while new operations are occurring, others would be plugged, abandoned, and reclaimed.

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Existing and future oil and gas operations would be required to comply with Current Legal and Policy Requirements to protect species of special concern, particularly the Endangered Species Act. Plans of Operations must include a biological survey performed by a qualified biologist when this information is determined to be needed by the NPS, in consultation with the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Service to evaluate the potential impacts of the proposed operation on species of special concern. The biologist conducting the field survey(s) must have sufficient technical knowledge and/or experience to appropriately time when and how biological surveys shall be performed and to identify species and habitat of species of special concern that may occur or be potentially impacted in and adjacent to the proposed operations area. If proposed operations have the potential to impact a species of special concern and/or its habitat, the NPS consults with the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department on a project-by-project basis, as per Endangered Species Act requirements, and develops measures to avoid impacting species of special concern. The information provided by biological resource surveys of proposed operations in the Preserve would increase the NPS's knowledge of the resource in the Preserve, a cumulative, negligible, beneficial impact.

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For species of special concern whose viability is not reliant on large, unfragmented areas, the long-term protection of species of special concern and their habitat in the Preserve would continue to receive added protection, so these species and their habitat would likely increase.

Over the long-term two federally-listed species of special concern known to occur in the Preserve and the analysis area are expected to improve. Implementation of the 1985 U.S. Fish and Wildlife Service Red-Cockaded Woodpecker Recovery Plan in the Pineywoods Region of East Texas (which includes the Preserve) would continue from federal and state agencies, The Woodlands Corporation, Louisiana-Pacific, Temple-Inland, and Champion International (pers. comm., Jeffrey Reid, 1999). Although improvement in red-cockaded woodpecker groups in the Pineywoods Region is anticipated, urbanization, agriculture, and short rotation forestry practices have severely fragmented red-cockaded woodpecker habitat (Lay and Swepston, 1973). Continued implementation of the Preserve's Draft Texas Trailing Phlox Recovery Plan (1994) and ongoing conservation efforts by the Nature Conservancy of Texas and others are expected to benefit phlox in Hardin, Polk and Tyler Counties.

Reclamation of disturbed areas in the Preserve must reestablish natural topographic contours, native vegetative communities and provide for the safe movement of native wildlife and the normal

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flow of surface waters. Wherever possible, habitats would be improved to perpetuate the viability of habitats and increase the survivability of species of special concern. The NPS would ensure that wells directionally drilled from locations outside the Preserve to bottomhole targets underlying the Preserve "pose no significant threat of damage to park resources, both surface and subsurface" (36 CFR § 9.32(e)); however, wellpads outside the Preserve may not be reclaimed to pre-disturbance conditions which could result in long-term decrease in site productivity and habitat value. Any adverse impacts on protected plants, fish and wildlife habitat resulting from reclamation operations would add to the existing adverse impacts on species of special concern and their habitat within and adjacent to the Preserve.

Other activities in the Preserve that could impact protected plants, fish and wildlife included wildlife harvest (hunting and trapping), non-consumptive recreation, and the Preserve's prescribed fire management program. Over the long-term, hunting and trapping could have beneficial impacts on wildlife populations. Recreational activities in the Preserve are focused near developed visitor use areas, trails, canoe routes, and roads. These developments and activities have a negligible, adverse impact on protected plants, fish and wildlife. The Preserve's prescribed fire management program could contribute to short-term habitat loss, wildlife displacement, and increase erosion and sedimentation, but would provide long-term cumulative beneficial impacts on Preserve vegetation, particularly to the Texas trailing phlox, and improved habitat for protected wildlife species.

In combination with human activities, including the Preserve's prescribed fire management program, recreational uses, and nonfederal oil and gas operations, natural events such as fire, flood, and drought, could all contribute to cumulative adverse effects on fish and wildlife. These cumulative effects cause stress that reduces the resiliency of the local wildlife populations. While some of these influences, particularly, the Preserve's prescribed fire management program, natural fire and flood events, would have short-term, adverse effects; over the long-term, their cumulative impacts could be beneficial for species of special concern and their habitat. Over the long-term, the application of Current Legal and Policy Requirements, particularly a well defined regulatory process under the Endangered Species Act, would result in no adverse impacts on species of special concern in the Preserve, with improvement of habitat for some species of special concern, a cumulative beneficial impact for species of special concern of the Preserve.

There is a remote possibility for the incidental take of an individual from a species of special concern as a result of any oil and gas operation or activity. During the course of oil and gas operations, it is possible that mortality to an individual of a population could result from vehicles, construction activities, seismic operations, or in the rare event of a spill of contaminating or hazardous substances that escapes containment systems, enters the environment, and comes into contact with a species of special concern. The incidental take of an individual of a species of special concern would be a major adverse impact.

On lands surrounding the Preserve, population growth and continued development including the construction and operation of the Sam Rayburn and B. A. Steinhagen Reservoirs, pipelines, roads, commercial and private forestry, and residential developments, in combination with natural events such as fire, flood and drought, could increase displacement of species of special concern, and increase stress that reduce the resiliency of local populations, resulting in the long-term incremental loss of species of special concern, and habitat decline primarily influenced through changes in water quality and quantity, particularly to bottomland hardwood forests. Because of the fragmented nature of the individual units of the Preserve, particularly the narrow riparian corridors, the influence of adjacent land-uses (particularly development activities) and introduction of non-native species that alter fish and wildlife habitat (Chinese tallow-tree) or compete with available habitat (feral hog), could reduce the viability of species of special concern and habitat in the Preserve.

Water withdrawals outside the Preserve could result in cumulative adverse impacts on aquatic habitats both within and outside the Preserve. Of the species of special concern that could occur in

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the 7 counties containing units of the Preserve most occupy bottomland hardwood forests and elsewhere, while 8 rely on such habitats. Three species that were in partly dependant on bottomland hardwood forests are presumed extirpated from the Preserve and State. The 3 species are the ivory-billed woodpecker, Bachmann's warbler, and the red wolf. Assessment of diversity of major fish and wildlife species by Harcombe et al. (1996) suggest regional declines in fish and some stream invertebrate groups, partially attributed to regional modification of waterways. Modification of waterways may change the overall amount and timing of stream flows, directly impacting stream channel morphology (structure or form), rate of meandering or migration, sedimentation, water quality, and the amount and type of aquatic habitat. These changes may indirectly impact the growth, availability, and regeneration of bottomland hardwood forests. Water withdrawals that alter water quantity, quality and temperature, particularly in the upper portions of Big Sandy Creek, Beech Creek, or Lower Neches River could cumulatively affect the viability of populations of 3 state-protected fish species that occur in these water segments within the Preserve.

Over the long-term, these effects would have cumulative, minor to moderate, adverse impacts on species of special concern in the region.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration, Drilling and Production, and Plugging/Abandonment/ Reclamation: The potential impacts on species of special concern would the same as those described under the impacts on vegetation, and fish and wildlife, discussed in the sections above. As per CLPR, particularly the Endangered Species Act, the NPS would not permit any action that is likely to jeopardize the continued existence of a species of special concern. Therefore, oil and gas operations would not be permitted to occur in areas or during specified times if there is a potential to adversely affect species of special concern. When species of special concern and their habitat are identified to be within the project area, sufficient distance offsets and/or seasonal/timing restrictions would result in avoiding impacts. Therefore, there should be no adverse impacts on species of special concern. Protection of species of special concern and improvement of habitat would be more readily attainable in Protected Areas where geophysical exploration, and drilling or production operations would not be permitted year-round under Current Legal and Policy Requirements on approximately 7,500 acres, or within 500 feet of waterways.

There is a remote possibility of the incidental take of an individual from a species of special concern as a result of any oil and gas operations or activity. During the course of oil and gas operations, it is possible that mortality to an individual of a species of special concern could result from vehicles, construction activities, seismic operations, or releases of oil or other contaminating and hazardous substances. Identification of the potential for a take would be performed during consultation with FWS and issuance of an incidental take permit would be required.

Indirect impacts on species of special concern and their habitats in the Preserve from directionally drilling wells from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in impacts ranging from no impact to localized to widespread, short- to long-term, moderate adverse impacts from drilling and production; and localized, short- to long-term, minor adverse impacts from plugging/abandonment/reclamation activities.

Cumulative Impacts: Over time, protection provided to species of special concern under Current Legal and Policy Requirements would result in maintaining and improving habitat for species of special concern in the Preserve, with cumulative beneficial impacts on species of special concern in the Preserve. The expectation that adjacent lands would continue to be developed with incremental loss

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of wildlife habitat over the long-term, could result in cumulative, minor to moderate, adverse impacts on species of special concern in the region.

Impairment Analysis: Because there would be no major adverse impacts to species of special concern or their habitat whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve species of special concern or their habitat.

Impacts on Species of Special Concern under Alternative B (Preferred Alternative)

Special Management Areas would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. By applying applicable Current Legal and Policy Requirements, including NPS Management Policies, 36 CFR 9B regulations, and particularly the Endangered Species Act, which have been discussed in Chapter 2, Parts II and III, and under Alternative A, impacts on species of special concern should be substantially reduced throughout the Preserve.

Geophysical Exploration: Similar to Alternative A, where geophysical exploration could be permitted in other areas of the Preserve, these activities and their effects are expected to avoid impacting species of special concern and their habitat. Through the well defined regulatory process under the Endangered Species Act, required biological surveys and consultations with FWS and TPWD would result in identification of potential impacts on species of special concern and their habitat, and the application of mitigation measures that should result in no adverse impacts on species of special concern.

Drilling and Production: Similar to Alternative A, where drilling and production operations could be permitted in other areas of the Preserve, potential adverse impacts on species of special concern could occur from the construction and maintenance of roads, wellpads, flowlines and pipelines. Drilling and production operations could range in duration from short-term (weeks or months for construction of roads, wellpads, flowlines and pipelines; and well drilling) to long-term lasting 20 years or longer (roads, flowlines, pipelines, wells and production operations). Through the regulatory process under the Endangered Species Act, required biological surveys and consultations with FWS and TPWD would result in identification of potential impacts on species of special concern and their habitat, and the application of mitigation measures that should result in no adverse impacts on species of special concern.

In SMAs that are geographically small, the added protection would primarily be provided for small mammals and invertebrates that occupy these areas. In larger SMAs, such as rare vegetation communities and rare forested wetland communities, protection from additional habitat fragmentation would benefit all fish and wildlife species. The increased offset from visitor use and administrative areas, from a 500-foot offset to a 1,500-foot offset, would further reduce the potential impacts of oil and gas operations and activities in these areas. The 1,500-foot offset from birding hot spots would reduce the possibility of impacts on birds and other wildlife using these areas during nesting, breeding, and migration.

While SMAs receive specific protection from new drilling and production operations, existing (24.2 acres) and abandoned (unreclaimed operations on 376 acres), and transpark pipelines (589 acres) could continue to adversely impact habitat for species of special concern in the Preserve. Some of these sites are located within SMAs.

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It is possible under Alternative B that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. The intensity of impacts on species of special concern is dependant upon where the operation is located with respect to species of special concern, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Similar to Alternative A, indirect impacts on species of special concern and their habitats in the Preserve from the drilling and production of wells drilled from outside the Preserve to bottomholes beneath the Preserve could result in adverse impacts if there is no federal involvement. Impacts could range from no impact to indirect, localized to widespread, moderate adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including Riparian Corridors SMA) unless there is no practicable alternative. ¶
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Specific protection provided to species of special concern habitat under Alternative B is described below:

Designation of SMAs that Would Improve Habitat for Red-cockaded Woodpeckers. Because of their importance as red-cockaded woodpecker habitat, old-growth pinelands are well protected on lands in southeast Texas. Continued implementation of the 1985 U.S. Fish and Wildlife Service Red-Cockaded Woodpecker Recovery Plan in the Pineywoods Region of East Texas (which includes the Preserve) from federal and State agencies, The Woodlands Corporation, Louisiana-Pacific, Temple-Inland, and Champion International, is expected to improve the potential habitat and viability of this species (pers. comm., Jeffrey Reid, 1999). Under Alternative B, the Preferred Alternative, the NPS would formally designate old growth trees (located both in wetlands and uplands), upland pine forests, and wetland pine savannas as SMAs in which the No Surface Use stipulation would apply to drilling and production operations; however, geophysical exploration (3-D seismic surveys) and nonmanipulative data-collection activities could be permitted. As a result, the NPS would protect old-growth pines that are potential nesting habitat for the red-cockaded woodpecker. Also, the NPS anticipates that in the long-term, 20 – 30 years or more from now, the younger pinelands would reach maturity, thereby increasing potential habitat for red-cockaded woodpeckers. It is possible that some immature pinelands located outside these SMAs could be lost to oil and gas development, but the small reduction in potential habitat in comparison to the SMA-designated pinelands would be unlikely to influence future woodpecker populations.

Designation of SMAs that Would Improve Habitat for Fish, Reptiles, Aquatic Invertebrates, Migratory and Marine Birds. The increase of the standard 500-foot offset under § 9.41(a), unless specifically authorized in an approved plan of operations, to a 1,500-foot offset where no oil and gas operations may occur for visitor use, administrative and other use areas, including canoe routes and water-oriented visitor use areas, in addition to the designation of Rare Forested Wetlands Communities SMA (includes wetland baygall shrub thickets, wetland pine savannas, cypress-tupelo swamp forests, and old growth trees), and the Riparian Corridors SMA, would increase protection and improve habitat for the Bachman's Sparrow and other migratory/marine birds, fish and water-dependant species of special concern that utilize these riparian areas. While influences from oil and gas activities would be substantially reduced by the increased offsets and SMA designations, productivity of wetlands and floodplain values in the riparian corridors would still be strongly affected by influences external to the Preserve which could contribute to degradation of water quality and quantity.

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Designation of SMAs that Would Improve Habitat for Uplands-Reliant Species. The NPS would formally designate the Rare Vegetation Communities SMA, including upland pine forests, sandhill pine forests, American Beech-Southern Magnolia-Loblolly Pine Forests, and old growth trees that are generally mid-slope to uplands vegetation communities. These vegetation communities would receive specific protection under a No Surface Use stipulation in which no oil and gas operations may occur, with the exception of geophysical exploration (3-D seismic surveys) and non-manipulative data collection activities. This added protection would increase protection and improve habitat for species of special concern that prefer these communities as habitat, including Bachman's sparrow, Rafinesque's Big-eared and Southeastern Myotis bats, Slender gay feather, Navasota Ladies'-Tresses, Texas trailing phlox, and White Firewheel, Louisiana pine and Smooth green snakes.

It is possible that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. Similar to Alternative A, indirect impacts on species of special concern and their habitats in the Preserve from directionally drilling and producing wells from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in impacts ranging from no impact to localized to widespread, short- to long-term, moderate adverse impacts. It the operations are conducted inside the Preserve, they are likely to occur in

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upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including Riparian Corridors SMA) unless there is no practicable alternative.

Plugging/Abandonment/Reclamation: Similar to Alternative A, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for release of oil, and other contaminating and hazardous substances, which could harm or kill species of special concern of plants, fish and wildlife. Through the well defined regulatory process under the Endangered Species Act, required biological surveys and consultations with FWS and TPWD would result in identification of potential impacts on species of special concern and their habitat, and the application of mitigation measures that should result in no adverse impacts on species of special concern.

Similar to Alternative A, indirect impacts on species of special concern and their habitats in the Preserve from plugging/abandonment/reclamation of wells directionally drilled from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in impacts ranging from no impact to indirect, localized, short- to long-term, minor adverse impacts.

Cumulative Impacts: Cumulative impacts are similar to Alternative A; however, designation of SMAs under Alternative B would minimize cumulative impacts on species of special concern and would result in beneficial impacts for several species dependent on wetlands and old growth areas.

Despite the protection afforded the red-cockaded woodpecker under the proposed action, the long-term viability of the species in the region is uncertain. The threat stems from the bird's total dependence on mature pine stands for its habitat. Pinelands have been heavily exploited throughout southeast Texas for the production of pulp and wood products, which require relatively short rotations between harvests. Most mature stands (that is, those over 60 years old) were previously cut, and those that remain are isolated, relict stands. Such isolation can lead to a loss of genetic viability and to reproduction failure.

The U.S. Fish and Wildlife Service currently is researching methods to improve genetic diversity in the species (for example, translocating breeding birds). It is hoped that practical solutions to the genetic isolation problem will be found in the near future. In the meantime, remaining habitat and colonies become increasingly important as a source of genetic stock and as locations for future colony expansion. Therefore, the Alternative B would assist in the overall recovery by maintaining existing red-cockaded woodpecker habitat and colonies. Moreover, the proposed action promotes protection of young pineland communities in the effort to improve the rangewide survival of the species.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration, Drilling and Production, and Plugging/Abandonment/ Reclamation: Impacts would be similar to Alternative A, resulting in no adverse impacts on species of special concern.

Protection of species of special concern and improvement of habitat would be more readily attainable in SMAs with the No Surface Use stipulation, or within 500 feet of waterways. Due to the designation of SMAs, well defined regulatory process under the ESA to protect species of special concern, and the application of mitigation measures, no adverse impacts on species of special concern are anticipated.

Similar to Alternative A, indirect impacts on species of special concern and their habitats in the Preserve from directionally drilling wells from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in impacts ranging from no impact to localized to

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widespread, short- to long-term, moderate adverse impacts from drilling and production; and localized, short- to long-term, minor adverse impacts from plugging/abandonment/reclamation activities.

Cumulative Impacts: Similar to Alternative A, with cumulative, minor to moderate, adverse impacts on species of special concern in the region, however, protection of species of special concern and improvement of habitat in the Preserve would be more readily attainable in SMAs where the No Surface Use stipulation would be applied.

Impairment Analysis: Because there would be no major adverse impacts to species of special concern or their habitat whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve species of special concern.

Impacts on Species of Special Concern under Alternative C (Maximum Resource Protection)

SMAs would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to geophysical exploration in all SMAs, except for the Hunting Areas and Birding Hot Spots SMAs that would have timing restrictions. The No Surface Use stipulation would be applied to drilling and production operations in all SMAs, except for the Hunting Areas SMA. In the remaining areas of the Preserve where operations could be permitted, the application of Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations and the NPS's wetlands protection guidelines (Director's Order 77-1), which have been described in Chapter 2, Parts II and III, and under Alternative A, should substantially reduce impacts on species of special concern throughout the Preserve.

Geophysical Exploration: Similar to Alternatives A and B, geophysical exploration could be permitted in other areas of the Preserve. The No Surface Use stipulation year-round in SMAs covering 39,657 acres may result in the modification of project designs for 3-D seismic surveys. As a result, it may be necessary to increase the density of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines. These adverse impacts could occur inside or outside the Preserve, and are dependant upon the layout of the seismic grid.

Despite the greater number of vehicles and equipment for concentrated operations, impacts would be similar to Alternatives A and B; where geophysical exploration could be permitted in other areas of the Preserve, these operations and their effects are expected to avoid impacting species of special concern and their habitat. Through the regulatory process under the Endangered Species Act, required biological surveys and consultations with FWS and TPWD would result in identification of potential impacts on species of special concern and their habitat, and the application of mitigation measures that should result in no adverse impacts on species of special concern.

Drilling and Production: Similar to Alternatives A and B, where drilling and production operations could be permitted in other areas of the Preserve, potential adverse impacts on species of special concern could occur from the construction and maintenance of roads, wellpads, flowlines and pipelines. Through the regulatory process under the Endangered Species Act, required biological surveys and consultations with the FWS and TPWD would result in identification of potential impacts

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Similar to Alternative A, indirect impacts on federally-listed species and their habitats in the Preserve from the drilling and production, and reclamation of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve should result in no adverse impacts due to the responsibility of private applicants or federal entities to comply with the Endangered Species Act. However, directional drilling operations could result in indirect impacts on State-listed species and their habitats in the Preserve; ranging from no impact to short- to long-term, moderate, adverse impacts. ¶
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Similar to Alternative A, indirect impacts on species of special concern and their habitats in the Preserve from the drilling, production, and eventual reclamation of wells drilled from outside the Preserve to bottomholes beneath the Preserve could result in adverse impacts if there is no federal involvement. Impacts could range from no impact to indirect, localized to widespread, moderate adverse impacts.¶
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on species of special concern and their habitat, and the application of mitigation measures that should result in no adverse impacts on species of special concern.

In SMAs that are geographically small, the added protection would primarily be provided for small mammals and invertebrates that occupy these areas. In larger SMAs, such as rare vegetation communities, rare forested wetland communities, and the riparian corridors, protection from additional fragmentation would benefit all fish and wildlife. The increased offset from visitor use and administrative areas, from a 500-foot offset to a 1,500-foot offset, would reduce the potential impacts of oil and gas operations and activities on riparian areas, providing added protection to species of special concern that rely on water and riparian areas for part or all of their life cycles. The 1,500-foot offset from birding hot spots would reduce the possibility of impacts on birds and other wildlife using these areas during sensitive seasons.

While SMAs receive specific protection from new drilling and production operations, existing (24.2 acres) and abandoned (unreclaimed operations on 376 acres), and transpark pipelines (589 acres) could continue to adversely impact habitat for species of special concern in the Preserve. Some of these sites are located within SMAs.

Specific protection provided to species of special concern habitat under Alternative B is described below:

Designation of SMAs that Would Improve Habitat for Red-Cockaded Woodpeckers. Because of their importance as red-cockaded woodpecker habitat, old-growth pinelands are well protected on lands in Southeast Texas. Continued implementation of the 1985 U.S. Fish and Wildlife Service Red-Cockaded Woodpecker Recovery Plan in the Pineywoods Region of East Texas (which includes the Preserve) from federal and State agencies, the Woodlands Corporation, Louisiana-Pacific, Temple-Inland, and Champion International, is expected to improve the potential habitat and viability of this species (pers. comm., Jeffrey Reid, 1999). Similar to Alternative B, the NPS would formally designate old growth trees (located both in wetlands and uplands), upland pine forests, wetland pine savannas, and expansive riparian corridors as SMAs in which the No Surface Use stipulation would apply to all oil and gas operations (including exploration, drilling and production operations), except that nonmanipulative research and data-collection activities may be permitted. As a result, the NPS would protect old-growth pines that are potential nesting habitat for the red-cockaded woodpecker. Also, the NPS anticipates that in the long-term, 20 – 30 years or more from now, the younger pinelands would reach maturity, thereby increasing potential habitat for red-cockaded woodpeckers. It is possible that some immature pinelands located outside these SMAs could be lost to oil and gas development, but the small reduction in potential habitat in comparison to the SMA-designated pinelands would be unlikely to influence future woodpecker populations.

Designation of SMAs that Would Improve Habitat for Fish, Reptiles, Aquatic Invertebrates, Migratory and Marine Birds. The increase of the standard 500-foot offset to a 1,500-foot offset where no oil and gas operations may occur near visitor use, administrative and other use areas, including canoe routes and water-oriented visitor use areas, in addition to the designation of the Rare Forested Wetlands Communities SMA (includes wetland baygall shrub thickets, wetland pine savannas, cypress-tupelo swamp forests, and old growth trees), and expansive Riparian Corridors SMA would increase protection and improve habitat for the Bachman's Sparrow and other migratory/marine birds, fish and water-dependant species of special concern that utilize these areas. While influences from oil and gas operations would be substantially reduced by the increased offsets and SMA designations, productivity of wetlands and floodplain values in the riparian corridors would still be strongly affected by influences external to the Preserve which could contribute to degradation of water quality and quantity.

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Designation of SMAs that Would Improve Habitat for Uplands-Reliant Species. The NPS would formally designate rare vegetation communities, including upland pine forests, sandhill pine forests, American Beech-Southern Magnolia-Loblolly Pine Forests, and old growth trees that are generally mid-slope to uplands vegetation communities. These vegetation communities would receive specific protection under a No Surface Use stipulation in which no oil and gas operations may occur (including exploration, drilling and production operations), with the exception of non-manipulative research and data collection activities. This added protection would increase protection and improve habitat for species of special concern that prefer these communities as habitat, including Bachman's sparrow, Rafinesque's Big-eared and Southeastern Myotis bats, Slender gay feather, Navasota Ladies'-Tresses, Texas trailing phlox, and White Firewheel, Louisiana pine and Smooth green snakes.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of impacts on species of special concern is dependant upon where the operation is located with respect to species of special concern, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed.

Similar to Alternatives A and B, indirect impacts on species of special concern and their habitats in the Preserve from directionally drilling and producing wells from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in adverse impacts. Impacts could range from no impact to indirect, localized to widespread, short- to long-term, moderate adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including the Riparian Corridors SMA) unless there is no practicable alternative.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles to reclaim sites could have the potential for release of oil, and other contaminating and hazardous substances, which could harm or kill plants, fish and wildlife. Through the well defined regulatory process under the Endangered Species Act, required biological surveys and consultations with the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department would result in identification of potential impacts on species of special concern and their habitat, and the application of mitigation measures that should result in no adverse impacts on species of special concern.

Similar to Alternatives A and B, indirect impacts on species of special concern and their habitats in the Preserve from plugging/abandonment/reclamation of wells directionally drilled from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in impacts ranging from no impact to indirect, localized, short- to long-term, minor adverse impacts.

Cumulative Impacts: Cumulative impacts are similar to Alternatives A and B; however, designation of SMAs where the No Surface Use stipulation would apply to all oil and gas operations would serve to keep cumulative adverse impacts on species of special concern to a minimum and would result in beneficial impacts in the Preserve for several species of special concern dependent on wetlands and old growth areas.

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Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration, Drilling and Production, and Plugging/Abandonment/ Reclamation: Impacts would be similar to Alternatives A and B, resulting in no adverse impacts on species of special concern.

Protection of species of special concern and improvement of habitat would be more readily attainable in SMAs where the No Surface Use stipulation would not permit geophysical exploration (39,657 acres), or drilling and production operations (46,273 acres), or within 500 feet of waterways. Due to the designation of SMAs, well defined regulatory process under the ESA to protect species of special concern, and the application of mitigation measures, no adverse impacts on species of special concern are anticipated.

Similar to Alternatives A and B, indirect impacts on species of special concern and their habitats in the Preserve from directionally drilling wells from surface locations outside the Preserve to reach bottomholes beneath the Preserve could result in impacts ranging from no impact to localized to widespread, short- to long-term, moderate adverse impacts from drilling and production; and localized, short- to long-term, minor adverse impacts from plugging/abandonment/reclamation activities.

Cumulative Impacts: Similar to Alternatives A and B, with cumulative, minor to moderate, adverse impacts on species of special concern in the region; however, protection of species of special concern and improvement of habitat in the Preserve would be more readily attainable in the larger acreage of SMAs where the No Surface Use stipulation would be applied.

Impairment Analysis: Because there would be no major adverse impacts to species of special concern or their habitat whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve species of special concern.

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IMPACTS ON CULTURAL RESOURCES

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Introduction

Cultural resources are an important component of Big Thicket's value as a National Preserve. Only a small area of the Preserve has been formally inventoried for cultural resources, resulting in the discovery of approximately 30 archeological sites. However, none of these has been evaluated for eligibility to the National Register of Historic Places (NRHP). The Brammer House is the only historic structure eligible for listing on the NRHP. Ethnographic consultations were initiated as part of this planning process, but, at this time, specific ethnographic resources that might be affected by oil and gas developments have not been confirmed. Consultation with the Alabama and Coushatta Tribes and other park-affiliated communities described in Chapter 3 will be undertaken as project-specific Plans of Operations are developed, in the effort to identify and ensure that ethnographic resources and associated community concerns are not adversely impacted by proposed oil and gas operations. Likewise, cultural landscapes are not fully understood because of the lack of information about cultural resources in the Preserve.

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Oil and gas operations can adversely impact cultural resources if proper surveys and protection measures are not implemented. Federal laws and regulations and NPS policies provide management tools for protection and management of cultural resources. These are described in Chapter 2, Parts II and III, and in Appendix C.

Methodology for Assessing Impacts

The NPS categorizes cultural resources by the following categories: archeological resources, cultural landscapes, historic structures, museum objects, and ethnographic resources. A review of reference materials regarding cultural resources within the Preseve, as well as communications with NPS staff, was completed to identify and evaluate potential impacts to cultural resources.

The NPS has developed the following threshold definitions under the NEPA guidelines. Each definition corresponds to the NHPA definitions used to assess impacts to cultural resources.

Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impact is at the lowest levels of detection with neither adverse nor beneficial consequences. The determination of effect for Section 106 would be *no adverse effect.*

Minor: **Adverse:** disturbance of the site(s) results in little, if any, loss of integrity. The determination of effect for Section 106 would be *no adverse effect*.
Beneficial: maintenance and preservation of the site(s). The determination of effect for Section 106 would be *no adverse effect*.

Moderate: **Adverse:** disturbance of the site(s) results in loss of integrity. The determination of effect for Section 106 would be *adverse effect*. A Memorandum of Agreement is executed among the NPS and applicable SHPO or tribal historic preservation officer, and if necessary, the ACHP in accordance with 36 CFR 800.6(b). Measures identified in the Memorandum of Agreement to minimize or mitigate adverse impacts reduce the intensity of impact under NEPA from major to moderate.
Beneficial: stabilization of the site(s). The determination of effect for Section 106 would be *no adverse effect*.

Major: **Adverse:** disturbance of the site(s) results in loss of most or all of the site(s) integrity. The determination of effect for Section 106 would be *adverse effect*. Measures to minimize or mitigate adverse impacts cannot be agreed upon and the NPS and applicable SHPO or tribal historic preservation officer and/or ACHP are unable to negotiate and execute a Memorandum of Agreement in accordance with 36 CFR 800.6(b).
Beneficial: active intervention to preserve the site(s). The determination of effect for Section 106 would be *no adverse effect*.

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Impacts on Cultural Resources under Alternative A (No Action/Current Management)

Under Alternative A, nonfederal oil and gas Plans of Operations would continue to be evaluated on a project-by-project basis, and the integrity of physical remains and the context therein of listed or potentially eligible historic properties would be protected. Under applicable Current Legal and Policy Requirements, including 36 CFR 9B regulations, and particularly the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer, which have been described in Chapter 2, Parts II and III, there should be no adverse impacts on cultural resources in the Preserve. However, the application of Current Legal and Policy Requirements, and project-specific operating stipulations, could result in variations in how, where, and to what extent resource protection is applied. Further, because of the limited scope of the NPS's directional drilling provision under 36 CFR § 9.32(e), the NPS has no regulatory authority to require applicants to perform cultural resource surveys on lands outside the Preserve where directional wells would be located, nor to require applicants to perform cultural resource surveys within the Preserve should the area of potential effect extend into the Preserve.

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Because only a very small percentage of the Preserve has been surveyed for archeological resources, it is possible that cultural resource surveys performed in and adjacent to the proposed operations area could lead to the discovery of previously unknown archeological sites and other cultural resources. When the Preserve was established, access and surface uses were permitted under Special Use Permits. Beginning in 1979, permits were authorized under the NPS's Nonfederal Oil and Gas Rights Regulations, 36 CFR 9B. Since that time, all new surface uses permitted under Plans of Operations, pursuant to the 36 CFR 9B regulations, have required cultural resource surveys. See the Nonfederal Oil and Gas Exploration and Production section in the Affected Environment Chapter for a description of existing and abandoned nonfederal oil and gas operations. To date, archeological surveys conducted during the development of plans of operations for nonfederal oil and gas operations have resulted in many new archeological discoveries.

Geophysical Exploration: Exploration operations (3-D seismic surveys) could have both beneficial and adverse impacts concerning unknown archeological sites. Because the seismic lines would run in a dense grid pattern over the entire Preserve, with shotholes drilled along lines in one direction and geophone lines (receiver lines) are placed at an angle to the source lines, there is potential for discovering previously unknown archeological sites, thereby increasing the NPS's knowledge of the cultural resources in the Preserve. Each shothole would be approximately 3 to 4 inches in diameter, which is smaller than the area typically disrupted by a professional archeologist performing a shovel test; therefore drilling the shotholes should result in no adverse effect.

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However, detonation of explosive charges associated with seismic exploration may have an effect on the distribution and condition of surface and subsurface artifact scatters or the condition of surface features. Explosive charges could be too large for the depth of shothole drilled, resulting in a blowout or cratering and the potential loss of archeological material/information. This unlikely, but unacceptable, impact would be halted immediately by the NPS until the operator relocates shotholes with the guidance of a qualified archeologist and approval of an NPS archeologist. These effects can be mitigated, however, by required cultural resource surveys and placing shotholes to avoid identified cultural sites. Alternatively, the operator could also redesign shotholes to adjust the size of explosive for a given shothole depth, given the nature of the soils and other physical conditions so blowouts and cratering would not occur. Redesign to avoid impacting archeological resources would require the technical involvement of a qualified archeologist.

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If noise and its effects on traditional cultural sites is an issue, use of avoidance screening or scheduling operations to avoid persons visiting these sites would help to minimize impacts.

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Potential adverse impacts on cultural resources and traditional cultural practices from exploration operations would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer. As a result, exploration operations that could occur on up to 465 acres of the Preserve should result in no adverse impacts on cultural resources.

Drilling and Production: By applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and consultation with the State Historic Preservation Officer, no adverse impacts should occur.

Potential adverse impacts on cultural resources and traditional cultural practices from the construction and maintenance of access roads, wellpads, flowlines, and pipelines would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act and consultation with the State Historic Preservation Office. This would result in no adverse impacts from drilling and production operations that could occur on up to 241 acres of the Preserve. If buried cultural resources cannot be avoided, impacts would be mitigated by recovery of data (excavation) and preservation of recovered materials and associated records, an irreversible adverse impact. Illegal collection or damage to previously-unidentified cultural resources listed or eligible for listing on the National Register of Historic Places (NRHP) would be an adverse impact.

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Ground disturbance associated with construction and maintenance of access roads, wellpads, flowlines and pipelines, has the potential to impact prehistoric, historic, and traditional cultural resources. Any ground disturbing activity could potentially damage site integrity. Specific actions could include: removing vegetation for constructing access roads and well/production pads, earthmoving, compaction, rutting, survey marking, foot and vehicle traffic, drilling, spill response, fire management, flowline and pipeline construction, and installation of fences.

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An indirect impact on cultural sites could result from increased erosion and increased soil deposition from construction activities associated with oil and gas development. Cultural resources could be exposed or buried.

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It is possible that important cultural sites may not be visible from the surface and could be damaged by construction activities associated with drilling and production. These potential impacts would be mitigated as much as possible by requiring a qualified archeologist to monitor all ground-disturbing activities. Operations would be stopped in the area where archeological resources are uncovered and an NPS archeologist would evaluate the significance of the discovery and to determine how the project in the area of discovery shall be conducted to avoid adversely impacting the site.

Known archeological sites are relatively small, so direct impacts by road construction and well drilling and production could be easily achieved by avoidance. When significant sites cannot be avoided, impacts could be avoided or mitigated by excavating the site, using methodologies defined in a reviewed and approved research design (described under Current Legal and Policy Requirements in Chapter 2, Part II, and in Appendix C). In these rare instances, while information is retrieved from the site, the impacts on the site would be an irreversible adverse impact. Certain sites are considered significant for reasons other than their scientific value. Sites associated with significant events (criterion “a”) or persons (criterion “b”) or which embody distinctive characteristics (criterion “c) cannot have direct impacts mitigated merely through data collection, and often memoranda of agreement stipulating other types of mitigation measures must be developed and signed before a proposed action can proceed. Indirect impacts must also be considered at these sites and some standing structures may require that a sensory offset be defined in which visual, audible or atmospheric elements do not alter the setting.

Sights, sounds, and odors from drilling and production operations could have an effect on traditional cultural practices. Solitude is often an important aspect of many traditional cultural practices; and

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the introduction of distractive elements could diminish the experience of the practitioner. While avoidance may be acceptable mitigation for geographically isolated areas (i.e., plant gathering locations), avoidance is not acceptable for sites significant for setting or associations (i.e., vision quest sites); other measures such as scheduling of activities, screening, or noise abatement may be employed to mitigate anticipated effects. While mitigation in traditional cultural sites is possible, it is often difficult or impossible to attain due to the cultural perspective of those persons utilizing the site. Similar actions may be necessary for non-Native American traditional users of the Preserve.

Indirect impacts on cultural resources would occur by increased access into areas that could increase the visibility of cultural resources and result in vandalism, illegal artifact collecting, or illegal excavation. While such activities could be minor and occur sporadically, over a period of time the impacts could be considered cumulatively major and adverse, if proper protective measures are not taken. Conversely, increased access can often increase the recreational or educational value of such sites.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact cultural resources in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions, such as steepness of slope and direction, and surface hydrology, and mitigation measures being employed. Based on these factors, indirect impacts on cultural resources in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Well plugging, shutting down, abandoning and removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could disturb and compact soil, increase soil erosion, release oil and other contaminating and hazardous substances. Potential adverse impacts on cultural resources and traditional cultural practices from plugging, abandonment and reclamation operations would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer. As a result, plugging, abandonment, and reclamation operations would result in no adverse impacts on cultural resources at sites throughout the Preserve.

Reclamation of sites and replanting with native vegetation would restore the natural character of the area, and may lessen any impacts related to disturbance in cultural setting or landscape.

Indirect impacts on cultural resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: The cumulative impact analysis area for cultural resources includes the seven-county area encompassing the Preserve. Impacts on undiscovered cultural resources could occur at oil and gas operations sites including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and 71 transpark oil and gas pipelines (589 acres). Future oil and gas operations including RFD-projected Preservewide geophysical exploration on up to 465 acres, and drilling of an estimated 40 wells with production of an estimated 27 wells from locations within or outside the Preserve, and ancillary facilities such as access roads and flowlines, could adversely impact cultural resources and traditional cultural practices if proper surveys and protection measures are not implemented. As some operations are being developed, others would be plugged, abandoned, and reclaimed; therefore, potential for impacts would be distributed over time.

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Other Preserve activities that could contribute to adverse impacts on cultural resources and traditional cultural practices include conducting prescribed fires; and performing routine maintenance of Preserve roads, visitor day use areas, trails, picnic areas, and boat launches. The information provided by cultural resource surveys required of the NPS prior to carrying out Preserve activities, or permitting oil and gas operations, would increase the NPS's knowledge of the resources in the Preserve, and would be used to preserve cultural resources, a cumulative, negligible beneficial impact. Over the long-term, protection provided to cultural resources in the Preserve under Current Legal and Policy Requirements, particularly the well-defined regulatory process under the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer, would result in the preservation of important cultural resources and traditional cultural practices, a cumulative beneficial impact on cultural resources in the Preserve.

The cultural resources and traditional cultural practices in the Preserve would become increasingly important as such resources outside the Preserve are lost to development. Because there are no requirements for developers on private property to survey their lands for archeological and other cultural resources before construction (such as for directional drilling exemptions under § 9.32(e)), no provisions exist for notifying professional archeologists and other cultural resource specialists of such finds, and there is no funding for mitigation on private lands, federal and State lands would increasingly become the places where such resources would be preserved. Without adequate mitigation, such sites could be lost, thus increasing the educational and scientific importance of those remaining inside the Preserve. Over the long-term, increasing population growth and development outside the Preserve could result in incremental losses of cultural resources, with cumulative, minor to moderate, adverse impacts on cultural resources and traditional cultural practices in the seven-county region.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: Where exploration operations could be permitted, drilling shotholes would result in no adverse impact. Detonation of explosives in shotholes could effect the distribution and condition of artifact scatters (surface/subsurface) or the condition of surface features. These potential effects would be mitigated by required cultural resource surveys and siting 3-D seismic source lines, including shotholes to avoid identified cultural sites, resulting in no adverse impacts on cultural resources in the Preserve.

Drilling and Production: Where drilling and production operations could be permitted, potential adverse impacts on cultural resources and traditional cultural practices from the construction and maintenance of access roads, wellpads, flowlines, and pipelines would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act and consultation with the State Historic Preservation Officer, resulting in no adverse impacts from drilling and production operations that could occur on up to 241 acres of the Preserve.

If buried cultural resources cannot be avoided, impacts would be mitigated by recovery of data (excavation) and preservation of recovered materials and associated records, an irreversible adverse impact. Illegal collection or damage to previously-unidentified cultural resources listed or eligible for listing on the National Register of Historic Places (NRHP) would be an adverse impact.

Indirect impacts on cultural resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

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Plugging/Abandonment/Reclamation: By applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, there should be no adverse impacts on cultural resources and traditional cultural practices from plugging, abandonment, and reclamation operations. Indirect impacts on cultural resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: The information provided in cultural resource surveys required by the NPS for proposed operations would be used to preserve cultural resources. Over time, protection provided to cultural resources in the Preserve under Current Legal and Policy Requirements would result in the preservation of important cultural resources, resulting in cumulative beneficial impacts on cultural resources and traditional cultural practices in the Preserve; while resources outside the Preserve could be incrementally lost over the long-term, with cumulative, minor to moderate, adverse impacts on cultural resources and traditional cultural practices in the region.

Impairment Analysis: Because there would be no major adverse impacts to cultural resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative A would not result in an impairment of Preserve cultural resources or values.

Impacts on Cultural Resources under Alternative B (Preferred Alternative)

Special Management Areas would be formally designated under Alternative B with surface use and timing stipulations protecting up to 75,293 acres. By applying applicable Current Legal and Policy Requirements, including 36 CFR 9B regulations, and particularly the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer, which have been described in Chapter 2, Parts II and III, and under Alternative A, there should be no adverse impacts on known cultural resources and traditional cultural practices in the Preserve.

Geophysical Exploration: Similar to Alternative A, where geophysical exploration could be permitted in other areas of the Preserve, drilling shotholes would result in no adverse impact. Detonation of explosives in shotholes could effect the distribution and condition of artifact scatters (surface/subsurface) or the condition of surface features. Potential adverse impacts on cultural resources and traditional cultural practices from exploration operations would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the well defined regulatory process under the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer. As a result, exploration operations that could occur on up to 465 acres of the Preserve would result in no adverse impacts on known cultural resources and traditional cultural practices.

Drilling and Production: Similar to Alternative A, where drilling and production operations could be permitted in other areas of the Preserve, potential adverse impacts on cultural resources and traditional cultural practices from the construction and maintenance of access roads, wellpads, flowlines, and pipelines would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act and consultation with the State Historic Preservation Officer, resulting in no adverse impacts from drilling and production operations that could occur on up to 241 acres of the Preserve. If buried cultural resources cannot be avoided, impacts would be mitigated by recovery of data (excavation) and preservation of recovered materials and associated records, an irreversible adverse impact. Illegal collection or damage to previously-

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unidentified cultural resources listed or eligible for listing on the National Register of Historic Places would be an adverse impact.

It is possible under Alternative B that some wells may be directionally drilled from outside the Special Management Areas to develop hydrocarbons underlying the SMAs. The intensity of impacts on cultural resources is dependant upon where the operation is located with respect to cultural resources, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Similar to Alternative A, indirect impacts on cultural resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts. If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including Riparian Corridors SMA) unless there is no practicable alternative. Uplands, or areas of higher topographic relief, are expected to have a greater concentration of cultural sites.

Plugging/Abandonment/Reclamation: Similar to Alternative A, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could disturb and compact soil, increase soil erosion, release oil and other contaminating and hazardous substances. Potential adverse impacts on cultural resources and traditional cultural practices from plugging, abandonment and reclamation operations would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer. As a result, plugging/abandonment/reclamation operations would result in no adverse impacts on cultural resources at sites throughout the Preserve.

Reclamation of sites and replanting with native vegetation would restore the natural character of the area, and may lessen any impacts related to disturbance in cultural setting or landscape.

Similar to Alternative A indirect impacts on cultural resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts would be similar to Alternative A, with cumulative, minor to moderate, adverse impacts on cultural resources and traditional cultural practices in the region. However, as a result of formal designation of SMAs in the Preserve where the No Surface Use stipulation would be applied, there would be a lower probability of inadvertent harm to previously unidentified cultural resources in SMAs from ground disturbing activities that would be prohibited in SMAs.

Conclusions under Alternative B (Preferred Alternative)

Geophysical Exploration: Similar to Alternative A, geophysical exploration could be permitted in other areas of the Preserve (on up to 465 acres); however, the potential adverse impacts on cultural resources would be avoided or mitigated, resulting in no adverse impacts on cultural resources.

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Drilling and Production: Similar to Alternative A, drilling and production could be permitted in other areas of the Preserve on up to 241 acres; however, by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and consultation with the State Historic Preservation Officer, no adverse impacts should occur.

Adverse impacts on cultural resources could occur if a site cannot be avoided and is excavated.

Similar to Alternative A, indirect impacts on cultural resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Same as Alternative A, plugging, abandonment and reclamation operations in the Preserve would result in no adverse impacts. Indirect impacts on cultural resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Same as Alternative A. The information provided in cultural resource surveys required by the NPS would be used to preserve cultural resources. Over time, protection provided to cultural resources in the Preserve under Current Legal and Policy Requirements would result in the preservation of important cultural resources, resulting in cumulative beneficial impacts on cultural resources and traditional cultural practices in the Preserve; while resources outside the Preserve could be incrementally lost over the long-term, with cumulative, minor to moderate, adverse impacts on cultural resources and traditional cultural practices in the region.

Impairment Analysis: Because there would be no major adverse impacts to cultural resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative B would not result in an impairment of Preserve cultural resources or values.

Impacts on Cultural Resources under Alternative C (Maximum Resource Protection)

SMAs would be formally designated under Alternatives B and C; however, under Alternative C, the No Surface Use stipulation would be applied to geophysical exploration in all SMAs, except for the Hunting Areas and Birding Hot Spots SMAs that would have timing restrictions. The No Surface Use stipulation would be applied to drilling and production operations in all SMAs, except for the Hunting Areas SMA. In the remaining areas of the Preserve where operations could be permitted, the application of Current Legal and Policy Requirements, including the NPS's 36 CFR 9B regulations and the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer, which have been described in Chapter 2, Parts II and III, and under Alternative A, should substantially reduce impacts on cultural resources throughout the Preserve.

Geophysical Exploration: Similar to Alternatives A and B, geophysical exploration could be permitted in other areas of the Preserve on up to 465 acres. The No Surface Use stipulation year-round in SMAs covering 39,657 acres may result in the modification of project designs for 3-D seismic surveys. As a result, it may be necessary to increase the density or intensity of seismic shotholes outside the SMAs to adequately image the subsurface under the SMAs. This can be done by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and

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receiver lines. These adverse impacts could occur inside or outside the Preserve, and are dependant upon the location and layout of the seismic grid.

Since fewer areas would be open for seismic exploration under this alternative, it is possible that seismic shotholes would be concentrated at the periphery of SMAs or deeper shotholes would be drilled. Truck-mounted drilling equipment would be required to drill deeper shotholes. The need to use vehicles to access and drill shotholes, and the greater concentration of shotholes in areas could result in increased ground disturbance (particularly if access is required through areas having hydrologic classes C and D soils) and a greater potential for impacting surface and subsurface artifact scatters. As a result, under Alternative C, cultural resource surveys would be required over a larger area where ground-disturbance could be anticipated. However, with cultural resource surveys and careful siting of operations, cultural resources are expected to be avoided. Therefore, impacts would be similar to Alternatives A and B. Drilling shotholes would result in no adverse impact. Detonation of explosives in shotholes could effect the distribution and condition of artifact scatters (surface/subsurface) or the condition of surface features. Potential adverse impacts on cultural resources and traditional cultural practices from exploration operations would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer. As a result, exploration operations would result in no adverse impacts on cultural resources.

Drilling and Production: Similar to Alternatives A and B, where drilling and production operations could be permitted in other areas of the Preserve, potential adverse impacts on cultural resources and traditional cultural practices from the construction and maintenance of access roads, wellpads, flowlines, and pipelines would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act and consultation with the State Historic Preservation Officer, resulting in no adverse impacts from drilling and production operations on up to 241 acres of the Preserve. If buried cultural resources cannot be avoided, impacts would be mitigated by recovery of data (excavation) and preservation of recovered materials and associated records, an irreversible adverse impact. Illegal collection or damage to previously-unidentified cultural resources listed or eligible for listing on the National Register of Historic Places would be an adverse impact.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The intensity of impacts on cultural resources and traditional cultural practices is dependant upon where the operation is located with respect to cultural sites, whether the operation is sited inside or outside the Preserve, and on the resource protection measures that are employed. Similar to Alternatives A and B, indirect impacts on cultural resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

If the operations are conducted inside the Preserve, they are likely to occur in upland areas since drilling and production operations would not be permitted within wetlands or the 500-year floodplain (including Riparian Corridors SMA) unless there is no practicable alternative. Uplands, or areas of higher topographic relief, are expected to have a greater concentration of cultural sites.

Plugging/Abandonment/Reclamation: Similar to Alternatives A and B, well plugging, shutting down and abandoning/removing flowlines and pipelines, and use of heavy equipment and vehicles during reclamation activities could disturb and compact soil, increase soil erosion, release oil and other contaminating and hazardous substances. Potential adverse impacts on cultural resources and traditional cultural practices from plugging, abandonment and reclamation operations would be avoided or mitigated by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and through consultation with the State Historic Preservation Officer. As a

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result, plugging/abandonment/reclamation operations would result in no adverse impacts on cultural resources at sites throughout the Preserve.

Reclamation of sites and replanting with native vegetation would restore the natural character of the area, and may lessen any impacts related to disturbance in cultural setting or landscape.

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Similar to Alternatives A and B, indirect impacts on cultural resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Cumulative impacts would be similar to Alternatives A and B, with cumulative, minor to moderate, adverse impacts on cultural resources in the region. However, as a result of formal designation of SMAs in the Preserve where the No Surface Use stipulation would be applied, there would be a lower probability of harm to previously unidentified cultural resources in SMAs from ground disturbing activities.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: Similar to Alternatives A and B, exploration operations could be permitted in other areas of the Preserve (on up to 465 acres); however, the potential adverse impacts on cultural resources would be avoided or mitigated, resulting in no adverse impacts on cultural resources.

Drilling and Production: Where drilling and production would not be permitted in SMAs with the No Surface Use stipulation, the modification of project designs could concentrate operations outside of the SMAs, and due to the large riparian corridor SMA, could concentrate operations onto uplands locations where there is increased potential for archeological resources.

Similar to Alternatives A and B, drilling and production could be permitted in other areas of the Preserve on up to 241 acres; however, by applying Current Legal and Policy Requirements, particularly the National Historic Preservation Act, and consultation with the State Historic Preservation Officer, no adverse impacts should occur.

Adverse impacts on cultural resources could occur if a site cannot be avoided and is excavated, or if cultural resources are lost or damaged.

Similar to Alternatives A and B, indirect impacts on cultural resources in the Preserve from drilling and production of directional wells drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging/Abandonment/Reclamation: Same as Alternatives A and B, plugging, abandonment and reclamation operations in the Preserve would result in no adverse impacts. Indirect impacts on cultural resources in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, minor, adverse impacts.

Cumulative Impacts: Same as Alternatives A and B. The information provided in cultural resource surveys required by the NPS would be used to preserve cultural resources. Over time, protection provided to cultural resources in the Preserve under Current Legal and Policy

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Requirements would result in the preservation of important cultural resources, resulting in cumulative beneficial impacts on cultural resources in the Preserve; while resources outside the Preserve could be incrementally lost over the long-term, with cumulative, minor to moderate, adverse impacts on cultural resources in the region.

Impairment Analysis: Because there would be no major adverse impacts to cultural resources whose conservation is: (1) necessary to fulfill specific purposes identified in the establishing legislation of Big Thicket National Preserve; (2) key to the natural or cultural integrity of the Preserve; or (3) identified as a goal in the Preserve's general management plan or other relevant National Park Service planning documents, selection of Alternative C would not result in an impairment of Preserve cultural resources or values.

IMPACTS ON VISITOR USE AND EXPERIENCE

Introduction

Visitor use and experience was analyzed in this Plan/EIS, because oil and gas operations could potentially conflict with visitor experiences in the Preserve, and pose threats to human health and safety. An average of 87,000 people have visited Big Thicket National Preserve every year since 1990 to fish, boat, hike, camp in the backcountry, view wildlife and vegetation, and spend time in a natural setting. Surface disturbances, restrictions on visitor access, increased noise, dust, and odors, and releases of oil or hazardous chemicals from oil and gas operations could cause direct and indirect adverse impacts on visitor uses, experiences, and human health and safety in the Preserve.

As described in Chapter 3, Big Thicket National Preserve offers the visitor many different options, ranging from very active recreational pursuits (e.g., motorized boating, mountain biking, hunting) to more passive enjoyment of nature. The visitor's perception of oil and gas operations depends greatly on their previous experiences with these types of activities, the purpose of their visit, and the expectations of what the Preserve has to offer the visitor. Some visitors are interested primarily in a nature experience, with minimal noise and visual disturbance. Others use Big Thicket National Preserve for active recreation such as motor boating and hunting, and may perceive fewer impacts from oil and gas operations than other visitors. Overall, Preserve staff has received few complaints about oil and gas operations.

Several areas in the Preserve are particularly important visitor use areas, are heavily used, are highly susceptible to adverse impacts from oil and gas operations, and/or there would be a high probability of conflict with oil and gas operations. These visitor use areas are designated as Protected Areas under Alternative A and Special Management Areas under Alternatives B and C.

- Visitor Use Areas
  - Day Use Areas, including boat ramps, picnic areas, parking lots (26 areas)
  - Hiking Trails (9 trails)
  - Canoe Routes (4 routes)

- Administrative Areas
  - Big Thicket Visitor Information Station
  - Big Thicket Visitor Center
  - Maintenance and Meeting Facility
  - Turkey Creek Ranch House

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- Other Use Areas
  - Cemeteries (3 sites)
  - Private Residences (2 sites)
- Birding Hot Spots
- Hunting Areas (in 5 units)

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Methodology for Assessing Impacts

Potential impacts on visitor use and experience were considered for all phases of oil and gas development. Several topics are described in this section in order to focus on those attributes that contribute to a positive visitor experience at Big Thicket National Preserve: public access, visual quality, sounds, odors, and human health and safety. The assessment of impacts is based on personal observations during site visits, and discussions with Preserve staff and EIS team members. Oil and gas operations that are anticipated under the Reasonably Foreseeable Development Scenario (RFD) that could impact different visitor uses and experiences at Big Thicket National Preserve are analyzed in this section. In addition, the impacts of Current and Legal Policy Requirements, including regulatory requirements, operating stipulations, and mitigation measures relevant to visitor use and experience are described in the following section.

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Impact Intensity Thresholds. The thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impacts would be barely detectable and/or will impact few visitors.

Minor: Impacts would be slightly detectable and/or will impact few visitors.

Moderate: Impacts would be measurable and/or will impact some visitors.

Major: Impacts would be severely adverse or exceptionally beneficial and/or will impact many visitors.

Impacts on Visitor Use and Experience under Alternative A (No Action/Current Management)

Under this alternative, continued implementation of Current Legal and Policy Requirements would result in protecting visitor use areas and visitor enjoyment on a case-by-case basis. Specific measures currently in-place to protect visitor uses or visitor use areas from oil and gas development include the requirement that surface operations cannot be conducted within 500 feet of waterways, or visitor use, administrative and other use areas, unless specifically authorized by an approved plan of operations (36 CFR § 9.41(a)). This stipulation would separate the visitor from most oil and gas operations in the Preserve.

Developed recreation sites, such as day-use areas, may not receive adequate protection if an oil and gas operation is conducted near these sites. Noise, dust, odors, increased traffic, and visual impacts from wellpads could significantly reduce the quality of the visitor experience if wellpads are sited too close to visitor use areas. It is expected that the measures provided for in the Current Legal and Policy Requirements would considerably lessen impacts on visitor use and experience.

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Oil and gas operations would have the most adverse impact on visitors who come to Big Thicket National Preserve to seek solitude or a quiet nature experience. Mitigation measures such as siting drilling and production operations near roads and away from large tracks of forest and wetlands and non-motorized trails would decrease the likelihood of disturbance to the wilderness character. Noise from helicopters used during 3-D seismic surveys probably constitutes one of the most severe yet short-term impacts on those seeking solitude in the Preserve. This impact could be partially mitigated by restricting helicopter access during certain times (e.g., in birding hot spots during peak nesting or migration periods) and to limit the use of helicopters during peak visitor use periods (e.g., holidays, high-use weekends).

The following sections provide more detailed descriptions of the types of impacts that could occur relating to access, visual quality, noise, odors, wilderness experience, and health and safety from the implementation of Alternative A.

Visitor Use and Experience: Given the geographic extent, the minimal amount of disturbance, and the limited duration (weeks to months) associated with 3-D seismic surveys, it is not expected that the operations would cause major adverse impacts on visitor access. Seismic operations could preclude short-term use of the survey areas by boaters, fishermen, hikers, and other Preserve visitors. Mitigation measures provided for in Plans of Operations such as scheduling operations outside of peak visitation periods would minimize impacts on visitor access. Therefore, it is expected that access limitations associated with geophysical exploration would result in localized, negligible to minor, adverse impacts on Preserve visitors.

For geophysical operations, the loss or modification of vegetation, the flagging used to mark trees, and the presence of oil and gas personnel could cause adverse visual impacts for the visitor. Mitigation that would minimize visual impacts include a 500-foot offset from waterways, visitor use, administrative and other use areas, use of Geographic Positioning Systems (GPS) to minimize vegetation trimming, removing trash and debris, replacing cuttings and covering shotholes, avoiding permanent marking of trees, and removing flagging after surveys are completed. Also, siting the data recording station and helicopter landing pad in areas that cannot be easily seen by the visitor would reduce visual impacts. With mitigation, geophysical exploration operations would result in localized, short-term, minor adverse impacts on visitors.

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There would be noise associated with 3-D seismic surveys from the use of vehicles and drilling equipment (drills and support vehicles), personnel working in the area, detonation of explosive charges in shotholes, and other equipment used such as chain saws and helicopters. Noise generated by the detonation of explosives is equivalent to a shotgun blast and lasts for a fraction of a second. Helicopter noise can be quite loud and intrusive, especially to users in quiet, undeveloped and backcountry settings. However, helicopter use is relatively short-term and, most importantly, it avoids many adverse impacts on soil, water resources, vegetation, and wildlife by eliminating the need for extensive use of vehicles. With the implementation of operating stipulations and mitigation measures, noises associated with geophysical exploration operations (detonation of explosives in shotholes and helicopter use) would result in localized, short-term, negligible to minor adverse impacts.

Seismic surveys would not be expected to contribute many offensive odors or smells, unless spills of fuels or other hazardous chemicals would occur or exhaust fumes were particularly offensive.

Drilling and production operations (surface uses for drilling and production operations, including the placement of flowlines) would not directly impact visitor use and experience in Protected Areas where operations would not be permitted under Current Legal and Policy Requirements on 7,493 acres (includes the fire and long-term monitoring plots; Royal Fern Bog Research Plot; and within 500 feet of visitor use, administrative and other use areas or birding hot spots); or within 500 feet of waterways. However, operations on 989 acres including existing (24.2 acres) and abandoned

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(unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) could continue to adversely impact visitor use and experience in the Preserve.

Where drilling and production operations would be permitted in the Preserve, the areas (access roads and wellpads) would be closed to visitor access. Under the RFD scenario, drilling and production operations could restrict visitation on up to 241 acres in the Preserve. Due to safety concerns, there may be additional stipulations on visitor access adjacent to these sites. Indirect impacts such as increased noise, dust, odors, night lighting, and human activity would not necessarily preclude recreational access, but would decrease the quality of the visitor experience in the vicinity of the operation, especially in less developed areas of the Preserve.

Visual impacts from drilling and production operations would be more substantial, especially if wellpads are placed in relatively undisturbed settings where visitors would be able to readily see the operation and all associated equipment and tanks. Exploratory drill rigs can reach heights of 180 feet, which would be visible through lower-growing trees and shrubs. Site clearing would remove up to 2.4 acres of vegetation for each wellpad, and access road construction would result in visible cuts through Preserve vegetation. Lighting of the drilling rig could interfere with views of night sky. The operations, especially drilling, would increase the presence of work crews and equipment. Since drilling is a 24-hour, 7-day a week operation, these impacts would be continuous for several months. Production operations, although having a less intrusive human presence, would be visible for 20 years or longer. The visual presence of oil and gas operations in a natural setting would adversely impact the areas by displacing the visitor or lessening the quality of the visitor experience.

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Mitigation measures that would reduce visual impacts during drilling and production operations include a 500-foot offset for visitor use areas, and siting the wellpads so they are screened from view with vegetation and topography. Flowlines would be sited along the shoulders of roads to avoid additional land disturbances. Drilling and production equipment could be painted to blend in with the surrounding environment. Low profile structures could be used for all permanent production facilities. Sites should be kept clean and orderly, and any spills, waste, or trash must be promptly cleaned up and removed from the operations site. To minimize effects on night sky, lighting should be kept to the minimum necessary for safe operation, lights should be shielded or designed to prevent offsite glare, and the use of low pressure sodium lights should be considered. With the implementation of these measures, impacts on visitor use and experience would be considerably reduced and could range from minor to moderate adverse impacts.

The intensity of adverse impacts from drilling would be greater than for seismic exploration, since drilling and production operations are conducted continuously until drilling is completed. There would be increased noise from construction activities (vehicles, saws, earth-moving equipment), drilling rigs, and the drilling crew. As noted in Chapter 3, background noise levels at many visitor use areas in the Preserve have been recorded, with most falling at or just below 40 dBA. Figure 3.6 shows that a drill rig at a distance of 1,500 feet is associated with a noise level of about 40 dBA, while near the drill rig, sound levels are approximately 80 dBA. The 500-foot offset required for visitor use and administrative areas under NPS's 36 CFR 9B regulations would result in reducing the adverse impacts from a drilling rig, but would not reduce sounds to background levels. Localized, moderate, adverse impacts could result if drilling or other loud noises occur close enough to a visitor use area to cause interference with the enjoyment or use of the area.

Production operations could also cause localized, moderate adverse impacts, since there periodically could be loud machinery and workover rigs operating on-site. However, most noise levels associated with production would be substantially less than those generated from a drilling operation. Impacts would be long-term, lasting up to 20 years or more.

The primary source of odors would be from drilling or production operations, especially if spill or leaks occurred and oil or other chemicals were not quickly cleaned up and removed from the site.

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Mitigation measures to reduce adverse impacts from odors are provided by the offsets required under Current Legal and Policy Requirements, since odors will dissipate with increasing distance from the source. Also, proper handling of hazardous or contaminating substances would be required; including keeping lids on containers, cleaning up spills, and preventing blowouts (for more information, see the Human Health and Safety discussion). With adequate offsets and implementation of these measures, there should be negligible to minor adverse impacts due to odors.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could indirectly impact visitor use and experience in the Preserve. The types of impacts are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations sited closer to the Preserve boundary. Impacts would depend on proximity to the Preserve, site-specific environmental conditions such as vegetation screening, topography, and mitigation measures being employed. Based on these factors, indirect impacts on visitor use and experience in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Plugging, abandonment and reclamation operations would have public access impacts similar to those described for drilling and production, but would be limited in duration to the time needed to plug, abandon and reclaim the operations site. Reclamation operations should not interfere substantially with visitor access, and, when completed, would restore access to areas previously off-limits to visitors.

Reclamation of the wellpads following plugging and abandonment of the wells would serve to reduce longer-term visual impacts and eliminate the unnatural views of the site. The actual time required to reclaim the site's visual quality will depend on many factors, including the erosion potential of the site, productivity of the vegetation, topography, and soil characteristics. The time needed for recovery could last from one to three years for grasses and shrubs, to decades for larger trees. The removal of the rig and associated structures and equipment, in conjunction with site reclamation, should eliminate any long-term or cumulative adverse visual impacts from the site operations.

The operations involved in site closure would cause temporary, minor adverse impacts on visitor experiences near the reclamation areas. Noises from earth moving and other equipment would be short duration, and mitigation measures could be used to reduce engine noise and to avoid peak visitor use periods. When closure and reclamation are completed, noise levels would return to background levels.

There could be odors during plugging, abandonment, and reclamation operations from exhaust from heavy equipment and from leaks and spills. Mitigation measures to reduce adverse impacts on visitor use and experience is provided by the offsets required under Current Legal and Policy Requirements, since odors will dissipate with increasing distance from the source. Also, proper handling of hazardous materials and contaminating materials would be required; including secondary containment, and promptly cleaning up spills.

Indirect impacts on visitor use and experience in the Preserve from reclamation of wells directionally drilled from outside the Preserve to bottomholes beneath the Preserve could result in impacts similar to those described above for operations inside the Preserve, but the intensity of impact would depend on proximity to the Preserve, site-specific environmental conditions, and mitigation measures employed; therefore, impacts could range from no impact to indirect, localized, short- to long-term, moderate, adverse and beneficial impacts.

Human Health and Safety: All oil and gas development operations under any of the alternatives could increase the potential for conflicts with visitors using the Preserve and could jeopardize their health and safety.

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Seismic exploration could expose Preserve visitors to hazards associated with coming into contact with explosives stored for the seismic survey and explosives that are placed in seismic shotholes, as well as hazards associated with increased vehicular traffic. During 3-D seismic surveys, operators would be required to safely store explosives and fuels away from the public. All shotholes would be plugged with bentonite, and where possible, all undetonated explosives would be removed. Only certified explosive handlers would handle explosives, and security guards may be employed as needed. Offsets required under 36 CFR § 9.41(a) from visitor use and administrative areas would help separate visitors from the oil and gas operations. Warning signs would be posted and notices placed in the park and the local newspaper about the operations. All generated wastes would be cleaned up and disposed of promptly. The seismic survey would need to have health and safety and spill prevention plans in place, in order for their Plan of Operations to be approved.

Drilling and production, and subsequent plugging, abandonment, and reclamation operations have the potential for releases of hydrocarbons or other hazardous substances and/or well blowouts, which could release hydrocarbons, drilling muds, and gases such as hydrogen sulfide (H_2S). Visitors could also be drawn to wellpads and sites out of curiosity, with potential exposure to dangerous equipment or stored chemicals. Hunters, in particular, would need to keep a safe distance from oil and gas operations and avoid shooting near drilling rigs and production facilities (i.e., storage tanks, wellheads, and pumpjacks). There is the possibility of storm or hurricane damage to drilling and production operations, which could spread hazardous and contaminating substances. Perforating or rupturing a storage tank at a production facility containing oil, produced water, or treatment chemicals would increase the threat of spills and subsequent harm to the public.

One of the biggest concerns for human health and safety is the potential exposure to hazardous and contaminating materials. During drilling and production operations, all potentially hazardous materials would be kept in completely enclosed storage containers. Drilling and production sites would not be permitted in floodplains unless there is no practicable alternative. Spill prevention and control measures and other contingency plans included in the Plan of Operations should assure that, in the event of storms, equipment failure, or operator error, accidental discharges of hydrocarbons and produced water would be minimal and would be contained within the operations area. The Preserve staff would be guaranteed access to the site to verify that operations are conducted in a manner which minimizes the potential for spills and provides for rapid spill response and clean up. Operations would also be inspected to ensure that they are conducted in accordance with other applicable regulations, including those enforced by the Railroad Commission of Texas, Texas Commission on Environmental Quality, Texas General Land Office, United States Fish and Wildlife Service, and the United States Environmental Protection Agency (for more information, see Chapter 2 Parts II and III).

In general, the required offsets between oil and gas sites and visitor use areas would help to limit visitors from seeing and going near these facilities. Other mitigation measures include the use of warning signs and notices, security guards (during active drilling), secondary containment (liners and berms), and fencing around the pad and all associated tanks and equipment. In some situations, the Superintendent can restrict public access on roads constructed and used exclusively for access oil and gas operations to safeguard human health and safety, and as may be necessary to protect Preserve resources.

Precautions should also be taken to prevent well blowouts and the sudden accidental release of H_2S during drilling operations. A well blowout could cause unpredictable damage near the well site. A blowout could release H_2S, and other gases, drilling fluids, formation waters, oil, or natural gas under pressure, which could spread some distance from the well site. If fires occurred, sulfur dioxide could be produced.

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Preventing blowouts during drilling operations can be accomplished by use of experienced drilling personnel and by implementing mitigation measures that address high pressure precautions (see Table 2.21). These include proper designs and use of drilling muds; constant monitoring of the characteristics and volume of drilling mud to manage drilling conditions; and proper casing and cementing. Wells must be equipped with blowout preventers, which are tested periodically and can be used to shut-in the well if needed. Plans of Operations would also include an emergency response plan that would address H_2S. For those wells that may encounter H_2S, a radius of exposure analysis should be performed prior to site selection.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could pose human health and safety concerns for Preserve visitors. Because the Preserve is comprised of 12 distinct units, and boundaries are not well defined, visitors may not be aware when they are leaving the Preserve. The types of health and safety concerns are expected to be similar to those described above for operations inside the Preserve, but the intensity of impacts could increase for operations located close to but outside the Preserve boundary. Directional wells exempted from the NPS's 36 CFR 9B regulations under § 9.32(e) may not be fenced or signed as operations are required inside the Preserve. Impacts would depend on proximity to the Preserve, site-specific environmental conditions such as accessibility and slope towards visitor use areas in the Preserve; and mitigation measures being employed. Based on these factors, indirect impacts on human health and safety in the Preserve could range from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Oil and Gas operations on 989 acres (including transpark pipeline corridors, and existing and abandoned operations) would continue to adversely impact visitor use and experience in certain areas of the Preserve. Reclamation of these sites (covering 989 acres) would result in a localized, moderate, beneficial impact on visitor use and experience.

Cumulative Impacts: The cumulative impact analysis area for visitor use and experience includes the seven county area encompassing the Preserve (includes Hardin, Jasper, Jefferson, Liberty, Orange, Polk and Tyler Counties). This analysis area was selected because it represents an area within a few hours drive of the Preserve. Except for visitors who travel considerable distances to visit the Preserve, the majority of the visitation (58 percent) is from persons living within a 2-1/2 hour drive of the Visitor Information Station in the Turkey Creek Unit (Gully 1999). Big Thicket National Preserve has received an annual average of over 87,000 visitors over the past ten years. The Preserve attracts visitors that typically live within a few hours drive of the Preserve, primarily from the Houston, Beaumont, Galvaston, Conroe, Spring, Austin, and San Antonio areas. Visitors primary reasons for coming to the Preserve are to enjoy nature, see wildlife, escape the crowds and noise, study nature, to see or support nature conservation, and to be with friends and family (Gully 1999).

Over the next several decades, visitation in the Preserve is expected to increase. The increase in visitation is attributed to increased tourism in the region as well as a growth in population. The population in the seven county analysis area is projected to increase an average of 12 percent over the next twenty years while the population in Texas is expected to increase 29 percent (Texas State Data Center 1999). As population increases, the demand for recreation areas and facilities will also increase. Increases in population can have cumulative, adverse impacts on visitor use and experience. As more visitors go to a limited number of recreational areas, there could be increased pressure on the recreational areas and facilities, and there could be conflicts with other users. Increased visitation could also result in resource degradation that could diminish the quality of the visitor experience. Population increases could indirectly impact recreational opportunities if wildlife habitat or populations decrease (i.e., loss in wildlife viewing opportunities and decreases in fish and wildlife populations), or if water quality is degraded (effects on fish populations).

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In addition to the Preserve, there are a variety of areas available for recreational activities in the region. Several state parks (Sabine Pass Battleground State Historic Park, Sea Rim State Park, Village Creek State Park, John H. Kirby State Forest, and Martin Dies, Jr., State Park) are located within a few hours drive of the Preserve. Additional undeveloped areas include: Roy E. Larson Sandyland Sanctuary, and various National Forests to the north and west of the Preserve (San Jacinto, Davey Crockett, Sam Houston, San Augustine and Sabine National Forests). The Sam Rayburn and Steinhagen Reservoirs provide recreational opportunities for persons desiring water-related activities. With the increases in population, there is the possibility that additional lands may be set aside (both public and private) for a variety of recreational opportunities, a beneficial impact on visitor use and experience.

Abandoned, ongoing and future oil and gas operations within and outside of the Preserve could adversely impact the quality of the visitor experience if resources are degraded from oil and gas operations. The visitor's experience could also be adversely impacted by restricted access, the views, sounds, and odors associated with these operations. Existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) nonfederal oil and gas operations, and transpark pipelines (589 acres) in the Preserve totaling 989 acres continue to adversely impact soils, water resources, wetlands, fish and wildlife within and possibly outside of the Preserve. Future oil and gas operations that are projected to occur on up to 465 acres for exploration operations and on up to 241 acres for drilling and production operations may directly impact visitor uses on Preserve lands or on adjacent lands if the operations are sited outside the Preserve. The total acreage that would be directly impacted by from oil and gas operations could be as high as 1,695 acres in the Preserve, but it is expected that as some operations are being developed, others would be reclaimed to pre-disturbance conditions. Oil and gas operations outside the Preserve that have not been inventoried may also be adversely impacting visitor use and experience in areas outside of the Preserve. Reclamation of existing oil and gas operations, including access roads and wellpads within and outside the Preserve would be a beneficial impact on visitor use and experience because additional lands would be available for recreational pursuits.

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Human health and safety could be threatened if there were an accidental leak or spill of hazardous or contaminating substances (oil, drilling mud, produced water, treatment chemicals), from a well blow-out, from production operations, including associated flowlines or pipelines. Mitigation measures and rapid response in the event of a spill should reduce the human health and safety threat to negligible. The use of heavy machinery is also a safety hazard if visitors come in contact with the equipment used to conduct operations. However, the requirement in the Preserve to site operations more than 500 feet from waterways, visitor use and administrative areas would greatly reduce the health and safety hazards from oil and gas operations. Mitigation measures for oil and gas operations that are in-place on other public lands are also expected to ensure visitor safety.

In summary, oil and gas operations within and outside the Preserve, in conjunction with population growth in the region and its associated impacts (i.e., increased pressure on recreational areas and facilities, visitor use conflicts with other users, degradation of fish and wildlife habitat) could result in cumulative, negligible adverse impacts on visitor use and experience and human health and safety. Required offsets from oil and gas operations and mitigation measures required under Current Legal and Policy Requirements would protect visitors and staff in the Preserve and on other public lands in the area.

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Conclusions under Alternative A (No Action/Current Management)

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Visitor Use and Experience: Exploration, drilling and production operations would not be permitted within 500 feet visitor use and administrative areas covering 7,469 acres, or within 500

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feet of waterways under Current Legal and Policy Requirements (unless specifically authorized in an approved plan of operations), or during specified times for exploration operations covering 52,307 acres would separate the visitor from most oil and gas operations.

In areas where nonfederal oil and gas operations would be permitted in the Preserve, the loss or modification of vegetation, construction and maintenance of drilling and production operations, flowlines and pipelines, presence of oil and gas personnel, increased traffic and noise, odors that are incongruent with the natural setting, and views of oil and gas operations would adversely impact visitor use and experience (including access, visual quality, noise and odors), but with mitigation could result in localized, negligible to moderate, adverse impacts on visitor use and experience where oil and gas operations would be conducted in the Preserve (on up to 465 acres for exploration operations and on up to 241 acres for drilling and production operations). Drilling muds, hydrocarbons, produced waters, or treatment chemicals could be released during drilling, production, or transport, with adverse impacts on visitor use and experience but with mitigation, and prompt response in the event of a spill, adverse impacts would be negligible to moderate. Operations on 989 acres (including transpark pipeline corridors, and existing and abandoned operations) would continue to adversely impact visitor use and experience in certain areas of the Preserve. Reclamation of these sites (covering 989 acres) would result in a localized, moderate, beneficial impact on visitor use and experience.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve, and their reclamation, could indirectly impact visitor use and experience in the Preserve, resulting in impacts ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse and beneficial impacts.

Human Health and Safety: Increased traffic, use of explosives (for 3-D seismic operations), use of large equipment, and accidental releases of oil or other hazardous and contaminating substances (during drilling and production operations, the transport of hydrocarbons, or site reclamation) could result in injury to visitors and Preserve staff, with major, adverse impacts. Required operating stipulations, mitigation measures to ensure human safety, and prompt response in the event of a spill should reduce the intensity of the impact to negligible.

Wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could pose human health and safety concerns for Preserve visitors ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: Oil and gas operations within and outside the Preserve, in conjunction with population growth in the region and its associated impacts (i.e., increased pressure on recreational areas and facilities, visitor use conflicts with other users, degradation of fish and wildlife habitat) could result in cumulative, negligible adverse impacts on visitor use and experience and human health and safety.

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Impacts on Visitor Use and Experience under Alternative B (Preferred Alternative)

Visitor Use and Experience: Drilling and production operations (surface uses for drilling and production operations, including the placement of flowlines) would not directly impact visitor use and experience in designated SMAs where the No Surface Use stipulation is applied on up to 46,273 acres (includes riparian corridors, fire and long-term monitoring plots with a 150-foot offset; rare vegetation communities, rare forested wetland communities, Royal Fern Bog with a 150-foot offset; visitor use, administrative and other use areas with a 1,500-foot offset; and birding hot spots with a 1,500-foot offset), or within 500 feet of waterways. Drilling and production operations may be permitted in the Hunting Areas SMA (52,172 acres). However, operations on 989 acres including existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) could continue to adversely impact visitor use and experience in the Preserve.

Overall, the designation of SMAs where offsets and timing stipulations would be applied, and the implementation of mitigation measures for lighting, siting of operations, health and safety precautions, security, spill prevention, and clean-up would result in localized, minor adverse impacts on visitor use and experience under Alternative B.

In areas of the Preserve where nonfederal oil and gas operations would be permitted, the types of impacts would be the same as described under Alternative A. The same mitigation measures would also be applied to protect visitor uses and experiences from oil and gas operations. Oil and gas operations could be conducted in the Preserve on up to 465 acres for geophysical exploration and on up to 241 acres for drilling and production operations. The loss or modification of vegetation, ground disturbances, construction and maintenance of drilling and production operations, flowlines and pipelines, presence of oil and gas personnel, increased traffic and noise, odors that are incongruent with the natural setting, and views of oil and gas operations could adversely impact visitor use and experience (including access, visual quality, noise and odors, and backcountry experiences). The presence of leaks and spills could have an adverse impact on visitor experience as well as posing a threat to the health and safety of the visitor (see section on Impacts on Human Health and Safety).

Noise generated during detonation of explosives in shotholes and helicopter use could adversely impact the quality of the visitor experience in the Preserve. Noise generated by the detonation of explosives is equivalent to a shotgun blast and lasts for a fraction of a second. Helicopter noise can be quite loud and intrusive, especially to users in quiet, undeveloped and backcountry settings. The use of helicopters for geophysical exploration is relatively short-term and, most importantly, it avoids many adverse impacts on soil, water resources, vegetation, and wildlife by eliminating the need for extensive use of overland vehicles. With the implementation of operating stipulations and mitigation measures, such as flight elevation, flight path, and timing stipulations, especially during peak visitor use periods, noises associated with geophysical exploration operations (detonation of explosives in shotholes and helicopter use) there should be localized, short-term, minor adverse impacts on visitor use and experience.

Operations on 989 acres (including transpark pipeline corridors, and existing and abandoned operations) would continue to adversely impact visitor use and experience in certain areas of the Preserve. Reclamation of these sites would result in a localized, moderate, beneficial impact on visitor use and experience.

Similar to Alternative A, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve, and their reclamation, could indirectly impact visitor use and

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experience in the Preserve, resulting in impacts ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse and beneficial impacts.

Human Health and Safety: The No Surface Use stipulation (covering 11,512 acres for exploration and up to 46,273 acres for drilling and production) and the timing stipulation (covering 52,272 acres for geophysical exploration) would increase the likelihood that more oil and gas operations would occur outside the Preserve rather than inside its boundaries. Where operations do occur, increased traffic, use of explosives (for geophysical exploration), use of large equipment, and accidental releases of hazardous or contaminating substances (during drilling and production operations, the transport of hydrocarbons, or site reclamation) could result in injury to visitors and Preserve staff, with major, adverse impacts. Required operating stipulations, mitigation measures to ensure human safety (described under Alternative A), and prompt response in the event of a spill should reduce the intensity of the impact to negligible.

One of the biggest concerns for human health and safety is the potential exposure to hazardous and contaminating materials during drilling and production operations. During drilling operations, blowouts could occur and release hydrocarbons, water, and drilling mud, but the use of blow-out preventers should prevent an uncontrolled contaminant release during drilling operations. There could also be accidental spills of drilling mud, diesel fuel, and other chemicals during drilling operations. There is the potential for leaks and spills of hazardous and contaminating substances from production operations (including flowlines and pipelines). Accidental leaks and spills of drilling fluids during workovers, hazardous waste spills including diesel fuel, well blowouts, rupture of flowlines and pipelines, and spills from tanker trucks could also occur. Mitigation measures required under Current Legal and Policy Requirements (described under Alternative A) would protect human health and safety under all alternatives and should reduce the intensity of impacts on human health and safety to negligible.

Similar to Alternative A, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could pose human health and safety concerns for Preserve visitors ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative B would be the same as described for Alternative A except that the No Surface Use stipulation on up to 75,293 acres for oil and gas development and the application of Current Legal and Policy Requirements including the required 500 foot offset from waterways, and increased offsets (1,500 feet for drilling and production operations) from visitor use and administrative areas would reduce adverse impacts on visitor use and experience and would ensure human health and safety in the Preserve. Oil and gas operations within and outside the Preserve, in conjunction with population growth in the region and its associated impacts (i.e., increased pressure on recreational areas and facilities, visitor use conflicts with other users, degradation of fish and wildlife habitat) could result in cumulative, negligible adverse impacts on visitor use and experience and human health and safety.

Conclusions under Alternative B (Preferred Alternative)

Visitor Use and Experience: The No Surface Use stipulation covering 11,512 acres for exploration operations (includes 500-foot offset near visitor use areas), on up to 46,273 acres for drilling and production operations (includes a 1,500-foot offset near visitor use areas), within 500 feet of waterways, and the timing stipulation for exploration operations in the Hunting Areas and Birding Hot Spots SMAs on 52,272 acres during designated times would separate the visitor from most oil and gas operations and may reduce the level of oil and gas activity in the Preserve.

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The designation of SMAs may result in more drilling and production operations being conducted on lands adjacent to the Preserve. Increased offsets (1,500 feet) from visitor use areas would minimize the potential for conflicts with visitor uses and experiences in the Preserve. Similar to Alternative A, operating stipulations in conjunction with mitigation measures should result in localized, negligible to moderate adverse impacts on visitor use and experience in the Preserve.

Similar to Alternative A, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve, and their reclamation, could indirectly impact visitor use and experience in the Preserve, resulting in impacts ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse and beneficial impacts.

Human Health and Safety: The No Surface Use stipulation (covering 11,512 acres for exploration and up to 46,273 acres for drilling and production) and the timing stipulation (covering 52,272 acres for exploration operations) would increase the likelihood that more oil and gas operations would occur outside the Preserve rather than inside its boundaries, reducing the likelihood of human health and safety impacts from these operations, resulting in negligible, adverse impacts on human health and safety in the Preserve. Accidental leaks and spills of hazardous or other contaminating substances could result in injury to visitors and Preserve staff, with major, adverse impacts. Required operating stipulations, mitigation measures to ensure human safety, and prompt response in the event of a spill should reduce the intensity of the impact to negligible.

Similar to Alternative A, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could pose human health and safety concerns for Preserve visitors ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: The cumulative impacts would be the same as Alternative A, except that formal designation of SMAs, and application of specific protection measures, would further protect visitor uses and experiences and human health and safety in designated areas of the Preserve. Oil and gas operations within and outside the Preserve, in conjunction with population growth in the region and its associated impacts (i.e., increased pressure on recreational areas and facilities, visitor use conflicts with other users, degradation of fish and wildlife habitat) could result in cumulative, negligible adverse impacts on visitor use and experience and human health and safety.

Impacts on Visitor Use and Experience under Alternative C (Maximum Resource Protection)

Visitor Use and Experience: Due to the designation of SMAs covering 46,273 acres where drilling and production would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. The increased area of the Preserve designated as SMAs, in conjunction with required mitigation should result in negligible adverse impacts on visitor use and experience.

In areas of the Preserve where nonfederal oil and gas operations could be permitted, the types of impacts would be the same as described under Alternatives A and B. The same mitigation measures would also be applied to protect visitor uses and experiences from oil and gas operations. Oil and gas operations could be conducted in the Preserve on up to 465 acres for geophysical exploration and on up to 241 acres for drilling and production operations. The loss or modification of vegetation, ground disturbances, construction and maintenance of drilling and production operations, flowlines and pipelines, presence of oil and gas personnel, increased traffic and noise, odors that are incongruent with the natural setting, and views of oil and gas operations would adversely impact visitor use and experience (including access, visual quality, noise and odors, and

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wilderness experiences). Under Alternative C, there could be additional adverse impacts on visitor uses and experiences resulting from geophysical exploration operations conducted outside of the SMAs. Where the No Surface Use stipulation would apply in SMAs, it may be necessary to concentrate operations (increase the density of source and receiver lines or increase the depth of shotholes) to image the subsurface underlying the SMAs. Also, noise from helicopter use, shothole drilling and detonation of explosives in shotholes, and well drilling, and production operations; and leaks and spills could have indirect, adverse impacts on visitor use and experience.

Operations on 989 acres (including transpark pipeline corridors, and existing and abandoned operations) would continue to adversely impact visitor use and experience in certain areas of the Preserve. Reclamation of these sites (covering 989 acres) would result in a localized, moderate, beneficial impact on visitor use and experience.

Similar to Alternatives A and B, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve, and their reclamation, could indirectly impact visitor use and experience in the Preserve, resulting in impacts ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse and beneficial impacts.

Human Health and Safety: The No Surface Use stipulation (covering 39,657 acres for exploration and 46,273 acres for drilling and production) and the timing stipulation (covering 52,272 acres for geophysical exploration) would increase the likelihood that more oil and gas operations would occur outside the Preserve rather than inside its boundaries. Increased traffic, use of explosives (for geophysical exploration), use of large equipment, and accidental releases of oil or other hazardous and contaminating substances (during drilling and production operations, the transport of hydrocarbons, or site reclamation) could result in injury to visitors and Preserve staff, with major, adverse impacts. Required operating stipulations, including increasing the required offset from visitor use areas to 1,500 feet, mitigation measures to ensure human safety (described under Alternative A), and prompt response in the event of a spill should reduce the intensity of the adverse impact to negligible.

Similar to Alternatives A and B, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could pose human health and safety concerns for Preserve visitors ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: Cumulative impacts under Alternative C would be the same as described for Alternatives A and B except that the No Surface Use stipulation on 75,293 acres would be applied in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development in the Preserve. The designation of SMAs in the Preserve, the application of Current Legal and Policy Requirements (500' offset from waterways), and SMA stipulations including the 1,500 feet offset from visitor use and administrative areas for drilling and productions operations would reduce adverse impacts on visitor use and experience and would ensure human health and safety. Oil and gas operations, in conjunction with population growth in the region and its associated impacts (i.e., increased pressure on recreational areas and facilities, visitor use conflicts with other users, degradation of fish and wildlife habitat) could result in cumulative, negligible adverse impacts on visitor use and experience and human health and safety.

Conclusions under Alternative C (Maximum Resource Protection)

Visitor Use and Experience: The No Surface Use stipulation covering 39,657 acres for exploration (includes a 500-foot offset near visitor use areas), on 46,273 acres for drilling and

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production (includes a 1,500-foot offset near visitor use areas), within 500 feet of waterways, and the timing stipulation for exploration operations in the Hunting Areas SMA on 52,172 acres during designated times would separate the visitor from most oil and gas operations and is likely to reduce the level of oil and gas activity in the Preserve.

Due to the designation of SMAs covering 46,273 acres where drilling and production operations would not be permitted, it is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. Increased offsets (1,500 feet) from visitor use areas would minimize the potential for conflicts with visitor uses and experiences in the Preserve. The designation of SMAs in conjunction with mitigation measures should result in negligible to minor adverse impacts on visitor use and experience in the Preserve.

Similar to Alternatives A and B, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve, and their reclamation, could indirectly impact visitor use and experience in the Preserve, resulting in impacts ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse and beneficial impacts.

Human Health and Safety: The No Surface Use stipulation (covering 39,657 acres for exploration and 46,273 acres for drilling and production) and the timing stipulation (covering 52,272 acres for exploration operations) would increase the likelihood that more oil and gas operations would occur outside the Preserve rather than inside its boundaries, reducing the likelihood of human and health and safety impacts from these operations, resulting in negligible, adverse impacts on human health and safety in the Preserve. Accidental leaks and spills of hazardous or other contaminating substances could result in injury to visitors and Preserve staff, with major, adverse impacts. Required operating stipulations, mitigation measures to ensure human safety, and prompt response in the event of a spill should reduce the intensity of the impact to negligible.

Similar to Alternatives A and B, wells directionally drilled and produced from outside the Preserve to bottomholes beneath the Preserve could pose human health and safety concerns for Preserve visitors ranging from no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts.

Cumulative Impacts: The impacts would be the same as Alternatives A and B, except that the No Surface Use stipulation in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development would further protect visitor uses and experiences and human health and safety in designated areas of the Preserve. Oil and gas operations within and outside the Preserve, in conjunction with population growth in the region and its associated impacts (i.e., increased pressure on recreational areas and facilities, visitor use conflicts with other users, degradation of fish and wildlife habitat) could result in cumulative, negligible adverse impacts on visitor use and experience and human health and safety.

IMPACTS ON ADJACENT LAND USES AND RESOURCES

Introduction

The emphasis of this impact topic is on the effect that nonfederal oil and gas operations could have on adjacent land uses and resources. The types of impacts on specific resources are similar to those that are presented throughout this chapter, and include Impacts on Air Quality, Geologic Resources, Water Resources, Floodplains, Wetlands, Vegetation, and Fish and Wildlife. For the most part, the NPS cannot mandate specific operating stipulations outside of the Preserve and the magnitude (intensity) of impacts may be greater than is characterized for operations occurring wholly inside of the Preserve. The reader is referred to these sections of Chapter 4 for a more detailed

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description of the activities and their associated impacts. Table 2.17, Summary of Impacts Chart, provides an overview of the range of impacts that could occur to resources within and adjacent to the Preserve.

The National Park Service encourages directionally drilling wells from previously disturbed areas or from surface locations outside the Preserve to protect Preserve resources and values. If nonfederal oil and gas operations that are accessed from outside the Preserve do not pose a significant threat to resources and values in the Preserve (36 CFR § 9.32(e)), the Regional Director of the NPS may grant an exemption from the NPS Nonfederal Oil and Gas Regulations (36 CFR 9B). In most cases, the operator would prepare what is called a § 9.32(e) Application rather than a Plan of Operations to directionally drill a well from outside the boundaries of the Preserve. The content of an Application is similar to a Plan of Operation except that specific project layout and resource information is less detailed because the NPS does not have the regulatory authority to require these data. The NPS may only require a prospective operator of a directional drilling operation to conduct resource surveys inside a park when there is a correlation between downhole operations within the park and potential impacts on park resources and values. In contrast, the NPS may request, but cannot require operators to conduct resource surveys inside a park associated with operations outside of the park but connected to the downhole activities in the park or to conduct resource surveys outside of the park.

Where operations are located near the boundary of the Preserve, the NPS and operator would collaboratively develop mitigation for the proposed oil and gas operation to protect resources both inside and outside of the Preserve. Resource protection (mitigation) measures that are encouraged by the NPS include: (1) using containerized mud systems, (2) constructing berms around drilling and production sites, and (3) lining drillpads and storage facilities with impermeable liners. In addition, operators would be required to comply with all federal, state, and local legal requirements (see chapter 2 Parts II and III for more information).

The operator would decide whether to directionally drill a well on lands outside the Preserve. This decision may depend on a variety of factors, including operational costs, access to a site suitable for drilling the well, logistical constraints of drilling wells in flood-prone areas of the Preserve, and the reduced regulatory requirements outside of the Preserve. Nonfederal oil and gas operations can only be conducted on lands adjacent to the Preserve with prior landowner approval. Surface use agreements, operating stipulations, and reclamation requirements can be specified by regulating authorities and private landowners.

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The degree of the impact on adjacent land uses and resources is dependent upon the type of oil and gas operation, mitigation measures, and adjacent land use. Nonfederal oil and gas operations that may occur on adjacent lands include geophysical exploration, construction of access roads, drilling exploratory and production wells, constructing and operating production facilities, and constructing and operating flowlines and pipelines to transport oil and gas. Bordering the Preserve there are individual homesites, residential subdivisions (i.e., Wildwood, Bevil Oaks), tribal lands (Alabama-Coushatta Indian Reservation), agricultural lands, industrial areas (Saratoga, refineries south of Beaumont Unit), commercial areas (i.e., Evadale, Beaumont), recreational areas (county park near Neches Bottom and Jack Gore Baygall Units), and commercial and private timber lands that could be impacted by oil and gas operations.

Methodology for Assessing Impacts

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The assessment of potential impacts on adjacent land uses and resources is based on best professional judgment and has been developed through discussions with staff from the National Park Service and through review of relevant literature.

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Impact Intensity Thresholds. Thresholds of change of the intensity of an impact are defined as follows:

Negligible: Adjacent land uses and resources would not be impacted, or changes in land use would be so slight, local, and likely short-term as a result of nonfederal oil and gas operations occurring outside the Preserve, that they would not be of any measurable or perceptible consequence.

Minor: Adjacent land uses and resources would result in a change, but the change would be small and of little consequence, short-term, and localized. Mitigation measures, if needed to offset adverse effects of nonfederal oil and gas operations occurring outside the Preserve, would be simple and successful.

Moderate: Adjacent land uses and resources would have measurable impacts that would be long-term, and of consequence, but would be relatively local. Mitigation measures, to offset adverse effects of nonfederal oil and gas operations occurring outside the Preserve, would likely succeed.

Major: Adjacent land uses and resources would have readily measurable impacts, with substantial consequences, and be noticed on a regional scale. Mitigation measures would be necessary to offset the adverse effects of nonfederal oil and gas operations occurring outside the Preserve, and their success would not be guaranteed.

Impacts on Adjacent Land Uses and Resources under Alternative A (No Action/Current Management)

Nonfederal oil and gas operations on lands adjacent to the Preserve could be permitted under the NPS's 36 CFR 9B regulations under an approved plan of operations, or exempted under 36 CFR § 9.32(e) (see Chapter 2, Part II). Oil and gas development may result in beneficial economic impacts because landowners could be compensated for allowing exploratory, drilling, or production operations on their lands. Surface use agreements, loss-of-use payments, and reclamation payments would be negotiated between the landowner and the operator. Resource impacts on lands outside of the Preserve may be greater than described in this chapter for operations inside the Preserve because the NPS does not have regulatory authority to require specific mitigation unless it can be demonstrated that the downhole operations have the potential to harm resources in the Preserve (§ 9.32(e)).

Geophysical Exploration: Under all alternatives, 3-D seismic surveys may be conducted on lands adjacent to the Preserve. Shotpoints and receivers may be placed on these lands to image the subsurface geology adjacent to and within the Preserve. These exploration operations may result in the development of drilling prospects within and adjacent to the Preserve. Impacts may include increased noise levels, unpleasant odors, minor clearing and removal of vegetation, soil compaction and rutting, localized increases in turbidity and sedimentation in water bodies, and water and soil contamination. These operations could adversely impact the rural quality of life, short-term uses of the land, and fish and wildlife species and their habitat.

Overall, geophysical operations could result in localized, short-term, negligible to moderate adverse impacts on adjacent land uses and resources. The resource impacts could be similar to those inside the Preserve, but the intensity of the impact may be different because operating requirements may not be the same on adjacent lands as are required by the NPS inside the Preserve. NPS operating stipulations within the Preserve may include limiting overland vehicles in certain areas,

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using helicopters to move personnel and equipment, reducing the size of dynamite charges (using mini-shotholes vs. larger deep holes), consolidating staging areas, and instituting timing stipulations to protect fish and wildlife species, to reduce conflicts with visitor use, and to protect human health and safety.

Drilling and Production: There could be adverse impacts on adjacent landowners and resources if an operator directionally drills a well next to the Preserve to develop oil and gas underlying the Preserve. Under Alternative A, oil and gas operations could be allowed throughout the Preserve, based on Current Legal and Policy Requirements. Operations would not be permitted in Protected Areas on approximately 7,500 acres, or within 500 feet of waterways. Surface uses for geophysical exploration operations would not be permitted in hunting areas from October 1st through January 15th or in the designated birding hot spots from March 1st through May 30th and from September 1st through November 30th.

Without the formal designation of SMAs in this alternative, it is less likely (but still probable) than under Alternatives B and C that oil and gas operators would site their wells outside the Preserve to develop hydrocarbons underlying the Preserve. Directional wells are encouraged by the NPS. Surface use agreements and loss of use payments could result in a minor to moderate, economic benefit on adjacent landowners if oil and gas drilling and production operations occur outside the Preserve.

Drilling and production operations may remove lands (such as residential, tribal, ranching, recreational, or commercial) from established uses for the short-term (several months for a dry hole) to long-term (up to 20 years or more for a productive well). Adverse environmental impacts could occur to air quality, soils, water, vegetation, wildlife species and habitat, species of special concern, cultural resources, rural character/quality of life, and recreational uses (see summary under these topics in Table 2.17). During operations, adjacent landowners may experience increased noise levels, odors, road surface degradation, and increased traffic. Overall, there could be minor to major adverse impacts on adjacent land uses and resources. The duration of impacts would range from short-term for construction activities and drilling operations and long-term, extending up to 20 years or more for roads, production operations, and flowlines and pipelines. If there is an accidental leak or spill of hazardous or other contaminating substances, there could be widespread, minor to major adverse impacts on soils, water resources, vegetation, fish and wildlife until the spill is remediated. The intensity of the impact from drilling and production operations would be dependent upon the land uses and resources that are impacted, the tolerances of the landowner, and the resource protection measures implemented by the operator. Generally, Current Legal and Policy Requirements and mitigation measures are more stringent on federal lands than on private lands, so it is possible that there could be more adverse impacts outside the Preserve than if the operations were conducted within the Preserve.

Plugging/Abandonment/Reclamation: The extent of site reclamation is dependent upon the requirements imposed by the landowner. It is possible that reclamation of oil and gas operation sites on adjacent lands may not be as extensive as would be required in the Preserve. Depending on the amount of reclamation, there could be localized, negligible to major adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources).

Cumulative Impacts: The cumulative impact analysis area for adjacent landowners covers the Lower Neches River Watershed which extends from the B. A. Steinhagen Reservoir on the north, southward to Beaumont, and from the watershed divide east of the Neches River westward to the Trinity River. The analysis area has been selected because it includes the major rivers and tributaries that flow through the Preserve, and activities that disrupt surface and subsurface water flow, or degrade water quality could potentially impact land uses, resources and values on adjacent lands.

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Comment [I3]: Linda, I deleted this throughout this section because I don't think we can require this any more.

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The Preserve is bordered by commercial and private timber lands, individual homesites, residential subdivisions, tribal lands, agricultural lands, commercial, industrial, and recreational areas that could be impacted by a variety of activities that are anticipated in the reasonably foreseeable future. Activities with potential adverse effects on adjacent land uses and resources include residential and urban development, commercial and private forestry, oil and gas operations, agricultural activities, and operation of publicly-owned facilities (e.g., water diversion and sewage treatment facilities). The reader is referred to previous cumulative impact sections in Chapter 4 for more detailed descriptions of the impacts from these various land uses. The degree of the impact on adjacent land uses and resources is dependent upon the adjacent land use, the type and level of activity, and the mitigation measures employed to protect the resources, land uses, and landowner's quality of life.

Over the next 15 to 20 years the population growth in east Texas is anticipated to increase. The population in the seven county area encompassing the Preserve is projected to increase an average of 12 percent over the next twenty years while the population in Texas is expected to increase 29 percent (Texas State Data Center 1999). With the increase in population, there would be construction activities associated with road building, and urban and residential developments. Adverse impacts on natural resources resulting from construction activities could include vegetation removal, increased erosion and sedimentation in waterways, water quality degradation, loss of wetlands, and wildlife habitat and habitat fragmentation. Land uses may change as a result of these developments, but would be up to the discretion of the landowner. The quality of life could also be adversely impacted by population growth, with increased noise, traffic, air quality degradation, and loss of natural areas. A beneficial impact of population growth would be the construction of infrastructure, facilities and other amenities (i.e., parks) that would serve the local population.

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Private and commercial forestry activities could adversely impact land uses, resources, and values on adjacent lands. Immediately adjacent to the Preserve, commercial and private forestry accounts for approximately 95 percent of the land area (Harcombe and Callaway, 1997). Since the majority of adjacent land uses are ongoing private and commercial logging activities, it is likely that impacts associated with these activities would continue over the foreseeable future. Potential impacts of forestry activities on natural resources include exposing soils to erosion, increased sedimentation and turbidity in surface waters, water quality degradation, loss of wildlife habitat and biodiversity, and habitat fragmentation.

Abandoned, current and future oil and gas operations within and outside of the Preserve could adversely impact resources, land uses and quality of life on adjacent lands. Existing (24.2 acres) and abandoned (unreclaimed sites comprising 376 acres) operations, and transpark pipelines (589 acres) in the Preserve totaling 989 acres continue to adversely impact soils, water resources, wetlands, fish and wildlife within and possibly outside of the Preserve. Future oil and gas operations that are projected to occur on up to 465 acres for exploration operations and on up to 241 acres for drilling and production operations may directly impact resources on adjacent lands if they occur outside of the Preserve and could indirectly impact non-Preserve lands if they occur within the Preserve. Oil and gas operations outside the Preserve that have not been inventoried or may be drilled in the future to develop private minerals outside of the Preserve may adversely impact adjacent lands. Cumulative, adverse impacts may include increased turbidity and sedimentation in waterways, and surface and groundwater contamination from accidental leaks and spills of hazardous or contaminating substances (oil, drilling mud, produced water, and treatment chemicals). Reclamation of existing oil and gas operations, including access roads and wellpads within and outside the Preserve would be a beneficial impact on natural resources in the analysis area.

Agricultural activities in the area could have cumulative adverse impacts on natural and cultural resources. Vegetation removal could expose soils to erosion and increase sedimentation in surface waters. Ground disturbance (i.e., plowing) could expose cultural artifacts. Alteration of vegetation composition could also reduce wildlife habitat and biodiversity. Run-off of fertilizers can cause

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nutrient and organic enrichment that increases organic matter and subsequently reduces dissolved oxygen in sediments and surface waters.

The operation of publicly-owned facilities (e.g., water impoundments and water diversion structures) may adversely impact soils, vegetation, wetlands, fish and wildlife habitat, water quality, and floodplain resources in the area. The Sam Rayburn and Steinhagen Reservoirs have reduced the frequency and duration of both high and low flows on the Neches River. Changes in the overall amount and timing of stream flows may directly impact stream channel morphology, rate of river migration, sedimentation, water quality, soil chemistry, and the amount and type of aquatic habitat downstream from the reservoirs. Indirectly, these changes could impact the growth, mortality, and regeneration of vegetation along riparian corridors. A number of water diversions exist in the southern portion of the Neches River Basin such as the Lower Neches River Valley Authority Canal. In addition, the transfer of water from the Sabine River Basin to the San Jacinto River Basin is being considered to accommodate increased water needs in southeast Texas. Water diversion structures can impact flooding frequency and duration by reducing (or increasing) the amount of water flowing through stream channels.

In summary, the use and development of non-Preserve lands could result in cumulative, minor to major, adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources). The intensity of the impact depends upon the adjacent land use, the type and level of activity, and the mitigation measures employed to protect these resources.

Conclusions under Alternative A (No Action/Current Management)

Geophysical Exploration: Depending on the methods employed and types of equipment used, there could be localized, short-term, negligible to moderate, adverse impacts on adjacent land uses and resources from geophysical exploration operations where shotholes and receivers are placed outside the boundaries of the Preserve.

Drilling and Production: There is the potential for wells to be directionally drilled from outside the Preserve since drilling and production would not be permitted under Current Legal and Policy Requirements on 7,469 acres, or within 500 feet of waterways within the Preserve. Nonfederal oil and gas operations on private lands outside the Preserve would be allowed based on Current Legal and Policy Requirements.

Surface use agreements and loss-of-use payments may result in minor to moderate, beneficial economic impacts on adjacent landowners. The overall impact on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources) from drilling and production operations would range from short-term (construction activities and drilling operations) to long-term (roads, production operations, and flowlines and pipelines), minor to major, adverse impacts, depending on the resource protection measures employed.

Plugging/Abandonment/Reclamation: Depending on the amount of reclamation on adjacent lands, there could be localized, negligible to major, adverse impacts on land uses, resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources), and values.

Cumulative Impacts: The use and development of non-Preservelands, including ground-disturbing activities within and outside of the Preserve such as residential and urban development,

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road building, commercial and private forestry, oil and gas operations, agricultural activities, and operation of publicly-owned facilities (e.g., water diversion and sewage treatment facilities) could result in cumulative, minor to major, adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources). The intensity of the impact depends upon the adjacent land use, the type and level of activity, and the mitigation measures employed.

Impacts on Adjacent Land Uses and Resources under Alternative B (Preferred Alternative)

Geophysical Exploration: Under Alternative B, impacts from geophysical exploration would be similar to those described for Alternative A, except that with the designation of SMAs where the No Surface stipulation would be applied on 11,512 acres, there could be more widespread adverse impacts on adjacent land uses and resources if shotholes and receivers are placed outside the boundaries of the Preserve to image the subsurface adjacent to and within the Preserve. These exploration operations may result in the development of drilling prospects within and adjacent to the Preserve. Adverse impacts may include increased noise levels, unpleasant odors, minor clearing and removal of vegetation, soil compaction and rutting, localized increases in turbidity and sedimentation in water bodies, and water contamination. These operations would indirectly adversely impact the rural quality of life, short-term uses of the land, and fish and wildlife species and their habitat.

Overall, the impacts from geophysical operations on adjacent land uses and resources are anticipated to be localized, short-term, minor to major, adverse impacts. Impacts could be similar to those inside the Preserve, but the intensity of the impacts may be different because operating requirements may not be the same on adjacent lands as are required inside the Preserve.

Drilling and Production: Due to the designation of SMAs covering up to 46,273 acres where the No Surface Use stipulation would be applied, and the logistical constraints of drilling in flood-prone areas of the Preserve, there is a greater potential that wells would be directionally drilled from outside the Preserve than under Alternative A. Surface use agreements and loss-of-use payments may result in minor to moderate, beneficial economic impacts on adjacent landowners. The overall impact on land uses, resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources), and values from drilling and production operations may range from short- to long-term, minor to major, adverse impacts on adjacent land uses and resources, depending on the resource protection measures employed. If there is an accidental leak or spill of hazardous or other contaminating substances, there could be widespread, minor to major adverse impacts on soils, water resources, vegetation, fish and wildlife until the spill is remediated. The intensity of the impact from drilling and production operations would be dependent upon the land uses and resources that are affected, the tolerances of the landowner, and the resource protection measures implemented by the operator. Since more wells may be drilled from outside the Preserve, it is possible that the adverse impacts on adjacent landowners could be more widespread than under Alternative A.

Drilling and production operations may remove lands (such as residential, tribal, ranching, recreational, or commercial) from established uses for the short-term (several months for a dry hole) to long-term (up to 20 years or more for a productive well). Adverse environmental impacts could occur to air quality, soils, water, vegetation, wildlife species and habitat, cultural resources, rural character, species of special concern, and recreational uses. During operations, adjacent landowners may experience increased noise levels, odors, road surface degradation, and increased traffic.

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Plugging/Abandonment/Reclamation: There are more lands designated with the No Surface Use stipulation than under Alternative A which increases the likelihood that oil and gas operations would be sited outside the Preserve, and upon completion of the operations, would be reclaimed. The extent of site reclamation is dependent upon the requirements imposed by the landowner. It is possible that reclamation of oil and gas operation sites on adjacent lands may not be as extensive as would be required in the Preserve. Depending on the amount of reclamation, there could be negligible to major adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources).

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Cumulative Impacts: Cumulative impacts under Alternative B would be the same as described for Alternative A, except that formal designation of SMAs, and application of specific protection measures, would provide consistent protection of natural and cultural resources within the Preserve, and may indirectly protect resources in some areas outside of the Preserve. However, the designation of SMAs could result in more nonfederal oil and gas activity (and associated impacts) outside of the Preserve. The use and development of non-Preserve lands in conjunction with oil and gas operations, including ground-disturbing activities within and outside of the Preserve such as residential and urban development, road building, commercial and private forestry, oil and gas operations, agricultural activities, and operation of publicly-owned facilities (i.e., water impoundments, water diversion and sewage treatment facilities) could result in cumulative, minor to major, adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources). The intensity of the impact depends upon the adjacent land use, the type and level of activity, and the mitigation measures employed.

Conclusions under Alternative B (Preferred Alternative)

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Geophysical Exploration: The impacts would be the same as Alternative A, except that with the designation of SMAs where the No Surface stipulation would be applied on 11,512 acres, there could be more widespread adverse impacts on adjacent land uses and resources if shotholes and receivers are placed outside the boundaries of the Preserve to image the subsurface adjacent to and within the Preserve, with localized, short-term, minor to major, adverse impacts

Drilling and Production: Due to the designation of SMAs on up to 46,273 acres where the No Surface Use stipulation would be applied, there is a greater potential that wells would be directionally drilled from outside the Preserve than under Alternative A.

Surface use agreements and loss-of-use payments may result in minor to moderate, beneficial economic impacts on adjacent landowners. The overall impact on land uses, resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources), and values from drilling and production operations may range from short-term to long-term, minor to major, adverse impacts, depending on the resource protection measures employed. Since more wells may be drilled from outside the Preserve, it is possible that the adverse impacts on adjacent landowners could be more widespread than under Alternative A.

Plugging/Abandonment/Reclamation: There are more lands designated with the No Surface Use stipulation than under Alternative A which increases the likelihood that oil and gas operations would be sited outside the Preserve, and upon completion of the operations, would be reclaimed. The impacts would be similar to Alternative A, ranging from negligible to major, adverse impacts, but could be more widespread than under Alternative A.

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Cumulative Impacts: The impacts would be the same as described for Alternative A, except that formal designation of SMAs, and application of specific protection measures, would provide consistent protection of resources in the SMAs and may indirectly protect resources adjacent to these areas. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, minor to major, adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources). The intensity of the impact depends upon the adjacent land use, the type and level of activity, and the mitigation measures employed.

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Impacts on Adjacent Land Uses and Resources under Alternative C (Maximum Resource Protection)

Alternative C has 75,293 acres (85 percent of the Preserve) designated as SMAs where either the No Surface Use or timing stipulations would be applied to geophysical exploration, drilling or production operations. Geophysical Exploration could occur during designated times in the Hunting Areas SMA (52,172 acres). Where surface use would not be permitted in SMAs that are adjacent to unit boundaries, geophysical exploration, and drilling and production operations could increase outside the Preserve. The intensity of the impacts on adjacent landowners could possibly be greater than under the other alternatives presented in this Plan/EIS because more nonfederal oil and gas operations may occur outside of the Preserve. Overall, the impacts from geophysical operations on adjacent land uses and resources are anticipated to be localized, short-term, minor to major, adverse impacts. Impacts could be similar to those inside the Preserve, but the intensity of the impacts may be different because operating requirements may not be the same on adjacent lands as are required inside the Preserve.

Geophysical Exploration: Geophysical exploration would not be permitted in any of the designated Special Management Areas in the Preserve, except with timing Stipulations in the Hunting Areas SMA. Due to the designation of 39,657 acres as SMAs under Alternative C, seismic shotholes and receivers may be placed outside the Preserve to image the subsurface adjacent to and within the Preserve. The 3-D seismic surveys may modified by placing larger charges in deeper shotholes or by designing a denser seismic grid of source and receiver lines outside of the Preserve. These exploration operations may result in the development of drilling prospects within and adjacent to the Preserve. Impacts from geophysical exploration may include increased noise levels, unpleasant odors, minor clearing and removal of vegetation, soil compaction and rutting, localized increases in turbidity and sedimentation in water bodies, and water contamination, resulting in localized, short-term, minor to major adverse impacts. These operations would indirectly adversely affect the rural quality of life, short-term uses of the land, and fish and wildlife species and their habitat.

Drilling and Production: Due to the designation of SMAs covering 46,273 acres where the No Surface Use stipulation would be applied, there is a greater potential for wells to be directionally drilled from outside the Preserve than under Alternatives A and B. Surface use agreements and loss-of-use payments may result in minor to moderate, beneficial economic impacts on adjacent landowners. The overall impact on land uses, resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources), and values from drilling and production operations may range from short- to long-term, negligible to major, adverse impacts, depending on the resource protection measures employed. If there is an accidental leak or spill of hazardous or other contaminating substances, there could be widespread, minor to major adverse impacts on soils, water resources, vegetation, fish and wildlife until the spill is remediated. The intensity of the impact from drilling and production operations would

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be dependent upon the land uses and resources that are affected, the tolerances of the landowner, and the resource protection measures implemented by the operator. Since more wells may be drilled from outside the Preserve, it is possible that the adverse impacts on adjacent landowners could be more widespread than under Alternatives A and B.

Drilling and production operations may remove lands (such as residential, tribal, ranching, recreational, or commercial) from established uses for the short-term (several months for a dry hole) to long-term (up to 20 years or more for a productive well). Adverse environmental impacts could occur to air quality, soils, water, vegetation, wildlife species and habitat, cultural resources, rural character, species of special concern, and recreational uses. During operations, adjacent landowners may experience increased noise levels, odors, road surface degradation, and increased traffic.

Plugging/Abandonment/Reclamation: There are more lands designated with the No Surface Use stipulation than under Alternatives A and B which increases the likelihood that oil and gas operations would be sited outside the Preserve, and upon completion of the operations, would be reclaimed. The extent of site reclamation is dependent upon the requirements imposed by the landowner. It is possible that reclamation of oil and gas operation sites on adjacent lands may not be as extensive as would be required in the Preserve. Depending on the amount of reclamation, there could be negligible to major adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources).

Cumulative Impacts: Cumulative impacts under Alternative C would be the same as described for Alternatives A and B except that the No Surface Use stipulation for SMAs on 39,657 acres for geophysical exploration and for SMAs on 46,273 acres for drilling and production operations would ensure widespread protection of natural and cultural resources in the Preserve, and would indirectly protect resources outside of the Preserve. However, the designation of SMAs could result in more nonfederal oil and gas activity (and associated impacts) outside of the Preserve. The use and development of non-Preserve lands, including ground-disturbing activities within and outside of the Preserve such as residential and urban development, road building, commercial and private forestry, oil and gas operations, agricultural activities, and operation of publicly-owned facilities (e.g., water impoundments, water diversion and sewage treatment facilities) could result in cumulative, minor to major, adverse impacts on adjacent land uses and resources (including air quality, geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources). The intensity of the impact depends upon the adjacent land use, the type and level of activity, and the mitigation measures employed.

Conclusions under Alternative C (Maximum Resource Protection)

Geophysical Exploration: The impacts would be the same as Alternatives A and B, except that with the designation of SMAs where the No Surface stipulation would be applied on 39,657 acres, there could be more widespread adverse impacts on adjacent land uses and resources if shotholes and receivers are placed outside the boundaries of the Preserve to image the subsurface adjacent to and within the Preserve, with localized, short-term, minor to major, adverse impacts.

Drilling and Production: Due to the designation of SMAs covering 46,273 acres where the No Surface Use stipulation would be applied, there is a greater potential for wells to be directionally drilled from outside the Preserve than under Alternatives A and B.

Surface use agreements and loss-of-use payments may result in minor to moderate, beneficial economic impacts on adjacent landowners. The overall impact on land uses, resources (air quality,

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including geologic resources, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources), and values from drilling and production operations may range from short- to long-term, minor to major, adverse impacts, depending on the resource protection measures employed. Since more wells may be drilled from outside the Preserve, it is possible that the adverse impacts on adjacent landowners could be more widespread than under Alternatives A and B.

Plugging/Abandonment/Reclamation: There are more lands designated with the No Surface Use stipulation than under Alternatives A and B which increases the likelihood that oil and gas operations would be sited outside the Preserve, and upon completion of the operations, would be reclaimed. The impacts would be similar to Alternative A, ranging from negligible to major, adverse impacts, but could be more widespread than under Alternatives A and B.

Cumulative Impacts: The impacts would be the same as Alternatives A and B, except that the No Surface Use stipulation in all SMAs (except the Hunting Areas SMA), for all phases of oil and gas development would ensure widespread protection of resources in the Preserve, which would indirectly protect resources adjacent to these areas. Past, present, and future oil and gas development, along with other types of ground disturbing activities within and outside the Preserve, should have cumulative, minor to major, adverse impacts on adjacent land uses and resources (including geologic resources, air quality, water resources, vegetation, wetlands, fish and wildlife, species of special concern, and cultural resources). The intensity of the impact depends upon the adjacent land use, the type and level of activity, and the mitigation measures employed.

COMPARATIVE ANALYSIS OF THE PROPOSED ACTION AND ALTERNATIVES

Impairment

Alternatives B and C in this Plan were developed to better ensure the prevention of impairment of Preserve resources and values. The impairment analyses in this Plan/EIS were done programmatically for all resources and values that could be impacted from oil and gas development within and adjacent to the Preserve. During the impact analyses for this Plan/EIS, Special Management Areas and operating stipulations were modified or added to the alternatives to reduce the level of potential impact on park resources and values.

In addition, a site-specific analysis of the potential for impairment of Preserve resources and values will be required on all proposed oil and gas projects in the Preserve. The analysis must be included in the NEPA document on the Plan of Operations for all oil and gas projects.

Under all alternatives, if mitigation measures are not adequately applied during the conduct of nonfederal oil and gas operations, there could be impacts on Preserve resources and values. If this were to occur, the NPS would be required to suspend the operation until appropriate mitigation is applied. If mitigation is not technically feasible to avoid the impairment, the oil and gas operation would not be allowed to continue.

If an accidental spill of hydrocarbons or other contaminating substance were to occur in the Preserve, there could be major adverse impacts particularly to water, vegetation, wetlands, soils, fish and wildlife resources. Even if there were a catastrophic spill, the site would be remediated and would not likely result in an impairment of Preserve resources and values.

Alternative A. Current law, regulation, and policy preclude Preserve resource managers from authorizing nonfederal oil and gas operations that would impair Preserve resources and values.

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Under Alternative A (the status quo), Preserve managers must carry out this responsibility on a case-by-case basis without the direction provided in a comprehensive oil and gas plan that provides upfront identification of resources that are most susceptible to adverse impacts from oil and gas operations and state-of-the-art mitigation measures. As a result, Preserve managers evaluate individual proposals with little guidance beyond the text of the 9B regulations and associated NEPA environmental analysis. Relative to Alternatives B and C, this increases the likelihood that the location of certain resources and available mitigation measures could be overlooked on any given proposed operation, placing Preserve resources and values at risk of impairment.

Alternatives B and C. The implementation of a comprehensive oil and gas management plan and the designation of Special Management Areas to further protect park resources and values would provide more certainty to oil and gas operators and consistent application of Current Legal and Policy Requirements that would protect Preserve resources and values from potential impairment from nonfederal oil and gas operations.

Special Management Areas have been designated in Alternatives B and C that would protect resources and values particularly susceptible to adverse impacts from oil and gas operations. Geologic resources, water resources, floodplains, wetlands, rare vegetation communities, and specific visitor use areas would be provided specific protection. Operating stipulations in SMAs, including setbacks and a No Surface Use stipulation would be required to avoid or minimize adverse impacts and would further reduce the likelihood of impairment of resources and values in the Preserve.

Due to the designation of Special Management Areas under Alternatives B and C, it is probable that more wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve. While indirect impacts on Preserve resources and values could be greater from directional wells drilled from outside the Preserve compared to operations inside the Preserve, it is unlikely that Preserve resources and values would be impaired by directional drilling and production. In some cases, directional drilling proposals would involve other federal agencies applying other permitting requirements (i.e., Clean Water Act Section 404 permitting). The NPS would participate with the other federal entity through its permitting process to request any necessary mitigation measures be applied to reduce the potential for major adverse impacts on Preserve resources and values. If NPS is the only federal entity involved, and a directional drilling and production proposal could pose major adverse impacts on Preserve resources and values, the NPS would need to base its § 9.32(e) exemption on the findings of an environmental impact statement (EIS). In most cases, operators would preclude the need to prepare an EIS by locating directional wells a sufficient distance from the Preserve, and applying other necessary mitigation measures to reduce impacts.

Enhancement of Long-term Relationship between Local Short-term Uses of the Environment and Maintenance and Productivity

For all alternatives in this Plan/EIS, most impacts would be relatively short-term and would be mitigated to avoid impairment of Preserve resources and values; however, continuation of the existing management program as discussed above under Alternative A could lead to impairment of these resources. Land disturbed during oil and gas operations would be reclaimed, all equipment and contamination or wastes removed, and the ground restored to its natural contours. However, some surface disturbances resulting from oil and gas development may cause long-term effects, if the areas are not totally reclaimed or are reclaimed after a very long period of time. For example, access roads may be used for more then one wellpad or for other multiple uses. In such cases, long-term productivity would likely decrease and possibly be lost in the areas used for access roads. Also, if wetlands cannot be avoided and the mitigation required is not successful in compensating for

Comment [l6]: Linda, I deleted this paragraph because even though alternative A is the status quo, an O&GMP is being prepared and if Alternative A were selected for implementation, some aspects of the plan would be utilized for future oil and gas operations. I have made a comment similar to this for the nonfederal oil and gas impact analysis section in Chapter 4.

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the original productivity of areas lost, there could be a loss in long-term productivity in these areas. This would be the case if certain out-of-kind wetland mitigation would be approved for replacement of productive wetland acreage.

Irreversible or Irretrievable Commitments of Resources

Irreversible impacts are those effects that cannot be changed over the long term or are permanent. An effect to a resource is irreversible if it (the resource) cannot be reclaimed, restored, or otherwise returned to its pre-disturbance condition.

For all the alternatives, there would be an irreversible commitment of the hydrocarbon resources underlying the Preserve, since oil and gas is being depleted at a much faster rate than it is being formed in the subsurface. The region is a mature hydrocarbon basin where exploratory and production drilling has occurred for the past 100 years and through time, oil and gas production is expected to decline in the Preserve and surrounding area. Even though 3-D seismic technology would contribute to new discoveries in the Preserve, production should continue to decline from current levels. This irreversible commitment of resources is not considered an impairment to Preserve resources because Congress did not establish the Preserve to specifically provide for oil and gas development. Rather, Congress recognized the Preserve for its outstanding natural, scenic, and recreational values while providing for the private property right to develop these resources.

Another irreversible commitment of resources would occur if any significant cultural resources were destroyed during any phase of oil and gas development. However, given the size of the shotholes during 3-D seismic operations and wellbores for drilling wells, this would be relatively minor. If buried cultural resources cannot be avoided, impacts would be mitigated by the recovery of data (excavation) and preservation of recovered materials and associated records, an irreversible adverse impact.

For all alternatives, there would be an irretrievable loss of undeveloped areas for visitor use and experience where the ground is cleared and disturbed for oil and gas exploration and development, including access roads and wellpads. This involves approximately up to 241 acres or 0.2 percent of the Preserve (based on the area being analyzed in this Plan/EIS). The potential for these lands to produce vegetation or be viewed in an undisturbed state would be irretrievably committed for the duration of the oil and gas development operations, and until the site(s) have been reclaimed.

Unavoidable Adverse Impacts that Cannot be Avoided Should the Action be Implemented

Unavoidable adverse impacts are adverse impacts that cannot be avoided and cannot be mitigated, and, therefore, would remain throughout the duration of the oil and gas operation. Under Alternatives B and C, the implementation of this oil and gas management plan would provide more direction to the oil and gas operator and greater protection to Preserve resources and values and hence avoid and mitigate potential damage to Preserve resources and values. If an operator's proposal could potentially lead to an impairment of Preserve resources, the NPS would not approve the proposed operation until adequate resource protection (mitigation measures) is integrated into the operation.

For any of the alternatives, there may be unavoidable adverse impacts if the mitigation proposed for any impacted wetlands is not successful and/or does not compensate for the original wetland functions and values. All alternatives would require avoidance of wetlands as the first mitigation

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measure. However, if avoidance is not possible, it may be difficult to ensure that either the restoration of wetlands required through compensation for a specific operation, or the reclamation of the wetlands after operations have been completed, would have similar functions, or the necessary hydrologic regime and other environmental conditions, especially if they are replacing forested wetlands.

There may also be unavoidable adverse impacts on visitor uses and experiences if the setback (500-foot to 1,500-foot distance) and other mitigation measures do not provide enough of a restricted area between oil and gas operations and visitor use areas. There is a distinct possibility that the noise from drilling rigs, compressors, and other oil and gas operations could adversely impact the visitor experience. This would depend on the specific location, intervening topography and vegetation, noise mitigation techniques utilized, and the existing background noise levels in the vicinity of the operation.

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CONSULTATION AND COORDINATION

CHAPTER 5



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CHAPTER 5
CONSULTATION AND COORDINATION

INTRODUCTION

The planning process for this Oil and Gas Management Plan/Environmental Impact Statement included formal and informal efforts to involve the public and local, state, and federal agencies. All applicable public participation has been documented and analyzed and is on file.

The interdisciplinary team consulted with the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department about threatened and endangered species that occur or could occur in the Preserve; with the State Historic Preservation Office about cultural resources; and with the Alabama-Coushatta Tribe of Texas and the Coushatta Tribe of Louisiana to inform them of the planning process and issues that could affect lands and waters that may be culturally significant, and to determine if there were any resource issues with which the Tribes had ethnographic affiliation.

The planning process was officially initiated through publication of a notice of intent to prepare a Draft Oil and Gas Management Plan/Environmental Impact Statement in the *Federal Register* on November 16, 1998. The NPS mailed a public scoping newsletter to over 350 individuals, organizations, and government agencies. The newsletter announced the beginning of the EIS scoping period and the location, date, and time of the scoping open house. The Notice of Intent provided the public an opportunity to request additional scoping meetings; however, none were requested.

The scoping newsletter also provided information on the planning process and schedule, and described how agencies and the public could be involved in the planning process. The newsletter identified oil and gas management plan goals and planning objectives, criteria for defining special management areas, resources and values potentially at stake, and a preliminary range of management strategies. The NPS developed the preliminary planning framework to inform agencies and the public of what the NPS was considering, but more important, to provide agencies and the public with enough information with which they could bring other ideas, comments, suggestions, and management strategies to the decision-making process.

The NPS hosted an open house in Beaumont, Texas, on December 3, 1998, to encourage early and open public participation on the oil and gas management planning effort. Thirty-five members of the public attended. Three participants represented state and federal agencies; ten participants represented environmental groups; six participants were adjacent landowners and residents; and 16 participants represented various oil and gas companies, mineral interests, and consulting firms.

In response to publishing the Notice of Intent, hosting the scoping open house, and distributing the Public Scoping Newsletter, 16 comment letters were received, and 8 individuals asked to be added to the mailing list.

Scoping Analysis

The following table lists, by category, the issues and questions raised in the comment letters received by the NPS during formal public scoping.

Table 5.1. Scoping Analysis, Big Thicket National Preserve Oil and Gas Management Plan/Environmental Impact Statement

TOPICS
Criteria for Defining Special Management Areas
Add to criteria: Areas that contain significant amounts of mineral resources.
Define the special management areas carefully and tightly, be exclusive rather than inclusive.
Cumulative impacts should be mentioned as a criterion.
In addition to the sensitive areas mentioned in the newsletter, oil and gas operators should avoid impacts to sensitive areas including wetlands, riparian corridors, and unique features and ecosystems.
All of the resource must be protected--not just areas identified as “sensitive.”
Impact Analysis
Concern is lack of a comprehensive, cumulative impact assessment of not only oil and gas activities in Big Thicket but also all other activities that have taken place in the past, present, and foreseeable future. That analysis would include, from historical information as well as information collected since Big Thicket was created, all the seismic lines, wells, tank farms, roads, recreational activities, trails, boat launches, air pollution, logging or cutting of trees, water pollution, noise, airplane overflights, research, and other activities that have occurred.
Cumulative impacts need exhaustive assessment, including impacts from areas adjoining the preserve.
NPS must also look at what impacts oil and gas activities are having outside Big Thicket and how what happens in or outside the preserve affects the preserve.
EIS must look at fragmentation effects on plants, animals, and ecosystems. The use of these pipeline rights-of-way as roads also impacts the native biodiversity and needs to be assessed in the EIS.
Identify all resources, since all will be impacted in some way by oil and gas activities and will need specific mitigation measures taken to minimize impacts.
The possibility of poaching and vandalism increases due to access by these rights-of-way is an important issue to discuss in the EIS.
Another issue to discuss is incompatible uses and how they degrade Big Thicket.
The natural environment is going to be significantly impacted by mineral exploitation.
Law, Policy, Regulations, and Mandates
How does Congress have the authority to control access, dictate operational procedures and require permits on property rights which the mineral owners own the dominant estate?
New requirements should not impede, impact or diminish the efforts of a mineral owner to encourage exploration and production during the development of the oil and gas management plan/EIS.
NPS must demonstrate that oil and gas operations are “detrimental to the purpose and objectives of the Preserve” to justify condemnation (including partial condemnation), or the NPS must not unjustifiably prevent, prohibit or delay mineral estate owners access to their property.
Rights granted under pre-existing easements should not be precluded or restricted in any way as to areas affecting the preserve.
-Efforts should be made to acquire mineral rights to prevent oil and gas development. -Long-range consideration should be given to purchase of mineral rights, and, if opportunities arise for purchase of mineral rights, NPS should seek funding. -Push Congress to appropriate funds to acquire mineral rights from willing sellers (and in the most sensitive areas by eminent domain, if necessary). -NPS must focus on acquiring mineral rights and protecting the water table levels and water inflows to Big Thicket. More land acquisition is required. -Make it policy that NPS will, wherever the opportunity arises, buy mineral rights in Big Thicket and retire these so that oil and gas activity impacts will never occur again.
Clearly defined regulations and operation requirements, rather than building each plan of operation from the ground up, will greatly ease the burden of the small operator. A standard plan that could then be customized would be of great use to the small operator.
Plan should require that operators submit and have approved an amendment to 36 CFR 9B or equivalent, to address operations on non-federal owned minerals. Operations should be conducted in accordance with the management plan, which would provide for general guidelines for drilling, production and exploration activities and be administered at the sole discretion of Big Thicket. The plan should have a statement of NPS goals and objectives in preserve management as well as a statement of cooperation with the dominant mineral estate owners.
Make it a policy that any further oil or gas drilling proposals in Big Thicket require an EIS to fully explore issues, environmental impacts, and the maximum mitigation that will be required.
NPS must make it a policy to make all information about oil and gas activities easily available to the public and to make proposals known widely so that people can participate and give their input.
Promote the environmentally friendly development of minerals in this area, and be very mindful of the cost/benefits involved.

TOPICS
-There should be a “No use of ATV’s” policy for seismic drilling in Big Thicket. -No ATV use can be permitted for exploration or other reasons. -There should be a no all terrain vehicles policy.
Need for the Project
Federal administrative procedures require notice of proposed rule making in the Federal Register, publishing draft/proposed rules, public comment and participation. NPS cannot develop new or revise its existing management plan under NEPA and circumvent federal administrative procedures. NPS needs to demonstrate a need for revision of existing or development of oil and gas management plans and adhere to the requirements of the Federal Administrative Procedures Act.
No need to proceed with development of an EIS at this time. NPS should provide justification and demonstrate the need to develop a new oil and gas management plan and EIS.
Other Issues
How will existing pipeline rights-of-way be managed?
Want better understanding of how pipelines are constructed and maintained.
Want better understanding of how leaks and spills can be monitored and avoided.
Want better understanding of general safety issues.
Mineral owner wants to be kept informed by lessees.
Current delays to seismic surveillance have already caused impairment (partial condemnation) to mineral owners’ rights and the proposed new oil and gas management plan and environmental impact statement will further impair rights.
It is very disturbing that while scoping is being done for this oil and gas management plan that NPS is allowing huge 3-D seismic survey projects to go forward.
Planning Goals and Objectives
Question to be answered should be: How can exploration and development of the mineral estate of the Big Thicket be undertaken while *minimizing* loss of natural and ecological integrity? The natural and ecological integrity cannot be "maintained while allowing exploration and development."
Perhaps priorities were not considered in listing of goals, but readers may believe they are implied. Consequently, the first priority should be “preserve, conserve, protect, and interpret resources and values.”
"Preserve, conserve, protect, and interpret resources and values," should be placed as first priority, not second.
Delete the term “interpret” from the 2nd goal.
Add as item 3, and move current item 3 to 4: Preserve, conserve and protect the rights and value of the mineral interest owners.
Add as item 4: Coordinate with Texas RRC and other state and federal agencies to coordinate and integrate NPS oil and gas regulations with other state and federal regulations, to ease and simplify regulatory burden on operators.
Add as item 5: Coordinate with state and federal agencies to identify, develop, and promote best practices to allow development of mineral resources within park while mitigating environmental disruption.
Planning objective #2 implies that performance standards will be developed. This is not necessary. There are numerous existing state and federal performance standards that are more than adequate for preservation and protection of the preserve. Development of new performance standards would be unwarranted, redundant, and wasteful and beyond the realm of the authority granted to NPS.
Remove "reasonable" from the second objective.
Revise objective #2 to state: “Identify from existing regulatory programs reasonable oil and gas exploration and development performance standards to protect park resources and values.”
Planning Process
NPS currently has an oil and gas management plan in existence. No reference to that existing management plan is made in the scoping newsletter.
No proposed action(s) by either the NPS or external applicant were noted in the newsletter. No statement of need or purpose was stated in the newsletter either.
Potential Elements of the Alternatives
As performance standards: Best available practices and technologies to minimize 1) extent of area disturbed, 2) noise, 3) leakage, and 4) air pollution.
There is an opportunity to develop and promote “best practices” in operating in an environmentally sensitive area. There are many private and government organizations that you could involve in this effort, including the Texas RRC, the Texas Bureau of Economic Geology, the Petroleum Technology Transfer Council, among others. These best practices could be promoted and transferred to the local operators, and promoted throughout the country to other areas, showing how oil and gas exploration and development can be done in an environmentally sensitive area.

TOPICS

The avoidance of sensitive areas may be achieved through various means, including

1) creating seismic grids with the largest possible bin size (i.e., greatest distance between shot lines) to reduce the total number of shot lines;
2) offsetting seismic shot lines to avoid sensitive sites completely;
3) declining requests to re-shoot an area already shot;
4) require the use of 4-D seismic technology to reduce the likelihood of an operator requesting a re-shoot to acquire better seismic data in the future;
5) requiring operators to shoot the largest possible acreage in the same effort to reduce the acreage of "overlap" involved in a seismic shoot of an adjoining area;
6) require directional drilling to avoid specific surface features and drill from the least sensitive surface area; and
7) require the use of third party monitors for seismic operations, selected at the approval of NPS, and funded by the operator. Such monitors must have transportation and communication provided by the operator

General guidelines for wells should include:

a. Prior approval of entrance location to the preserve and limitation on what roads can be used.
b. Environmental and safety meetings should be co-sponsored with Big Thicket and the operator on the site with all personnel actually supervising operations on the ground and with all vendors supplying services.
c. Drilling should be restricted where possible to those times of year less likely to conflict with hunting or the time period where visitor access is the greatest.
d. Large signs should be placed at all entrances requesting vehicle operators to check and repair any leaky or unsecured equipment prior to entry.
e. Signs should also be placed at the drill site with emergency phone numbers.
f. The information listed in Appendix III - Plan of Operation Information Requirements (where applicable) should be provided.
g. EPA emergency spill response plan to be on file prior to drilling.
h. Drilling and plugging requirements to follow those set forth by the Texas Railroad Commission, Texas Water Board, Corp of Engineers, and other agencies responsible for all other wells drilled in the State of Texas.
i. All wells to be drilled with a closed loop mud system where practical.
j. Plastic liner (need to decide on minimum mil thickness) to be placed under board matting.
k. Drip pans placed under equipment connections.
l. Minimize surface area of drill sites and production facilities.
m. Multiple wells drilled from a single location if possible.
n. Air quality control equipment installed on production facilities.

Other alternatives include putting all wetland and streamside areas off limits, putting entire units off limits, putting areas with sensitive plant species, animals species, and ecosystems off limits, allowing drilling only on existing roads or cleared areas used for other resource management, no ATV use, use of only rickshaw and backpack seismic survey drills, no oil and gas activities in the small units like Loblolly and Hickory Creek Savannah Units, no drilling along river corridors.

No destruction of habitat when alternatives are exercised.

NPS must have as a basic policy to maximize the reduction of any oil and gas activity's footprint.

Provide procedures that allow mineral estate owners timely access to their property if not already a part of the existing oil and gas management plan.

Existing pipelines and power lines should be consolidated in a few corridors.

Activity should be confined to existing roads and areas previously disturbed by oil activity.

NPS regulations should allow simplified and less costly plans-of-operations and expedited approval processes. Waivers for plans-of-operations, where feasible, should be allowed. These could be similar to the waivers currently allowed for production from the Big Thicket resulting from directional drilling from outside the preserve. Simplified plans-of-operation and waivers would substantially reduce economic losses to mineral owners due to burdensome and costly NPS requirements.

Management plan should include the requirements for a specific use fee dedicated to restoring minor impacts and rehabilitating areas already impacted by oil and gas work at the discretion of the preserve superintendent. Both seismic and exploratory/ production work can have impacts that may not be detected until long after operators have vacated the site. This fee would not permit or authorize damages; i.e., it would not be damage waiver fee. Damages from oil and gas work would be taken care of by the operator according to management plan requirements.

NPS should have the capability to receive direct or indirect compensation, either in the form of payment, services, or equipment, to mitigate for impacts the natural resources of national significance they administer and protect in trust for the American public.

TOPICS
Suggest: For each acre damaged on the preserve, 100 contiguous acres of the same community type outside the preserve will be located, restored (if needed), and given to Big Thicket (or some management-minded conservation organization such as the Nature Conservancy). This acreage would include mineral rights. For each hole drilled in the ground, an additional acre will be added to the holdings off the preserve. All lands will be acquired in Hardin, Tyler, or surrounding counties and in all cases large tracts that can be managed will be obtained, not single scattered acres. A botanist and an ecologist (operating independently of both the oil companies and the preserve) will help decide what land to acquire and develop management guidelines that will be followed. Money to manage the land will be put in a fund by the company and used by the managers when necessary, for example, for burning, hand clearing, etc. When the company leaves the Big Thicket site, it will restore the damage done to the satisfaction of an ecologist/botanist who specializes in that community, hired independently of the company and the preserve. If the company does not restore the site, it will forfeit bond. The bond will be used to purchase more land offsite because "restoration" to original condition is a myth.
Resources and Values Potentially at Stake
Ninety-nine percent of Texas is privately owned. Much of the tiny fraction of land in public ownership is heavily exploited for resources: petroleum, gas, minerals, and timber. Public lands are virtually the only areas where natural and ecological integrity can even be hoped to remain "unimpaired for future generations."
The vast majority of the natural landscape has been destroyed or is on the verge of destruction. Wetland pine savannas (which are jurisdictional wetlands) have been virtually destroyed in the West Gulf Coastal Plain. The community is considered endangered.
Need to recognize that the mineral interest owners have a stake in this too, not just the operators. If you prohibit the drilling in an area, you are effectively taking the rights of the mineral interest owner to realize the mineral value in the property he/she owns.
The mineral estate is the superior estate in Texas. Be aware of this and do not impose restrictions that would result in a taking of the mineral rights.
The proposed oil and gas management plan/EIS and NPS regulations must recognize, provide for, and protect the distinct and extraordinary property rights of mineral owners.
Under "Resources and Values Potentially at Stake," add solitude to natural quiet.
Also add wilderness like and wild lands character as an important resource that Big Thicket has.

LIST OF DOCUMENT RECIPIENTS

In December 2004, the NPS released the Draft Oil and Gas Management Plan/EIS to the "List of Document Recipients" shown below, for a 60-day public review period which was subsequently extended 30 days ending on March 10, 2005. Notices of Availability of the Draft Plan/EIS were published in the *Federal Register* by the U.S. Environmental Protection Agency (December 10, 2004), and the NPS (December 13, 2004). The NPS received 71 comment letters on the Draft Plan/EIS: 2 from Federal agencies; 2 from State agencies (one was a no comment response); 7 from mineral interest holders and operators; 1 from a group of environmental interests; and 59 form letters. They are reprinted at the end of this chapter. The National Park Service's responses to substantive comments are also provided. This Final Plan/EIS includes corrections and additions based upon the substantive comments received.

Federal Government

Congressional Delegation

United States Senator Kay Bailey Hutchison
United States Senator John Cornyn
United States Representative Ted Poe – 2nd District
United States Representative Al Green – 9th District

Agencies

Department of the Army
U.S. Army Corps of Engineers, Galveston District

U.S. Department of Agriculture
- Natural Resources Conservation Service
  - USDA Hardin County Office
  - USDA Jasper County Office
  - USDA Liberty County Committee
  - USDA Polk County Office
  - USDA Service Center, Beaumont, TX
  - USDA Service Center, Jefferson / Orange County
- U.S. Forest Service
  - Angelina National Forest
  - Caddo-LBJ National Grasslands
  - Davy Crockett National Forest
  - Sabine National Forest
  - Sam Houston National Forest
  - Southern Research Station

U.S. Department of Energy
- Federal Energy Regulatory Commission, Washington, D.C.

U.S. Department of the Interior
- Bureau of Reclamation – Area Planning Office, Austin, Texas
- U.S. Fish and Wildlife Service
  - Anahuac National Wildlife Refuge
  - Clear Lake Ecological Services Field Office
  - McFaddin National Wildlife Refuge
  - Texas Point National Wildlife Refuge
  - Trinity River National Wildlife Refuge
- U.S. Geological Survey
  - National Wetlands Research Center, Lafayette, Louisiana
  - Water Resources Division, Fort Worth Subdistrict
  - Water Resources Division, Houston Subdistrict
  - Water Resources Division, Texas District
- National Park Service
  - Big Cypress National Preserve
  - Big South Fork National River and Recreation Area/Obed Wild and Scenic River
  - Jean Lafitte National Historical Park and Preserve
  - Lake Meredith National Recreation Area/Alibates Flint Quarries National Monument
  - New River Gorge National River
  - Padre Island National Seashore

U.S. Department of Justice
- U.S. Attorney General

U.S. Department of Transportation
- U.S. Coast Guard
  - Port Arthur Safety Office
  - Sabine Pass Station

Federal Emergency Management Agency – Insurance and Mitigation Division, Region VI

TRIBAL GOVERNMENT

Alabama-Coushatta Tribe of Texas
Coushatta Tribe of Louisiana

STATE GOVERNMENT

Texas State Governor Rick Perry
Texas State Lt. Governor David Dewhurst
Texas State Senator Kyle Janek
Texas State Senator Todd Staples
Texas State Senator Tommy Williams
Texas State Congressman Joe Deshotel
Texas State Congressman John C. Otto
Texas State Congressman Roy Blake
Texas State Congressman Mike “Tuffy” Hamilton
Texas State Congressman Jim McReynolds
Texas State Congressman Allan Ritter
Texas Attorney General Greg Abbott
Texas Department of Agriculture
Texas Department of Agriculture Gulf Coast Regional Office
Texas Department of Economic Development
Texas Department of Health
Texas Department of Public Safety
Texas Department of Transportation
Texas Forest Service
Texas General Land Office
Texas Historical Commission
Texas Natural Resources Conservation Commission
    Office of Air Quality
    Water Resource Management
Texas Parks and Wildlife Department
Texas Railroad Commission
Texas Water Development Board

REGIONAL, COUNTY AND CITY GOVERNMENT AGENCIES AND COMMISSIONS

Regional Agencies

Angelina and Neches River Authority
Deep East Texas Council of Governments
Lower Neches Valley Authority
Sabine River Authority
South East Texas Regional Planning Commission
Trinity River Authority of Texas
Upper Neches River Municipal Water Authority

County Government

Hardin County Judge
Hardin County Commissioner Precinct 1
Hardin County Commissioner Precinct 3
Hardin County Commissioner Precinct 4
Jefferson County Judge
Jefferson County Commissioner Precinct 1
Jefferson County Commissioner Precinct 2
Jefferson County Commissioner Precinct 3

Liberty County Judge

City Government

City of Beaumont
City of Bevil Oaks
City of Bridge City
City of China
City of Groves
City of Kountze
City of Lumberton
City of Nederland
City of Nome
City of Orange
City of Pine Forest
City of Port Arthur
City of Port Neches
City of Rose City
City of Silsbee
City of Sour Lake
City of Vidor
City of West Orange

OIL AND GAS INDUSTRY

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Ballard Exploration Company, Inc.
Basil Oilfield Service, Inc.
Black Hills Operating Company, LLC
Black Lake Pipeline
Buford Curtis, Inc.
Caskids Operating Company
Centana Intrastate Pipeline Company
Century Resources Land, LLC
Chevron Pipe Line Company
Citgo Pipeline Company
CMS Trunkline Gas Company
Coastal States Gas Transmission Company
Cobra Exploration Company
Colonial Pipeline Company – Gulf Coast District
Comstock Oil and Gas, Inc.
Clark Port Arthur Pipeline Company
Crown Petroleum Company
Cypress Pipeline Operations
Davis Bros. Oil Producers, Inc.
Duncan Energy Company
Dynegy Midstream Services – Hackberry Storage Facility
El Paso Field Services
Enron Gas and Pipeline Group
Entergy
Enterprise Products Operating L.P.
Explorer Pipeline Company
Exxon Pipeline Company-Mt. Belvieu Operations

Fina Pipeline Systems
Grant Geophysical Corporation
Gulf State Pipe Line Company
Houston Pipeline Company
Huntsman Petrochemical Corporation
Inland Geophysical Services
Kinder Morgan Energy Partners, L.P.
Koch Gateway Pipeline Company
Koch Pipeline Company, L.P.
Lion Oil Company
Litchfield Production Company
Merit Energy Company
Milestone Operating, Inc.
Minerals Search, Inc.
Mobil Pipe Line Company
Murphy Exploration and Production Co.
Natural Gas Pipeline Co. of America/Mid–Con Texas Pipeline Corporation
North Central Oil Corporation
Omega Energy Corporation
Oxy Petroleum, Inc.
Penwell Energy, Inc.
Petronomics, Inc.
PPG Industries, Inc.
Praxair, Inc.
Premium Exploration Company
Quail Creek Oil, Inc.
Reid Production Company
Richman Petroleum Corporation
Sanchez Oil and Gas Corporation
Seagull Products Pipeline Corporation
Seismic Exchange, Inc.
Seminole Pipeline Company
Smith Production, Inc.
Spirit Energy 76
Star Enterprise
Sun Pipe Line Company
Swelco Inc.
Tennessee Gas Pipeline Company
Tennessee Gas Pipeline Company – Pipeline Services
Texaco Pipelines LLC
Texas Eastern Transmission Corporation
Torch Energy TM, Inc.
Transcontinental Gas Pipe Line Corporation
Tri-C Resources, Inc.
Ultramar Diamond Shamrock
Union Pacific Resources Company
Unocal Corporation
Weems Geophysical
WesternGeophysical
Westport Oil and Gas

ORGANIZATIONS AND BUSINESSES

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America's Wetland
Armand Bayou Nature Center
Bat Conservation International
Bayou Preservation Association
Beaumont BASS Anglers/Texas BASS
Berg-Oliver Associates, Inc.
Big Thicket Association
Big Thicket Institute
Big Thicket Natural Heritage Trust
Blanton & Associates, Inc.
Bog Research
Champion International Corporation
Clean Air & Water, Inc.
Coalition Advocating a Safe Environment
Coastal Conservation Association of Texas
Coastal Environments, Inc.
Ekistics Corporation
Fulbright & Jaworski L.L.P.
Garner Environmental Services, Inc.
Gulf Coast Prairies Foundation
Hogan and Hartson
Houston Audubon Society
League of Women Voters of Texas
Louisiana Pacific Corporation
Moore Archeological Consulting
National Association of Conservation Districts
National Audubon Society
National Fish and Wildlife Foundation
National Parks and Conservation Association
Native Plant Society
Nature Conservancy of Texas
Northrup Associates, Inc.
Parks and Wildlife Foundation of Texas
Preservation Planning & Consulting
Roy E. Larson Sandyland Sanctuary
Sabine – Neches Conservation Club
Safari Club International of Texas, Pineywoods Chapter
Sierra Club – Houston Chapter
State Resource Strategies
Temple-Inland Forest Products Corp.
Temple-Inland Industries
Texas Committee on Natural Resources
Texas Folklore Society
Texas Logging Council
Texas Parks and Recreation Foundation
Texas Rural Development Council
Texas Wildlife Association
Texas Wildlife Society
Timber Ridge Tours
United Conservation Alliance

Waldman & Smallwood
Wetland Habitat Alliance of Texas

UNIVERSITIES AND COLLEGES

Baylor University
Houston Community College
Lamar University at Beaumont
Rice University
Sam Houston State University
Stephen F. Austin State University – College of Forestry
Texas A&M University – Department of Soil and Crop Sciences
Texas A&M University – Department of Wildlife and Fisheries
University of North Texas – Department of Biological Sciences

NEWSPAPERS AND MAGAZINES

Beaumont Enterprise
The Examiner
Hardin County News
Houston Chronicle
Jasper News-Boy
Jefferson County Court News
Journal of Conservation Biology
Orange Leader
Port Arthur News

RADIO AND TELEVISION

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KBMT-TV
KFDM-TV
KITU-TV
KLVI
KVHP-TV

COMMENTS	RESPONSES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

MAR 07 2005

Art Hutchinson
Superintendent
United States Department of the Interior
National Park Service
Big Thicket National Preserve
3785 Milam
Beaumount, TX 77701

Dear Mr. Hutchinson:

In accordance with our responsibilities under Section 309 of the Clean Air Act, the National Environmental Policy Act (NEPA), and the Council on Environmental Quality (CEQ) Regulations for Implementing NEPA, the U.S. Environmental Protection Agency (EPA) Region 6 office in Dallas, Texas, has completed its review of the Draft Oil and Gas Management Plan and Environmental Impact Statement (DEIS) for the Big Thicket National Preserve.

EPA rates the DEIS as "**EC-2,**" i.e., EPA has "**Environmental Concerns and Requests Additional Information in the Final EIS** (FEIS)." EPA has identified environmental concerns and informational needs to be included in the FEIS to complement and to more fully insure compliance with the requirements of NEPA and the CEQ regulations. Areas requiring additional information or clarification include: jurisdictional wetlands delineation and more information supporting preferred alternative selection.

Our classification will be published in the Federal Register according to our responsibility under Section 309 of the Clean Air Act to inform the public of our views on proposed Federal actions. Detailed comments are enclosed with this letter, which more clearly identify our concerns and the informational needs requested for incorporation into the FEIS. If you have any questions, please contact Mike Jansky of my staff at 214-665-7451 or e-mail him at jansky.michael@epa.gov for assistance.

EPA appreciates the opportunity to review the DEIS. Please send our office five copies of the FEIS when it is sent to the Office of Federal Activities, EPA (Mail Code 2252A), Ariel Rios Building, 1200 Pennsylvania Ave, N.W., Washington, D.C. 20460.

Sincerely yours,

Gedell Cerny for 03/7/05

Bonnie Braganza, Acting Chief
Office of Planning and
Coordination (6EN-XP)

Enclosure

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COMMENTS	RESPONSES

DETAILED COMMENTS
ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
FOR THE
OIL AND GAS MANAGEMENT PLAN
FOR
BIG THICKET NATIONAL PRESERVE, TEXAS

BACKGROUND

The DEIS analyzes three alternative approaches that could be implemented over the next 15-20 hears for managing existing and anticipated oil and gas operations associated with the exercise of non-federal oil and gas interests underlying the Preserve, and existing transpark oil and gas pipelines and activities in their associated rights-of-way within a unit. The documents states that approximately 29 wells would be drilled over the next 10-15 years and would directly impact approximately 153 acres or 0.2 percent of the Preserve.

COMMENTS

Alternative Selection and Wetlands

1. EPA is primarily concerned with potential impacts to wetlands because 40% of the Preserve is comprised of wetlands of various types. The impact acreage given above was not broken down into wetlands and uplands, so one would assume this would not all be wetlands. However, on page 4-76 of the DEIS, the 153-acre figure is used in discussing wetland impacts, so one might infer it is all wetlands. This should be clarified, although we do not expect a precise acreage of wetland impacts to be known at this time.

Of particular concern are some of the rare and fragile wetland types such as Wetland Pine Savanna, Cypress Tupelo Swamp, and Baygall Shrub Thickets. Impacted wetlands are generally difficult to restore or replace, but it may not be possible to fully restore or replace these especially sensitive areas. Thus we would support maximum protection for such areas.

Alternative A is the no action plan where existing management would continue, which is apparently involves no comprehensive plan for managing oil and gas exploration activities. Each activity is handled on a case-by-case basis. Alternatives B and C specify Special Management Areas in which activity would be restricted seasonally or year round as specified on the maps (figs 2.3– 2.6). This would result in most wells being directionally drilled to avoid wetlands and other sensitive areas.

2. The main difference we perceive in Alternative C is that activities would be somewhat more restricted than in Alternative B. Although either B or C would be preferable Alternative A, we recommend Alternative C since an increased level of protection is warranted for the above mentioned sensitive wetland types. Alternative C is identified as the environmentally preferred approach. The EIS needs to explain why Alternative B was chosen over the environmentally preferred alternative, Alternative C.

Furthermore, oil and gas exploration activities in wetlands generally require authorization from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. The "Section 404(b)(1) Guidelines" [40CFR230] under which the EPA comments on proposed Section 404

1. The Draft Plan/EIS is a programmatic management plan, and the impact analysis describes impacts "on up to 153 acres of the Preserve, which could include wetland vegetation if wetlands are not avoided." The "on up to 153 acres in the Preserve" derives from the RFD scenario that projects approximately 29 wells could be drilled on up to 153 acres or 0.2 percent of the Preserve over the next 15 to 20 years. Operators are generally expected to avoid development in wetlands to avoid triggering U.S. Army Corps of Engineers Section 404 and NPS wetlands requirements. It can be reasonably assumed that the rare wetlands communities proposed as SMAs will not be directly impacted but other types of wetlands that are more resilient to disturbance and have been restored successfully in the past may be developed. Under any alternative, the acreage of total wetlands impacts from future nonfederal oil and gas development will be much less than the "up to 153 acres or 0.2 percent of the Preserve."

2. The following text was inserted in the Final Plan/EIS, on page 2-14, at the end of the text under the heading "Alternative B, Preferred Alternative:" "Alternative B was chosen as the preferred alternative over Alternative C, the environmentally preferred alternative, because it would meet the planning objectives better than Alternative C (shown on Table 2.3, Description of the Extent that Each Alternative Meets the Planning Objectives Presented in this Plan/EIS). The NPS believes Alternative B would fulfill its park protection mandates while allowing nonfederal oil and gas operators to exercise their property interests."

COMMENTS	RESPONSES
2. Cont. permits requires that the least environmentally damaging practicable alternative be selected. Thus our recommendation is consistent with these regulations. Finally, if we receive permit applications for Section 404 permits in the future for proposed individual projects on the Preserve, EPA may make additional, site specific comments at that time. If you have any questions regarding these comments, please contact Norm Sears at 214-665-8336.	

COMMENTS	RESPONSES

United States Department of Agriculture | Forest Service | Southern Research Station | Wildlife Habitat and Silviculture Lab
P.O. Box 7600 SFA
Nacogdoches, TX 75962
936/569-7981 Phone
936/569-9681 Fax

File Code:

Date: 20 January 2005

Linda Dansby
EIS Project Manager
Office of Minerals/ Oil and Gas Support
Intermountain Region
Santa Fe, NM 87504-0728

Dear Ms Dansby:

I appreciate the opportunity to comment on the Draft Oil and Gas Management Plan for the Big Thicket National Preserve. Achieving a balance between resource protection and oil and gas extraction is an important management issue on the Big Thicket National Preserve. I have attached my comments to this letter. I have also enclosed a number of publications that are relevant to impacts on the Big Thicket National Preserve, especially in relation to roads, that could be cited in the Plan.

I hope that these comments are helpful in preparing the Final Oil and Gas Management Plan.

Best Regards,

D. Craig Rudolph

D. Craig Rudolph
Research Ecologist
Southern Research Station
506 Hayter Street
Nacogdoches, TX 759655

Ph.: 936-569-7981
E-mail: crudolph01@fs.fed.us

Enc.

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COMMENTS	RESPONSES
COMMENTS ON "OIL AND GAS MANAGEMENT PLAN – ENVIRONMENTAL IMPACT STATEMENT BIG THICKET NATIONAL PRESERVE" As a U. S. Forest Service Research Ecologist working in eastern Texas I have some familiarity with impact issues in the region. My research has primarily involved Red-cockaded Woodpeckers (*Picoides borealis*), Louisiana pine snakes (*Pituophis ruthveni*), timber rattlesnakes (*Crotalus horridus*), topics involving fire-maintained ecosystems, threatened/endangered/sensitive species (TES), and road impacts on vertebrate species. I have briefly scanned the draft plan and have identified several points that I comment on below. I did not thoroughly read the entire draft. Comments below apply primarily to the Fish and Wildlife Sections. Some general comments are listed first, followed by specific comments referenced by page. 1. The environmental impacts of geophysical exploration seem to be minimal and short term if heavy equipment is not used. ATVs and hand lines would be preferred. However, if multiple surveys occur, cumulative effects could be an issue. **3.** 2. Drilling and production raise some issues. It is very difficult to assess the impact of surface disturbances, especially roads and pipelines on species of concern. Since proposed exploration has not yet occurred, the extent and location of the road system that will be developed and levels of use are unknown. Given these unknowns, I do not see how it is possible to accurately evaluate impacts. Consideration of the maps provided, indicate that roads could be constructed in most areas of the preserve, and greatly compromise the current extent of roadless areas. This is of concern because the impacts of road-related mortality can extent many hundreds of meters from the actual road corridor. My research on timber rattlesnakes (see attachments), a state listed threatened species in Texas, suggests that road-related mortality is a primary cause of population extirpation. The BTNP currently represents some of the best habitat blocks in the state for this species. Construction of additional roads within the larger blocks of habitat could potentially lead to extirpation of this species within the BTNP. The maps provided under both Alternatives B and C indicate that surface impacts, including roads, could occur within a few hundred meters of essentially all points on the BTNP. Without more detailed regulation of areas to be impacted, it is not unreasonable to assume that core areas of the Preserve would be involved because the companies would be trying to access larger Special Management Areas (SMAs) using directional drilling. The cumulative impacts of these roads need to be assessed, in conjunction with present and future development on private lands adjacent to the preserve, to reasonably assess potential impacts on various species. The limited extent of un-fragmented habitat blocks within BTNP is currently one of the most serious limitations impacting the ability of managers to maintain viable populations of some species.	**3.** This programmatic management plan is not intended to analyze project-level impacts. Roads are quantified in Chapter 2 as part of the reasonably foreseeable development scenario, and in Chapter 3 to describe current operations. The quantification of roads is included in Chapter 4, Environmental Consequences, to assess impacts from geophysical exploration, drilling and production, and plugging/abandonment/reclamation, in addition to assessing cumulative effects. Scoping will be carried out for each project to identify important issues for consideration in a project-specific analysis. Similarly, the NPS will carry out its Section 7 responsibilities under the Endangered Species Act on a case-by-case basis.

COMMENTS	RESPONSES
Limitations on surface impacts appeared to be based on withdrawal of sensitive areas. This is a necessary first step. However, consideration of additional withdrawals to preserve large blocks of un-fragmented habitat would also be desirable. These may be the only refuge for area sensitive species on the BTNP. There may be substantial benefits in the design of these areas, in conjunction with directional drilling, that could greatly limit adverse ecological impacts. 3. Prescribed fire is a critical ecological process required to maintain habitat for many species in the BTNP. Current levels of prescribed fire are low compared to what is needed to maintain habitat. I saw no discussion of how development of oil and gas infrastructure might further impact the efficiency of the prescribed fire program. It is important for management of many species within the BTNP that development not compromise the current, and hopefully increasing, use of prescribed fire on the preserve. Impacts of the fire program are cumulative and need to be assessed in conjunction with all other limitations on use of prescribed fire. Species are undoubtedly being extirpated on the BTNP due to insufficient fire-maintained habitat and additional impediments to the prescribed fire program will be detrimental.	
4.	**4.** Refer to the discussion of "Park Operations for Fire and Facility Management" on pages 1-23 and 1-24 of the Draft Plan/EIS.
4. Clearly, Alternatives B and C, with greater extent of surface use withdrawal, are to be preferred. However, without the information needed to project the actual level and location of infrastructure development, it is not possible to assess the impacts of either alternative with any accuracy. However, even under Alternatives B and C impacts, especially of roads, could be severe.	
5.	**5.** Due to the programmatic nature of the Draft Plan/EIS, the analysis describes impacts "on up to 153 acres of the Preserve." To quantify impacts as much as reasonably possible, the NPS uses the "on up to 153 acres in the Preserve" to correlate with the RFD scenario that projects that approximately 29 wells could be drilled on up to 153 acres or 0.2 percent of the Preserve.
5. I would have liked to have seen the inclusion of an alternative that relied on more extensive use of directional drilling from adjacent lands and within the preserve. I suspect that most oil and gas resources could be extracted using directional drilling. Such an alternative could preserve what will, within a very short time-frame, be the only sizable blocks of natural, unfragmented habitat remaining in this portion of Texas. Use of directional drilling would not need to be an "all or nothing" strategy, but could be designed to limit surface impacts within some of the more extensive blocks of habitat. These blocks should be stipulated in such an alternative.	
6.	**6.** Directional drilling is a prominent feature of all three alternatives, particularly where the no-surface-use stipulation is applied in Protected Areas or Special Management Areas during specified times or year-round.
6. Point # 5 raises an additional issue. It is difficult to formulate an overall opinion on the proposed development given only one side of the issue. There is no information provided on the impacts of various constraints on the oil and gas operators. Is restriction of surface access and use of directional drilling a major issue? How would increasing restrictions on road construction impact oil and gas interests? How much education and oversight would be given to personnel, and how effective would it be, in relation to reducing road mortality? Answers to these and other questions would be required to adequately evaluate impacts and devise strategies to mitigate impacts. This document should be an attempt to balance resource protection and extraction of oil and gas. It is not possible to do so without knowing the tradeoffs involved.	
7.	**7.** The cost and complexity for an operator to develop its mineral interests depends on site-specific environmental conditions and the specific type of operation proposed; therefore, developing strategies to satisfy project-specific issues is beyond the scope of this programmatic management plan. The analysis of impacts in Chapter 4, Environmental Consequences, describes how the restriction of surface access and directional drilling would increase the cost and complexity of an oil and gas proposal. In some cases, the additional costs and complexity may be balanced by avoiding additional costs and complexity associated with permitting requirements such as avoiding Section 404 permitting by avoiding wetlands impacts.

COMMENTS	RESPONSES
8. 7. The overall tenor of the draft seems to be one of minimizing impacts (Pg. 4-112: "no adverse impacts of species of special concern"), and maximizing supposed benefits (Pg. 4-111: "Designation of SMAs would improve habitat …."). The former is unlikely to be true and the latter is misleading as designating SMAs is, at best, maintaining the status quo.	**8.** The NPS currently protects resources and values within the areas described in this plan as SMAs on a case-by-case basis. The formal designation of SMAs proposed under Alternative B, along with the application of timing restrictions and the no surface use stipulation, is expected to provide more consistent protection of species of special concern.
Specific comments referenced by page.	
9. 1. Pg. 3-49: The Bordelon and Knutsen (1999) reference is limited to lepidoptera, it is not a "comprehensive inventory of invertebrates."	**9.** This was changed in the Final Plan/EIS.
10. 2. Pg. 3-55: Louisiana pine snake. Published literature is available (enclosures) that further define ecology, habitat, threats, and status of this species and should be cited.	**10.** The Draft Plan/EIS provides an overview of the Louisiana pine snake and occurrence in the Preserve. The commenter's published literature will be applied in project-specific analyses, as appropriate.
11. 3. Pg. 3-55: Timber rattlesnake. Published literature (enclosures) documenting the threats due to road related mortality are available and should be cited.	**11.** The Draft Plan/EIS provides an overview of the Timber rattlesnake and occurrence in the Preserve. The commenter's published literature will be applied in project-specific analyses, as appropriate.
12. 4. Several statements in the draft (Pg. 4-89, "localized, short-term, negligible to minor, adverse impacts"; Pg. 4-90, "up to 153 acres of the Preserve", Pg. 4-92, "no impact to indirect, localized to widespread, short- to long-term, moderate, adverse impacts"; Pg. 4-93, "376 acres inside the Preserve"; Pg. 4-95, "short- to long-term, moderate, adverse impacts"; Pg. 4-96, "short- to long-term, moderate, adverse impacts"; Pg. 4-97, "short- to long-term, moderate, adverse impacts"; and similar statements in the Alternative C section understate the area and extent of potential impacts due to road construction. Many species, snakes in particular, are vulnerable to road related mortality that can result in population reduction or extirpation (see enclosures) with impacts extending far beyond actual road corridors. These impacts apply to two of the listed species (timber rattlesnake, Louisiana pine snake) that occur, or potentially occur, on the preserve. Data indicate that measurable impacts can extend for several hundred meters, perhaps 0.5 miles, from roads.	**12.** Site-specific analysis will be undertaken on a project-by-project basis, in consultation with the U.S. Fish and Wildlife Service, as appropriate. The NPS believes that the application of mitigation measures to plans of operations, on a project-specific basis, which may include training the operator and contractor in species identification, reduced speed limits, employing road monitors on ATV in advance of large vehicles that have reduced visibility of the road, among others, would result in the impacts described.
13. 5. Pg. 4-91: The statement that "Superintendent can close or restrict motorized public access on roads" gives no indication as to the probability of this actually occurring. Wildlife mortality, inadvertent or purposeful, always occurs on roads. Are "oil and gas" roads viewed by BTNP as eventually increasing public access?	**13.** When a nonfederal oil and gas operator is permitted by the NPS to construct an access road, the road is accessible only by the operator, its contractors and subcontractors, and the NPS. Access to the roads is controlled by locked gates. On occasion, when an operator ceases an operation, the Preserve may opt to retain an access road or portion of an operations area for conversion to park and/or visitor use. In this event, the Preserve assumes responsibility for the maintenance and eventual reclamation of the developments.
14. 6. Pg. 4-97: The "Cumulative Impacts" statement at the bottom of the page, and similar statements elsewhere (Pg. 4-111: "SMAs that would improve habitat for Red-cockaded Woodpeckers…"), is misleading. These statements indicate that improvements would result from designation of SMAs. A more straightforward statement would indicate that designation of SMAs would	**14.** The analysis is focused on where operations could occur. The formal designation of SMAs under Alternatives B and C would improve habitat for Red-cockaded Woodpeckers by closing these areas either seasonally or year-round to geophysical and/or drilling and production operations, as described on pages 4-110 through 4-116 of the Draft Plan/EIS.

COMMENTS

14. Cont.

partially maintain the status quo. Partially, because development closely adjacent to SMAs would have impacts on the SMAs. The focus of impact assessment should be on the non-SMA areas.

15.

7. Pg. 4-97: "natural events, such as fire, flood and drought," and similar statements elsewhere (Pg. 4-108: fire management program could contribute to short-term habitat loss"), tend to place a negative connotation on these ecological processes required to maintain ecosystem function and sustain many of the species specifically listed in the draft. A much more positive emphasis on these processes would be preferable. This is especially the case since ongoing impacts, fire suppression and reduction in flood events due to reservoir construction, have resulted in major detrimental impacts to essentially all of the BTNP.

16.

8. Pg. 4-105: "Low speed roads are not expected to appreciably increase mortality." I assume this means in relation to absence of roads. However, species that are intentionally targeted or slow-moving will suffer increased mortality. Snakes are an obvious group that will likely experience significantly increased mortality rates.

17.

9. Pg. 4-107: "two federally-listed species ..... are expected to improve." Not, however, as a result of oil and gas activities!

18.

10. Pg. 4-108: "remote possibility for the incidental take .... a species of special concern." Incidental take is almost a certainty. Development of a road network with substantial vehicle use will almost certainly result in mortality of most, if not all, snake species found on the preserve. Timber rattlesnakes, in particular, will be vulnerable to substantial population level impacts.

In summary, the draft protocol does not adequately assess the impacts of oil and gas development on the BTNP, especially in relation to TES species. Given the vague estimates of levels and distribution of development, perhaps all that is available, it is not possible to accurately forecast impacts. However, detrimental population level impacts on some TES species are almost certain to occur.

/s/ D. Craig Rudolph
Research Ecologist
USDA Southern Research Station
506 Hayter St.
Nacogdoches, TX 75965

RESPONSES

15. Taken in context with the remainder of the sentence, the statement on page 4-97 is accurate. In the paragraph preceding the one cited, prescribed fire management practices are noted to result in improving fish and wildlife habitat. These statements are found in the brief conclusion statements which summarize the preceding analysis. We refer the reader to the cumulative impact analysis under Alternative A, on pages 4-93 and 4-94, particularly, the last sentence in the 2nd paragraph on page 4-94 of the Draft Plan/EIS that states, "The Preserve's prescribed fire management program could contribute to short-term habitat loss and result in adverse effects to wildlife including increased stress and mortality, and decreased productivity, but would provide long-term cumulative beneficial impacts on Preserve vegetation by restoring and maintaining wildlife habitats and biodiversity."

16. The analysis of impacts on Fish and Wildlife under Alternative A, on page 4-90 of the Draft Plan/EIS, states: "Increased mortality could result from vehicles, construction activities, and increased access into previously inaccessible areas… Many of the impacts on fish and wildlife from drilling and production are associated with construction activities. Fish and wildlife, particularly small mammals, invertebrates, and herpetofauna (reptiles and amphibians) that cannot escape an area during construction could be killed, and increased mortality for small mammals is also likely to occur along access roads."

17. Comment noted.

18. During the development of a plan of operations, if the NPS identifies the potential for an incidental take, the NPS is responsible for carrying out Section 7 responsibilities under the Endangered Species Act which would entail formal consultation in order to receive an incidental take permit if mitigation measures could not be applied to negate the need for one. Appropriate mitigation measures would be developed, to avoid or reduce the potential for incidental take.

COMMENTS	RESPONSES

Kathleen Hartnett White, *Chairman*
R. B. "Ralph" Marquez, *Commissioner*
Larry R. Soward, *Commissioner*
Glenn Shankle, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

March 8, 2005

Linda Dansby
EIS Project Manager
Office of Minerals/ Oil and Gas Support
Intermountain Region
P.O. Box 728
Santa Fe, New Mexico 87504-0728

Re: TCEQ GEARS #6382, Draft Oil and Gas Management Plan/EIS for Big Thicket National Preserve

Dear Ms. Dansby:

The Texas Commission on Environmental Quality (TCEQ) has reviewed the above-referenced project and offers the following comments:

We have no comments. The environmental assessment addresses issues related to surface and groundwater quality.

Thank you for the opportunity to review this project. If you have any questions, please call Mr. Forrest Brooks at (512) 239-4900.

Sincerely,

Thomas W. Weber

Thomas W. Weber
Manager, Water Section
Chief Engineer's Office

P.O. Box 13087 • Austin, Texas 78711-3087 • 512/239-1000 • Internet address: www.tceq.state.tx.us
printed on recycled paper using soy-based ink

COMMENTS

TEXAS GENERAL LAND OFFICE
JERRY PATTERSON, COMMISSIONER

March 9, 2005

Linda Danby, EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Support Office
1100 Old Santa Fe Trail
Santa Fe, New Mexico 87504-0728

RE: Comments on Draft Oil and Gas Management Plan
September 2004 Environmental Impact Statement ("Plan")
Big Thicket National Preserve, Texas

Dear Ms. Danby:

The Texas General Land Office (GLO) owns the oil and gas rights under numerous river tracts located within the current boundaries of the Big Thicket National Preserve, as well as additional areas sought to be included in the Preserve.

As you know, the GLO is charged with the responsibility of protecting state lands and generating revenue for the Permanent School Fund (PSF) in an environmentally and economically prudent manner. Royalties from oil and gas produced on state lands are deposited into the PSF, which generates revenue for Texas public school students from kindergarten through the 12th grade. Of the more than 13 million acres held by the PSF, approximately 1 million acres are estimated to be within riverbeds in the State of Texas.

19.

While this office appreciates the extensive volume of research that went into drafting the Plan, the GLO has objections to Alternatives B and C of the Plan. In particular, these alternatives restrict or prohibit the mineral owners' rights of ingress and egress by virtue of designating a significant percentage of the acreage within the boundaries as no surface access and no surface occupancy areas. The imposition of these alternatives would essentially result in a partial condemnation of the mineral estate. The GLO believes that consideration should be given to creating designated surface drilling site locations at reasonable intervals, such that all mineral interest owners' rights of ingress and egress can be accomplished using currently available drilling technology.

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RESPONSES

19. One of the objectives of this Plan/EIS, listed on page 1-16 of the Draft Plan/EIS, is to "Provide holders of oil and gas rights reasonable access for exploration and development." The alternatives described and evaluated in this Plan/EIS are designed to meet this objective, in addition to the other planning objectives necessary to protect park resources and values, visitor use and enjoyment, and human health and safety; and to prevent an impairment to park resources and values. This Plan/EIS is intended to provide information to facilitate nonfederal oil and gas owners' and operators' exploration and development of their mineral interests.

The NPS's application of its regulatory authority to nonfederal oil and gas activities under 36 CFR Part 9, Subpart B, is not intended to result in the taking of a property interest, but rather is designed to impose reasonable regulations on activities that involve or affect federally-owned lands. See 36 CFR § 9.30(a). Since the 9B regulations were promulgated in 1979, the NPS has never denied a plan of operations. Furthermore, the NPS has complied fully, and will continue to comply fully, with Exec. Order No. 12,630, 3 C.F.R. 554 (1989), "Governmental Actions and Interference with Constitutionally Protected Property Rights." Under each of the alternatives analyzed in this document the NPS considers an operator's proposal on a case-by-case and site-specific basis. The 9B regulations were designed to encourage technological innovation, see § 9.37(a)(1). If an operator can demonstrate that a particular technology would reduce the potential for impact on resources in the parks, the operator may be exempt from specific operating stipulations described in this plan as noted on page 2-3 of the Draft Plan/EIS. The NPS anticipates that the Oil and Gas Management Plan/EIS will be a useful tool to facilitate planning and conducting nonfederal oil and gas operations in the Preserve.

The following 2 sentences on Page 2-62 of the Draft Plan/EIS were deleted:
"The NPS's position to not contravene the Fifth Amendment is further underscored by Executive Order 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights." The alternatives selected and evaluated in this document comply with this executive order."

The following sentence was inserted in their place:
Furthermore, the NPS has complied fully, and will continue to comply fully, with Exec. Order No. 12630, 3 C.F.R. 554 (1989), "Governmental Actions and Interference with Constitutionally Protected Property Rights."

COMMENTS

Ms. Linda Danby, EIS Project Manager
March 9, 2005
Page 2

The GLO leases its minerals to third-party oil and gas companies who seek to drill wells, after using methods such as 3-D seismic to evaluate property. Under this process, the GLO is paid bonus money for awarding the leases, and receives a percentage of production as a royalty. As stated, these funds are deposited into the PSF. The costs to industry associated with the 9(B) regulations and implementation of the Plan may discourage companies from acquiring such leases in the area due to the added costs.

20.

There will also be impacts to the Southeast Texas economy, including local entities that depend on ad valorem taxes for revenue. For example, entities such as school and hospital districts are adversely impacted by lost ad valorem tax revenues caused by premature abandonment of a well or from wells that are not drilled due to the additional cost of compliance with these regulations. Additionally, many service and supply companies, such as drilling contractors and service companies are affected by regulations that substantially limit oil and gas exploration and development.

The GLO respectfully requests that the Park Service reconsider its options and consider the rights of the mineral owners within the Preserve before implementing the Plan, or further regulating mineral development in the Preserve. I appreciate the opportunity to comment on the Plan. I look forward to a continued cooperative working relationship with the National Parks Service.

Sincerely,

Matt Edling
Deputy Commissioner
Energy Resources

RESPONSES

20. Implementation of any of the alternatives presented in the Draft Plan/EIS is not expected to measurably affect future oil and gas activities or production volumes in the Preserve and southeast Texas. No additional regulatory requirements will be imposed as a result of implementation of this plan. Thus, ad valorem tax revenue and economic activity in the oil and gas community are not expected to be affected by the alternatives presented in the EIS.

To be of interest to the petroleum industry, petroleum deposits must be commercially valuable. There must be a reasonable chance of making a profit on the eventual sale of the oil and gas. Factors such as the market price of oil and gas, the amount of recoverable petroleum, the expected production rates, and the cost of drilling wells, producing, and transporting the product to market all determine the economic viability of developing a deposit once it is discovered. The cost of regulatory compliance is only one component in a myriad of factors (geological promise, timing and logistics, costs) that industry considers when deciding whether to pursue an oil and gas prospect.

There is an additional cost to conduct operations in units of the NPS. However, these costs are normally a small percentage of an operator's total expenses. Costs specific to conducting oil and gas operations under an NPS-approved plan include the following:

1. plan preparation (including any biological surveys, cultural surveys, etc.),
2. generally higher standards placed on operators to meet NPS resource and visitor use protection objectives,
3. generally higher reclamation standards, and
4. yearly premiums to surety companies for performance bonding.

It is important to note that some up-front expenditures can result in future savings for operators. For example, the NPS requires dikes or berms around oil storage tanks to provide secondary containment in the event of an accidental discharge or release of oil or hazardous/contaminating substances. An unconfined oil spill from a tank can cover large areas, flow into nearby surface waters, and seep into ground waters. Federal laws, such as the Clean Water Act; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and the Park System Resource Protection Act, will require cleanup and restoration of the damaged area and disposal of contaminated materials at a cost to the operator that may reach hundreds of thousands of dollars. A typical $2,000 investment to install berms at a wellsite has the potential to save the operator 100 times that amount. In other words, many of the measures that the park requires of an operator to protect resources and visitor values also provide inexpensive insurance to the operator against potential future liability.

The timeline for the NPS to process a plan of operations is a minimum 3 to 4 months, as shown in Table 2.18, NPS Processing Time for a 36 CFR 9B Plan of Operations. The table does not reflect the operator's timeline to complete surveys and prepare a plan of operations.

COMMENTS	RESPONSES
21.	**21.** The RFD scenario prepared by the NPS used the USGS assessment of undiscovered oil and gas underlying the Preserve to estimate the types and extent of oil and gas exploration and production operations that would be necessary to discover and develop the undiscovered oil and gas underlying the Preserve. All currently producing or potentially productive oil and gas reservoirs in the vicinity of Big Thicket National Preserve were used in both the preparation of the USGS assessment and the NPS's RFD scenario. The USGS assessment included the prospective Eocene through Cretaceous-aged Wilcox, Yegua (Claiborne Group), Vicksburg, Frio, Tuscaloosa, Austin Chalk, and Eagle Ford oil and gas reservoirs. Based on USGS analysis of existing data, they concluded that there are no potential Jurassic-aged rock reservoirs. For the Plan/EIS, these reservoirs were grouped into the Tertiary oil and gas and Upper Cretaceous gas plays. The purpose of the RFD scenario is to provide a reasonable basis for the NPS to analyze the potential effects of oil and gas related operations within and outside of the Preserve for the alternatives presented in the Plan/EIS. Development of oil and gas resources underlying the Preserve could occur regardless of whether the specific geologic formation was included in the USGS assessment and RFD scenario.

Robert W. Ramsey
3103 Ivy Falls Drive
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281-537-8701

March 7, 2005

Linda Dansby, EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Support Office - Santa Fe
1100 Old Santa Fe Trail
Santa Fe, NM 87504-0728

RE: Comments on Draft Oil and Gas Management Plan
Environmental Impact Statement ("Plan")
September 2004
Big Thicket National Preserve, Texas

Dear Ms. Dansby:

I am an individual in the oil and gas exploration and production business. I am familiar with oil and gas operations in the Big Thicket National Preserve and in adjacent areas. I write in opposition to the Plan referenced above and to give my views on the impact of federal regulation on the production of oil and gas in this part of Texas.

First, oil and gas exploration is a unique business in which new technologies and prices significantly drive exploration. Prices are now getting to the point that new exploration will occur and any reference to reserves based on past production is wildly inaccurate. Exploration concepts and trends are continually changing. There are potentially new trends deeper under the subsurface that can significantly increase the reserve estimates lost under the Plan. These potentially new sources of energy will never be developed with the proposed Plan in place. I believe the remaining reserves will greatly exceed the

COMMENTS	RESPONSES
21 Cont. Page 2 estimates set out in the Plan.	
22. Second, the National Park Service only owns the surface estate in the Big Thicket. The Park Service's right to control the mineral estate by their ownership of the surface seriously undermines the fundamental rights of the mineral owner to explore for oil and gas by using a reasonable amount of the surface. The Plan basically devalues the mineral estate to zero. Is there a Plan to reimburse the mineral, and royalty owners for these lost reserves??? Companies and individuals alike have spent a tremendous amount of time and money to develop exploration ideas within the area in which you now wish to arbitrarily disallow any exploration activities to occur. I think they too should be compensated. Owners of pipelines, owners of seismic data, owners of leases, owners of structure maps with ideas you have now rendered valueless should be compensated.	**22.** As described in the Draft Plan/EIS on pages 1-4 and 1-7 to 1-10, the NPS has unambiguous authority to regulate nonfederal oil and gas development in units of the National Park System, including Big Thicket National Preserve. In addition to the cases cited therein, please also see Dunn McCampbell v. National Park Service, 964 F.Supp. 1125, *aff'd* 112 F.3d 1283 (5th Cir. 1997), *reh'g, en banc, denied*, 124 F.3d 195 (5th Cir. 1997). See also Response 19**.** The application of 36 CFR 9B regulations stop short of a taking.
23. Third, the Plan's attempts to regulate lands outside the Big Thicket are ludicrous. I do not think this part of the Plan even warrants a comment. Why should the Park Service be able to dictate what takes place on lands it does not own? Again, compensate the offset owners for the rights that you are taking away from them.	**23.** Please fully review the language in the Draft Plan/EIS on pages 1-8 through 1-9, 2-62, 2-66, and 2-68 regarding the NPS's authority over directional drilling operations occurring from a surface location outside the boundary of the park. The language in the Plan/EIS clearly describes the limitation on NPS's authority over activities occurring outside the park boundary.
In summary, I request that the Park Service reconsider its position as stated in the Plan. It adversely affects many sectors while benefiting only a small group. It seems that both industry and the Park Service have been able to compromise and coexist in areas much more environmentally sensitive than this. I would further suspect that both parties benefit from a cohabitant relationship. Sincerely, Robert W. Ramsey Robert W. Ramsey	

COMMENTS	RESPONSES
24.	**24.** See Response 22.

Black Stone
MINERALS COMPANY, L.P.

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March 9, 2005

Linda Dansby, EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Region
1100 Old Santa Fe Trail
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VIA FEDERAL EXPRESS

RE: Comments on Draft Oil and Gas Management Plan
Environmental Impact Statement ("Plan")
September 2004
Big Thicket National Preserve, Texas

Dear Ms. Dansby:

Black Stone Minerals Company, L.P. ("Black Stone") owns the oil, gas and other minerals under numerous tracts located within the current boundaries of the Big Thicket National Preserve.

Prior to commenting on the Draft Oil and Gas Management Plan, it is first necessary to address the question of whether or not the National Park Service, or any other Federal agency is authorized to regulate oil, gas and mineral development under the language contained in current legislation. It is submitted that despite previous attempts at regulation by the Federal Government, its jurisdictional authority with respect to mineral development at Big Thicket National Preserve is questionable.

The Federal Government ultimately acquired the lands now included within the Preserve by virtue of the Federal Enabling Act. At the time the Federal Government acquired the surface estate of the lands which now constitutes the Big Thicket National Preserve, it intentionally declined to acquire the underlying mineral estate, probably due to the prohibitive cost of such acquisition.

In considering this, it should be remembered that this mineral estate, such as owned by Black Stone, is dominant to the surface estate under Texas law, and this dominant status prevails even when the United States acquires the surface estate. Moreover, ownership of this dominant mineral estate actually includes the ownership of a part of the surface estate, in that it includes an easement to use the surface for mineral development. The Federal Government clearly has never acquired, and therefore does not own this surface easement.

Despite its lack of mineral ownership, the National Park Service asserts the right to regulate the minerals underneath the Big Thicket National Preserve pursuant to the National Park Act of August 25, 1916, (16 U.S.C. §1 et seq.). The current nationwide Non-Federal Oil and Gas Rights Regulations are

COMMENTS	RESPONSES
Linda Dansby, EIS Project Manager March 9, 2005 Page 2	
24 Cont. codified at Title 36 of the Code of Federal Regulations, Part 9, Sub-part B. We have assumed for purposes of these comments, that the Draft Plan has been promulgated under the auspices of these regulations. With the above historical and legal framework in mind, Black Stone generally objects to the Draft Plan as a whole due to the fact that the regulations and restrictions proposed under such plan have not been authorized by a valid governmental authority having jurisdiction.	
25. More specifically, the implementation of Alternatives A, B or C, as set out in the Plan may very well give rise to a new cause of action for a taking in that they constitute an outright prohibition of mineral development on certain lands, in violation of the rights of mineral owners. In particular, the Alternatives, particularly B and C both clearly prohibit the mineral owners' rights of ingress and egress by virtue of designating a significant percentage of the acreage within the boundaries as no surface access and/or no surface occupancy areas. Indeed, the imposition of the Alternatives would likely give rise to additional Constitutional claims based upon the taking of private property without just compensation due to the fact that such alternatives will essentially result in a partial condemnation of the mineral estate.	**25.** See Response 19.
26. Beyond the objections noted above which pertain to regulation of mineral development within the boundaries of the Big Thicket National Preserve, both the existing and proposed regulations and Plan attempt to regulate oil and gas development activity which occurs on land outside of the Preserves boundaries. This is a clear case of overreaching. Both the current and proposed regulations require operators to obtain an approved Plan of Operations even when a proposed surface location occurs outside of the Preserve boundaries in the event such operation involves directional drilling in order to access minerals underneath the Preserve boundaries. Directional drilling from outside the Preserve boundaries in order to access minerals underneath the Preserve boundaries in no way involves access through or interference with the surface estate owned by the Federal Government. Therefore, the National Park Service has no right to regulate in any manner the conduct of directional drilling activities from surface locations outside the Preserve boundaries.	**26.** See Response 23.
27. In particular, Black Stone objects to the Plan in that its implementation greatly restricts the transportation infrastructure that is necessary for the production of oil and gas. Specifically, because of the sprawling configuration of the Big Thicket National Preserve, production on tracts outside of its boundaries necessarily will require right-of-ways for pipelines to cross lands lying within its boundaries. Under the Plan, both regulation, and in some instances, outright prohibition prevents these vital pipelines to cross lands where most desirable both from an economic, engineering, and environmental standpoint. As a result, the energy industry as a whole will be increasingly discouraged from operating in this entire portion of Southeast Texas.	**27.** Use of federal surface inside the park boundary is premised upon the operator demonstrating to the NPS that it holds a right to operate in a unit of the National Park System. If an operator of a well outside the park can demonstrate the right to use of the federal surface inside the park, the park will consider the proposal for approval under the NPS's 9B regulations. Regarding the limitation on NPS's authority to issue new rights of way, please see the Draft Plan/EIS, page 1-9.
28. Black Stone primarily leases its minerals to third-party oil companies who seek to explore, after using methods such as 3-D seismic, and who also wish to drill wells when warranted. Under this process, Black Stone is paid bonus money for signing the leases, and receives as royalty a percentage of production. Both enforcement of the 9(B) regulations and implementation of the Plan generally discourage companies from acquiring such leases from Black Stone, both as to lands in the Big Thicket National Preserve, as well as to lands nearby.	**28.** See Response 20.

28. Cont.

In this respect, you should note the general effect of the Plan on the Southeast Texas economy, as well as on local entities in that area that depend on ad valorem taxes for revenue. For example, many service and supply companies, such as drilling contractors, service companies, etc. are affected by the restrictive uncertainty caused by these regulations and the Plan, which generally discourages oil and gas exploration and development within a broad area of Southeast Texas. Additionally, local entities such as school and hospital districts are adversely affected in that oil and gas reserves undoubtedly will not be explored for, discovered, and produced because of these overreaching regulations. When this happens, these entities are deprived of a significant source of ad valorem tax revenue, which is based on the value of such production.

29.

With respect to its specific economic projections surrounding future oil and gas development, the Plan grossly underestimates the future oil and gas reserve potential. The estimates of 1.25 million barrels of oil, 70.16 BCF of gas and 1.02 MMB of condensate are apparently based on historical production data from known plays and do not account for the potential for discovery of additional production as a result of new ideas or plays. Almost certainly these estimates are wrong. 3-D seismic has never been acquired over many areas of the Preserve, and historically the acquisition and utilization of first-time 3-D data has resulted in greatly enhanced reserves. In summary, Black Stone believes the remaining discoverable reserves in all likelihood will greatly exceed the estimates set out in the Plan.

Black Stone respectfully requests that the Park Service reconsider its position, and properly consider the vested private property rights of the mineral owners before implementing the Plan, or further regulating mineral development in the Preserve.

Sincerely,

Black Stone Minerals Company, L.P.

Michael M. Ellis
Director - Special Projects

cc: United States Senator Kay Bailey Hutchison
United States Senator John Cornyn
United States Senator Pete V. Domenici
United States Representative Ted Poe – 2nd District
United States Representative Kevin Brady – 8th District
United States Representative Joe Barton
United States Representative Richard W. Pombo

29. The NPS acknowledges that the USGS assessment of undiscovered hydrocarbon resources may differ from those of oil and gas operators and mineral owners. The intent of the oil and gas management plan is not to estimate resource volumes but to develop a management strategy to protect Preserve resources and values and to analyze the potential impacts of oil and gas exploration and development. The number of wells and the acres of disturbance projected in the RFD scenario do not represent a benchmark or decision point for acceptable level of activity that could occur to develop the oil and gas underlying the Preserve. The USGS Monte Carlo simulation shown on Table 1 in Appendix E of the Plan/EIS includes a probability range of oil and gas resources ranging from a low case (95% probability) of that amount occurring, to a high case (5% probability) of having of that amount occurring. The NPS used the mean estimate when preparing its RFD scenario for the Draft Plan/EIS, but due to public comments received on the Draft Plan/EIS and the current increase in drilling activity, the NPS has decided to develop a revised RFD scenario for the Final Plan/EIS. Since it is unlikely that USGS's upper estimate (5% probability) would be discovered over the life of this Plan/EIS, the NPS has decided to use the 25% probability estimate in the revised RFD scenario.

The USGS oil and gas assessment, not the NPS's RFD scenario, estimates the undiscovered oil and gas underlying the Preserve. The USGS assessment for this OGMP is based on an unbiased, thorough geological and statistical analysis of relevant scientific literature, available drilling and production data from 227,000 dry holes, 235,000 oil wells, and 105,000 gas wells in the Western Gulf Oil and Gas Province, and discussions with colleagues in the oil and gas industry and state and federal agencies. When completed, the USGS assessment underwent rigorous peer reviews within the USGS by geologists with expertise in evaluating hydrocarbon potential worldwide. Proprietary data such as 3-D seismic is not available to the USGS and was not used in their oil and gas assessment.

To prepare an assessment of the remaining undiscovered oil and gas in the province, the USGS looked at all of the components of each oil and gas play including reservoir, source rocks, trap, seal, and hydrocarbon migration. (A play is a set of discovered or undiscovered oil and gas accumulations or prospects that are geologically related.) Based on the regional oil and gas assessment, the USGS then estimated the undiscovered hydrocarbons underlying the Preserve.

USGS assessments are redone on a periodic basis using the most currently available data. The Western Gulf Oil and Gas Province assessment will be redone by the USGS in the next several years and will be updated based on the data available to them at that time.

COMMENTS	RESPONSES
COBRA OIL & GAS CORPORATION March 9, 2005 Linda Dansby, EIS Project Manager Office of Minerals/Oil and Gas Support Intermountain Support Office - Santa Fe 1100 Old Santa Fe Trail Santa Fe, NM 87504-0728 RE: Comments on Draft Oil and Gas Management Plan Environmental Impact Statement ("Plan") September 2004 Big Thicket National Preserve, Texas Dear Ms. Dansby: Cobra Oil & Gas Corporation ("Cobra") is active in the exploration and development of oil and gas. We operate in southeast Texas, and are familiar with oil and gas operations both in the Big Thicket National Preserve, and in adjacent areas. Cobra has undertaken both a 3-D Seismic Project and drilled a deviated well under the BTNP. Both projects were located in the Lance Rosier Unit of the BTNP. We write in opposition to the Plan referenced above, and to give our views on the impact of federal regulation on the production of oil and gas in this part of Texas. **30.** First, in reading the Plan, the economic projections surrounding future oil and gas development do not seem accurate. The estimates of 1.25 million barrels of oil, 70.16 BCF of gas and 1.02 MMB of condensate are apparently based on historical production data from existing wells, and do not account for the potential for discovery of additional reserves as a result of new exploration and new technology. Almost certainly these estimates are greatly understated. For example, 3-D seismic has never been	**30.** See Response 29.

COMMENTS	RESPONSES
Linda Dansby, EIS Project Manager March 9, 2005 Page 2 **30. Cont.** acquired over many areas of the Preserve, and historically the acquisition and utilization of 3-D data results in greatly enhanced reserve estimates. In summary, we believe the remaining discoverable reserves in all likelihood will greatly exceed the estimates set out in the Plan, and this fact emphasizes the importance of our comments that follow.	
31. It is noted that in our review of the Plan, Cobra's Quinn #2-84 Well that was deviated under the BTNP and permitted by the BTNP, is not shown in the wells drilled in or under the BTNP. If this well, permitted by the BTNP, was not considered during development of the Plan, we wonder how much other data may have also been overlooked or not included for consideration.	**31.** Table 3.2, Nonfederal Oil and Gas Operations, was updated in the Final Plan/EIS. It now includes Cobra's Quinn #2-84 Well; removes the Comstock Ogletree #1 Well that did not proceed to development of a plan of operations; and reflects the current status of each well. Throughout the Final Plan/EIS, references to the number of wells under the Preserve are changed to reflect the updated table. The analysis in the Draft Plan/EIS did not change as a result of updating the table.
32. Please note, the National Park Service only owns the surface estate in the Big Thicket, and therefore we have serious concerns about the ability of the federal government to regulate a mineral estate that it does not own. In addition, provisions in the Plan clearly seem to ignore established Texas law attendant to mineral ownership, and prohibit oil and gas operators' rights of ingress and egress by designating a significant percentage of the acreage within certain boundaries as areas that allow no surface access and/or no surface occupancy.	**32.** See Response 24.
33. Beyond these objections regarding mineral development within the boundaries of the Big Thicket Preserve, both the existing regulations and the Plan attempt to regulate oil and gas development activity which occurs on land outside of the Preserves boundaries. For example, the National Park Service has no right to regulate directional drilling activities from surface locations that it does not own located outside the Preserve boundaries. Cobra drilled its' Quinn #2-84 in the R. Miller Survey, A-398 completing a	**33.** See Response 23.

deviated hole that reached total depth under the P. Brewster Survey, A-84. We elected to deviate rather than try to permit a well to be drilled in the BTNP based on the parameters placed on obtaining such a permit by the BTNP. As a result of drilling the deviated hole, we encountered extreme drilling problems due to the deviated hole that caused the well to cost well over 200% of the original cost estimates. A straight hole would not have encountered most of these problems. However, the potential delay of an additional year or more to get a permit to drill inside the BTNP ("this was based on the timing to do the necessary work to get a permit to drill in the BTNP") was not an option due to lease expirations and other operations planned in our drilling program in this area.

34. We particularly ask you to consider the impact of your proposals that affect acreage outside the Preserve, for example, on the transportation infrastructure in southeast Texas necessary for the production of oil and gas. Specifically, production on tracts outside the boundaries of the Preserve will necessarily require right-of-ways for pipelines to cross lands lying within its boundaries. Under the Plan, either regulation or outright prohibition prevents these vital pipelines from crossing lands at the most desirable point based on economic, engineering, and environmental considerations. As a result, not only will oil and gas not be discovered and produced, but the energy industry as a whole will be increasingly discouraged from operating in this area. Having worked in the largest unit of the BTNP, we believe there could be instances where utilizing existing pipelines would be preferable to building new lines not associated with existing corridors. No owner of an existing line would let their line come under the control of the BTNP only to allow a producer to tie into their line inside the BTNP. Why should they give up an existing right to accommodate new production? Under your Plan, almost all new lines would require crossing areas where no pipelines currently exist. It seems that building new lines where alternatives exist would actually

34. See Response 27.

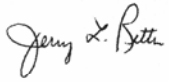
COMMENTS	RESPONSES
 34. Cont. increase potential pollution rather then limit same as proposed in the Plan.	
35. All of the proposed regulation discourages oil and gas development by increasing both its cost and risk. For example, directional wells are more expensive and involve much more risk. Further, compliance with regulations, and the resulting delay in permitting, add greatly to the cost of operations, and the Plan does not appear to attach much importance to such matters. Please consider my above comments regarding Cobra's Quinn #2-84 Well.	**35.** See Response 20.
36. The Plan also appears to ignore the effect of regulation on the southeast Texas economy, as well as on local entities in the area dependent on ad valorem taxes for revenue. For example, many service and supply companies, such as drilling contractors, dirt contractors, service companies, etc. are affected by the restrictive uncertainty caused by these regulations and the Plan, which generally discourages oil and gas exploration and development within a broad area of southeast Texas. Additionally, local entities such as school and hospital districts are adversely affected in that oil and gas reserves undoubtedly will remain undiscovered and not produced because of these regulations, which will no doubt reduce tax revenue. Due to the wide variety of wildlife and landscape in the BTNP, which is why the Preserve was created in 1974 to protect the area's biological diversity, no Plan can fully cover any situation that may develop in different parts of the BTNP. You are trying to set controls on an industry when you don't understand what they are trying to do and how we can accomplish our goals. Remember, the rights of the mineral owners and their prospective operating companies were in place when the BTNP was created. You should not try to enact a Plan to take away these rights. That's why we're in IRAQ, trying to protect the rights of people.	**36.** See Response 20.

COMMENTS	RESPONSES

We respectfully request that the Park Service reconsider its position, and properly consider three factors before implementing a revised Plan, or further regulating mineral development either in the Preserve or on adjacent lands: (1) the economic impact on this area of Texas, (2) the ever increasing energy needs of the United States, and (3) the vested private property rights of mineral owners and oil companies. We are confident that all three of these considerations can be accommodated without adversely affecting the environment in the Big Thicket National Preserve.

Sincerely,

Cobra Oil & Gas Corporation



Jerry L. Ritter, CPL
Land Consultant

cc: George W. Bush, President of the United State of America
Rick Perry, Governor of the State of Texas

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COMMENTS	RESPONSES

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March 9, 2005

Linda Dansby
EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Region
Santa Fe, New Mexico 87504-0728

Dear Sirs,

Before I comment on the Oil & Gas Management Plan for the BTNP dated September, 2004 "the Plan," I want to express my appreciation to the BTNP for their prior efforts in resolving issues regarding directional drilling for oil and gas under the BTNP from surface locations outside the BTNP. Many of these issues were raised in my letter dated 31st October 2001 to Mr. David Smith, the Counselor to the Assistant Secretary for Fish, Wildlife and Park. This letter is attached and is also relevant to a discussion concerning the Plan.

Before getting into my specific criticisms of the Plan, my general comments will be directed primarily to the protection of private property rights. In my letter, I referenced the enabling legislation and the final judgment from the courts which created the BTNP. The terms and conditions under which the Park was created was subject to the following provision, "*. . . excluding and exempting from this the taking of all gas and other minerals in and under said lands with all appurtenant rights for the exploration, development, production and removal of said oil, gas, and other minerals.*"

In some cases the rights of the mineral owner as these rights relate to the National Preserve appear to be clearly stated in the Plan.

If the National Park Service determines that the proposed oil and gas operation within a park unit would conflict with preservation, management, or use of the parks, or would impair park resources or values, the 36 CFR 9B regulations and NEPA process would result in identifying measures to mitigate impacts. Mitigation measures may be applied to the Plan of Operations as conditions of approval, subject to the operator's acceptance of specific provisions and operating stipulations (36 CFR 9.37 (b)(2)). However, if a proposed operation cannot be sufficiently modified to prevent the derogation of park values and purposes, then the NPS may seek to extinguish the associated mineral right through acquisition, unless otherwise directed by Congress.

In applying the NPS's Nonfederal Oil and Gas Rights Regulations, the NPS respects the constitutionally guaranteed property rights of mineral owners. As set forth in the Fifth Amendment to the Constitution, "...no person shall be deprived of property without due process of law; nor shall private property be taken for public use without just compensation." In two places, § 9.30(a) and 9.37(a)(3), the 9B regulations emphasize that they are not intended to

COMMENTS

result in the taking of a property interest, but rather are designed to impose reasonable regulations on activities that involve and affect federally-owned lands. The NPS's position to not contravene the Fifth Amendment is further underscored by Executive Order 1263, "Governmental Actions and Interference with Constitutionally Protected Property Rights." The alternatives presented and evaluated in this document comply with this executive order. Any alternative selected and applied to oil and gas activities in the park as a result of this planning would be subject to the NPS's statutory mandates, regulatory provisions, policies, and Executive Orders, including the above described limitations regarding the taking of private interests.

However, in other cases, the elimination of surface rights for oil and gas exploration in SMA's is clearly a violation of the conditions under which the Park was created.

Under all three alternatives, the impacts are generally the same because the level of development projected under each alternative would be the same as theorized under the RFD scenario. The key difference between the alternatives and their potential impacts is where impacts could occur. Under Alternative A, Current Legal and Policy Requirements would preclude operations in Protected Areas and additional resource areas with offsets are formally designated as Special Management Areas where the No Surface Use stipulation would preclude operations from occurring in an increasingly larger acreage of the Preserve. Alternative C would preclude operations in the greatest area of the Preserve, and is likely that most wells would be directionally drilled from outside the Preserve to develop hydrocarbons underlying the Preserve.

37.

38.

Since a major portion of the Plan is devoted to creating the SMA's in the Plan, at best, the interpretation of the language in the Plan is unclear as to whether the rights of the mineral owner to use of the surface for exploitation of oil and gas is allowed (as is the law) or whether these rights have been confiscated by the federal government

Assuming the latter is true, any attempt by the BTNP to unduly restrict or otherwise prevent drilling as proposed in the SMA's or in some other way is illegal and represents inverse condemnation by the federal government, assuming that, of course, the operator adheres to prevailing federal and state laws as it applies to oil and gas drilling (i.e. all Texas Railroad Commission rules and regulations, the Endangered Species Act, the Clean Water Act, the EPA Spill Prevention Control and Countermeasures (SPCC) regulations, the Clean Air Act, Floodplain Management Regulation, wetland regulations and other applicable acts). While the creation of SMAs may involve laudable efforts to protect, "*. . . park resources and values . . .*" not currently protected under state or federal law, it is inimical to the interests of the affected owner of the mineral rights in fee or their lessees. These private property rights must be protected even if the exercise of these rights will derogate park values and purposes as contemplated in the Organic Act (Mantell & Metzger,1190). This statement is especially cogent to a discussion of the planning objections in the Plan. Some objectives clearly carry much greater weight over others.

Namely, in the planning objectives reprinted below, planning objective #4 is generally superior to planning objective #2 by law, as long as the impairment which results from oil and gas activities was originally contemplated in the enabling legislation and takes place in the normal course of operations.

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37. In developing the Plan, the National Park Service had no intention of causing any take of private property, as defined by the last two paragraphs under the heading "NPS Nonfederal Oil and Gas Rights Regulations," on page 2-62 of the Draft Plan/EIS, and the 9B regulations found in Appendix B of the Plan/EIS, and referenced in the comment. The section titled "Exemptions from this Plan" on page 2-3 of the Draft Plan/EIS describes how the NPS would grant exemptions from specific operating stipulations described in the Plan. However, because some commenters did not clearly understand the text in the "Exemptions from this Plan" section of the Plan, the section was revised to read as follows:

> The designation of Protected Areas, which is a component of all three alternatives, and the proposal in Alternatives B and C to designate Special Management Areas and apply operating stipulations are not intended to result in a taking of private property rights. Regulations at 36 CFR Part 9, Subpart B (9B regulations), were written to encourage technological innovation (§ 9.37(a)(1)). If an operator can demonstrate that a particular technology could reduce the potential for impact on resources in the Preserve, the operator may be exempted from specific operating stipulations described in this plan. All requests for an exemption must be presented in a Plan of Operations and must describe how replacing the plan requirements with a technological innovation would protect park resources and values. Approval of an exemption would be documented in the accompanying NEPA document (Environmental Assessment/Finding of No Significant Impact or Environmental Impact Statement/Record of Decision) for a proposed Plan of Operations. Therefore, in the event that an operator cannot explore for or develop nonfederal oil and gas from a surface location outside of an SMA with the "No Surface Use" stipulation, the National Park Service will work with the operator, and in consultation with other state and federal agencies as required under applicable laws and regulations, to develop reasonable mitigation measures so as to allow the proposed operations surface use within the SMA. However, as noted on page 2-62, if the Service determines that the proposed mineral development would impair park resources, values, or purposes, or does not meet approval standards under applicable NPS regulations and cannot be sufficiently modified to meet those standards, the Service will seek to extinguish the associated mineral right through acquisition, unless otherwise directed by Congress.

Also, the last sentence of the 1st paragraph on page 2-62, was replaced with the last sentence from above. Also see Responses 24 and 27.

38. See Responses 19, 24, 27, and 37.

COMMENTS	RESPONSES
38. Cont.	

Planning Objectives:

1) Identify Preserve resources and values susceptible to adverse impacts from oil and gas operations.

2) Establish performance standards and impact mitigation measures for oil and gas operations to protect and prevent impairment to Preserve resources and values form adverse impacts from oil and gas operations.

3) Establish performance standards and impact mitigation measures for oil and gas operations to avoid or minimize impacts from oil and gas operations on visitor use and enjoyment, and human health and safety.

4) Provide holders of oil and gas rights reasonable access for exploration and development.

5) Provide pertinent information to oil and gas operators to facilitate planning and compliance with NPS and other applicable regulations.

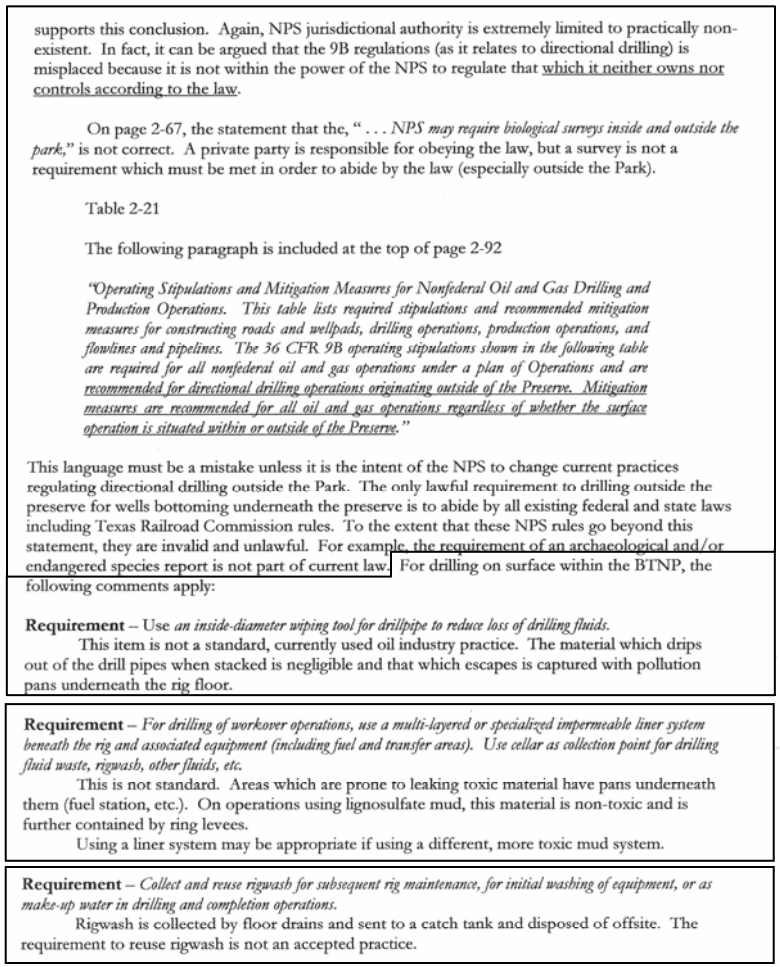
In order to fully appreciate the "taking" which is occurring by the federal government, it is important to understand that the exploitation of oil and gas is inextricably connected to rights of ingress and egress and surface use. To restrict or eliminate this right is to absolutely diminish the rights and abilities of these owners to derive income from the sale of oil and gas. In the private commercial environment, it is not unusual at all for persons who wish to develop real estate to purchase the underlying mineral estate or surface access rights to assure good title. This is necessary in the state of Texas because the mineral estate is dominant over the surface estate. Also, any regulation which reduces the ability of a private party to access his minerals to such an extent that it is either unduly time consuming or onerous represents a "taking" by the federal government.

An attorney, Joe Williams of Williams and Lindahl was hired to examine the exact case law which applies to this type of inverse condensation by the federal government. His comments and analysis are below:

Under Texas law, when a mineral severance has occurred, the right to minerals is accompanied by "the right to enter upon and extract them and all such incidents thereto as are necessary to be used for getting and enjoying them." Cowan v. Hardeman 26 Tex.217 (1862). This doctrine is applicable "because a grant or reservation of minerals would be wholly worthless if the grantee or reservor would not enter upon the land in order to explore for and extract the minerals granted and reserved." Harris v. Currie 142 Tex.93 (1944). Therefore, the mineral estate and the attendant right to use the surface for developing minerals is the dominate estate which means that the mineral owner's common law right to use the surface has superiority and priority over any purposes to which the surface owner desires to use the surface even when the surface owner is a public entity keeping the property for public use. Chambers Liberty County Navigation Dist. v. Banta 453 S.W.2d 134 (Tex.Doc. 1970).

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38. Cont. *Private property cannot be taken from an owner without just compensation and due process of law. U.S. Const. amended V and Texas Constitution, Article I, Section 17. Any attempt by a governmental entity which results in conditions which either limit or totally preclude mineral exploration rise to the level of a taking of private property rights for public use when such taking is without consent and without payment of just compensation.* *A primary cause of action by a mineral owner or its lessee against a governmental entity which attempts to divest such parties of their private property rights without just compensation is a claim for inverse condemnation. The ten (10) year statute of limitations to acquire land by adverse possession governs inverse condemnation claims. Adverse possession is an actual and visible appropriation of real property, commenced and continued under a claim of right that is inconsistent with and is hostile to the claim of another person. Tex. Civ. Prac. & Rem. Code Ann. Sec. 16.021(a)(2002) Brazos River Auth. V. City of Graham, 354 S.W.2d 99 (Tex. 1961). The statute of limitations for adverse possession begins to run when entry on the land is made. The rationale for the applicability of this statute of limitations is that there is a constitutional prohibition on the taking of property without compensation whereby a governmental entity can eliminate the need to compensate the plaintiff only by actually acquiring title by adverse possession, and an inverse condemnation claim may be brought at any time before the defendant acquires title. Ackerman v. Port of Seattle 348 P.2d 664 (Wash. 1960).* *I have limited my discussion above regarding the statute of limitations to a claim for inverse condemnation. Of course additional causes of action may be applicable which may be subject to different statutes of limitations.* Having articulated my general position on creation of SMA's, I will now comment on the specific measures proposed in the Plan as they appear in the Plan. **39.** Pg. S-7 under Alternatives A, B, and C Unless specifically protected by state or federal law, I am unaware of any acreage that is, by Definition, precluded for use by operators. Even access or destruction of wetlands are allowed with mitigation. I would like some clarification of legal justification for declaring certain areas off limits. **40.** Pg. S-8, S-9 Under environmental consequences, the mitigation of adverse consequences to the Park is favorable result as long as private property rights are protected. It appears that hunting and birding rights have preferential treatment over oil and gas rights even though the opposite should be true by law. "While up to 29 new wells could be drilled in the Park . . . ," is mentioned in the Plan, I assume no limitation on the number of wells actually drilled is intended. **41.** Pg. 1-1, pg. 1-7, pg. 1-9 The discussion of the Organic Act and the Enabling Act, fails to mention that the Park owns no rights to oil and gas and is therefore *subject* to these rights even if those oil and gas activities serve to derogate Park values. I believe there is a limit to the ability of the NPS to regulate property (oil and gas rights) which is *not* owned by them. Therefore, I find this discussion somewhat misleading. I:\BTNP 18th February 2005.doc 4	**39.** The NPS has the authority via a plan of operations under the 36 CFR 9B regulations and via NEPA, to apply mitigation measures, including a surface use restriction, to avoid or minimize the potential impacts of a project-specific proposal. Through its approval of a plan of operations under the regulations found at 36 C.F.R. Part 9, Subpart B (9B regulations), the NPS has the authority to impose on an operator specific "mitigation measures," including surface use restrictions, to avoid or minimize the operation's potential impacts to the Preserve's resources and values. Similarly, through the development of the programmatic Oil and Gas Management Plan, the NPS has the authority to designate Special Management Areas (SMAs) within the Preserve and to adopt general "operating stipulations," based on applicable law, which the NPS will impose on all operators within the Preserve unless the NPS approves a project- or site-specific exception. **40.** The NPS believes that the exercise of rights associated with nonfederal oil and gas estates and the privilege of hunting can co-exist in the park. If, however, there are irreconcilable differences between the use of federal surface estate by an oil and gas operator and hunters, the mineral right will take precedence over the privilege. The following text was added in the Final Plan/EIS under the heading "Special Management Areas," at the end of the 3rd paragraph on page 2-9 to reflect this principle: "If, however, an operator can demonstrate a compelling reason why it must conduct geophysical operations in a hunting area when the timing stipulations are in effect, the right of the oil and gas operator to access the federally owned surface will take precedence over the hunting privilege." **41.** See Response 24.

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42. To the extent pipelines and gathering lines are referenced, the statement that there is no statutory authority for granting new rights of way for oil and gas pipelines (1-9) is not exactly correct. To the extent flow lines or pipelines are necessary for the extraction of oil and gas by an operation producing oil and gas from under the Park then this right is specifically granted to the operator under the enabling legislation.	**42.** Establishment of new gathering lines for an operation producing oil and gas from beneath the Preserve will not require the issuance of a new right-of-way. The right to lay gathering lines directly tied to production from an operation producing oil and gas from beneath the Preserve is a right associated with the mineral estate being developed. However, the NPS does not have the legal authority to grant any entity a new right-of-way for an oil or gas pipeline across federally owned land within the Preserve. Also see Response 27.
43. Under Alternative Plan B and C (2-9), certain lands would be prohibited from surface use. It should be noted that oil and gas occurs in this area as shallow as 3,800' or so. Depending upon the area excluded from surface use and the depth of the target, certain drilling may effectively be impossible using current directional drilling technology. No attempt has been made by the NPS to ascertain the area and rights which would be rendered inaccessible and therefore valueless. The rationale for creation of SMA's may be consistent with Park values but are subordinate to private property rights. Certain park values mentioned including the ability, "*. . . to determine the nature and extent of global climate change . . .*," appears to represent a political position rather than a scientific one.	**43.** See Response 37.
Under 2-12, I assume the below paragraph is meant as a criticism to Alternate Plan A: *"Currently there is no formal protection provided for sand mounds and rare vegetation community (including Sandhill Pine Forest, Upland Pine Forest, American Beech-Southern Magnolia-Loblolly Pine Forest, and old growth trees) during non federal oil and gas development in the Preserve. Variations for protection of these resources may occur under Alternative A, resulting in different interpretations and applications of policy. In addition, the interpretation and application of Current Legal and Political Requirements to protect floodplains, wetlands, riparian corridors, fish and wildlife, and cultural resources could also result in variations in how, where and to what extent resource protection is applied."*	
44. However, the real question to be answered is whether or not sand mounds, and rare but not endangered vegetation communities are protected by federal law (not rules and regulations promulgated by the Interior Department). I find no problem with operators cooperating with the BTNP on a case by case basis. The treatment of these concerns may in fact vary by definition.	**44.** See Response 39. Based on public comment received on the Draft Plan/EIS and a re-evaluation by the NPS, it is not necessary to designate sand mounds as a SMA because they would be provided adequate protection under current legal and policy requirements, including the National Historic Preservation Act. Therefore, sand mounds were removed as a SMA throughout the Final Plan/EIS and may be available for oil and gas operations in the Preserve. In the future, the protection of sand mounds and any resources associated with the mounds will be evaluated on a case-by-case, site-specific basis and applicable operating stipulations will be applied to protect Preserve resources, including cultural resources located on the sand mounds.
45. On page 2-66, if the NPS determines that, "*. . . impacts to subsurface resources cannot be adequately mitigated to yield no measurable effects then a Plan of Operations is required.*" It is uncertain that such a standard if adopted is the correct one. I believe the standard should be less stringent. A less stringent standard would not allow a special interest group to block drilling based on a literal interpretation of , "*. . . no measurable effect.*"	**45.** "No measurable effect" is used by the NPS in determining the appropriate level of NEPA compliance documentation. The NPS describes the severity of impacts using four intensity levels: negligible, minor, moderate, and major. The NPS defines "measurable" as moderate or greater effects. "No measurable effects" equates to minor or less effects.
46. On page 2-67, I have always contested the applicability of NEPA to directional drilling on surface outside the Park to bottom under the Park. This is clearly a position which is indefensible in terms of the law but which has been adopted to mollify certain special interest groups. I especially object to language regarding the, "*. . . potential impacts that occur . . . outside of the Park.*" This NEPA trigger sets a dangerous precedent, and depending upon how NEPA is interpreted and satisfied, it may materially interfere with oil and gas rights. Obtaining a waiver for the federal government on directional drilling for outside the Park to bottom within the Park is not a federal action. In addition, the 9B regulations were originally meant as an informational requirement to be met not by an operator. It was never intended to control or regulate that activity unless it represented a clear danger to Park resources. Existing case law	**46.** Under the 9B regulations the NPS has authority only over activities within the park boundary, and exemption determinations under 36 CFR § 9.32(e) are based on the impacts of downhole activities occurring in the Preserve. Also see Response 24. For purposes of public disclosure and education, NPS prepares NEPA documents on all directional drilling proposals submitted to the NPS. Through its NEPA analysis, the NPS assesses impacts both in and outside of the park associated with the downhole operations in addition to the connected actions outside of the park. The downhole activities occurring in the park are analyzed to determine whether there is a significant threat to park resources and if a § 9.32(e) exemption should be granted. As required by NEPA, the analysis of the impacts from the connected actions occurring outside of the park are presented in addition to the downhole operations both inside and outside of the park to disclose to the public all of the potential impacts on the human environment. Cumulative impacts are presented for the analysis area which includes areas inside and outside of the park. See also Response 24.
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46. Cont.  supports this conclusion. Again, NPS jurisdictional authority is extremely limited to practically non-existent. In fact, it can be argued that the 9B regulations (as it relates to directional drilling) is misplaced because it is not within the power of the NPS to regulate that which it neither owns nor controls according to the law. On page 2-67, the statement that the, " . . . *NPS may require biological surveys inside and outside the park,*" is not correct. A private party is responsible for obeying the law, but a survey is not a requirement which must be met in order to abide by the law (especially outside the Park). Table 2-21 The following paragraph is included at the top of page 2-92 *"Operating Stipulations and Mitigation Measures for Nonfederal Oil and Gas Drilling and Production Operations. This table lists required stipulations and recommended mitigation measures for constructing roads and wellpads, drilling operations, production operations, and flowlines and pipelines. The 36 CFR 9B operating stipulations shown in the following table are required for all nonfederal oil and gas operations under a plan of Operations and are recommended for directional drilling operations originating outside of the Preserve. Mitigation measures are recommended for all oil and gas operations regardless of whether the surface operation is situated within or outside of the Preserve."* This language must be a mistake unless it is the intent of the NPS to change current practices regulating directional drilling outside the Park. The only lawful requirement to drilling outside the preserve for wells bottoming underneath the preserve is to abide by all existing federal and state laws including Texas Railroad Commission rules. To the extent that these NPS rules go beyond this statement, they are invalid and unlawful. For example, the requirement of an archaeological and/or endangered species report is not part of current law. For drilling on surface within the BTNP, the following comments apply: **47.** **Requirement** – Use *an inside-diameter wiping tool for drillpipe to reduce loss of drilling fluids.* This item is not a standard, currently used oil industry practice. The material which drips out of the drill pipes when stacked is negligible and that which escapes is captured with pollution pans underneath the rig floor. **48.** **Requirement** – *For drilling of workover operations, use a multi-layered or specialized impermeable liner system beneath the rig and associated equipment (including fuel and transfer areas). Use cellar as collection point for drilling fluid waste, rigwash, other fluids, etc.* This is not standard. Areas which are prone to leaking toxic material have pans underneath them (fuel station, etc.). On operations using lignosulfate mud, this material is non-toxic and is further contained by ring levees. Using a liner system may be appropriate if using a different, more toxic mud system. **49.** **Requirement** – *Collect and reuse rigwash for subsequent rig maintenance, for initial washing of equipment, or as make-up water in drilling and completion operations.* Rigwash is collected by floor drains and sent to a catch tank and disposed of offsite. The requirement to reuse rigwash is not an accepted practice. I:\BTNP 18th February 2005.doc 6	**47.** Use of an inside diameter wiping tool is not a specific requirement, but one of many available techniques for minimizing environmental impacts. The primary benefit for using an inside diameter wiping tool for drillpipe is waste reduction, which has both environmental and economical benefits. Operators do use the tool when appropriate as it can prevent waste of up to 0.4 barrels per 1000 feet of drill pipe. We note that the State of Texas endorses this waste reduction technique in its "Waste Minimization in the Oil Field" manual. The mitigation measures shown in Table 2.21 provide operators a list of possible techniques that could be selected when designing their operations to meet the NPS requirement at 36 CFR § 9.37 that "…operations will be conducted in a manner which utilizes technologically feasible methods least damaging to the federally-owned or controlled lands, waters and resources of the unit while assuring the protection of public health and safety." **48.** Use of a properly designed liner system is not a specific requirement, but one of many available techniques for minimizing environmental impacts. An impermeable liner beneath equipment prone to leaks is a widely used practice to prevent contaminants from reaching the ground. While secondary containment may be designed into some equipment, in many cases it is not. Even relatively benign water-based lignosulfate mud systems can accumulate heavy metals (from pipe dope and some mud additives), oil and grease, and other toxins. Ring levees do provide containment if the location is managed as a zero-discharge operation through remediation and reclamation. Liners can be an appropriate component of all drilling location designs, and become more important as the toxicity of materials on location increases. The mitigation measures shown in Table 2.21 provide operators a list of possible techniques that could be selected when designing their operations to meet the NPS requirement at 36 CFR § 9.37 that "…operations will be conducted in a manner which utilizes technologically feasible methods least damaging to the federally-owned or controlled lands, waters and resources of the unit while assuring the protection of public health and safety." **49.** Collection and reuse of rig wash is not a specific requirement, but one of many available techniques for minimizing environmental impacts. Judicious management of rig wash is perhaps one of the most basic components of any waste minimization program used in drilling operations. We note that the State of Texas endorses this waste reduction technique in its "Waste Minimization in the Oil Field" manual. The mitigation measures shown in Table 2.21 provide operators a list of possible techniques that could be selected when designing their operations to meet the NPS requirement at 36 CFR § 9.37 that "…operations will be conducted in a manner which utilizes technologically feasible methods least damaging to the federally-owned or controlled lands, waters and resources of the unit while assuring the protection of public health and safety."

COMMENTS

50.

Requirement – *Place impermeable plugs in soils where pipelines intersect waterways. Also place impermeable plugs in soils approximately every 1000 feet across long, straight segments of pipelines to prevent water flow along pipeline route.*

Clarification is necessary for the placement of impermeable plugs in soils along pipeline routes.

51.

Pg. 3-22

I note the rationale for classifying sand mounds as SMA's. "Sand mounds" is not a commonly used term in the literature and is rather general. Temple mounds are sand rich mounds created by Native Americans and contain artifacts. Other mounds are known as "pimple mounds." Pimple mounds are associated with fluvial processes. From a paper, "Origin of Pimple Mounds," by E.L. Krinitzsey, pimple mounds are described as follows:

B. Meander Belt Pimple Mounds

In plate 1 there is shown the appearance of typical pimples situated on Recent alluvial deposits in the Advance lowland near Cape Giradeau, MO. It can be seen from the still distinct river scars that this entire surface has been reworked by a meandering stream which has since migrated away from the area. Typical Meander bends, swales and accretion topography on point bars are easily distinguished, And, associated with these features, are pimples oriented in patterns which are entirely conformable to the accretion ridges developed on point bars of the meandering stream.

The above conformity of pimples to meander belt topography is by no means unique. Similar situations are found in many areas. Typical examples occur in the Red River valley in Oklahoma and Texas, and in flood plain areas of Arkansas and Tennessee.

Accretion ridges on growing point pars along much of the lower Mississippi River are typically sandy, as are many towheads. These are sculptured by river currents during high water, built up as a result of accretion during falling water and left exposed when lower water levels are reached. Since these accretions are periodic and occur generally after intervals during which the river bends have been migrating, most sandy accretion ridges are separate and distinct. Between these accretion ridges are the so-called swales which develop luxuriant growths of willows and trap fine sediments when flooded during times of high water. Thus the topography contains very gentle swells of coarse sediments protruding from areas filled with finer alluvium. In very short order, mantles of vegetation creep onto these sediments and develop soil profiles into them. To a great extent, vegetation aids in preserving certain of the topographic configurations. With removal of this covering by agriculture, many meander belt features such as are exhibited by soil fertility and topographic variations come into prominence again . . .

Thus it becomes apparent that meandering behavior of rivers tend to develop silty and sandy concentrations of sediment in individual strips which eventually cover much of the total surface area within a meander belt. As these coarse deposits are forming, their surfaces are sculptured with water carved mounds. Vegetation quickly moves in to for a protecting cover and, with the formation of a soil profile, these mounds become our familiar pimples.

All sand mounds are neither temple mounds nor pimple mounds. Pimple mounds, while somewhat mysterious in their formation, are not rare. Temple mounds which evidence the presence of Native Americans, are already covered by federal acts including but not limited to the Nation Historic Preservation Act.

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RESPONSES

50. The mitigation measure shown in Table 2.21 to place impermeable plugs along pipelines is an available mitigation technique for nonfederal oil and gas operations in the Preserve. The placement of impermeable plugs where pipelines intersect waterways would help reduce erosion and exposure of pipelines in waterways in the Preserve. Similarly, impermeable plugs placed along straight pipeline segments would reduce waterflow and erosion along pipelines.

The mitigation measures shown in the Table 2.21 are presented to provide operators a list of available techniques that could be selected when designing their operations to meet the NPS requirement at 35 CFR § 9.37 that "…operations will be conducted in a manner which utilizes technologically feasible methods least damaging to the federally-owned or controlled lands, waters and resources of the unit while assuring the protection of public health and safety."

51. The intent in formally designating sand mounds as SMAs was to protect archeological resources. As noted in the comment, protection will be provided under Current Legal and Policy Requirements, most notably the National Historic Preservation Act of 1966, as amended. The description of sand mounds wais corrected on pages 3-22 and 3-23 of the Final Plan/EIS; and "sand mounds" were removed as a proposed SMA under Alternatives B and C throughout the Final Plan/EIS. Also see Responses 39 and 44.

COMMENTS

51. Cont.

As a geologist, the presence of a sand mound is no more *geologically* significant than a clay rich area. Obviously the flora and fauna varies according to the type of soil, etc. The case to protect sand mounds in a geomorphilogical or geological context as an SMA is not appropriate. Sand mounds per se are not protected by federal laws. Furthermore, the sand mounds or ridges or sand rich areas generally represent higher ground and are the *exact* places where oil and gas operations need to occur within the Park. An exceedingly high percentage of the Big Thicket is wetland. Therefore, according to the NPS, oil companies can't drill on the high areas (sand rich areas) and according to the United States Army Corps of Engineers, oil companies are to avoid drilling in wetlands. Aside from environmental concerns, oil companies do not want to drill in wetlands for a variety of practical reasons. The net effect of all this is to effectively ban drilling within the Park. The definition of a sand mound is sufficiently vague in order to effect this result if NPS employees wish it.

52.

The designation of riparian corridors as SMA's is too all-inclusive as to constitute an SMA. Riparian corridors are not protected by federal law. In fact, practically the entire BTNP could be classified as a riparian corridor. Of course, within this riparian corridor of the Big Thicket, existing law protects endangered species which may live there, wetlands which constitute a large part of the area, and the floodplains which are necessary for proper drainage within the Neches River system. Another layer of regulation is unnecessary and overlaps statutes already in place.

53.

While the Plan, if enacted as written, could pose significant legal challenges to the rights of the mineral owners and their lessees, covering affected lands, I believe that the Plan may be modified by the NPS to achieve the major objectives of the NPS while preserving private property rights.

A possible solution might be to create SMA's, as limited by my comments above, where use of certain surface lands is discouraged but not altogether prohibited. Identifying sensitive areas within the Preserve allows the Preserve to develop a Management Plan for the Preserve and informs operators of the areas within the Preserve that might require greater security and/or regulation if surface drilling occurs within these areas. I am sure that there are other solutions which would be equally acceptable to the oil industry which would maintain flexibility on the part of the Preserve and Operators to develop acceptable solutions based on facts on the ground and existing law. Such a solution or solutions would preclude costly litigation over the adoption of a Plan initiated by mineral owners whose rights would be adversely affected. Such litigation would not be in the interests of the Preserve or the affected owners. Further, it is highly likely that the surface of the lands within the SMA's will never be drilled based on practical considerations such as access, susceptibility to flooding, etc. Yet mineral owners and others will be forced to litigate in order to prevent confiscation of surface rights on affected lands that <u>may</u> or <u>may not</u> prevent the development of oil and gas underneath the affected lands.

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52. As required by the National Environmental Policy Act (NEPA), the EIS must include a reasonable range of alternatives. The alternatives presented in the Plan/EIS provide a reasonable range of alternatives to protect resources in riparian corridors and other resource areas of the Preserve. Alternative A (current conditions) does not include a Riparian Corridors SMA. The Riparian Corridors SMA is a component of Alternatives B and C. These alternatives include additional operating stipulations that are not specifically a part of current legal and policy requirements.

The NPS believes that including a Riparian Corridor SMA in the Plan/EIS will help guide the overall protection of sensitive riparian and water resources within the Preserve by providing the operator a "roadmap" to use when selecting drilling locations within the Preserve. Since exceptions to SMA and other operating stipulations identified in the plan may be permitted on a case-by-case basis during planning review and approval, an operator may still be permitted to drill in a riparian corridor if he/she can demonstrate the NPS least damaging approval standard at 35 CFR § 9.37 (see page 2-3 of the Draft Plan/EIS).

53. See Response 37.

COMMENTS	RESPONSES
I respectfully request that the NPS review and amend the elements of the Plan which have been addressed in my comments above in order to provide a lawful, workable framework for the safe and orderly exploitation of oil and gas within (or underneath) the Preserve. Sincerely, Ross Davis For Davis Bros. Oil Producers Inc. And Davis Southern Operating Company Cc: Art Hutchinson Big Thicket I:\BTNP 18th February 2005.doc 9	

COMMENTS	RESPONSES
March 9, 2005 Linda Darnby, EIS Project Manager Office of Minerals/Oil and Gas Support Intermountain Region 1100 Old Santa Fe Trail Santa Fe, NM 87504-0728 RE: Comments on Draft Oil and Gas Management Plan Environmental Impact Statement September 2004 Big Thicket National Preserve, Texas Dear Ms. Dansby: The Independent Petroleum Association of America (IPAA), which represents thousands of independent oil and natural gas producers and service companies across the United States, endorses the views submitted by Black Stone Minerals Company in opposition to the Draft Oil and Gas Management Plan for the Big Thicket National Preserve in Texas. **54.** Oil and natural gas production play a vital role in the economy of Southeast Texas. We are greatly concerned that the proposed Oil and Gas Management Plan for the Big Thicket National Preserve would hamper oil and natural gas development by increasing costs and risk to petroleum producers. At a time when the energy needs of our nation continue to increase, we do not believe it is wise to implement a new oil and gas management plan for this area which could result in delays in permitting, add significant costs to operations and create further regulatory challenges for producers. Thanks you for your attention to this request. Sincerely, Daniel Naatz Director, Federal Resources Independent Petroleum Association of America	**54.** See Response 20. Also note that the development of the Draft Plan/EIS is "memorializing" the Preserve's current application of the 9B regulations to oil and gas operators. No new statutory or regulatory requirements are being (nor could they be) created under this Plan/EIS. The NPS anticipates that the Final Plan/EIS will be a useful tool to facilitate operators' planning to conduct nonfederal oil and gas operations in the parks.

COMMENTS	RESPONSES

Samson

Samson Plaza
Two West Second Street
Tulsa, Oklahoma 74103-3103
USA
918/591-1791
Fax 918/591-1796

March 10, 2005

Linda Dansby, EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Region
1100 Old Santa Fe Trail
Santa Fe, NM 87504-0728

RE: Comments on Draft Oil and Gas Management Plan Environmental Impact Statement ("Plan") September 2004 Big Thicket National Preserve, Texas

Dear Ms. Dansby:

Samson Lone Star Limited Partnership (Samson) is a company active in the exploration and development of oil and gas. We operate in Southeast Texas and have oil and gas operations in the area of the Big Thicket National Preserve (Preserve). We write in opposition to the Plan referenced above, and to give our views on the impact of federal regulations on exploration and production of oil and gas in this part of Texas.

Samson has reviewed the three alternatives presented in the Plan and has several concerns. The following provides an overview of our concerns.

Alternatives B and C presented in the Plan create "Special Management Areas" (SMAs) that restrict and/or preclude the exploration, drilling and production of underlying privately held minerals. Alternate B, which is described as the "Preferred Alternative" would apply "no surface use" stipulations to 46,273 acres (i.e. 52.5%) of the Preserve. Additionally, setback requirements appear to further restrict lands available for surface occupation in the Preserve and adjacent private lands. Alternative C presents even greater restrictions. We believe prudent operators are capable of operating in most areas of the Preserve while protecting the environment using advanced technology designed to extract mineral resources with very minimal surface footprints. For this reason most all areas of the Preserve should be available for consideration for drilling.

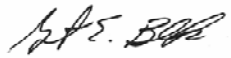
55.

The broad use of SMAs will restrict the development of privately held minerals underlying the Preserve. Oil companies that have taken mineral leases in these areas have a responsibility to develop them. The interests of all parties including private ownership of minerals must be

56.

55. The purpose of this planning effort is to develop a programmatic plan to guide oil and gas activities within the Preserve so there is a common understanding of the special resource values in the Preserve, and how to protect them.

56. See Response 37.

COMMENTS	RESPONSES
protected and developed with proper regard for the surface estate. Restricting the use of the surface in areas where the estate is split does not support that ideology. **57.** The restriction of surface use for pipeline routes will adversely impact the ability to effectively transport the recovered oil and gas resources underlying the Preserve and surrounding areas. The lack of access to lay pipelines would result in waste of our natural resources. Please be assured that Samson is committed to recovery of oil and gas minerals in a safe manner which emphasizes environmental stewardship. Samson would support any effort within industry and the National Park Service to streamline the current permitting process to allow for environmental protection of the Preserve while maximizing the recovery of natural resources. **58.** We respectfully request that the Park Service reconsider its position, and properly consider four factors before implementing the Plan, or further regulating mineral development either in the Preserve or on adjacent lands. (1) the economic impact on this area of Texas, (2) the responsibility of all stakeholders to prudently support the development of the mineral resources of the areas affected by this plan, (3) the vested private property rights of oil companies and royalty owners, and (4) the oil and gas industry's proven ability to utilize advanced technology to recover the mineral resources with minimal impact to the environment. We are confident that all four of these considerations can be accommodated without adversely affecting the environment in the Big Thicket National Preserve. Sincerely, SAMSON LONE STAR LIMITED PARTNERSHIP By: Samson Resources Company, General Partner  Grant E. Black Director of Governmental Affairs	**57.** See Response 27. **58.** See Responses 20 and 24.

COMMENTS	RESPONSES

Linda Dansby, EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Region
1100 Old Santa Fe Trail
Santa Fe, NM 87504-0728

RE: Comments on Draft Oil and Gas Management Plan
Environmental Impact Statement
Big Thicket National Preserve, Texas

Dear Ms. Dansby:

I manage several thousand acres of mineral and royalty property under and adjacent to the B.T.N.P. I monitor all oil and gas activity in the several counties that contain Big Thicket Units. I did not become aware of the proposed plan to regulate oil and gas activity in the Big Thicket National Preserve until January 26, 2005.

I serve on the Advisory Council of the National Association of Royalty Owners and the Board of Directors of N.A.R.O-Texas. The National Association of Royalty Owners is a known and respected non-profit organization. The purpose and mission of N.A.R.O. is to inform, educate and protect the rights of mineral and royalty owners. N.A.R.O. is the largest national association dedicated to this purpose.

According to the draft, the general public was initially notified in 1998 and included in the scoping process. No additional scoping meetings were requested by the public. The plan was scoped, drafted and published over a six year period between December 1998 and September 2004. The public comment period was published in the Federal Register in December 2004. Throughout the scoping and planning process, the N.P.S. went to considerable expense and effort to notify and include leasehold interests/operators, educational institutions, federal, state and local governments and many other individuals, institutions and associations.

59. To the best of my knowledge the National Association of Royalty Owners and N.A.R.O.-Texas were not notified or provided a draft of the proposed O&GMP/EIS. The mineral and royalty properties underlying the Big Thicket are owned by "private entities" as stated in the first paragraph of the plan's summary. These properties are also owned by thousands of individual mineral and royalty owners. The N.P.S. made efforts to notify producers with operations proximate to the B.T.N.P. However, the scoping and planning process failed to adequately notify the mineral and royalty owners and representative organizations such as N.A.R.O.

60. Before submitting specific comments on the plan, it is important to remember that the mineral estate is dominant in the State of Texas. Mineral rights are vested in the mineral estate. These rights include reasonable access and use of the surface estate for the exploration and development of the mineral estate. The N.P.S. manages the surface estate of the B.T.N.P. and therefore has legitimate mitigation concerns. Site specific and reasonable mitigation requirements can adequately address these concerns and protect the resources and values of the B.T.N.P.

61. I strongly disagree with the plan's assumption that the N.P.S. has the statutory authority to regulate mineral development on lands adjacent to the B.T.N.P.

59. The mailing list to distribute the Draft Plan/EIS was prepared through the public scoping process as described in Chapter 5. The notice of intent to prepare a draft oil and gas management plan/environmental impact statement, and the subsequent notice of availability of the draft plan/EIS, were both published in the *Federal Register* and local newspapers. The NPS followed guidance provided in 40 CFR 1506.6 and NPS NEPA policy in Director's Order 12. We regret that your organization and many owners of the minerals and royalties underlying the Preserve did not see either the notice of intent or the notice of availability in the *Federal Register* or local newspapers. However, the National Park Service believes it provided sufficient notice for public participation in this planning process and will not re-open the public review and comment period.

60. See Response 24.

61. See Response 23.

COMMENTS	RESPONSES
  Specific Comments Appendix B, page 1 **62.** The plan references 36 CFR 9B. Section 9.30 of the code says," These regulations are not intended to result in the taking of a property interest, but rather to impose reasonable regulations on activities which involve and affect federally-owned lands" The proposed plan limits or prohibits the mineral estates right of ingress and egress. This raises serious takings questions that should be considered and discussed in detail. A prudent mineral or royalty owner would likely seek compensation for the condemnation of their property. Chapter 1, page 2, paragraph 2 and S-4 **63.** The N.P.S. clearly has no authority to regulate operations outside the surface estate of the B.T.N.P. The inclusion of lands outside the B.T.N.P. in the analysis raises questions about the intended purpose of the plan. It is also in conflict with the stated planning objectives. Specifically, the fourth objective which says, "Provide holders of oil and gas rights reasonable access for exploration and development" Chapter 1, page 21 -22 **64.** The interdisciplinary team concluded that under the required Current Legal and Policy Requirements that anticipated impacts to the local and regional economy would be negligible, and were dropped from further analysis. Therefore, the plan does not consider a detailed analysis of potentially negative impacts on the local and regional economies. Alternatives B and C, if adopted, could possibly have negative impacts on the local and regional economies. The possible negative impacts include lost or diminished bonus, rental and royalty income, lost or diminished severance tax, lost or diminished ad valorem taxes, lost or diminished tax revenue for school districts, counties, cities and municipal utility districts, lost or diminished oil and gas industry jobs, lost or diminished service jobs, lost or diminished pipeline access and negative impacts on planned L.N.G. facilities. A detailed analysis should be performed to qualify and quantify the potential negative affects of the O&GMP/EIS. Chapter 1, page 22, 2nd paragraph from bottom **65.** I suspect that the natural gas totals were erroneously reported in millions instead of billions.	**62.** See Response 19. **63.** See Response 23. **64.** The impact on the local and regional economy from exploration and development of nonfederal oil and gas underlying the Preserve would be negligible, compared to the overall effect from such exploration and development in District 3 or the 7-county area in which the Preserve is located. Also see Response 20. **65.** This error was corrected; and the production of oil and condensate, and natural gas was updated in the Final Plan/EIS.

COMMENTS	RESPONSES
ar 11 05 12:35p KB Cronin Company,LLC 409 833 8895 p.4 **66.** In closing, I respectively ask that the N.P.S. reconsider submitting the O&GMP/EIS until such time that the owners of the mineral and royalties underlying the B.T.N.P. have been properly notified and have had a reasonable opportunity to comment on the plan. Additionally, private entities and individuals have acquired mineral and royalty property under the B.T.N.P. subsequent to the public scoping process in 1998. These stakeholders in particular, should be notified and given the opportunity to comment. Sincerely, Kevin B. Cronin 479 Pine St. Beaumont, Texas 77701	**66.** See Response 59.

COMMENTS	RESPONSES

SIERRA CLUB
FOUNDED 1892

Houston Regional Group
P. O. Box 3021
Houston, Texas 77253-3021
713-895-9309
http://texas.sierraclub.org/houston/

March 4, 2005

Ms. Linda Dansby
EIS Project Manager
Office of Minerals/Oil and Gas Support
Intermountain Region
P.O. Box 728
Santa Fe, New Mexico 87504-0728

Dear Ms. Dansby,

Enclosed are the comments of the Lone Star Chapter of the Sierra Club; Houston Regional Group of the Sierra Club; Big Thicket Association; Texas Public Interest Research Group (TexPIRG); and the Texas Committee on Natural Resources (TCONR) (collectively Sierra Club) regarding the National Park Service's (NPS) Draft Oil and Gas Management Plan (DOGMP)/Draft Environmental Impact Statement (DEIS) for Big Thicket National Preserve (BTNP).

67.

I called you on behalf of the Lone Star Chapter of the Sierra Club (Sierra Club) on December 10, 2004 to request that a copy of the DOGMP/DEIS for the BTNP be sent to my home address. My home address (see the address at the end of this letter) is where I have received National Environmental Policy Act (NEPA) oil/gas activity documents for BTNP for almost three years. I received my copy of the DOGMP/DEIS on December 20, 2004.

The Sierra Club was concerned that the NPS sent a copy of the DOGMP/DEIS to the incorrect address and that this delayed our receiving and beginning our review of the document. This was of great concern to us since the Sierra Club has commented on BTNP oil/gas activity proposals for 20 years and has commented on almost all such proposals for the past 3 years.

68.

The Sierra Club was concerned that the NPS was conducting its public review and comment period for the DOGMP/DEIS during the Christmas and New Year's holiday periods. During these holiday periods many members of the public are on vacation or are engaged in family activities and are not likely to know about the availability of the DOGMP/DEIS. The NPS should have begun its public review and comment period when the public had a better opportunity to become aware of the availability of the DOGMP/DEIS. Beginning the comment period in December 2004 was especially peculiar since the date that the DOGMP/DEIS was finalized was August 20, 2004 and the date on the cover of the DOGMP/DEIS was September 2004.

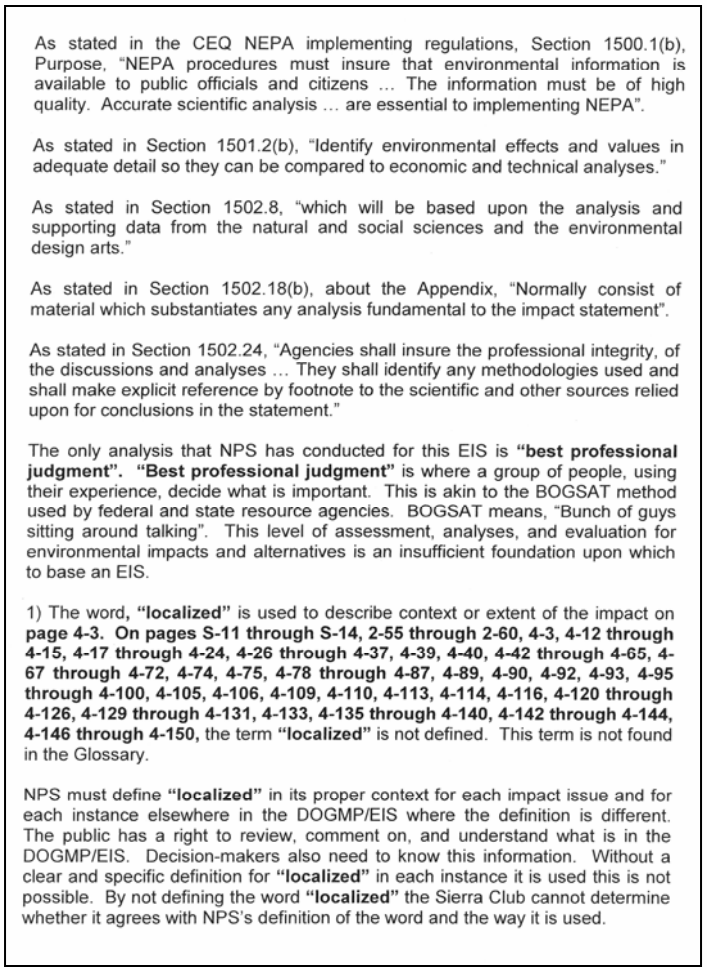
"When we try to pick out anything by itself, we find it hitched to everything else in the universe." *John Muir*

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67. On December 3, 2004, the Draft Oil and Gas Management Plan/EIS was inadvertently mailed to the office address on your letterhead, despite instructions to send it to your home address. Upon being notified of the error on December 10, 2004, the National Park Service mailed a copy to your home address and corrected its mailing list.

68. The Draft Plan/EIS was completed in August 2004 and sent to a contractor to copy and bind. The Draft Plan/EIS is dated September 2004 because the delivery of the document was anticipated in September. However, the contractor ran into problems both with copying and binding due to the size of the document and number of large-scale maps. The copied and bound documents were delivered in phases between the latter part of November and early December. As soon as the documents were available, the NPS released it for public review and comment. As described in Chapter 5, the NPS subsequently extended the public review and comment period 30 days to end on March 10, 2005.

COMMENTS	RESPONSES
The environmental assessment (EA) for the Famcor Oil, In. Roberts/Duke #1 Flowline, states on page 7 that "During the scoping and development of the Plan of Operations for the Famcor Roberts/Duke #1 Flowline and the EA, the planning framework provided in the Preserve's GMP and Draft OGMP/EIS, have been followed." The scoping letter for this EA is dated August 23, 2004 and the Sierra Club's comments are dated August 29, 2004. It appears that NPS had already completed the DOGMP/EIS at these dates and could have released it at any time between late August and the time the document was actually released, about December 3, 2004. This lost three month period is both puzzling and frustrating with regard to the inadequate time that the public and the Sierra Club initially had to review the 550 page EIS. It appeared that NPS delayed the release of the DOGMP/DEIS for over three months. The NPS released the DOGMP/DEIS during the Christmas and New Year's holiday periods when the public is most likely to be busy and not notice the document's availability. By beginning the comment period during the Christmas and New Year's holiday periods the NPS may have violated the spirit and substance of NEPA and the Council on Environmental Quality's (CEQ) NEPA implementing regulations. The CEQ regulations stress numerous times how important public participation is for the NEPA process. The CEQ regulations also stress the need for concerted efforts by federal agencies to ensure that the public is informed and participates in the process. **The Sierra Club appreciates that the NPS granted its request for a 30 day extension of the comment period to March 10, 2005.** **The Sierra Club requests a hard copy of the Final OGMP/FEIS/Record of Decision (ROD) and associated documents when the ROD is approved and the documents are released to the public.**	
69. **DOGMP/DEIS Poorly Defined Words and Phrases** For an EIS, dictionary usage of words or phrases will not suffice to provide the public with a clear picture of what the intensity, significance, and context of environmental impacts are. In other words, an all qualitative assessment, analysis, and evaluation of environmental impacts is not sufficient to deal with the clearly articulated CEQ requirements in Section 1502.14, that the EIS "should present the environmental impacts of the proposal and the alternatives in comparative form, thus **sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public".** Quantitative assessment, analysis, and evaluation are necessary to ensure that alternatives and environmental impacts are clearly defined and shown in the EIS. 2	**69.** The NPS has written the Draft Plan/EIS in plain language the general public can understand (40 CFR § 1502.8). Only jargon, technical terms, and acronyms are defined in the Draft Plan/EIS. Words used to define impact intensity thresholds for "negligible, minor, moderate, and major" impacts are intended to be understandable using standard dictionary definitions. The NPS included both quantitative and qualitative analysis of impacts. The NPS performed a quantitative analysis where it had the specific information to do so. A few examples of the quantitative analysis performed include: 1) measurements of the direct area of disturbance resulting from existing operations, and reasonably foreseeable surface impacts under the RFD were provided in all impact analyses, 2) the size of SMAs in acres were provided and used in the impact analyses, and 3) decibel levels were used to describe impacts from drilling and production operations on visitor use and experience. The NPS did not use a quantitative change in decibels to define impact intensity levels because impacts are not simply determined by a quantifiable change but also by the particular uses that would be affected.

COMMENTS	RESPONSES
69 Cont. 	Where specific information was lacking to perform a quantitative analysis, the NPS believes that its qualitative analysis is adequate to satisfy NEPA. The assessment of impacts using "best professional judgment" is an acceptable methodology and is based on the judgment of the writers of the EA and NPS technical specialists consulted during the preparation of the Plan/EIS, who possess the knowledge and skill to make an assessment of effects of the proposal. The definition of "localized" impacts is included on page 4-2 of the Final Plan/EIS and would "affect the operations area but would not extend beyond 1,500 feet from a well/production pad or 100 feet from an access road or flowline." "Widespread or regional impacts" would extend beyond the area of localized effects. These definitions apply to all impact topics evaluated. "Mitigation" is defined in the Glossary on page Glossary-5. We have included in the Glossary definition, that the term "mitigation" is used interchangeably with other terms used in this Final Plan/EIS, including "mitigation measure," "mitigation techniques," and "mitigation strategies." The NPS uses the term "mitigation" as it is defined in NPS Director's Order 12, as "a modification of the proposal or alternative that lessens the intensity of its impact on a particular resource." The definition references 40 CFR § 1508.20 which is the definition provided in the Glossary. When the terms "voluntary resource protection methods" cited from page 2-1 is taken in context with the text from which it is excerpted, it distinguishes between required operating stipulations and voluntary mitigation measures. 'Voluntary' implies that the mitigation measures are designed by the operator to meet NPS-defined resource protection objectives. The NPS reviews and determines whether an operator's "voluntary" mitigation measures would meet those objectives. "Operating standards," synonymous with operating stipulations in the Draft OGMP/EIS, are required by specific laws and regulations. An example would be the operating standards listed in 36 CFR § 9.41. Short-term, and long-term duration of impacts is defined at the top of page 4-3. The definition for a "qualified biologist" is provided in the next sentence. The definition for a "qualified archeologist" is one that meets the Secretary of Interior Standards and Guidelines for Archeology and Historic Preservation, as described in the last bullet on page 2-77.

As stated in the CEQ NEPA implementing regulations, Section 1500.1(b), Purpose, "NEPA procedures must insure that environmental information is available to public officials and citizens … The information must be of high quality. Accurate scientific analysis … are essential to implementing NEPA".

As stated in Section 1501.2(b), "Identify environmental effects and values in adequate detail so they can be compared to economic and technical analyses."

As stated in Section 1502.8, "which will be based upon the analysis and supporting data from the natural and social sciences and the environmental design arts."

As stated in Section 1502.18(b), about the Appendix, "Normally consist of material which substantiates any analysis fundamental to the impact statement".

As stated in Section 1502.24, "Agencies shall insure the professional integrity, of the discussions and analyses … They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement."

The only analysis that NPS has conducted for this EIS is **"best professional judgment". "Best professional judgment"** is where a group of people, using their experience, decide what is important. This is akin to the BOGSAT method used by federal and state resource agencies. BOGSAT means, "Bunch of guys sitting around talking". This level of assessment, analyses, and evaluation for environmental impacts and alternatives is an insufficient foundation upon which to base an EIS.

1) The word, **"localized"** is used to describe context or extent of the impact on **page 4-3. On pages S-11 through S-14, 2-55 through 2-60, 4-3, 4-12 through 4-15, 4-17 through 4-24, 4-26 through 4-37, 4-39, 4-40, 4-42 through 4-65, 4-67 through 4-72, 4-74, 4-75, 4-78 through 4-87, 4-89, 4-90, 4-92, 4-93, 4-95 through 4-100, 4-105, 4-106, 4-109, 4-110, 4-113, 4-114, 4-116, 4-120 through 4-126, 4-129 through 4-131, 4-133, 4-135 through 4-140, 4-142 through 4-144, 4-146 through 4-150,** the term **"localized"** is not defined. This term is not found in the Glossary.

NPS must define **"localized"** in its proper context for each impact issue and for each instance elsewhere in the DOGMP/EIS where the definition is different. The public has a right to review, comment on, and understand what is in the DOGMP/EIS. Decision-makers also need to know this information. Without a clear and specific definition for **"localized"** in each instance it is used this is not possible. By not defining the word **"localized"** the Sierra Club cannot determine whether it agrees with NPS's definition of the word and the way it is used.

3

COMMENTS	RESPONSES

69 Cont.

The Sierra Club assumes that **"localized"** has a different context for the different impact issues of nonfederal oil and gas development, air quality, geologic resources, water resources, floodplains, vegetation, wetlands, fish and wildlife, species of special concern, cultural resources, and visitor use and experience, and adjacent land uses. Each of these resources affects the environment in a different way and to a different extent. It would be logical that **"localized"** would not mean the same thing for each impact issue.

2) The phrase **"mitigation measures"** is used on pages **S-4, S-6, S-8, 1-2, 2-1, 2-8, 2-11, 2-13, 2-14, 2-18 through 2-20, 2-22, 2-24, 2-61, 2-62, 2-64, 2-67, 2-69, 2-70, 2-85 through 2-103, 4-2, 4-4, 4-5, 4-12, 4-22, 4-23, 4-35, 4-40, 4-44, 4-45, 4-49 through 4-54, 4-56, 4-58, 4-59, 4-62, 4-64 through 4-66, 4-72 through 4-75, 4-77, 4-86 through 4-88, 4-90 through 4-93, 4-96, 4-97, 4-99, 4-100, 4-102 through 4-104, 4-106, 4-110, 4-112 through 4-115, 4-119, 4-128 through 4-138, 4-140 through 4-142, 4-144, 4-146, 4-148, and 4-150 through 4-153.**

On page 2-1, the NPS states that **"mitigation measures"** "are not required by law but are **voluntary** resource protection methods that an oil and gas operator **may use** while conducting oil and gas operations ... the specific methods are up to the discretion of the operator ...".

It is of great concern to the Sierra Club that the foundation for protection of BTNP by the NPS consists of **"voluntary measures"** that the operator **"may use".** The NPS must make **"mitigation measures"** mandatory and not at the discretion of the operator. NPS does not define **"mitigation measures"** in the Glossary. NPS must define what **"mitigation measures"** are so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information.

On page 1-2, NPS talks about **"mitigation techniques"** and **page 2-65,** NPS talks about **"mitigation strategies".** How are these different than **"mitigation measures"?** These terms need to be defined in the Glossary. In addition NPS also uses the term **"mitigation"** when referring to implementation of protective measures. NPS must be consistent in the use of terminology. If NPS is not consistent then the public will not understand what NPS refers to when it uses the term **"mitigation measures".**

3) **On pages S-10 through S-14 and pages 2-55 through 2-59,** the phrase **"better protected"** is used to describe how Alternative B or Alternative C protects resources better than Alternative A. This phrase is not found in the Glossary. NPS must define what **"better protected"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ's mandatory NEPA implementing regulations. These regulations state,

4

69. Cont.

in **Section 1502.14, Alternatives including the proposed action,** that, "This section is the heart of the EIS ... it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision-maker and the public ... Devote substantial treatment to each alternative in detail ... so that reviewers may evaluate their comparative merits."

The CEQ also states, in **Section 1502.16 and (d), Environmental consequences,** that, "This section forms the scientific and analytic basis for the comparisons ... The environmental effects of alternatives including the proposed action the comparisons under Section 1502.14 will be based on this discussion."

It is key for NPS to clearly compare and make apparent the distinctiveness of each alternative and its impacts or protectiveness. This is not accomplished when phrases like **"better protected"** are used instead of quantitative information or more detailed and clear descriptions of qualitative information. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

4) **On pages 2-1, 4-5, 4-13, 4-23, 4-25, 4-51, 4-52, 4-56, 4-57, 4-66, 4-75, 4-82, 4-85, 4-93, the phrase "least damaging methods"** and **"least damaging to Preserve resources and values"** is not defined in the Glossary. NPS must define what **"least damaging methods, etc."** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

5) **On page 2-21,** the phrase **"with exceptions"** is not defined in the Glossary. NPS must define what **"with exceptions"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

6) **On pages 2-13, 2-21 2-25, 2-32, 2-34, 2-36, 2-38, 2-40, 2-42, 2-44, 2-46, 2-48, 2-50, 2-52, the phrase "adjacent to existing roadways"** is not defined in the Glossary. NPS must define what **"adjacent to existing roadways"** means so that the public can review, comment on, and understand what NPS is referring

5

COMMENTS	RESPONSES

69. Cont.

to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. NPS does not tell how many acres are included in this **"adjacent to existing roadways"** so the public knows just how extensive this area is compared to the "no surface use" requirement in Alternative C. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

7) **On pages 2-55 through 2-59, 4-26, 4-28, 4-31, 4-34, 4-39, 4-40, 4-42, 4-43, 4-44, 4-45, 4-46, 4-47, 4-48, 4-49, 4-52, 4-53, 4-55, 4-56, 4-57, 4-58, 4-61, 4-65, 4-67, 4-68,4-69, 4-70, 4-71, 4-72, 4-78, 4-79, 4-81, 4-82, 4-83, 4-85, 4-86, 4-92, 4-93, 4-95, 4-96, 4-97, 4-99, 4-100, 4-106, 4-109, 4-113, 4-114, 4-116, 4-120, 4-121, 4-122, 4-123, 4-124, 4-125, 4-126, 4-131, 4-133, 4-135, 4-137, 4-138, 4-139, 4-140, 4-147, 4-149, the phrase "widespread protection or widespread"** is not defined in the Glossary. NPS must define what **"widespread protection or widespread"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

8) **On pages 2-55 through 2-59, the phrase "consistent protection"** is not defined in the Glossary. NPS must define what **"consistent protection"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

9) **On pages 2-55 through 2-60, the phrase "similar to"** is not defined in the Glossary. NPS must define what **"similar to"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

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10) **On page 2-66, the phrase "no measurable effect"** is not defined in the Glossary. NPS must define what **"no measurable effect"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

11) **On page 3-4, the phrase "greatly reduced"** is not defined in the Glossary. NPS must define what **"greatly reduced"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. What number of leaks/spills has occurred at oil/gas sites for each year since the BTNP was created? What are the trends for leaks/spills? **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

12) **On page 3-4, the phrase "substantially reduced or avoided"** is not defined in the Glossary. NPS must define what **"substantially reduced or avoided"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. How often have light-weight vehicles or hand-held drilling equipment been used in the past? What is the rutting and compaction of soils and damage to vegetation from off-road vehicle use like in comparison to other equipment use? NPS must provide data that documents what the real-life experiences show in BTNP. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

13) **On page 4-4, the phrase "best professional judgment"** is not defined in the Glossary. NPS must define what **"best professional judgment"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3.

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The use of **"best professional judgment"** is not a substitute when quantitative information is available to show what impacts are or could be. This is the concern that the Sierra Club has when NPS develops and uses the **"Methodology for Assessing Impacts".** This methodology is based on **"best professional judgment"** but the public is not told what this phrase means. The interaction of the **"Methodology for Assessing Impacts"** with the requirement in **Section 1502.22** of the CEQ's NEPA implementing regulations must be discussed in detail in this EIS.

Section 1502.22, requires that when evaluating reasonably foreseeable significant adverse effects on the human environment in an EIS that incomplete or unavailable information be plainly stated as lacking in the EIS. This section requires that if the costs of obtaining this information are "not exorbitant" then the agency must include the information in the EIS. Finally, this section requires that if the information cannot be obtained due to exorbitant costs that the agency must state the information is incomplete or unavailable; state the relevance of this information to evaluating the significant adverse impacts; summarize the credible scientific evidence; and then provide the agency's evaluation of impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

In the DOGMP/DEIS the use of **"best professional judgment"** is the theoretical approach or research method that is generally accepted in the scientific community that NPS uses to assess the environmental impacts of oil/gas activities in, on, or through BTNP. Therefore NPS must give a thorough discussion of the use of this evaluation method in place of using quantitative data for the impact issue that is being discussed.

NPS cannot substitute **"best professional judgment"** for gathering existing quantitative data that it does have or gathering quantitative data that does not cost an exorbitant amount to collect for this EIS. The Sierra Club opposes the use of **"best professional judgment"** in lieu of using existing or not exorbitantly costly acquired quantitative data. For instance, the impact issue, "nonfederal oil and gas development", NPS should have data concerning the time it took to file information and get approval under Alternative A. This can be compared to the estimated approval times that Alternatives B and or C might provide if implemented. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

14) **On page 4-5, the phrase "barely measurable"** is not defined in the Glossary or in the definition for **"Negligible"** under **"Impact Intensity Thresholds".** NPS must define what **"barely measurable"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an

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alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

15) **On page 4-5, the phrase "slight but measurable"** is not defined in the Glossary or in the definition for **"Minor"** under **"Impact Intensity Thresholds".** NPS must define what **"slight but measurable"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

16) **On pages 4-5 and 4-128, the phrase "readily apparent"** is not defined in the Glossary or in the definition for **"Moderate"** under **"Impact Intensity Thresholds".** NPS must define what **"readily apparent"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

17) **On page 4-5, the phrase "would be substantial"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"would be substantial"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

18) **On page 4-5, the phrase "would provide minimum protection"** is not defined in the Glossary. NPS must define what **"would provide minimum protection"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences**

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between each alternative and define clearly what the words or phrases used mean.

19) **On pages 4-12, 4-35, 4-50, 4-62, 4-73, 4-87, 4-101, the phrase "would be so slight that it would not be of any measurable or perceptible consequence"** is not defined in the Glossary or in the definition for **"Negligible"** under **"Impact Intensity Thresholds".** NPS must define what **"would be so slight that it would not be of any measurable or perceptible consequence"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

20) **On page 4-12, 4-35, 4-50, 4-62, 4-73, 4-101, the phrase "small and of little consequence"** is not defined in the Glossary or in the definition for **"Minor"** under **"Impact Intensity Thresholds".** NPS must define what **"small and of little consequence"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

21) **On page 4-12, 4-35, 4-50, 4-62, 4-73, 4-87, 4-102, 4-142, the phrase "would be simple and successful"** is not defined in the Glossary or in the definition for **"Minor"** under **"Impact Intensity Thresholds".** NPS must define what **"would be simple and successful"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

22) **On page 4-12, 4-35, 4-50, 4-62, 4-73, 4-87, the phrase "readily detectable"** is not defined in the Glossary or in the definition for **"Moderate"** under **"Impact Intensity Thresholds".** NPS must define what **"readily detectable"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information.

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The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

23) **On page 4-12, the phrase "extensive and likely successful"** is not defined in the Glossary or in the definition for **"Moderate"** under **"Impact Intensity Thresholds".** NPS must define what **"extensive and likely successful"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

24) **On pages 4-12 and 4-128, the phrase "severely adverse"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"severely adverse"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

25) **On pages 4-12 and 4-102, the phrase "Extensive mitigation measures"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"Extensive mitigation measures"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

26) **On pages 4-12, 4-35, 4-50, 4-62, 4-73, 4-88, 4-102, 4-142, the phrase "success would not be guaranteed"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"success would not be guaranteed"** means so that the public can review,

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comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

27) **On page 4-14, the phrase "visibility may be slightly impacted"** is not defined in the Glossary. NPS must define what **"visibility may be slightly impacted"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. This phrase is not found under the **"Impact Intensity Thresholds"** definitions. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

28) **On pages 4-17, 4-19, 4-23, 4-29, 4-32, 4-47, 4-51, 4-55, 4-59, 4-68, 4-70, 4-81, 4-84, 4-90, 4-95, 4-98, 4-111, 4-113, 4-115, 4-124, the phrase "substantially reduced or substantially reduce"** is not defined in the Glossary. NPS must define what **"substantially reduced or substantially reduce"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. This phrase is not found under the **"Impact Intensity Thresholds"** definitions. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

29) **On pages 4-35, 4-50, 4-62, 4-73, 4-88, 4-102, the phrase "could be extensive, but would likely be successful"** is not defined in the Glossary or in the definition for **"Moderate"** under **"Impact Intensity Thresholds".** NPS must define what **"could be extensive, but would likely be successful"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

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30) **On pages 4-35, 4-50, 4-62, 4-73, 4-102, the phrase "substantial consequences"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"substantial consequences"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

31) **On page 4-54, the phrase "do not substantially alter"** is not defined in the Glossary. NPS must define what **"do not substantially alter"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

32) **On page 4-71, the phrase "with greater certainty"** is not defined in the Glossary. NPS must define what **"with greater certainty"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

33) **On page 4-87, the phrase "within the range of natural fluctuations"** is not defined in the Glossary or in the definition for **"Negligible"** under **"Impact Intensity Thresholds".** NPS must define what **"within the range of natural fluctuations"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

34) **On pages 4-87 and 4-88, the phrase "natural range of variability"** is not defined in the Glossary or in the definition for **"Minor, Moderate, and Major"**

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under **"Impact Intensity Thresholds".** NPS must define what **"natural range of variability"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

35) **On page 4-87, the phrase "short-term disruptions that would be within natural variation"** is not defined in the Glossary or in the definition for **"Minor"** under **"Impact Intensity Thresholds".** NPS must define what **"short-term disruptions that would be within natural variation"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

36) **On pages 4-87 and 4-88, the phrase "maintain viability of all species or all native fish and wildlife species"** is not defined in the Glossary or in the definition for **"Minor and Moderate"** under **"Impact Intensity Thresholds".** NPS must define what **"maintain viability of all species or all native fish and wildlife species"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

37) **On page 4-87, the phrase "critical reproductive periods"** is not defined in the Glossary or in the definition for **"Minor"** under **"Impact Intensity Thresholds".** NPS must define what **"critical reproductive periods"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

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38) **On page 4-88, the phrase "population numbers significantly depressed"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"population numbers significantly depressed"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

39) **On page 4-88, the phrase "long-term decrease in population levels"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"long-term decrease in population levels"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

40) **On page 4-89, the phrase "often greatly reduced"** is not defined in the Glossary. NPS must define what **"often greatly reduced"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

41) **On page 4-92, the phrase "relatively short-term duration"** is not defined in the Glossary. NPS must define what **"relatively short-term duration"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

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42) **On page 4-93, 4-94, 4-108, the phrase "viability of habitats"** is not defined in the Glossary. NPS must define what **"viability of habitats"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

43) **On page 4-93, 4-94, 4-108, the phrase "survivability of species"** is not defined in the Glossary. NPS must define what **"survivability of species"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

44) **On page 4-94, the phrase "viability of populations"** is not defined in the Glossary. NPS must define what **"viability of populations"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

45) **On page 4-96, the phrase "least-damaging site"** is not defined in the Glossary. NPS must define what **"least-damaging site"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

46) **On pages 4-99 and 4-108, the phrase "resiliency of the local populations or wildlife populations"** not defined in the Glossary. NPS must define what **"resiliency of the local populations"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to

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describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

47) **On page 4-99, the phrase "long-term incremental loss"** not defined in the Glossary. NPS must define what **"long-term incremental loss"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

48) **On page 4-102, the phrase "would be noticeably impacted"** not defined in the Glossary or in the definition for **"Moderate and Major"** under **"Impact Intensity Thresholds".** NPS must define what **"would be noticeably impacted"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

49) **On pages 4-103 and 4-107, the phrase "qualified biologist"** not defined in the Glossary. NPS must define what **"qualified biologist"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

50) **On page 4-105, the phrase "appreciably increase"** not defined in the Glossary. NPS must define what **"appreciably increase"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify**

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and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.

51) **On page 4-105, the phrase "limited to a localized area and relatively short-term duration"** is not defined in the Glossary. NPS must define what **"limited to a localized area and relatively short-term duration"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

52) **On pages 2-24, 2-94, 4-105, and 4-106, the phrase "appropriate mitigation"** is not defined in the Glossary. NPS must define what **"appropriate mitigation"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

53) **On page 4-108, the phrase "no adverse impacts on species of special concern"** not defined in the Glossary. NPS must define what **"no adverse impacts on species of special concern"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

54) **On page 4-108, the phrase "viability of species"** not defined in the Glossary. NPS must define what **"viability of species"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

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55) **On page 4-112, the phrase "long-term viability"** not defined in the Glossary. NPS must define what **"long-term viability"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

56) **On page 4-117, the phrase "lowest levels of detection"** not defined in the Glossary or in the definition for **"Negligible"** under **"Impact Intensity Thresholds".** NPS must define what **"lowest levels of detection"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

57) **On page 4-117, the phrase "loss of integrity"** not defined in the Glossary or in the definition for **"Minor, Moderate, and Major"** under **"Impact Intensity Thresholds".** NPS must define what **"loss of integrity"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

58) **On page 4-117, the phrase "active intervention"** not defined in the Glossary or in the definition for **"Minor, Moderate, and Major"** under **"Impact Intensity Thresholds".** NPS must define what **"active intervention"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

59) **On page 4-119, the phrase "qualified archeologist"** not defined in the Glossary. NPS must define what **"qualified archeologist"** means so that the public can review, comment on, and understand what NPS is referring to.

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Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

60) **On page 4-128, the phrase "barely detectable"** not defined in the Glossary or in the definition for **"Negligible"** under **"Impact Intensity Thresholds".** NPS must define what **"barely detectable"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

61) **On page 4-128, the phrase "slightly detectable"** not defined in the Glossary or in the definition for **"Minor"** under **"Impact Intensity Thresholds".** NPS must define what **"slightly detectable"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

62) **On page 4-128, the phrase "readily apparent"** not defined in the Glossary or in the definition for **"Moderate"** under **"Impact Intensity Thresholds".** NPS must define what **"readily apparent"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

63) **On page 4-130, the phrase "more substantial"** not defined in the Glossary. NPS must define what **"more substantial"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as

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69. Cont.

outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

64) **On page 4-131, the phrase "should not interfere substantially with"** is not defined in the Glossary. NPS must define what **"should not interfere substantially with"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

65) **On page 4-142, the phrase "would be considered slight, local"** is not defined in the Glossary or in the definition for **"Negligible"** under **"Impact Intensity Thresholds".** . NPS must define what **"would be considered slight, local"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

66) **On page 4-142, the phrase "changes would be small"** is not defined in the Glossary or in the definition for **"Minor"** under **"Impact Intensity Thresholds".** NPS must define what **"changes would be small"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

67) **On page 4-142, the phrase "would likely succeed"** is not defined in the Glossary or in the definition for **"Moderate"** under **"Impact Intensity Thresholds".** NPS must define what **"would likely succeed"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify**

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69. Cont. **and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.** 67) **On page 4-142, the phrase "would have readily measurable impacts with substantial consequences"** is not defined in the Glossary or in the definition for **"Major"** under **"Impact Intensity Thresholds".** NPS must define what **"would have readily measurable impacts with substantial consequences"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.** 68) **On page 4-152, Irreversible or Irretrievable Commitments of Resources, the phrase "pre-disturbance condition"** is not defined in the Glossary. NPS must define what **"pre-disturbance condition"** means so that the public can review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information.	
70. **Summary** 1) **On page S-1, Purpose and Need for This Plan, and pages 2-61-2-70,** the Sierra Club disagrees with NPS when it states that "NPS specific regulations only apply to nonfederal oil and gas operations occurring within park boundaries." In fact those operations that are connected to the slant drilling under the BTNP must comply with NPS requirements as noted by those who created the regulations in the late 1970's and as required by stipulations and mitigation measures that allow wells to have the plan of operations (POO) waived. **See Attachment 1.** In addition, in Appendix I, National Park Service Well Plugging Guide for Nonfederal Oil and Gas Wells in the State of Texas, NPS states that, "The NPS regulates plug and abandonment operations for all wells in National Park Units that are reached by crossing Federal Property. Even wells that have been exempt from NPS regulatory requirements often lose their exempt status when they are to be plugged and abandoned." Due to NPS's failure to accept its responsibility to regulate slant wells under BTNP and due to changes in 9B regulations which were re-interpreted without a public review and comment period, the Sierra Club and TCONR has sued NPS to ensure that National Park System natural resources are fully protected. The NPS must give a full explanation about the re-interpretation of the 9B regulations for directionally drilling and producing the well from a surface location 22	**70.** See Response 46.

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70. Cont. outside the boundaries of the BTNP. The Sierra Club disputes the assertion that the NPS is interpreting its 36 CFR 9B regulations appropriately. The record is replete with NPS back-tracking on these regulations and re-interpreting them without public input as required in the Federal Register. The NPS relies on a "draft" solicitor's opinion that is not final. "Draft" means that the opinion is not final. The Sierra Club requested a copy of this "draft" opinion via the Freedom of Information Act (FOIA) but NPS refused to provide a copy, claiming attorney-client privilege. An appeal has been pending since September 8, 2003 for information about NPS activities connected with this re-interpretation of the 9B regulations. The NPS has in its files interviews with some of the persons who originally developed the 9B regulations. Their statements contradict NPS's re-interpretation of the 9B regulations. **See Attachment 1.** From 1979 to 2002 the 9B regulations were implemented differently than NPS implements them now. **See Attachment 2.** The jurisdiction that NPS does have on activities outside the BTNP is in protecting park resources. If park resources are threatened, adequate protection cannot be achieved, and the values and resources will suffer impairment then NPS can condemn those minerals rights so they will not cause the degradation of park resources. A full narrative and description of the environmental impacts of an alternative to acquire all or a portion of the mineral interests which are under BTNP must be prepared and provided in the DOGMP/DEIS.	
71. **On page 2-62,** NPS says that it implements its responsibilities by "considering acquisition of the nonfederal oil and gas interest." If NPS has done this then it should have documentation that shows the analyses it conducted during this consideration for each well it has approved. These analyses should include cost estimates for acquiring private mineral rights under BTNP as a whole and in certain units or parts of units. NPS has never presented any such information in its EAs for any oil/gas activity and does not do so for the DOGMP/DEIS. NPS has made no serious analysis about acquiring private oil/gas mineral rights and continues to stonewall the Sierra Club and the public by not providing the appropriate information in the DOGMP/DEIS for public review and comment. Decision-makers also need to know this information. Shame on NPS for abdicating its responsibility for protecting public resources and taking the "hard look" that NEPA requires. NPS refuses to mention its responsibilities under the Commerce Clause of the Constitution and other laws to acquire private mineral rights. No one has stated that NPS should acquire private mineral rights without "due process of law or just compensation". NPS is using the Fifth Amendment of the U.S. Constitution to avoid its responsibility to protect the public's resources in BTNP.	**71.** The NPS considers acquisition of the nonfederal oil and gas interest in project-specific analyses it undertakes under NEPA. Thus far, the acquisition of the nonfederal oil and gas interest has been considered but dismissed from further consideration. As stated in the EAs, "In the event that a proposed operation cannot be sufficiently modified to prevent the impairment of park resources and values, the NPS may seek to extinguish the associated mineral right through acquisition, subject to the appropriation of funds from Congress." In all cases thus far, no nonfederal oil and gas proposal submitted has presented a significant threat of damage to park resources. Therefore, in each case, the alternative to acquire the nonfederal oil and gas interest was considered but dismissed from further consideration. Likewise, in the Draft Plan/EIS, on page 2-17, NPS considered alternatives to acquire a portion or all of the nonfederal mineral rights in the Preserve. These alternatives were considered but for the reasons provided were dismissed from detailed analysis. To pursue evaluating these unreasonable alternatives would be inconsistent with CEQ and DO-12. These alternatives were analyzed to a limited extent before being dismissed from further evaluation. CEQ requires that NEPA documents be "concise, clear, and to the point." They must "emphasize real environmental issues and alternatives" and be useful to the decision-maker and the public (1500.2). "Most important, NEPA documents must concentrate on the issues that are truly significant (i.e., pivotal) to the action in question, rather than amassing needless detail" (1500.1(b)). Therefore, the NPS did not include a cost analysis for acquiring some or all of the mineral interests.
72. **On page 2-64,** the Sierra Club vigorously disagrees with the NPS that "Activities located outside park boundaries but connected to operations occurring within a	**72.** See Response 46.

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72. Cont. park" are beyond the jurisdiction of the NPS. NPS has an April 16, 1998 solicitor's opinion (final) that contradicts this statement. **See Attachment 3.** **On pages 2-66 and 2-67,** the Sierra Club disagrees with the NPS over its so-called exemption process as well as its opinion that NEPA does not apply. These positions by NPS are why the Sierra Club has filed suit over its implementation of the 9B regulations. NPS is silent in this DOGMP/DEIS about the lawsuit and the fact that its re-interpretation of the 9B regulations is so controversial that this had led to a lawsuit in federal court. NPS has also stated in EAs prepared for oil/gas activities in BTNP that it is not granting an "approval" and therefore it does not have to conduct an EA. This is an incorrect statement. The granting of a "waiver" to allowing drilling through the BTNP is an approval because it ensures that an operator does not have to develop a plan of operations (POO). Drilling by an operator does trigger the significance test in NEPA so this is a "major federal action significantly affecting the quality of the human environment." Therefore an EIS should be prepared. Drilling inside BTNP further strengthens that these are "major federal action(s)" because a POO is necessary and an EIS is required. Yet NPS prepares EAs exclusively and ignores the requirement for an EIS. The Sierra Club objects to this unwarranted action. If NPS argues that the drilling of a well is not significant then the Sierra Club's response is that the drilling of a well inside BTNP or through the BTNP, via slant drilling, in addition to the proposals to drill wells within other units of BTNP, does constitute the crossing of the significance threshold. In Anderson v. Evans, 314 F. 3d 1006, 1019 (9th Cir. 2002), the court ruled that an EA would be set aside when the record showed that the "whole population in the local Washington area may be significantly affected" and because "such local effects are a basis for a finding that there will be a significant impact". It is obvious that on an individual well basis that this court ruling may in fact apply to the failure of the NPS to conduct an EIS for individual or multiple wells that are drilling inside or just outside the boundaries of BTNP.	
73. This DOGMP/DEIS does not assess the total direct, indirect, connected, secondary, and cumulative impacts of multiple wells drilled inside and just outside the BTNP. The Sierra Club requests NPS withdraw the DOGMP/DEIS, modify it to discuss these issues, and re-issue it for public review and comment. Decision-makers also need to know this information.	**73.** Chapter 4, Environmental Consequences, on pages 4-1 through 4-154 of the Draft Plan/EIS, is devoted to assessing the environmental impacts by resource topic or concern, under each alternative.
74. **On page 2-67, Collection of Resource Information by Prospective Operators,** the NPS use to require more information than it currently does for a "waiver". Because Davis Brothers complained NPS emasculated its data requirements and has bent over backwards to be on the operator's side. This 24	**74.** The scope of the NPS's jurisdiction under its regulations at 36 CFR Part 9B, including its authority under section 9.32(e), is limited to operations that occur inside the boundary of the park. On September 1, 2005, the District Court for the District of Columbia issued an order in Sierra Club v. Mainella, (Civ. No. 04-2012, 2005 U.S. Dist. LEXIS 18911), affirming this interpretation and validating NPS's application of section 9.32(e). The court said that "the plain language of the 9B Regulations limits NPS's exemption process to the consideration of impacts from activities within a unit." Nonetheless, through its compliance with the National Environmental Policy Act, the NPS discloses potential impacts to park resources associated with operations occurring outside park boundaries and outside the Service's regulatory jurisdiction. The NPS also works with operators to encourage them to adopt mitigation measures on their operations located outside park boundaries in order to protect park resources.

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74. Cont. blatant abdication of the NPS's responsibility is one of the reasons why the Sierra Club has sued NPS. But NPS stays silent about the lawsuit. **See Attachment 4.**	
75. **On page 2-67, Access to Surface Location Outside Park Boundaries and Monitoring,** NPS has weakened its ability to monitor slant drilling outside BTNP to ensure that BTNP resources are not being harmed and the waiver is being implemented as agreed on by the operator. NPS undermined its own employees when violations of "waivers" were found. NPS weakens its own ability to enforce mitigation measures by calling them voluntary and allowing operators like Davis Brothers to challenge NPS that it has no authority to enforce mitigation measures outside BTNP (even if Davis has voluntarily agreed to implement them and signed off on this agreement). The Sierra Club vigorously disagrees with NPS when it states, "When the NPS has made an upfront determination that a directional drilling operation is exempt without conditions from the regulations because of the lack of impacts, there is no 9B regulatory reason to access the surface location outside the park." This blatant abdication of the NPS's responsibility is one of the reasons why the Sierra Club has sued NPS. But NPS stays silent about the lawsuit. **See Attachment 5.**	**75.** See Response 74. Also note that the NPS's authority to require and enforce mitigation measures is tied to the scope of its jurisdiction under the regulations.
76. **On page 2-69, Table 2.19, Mitigation Measures column,** NPS formally states that it will not necessarily participate in "other agencies' permitting processes to identify potential impacts on park resources and values and recommend mitigation". This occurs when NPS states that it "Should" participate rather than "Will" participate. This blatant abdication of the NPS's responsibility is one of the reasons why the Sierra Club has sued NPS. But NPS stays silent about the lawsuit. NPS, by not committing to participating in other agencies' permitting process and refusing the incorporate other agency's environmental protection rules in its waivers and permits, violates its responsibility under the Organic Act and other laws to protect the public's resources in BTNP in perpetuity. **See Attachment 6.**	**76.** Section 1.5 of NPS Management Policies states, "[R]ecognizing that parks are integral parts of larger regional environments, the Service will work cooperatively with others to anticipate, avoid, and resolve potential conflicts; protect park resources and values; provide for visitor enjoyment; and address mutual interests in the quality of life of community residents, including matters such as compatible economic development and resource and environmental protection." As appropriate, the NPS participates in other agencies' permitting process to identify potential impacts to park resources and values. The following text was inserted in the Final Plan/EIS on page 2-71, Table 2.19, last column, 3rd bullet: "The NPS will work cooperatively with other agencies during their permitting processes to identify potential impacts on park resources and values and recommend mitigation measures/conditions of approval."
77. 2) **On page S-2, Purpose and Need for This Plan,** NPS states that special use permits are issued before an activity can be conducted in existing oil/gas right-of-ways (ROW). The Sierra Club requests that it be notified when these special use permits are requested; that the Sierra Club be allowed to comment on each special use permit; and the public be granted a public review and comment period for each proposed special use permit.	**77.** Comment noted.
78. 3) **On page S-2, Planning Direction,** the date given for the DOGMP/DEIS scoping open house is December 3, 1988. The date should be December 3, 1998.	**78.** The date of the public scoping open house was corrected in the Final Plan/EIS.
79. The Sierra Club is concerned that this DOGMP/DEIS took 6 years to complete. The DOGMP/DEIS appears to have been updated little since work on this document began. The information is dated and the age of the information affects the analysis conducted. Two years went by without any work on the plan. Because of the length of time that the DOGMP/DEIS was in preparation the NPS should have reopened the scoping process to ensure that the newest information	**79.** Members of the interdisciplinary team continued to work on development of the Draft Plan/EIS during the 6-year period. Factual information such as the number of wells drilled, the status of these operations, and other information have been updated in the Final Plan/EIS. The data provided in the Plan/EIS were determined to be current and valid. Also see Responses 74 and 75.

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79. Cont.

was included in the document. If this had been done then the Sierra Club would have raised as an issue of concern the re-interpretation of the 9B regulations and the ability of the NPS to monitor slant wells that are adjacent to, but off public lands. The Sierra Club protests NPS's decision not to reopen scoping for the DOGMP/DEIS.

80.

4) **On pages S-4 and S-5, Planning Direction,** another change NPS has made since it re-interpreted the 9B regulations is it no longer incorporates other agency mitigation and environmental protection stipulations into the "waiver" of the POO. This incorporation of local, state, and federal mitigation ensures that natural resource protection inside and outside BTNP is maximized. **See Attachment 6.**

81.

5) **On page S-4, 2-1, 2-5, 2-15, 4-1, Reasonably Foreseeable Development Scenario (RFD),** the RFD is obsolete and the way the NPS uses it in the DOGMP/DEIS distorts its original purpose. The RFD was conducted in 1999-2000 using 1995 data. It was meant to estimate, from the 2000 date, the amount of oil/gas that might be found in the next 15-20 years. The RFD presented in Appendix E does not indicate how the proposed number of 29 wells used by the DOGMP/DEIS was calculated and or determined. The number of oil/gas fields is calculated in the RFD.

Already, the number of oil/gas wells projected to be drilled in or under BTNP is obsolete. At least 20 wells have been approved or drilled since the preparation of the RFD in 2000. NPS should revise the RFD because the 29 well estimate is low and will be exceeded in the next 3 years. The 29 well estimate, using a starting date of 2004, underestimates the number of wells that will be drilled in BTNP because the RFD estimate is from 2000 and not 2004.

82.

6) **On pages S-5 and S-6, Summary of Plan Alternatives, and 2-1, Introduction, and 2-16, 2-17, 2-61-2-64,** a reasonable alternative that was not analyzed is the buy-out of all or some of the private mineral rights under BTNP. NPS has refused to analyze this reasonable alternative although the Sierra Club has submitted this alternative in its scoping and EA comments for the past several years. NPS violates CEQ NEPA implementing regulations found in Section 1502.14(a) when this occurs.

The NPS is having difficulty obtaining the surface title to lands along Big Sandy and Village Creeks to add to BTNP after Congress appropriated over $11,000,000 the past three years. This is of great concern and is relevant to the issue of analyzing the buy-out of oil/gas mineral rights in BTNP in this EIS. Blackstone Minerals is resisting the surface right buy-out for these lands because certain surface access and use rights have not been agreed to by the NPS. Apparently the NPS finds it unacceptable in a unit of the National Park System to allow the type of guaranteed for surface access and use rights that Blackstone is requesting. This problem, which endangers the lands to be added to BTNP by

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80. See Responses 74 and 75.

81. Also see Response 29. The comment incorrectly states that the purpose of the RFD scenario is to "…estimate, from the 2000 date, the amount of oil and gas that might be found in the next 15 – 20 years." The USGS assessment was prepared for this purpose, not the RFD scenario prepared by the NPS. The purpose of the RFD scenario is to provide a reasonable basis for analyzing the potential effects of oil and gas related operations within and outside the Preserve for the alternatives presented in this Plan/EIS. The number of wells and the acres of disturbance projected in the RFD scenario do not represent a benchmark or decision point for acceptable level of activity that could occur to develop the oil and gas underlying the Preserve. Rather, they are meant to provide the interdisciplinary team, public, and NPS decision-makers with an understanding of the types and extent of oil and gas exploration and production operations expected under this Plan/EIS. The NPS will track the number of wells and the acres of disturbance for nonfederal oil and gas operations in the Preserve. If the number of wells or the acres of disturbance presented in the RFD scenario, or the impacts (context, intensity, and duration) from future oil and gas projects exceed those anticipated in this Plan/EIS, then the NPS will re-examine whether to supplement the Plan/EIS as required by the NEPA and NPS Director's Order and Handbook – Conservation Planning, Environmental Impact Analysis and Decision-Making.

The methodology used by the NPS to prepare the RFD scenario is based on previous 3-D seismic surveys, well drilling in and near the Preserve, and Texas Railroad Commission regulatory requirements. As shown in the footnote to Table 2.1 on page 2-7 of the Draft Plan/EIS, the NPS assumed that 3-D seismic surveys could be conducted Preserve-wide. Since it is unlikely that Preserve-wide proprietary 3-D seismic surveys would be conducted in areas that already have seismic coverage, this results in a worst case scenario (large) acreage estimate in the RFD scenario. It is more likely that smaller, site-specific 3-D surveys would be conducted to delineate drilling targets. The number of shotholes, line spacing for source and receiver lines, and extent of selective vegetative trimming that used in the calculation of surface disturbances are based on the Seismic Assistants Ltd. 3-D seismic survey conducted during 2004 in the Preserve.

Wellpad and access road dimensions used in the RFD scenario were derived by averaging surface disturbances for existing operations within and outside of the Preserve. Average field sizes and cumulative production per well were determined by USGS during their review of all wells drilled in the Western Gulf Oil and Gas Province. Exploratory and production drilling success rates were determined by looking at drilling results for wells in and near the Preserve. All of these components have been updated by contacting companies currently conducting oil and gas operations in the Preserve and have been used to prepare the revised RFD scenario shown in the Final Plan/EIS. Since 1997, no wells have been drilled from surface locations inside of the Preserve. It is anticipated

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82. Cont.

the 1993 Big Thicket Addition Act, speaks to the need and reasonableness of analyzing the buy-out of oil/gas mineral rights in this EIS.

It is incredible that America's first National Preserve is not fully protected from all the environmental impacts due to oil/gas activities. NPS is against analyzing the buy-out of private mineral rights to protect public lands the American People have entrusted to it to protect forever. Apparently NPS is more concerned about protecting the "planning goal to permit reasonable access for exploratory drilling, production, and transportation of nonfederal oil and gas resources" than the public's natural resources in BTNP.

NPS has ignored alternatives that provide a mix of protective strategies. For instance, a buy-out of mineral rights for sensitive areas while allowing drilling in less sensitive areas. The NPS is ignoring CEQ NEPA implementing regulations which require the consideration and analysis of "all reasonable alternatives".

83.

7) **On page S-7, Table S1, Alternative B, page S-9, Table S2, 2-13, 2-25, 2-55,** for "Total Area with Operating Stipulations", NPS uses a total figure of "up to 75,293 acres". The public deserves to know and to be clearly and easily shown how much protection each alternative provides in total acres. Decision-makers also need to know this information. This table is deficient in this respect. The same deficiency is found for the column under "Drilling and Production Operations – No Surface Use", where instead of stating how many acres each unit and special protected area will consist of NPS gives the figure "less than 46,273 acres". This is not acceptable under Section 1502.14 and 1502.16 of CEQ's NEPA implementing regulations. Both of these columns also are footnoted with (4), but footnote 4 is not found at the bottom of S-7.

NPS must clearly show how many acres are designated as **"no surface use"** areas for each BTNP unit; for each ecosystem in BTNP; and for each special management area.

On page 2-32, NPS fails to tell the public, for Alternative B, Beaumont Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 5,547 acres". Decision-makers also need to know this information.

On page 2-32, NPS fails to tell the public, for Alternative B, Beaumont Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 3,258 acres". Decision-makers also need to know this information.

On page 2-34, NPS fails to tell the public, for Alternative B, Beech Creek Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 4,753 acres". Decision-makers also need to know this information.

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that most of the wells that will be drilled in the future to develop oil and gas resources underlying the Preserve will be directionally drilled from outside of the Preserve. Therefore, the acreage estimate shown in the RFD scenario in the Plan/EIS represents an upper estimate of activities and surface disturbances, most of which are likely to occur on lands outside of the Preserve.

82. Two alternatives to acquire a portion of or all of the nonfederal mineral rights in the Preserve were evaluated to a limited extent on page 2-17. As described in the text, the NPS currently only has the authority to acquire the nonfederal mineral rights on a case-by-case basis if it determines that an oil and gas operation poses a significant threat to park resources and values. This was one of the reasons the alternatives to acquire a portion or all of the nonfederal mineral rights in the Preserve was dismissed from further consideration. See Response 71. According to § 4.5E(6) of DO-12: "Reasons to eliminate alternatives include:…(c) duplication of other, less environmentally damaging or less expensive alternatives." Targeted buyouts, when needed, would be substantially less expensive than extinguishing mineral rights, therefore the latter is eliminated from detailed consideration.

83. Please refer to Table 2.4, Summary of Alternatives. On page 2-21of the Draft Plan/EIS, under the Riparian Corridors SMA for Alternative B, the "No Surface Use" operating stipulation would be applied to drilling and production operations, with an exception that states, "except drilling and production operations could be permitted adjacent to existing roadways, within previously disturbed areas, subject to Current and Legal Policy Requirements. No new roads would be permitted. Associated flowlines and gathering lines could be located within previously disturbed areas." Therefore, Tables S-1, and 2-5 through 2-16, under Alternative B, have the "<" before the acreage for "Total Area with Operating Stipulations" and "Total Area for Drilling and Production Operations with No Surface Use," to remind the reader that the acreage could be less than the total number if exceptions for drilling and production operations are permitted within the SMA. Each of the acreage totals are footnoted to explain why the "<" appears before the acreage total.

The numbering of the footnotes was corrected in the Final Plan/EIS.

COMMENTS	RESPONSES
83. Cont.	

On page 2-34, NPS fails to tell the public, for Alternative B, Beech Creek Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 3561 acres". Decision-makers also need to know this information.

On page 2-36, NPS fails to tell the public, for Alternative B, Big Sandy Creek Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 12,608 acres". Decision-makers also need to know this information.

On page 2-36, NPS fails to tell the public, for Alternative B, Big Sandy Creek Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 8,552 acres". Decision-makers also need to know this information.

On page 2-38, NPS fails to tell the public, for Alternative B, Hickory Creek Savannah Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 395 acres". Decision-makers also need to know this information.

On page 2-38, NPS fails to tell the public, for Alternative B, Hickory Creek Savannah Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 395 acres". Decision-makers also need to know this information.

On page 2-40, NPS fails to tell the public, for Alternative B, Lance Rosier Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 23,515 acres". Decision-makers also need to know this information.

On page 2-40, NPS fails to tell the public, for Alternative B, Lance Rosier Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 4,212 acres". Decision-makers also need to know this information.

On page 2-42, NPS fails to tell the public, for Alternative B, Lower Neches River Corridor Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 2,544 acres". Decision-makers also need to know this information.

On page 2-42, NPS fails to tell the public, for Alternative B, Lower Neches River Corridor Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 2,544 acres". Decision-makers also need to know this information.

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COMMENTS	RESPONSES
83. Cont.	

On page 2-44, NPS fails to tell the public, for Alternative B, Menard Creek Corridor Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 2,025 acres". Decision-makers also need to know this information.

On page 2-44, NPS fails to tell the public, for Alternative B, Lower Neches River Corridor Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 2,025 acres". Decision-makers also need to know this information.

On page 2-46, NPS fails to tell the public, for Alternative B, Neches Bottom/Jack Gore Baygall Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 11,981 acres". Decision-makers also need to know this information.

On page 2-46, NPS fails to tell the public, for Alternative B, the Neches Bottom/Jack Gore Baygall Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 5,803 acres". Decision-makers also need to know this information.

On page 2-48, NPS fails to tell the public, for Alternative B, Little Pine Island Bayou Corridor Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 1,528 acres". Decision-makers also need to know this information.

On page 2-48, NPS fails to tell the public, for Alternative B, Little Pine Island Bayou Corridor Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 1,528 acres". Decision-makers also need to know this information.

On page 2-50, NPS fails to tell the public, for Alternative B, Turkey Creek Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 6,439 acres". Decision-makers also need to know this information.

On page 2-50, NPS fails to tell the public, for Alternative B, Turkey Creek Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 6,439 acres". Decision-makers also need to know this information.

On page 2-52, NPS fails to tell the public, for Alternative B, Upper Neches River Corridor Unit, Total Area with Operating Stipulations. NPS does not give a definitive acreage and simply states "less than 3,958 acres". Decision-makers also need to know this information.

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83. Cont. **On page 2-52,** NPS fails to tell the public, for Alternative B, Upper Neches River Corridor Unit, Total Acres with No Surface Use. NPS does not give a definitive acreage and simply states "less than 3,958 acres". Decision-makers also need to know this information.

Chapter 1 Introduction

84. 1) **On page 1-1, Purpose and Need for This Plan,** NPS states that further NEPA analysis will be conducted for specific POO and special use permit applications. NPS does not mention that "waivers" from the POO must go through NEPA. NPS does not mention that no EISs have been conducted on any site specific oil/gas project that the Sierra Club has reviewed since 1984 (20 years). The reality is that the best and most comprehensive environmental analysis, as found in an EIS, is not conducted on site specific oil/gas projects in BTNP. Surely for some site specific oil/gas projects an EIS is required and should receive that most intense analysis.

85. 2) **On page 1-1, Purpose and Need for This Plan, paragraph 1,** NPS states that the DOGMP/DEIS will be implemented over 15-20 years. The last paragraph of page 1-1 says the plan will provide direction for 10-15 years. Which is correct?

86. 3) **On page 1-3, NPS Organic Act and General Authorities Act,** the Sierra Club disagrees that "An impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot be reasonably further mitigated, of an action necessary to preserve or restore the integrity of park resources or values." An action causes an impairment or it does not. The fact that it is unavoidable should have nothing to do the decision of deciding whether impairment has occurred. If NPS allows impairment for any purpose it indicates that NPS is unable to protect public lands in perpetuity for the enjoyment of the public.

87. 4) **On page 1-3, NPS Organic Act and General Authorities Act, fourth paragraph,** the Sierra Club is concerned that NPS does not list "solitude" as a park resource and value that should be protected using the impairment standard. The Sierra Club requests that solitude be added to the basic value and resource list for this EIS and which is found on NPS lands and in BTNP.

88. 5) **On page 1-5, Natural Resource Management,** NPS has failed "To initiate joint planning and natural resources management programs with neighboring landowners to promote continued compatible land use" with regard to oil/gas activities." As a result adjacent landowners have suffered additional environmental degradation due to slant wells located on their lands and which bore under BTNP. Temple-Inland has not been happy with the way Davis Brothers has operated on its lands. NPS must discuss why it has not aggressively sought a joint plan for oil/gas activities with adjacent landowners

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84. Comment noted.

85. The plan is intended to provide direction for long-term management of existing and anticipated oil and gas operations. "Long-term" is defined on page 4-3 of the Draft Plan/EIS for describing impacts as extending up to 20 years or longer. The Final Plan/EIS was corrected to consistently state that the plan covers the next 15-20 years, and possibly longer, if there are no major changes in technology, and impacts do not significantly change from those described.

86. The text quoted comes from §1.4.5 of NPS *Management Policies*. Please note the analysis in the Draft Plan/EIS determined that there would be no potential for impairment to Preserve resources or values from implementation of any of the three alternatives. Impairment is determined based on the NPS Organic Act, and the Preserve's enabling legislation, which specifically addresses exploration and development of non-federal oil and gas.

87. "Solitude" is included in the topic "Visitor Use and Experience." "Solitude" is described in the issue statement on page 1-21 under 'Visitor Use and Experience." The description of "Wild Character – Solitude" on pages 3-71 and 3-72 of the Draft Plan/EIS describes how wild character–solitude contributes to some visitor experiences. This discussion is under the overall heading "Visitor Use and Experience" on pages 3-61 through 3-72. This section of the Draft Plan/EIS describes the types of visitor uses, how natural quiet is a component of visitor experience, and how wild character-solitude contributes to some visitor experiences. Environmental consequences on visitor use and experience, is found in Chapter 4 under the same overall heading "Visitor Use and Experience."

88. The purpose of summarizing the Preserve's 1980 General Management Plan is to show that the Oil and Gas Management Plan/EIS would be consistent with the GMP direction.

COMMENTS	RESPONSES
88. Cont. and what will be done in the future to ensure it does a better job. **See Attachment 7.**	
89. 6) **On pages 1-5 through 1-9,** NPS does not discuss that it changed the 9B regulations by reinterpreting them via two memos, one which was issued on May 22, 2003 and one which was issued on November 14, 2003. The very fact that these memos exist and were written after Davis Brothers complained to the Department of the Interior (DOI) about having to conduct and submit important environmental analyses is disconcerting. The Sierra Club is also concerned that NPS does not even mention these documents in this discussion of the 9B regulations. Is NPS trying to hide something? NPS fails to mention and discuss the solicitor's opinion (not a draft, but a final opinion) of April 16, 1998, which indicates that NPS has some regulatory authority outside the boundaries of the National Park System. The Sierra Club requests that the NPS discuss these two memos and the events that led to their creation, including the draft solicitor's opinion that NPS used to justify reinterpreting the 9B regulations. **See Attachments 3 and 4.**	**89.** See Response 46.
90. 7) **On page 1-9, Regulation of Transport Oil and Gas Pipelines and Activities in Associated Rights-of-Way,** NPS should provide in an appendix the oil/gas pipeline ROW documents that exist for BTNP. NPS should explain in this DOGMP/DEIS what the ROW documents say for each pipeline so that the public can review, comment on, and understand them. Decision-makers also need to know this information.	**90.** The NPS sees no point in attaching to the Final Plan/EIS copies of all documents creating oil or gas pipeline rights-or-way (all of which are publicly available) or in trying to "explain" what each document "says." What a particular right-of-way document "says" is a matter of legal interpretation and must be determined on a case-by-case basis.
91. 8) **On page 1-13, Establishing a Planning Team,** did NPS ask any of the federal or state agencies to be a cooperating agency?	**91.** No, as stated on page 1-13 of the Draft Plan/EIS, in the 2nd and 3rd paragraphs under the heading "Establishing a Planning Team."
92. 9) **On page 1-13, Establishing a Planning Team,** NPS does not state that on a case-by-case basis, site specific oil/gas projects, are supposed to be assessed to determine weather an EA/EIS should be prepared. Instead NPS states that a POO and EA are prepared. This demonstrates a bias against assessing whether an EIS is required versus an EA for site specific oil/gas projects.	**92.** The text in the first bullet under the heading "Establishing a Planning Team" incorrectly assumes that the NPS could satisfy NEPA requirements for future oil and gas proposals by development of environmental assessments. While oil and gas proposals in the past have never required the preparation of an environmental impact statement (EIS), the possibility exists that an EIS may be required in the future. The text was modified in the Final Plan/EIS to read: "The NPS consults with the following entities on a project-by-project basis if a proposal could have effects on floodplains or wetlands."
93. 10) **On page 1-18, Resources and Concerns to be Addressed in the Plan,** NPS should include "solitude" in this list of resources and concerns.	**93.** See Response 87.
94. 11) **On page 1-19, Table 1.3, Nonfederal Oil and Gas Development,** please note that non-federal oil and gas operations contribute "Minimally" to domestic energy supply.	**94.** The third issue statement under the heading "Nonfederal Oil and Gas Development" on page 1-19 was deleted in the Final Plan/EIS. The NPS evaluated the effect the action alternatives would have on the local and regional economies to a limited degree on pages 1-22 and 1-23, before dismissing the topic from further analysis because effects would not be measurable (meaning there would be minor or less effects).
95. 12) **On page 1-19, Table 1.3, Geologic Resources,** NPS does not mention that the destruction of organic or the living portion of the soil is one impact that occurs due to oil/gas activities in BTNP.	**95.** The organic or living portion of soil is addressed in the first issue statement as "other soil characteristics," and in the third issue statement as "could alter the soil's chemical and physical properties."

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COMMENTS

96.

13) **On page 1-19, Table 1.3, Water Resources,** NPS does not mention about the need to protect groundwater recharge areas, shallow water aquifers, connected biological communities like seeps and bogs, and the recharge of the alluvium stream aquifers from the impacts of oil/gas activities.

97.

14) **On page 1-21, Table 1.3, Visitor Use and Experience,** NPS must include solitude, quiet, and the protection of natural sounds as important values for visitor use.

98.

15) **On page 1-22, Local and Regional Economies,** NPS must define what **"technological feasible precautions"** means. This phrase is not in the Glossary. The public must be able to review, comment on, and understand what NPS is referring to. Decision-makers also need to know this information. The qualitative description of phrases used to describe environmental impacts or the protectiveness of an alternative does not provide the public with the degree of comparison required by the CEQ as outlined above in 3. **The Sierra Club requests that NPS clarify and detail clearly the comparative differences between each alternative and define clearly what the words or phrases used mean.**

99.

16) **On page 1-22, Local and Regional Economies,** NPS uses an average of 2 wells drilled/year over the past 4 years. This information is out-of-date. According to the EA Famcor Oil, Inc. Roberts/Duke #1 Flowline, December 2004, on page 15, "From 1998 through 2004, there were no wells drilled within the Preserve. However, 19 directional wells were drilled from surface locations outside the Preserve to reach bottomholes inside the Preserve." NPS does not say that it has approved or is in the act of approving 19 wells in the past two and one-half years (2002-2004). NPS must give the public the full and correct story and not fail to disclose all the facts.

100.

17) **On page 1-23, Park Operations for Fire and Facility Management,** NPS calls the visitor center an "Information Station". Why?

101.

18) **On page 1-24, Possible Conflicts Between the proposed Action and land Use Plans, Policies, or Controls,** NPS does not mention how it changed and reinterpreted the 9B regulations. This was done via a draft solicitor's opinion and two memos without public input. NPS does not say anything about the lawsuit that the Sierra Club has filed over reinterpretation of the 9B regulations. NPS must give the public the full and correct story and not fail to disclose all the facts.

Chapter 2 Part 1 –Plan Alternatives

102.

1) **On pages 2-2, Alternative A, 2-18, 2-19,** NPS states that Alternative A does not consist of a "formalized Preserve-wide oil and gas management plan and specific resource protection goals (called performance standards) and operating

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RESPONSES

96. The issue statements define problems that could affect water quality and quantity, both surface and subsurface.

97. "Solitude" and "background sound levels" are described in the 2nd issue statement.

98. The following parenthetical citation was inserted at the end of the 2nd paragraph under the heading "Local and Regional Economies, on page 1-22: "(36 CFR § 9.46)." The first sentence of this citation reads: "The operator shall take technologically feasible precautions to prevent accidents and fires, shall notify the Superintendent within 24 hours of all accidents involving serious personal injury or death, or fires on the site, and shall submit a full written report thereon within ninety (90) days." Also see Response 69.

99. The 4th paragraph under the heading "Local and Regional Economies" was revised in the Final Plan/EIS to read: "From 1998 through 2000, no wells were drilled in or outside the Preserve to develop the underlying hydrocarbons. From 2001 through June 2005, 19 directional wells were drilled from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve. During 2004 and up to June 1, 2005, applicants received § 9.32(e) exemption determinations for 15 additional directional wells. The historic drilling activity in the Preserve is further described in the Nonfederal Oil and Gas Operations section in Chapter 3."

100. Big Thicket National Preserve has both a visitor center and an information station. The visitor center is located just east of Highway 69 on FM 420, and the information station is located at the south end of the Turkey Creek Unit as shown on Figure 3.5. The photograph on page 3-66 of the Draft Plan/EIS is of the visitor center and is incorrectly identified as the Big Thicket Information Station. This is corrected in the Final Plan/EIS.

101. See Response 46.

102. The analysis of impacts under each of the three alternatives is included in Chapter 4, Environmental Consequences.

COMMENTS	RESPONSES
102. Cont. stipulations would continue to be applied on a case-by-case basis". NPS indicates that such a program is not as protective as Alternatives B and C because of the lack of a formal oil/gas management plan and the need to look at each oil/gas activity on a case-by-case basis. NPS does not provide any evidence or discussion of the implementation of Alternative A. If Alternative A has caused damage that could have been avoided in BTNP then the NPS should be able to provide examples and discuss the alternative's shortcomings in specific detail. This is particularly important for recent actions (since 1999). The NPS has championed the existing program in relation to the Sierra Club's concerns for the past 6 years.	
103. 2) **On page 2-2, Alternative B,** the Sierra Club is concerned about this alternative's protected areas ambiguity. As we mention elsewhere in this letter, NPS puts "less than" signs in front of acreage that is supposed be protected by Alternative B. Therefore the public has no idea about how many acres actually are protected. NPS states that these protections are "similar to" those of Alternative C. However, Alternative C guarantees protection in certain areas (no "less than" signs). NPS must clearly define and tell the public how much of each unit and how much of each sensitive ecosystem classification is actually protected (no surface use stipulation) so that the public can review, comment on, and understand the alternatives. Decision-makers also need to know this information. NEPA and CEQ regulations that implement NEPA require this.	**103.** See Response 83. The summary description of Alternative B on page 2-2, does not describe the alternative to be "similar to" Alternative C. In the Summary of Impacts tables S-2 and 2.17 (which are identical) the impacts under Alternative B are described either as "same as" when they are exactly the same as Alternative A; or "similar to Alternative A, except…" to distinguish similarity and differences. The same descriptions are used in describing Alternative C in comparison to Alternative B.
104. 3) **On page 2-2, Alternative C,** NPS claims that Alternative C is "similar to" Alternative B. However, Alternative C is not similar to Alternative B because it protects almost all of the Special Management Areas while Alternative B does not. This make Alternative C a much more protective alternative and NPS should make it the "Preferred Alternative". By not making Alternative C the "Preferred Alternative" NPS shows that it is more concerned about allowing private operators their authority and access and less concerned about damaging the world recognized BTNP and its important ecosystems.	**104.** See Response 103. Alternative C is "similar to" Alternative B. Both alternatives have the same Special Management Areas; however, as noted in the comment, under Alternative C more of the Special Management Areas would be closed year-round to oil and gas operations by the application of the No Surface Use stipulation. Also see Response 2.
105. 4) **On page 23, Applicability of this Plan if the Boundaries of the Preserve are Modified, Park Facilities are Constructed, or Areas Change in Response to Dynamic Environmental Processes,** NPS states that "If these or other changes were to occur, the resource and Special Management Area maps would be revised to reflect the current conditions and the provisions in this plan". The Sierra Club requests that the public have an opportunity to review and comment on any changes to the Special Management Area maps and other changes to the DOGMP/DEIS when they are proposed.	**105.** Comment noted.
106. 5) **On page 2-4, Exploration Operations, second paragraph,** NPS states that receiver lines up to 3-6 feet wide will consist of "selectively trimming vegetation". NPS should say that seedlings, saplings, and small trees up to three inches in	**106.** This section of the DEIS describes "Types of Oil and Gas Operations," and references Appendix D, Types of Oil and Gas Operations. The purpose is to provide an overview of the type of nonfederal oil and gas operations that may occur in and adjacent to the Preserve prior to explaining the reasonably foreseeable development scenario. Impacts on vegetation from oil and gas activities can be found in Chapter 4, pages 4-62 through 4-72.

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COMMENTS

106. Cont.

diameter and other vegetation will be killed by cutting. NPS should not soft-pedal the damage that will occur due to these operations.

107.

6) **On page 2-6, Reasonably Foreseeable Development Scenario,** the assumption that "the demand, price, and availability of domestically produced hydrocarbons would remain somewhat stable over the next 15 to 20 years" is unlikely. With oil way above $30-40 per barrel and competition increasing due to China, India, and other nations' increased growth the price of oil can hardly be called "somewhat stable".

7) **On page 2-7, Reasonably Foreseeable Development Scenario,** NPS states that "Production operations would have a life expectancy of 20 to 30 years". Using past information what is the current trend in the life expectancy of production operations? Where is the discussion using existing data that NPS should have examined when making this analysis?

108.

8) **On page 2-11, Description of the Alternatives,** the Loblolly Unit and Hickory Creek Savannah Unit should be totally protected from surface use due to their small sizes and because slant drilling can be conducted with little difficulty.

109.

9) **On page 2-11, Description of the Alternatives,** NPS states that "it is possible that the site-specific vegetation may differ (or may be absent) from what is depicted on the vegetation maps". How will NPS make-up for any errors in the vegetation maps?

110.

10) **On page 2-12, Alternative A, No-Action/Current Management,** the term **"old growth trees"** is used but is not defined in the Glossary. What is the definition of **"old growth trees"?** Where are these trees in the units of BTNP and in the Special Management Areas? The public must be able to review, comment on, and understand the alternatives. Decision-makers also need to know this information.

111.

11) **On pages 2-18 and 2-19, Table 2.3,** NPS demonstrates a bias for Alternative B, its "The Preferred Alternative" and against Alternative C, "The Environmentally Preferred Alternative". NPS does this in the Alternative C column by saying that, with regard to meeting a certain objective, that it is the "Same as Alternative B" or by saying that Alternative C "partially" meets the objective. NPS says that Alternative C is "Same as Alternative B" and then goes on to show, for the third planning objective, that Alternative C is much better than Alternative B.

Why is NPS playing these semantic word games? The only answer is that it wants to confuse the public by not stating that Alternative C is better than Alternative B. NPS knows that by having more Special Management Areas in Alternative C that this alternative better meets planning objective 1, identifying resources and values that may be impacted by oil/gas operations, than

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107. Based on current worldwide fluctuations in the price of oil and gas, the assumption that prices would remain somewhat stable over the next 15-20 years is no longer valid. Text in the 4th bullet on page 2-6 of the Draft Plan/EIS was changed to read: "The demand, price, and availability of domestically produced hydrocarbons would support the oil and gas development presented in the RFD scenario."

108. The NPS will consider proposals to conduct geophysical exploration and drilling from surface locations in or outside these units on a project-by-project basis to determine appropriate mitigation measures.

109. Data collection will be required on a project-by-project basis so that a site-specific analysis can be performed.

110. See Responses 69 and 109. Also refer to the bottom of page 3-43 that explains that most of the old growth forest in the region has been removed over the past 100 years, but that it is likely that individual trees escaped harvest. Although the Preserve does not currently have a database of locations for old-growth trees, the programmatic oil and gas management plan establishes an objective to protect old-growth trees when they are identified through project-specific surveys.

111. See Responses 103 and 104. The description of the alternatives using "similar to" or same as" is not intended to favor one alternative over another. The word "may" is used to describe how the planning objective to provide holders of oil and gas rights reasonable access for exploration and development is met under each alternative. The use of the word "may" recognizes that Protected Areas under Alternative A, or Special Management Areas (and Protected Areas) under Alternatives B and C restrict surface use in these areas of the Preserve. A determination whether the No Surface Use operating stipulation is applied, or whether an exemption will be granted from the 36 CFR 9B regulations or the plan (as per the exemption process described on page 2-3), can only be made on a project-by-project basis by applying a site-specific analysis. The plan recognizes in Chapter 4, Environmental Consequences, in the Nonfederal Oil and Gas Development impact analysis that all operations would be impacted by the alternatives to varying degrees.

COMMENTS

111. Cont.

Alternative B. NPS knows that by having more Special Management Areas Alternative C better meets planning objective 3, establish performance standards and impact mitigation measures, than Alternative B.

NPS provides no data that documents that Alternative C will limit an operator's ability to conduct operations in the Preserve. In fact NPS uses the word "may" which means that this could happen or this could not happen. What NPS does not do is provide an estimate of what percentage of drilling rights "may" be impacted or "will" be impacted. NPS is not conducting the analyses that NEPA requires.

112.

12) **On page 2-21, Table 2.4, Floodplains,** the Alternative B column states that this alternative has exceptions. The exceptions are not explained and what additional environmental impacts will occur. NPS should state clearly that Alternative C is a more protective alternative than Alternative B because all Riparian Corridors are in Special Management Areas with no surface use.

113.

13) **On page 2-24, Table 2.4,** NPS states that the analysis figure in total acres for BTNP is 88,132. This figure conflicts with the total acreage figure derived when you solve for total BTNP acres by setting up a ratio of 91% over 100% and equal this to 80,670 acres over x as can be done using information on **page 2-11** at the bottom of the page under Alternative A, No-Action/Current Management. Using this equation the total BTNP acreage should be 88,648. Please explain the difference between these two figures for total acreage of BTNP.

114.

14) **On page 2-65, Table 2.18, NPS Response Time,** for the 60-day data collection permits, the Sierra Club requests that in the future it be notified in writing of the issuance of any such permits pursuant to 36 CFR 9.52(a) so that it can respond, if necessary, with comments as to their appropriateness.

115.

15) **On page 2-65, Table 2.18, Action column,** NPS states that "Park staff prepares NEPA document (EA or EIS)". As mentioned previously NPS issues an EA and is biased against issuing an EIS for site specific oil/gas projects.

116.

16) **On page 2-66, Overview of 36 CFR 9.32(e) Application Process,** NPS is using a new word, **"exemption"** for this process. In the past NPS has used the word **"waiver"** from the POO requirement. Why is NPS using a new word to describe this process?

117.

17) **On page 2-73, Performance Standards,** NPS incorrectly calls the Texas Parks and Wildlife Department the "Texas Plants and Wildlife Department."

Chapter 2 – Part III Mitigation Measures

118.

1) **On pages 2-86 through 2-103,** for many operating stipulations and recommended mitigation measures not all resources are listed that are benefited

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112. Taken in context with the remainder of the operating stipulation that states, "NSU in Riparian Corridors SMA with exceptions," the exceptions pertain to the Riparian Corridors SMA which is described in the row below the one cited. Impacts are described in Chapter 4, Environmental Consequences, under Impacts to Floodplains.

113. To correctly calculate the acreage, we suggest you use the total 7,462 acres that would be closed year-round to geophysical exploration or drilling and production operations under Alternative A as shown in Table 2.5 on page 2-25 in the following way:

88,132 total acres of the Preserve – 7,462 acres = 80,670 acres remaining for operations.

80,670 acres remaining = 0.9153315 x 100 = 91.53 rounded to 91% of the Preserve
88,132 total Preserve acreage

By performing the inverse calculation without the exact percentage, you invariably derive an inaccurate total acreage of the Preserve. But, if you do use the correct percentage rather than the rounded number, you will also derive the 88,132 acres of the Preserve you are attempting to double-check.

114. The 36 CFR § 9.52(a) notice is simply that – a notification. The Preserve Superintendent publishes a § 9.52(a) notice on the NPS's Planning, Environment and Public Comment website upon issuing temporary approval to the operator under 36 CFR § 9.38(a)(1) to collect basic information necessary to prepare a plan of operations. However, for efficiency and cost savings, the Superintendent routinely publishes the § 9.52(a) notice within a public scoping brochure to initiate a public scoping process under NEPA. It is during the public scoping process under NEPA that the Superintendent invites the public to comment on issues and alternatives to be considered in the NPS's analysis of the proposal.

115. Through all of its NEPA analyses performed on previous proposals, NPS determined there will be no major effects from the proposals. Major effects would be considered significant effects and trigger the need for an EIS; the effects of previous proposals did not reach that threshold so no EIS's were triggered.

116. The term "exemption" is a more accurate description of the situation when an operator need not comply with the remainder of the 9B regulations pursuant to § 9.32(e). Also see Response 46.

117. This was corrected in the Final Plan/EIS.

118. Operators are required to comply with all legal and policy requirements when conducting oil and gas operations in the Preserve. Mandatory requirements are called operating stipulations throughout the Plan/EIS and are shown at the beginning of Tables 2.20 through 2.22. In contrast, the recommended mitigation measures shown after the operating stipulations provide operators a list of possible techniques that could be selected when designing oil and gas operations to meet the NPS requirement at 36 CFR § 9.37 that "…operations will be conducted in a manner which utilizes technologically feasible methods least damaging to the federally-owned or controlled lands, waters and resources of the unit while assuring the protection of public health and safety." The NPS 9B regulations allow an operator flexibility in selecting

COMMENTS	RESPONSES
118. Cont.	appropriate mitigation beyond legally mandated requirements to meet this NPS approval standard. The operating stipulations and mitigation measures shown in Tables 2.20 through 2.22 identify the primary resource(s) that would benefit from the use of the stipulation or measure. Other resources that would likely benefit from the stipulation or measures are also marked in the table. While the NPS acknowledges that the operating stipulations and mitigation measures shown in these tables could have a beneficial effect on many resources, only the resources that are most likely to be protected are noted in the tables. The NPS has made every effort to "...concentrate on the issues that are truly significant, rather than amassing needless detail." (CEQ regulations 1500.1(b)). With this in mind, the NPS has reviewed Tables 2.20 through 2.22 and, where appropriate, has revised the list of resources that are benefited by the use of specific resource protection techniques. These changes are shown in the Final Plan/EIS.

by the stipulations/measures. Some mitigation measures should be mandatory requirements and not voluntary because of the critical environmental protection that they provide.

The Sierra Club lists below the other resources benefited, some directly and some indirectly, by the stipulations/measures. The Sierra Club also lists which mitigation measures should be mandatory requirements and not voluntary.

On page 2-86, Geophysical Exploration Operations, the third operating stipulation on the page, should include Visitor Use and Experience as being benefited.

On page 2-86, Geophysical Exploration Operations, the fifth operating stipulation on the page, should include Visitor Use and Experience and Human Health and Safety as being benefited.

On page 2-86, Geophysical Exploration Operations, the sixth operating stipulation on the page, should include Floodplains, Vegetation, Wetlands, Visitor Use and Experience, and Human Health and Safety as being benefited.

On page 2-86, Geophysical Exploration Operations, the seventh operating stipulation on the page, should include Floodplains, Vegetation, Wetlands, Fish and Wildlife, Species of Special Concern, Cultural Resources, and Visitor Use and Experience as being benefited.

On page 2-86, Geophysical Exploration Operations, the eighth operating stipulation on the page, should include Cultural Resources as being benefited.

On page 2-87, Geophysical Exploration Operations, the fourth operating stipulation on the page, should include Air Quality, Geologic Resources, Water, Floodplains, Vegetation, Fish and Wildlife, and Human Health and Safety as being benefited.

On page 2-87, Geophysical Exploration Operations, the fifth operating stipulation on the page, should include Air Quality, Geologic Resources, Water, Floodplains, Vegetation, Fish and Wildlife, Species of Special Concern, and Human Health and Safety as being benefited.

On page 2-87, Geophysical Exploration Operations, the sixth operating stipulation on the page, should include Vegetation, Wetlands, and Cultural Resource as being benefited.

On page 2-87, Geophysical Exploration Operations, the eighth operating stipulation on the page, should include Cultural Resource and Visitor Use and Experience as being benefited.

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COMMENTS	RESPONSES
118. Cont.	

On page 2-87, Geophysical Exploration Operations, the tenth operating stipulation on the page, should include Floodplain, Fish and Wildlife, Species of Special Concern, and Visitor Use and Experience as being benefited.

On page 2-87, Geophysical Exploration Operations, the first mitigation measure on the page, should be a mandatory requirement and not voluntary.

On page 2-88, Geophysical Exploration Operations, the first through fourth mitigation measures on the page, should be mandatory requirements and not voluntary.

On page 2-88, Geophysical Exploration Operations, the seventh mitigation measure on the page, should include Air Quality as being benefited and should be a mandatory requirement and not voluntary.

On page 2-88, Geophysical Exploration Operations, the ninth through twelfth mitigation measures on the page, should be mandatory requirements and not voluntary.

On page 2-88, Geophysical Exploration Operations, the thirteenth mitigation measure on the page, should include Wetlands, Fish and Wildlife, and Species of Special Concern as being benefited and should be a mandatory requirement and not voluntary.

On page 2-88, Geophysical Exploration Operations, the fifteenth mitigation measure on the page, should include Visitor Use and Experience as being benefited and be a mandatory requirement and not voluntary.

On page 2-88, Geophysical Exploration Operations, the sixteenth mitigation measure on the page, should be a mandatory requirement and not voluntary.

On page 2-88, Geophysical Exploration Operations, the seventeenth mitigation measure on the page, should include Fish and Wildlife, Species of Special Concern, Cultural Resources, and Visitor Use and Experience as being benefited and should be a mandatory requirement and not voluntary.

On page 2-89, Geophysical Exploration Operations, the first through sixth, eighth through fourteen, sixteenth, and nineteen through twenty-second mitigation measures on the page, should be mandatory requirements and not voluntary.

On page 2-89, Geophysical Exploration Operations, the first mitigation measure on the page, should include Fish and Wildlife, Species of Special Concern, Cultural Resources, and Visitor Use and Experience as being benefited.

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COMMENTS	RESPONSES
118. Cont.	

On page 2-89, Geophysical Exploration Operations, the second mitigation measure on the page, should include Fish and Wildlife, Species of Special Concern, and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the third mitigation measure on the page, should include Fish and Wildlife, Species of Special Concern, and Cultural Resources as being benefited.

On page 2-89, Geophysical Exploration Operations, the fourth mitigation measure on the page, should include Species of Special Concern and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the fifth mitigation measure on the page, should include Species of Special Concern and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the sixth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the eighth mitigation measure on the page, should include Geologic Resources and Cultural Resources as being benefited.

On page 2-89, Geophysical Exploration Operations, the tenth mitigation measure on the page, should include Cultural Resources and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the eleventh mitigation measure on the page, should include Floodplains, Vegetation, Cultural Resources, and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the twelfth mitigation measure on the page, should include Cultural Resources and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the thirteen mitigation measure on the page, should include Cultural Resources and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the fourteenth mitigation measure on the page, should include Geologic Resources, Floodplains, Vegetation, and Cultural Resources as being benefited.

On page 2-89, Geophysical Exploration Operations, the sixteenth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

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COMMENTS	RESPONSES
118. Cont.	

On page 2-89, Geophysical Exploration Operations, the seventeenth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the eighteen mitigation measures on the page, should include Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the nineteenth mitigation measure on the page, should include Fish and Wildlife and Visitor Use and Experience as being benefited.

On page 2-89, Geophysical Exploration Operations, the twentieth mitigation measure on the page, should include Fish and Wildlife, Species of Special Concern, and Visitor Use and Experience as being benefited.

On page 2-90, Geophysical Exploration Operations, the first through the third, fifth through the eighth, twelfth, sixteenth, and eighteenth mitigation measures on the page, should be mandatory requirements and not voluntary.

On page 2-90, Geophysical Exploration Operations, the second mitigation measure on the page, should include Floodplains, Vegetation, Wetlands, Fish and Wildlife, Species of Special Concern, and Visitor Use and Experience as being benefited.

On page 2-90, Geophysical Exploration Operations, the third mitigation measure on the page, should include Floodplains, Fish and Wildlife, Species of Special Concern, and Visitor Use and Experience as being benefited.

On page 2-90, Geophysical Exploration Operations, the fourth mitigation measure on the page, should include Air Quality and Visitor Use and Experience as being benefited.

On page 2-90, Geophysical Exploration Operations, the fifth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-90, Geophysical Exploration Operations, the sixth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-90, Geophysical Exploration Operations, the seventh mitigation measure on the page, should include Visitor Use and Experience as being benefited.

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COMMENTS	RESPONSES
118. Cont.	

On page 2-90, Geophysical Exploration Operations, the eighth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-90, Geophysical Exploration Operations, the twelfth mitigation measure on the page, should include Vegetation and Wetlands as being benefited.

On page 2-90, Geophysical Exploration Operations, the sixteenth mitigation measure on the page, should include Fish and Wildlife and Species of Special Concern as being benefited.

On page 2-91, Geophysical Exploration Operations, the first mitigation measure on the page, should include Wetlands, Fish and Wildlife, Species of Special Concern, and Visitor Use and Experience as being benefited.

On page 2-91, Geophysical Exploration Operations, the second mitigation measure on the page, should include Wetlands, Fish and Wildlife, Species of Special Concern, Cultural Resources, and Visitor Use and Experience as being benefited.

On page 2-91, Geophysical Exploration Operations, the third mitigation measure on the page, should include Cultural Resources as being benefited. This measure should be modified to mention specifically silt fencing.

On page 2-91, Drilling and Production Operations, the first operating stipulation on the page, the Sierra Club does not support allowing the use of water from the BTNP because water is available elsewhere and use of BTNP water reduces the water for vegetation and fish and wildlife.

On page 2-91, Drilling and Production Operations, the third operating stipulation on the page, should include Visitor Use and Experience as being benefited.

On page 2-91, Drilling and Production Operations, the fifth operating stipulation on the page, should include Visitor Use and Experience and Human Health and Safety as being benefited.

On page 2-91, Drilling and Production Operations, the sixth operating stipulation on the page, should include Visitor Use and Experience as being benefited.

On page 2-93, Drilling and Production Operations, the second operating stipulation on the page, should include Air Quality as being benefited.

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COMMENTS	RESPONSES
118. Cont.	

On page 2-93, Drilling and Production Operations, the fourth operating stipulation on the page, should include Air Quality as being benefited.

On page 2-94, Drilling and Production Operations, the fourth, fifth, and ninth operating stipulations on the page, should be requirements and not voluntary.

On page 2-94, Drilling and Production Operations, the third operating stipulation on the page, should include Fish and Wildlife and Species of Special Concern as being benefited.

On page 2-94, Drilling and Production Operations, the fourth operating stipulation on the page, should include Visitor Use and Experience as being benefited.

On page 2-94, Drilling and Production Operations, the fourth through sixth operating stipulations on the page, should include Visitor Use and Experience as being benefited.

On page 2-94, Drilling and Production Operations, the fifth and sixth operating stipulations on the page, should include Floodplains and Visitor Use and Experience as being benefited and should include the Production phase.

On page 2-95, Drilling and Production Operations, the second operating stipulation on the page, should include Visitor Use and Experience as being benefited.

On page 2-95, Drilling and Production Operations, the second, third, and fifth through seventh mitigation measures on the page, should be requirements and not voluntary.

On page 2-95, Drilling and Production Operations, the third through sixth mitigation measures on the page, should include Visitor Use and Experience as being benefited.

On page 2-95, Drilling and Production Operations, the ninth mitigation measure on the page, should include Air Quality as being benefited.

On page 2-95, Drilling and Production Operations, the tenth mitigation measure on the page, should include Air Quality and Water as being benefited.

On page 2-95, Drilling and Production Operations, the eleventh and twelfth mitigation measures on the page, should include Water as being benefited.

On page 2-95, Drilling and Production Operations, the thirteenth mitigation measure on the page, should include Air Quality and Water as being benefited.

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COMMENTS	RESPONSES
118. Cont.	

On page 2-96, Drilling and Production Operations, the second, third, and fifth through seventh mitigation measures on the page, should be requirements and not voluntary.

On page 2-96, Drilling and Production Operations, the first and seventh mitigation measures on the page, should include Visitor Use and Experience as being benefited.

On page 2-96, Drilling and Production Operations, the third and fourth mitigation measures on the page, should include Air Quality as being benefited.

On page 2-96, Drilling and Production Operations, the fifth mitigation measure on the page, should include Air Quality and Visitor Use and Experience as being benefited.

On page 2-96, Drilling and Production Operations, the sixth and seventh mitigation measures on the page, should include Visitor Use and Experience as being benefited.

On page 2-96, Drilling and Production Operations, the eighth mitigation measure on the page, should include Air Quality Visitor and Use and Experience as being benefited.

On page 2-96, Drilling and Production Operations, the second, third, and fifth through seventh mitigation measures on the page, should be requirements and not voluntary.

On page 2-97, Drilling and Production Operations, the first through third, fifth, ninth, tenth, thirteenth, and sixteenth mitigation measures on the page, should be requirements and not voluntary.

On page 2-97, Drilling and Production Operations, the first mitigation measure on the page, should include Cultural Resources and Visitor Use and Experience as being benefited.

On page 2-97, Drilling and Production Operations, the third mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-97, Drilling and Production Operations, the fifth mitigation measure on the page, should include Air Quality as being benefited.

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COMMENTS	RESPONSES
118. Cont.	

On page 2-97, Drilling and Production Operations, the ninth and tenth mitigation measures on the page, should include Air Quality as being benefited.

On page 2-97, Drilling and Production Operations, the thirteenth mitigation measure on the page, should include Air Quality and Visitor Use and Experience as being benefited.

On page 2-97, Drilling and Production Operations, the fifteenth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-98, Drilling and Production Operations, the first, seventh, and eighth mitigation measures on the page, should be requirements and not voluntary.

On page 2-98, Drilling and Production Operations, the second through fifth, tenth, thirteenth, and fourteenth mitigation measures on the page, should include Visitor Use and Experience as being benefited.

On page 2-98, Drilling and Production Operations, the sixteenth mitigation measure on the page, should include flowlines/pipelines.

On page 2-99, Drilling and Production Operations, the first and fourth mitigation measures on the page, should be requirements and not voluntary.

On page 2-99, Drilling and Production Operations, the second and seventh mitigation measures on the page, should include Air Quality and Visitor Use and Experience as being benefited.

On page 2-99, Drilling and Production Operations, the sixth mitigation measure on the page, should include Visitor Use and Experience as being benefited.

On page 2-100, Drilling and Production Operations, the fourth, fifth, seventh, fifteenth, and sixteenth mitigation measures on the page, should include Air Quality as being benefited.

On page 2-100, Drilling and Production Operations, the fifth, seventh, fifteenth, sixteenth, and twenty-second mitigation measures on the page, should include Visitor Use and Experience as being benefited.

On page 2-101, Drilling and Production Operations, the first, third, fourth, sixth, seventh, ninth, tenth, twelfth, and sixteenth mitigation measures on the page, should include Air Quality as being benefited.

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COMMENTS	RESPONSES
118. Cont. **On page 2-101, Drilling and Production Operations, the third mitigation measure on the page,** should be requirements and not voluntary. **On page 2-102, Well Plugging, Abandonment, and Site Reclamation, the second and tenth operating stipulations on the page,** should be requirements and not voluntary. **On page 2-102, Well Plugging, Abandonment, and Site Reclamation, the fourth operating stipulation on the page,** should include Visitor Use and Experience as being benefited. **On page 2-102, Well Plugging, Abandonment, and Site Reclamation, the fifth operating stipulation on the page,** should include Geologic Resources, Water, Floodplains, Vegetation, Wetlands, Fish and Wildlife, and Species of Special Concern as being benefited. **On page 2-103, Well Plugging, Abandonment, and Site Reclamation, the first through third mitigation measures on the page,** should be requirements and not voluntary. **On page 2-103, Well Plugging, Abandonment, and Site Reclamation, the first mitigation measure on the page,** should include Geologic Resources as being benefited. **On page 2-103, Well Plugging, Abandonment, and Site Reclamation, the second and third mitigation measures on the page,** should include Air Quality and Visitor Use and Experience as being benefited. **On page 2-103, Well Plugging, Abandonment, and Site Reclamation, the ninth and eleventh mitigation measures on the page,** should include Visitor Use and Experience as being benefited. **Chapter 3 – Affected Environment** **119.** 1) **On pages 3-4-3-7, Table 3.2, Nonfederal Oil and Gas Operations,** NPS does not provide the proper status for all wells. For instance Comstock Oil & Gas, In., Collins #3; Comstock Oil & Gas, Inc. BSMC Unit B #1; Comstock Oil and Gas, Inc. BSMC Unit D #1; David Brothers Oil Producers, Inc., Johnson-Hayden #1; Davis Brothers Oil Producers, Inc.; Johnson-Reese #1; Davis brothers Oil Producers, Inc., Johnson-Whitman #1; Davis Brothers Oil Producers, Inc., Nelson-Kate #1; Davis Brothers Oil Producers, Inc., Nelson-Emmie #1; Davis Brothers Oil Producers, Inc., Nelson-Allie #1; Davis Brothers Oil Producers, Inc., Nelson-Lynn #1; Davis Brothers Oil Producers, Inc., Nelson-Lance #1; David Brothers Oil Producers, Inc., Nelson-Pidgeon #1; Davis Southern Operating Co., P.C. Bernal #1; Davis Southern Operating Co., P.C. Bernal #2; Davis Southern Operating Co., P.C. Bernal #3; and Davis Southern 44	**119.** The table was updated in the Final Plan/EIS. Also see Responses 31 and 124.

COMMENTS	RESPONSES
119. Cont. Operating Co., P.C. Bernal #4 have all been approved by NPS. In addition, the NPS states in the EA for Famcor Oil, Inc. Roberts/Duke #1 Flowline, on page 15, that "19 directional wells were drilled from surface locations outside the Preserve to reach bottomholes inside the Preserve." NPS must state clearly which wells have been approved, which have been drilled, and which are still going through the approval process.	
120. 2) **On pages 3-4-3-7, Table 3.2, Nonfederal Oil and Gas Operations,** eight well sites are listed as undergoing reclamation. These well sites include: a. Caskids Operating Co., W.R. Carr #1, which has been undergoing well plugging and or reclamation since 1995 **(10 years);** b. Hanson Production Co., Mann Fee #307-1, which has been undergoing well plugging and or reclamation since 1997 **(8 years);** c. Merit Energy Co., James Rafferty Fee #1, which has been undergoing well plugging and or reclamation since 2001 **(4 years);** d. Merit Energy Co., James Rafferty Fee #1-N, which has been undergoing well plugging and or reclamation since 2001 **(4 years);** e. Merit Energy Co., M.J. Cunningham #5, which has been undergoing well plugging and or reclamation since 2001 **(4 years);** f. Merit Energy Co., James Rafferty Fee #7, which has been undergoing well plugging and or reclamation since 2001 **(4 years);** e. Murphy Exploration and Production Co., L.L. Williams #2, which has been undergoing well plugging and or reclamation since 1995 **(10 years);** f. Buford Curtis, Inc., James Rafferty Fee #1, which has had the well plugged since 2002 but no Plan of Operations has been submitted or approved **(3 years)** How much time does NPS allow an operator to reclaim a well site? This DOGMP/DEIS must have a discussion about this issue and why it is taking more than 4-10 years to reclaim some wells. A review of the problems that NPS has had regarding reclamation as well as the solutions that NPS has developed to address these problems must be in the DOGMP/DEIS so the public can review, comment, and understand what NPS's policy will be after the DOGMP/DEIS is approved. Decision-makers also need to know this information.	**120.** See Responses 31, 119, and 124. Please note that the period of time required for reclamation differs from site to site. It may require longer periods of time for a site to reach full recovery to pre-disturbance conditions.
121. 3) **On page 3-5, Table 3.2, Nonfederal Oil and Gas Operations,** Comstock Oil and Gas, Inc., BSMC Unit D #1, in the "Remarks" column, NPS left out the word "outside" at the end of the phrase in the box.	**121.** This was corrected in the Final Plan/EIS.
122. 4) **On pages 3-6 and 3-7, Table 3.2, Nonfederal Oil and Gas Operations,** for the Litchfield Production Co., Campbell #2 and the Reid Production Co., Campbell #3 wells the NPS has stated that these wells have been suspended since January 30, 1991 and February 5, 1991, respectively. The NPS should discuss what suspended means, how long a well is allowed to be suspended, and what is the actual status of these wells. What is NPS's policy on suspended wells?	**122.** These operations were suspended because the operators did not have approved plans of operations to serve as access permits as required under 36 CFR § 9.32(a). A suspended operation means the well is shut-in and locked. A well can remain shut-in for many years, as long as the operator adheres to Railroad Commission of Texas' Statewide Rules which administers a permit program for shut-in wells and governs maintenance and routine down-hole mechanical integrity testing.

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COMMENTS	RESPONSES
123. 5) **On page 3-7, Table 3.2, Nonfederal Oil and Gas Operations,** NPS does not state whether the Milestone Operating Inc., William M. Rice Institute B-5; the Premium Exploration Co., ARCO Rafferty #1A; Premium Exploration Co., James Rafferty Fee #3; Reid Production Co., Campbell #4; and the Reid Production Co., Campbell #3 are inside or outside the BTNP. This information must be in the DOGMP/DEIS.	**123.** These wells are all located inside the Preserve. See also Responses 31 and 119.
124. 6) **On page 3-9, Plugged and Abandoned Oil and Gas Wells,** NPS states that two wells sites have "documented contamination by saltwater, heavy metals, and hydrocarbons". Which well sites are these? What is their current disposition? When will they be reclaimed? What is NPS's policy on contaminated well sites?	**124.** The fourth paragraph describes the ongoing investigation of contamination at abandoned oil and gas sites in the Preserve; therefore, the last sentence of the 2nd paragraph was deleted in the Final Plan/EIS.
125. 7) **On page 3-9, Plugged and Abandoned Oil and Gas Wells,** NPS states that two wells "are located in the Neches River, approximately 40 feet from the eastern bank. Removal of the well casings in these wells and setting the surface plug to a depth of 50 feet below the surface to meet NPS requirements remains problematic due to engineering, logistical, and financial constraints." The U.S. Forest Service plugged two wells in the Upland Island Wilderness Area in the late 1990s because the wells were leaking brine and or oil. EPA and the Railroad Commission acted on one of the wells due to the threat to water quality. NPS should contact EPA and then discuss its options of plugging these wells as soon as possible.	**125.** The wells referred to were plugged by Marshall Petroleum in January 1986. In or about 1989, a severe flood event changed the course of the Neches River, exposing the surface casings of the two wells. The company, at the request of the NPS, hired a consulting engineer to develop a plan of operations to re-enter the wells via a waterborne operation, deepen the surface plugs, and cut the well stems at the river bottom. During the scoping process on the Plan, Marshall Petroleum not only contacted the U.S. Environmental Protection Agency, but the U.S. Fish and Wildlife Service, the U.S. Coast Guard, U.S. Army Corps of Engineers, Jasper County Judge Joe N. Polk, the Texas Railroad Commission, the Texas Natural Resources Conservation Commission, and the Texas Parks and Wildlife Department among others. According to the Texas Railroad Commission, the wells were properly plugged and abandoned according to Statewide Rules. Also, the Texas General Land Office has stated that Marshall Petroleum no longer owns the wells, and the Texas Parks and Wildlife Department expressed concerns about the planned use of high explosives to cut the surface casings at the river bottom.
126. 8) **On page 3-9, Plugged and Abandoned Oil and Gas Wells,** the NPS states that it has requested funding to delineate and characterize contamination of well sites. NPS should state and discuss the approximate cost to delineate and characterize all well sites of interest; how long this is estimated to take; what it will take to clean-up all well sites of interest; an estimate of the costs; and what is NPS's policy on cleaning up contaminated well sites.	**126.** The Preserve is using available funds to characterize and prioritize abandoned sites in the Preserve where there is no responsible party. All of the sites pre-existed the establishment of the Preserve. It is impossible to estimate the cost for the full characterization, remediation and reclamation of these sites because initial characterization is needed to determine whether more extensive testing is warranted.
127. 9) **On page 3-11, Table 3.3, Tow Dimensional and Three-Dimensional Seismic Surveys,** NPS fails to provide to the public the total number of miles of vegetation cut due to seismic surveys. The NPS uses two different units of measure (feet and square miles) that measure two different measures (length and area) even though the column for "Total Line Length" states plainly that the numbers are to be in "(Feet)". Because of this problem It is difficult to understand how many total feet and miles have been cut in BTNP due to seismic surveys. The Sierra Club added together the total line length in feet provided by the NPS in this table. The total line length in feet comes to 312,060 feet or 59.07 miles. The Sierra Club added together the total square miles of line length provided by the NPS in this table. This total line length in square miles comes to 77 square miles. The Sierra Club requests that NPS use the same unit of measure (feet) for this table in the column labeled (Total Line Length (Feet)" and convert 77 46	**127.** Two-dimensional (2-D) seismic surveys are measured in linear feet; 3-D seismic surveys are measured in areal extent, i.e., in square miles. Table 3.3 was divided into two separate tables, one for 2-D surveys and one for D-3 surveys, in the Final Plan/EIS.

COMMENTS	RESPONSES
127. Cont. square miles to feet so that the public can understand the magnitude of impacts that have occurred to BTNP due to the cutting of seismic surveys.	
128. 10) **On pages 3-11 through 3-13, Table 3.4, Existing Transpark Oil and Gas Pipelines within Big Thicket National Preserve,** it is of great concern to the Sierra Club that the NPS does not know the date of construction for all pipelines in BTNP. According to this table the NPS does not know the date of construction for: a. 24. Chevron Pipe Lone Company, Not in Service b. 28. Sun Pipe Line Company, Abandoned c. 31. Unknown, Unknown d. 43. Mobil Pipe Line Company e. 56. El Paso Field Services f. 57. Black Lake Pipeline g. 1. Houston Pipe Line Company The NPS must estimate the age of the seven unknown pipelines so that the public understands and can review, comment on, and understand this information. Decision-makers also need to know this information.	**128.** The table was updated in the Final Plan/EIS. The age of some of the pipelines is still unknown; however, it is known that these pipelines were constructed prior to the establishment of the Preserve in 1974.
129. 11) **On pages 3-11 through 3-13, Existing Transpark Oil and Gas Pipelines within Big Thicket National Preserve,** NPS must define what it means by **"Abandoned"** and **"Not in Service"** so the public can review, comment on, and understand what these terms mean. Decision-makers also need to know this information.	**129.** The term "Abandoned" denotes a permanent cessation of operations. "Not in Service" denotes the pipeline is not active, but has the potential to be brought back into active service.
130. 12) **On page 3-12, Existing Transpark Oil and Gas Pipelines within Big Thicket National Preserve,** the Sierra Club is concerned that NPS does not know the operator, product, size, and date constructed of the pipeline labeled 31. Without this basic information how can NPS determine the risk of the pipeline leaking or if it has leaked the danger it poses to natural resources? NPS must find out this information so the public can review, comment, and understand this information. Decision-makers also need to know this information.	**130.** See Response 128.
131. 13) **On pages 3-11 through 3-15, Existing Transpark Oil and Gas Pipelines and Associated Rights-of-Way,** NPS does not state the condition that each pipeline is in. For instance, two Crude Oil pipelines were constructed in 1929-1930 (8. Pure Transmission Company and 44. Unocol Corporation) which means they are 75 years old. There are 25 other pipelines that are at least 50 years old. The pipeline material used in the 1930's through the 1950's is not as good as the pipeline material that is used today. What is the lifetime of each pipeline; the material that was used to construct it; the condition of each pipeline; how often are the pipelines checked; and what are the results of the last integrity checks for each pipeline? NPS	**131.** Please refer to the section "Regulation of Transpark Oil and Gas Pipelines and Activities in Associated Rights-of-Way," on pages 1-9 and 1-10, that explains that the NPS has no authority to regulate the below-ground pipeline activities.

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COMMENTS	RESPONSES
131. Cont. needs to discuss in detail the condition of pipelines and how it will ensure that they do not leak. Relying on operators is not the way to ensure that leaks do not occur and pipelines remain in good condition.	
132. 14) **On pages 3-14 and 3-15, Administration of Nonfederal Oil and Gas Program,** NPS states that "additional staff support for the program is needed to ensure timely processing of plans of operations, and to protect Preserve resources and visitor experience." NPS does not discuss how many additional people are needed; what the additional staff will cost; and when the additional staff will be hired. This information must be placed in the DOGMP/DEIS so that the public can review, comment on, and understand it. Decision-makers also need to know this information. The Sierra Club is less concerned with ensuring the "timely processing of plans of operation" than with protecting BTNP natural resources and visitor safety and experience. The most important thing the NPS can do is protect BTNP resources from the impacts of oil/gas activities. NPS must make this statement very clear in the DOGMP/DEIS. Otherwise NPS will send the message that oil/gas operators can get away with doing less than the best.	**132.** Currently, there are no funds available to hire additional staff. In the future, if funding becomes available, an additional staff person could assist with processing new proposals, and monitoring operations.
133. 15) **On page 3-30, Hydrochemical Regime, Neches River,** NPS states that "Alkalinity appeared to peak in the fall; and sulfate and manganese concentrations seemed to reach the highest levels in the spring." What is the cause of these water quality problems? What is NPS doing to reduce or stop them?	**133.** The NPS disagrees with the commenters' characterization of "water quality problems." This paragraph is meant to describe the seasonal variation of the hydrochemical regime in the river, not to point out instances where water quality levels exceeded federal or state standards.
134. 16) **On page 3-34, Hydrochemical Regime for Menard Creek,** why are data "not available for Menard Creek from water quality assessment reports published by the Trinity River Authority? What will it take to acquire these data? Will NPS acquire and analyze these data?	**134.** The NPS cannot respond on behalf of the Trinity River Authority. At present, the NPS has no funding to conduct a water quality assessment for Menard Creek. The Preserve would conduct an assessment when this particular data need reaches a priority level over other Preserve data needs.
135. 17) **On page 3-47, Figure 3.4, Wetlands Map,** does not show any wetlands in the Loblolly Unit and the Hickory Creek Savannah Unit. The Sierra Club has visited the Loblolly Unit and the Hickory Creek Savannah Unit on a number of occasions. The Loblolly Unit has baygall and bottomland hardwood wetland vegetation types. The Hickory Creek Savannah Unit has baygalls and pitcher plant bog wetland types. Please note what is said on page 3-46 where National Wetlands Inventory maps underestimate wetlands in forested regions. This may explain why no wetlands are shown on Figure 3.4, Wetlands Map, for the Loblolly Unit and Hickory Creek Savannah Units.	**135.** See Response 109.
136. 18) **On page 3-50, Edge Habitat,** the NPS states that for the impacts due to edge effects that "there is no generally accepted threshold of significance." The Sierra Club disagrees. Studies have shown that the edge effect, in forests, extends about two or three tree lengths into the forest when considering changes in temperature, humidity, sunlight, and moisture retention in leaf litter. In addition	**136.** "Although edge effect is an important concept in wildlife management, and is often emphasized in wildlife management texts, relatively little empirical justification for edge effect is available." (Kroodsma, 1987) A substantial portion of the research done on edge effects comes from studies of birds. When considering edge effect on the nesting success of birds, a review of studies from a mix of habitat types in Central and North America, as well as Europe, found that, "Researchers investigating this question have been inconsistent in their experimental designs, making generalizations about edge effect patterns difficult." (Paton, 1994) Discounting the difficulty of generalization about edge effects, NPS feels that it is irresponsible to assume that studies of edge effects done elsewhere can be applied to the Preserve. There is evidence that, "Edge effects depend, at least in part, on the landscape context, indicating that

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136. Cont. the edge effect can be calculated, when dealing with roads or other linear clearings by calculating the number of miles of road/square mile of forest or other habitat.	results obtained from locally conducted studies should be evaluated in light of landscape-scale forest cover." (Donovan et al., 1997) There have been no detailed studies of edge effects in the Preserve. Also, adding to the problem of generalization even on a landscape scale, local factors have been shown to produce differences in edge effects. For example, whether an edge faces north or south was shown to affect edge effect penetration when studying floral species composition in North Carolina mixed hardwood forests. (Fraver, 1994)
137. 19) **On page 3-54, Paddlefish,** NPS states that Texas Parks and Wildlife Department (TPWD) has annual stocking of Paddlefish. The Sierra Club understands that the TPWD no longer is hatchery raising and stocking Paddlefish because previous stocking efforts have not succeeded and there is not enough spawning habitat to sustain a population especially with the impacts that dams have had and create as obstacles to Paddlefish migration.	**137.** The text refers to the recovery plan including annual stocking; however, TPWD is not stocking paddlefish in the lower Neches River. This was clarified in the Final Plan/EIS.
138. 20) **On page 3-59, Park User/Affinity Groups,** although NPS states that it consults with the Alabama and Coushatta tribes, in the past this has been discounted when dealing with slant wells drilled adjacent to BTNP. NPS must discuss how it will ensure that it fully consults with the Alabama and Coushatta tribes in the future and how this DOGMP/DEIS will change, improve, and assist in that process.	**138.** The NPS consults with the Tribes under Section 106 of the National Historic Preservation Act of 1966, as amended, as described on pages C-17 and C-18. Chapter 4, Environmental Consequences, analyzes impacts on cultural resources.
139. 21) **On page 3-64, Birding Hot Spots,** NPS states that the more sought after birds in BTNP include the "Red-cockaded Woodpecker". However, on page 3-53, NPS states that the RCW is no longer found in BTNP. Please clarify this statement.	**139.** Please see page 3-53 of the Draft Plan/EIS that describes that until the mid-1990's, active colonies of Red-cockaded Woodpeckers had been documented in the Big Sandy Unit; and that through pine forest regeneration and periodic prescribed fire, favorable habitat should be created so that this species could recolonize in the future. Therefore, while there are no known colonies of Red-cockaded Woodpeckers currently within the Preserve, many birdwatchers are still drawn to the area in hopes of sighting a Red-cockaded Woodpecker.
140. 22) **On page 3-68, Visual Quality, including Night Sky, as a Component of Visitor Experience,** NPS states that "Oil and gas operations ... are not expected to appreciably add to sky glow from outdoor lighting or air pollution." NPS does not say why this is true. Please provide a discussion of this statement as well as a definition for "appreciably add".	**140.** This statement was deleted in the Final Plan/EIS. It did not belong in this section of the Draft Plan/EIS. The assessment of effects is found in Chapter 4, Environmental Consequences.
141. 23) **On page 3-69, Visitor Perception of Oil and Gas Operations,** NPS states that "Overall, past and current levels of public use do not appear to have adversely affected Preserve resources, and conflict between public uses or between public uses and nonfederal oil and gas operations has been minimal." NPS provides no information on which to base this statement. The public has a right to review, comment on, and understand the bases for NPS analyses statements. NPS must provide the public with this information in this DOGMP/DEIS. Decision-makers also need to know this information.	**141.** The Preserve staff received a single complaint from a visitor many years ago regarding a well near the Turkey Creek Trail in the northern part of the Unit. This well is now gone.
142. 24) **On page 3-70, Visitor Perception of Oil and Gas Operations,** NPS states that "there have been few complaints registered at the Preserve about oil and gas operations." How many complaints have been registered? What were the complaints about? NPS needs to discuss clearly and fully what the public's concerns have been about oil/gas activities in BTNP.	**142.** See Response 141.
143. 25) **On pages 3-71 and 3-72, Wild Character – Solitude,** NPS only discusses "solitude" with respect to Wilderness designation, of which there is none in	**143.** See Responses 87 and 97.

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143. Cont. BTNP. People value "solitude" outside of Wilderness also. NPS must discuss the opportunities for "solitude" in BTNP that visitors can find and how oil/gas operations affect "solitude" currently and how they will in the foreseeable (cumulative impacts) future.	
144. 26) **On page 3-72, Adjacent Land Uses and Resources,** NPS does not discuss the foreseeable future impacts that development will have in East Texas and areas around the BTNP. We are seeing the urbanization of East Texas and in the next 15-20 years the effects of urbanization will get worse. The average size of a parcel of land in East Texas has dropped to 50 acres. With the divestment of 1.5 million acres by Louisiana-Pacific and International Paper in East Texas many of the parcels sold will be subdivided and developed. BTNP has expressed concern to the Texas Department of Transportation about the fragmentation and development influence that construction of a new and wider U.S. 69 will have on BTNP and particularly the Hickory Creek Savannah and Turkey Creek Units. NPS supported the recent acquisition of about 700 acres next to the visitor center which links it to Village Creek and the Turkey Creek Unit and thus protects this area from subdivision development. NPS must look at the most recent data on development in the BTNP area and discuss what the foreseeable future will look like including environmental impacts. This has not been done adequately on this page in this DOGMP/DEIS.	**144.** The cumulative impact analyses are found in Chapter 4, Environmental Consequences.
Chapter 4 – Environmental Consequences	
145. 1) **On page 4-8, Cumulative Impacts, Alternative A,** the NPS states that "there should be no cumulative adverse impacts on oil and gas development". This is not true. Implementation of Alternative A has resulted in the Sierra Club filing a lawsuit against the NPS which could result in the stoppage of all or a portion of the drilling that occurs in, under, or through the BTNP. In addition, the lawsuit will cost the NPS money to defend against and has brought adverse publicity to the NPS. The reinterpretation of the 9B regulations has resulted in uncertainty and poor decision-making. Sanchez has proposed the drilling of one well. Comstock proposes drilling three wells. Davis Brothers has drilled 4 wells and the NPS has proposed or approved 12 more wells for Davis. Many other wells have been drilled both in the BTNP and adjacent to it on private lands. Many pipelines, roads, logging operations, prescribed burning, and other actions have occurred in the past, present, and reasonably foreseeable future in BTNP and adjacent to BTNP but NPS has not assessed all the cumulative impacts of these actions in EAs in the past. **At minimum, NPS must prepare an adequate cumulative effects analysis that:** 50	**145.** Impacts on nonfederal oil and gas development were assessed in the Draft Plan/EIS because provisions in the plan could affect how, where and to what extent an operator could conduct oil and gas operations in the Preserve. The analysis area for this impact topic is Railroad Commission District 3 which includes 29 counties in East Texas. Through its analyses, the NPS has determined that the projected drilling activity in the Preserve would not have measurable cumulative impacts on the overall drilling activity in RRC District 3 (meaning minor or less effects) and therefore concluded that there should be no cumulative, adverse impacts on oil and gas development. The underlined text was corrected in the Final Plan/EIS, on the last line under the heading "Cumulative Impacts" (Alternative A) on page 4-7, in the Cumulative Impacts conclusion statement (Alternative A) on page 4-8, on the first line under the heading "Cumulative Impacts" (Alternative B) on page 4-9, in the Cumulative Impacts conclusion statement (Alternative B) on page 4-9, on the first line under the heading "Cumulative Impacts" (Alternative C) on page 4-11, and in the Cumulative Impacts conclusion statement (Alternative C) on page 4-11, to: "…negligible, cumulative adverse impacts…" The outcome of the lawsuit filed by Sierra Club does not limit or prevent the ability of the holders of nonfederal oil and gas rights under Big Thicket National Preserve to exercise those rights. Further, as noted above in Response 74, the District Court for the District of Columbia issued an order on September 1, 2005 in Sierra Club v. Mainella, (Civ. No. 04-2012, 2005 U.S. Dist. LEXIS 18911), affirming the NPS's interpretation of its regulations. This decision affirms to the public that the NPS is acting within the limits of its regulatory authority, which does not extend beyond park boundaries. With respect to cumulative impacts, the NPS has sufficiently discussed and analyzed them in the Draft Plan/EIS. The NPS included both quantitative and qualitative analysis of impacts. The NPS

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145. Cont.	performed a quantitative analysis where it had the specific information to do so. Some examples of the quantitative analysis performed in the Draft Plan/EIS include: 1) Chapter 3 includes 12 tables and 6 figures, to support narrative describing each of the impact topics assessed in this Plan/EIS. To list just some of these include: a table of total acreages of four slope classes by unit (0-3%, 3-5%, 5-12% and >12%), ambient sound levels at various locations in the Preserve along with a sound level comparison chart depicting how the recorded sound levels in the Preserve relate to sound level measurements at varying distances from a drilling rig and other equivalent sounds, visitor use statistics, wetlands, floodplains, and vegetation classes. 2) Chapter 3 also includes tables that list each existing oil and gas operation located inside or outside the Preserve that is extracting hydrocarbons from under the Preserve, transpark oil and gas pipeline segments, and 2-D and 3-D seismic surveys that have been conducted in the Preserve. Specific measurements are provided of the direct area of surface impacts from past activities that continue to have effects, existing activities, and reasonably foreseeable development to support impact analyses in Chapter 4. 3) Chapter 2 provides maps and acreages of Protected Areas and Special Management Areas. 4) Chapter 2 also describes the Reasonably Foreseeable Development scenario and provides specific acreages of anticipated direct disturbance for geophysical and drilling operations. Quantitative analyses are provided in the impact analyses in Chapter 4 as much as reasonably possible for a programmatic management plan. An example is under the topic "Visitor Use and Experience" where anticipated elevated noise levels from nonfederal oil and gas activities and other activities are provided to describe impacts. Where specific information was lacking to perform a quantitative analysis, the NPS believes that its qualitative analysis is adequate to satisfy NEPA. NPS technical specialists (regulatory specialists, petroleum engineer, petroleum geologist, resources specialists, etc.) listed in Chapter 6 of the Draft Plan/EIS provided input on the qualitative assessment of effects presented in the draft Plan/EIS. Also see Responses 69 and 173.

1) Identifies the past, present, and reasonably foreseeable actions of NPS and other parties affecting each particular aspect of the affected environment

2) Provides quantitative information regarding past changes in habitat quality and quantity, water quality, resource values, and other aspects of the affected environment that are likely to be altered by NPS actions

3) Must estimate incremental changes in these conditions that will result from NPS actions in combination with actions of other parties, including synergistic effects

4) Must identify any critical thresholds of environmental concern that may be exceeded by NPS actions in combination with actions of other parties

5) Must identify specific mitigation measures that will be implemented to reduce or eliminate such effects

The NEPA and the CEQ require that analysis, assessment, and evaluation of cumulative impacts be conducted. See Chapter 1508.7 and 1508.8 of the CEQ regulations which are binding on all federal agencies to implement.

See also the CEQ's January 1997 document, "Considering Cumulative Effects Under the National Environmental Policy Act." It is clear that the NPS has an affirmative duty, a statutory duty, and a regulatory duty to carry out cumulative impacts assessment.

The NPS in the past has attempted to short-circuit this required duty by suggesting that there are no significant effects. NPS must use the CEQ's "Considering Cumulative Effects Under the National Environmental Policy Act" to conduct a cumulative impacts assessment. **Some of the especially important quotes from the CEQ document that NPS must implement include:**

a. On page v, "Only by reevaluating and modifying alternatives in light of the projected cumulative effects can adverse consequences be effectively avoided or minimized. Considering cumulative effects in also essential to developing appropriate mitigation and monitoring its effectiveness."

b. On page v, "By evaluating resource impact zones and the life cycle of effects rather than projects, the analyst can properly bound the cumulative effects analysis. Scoping can also facilitate the interagency cooperation needed to identify agency plans and other actions whose effects might overlap those of the proposed action."

c. On page vi, "When the analyst describes the affected environment, he or she is setting the environmental baseline and thresholds of environmental change that are important for analyzing cumulative effects. Recently developed

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indicators of ecological integrity (e.g., index of biotic integrity for fish) and landscape conditions (e.g., fragmentation of habitat patches) can be used as benchmarks of accumulated change over time ... GIS technologies provide improved means to analyze historical change in indicators of the condition of resources, ecosystems, and human communities, as well as the relevant stress factors.

d. On page vi, "Most often, the historical context surrounding the resource is critical to developing these baselines and thresholds and to supporting both imminent and future decision-making."

e. On page vi "... the consequences of human activities will vary from those that were predicted and mitigated ... therefore, monitoring the accuracy of predictions and the success of mitigation measures is critical.

f. On page vi, "Special methods are also available to address the unique aspects of cumulative effects, including carrying capacity analysis, ecosystem analysis, economic impacts analysis, and social impact analysis.

g. On page vii, Table E-1, "CEA Principles ... Cumulative effects analysis ...Address additive, countervailing, and synergistic effects ... Look beyond the life of the action.

h. On page 1, "The range of actions that must be considered includes not only the projects proposal but all connected and similar actions that could contribute to cumulative effects.

i. On page 3, "The purpose of cumulative effects analysis, therefore is to ensure that federal decisions consider the full range of consequences of actions ... If cumulative effects become apparent as agency programs are being planned or as larger strategies and policies are developed then potential cumulative effects should be analyzed at that times.

j. On page 3, Cumulative effects analysis necessarily involves assumptions and uncertainties, but useful information can be put on the decision-making table now ... Important research and monitoring programs can be identified that will improve analyses in the future, but their absence should not be used as a reason for not analyzing cumulative effects to the extent possible now ... adaptive management provisions for flexible project implementation can be incorporated into the selected alternative."

k. On page 4, "The Federal Highway Administration and state transportation agencies frequently make decisions on highway projects that may not have significant direct environmental effects, but that may induce indirect and cumulative effects by permitting other development activities that have significant effects on air and water resources at a regional or national scale. The highway

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and other development activities can reasonably be foreseen as "connected actions.

l. On page 7, "Increasingly, decision makers are recognizing the importance of looking at their projects in the context of other development in the community or region (i.e., of analyzing the cumulative effects) ... Without a definitive threshold, the NEPA practitioner should compare the cumulative effects of multiple actions with appropriate national, regional, state, or community goals to determine whether the total effect is significant ... Cumulative effects results from spatial (geographic) and temporal (time) crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effect of the first perturbation."

m. On page 8, Table 1-2, lists 8 principles of cumulative effects analysis. **A summary of summary of these principles includes:**

1) Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.

2) Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken no matter who has taken the actions.

3) Cumulative effects needs to be analyzed in terms of than specific resource, ecosystem, and human community being affected.

4) It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.

5) Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.

6) Cumulative effects may result form the accumulation of similar effects or the synergistic interaction of different effects.

7) Cumulative effects may last for many years beyond the life of the action that caused the effects.

8) Each affected resource, ecosystem, and human community must be analyzed in term of its capacity to accommodate additional effects, based on its own time and space parameters.

n. On page 19, "The first step in identifying future actions is to investigate the plans of the proponent agency and other agencies in the area. Commonly,

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analysts only include those plans for actions which are funded or for which other NEPA analysis is being prepared. This approach does not meet the letter or intent of CEQ's regulations ... The analyst should develop guidelines as to what constitutes "reasonably foreseeable future actions" based on planning process within each agency ... In many cases, local government planning agencies can provide useful information on the likely future development of the region, such as master plans. Local zoning requirements, water supply plans, economic development plans, and various permitting records will help in identifying reasonably foreseeable private actions ... These plans can be considered in the analysis, but it is important to indicate in the NEPA analysis whether these plans were presented by the private party responsible for originating the action. Whenever speculative projections of future development are used, the analyst should provide an explicit description of the assumptions involved ... NEPA litigation ... has made it clear that "reasonable forecasting" is implicit in NEPA and that it is the responsibility of federal agencies to predict the environmental effects of proposed actions before they are fully known.

o. On page 23, "Characterizing the affected environment in a NEPA analysis that addresses cumulative effects requires special attention to defining baseline conditions. These baseline conditions provide the context for evaluating environmental consequences and should include historical cumulative effects to the extent feasible.

p. On page 29, "Lastly, trends analysis of change in the extent and magnitude of stresses in critical for projecting the future cumulative effects.

q. On page 29, "Government regulations and administrative standards ... often influence developmental activity and the resultant cumulative stress on resources, ecosystems, and human communities.

r. On page 31, "Cumulative effects occur through the accumulation of effects over varying periods of time. For this reason, an understanding of the historical context of effects is critical to assessing the direct, indirect, and cumulative effects of proposed actions. Trends data can be used ... to establish the baseline for the affected environment more accurately (i.e., by incorporating variation over time) ... to evaluate the significance of effects relative to historical degradation (i.e., by helping to estimate how close the resource is to a threshold of degradation) ... to predict the effects of the actions (i.e., by using the model of cause and effects established by past actions)."

s. On pages 38-40, "Using information gathered to describe the affected environment, the factors that affect resources (i.e., the causes in the cause-and-effect relationships) can be identified and a conceptual model of cause and effect developed ... The cause-and-effect model can aid in the identification of past, present, and future actions that should be considered in the analysis ... The cause-and effect relationships for each resource are used to determine the

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magnitude of the cumulative effect resulting from all actions included in the analysis ... one of the most useful approaches for determining the likely response of the resource ... to environmental change is to evaluate the historical effects of activities similar to those under consideration.

t. On page 41, "The analyst's primary goal is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and future actions ... The critical element in this conceptual model is defining an appropriate baseline or threshold condition of the resource.

u. On page 43, "Situations can arise where an incremental effect that exceeds the threshold of concern for cumulative effects results, not from the proposed action, but the reasonably foreseeable but still uncertain future actions.

v. On page 45, "The significance of effects should be determined based on context and intensity ... Intensity refers to the severity of effect ... As discussed above, the magnitude of an effect reflects relative size or amount of an effect. Geographic extent considers how widespread the effect might be. Duration and frequency refers to whether the effect is a one-time event, intermittent, or chronic.

w. On page 45, "Determinations of significance ... are the focus of analysis because they lead to additional (more costly) analysis or to inclusion of additional mitigation (or a detailed justification for not implementing mitigation) ... the project proponent should avoid, minimize, or mitigate adverse effects by modifying alternatives ... in most cases, however, avoidance or minimization are more effective than remediating unwanted effects."

y. On page 51, "different resource effects that cumulatively affect interconnected systems must be addressed in combination."

The NPS must utilize the CEQ document referenced above to the maximum extent possible so that a full and legal cumulative impacts assessment is conducted.

There is no specific quantitative cumulative impact analysis for all past, present, and reasonably future foreseeable actions. NPS is deficient in its cumulative impacts assessment. What are the impacts from other oil/gas activities? What are the impacts from past logging? What are the impacts from past grazing? What are the impacts from roads? What are the impacts from prescribed burning? Where is an assessment, evaluation, and analysis that take all of these past impacts into account? NPS must prepare an EIS that assesses all cumulative impacts in addition to all potential impacts from each of the estimated 29 wells that will be drilled in the future plus all past and present impacts.

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2) **On pages 4-6, 4-8, 4-9, 4-11, 4-17 through 4-21, 4-27, 4-28, 4-30, 4-31, 4-34, 4-40, 4-43, 4-45, 4-46, 4-48, 4-49, 4-53, 4-55, 4-58, 4-60, 4-61, 4-66, 4-68 through 4-72, 4-79, 4-81 through 4-83, 4-85, 4-86, 4-93, 4-95, 4-97, 4-99, 4-100, 4-106, 4-109, 4-112, 4-113, 4-116, 4-120, 4-122 through 4-124, 4-126, 4-133, 4-135, 4-137, 4-138, 4-140, 4-144, 4-146 through 4-148, and 4-150, Cumulative Impacts,** NPS provides a flawed cumulative impacts assessment. Not only is the assessment not quantified, when it could be, it is so general that it does not give the reader a clear understanding of the degree that actions that have occurred outside and inside BTNP.

See in the section of this letter entitled "**DOGMP/DEIS Poorly Defined Words and Phrases**" which relates specifically how words and phrases used, because they are not defined or are poorly defined, make it unclear to the reader the degree that environmental impacts have on BTNP resources.

See in the section in this letter entitled "**DOGMP/DEIS Poorly Defined Words and Phrases" pages 2-3,** the problem with **"best professional judgment"** when it is only used to define intensity, context, and significance and quantitative requirements in the CEQ's NEPA implementing regulations are not implemented.

Some specific examples of how cumulative impacts could have been quantified follow along with specific comments on Chapter 4. **These are simply examples and other measures of cumulative impacts could have been used by NPS to determine the impact intensity thresholds.**

3) See 1) above, which begins this section of the letter about **Impacts on Nonfederal Oil and Gas Development** cumulative impacts.

4) **On pages 4-16, 4-17, 4-18, 4-19, and 4-20, for Air Quality,** the actual federal or state health based concentration levels for each pollutant considered (for example: ozone, hydrogen sulfide, carbon monoxide, volatile organic compounds, nitrogen oxides, particulates with an aerodynamic diameter of 10 micrometers, particulates with an aerodynamic diameter of 2.5 micrometers, sulfur dioxide), in BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature. The concentration levels for each pollutant that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. Concentration levels could have been developed using "best professional judgment" but were not.

5) **On pages 4-27, 4-28, 4-30, 4-31, and 4-34, for Geologic Resources,** the actual amount of erosion and compaction for soil in BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities, are not given in the cumulative effects sections. This information can be found in the literature. The

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levels for erosion and compaction that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. Such erosion and compaction levels for soil could have been developed using "best professional judgment" but were not.

Although the number of acres that may be affected by oil/gas operations is provided no acreages that are related to the impact intensity thresholds of negligible, minor, moderate, and major are given. These acreages could have been developed using "best professional judgment" but were not. No acreages are given for all other activities that affect cumulative effects.

6) **On pages 4-4, 4-43, 4-45, 4-46, 4-48, and 4-49, for Water Resources,** the actual federal or state water quality standards for water quality parameters (for example: total suspended solids, dissolved oxygen, pH, fecal coliform, etc.) in BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature. The concentrations for each pollutant that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. Concentrations could have been developed using "best professional judgment" but were not.

The same procedures could have been used for duration of flows and frequency of flows into the 100 year floodplain; for groundwater level changes; and for levels of saltwater intrusion. The actual effects; the amount of times that the duration of flows and frequency of flows have been impacted; and the specific degree to which this has occurred are not mentioned in the cumulative effects sections.

No mention is made of the proposals to raise the levels of Steinhagen and Sam Rayburn Reservoirs by the Corps of Engineers and supported by the Lower Neches River Authority. The NPS does not mention that Region H, the official water planning group for the Houston Area and the Lone Star Groundwater Conservation District are actively considering alternatives that transfer water from East Texas to the Houston in their updated Region H water plan that is due out in June 2005.

7) **On pages 4-53, 4-55, 4-58, 4-60, and 4-61, for Floodplains,** although total acres are given for oil/gas activities, the acreages that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. Acres are not estimated for other cumulative effects actions. This could be done by looking at development and population growth for the past ten years and the estimates of development and population growth for the next 10-20 years. Such estimates could have been developed using "best professional judgment" but were not.

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The same duration and frequency changes that are mentioned in 4 above should also be assessed quantitatively under Floodplains or referred to under Water Resources.

8) **On pages 4-66, 4-68, 4-69, 4-70, 4-71, and 4-72, for Vegetation,** the acreages that will be destroyed for each vegetation type in BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature or can be estimated from the literature. The vegetation type acreages that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. These acreages could have been developed using "best professional judgment" but were not.

9) **On pages 4-79, 4-81, 4-82, 4-83, 4-85, and 4-86, for Wetlands,** the acreages that will be destroyed for each wetlands type in BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature or can be estimated from the literature. The wetlands type acreages that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. Acreages could have been developed using "best professional judgment" but were not.

10) **On pages 4-93, 4-95, 4-97, 4-99, and 4-100, for Fish and Wildlife,** the acreages that will be destroyed for habitat for management indicator species in BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature or can be estimated from the literature. The fish and wildlife habitat acreages that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. Acreages could have been developed using "best professional judgment" but were not.

11) **On pages 4-106, 4-109, 4-112, 4-113, and 4-116, for Species of Special Concern,** the acreages that will be destroyed for habitat for species of special concern in BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature or can be estimated from the literature. The species of special concern acreages that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. Acreages could have been developed using "best professional judgment" but were not.

12) **On pages 4-120, 4-122, 4-123, 4-124, and 4-126, for Cultural Resources,** the number of cultural resource sites damaged or destroyed in BTNP and the

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145. Cont. region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature or can be estimated from the literature. The number of cultural resource sites damaged or destroyed that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. The number of cultural resource sites damaged or destroyed could have been developed using "best professional judgment" but were not. 13) **On pages 4-133, 4-135, 4-137, 4-138, and 4-140, for Visitor Use and Experience,** the number of visitors that would not come to BTNP and the region due to oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) and all other activities are not given in the cumulative effects sections. This information is easily found in the literature or can be estimated from the literature. The number of visitors that would not come that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. These numbers could have been developed using "best professional judgment" or surveys of visitors to BTNP or the region but were not. NPS could also have used the increase in decibel levels to determine impact intensity thresholds for visitor use and experience. These increases in decibel levels could have been developed using "best professional judgment" but were not. 14) **On pages 4-144, 4-146, 4-147, 4-148, and 4-150, for Adjacent Land Uses and Resources,** the number of oil/gas activities (geophysical, drilling and production, and plugging/abandonment/reclamation) that impact adjacent land uses and resources due to the alternative BTNP oil/gas management policies in this DOGMP/DEIS and the number of such actions that occur in the region are not given in the cumulative effects sections. This information is easily found in the literature or can be estimated from the literature. The numbers of these activities that are related to the impact intensity thresholds of negligible, minor, moderate, and major are not given. These numbers could have been developed using "best professional judgment" but were not.	
146. 15) **On page 4-3, and elsewhere in the DOGMP/DEIS,** NPS states that 1-3 years is short duration for environmental impacts. The Sierra Club disagrees. Up to 1 year shows a short duration for environmental impacts. From 1-3 years shows a moderate level of duration for environmental impacts. NPS does not provide the background data that was used during its "best professional judgment" method to determine that 1-3 years is short duration.	**146.** The NPS disagrees with the comment's interpretation of "short-term" duration. The 1 to 3-year term is an appropriate duration for describing short-term oil and gas impacts.
147. 16) **On page 4-3, Organization of Impact Discussions, Cumulative Impacts,** NPS states that, "Cumulative impacts are based on incremental actions from any type of development that is foreseeable over the life of the Plan." This statement is not entirely. The CEQ NEPA implementing regulations have a definition for	**147.** This text was changed in the Final Plan/EIS to read: "Cumulative Impacts – A cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions (in the NPS, major actions are synonymous with significant actions) actions taking place over a period of time (see 40 CFR Part 1508.7). The cumulative impact analysis area for each resource topic may cover a different geographic area, depending on the specific resource being evaluated."

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147. Cont. "Cumulative impact" in Section 1508.7 which states, "Cumulative impact is the impact on the environment which results from the incremental impact of the action when **added to other past, present, and reasonably foreseeable future actions ... Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.**" NPS leaves out the past and present portion of the definition for cumulative impact in this statement although it mentions the past and present portion of cumulative impact in the sentence before this one.	
148. 17) **On page 4-3, Directional Drilling from Outside the Preserve,** NPS states that "The NPS's regulatory authority ... is limited in scope to only that portion of the operations occurring inside the Preserve." While the Sierra Club disagrees about how limited NPS's authority is, the NPS forgets to add to this sentence that its responsibility to assess environmental impacts outside of BTNP is required by NEPA and not limited.	**148.** See Response 46.
149. 18) **On page 4-4, Directional Drilling from Outside the Preserve,** meeting minimum state and federal requirements for directional drilling outside BTNP does not mean that the drilling does not result in "major adverse impacts" and therefore does not require an EIS. As NPS is aware, but does not state, the regulation of oil and gas activities is mostly the State of Texas' responsibility. The Railroad Commission is the state regulatory agency for oil/gas drilling and has no requirements for environmental protection on private lands except those dealing with some requirements to protect surface or groundwater. Environmental impacts on endangered species, vegetation, wetlands, etc. are not the Railroad Commission's responsibility or it has decided not to exercise its responsibility over impacts on these natural resources on private lands. The Corps of Engineers has responsibility regarding wetlands but has issued nation-wide permits; allows the dredging and filling of many wetlands; and does not regulate many wetlands which it should. The U.S. EPA has responsibility for water pollution and has National Pollutant Discharge Elimination System (NPDES) nation-wide permits. These are usually boiler plate and there is little regulatory oversight from the EPA and the Texas Commission on Environmental Quality (TCEQ) which implements the NPDES permit system in Texas. The TCEQ also implements air quality controls over oil/gas activities but allows many such operations to operate with either a permit by rule or standard permit which are much less protective and onerous than an air permit. The amount of regulation that oil/gas activities receive in Texas does not necessarily reduce the potential for "major adverse impacts" and the need for an EIS.	**149.** Comment noted. In the past, the NPS has never found a directional drilling proposal that qualifies for the exemption determination under 36 CFR § 9.32(e) to pose "major adverse impacts" and the need for an EIS.
150. 19) **On page 4-4, Impacts on Nonfederal Oil and Gas Development, Introduction,** what type of NEPA process must the issuance of special use permits for access and maintenance of pipeline rights-of-way undergo? The	**150.** Depending on the level of the project's effects, there are four NEPA pathways the NPS may follow: 1) prepare a memo to files for projects with previously prepared NEPA documentation; 2) apply a categorical exclusion; 3) prepare an EA; or 4) prepare an EIS. NPS allows for public comment on the last three and will note your comment where applicable.

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150. Cont. Sierra Club requests that it be notified of any consideration of special use permits in BTNP so that we can comment on these.

151. 20) **On page 4-4, Methodology for Assessing Impacts,** NPS states that "Because of the uncertainties of the petroleum industry and the financial considerations inherent in each operation, it is not possible to quantify the impacts on oil and gas development." This statement is not correct. The impacts that past geophysical exploration, drilling and production, and well plugging/abandonment/reclamation have had on BTNP are known. Therefore it should not be difficult estimate into the future what the impacts may be in the future. NPS is copping out and is not quantifying impacts as required by NEPA.

152. 21) **On page 4-5, Alternative A, Project Planning,** NPS states that "it has been difficult to consistently apply Current Legal and Policy Requirements to operations throughout the Preserve." NPS must provide an analysis and give examples of its difficulty in consistently applying legal and policy requirements using Alternative A so the public can review, comment on, and understand exactly what this means. Decision-makers also need to know this information.

153. 22) **On page 4-5, Alternative A, Project Planning,** NPS states that continued implementation of Alternative A "could result in project delays". NPS must provide an analysis and give examples of where this has occurred, how often it has occurred, and why the delays occurred so that the public can review, comment on, and understand exactly what this means. Decision-makers also need to know this information.

154. 23) **On page 4-5, Alternative A, Geophysical Exploration, on page 4-6, Alternative A, Plugging/Abandonment/Reclamation, page 4-7, Geophysical Exploration, page 4-8, Drilling and Production and Plugging/Abandonment/Reclamation,** NPS states that there would be increased costs for operators or operations would be "more costly" due to Alternative A. NPS must provide an analysis and give examples of where this has occurred, how often it has occurred, and the amount of the increased costs so that the public can review, comment on, and understand exactly what this means. Decision-makers also need to know this information.

155. 24) **On page 4-6, Alternative A, Drilling and Production**, NPS states that operator's costs "could be reduced outside of the Preserve, because fewer resource protection measures may be required". At the same time, because fewer resource protection measures may be required there would be less resource protection and presumable more resource damage outside the BTNP. NPS must mention this as a negative environmental impact of slant drilling outside the BTNP and estimate the costs of the greater resource damage.

156. 25) **On pages 4-22 through 4-35,** NPS never states in the EIS why subsidence and surface or subsurface fault activation due to slant drilling under BTNP or

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151. Pages 4-4 through 4-11 of the Draft Plan/EIS include an assessment of impacts of each of the three alternative management strategies on nonfederal oil and gas development. Specific impacts on Preserve resources and values carried forward for further analysis are described under the specific impact heading later in chapter 4. Page 4-4 of the Draft Plan/EIS explains that the NPS cannot quantify impacts on oil and gas development in the Preserve because of the uncertainties in the petroleum industry and the financial considerations inherent in each operation. Whether an operator chooses to conduct an oil and gas operation in the Preserve is dependant upon many factors including financial considerations of their respective companies, project risks, costs to implement mitigation specific to each operation, and the current price of oil and gas. For these reasons, the NPS did not quantitatively analyze impacts on oil and gas development and focused on the relative costs of conducting operations in the Preserve, such as the cost to prepare a plan of operations, implement mitigation, and to comply with all other current legal and policy requirements.

152. The referenced statement is an acknowledgement of the inherent difficulties of maintaining consistency in a case-by-case management process when operator representatives, NPS representatives, and involved public change over time and from project to project. The difficulties can cause extra time and effort for all concerned. The statement is not an evaluation of the consistency with which Current Legal and Policy Requirements have been applied, but rather an evaluation of the process by which it has been accomplished. The NPS does not track these particular nuances of the permitting process, but decision-makers can understand the basis of the statement noted on page 4-5 of the Draft Plan/EIS.

153. The referenced statement is an acknowledgement that the planning and evaluation necessary in the permitting process can contribute to delays when operator representatives, NPS representatives, and interested public change with over time and from project to project. The nonfederal oil and gas permitting process timeline shown on page 2-18 of the Draft Plan/EIS is the target timeline used by the NPS when working with an operator on a proposed plan of operations. Under Alternative A (current conditions), NPS staff currently spend considerable time with operators explaining where operations may be sited, operating stipulations, 9B regulations, and other legal and regulatory requirements. With a comprehensive oil and gas management plan, this information would be available to operators prior to contacting the NPS, eliminating many of the uncertainties of operating in the Preserve, thus reducing the time required to do project planning and permitting by both the NPS and operator. The NPS does not track these particular nuances of the permitting process, but decision-makers can understand the basis of the statement noted on page 4-5 of the Draft Plan/EIS.

154. It would be more costly for operators to conduct operations in the Preserve under any of the alternatives presented in the Plan/EIS. The NPS 9B regulations and other federal laws and regulations impose certain operating requirements on federal lands that are not required on private lands. Operating requirements on private lands are developed in collaboration with the landowner and are specified in surface use agreements. Several requirements that would increase the cost of an operation in the Preserve are: surveying the project area for natural and cultural resources, preparing a plan of operations, spill prevention and containment and waste handling/disposal requirements, and reclaiming the site to predisturbance conditions. Other requirements are described throughout the impact analyses in Chapter 4. In addition, many but not all of the federal operating stipulations are listed for geophysical operations in Table 2.20, drilling and production operations in Table 2.21, and well plugging and surface reclamation in Table 2.22. Also see Response 20.

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156. Cont.

other drilling in BTNP will not occur or what the risk is of subsidence and surface or subsurface fault activation in different units of BTNP.

157.

26) **On page 4-6, Alternative A, Plugging/Abandonment/Reclamation,** NPS states that "specific plugging requirements ... for directional sells only is the proposed well-bore would intersect usable quality groundwater zones beneath the Preserve". NPS does not acknowledge that by allowing pollution on non-usable quality groundwater zones today that it ensures that in the future, if these zones can be used due to new treatment technology that clean-up either will not be able to be accomplished or will be more expensive to accomplish. NPS is removing from future generations the choice to use this water or use it more easily if it were not polluted due to oil/gas actions now. This is a negative environmental impact.

158.

27) **On page 4-7, Cumulative Impacts,** NPS states that "During the past 4 years, there has been an average of two wells drilled per year on prospects underlying Big Thicket". This is not true. About 19 wells have been approved since May 2002 and 19 of those have been drilled according to the NPS's EA Famcor Oil, Inc. Roberts/Duke #1 Flowline, page 15, which states, "From 1990 through 2004, there were no wells drilled within the Preserve. However, 19 directional wells were drilled from surface locations outside the Preserve to reach bottomholes inside the Preserve." Which statement is correct?

159.

28) **On page 4-7, Cumulative Impacts,** it is silly to say that "an overall decline in oil and gas drilling and production is expected over the long-term ... 3-D seismic in the region, would essentially be offset by the overall decline of drilling activity (and production) in the region, resulting in no cumulative, adverse impacts on oil and gas development." The cumulative impacts are that there will be decreased drilling but that in the short-term there will be more drilling as has been shown from May 2002 through the end of 2004.

160.

29) **On pages 4-7, 4-8, 4-9, 4-10, 4-11,** NPS states that implementation of a comprehensive management plan for Alternatives A and or B would facilitate project oversight. NPS must provide an analysis and examples of how this will occur so the public can review, comment, and understand exactly what NPS means. Decision-makers also need to know this information.

161.

30) **On pages 4-13 and 4-15, Alternative A, Air Quality,** NPS states that pollution control devices are used on exhaust systems (catalytic converters). What operations will these devices be used on and how often are these devices used?

162.

31) **On pages 4-13 and 4-14, Alternative A, Geophysical Exploration and Drilling and Production,** NPS should list particulate matter as an air pollutant emitted during these oil/gas activities.

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155. Impacts of directional drilling from surface locations outside the Preserve to reach bottomhole targets beneath the Preserve are assessed under each impact topic in Chapter 4, Environmental Consequences, in the drilling and production sections.

156. The following text was added in Chapter 4, under the impact topic "Geologic Resources," under the drilling and production subheading for all three alternatives: "Surface subsidence caused by fluid withdrawals from beneath Big Thicket National Preserve is not expected because of the properties (depth, porosity, compaction, hydropressure, etc.) of the target reservoirs and adjacent overlying sediments. There is no evidence that past production has contributed to any subsidence in the Preserve. While subsidence related to oil and gas withdrawals is possible, conditions conducive to it occurring (very shallow, high porosity reservoirs combined with high fluid withdrawal volumes, or fractures extending from reservoir depths to the surface) are not known to exist in or near the Preserve."

157. Where directional wells do not intersect usable quality water zones inside the Preserve, the NPS does not impose drilling, completion, or plugging standards stricter than those of the State of Texas. Texas standards are designed to keep fluids within zones that are capable of flowing during drilling, production, and after the well is plugged. Therefore, the properties of water or brine water in all zones penetrated by the well are not expected to be affected.

158. The text on page 4-7 was replaced with new text from Response 99.

159. Production data for the past 10 years, from the extensively drilled Western Gulf Oil and Gas Province encompassing the Preserve, shows a steady decline in oil and gas production (RRC 2005). When the price of oil and gas increases and operators identify drilling targets with exploration technologies such as 3-D seismic, there will be increases in the number of wells drilled and the resultant discovery of hydrocarbons, but due to the overall depletion of the reservoirs in the western Gulf Coast, an overall long-term decline in hydrocarbon production in the region is still expected to occur.

160. Project oversight will improve with implementation of the Oil and Gas Management Plan at the Preserve because it will provide operators necessary upfront information to help them better plan and conduct operations in the Preserve. During the EIS planning effort, the interdisciplinary team developed information that would help the NPS gain job efficiencies and facilitate and maintain quality project oversight in the Preserve, and will help the operator understand the NPS requirements they need to comply with and assist operators to plan and conduct their operations. Prior to preparing this Plan/EIS this information was available during project planning and permitting on a case-by-case basis, which requires considerable time and effort on the part of NPS staff and the operator. Information in the Draft Plan/EIS that will be available prior to planning an operation includes maps showing areas where no surface use and timing stipulations will apply (Figures 2.1 through 2.17 and Tables 2.6 through 2.16), a listing of operating stipulations and recommended mitigation measures (Tables 2.20 through 2.22), summaries of applicable current and legal policy requirements (Appendix C), and guidelines for sampling and detecting contamination in the Preserve (Appendix F). Also see Response 152.

161. Catalytic converters are used on vehicles that use unleaded gasoline. These vehicles will be primarily used by oil and gas personnel during drilling and production operations, but could also be used during geophysical exploration and plugging and reclamation activities. The text noted on pages 4-13 and 4-15 of the Final Plan/EIS is changed to clarify that these types of exhaust systems are used on vehicles.

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163. 32) **On page 4-15, Alternative A, Drilling and Production,** the cumulative impacts on air quality from particulates due to oil/gas used in refineries and other uses which comes from BTNP is not provided. These are regional air cumulative impact issues that should be discussed in this section.	**162.** Particulates or particulate matter emissions are discussed at the bottom of page 4-13, under "Geophysical Exploration;" and in paragraph on page 4-14 that begins "Particulate matter emissions…" under the heading "Drilling and Production."
164. 33) **On page 4-16, Alternative A, Cumulative Impacts,** NPS states that "impacts would be distributed over time." These impacts will last 20 years or more and there should be estimates of air pollutant emissions that are emitted over this time period cumulatively and for each well to be drilled. Emission factors can be used and to generate reasonable estimates.	**163.** The third paragraph in the cumulative impact analysis describes cumulative effects from particulate matter emissions. **164.** The sentence referenced reads: "As some operations are developed, others would be plugged, abandoned, and reclaimed; therefore, impacts would be distributed over time." Because wells will be drilled to different depths, and technology and equipment used will vary, it is not possible to calculate with accuracy the total emissions of pollutants. The cumulative impact analysis concludes: "with adherence to State and federal ambient air quality standards, air pollution control requirements, and air quality management programs specified in State Implementation Plans, air quality in regional airsheds are expected to be maintained or improved."
165. 34) **On pages 4-23, 4-35, 4-50, 4-73, and 4-143, for Geologic Resources, Water Resources, Floodplains, Wetlands, and Adjacent Land Use and Resources,** NPS uses "regional scale" to define "Major". There are impacts that can occur which are not of a "regional scale" but which are significant and "Major". For instance, burning on the boundary of or within BTNP could produce smoke that would cause one or more people to go to the hospital. This is a "Major" impact because one or more person's health was directly affected by air pollution. An oil or toxic material spill could occur on the Neches River or a tributary, which covered a relatively short distance but resulted in a "Major" fish kill. Using "regional scale" sets the bar so high for defining "Major" impact that no matter what oil/gas or cumulative developments occur they will not be defined as "Major" by NPS. NPS must change the definition of "Major" to ensure that it fits what this word actually means.	**165.** The NPS routinely uses an increasing context and/or duration to define major effects.
166. 35) **On page 4-29, Alternative B, Geophysical Exploration,** NPS says that "Seismic shot-holes would not be permitted within 25 to 50 feet of the highest point in a center of a mound." Why does NPS not simply ban shot-hole placement on sand mounds? If a sand mound is larger than 25-50 feet a shot-hole will still be allowed under Alternative B. NPS states on page 3-22 that sand mounds "vary in diameter from 6 feet to 180 feet." This means that from 130-155 feet of a sand mound could be unprotected from impacts that shot-hole use entails. NPS is incorrect to say that "The designation of a SMA … would eliminate any direct impacts on these unique geologic features." Therefore the protectiveness of alternative B is less than stated and sand mounds are not fully protected. The Sierra Club supports protection of all sand mounds by banning shot-hole use on any portion of a sand mound.	**166.** Due to public comment and a re-evaluation of its merit by the NPS, the Sand Mounds SMA is removed from the Final Plan/EIS. Also see Response 44.
167. 36) **On page 4-30, Alternative B, Cumulative Impacts,** NPS states that Alternative B "would provide consistent protection of geologic resources in the SMAs". This is incorrect. As already mentioned above sand mounds are not fully protected by Alternative B. Because NPS uses the phrase "less than" before total area with operating stipulations for each unit and for BTNP and the total area with drilling and production operations no surface use (pages S-7, 2-25, 2-32, 2-34, 2-36, 2-38, 2-40, 2-42, 2-44, 2-46, 2-48, 2-50, and 2-52) for each unit and for BTNP, the different acreages that NPS will protect or allow impacts 63	**167.** See Responses 51 and 83.

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167. Cont. on in SMAs are not known to the public, from one oil/gas activity to another. Alternative B is not that different from the "case-by-case" method that Alternative A uses yet NPS states that it is without clearly defining the differences. NPS does not provide the consistency that is needed for the public to know what it will allow for resource protection and impacts, from oil/gas proposal to proposal.	
168. 37) **On pages 4-35 through 4-49, Water Resources,** NPS never states how long plugged wells last before they leak. Because NPS is relying on this form of operational stipulation to prevent groundwater contamination it must reveal to the public for review, comment, and to understand how long such wells are expected to stay leak free due to plugging. Decision-makers also need to know this information. The wells that are in the Neches River (page 4-39), should be plugged to ensure that surface water is not contaminated with brine, produced waters, and other water pollutants and to ensure that groundwater is not contaminated with surface water that is polluted.	**168.** Well plugging is designed to provide for permanent sealing and isolation of zones capable of flowing contaminants (brine or hydrocarbons). Decision-makers should be comfortable in knowing that once a well is properly plugged and abandoned, the probability that a leak will develop is extremely low. On the rare occasion that a plugged well develops a leak, it is generally an indicator that the job was not well done, and not an indicator that a well done job deteriorated over time. Also see Response 125.
169. 38) **On page 4-40, Plugging/Abandonment/Reclamation,** as noted in previous comments in this letter, reclamation is on-going from more than the 2-5 years claimed by NPS on this page. Therefore NPS must explain what is the maximum amount of time reclamation will take and the time that reclamation is currently taking (pages 3-4 through 3-7).	**169.** See Response 120.
170. 39) **On pages 4-38, 4-42, 4-44, 4-48, 4-51, 4-57, 4-58, 4-60, 4-63, 4-67, 4-69, 4-72, 4-76, 4-78, 4-80, 4-82, 4-83, 4-85, 4-86, 4-90, 4-95, 4-96, 4-97, 4-99, 4-100, and 4-105, 4-144, 4-146, 4-145, 4-147, 4-148, 4-149, and 4-150,** NPS states that a spill or other actions "**could result in** major" adverse impacts. But then NPS states that with the application of mitigation measures these impacts **could be** less than major. Because NPS cannot guarantee that the mitigation measures will be applied and will work it cannot state on **pages 4-43, 4-46, 4-49, 4-55, 4-58, 4-61, 4-68, 4-70, 4-72, 4-81, 4-83, 4-86, 4-95, 4-97, 4-98, 4-100, 4-146, 4-148, and 4-151, Cumulative Impacts and Impairment Analysis,** that "there would be no major adverse impacts". NPS must state under **Cumulative Impacts and Impairment Analysis** that in the case that mitigation measures are not applied or do not work that cumulative impacts will be "major" and impairment will occur.	**170.** The impact analysis referenced is for operations under approved plans of operations for which the NPS can require and enforce the mitigation measures.
171. 40) **On page 4-50, Impacts on Floodplains under Alternative A,** NPS states that "Interpretation and application of CLPR, and project-specific considerations, could result in variations in how, where, and to what extent resource protection is applied." NPS must provide an analysis and examples of how this has occurred so the public can review, comment on, and understand this. Decision-makers also need to know this information.	**171.** See Response 174. Specific examples of how guidance documents can be interpreted and applied differently by different practitioners, with varying levels of experience, is not necessary for the reader to understand the flexibility that Alternative A provides.
172. 41) **On pages 4-74 and 4-77, Drilling and Production,** a 1:1 or 2:1 mitigation/compensation is not sufficient to replace destroyed bottomland	**172.** As described in the cited pages, wetland restoration proposals must, at a minimum, provide one-for-one (1:1) wetland function replacement (i.e., focus on no net loss of wetland functions, not just wetland acreage). Final compensation ratios may need to be greater than 1:1 in cases where: (1) the functional values of the site being impacted are determined to be high and the restored wetlands will be of lower functional value; (2) it will take a number of years for the restored site to become fully functional (e.g., reestablishment of forested wetlands); or (3) the likelihood of full restoration success is unclear. Conversely, the replacement ratio may simply be 1:1 for areas where the functional values associated with the area being impacted are determined to be low relative to the replacement site and the likelihood of fully successful, timely replacement of functions at the restoration site is high. Wetland compensation decisions are made on a project-by-project basis. (NPS Procedural Manual 77-1, 5.2(C), Compensating for Wetland Impacts).

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172. Cont. hardwood and cypress swamp forest wetlands. The compensation ratio should be at least 7:1 to account for fragmentation, hydrological flow regime alterations, and other functions and because humans cannot create forested wetlands that function as well as naturally created forested wetlands. Recently the Corps of Engineers, Galveston District, told a permit applicant that a 7:1 ratio to mitigate for wetlands destroyed was necessary (see enclosed Corps permit sheet). **See Attachment 8.**	
173. 42) **On pages 3-69, 3-70, 4-105, and 4-128 through 4-142,** NPS talks about the impacts of noise. However, NPS does not give the decibel levels that cause negligible, minor, moderate, and major impacts. This could be done simply by using a range of decibel limits based on information in the literature regarding the effects that noise has on wildlife and human visitors. NPS must provide an analysis and examples of noise impacts with decibel levels so the public can review, comment, and understand exactly what NPS means when it says there are negligible, minor, moderate, and major noise impacts. Decision-makers also need to know this information.	**173.** Pages 3-68 and 3-70 of the Draft Plan/EIS describe ambient sound levels at various locations within the Preserve ranging from 36 to 61 decibels. Impact analyses in Chapter 4, Environmental Consequences, describe the effects of elevated noise on some impact topics. The NPS does not use a change in decibels to define impact intensity levels because impacts are not simply determined by decibel change but also by the particular uses that would be affected within the analysis area. The NPS does use decibel levels to describe impacts. For example, in the 4th paragraph on page 4-105, "Drilling operations introduce noise with the highest measurements in the 90 dBA range for a period of 30 to 90 days, with noise coming most from multiple diesel engines." The impacts of drilling and production operations on visitor use and experience under Alternative A, No-Action, is described on page 4-130, 5th paragraph, as follows: "As noted in Chapter 3, background noise levels at many visitor use areas in the Preserve have been recorded, with most falling at or just below 40 dBA. Figure 3.6 shows that a drill rig at a distance of 1,500 feet is associated with a noise level of about 40 dBA, while near the drill rig, sound levels are approximately 80 dBA. The 500-foot offset required for visitor use and administrative areas under NPS's 36 CFR 9B regulations would result in reducing the adverse impacts from a drilling rig, but would not reduce sounds to background levels. Localized, moderate, adverse impacts could result if drilling or other loud noises occur close enough to a visitor use area to cause interference with the enjoyment or use of the area."
174. 43) **On pages 4-116 through 4-127,** NPS has not fully protected cultural resources for the past two years. For instance, an August 23, 2004 letter from the Texas Historical Commission states for the Comstock Oil and Gas, Crown Petroleum Corporation, Northup and Associates, and others, Multiple Drill Projects that, "These impacts have the potential to impact significant cultural resources. We believe that the well pad and access road construction constitutes an undertaking as defined in the National Historic Preservation Act ... The NPS Directional Drilling Provision, which exempts these well pad locations from review under Section 106 of the NHPA, cannot supercede federal law. Although the well pad locations are not under federal control, they would not be constructed were it not for the federal minerals present beneath the BTNP. Therefore, in our opinion, any adverse effects to historic properties caused by their construction in an effort to extract federal minerals is a federal undertaking that must be addressed by the NPS ... We have contacted the Advisory Council on Historic Preservation for guidance on this issue." Because of problems like this one the NPS must discuss how it will conduct itself so that it fully complies with the National Historic Preservation Act and how it will do business in a different way than the example given above. **See Attachment 9.**	**174.** The Texas Historical Commission (THC) believed that the NPS had authority under Section 106 of the National Historic Preservation Act of 1966, as amended, to require directional drilling applicants that qualified for the 36 CFR § 9.32(e) exemption determination to perform archeological surveys on private property. The THC referred the issue to the Advisory Council on Historic Preservation (ACHP). The ACHP determined that issuing a § 9.32(e) exemption determination is not a federal undertaking by the NPS; therefore, the NPS has no Section 106 authority or responsibility.
175. 44) **On pages 4-127 through 4-141, Visitor Use and Experience,** NPS states that "Oil and gas operations would have the most adverse impact on visitors who come to BTNP to seek solitude or a quiet nature experience." But then NPS provides no information on the negligible, minor, moderate, and major impacts that oil/gas activities have specifically on "solitude". The impacts on "solitude" that oil/gas activities have should be provided in this EIS so that the public can	**175.** Impact intensity threshold definitions for negligible, minor, moderate, and major impacts on visitor use and experience are provided on page 4-128 of the Draft Plan/EIS. Impacts from elevated noise on visitor use and experience is described in the 5th paragraph on page 4-130 (Alternative A), the 5th paragraph on page 4-136 (Alternative B); and the 2nd paragraph on page 4-139 (Alternative C).

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review, comment, and understand what the impacts are. Decision-makers also need to know this information.	
175. Cont. 45) **On page 4-145, Cumulative Impacts,** NPS states that "Since the majority of adjacent land uses are ongoing private and commercial logging activities, it is likely that impacts associated with these activities would continue over the foreseeable future." This would have been a true statement in 1998, when the preparation of this EIS began, but it is not true today. With Louisiana-Pacific and International Paper selling 1.5 million acres in East Texas, much of which is near or next to BTNP, there is no assurance that this land will continue in logging activities. In fact the land is being broken up and sold and is not in the process of being developed. NPS must discuss this very real threat to the BTNP in detail.	
176.	**176.** The lands adjacent to the Preserve remain predominantly in private and commercial timber production, as described.
46) **On pages 4-61 through 4-72 and 4-147 and 4-149, Geophysical Exploration and Drilling and Production,** an impact that is not discussed is the destruction of sensitive ecosystems. The kinds and amounts of sensitive ecosystems that would be destroyed, both from oil/gas activities, and **Cumulative Impacts,** must be detailed here so that the public can review, comment, and understand exactly what may occur. Decision-makers also need to know this information. NPS must assess, analyze, and evaluate the full impacts of losing vegetation types for the full life of the oil/gas well or reclamation of the oil/gas well site and or field on either NPS land and or private lands. Depending on the age and composition of the vegetation, the impacts will be long lasting from several decades to several hundred years. If the vegetative composition is altered from what exists today and the likelihood of it growing back is not great then the impact could be almost permanent. Such assessments of impacts need to be stated clearly and fully in this EIS.	
177.	**177.** Impacts on vegetation in the Preserve are assessed on pages 4-61 through 4-72 of the Draft Plan/EIS. Impacts on vegetation on adjacent lands are assessed on pages 4-141 through 4-151. The analyses describe the context, duration, and intensity of impacts. Because the Draft Plan/EIS is a programmatic management plan, it is not intended to analyze project-level impacts. Scoping will be carried out for each project to identify important issues for consideration in a project-specific analysis.
47) **On page 4-151, Impairment,** NPS states that "Even if there were a catastrophic spill, the site would be re-mediated and would not likely result in an impairment of Preserve resources and values." NPS offers no data to support this assertion. In fact a major spill of oil in a cypress swamp or bottomland hardwood forested wetland would be virtually impossible to re-mediate and would result in an impairment of those resources for a long time to come. Scientists have studied the impacts that oil has on wetlands and found that well-fouled wetland areas are especially hard hit and may take decades to recover.	
178.	**178.** The Draft Plan/EIS describes how wetlands will be avoided under Current Legal and Policy Requirements and the additional operating stipulations prescribed under Alternatives B and C. If there is no practicable alternative to avoid locating nonfederal oil and gas operations in a wetlands, appropriate mitigation measures will be applied. See also Response 177.
48) **On page 4-151, Impairment, Alternatives B and C,** these two alternatives should not be grouped together since they have very different levels of environmental protection and potential impacts. Alternative C has definite no drill zones that are much more extensive than Alternative B and which do not use the caveat of "less than" for number of acres covered. By grouping these two alternatives together NPS blurs their differences and does not make them clear	
179.	**179.** For the discussion of impairment as described on pages 4-151 and 4-152 of the Draft Plan/EIS, combining Alternatives B and C is appropriate.
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179. Cont. and distinct for the public to review, comment on, and understand. Decision-makers also need to understand the distinctions between alternatives.	
180. 49) **On pages 4-152 and 4-153, Alternatives B and C, Impairment, last paragraph and Unavoidable Adverse Impacts that Cannot be Avoided Should the Action be Implemented, first paragraph,** NPS is overly strict in limiting what oil/gas activities it considers qualify for the preparation of an EIS. This strictness of when an EIS is required plus NPS's strict definition of what constitutes a "Major" impact ensure that an EIS will probably never be required for an individual drilling well site.	**180.** Comment noted.
181. 50) **On page 4-152, Enhancement of Long-term Relationship between Local Short-term Uses of the Environment and Maintenance and Productivity,** NPS states that "continuation of the existing management program as discussed above under Alternative A could led to impairment of these resources." **On pages 4-17, 4-28, 4-43, 4-55, 4-68, 4-81, 4-95, 4-110, 4-122, and 4-135,** NPS states that the "selection of Alternative A would not result in an impairment". NPS cannot have it both ways. Which statement is correct?	**181.** The word "could" merely implies that Alternative A has greater potential to lead to impairment than Alternatives B and C.
182. 51) **On pages 4-152 and 4-153, Enhancement of Long-term Relationship between Local Short-term Uses of the Environment and Maintenance and Productivity and Unavoidable Adverse Impacts that Cannot be Avoided Should the Action be Implemented,** NPS states that if wetlands cannot be avoided and the mitigation required is not successful in compensating for the original productivity of areas lost, there could be a loss in long-term productivity in these areas or unavoidable adverse impacts. What will NPS do, under this DOGMP/DEIS if this scenario occurs? Will NPS require compensation via the purchase of equivalent wetlands? What is NPS's recourse if this scenario comes true?	**182.** The Plan/EIS is not intended to provide direction in dealing with unsuccessful wetlands restoration. In the event that wetlands restoration is not successful, the NPS will work with the operator under the NPS's DO 77-1, and with the U.S. Army Corps of Engineers under the Section 404 process, to determine the correct course of action.
183. 52) **On page 4-153, Irreversible or Irretrievable Commitments of Resources,** NPS states that "The potential for these lands to produce vegetation or be viewed in an undisturbed state would be irretrievably committed for the duration of the oil and gas development operations, and until the site(s) have been reclaimed." This is an understatement of what the impacts will be. The impacts will last, not until the site has been "reclaimed", but until the vegetation type has reached the age that it was when it was cleared. Even this may underestimate the length of the impacts because the vegetation type that was cleared from the site may not be the vegetation type that grows back at the site. Impacts could last for several centuries or may be permanent if the vegetation type that originally grew on the site never grows back. In addition, NPS also does not include the unavoidable adverse impacts of the loss of solitude, quiet, clean air, and the destruction of ecosystems.	**183.** The opening text to this section states "Irreversible impacts are those effects that cannot be changed over the long term or are permanent. An effect to a resource is irreversible if it (the resource) cannot be reclaimed, restored, or otherwise returned to its pre-disturbance condition." Elevated noise levels and air pollution would not result in an irreversible impact because when the oil and gas operation ceases, the impacts cease. Please note the NPS's goal for reclamation is defined by reclamation requirements in 36 CFR § 9.39(a)(2) (see Appendix B), and is to restore natural conditions and processes.

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184. 53) The Sierra Club does not find in Chapter 4 where the NPS has assessed the impacts that additional traffic will have on the BTNP and its visitors and or private property via air pollution, noise, and destruction of the road surface by heavy vehicles. NPS must also reveal the impacts on all roads and bridges that are used to access the well site, the pipeline, and any associated activities.

Appendices

185. 1) **On page C-31, Appendix C,** NPS should list 30 TAC 106 and 116 for permit by rule and permit requirements for air quality.

186. 2) **On page E-1, Introduction Appendix E,** the use of 1995 data for oil/gas plays means the estimation of oil/gas reserves that are left in BTNP is 10 years old. A more recent estimation is needed to take into account the finds that have occurred in the last 10 years.

187. 3) **On page 1, Introduction, Appendix E,** what is the percent error for the Monte Carlo simulation model?

188. 4) **On page 2, Tertiary Oil and Gas Play, Appendix E,** the fact that BTNP only makes up 0.6% of the total play area indicates how minor the oil/gas resources under BTNP.

189. 5) **On page 3, Upper Cretaceous Oil and Gas Play, Appendix E,** the fact that BTNP only makes up 0.32% of the total play area indicates how minor the oil/gas resources under BTNP.

190. 6) **On page 4, Step 2. Oil and Gas Data Allocation and Evaluation, Appendix E,** NPS should tell the public how well predictions matched reality in the past so that the public can review, comments on, and understand this information. Decision-makers also need to know this information.

191. 7) **On pages C-5 and E-6, Appendix E,** because of new seismic technologies this reserve estimate underestimates the amount of finds that will be discovered and thus the number of wells that will be drilled. This reserve estimate document states that if a deeper pool were discovered in an existing salt-dome field, for example, that the pool would fall under the category of reserves in an existing field and would not be reflected in this estimate. Therefore the DOGMP/DEIS, since it relies on the RFD, underestimates the environmental impacts that will occur inside and outside BTNP. A better estimate of total drilling activity needs to be developed for this DOGMP/DEIS.

192. 8) **On page F-1, I. What is the Purpose of this Document, Appendix F,** NPS states that owner/operators are supposed to collect samples. How will NPS know that owners/operators have collected samples correctly? NPS should trust,

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184. Impacts from the use of heavy equipment and vehicles, and construction and maintenance of access roads are assessed under all resource topics in Chapter 4, Environmental Consequences. Because the Draft Plan/EIS is a programmatic management plan, it is not intended to analyze project-specific impacts. The RFD scenario in the Plan/EIS has been used to assess impacts associated with oil and gas operations within and outside of the Preserve. Table 2.1 on page 2-8 of the Final Plan/EIS illustrates projected surface disturbances associated with these operations. Of the 241 acres projected to be developed in the Preserve, 145 acres could be disturbed to construct new oil and gas access roads. Scoping would be carried out for each project to identify important issues for consideration in a project-specific environmental analysis.

185. Comment noted. The NPS focused on selected Texas Laws and Regulations in Appendix C on Texas Administrative Code chapters directly related to oil and gas operations. The air quality permits noted in the comment as well as other general construction permitting requirements may apply to oil and gas operations. It is the responsibility of the operator to determine which permits are applicable to each specific operation.

186. See Response 81.

187. The USGS and NPS acknowledge the geologic uncertainties associated with estimating undiscovered oil and gas underlying the Preserve. There is no percent error associated with the Monte Carlo simulation; rather, the Monte Carlo simulation generates a probability distribution of oil and gas resources ranging from a low case of having a 95% probability of that amount or more occurring to a high case of having a 5% probability of that amount or more occurring. The NPS used the mean estimate when preparing its RFD scenario for the Draft Plan/EIS and has updated the RFD scenario for the Final Plan/EIS using the 25% probability distribution (see Chapter 2 – Reasonably Foreseeable Development Scenario and Appendix E, Table 1 in the Final Plan/EIS).

188. The commenter is correct in stating that the Preserve encompasses only 0.6% of the Tertiary play area defined by the USGS for the Western Gulf Oil and Gas Province. In order to accurately depict future activities that could occur to develop the projected oil and gas resources underlying the Preserve, all of the productive and potentially productive reservoirs were included in the NPS's RFD scenario, including the Tertiary oil and gas play.

189. The commenter is correct in stating that the Preserve encompasses only 0.32% of the Cretaceous play area defined by the USGS by the USGS for the Western Gulf Oil and Gas Province. In order to accurately depict future activities that could occur to develop the projected oil and gas resources underlying the Preserve, all of the productive and potentially productive reservoirs were included in the NPS's RFD scenario, including the Cretaceous gas play.

190. The USGS assessment is an estimate of undiscovered oil and gas resources underlying the Preserve. Since the oil and gas exploration and development described in the plan is projected to occur over the next 15 to 20 years, and it may take even longer to produce the hydrocarbons, it is not possible in this EIS to compare actual production figures with the USGS estimate of undiscovered resources in the Preserve.

191. See Response 81.

192. The NPS requires operators to use the guideline in the following situations: 1) to establish baseline conditions prior to beginning operations, 2) following a spill, to characterize the type and areal extent of contaminants prior to developing remediation techniques and clean-up levels, or 3) at the completion of operations or remediation to ensure reclamation/remediation has been

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but verify. NPS should conduct split samples and audits to keep owners/operators honest. Does NPS do this and if so for how many well sites?

192. Cont.

9) **On pages F-1 and F-2, I. What is the Purpose of this Document, Appendix F,** NPS must define **"contaminating substance"** so that the public can review, comment on, and understand what this term means. Decision-makers also need to know this information.

193.

10) **On page F-5, III. What Contaminants to Test for, Appendix F,** NPS must define **"clean-up activities"** so that the public can review, comment on, and understand what this term means. Decision-makers also need to know this information.

194.

11) **On page I-2, III. Well Plugging Goals, Appendix I,** NPS does not state how long a well is allowed to be unplugged before well plugging must occur. NPS should provide this information.

195.

12) **On page I-4, Zones Containing liquid or Gas with the Potential to Migrate, Appendix I,** it is not clear how these requirements address lateral fractures and ensure that they do not cause water contamination. NPS should provide this information.

196.

Final Comment

The NPS should not be surprised by the issues and concerns that the Sierra Club has brought up in this comment letter. Many of these concerns and issues were first brought up in the December 17, 1998 scoping comments that the Sierra Club submitted to the NPS. Other issues and concerns have been brought up in our scoping and EA comments regarding the 19 oil/gas wells that have been proposed or approved by the NPS since 2002. **See Attachment 10.**

The Sierra Club, Big Thicket Association, TexPIRG, and Texas Committee on Natural Resources request:

1) That no further oil/gas activities are allowed in the BTNP until the Final OGMP/FEIS/ROD is complete, with full public input, and approved in the ROD.

2) That the DOGMP/DEIS for BTNP be withdrawn and not re-released until a complete qualitative and quantitative cumulative effects analysis, assessment, and evaluation based on the CEQ document, "Considering Cumulative Effects Under the National Environmental Policy Act".

3) That NPS no longer re-interpret the 9B regulations for any oil/gas wells in or outside of BTNP and the National Park System unless it enters into an administrative rule change process in the Federal Register with a public review and comment period of at least 60 days.

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satisfactorily achieved. The guideline includes guidance for Quality Assurance/Quality Control. The NPS reviews plans for sampling/analysis and remediation prior to implementation by an operator. The NPS uses the guideline for collecting soil and surface/groundwater samples at abandoned oil and gas sites as funding is available. See also Response 120.

193. "Contaminating substances" is defined in the glossary on page Glossary-2. The definition derives from the 36 CFR 9B regulations. The 36 CFR § 9.31(n) reference was added at the end of the definition.

194. Clean up activities are designed for a specific operations site or spill event, and depend upon many factors, including the type of contaminating substance, areal extent of contamination, and environmental receptors.

195. See Response 122.

196. The requirement applies to zones containing liquid or gas with the potential to migrate whether the flowing capacity of the zone is the result of matrix permeability or the presence of fractures, or a combination of the two.

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4) That the DOGMP/DEIS for BTNP be withdrawn until NPS updates its United States Geological Service cumulative impacts analysis for the number of oil/gas wells estimated to be drilled in or next to the BTNP for the next 20-30 years using current oil/gas drilling data and information because that number has been underestimated.

5) That the public be notified when each special use permit for right-of-way activities is requested so that the four organizations that have endorsed these comments and the public can comment on each special use permit.

6) The four organizations that have endorsed these comments request that they be notified in writing when the 60-day data collection permits are proposed pursuant to 36 CFR 9.52(a), so that they can respond, if necessary, with comments as to their appropriateness.

The Sierra Club, Big Thicket Association, TexPIRG, and Texas Committee on Natural Resources appreciate this opportunity to comment. Thank you.

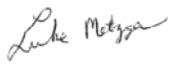
Sincerely, Brandt Mannchen

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COMMENTS	RESPONSES
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COMMENTS	RESPONSES
59 letters were received from Sierra Club members that included the following standard comments:	
197. 1) Support and request environmental analysis for alternatives that buy all oil/gas private mineral rights in BTNP and/or do not allow the surface use of BTNP for new oil/gas activities.	**197.** See Response 82.
198. 2) Withdraw and revise the DOGMP/DEIS to include a complete qualitative/quantitative cumulative effects analysis, assessment, and evaluation based on the document, "Considering Cumulative Effects under the National Environmental Policy Act."	**198.** See Responses 73 and 145.
199. 3) State that Alternative C, the environmentally preferred alternative, is the best of the three alternatives presented in the DOGMP/DEIS and should be adopted if buying mineral rights or not allowing surface use alternatives are not chosen.	**199.** See Response 2.

PREPARERS AND CONSULTANTS

CHAPTER 6



CHAPTER 6
PREPARERS AND CONSULTANTS

PREPARERS

Name	Responsibility	Education	Years Related Experience
Linda Dansby	EIS Project Manager Summary Ch 1, Introduction Ch 2, Pt I, Plan Alternatives Pt II, CLPR Pt III, Mitigation Measures Ch 3, Affected Environment - Nonfederal Oil and Gas Development Ch 4, Environmental Consequences -Nonfederal Oil and Gas Development -Air Quality -Geologic Resources -Water Resources -Floodplains -Vegetation -Wetlands -Fish and Wildlife -Species of Special Concern -Cultural Resources -Visitor Use and Experience -Adjacent Land Uses and Resources -Comparative Analysis of the Proposed Actions and Alternatives Ch 5, Consultation and Coordination GIS Map Development	BS-Biology	NPS-27 yrs Environmental Protection Specialist
Lisa Norby	Ch 1, Introduction -Local and Regional Economies Ch 2, RFD Scenario Pt I, Plan Alternatives Pt II, CLPR Pt III, Mitigation Measures Ch 3, Affected Environment -Geologic Resources -Adjacent Landowners and Uses Ch 4, Environmental Consequences -Nonfederal Oil and Gas Development -Geologic Resources -Water Resources -Floodplains -Visitor Use and Experience -Adjacent Land Uses and Resources Appendix C, Federal Laws, Regulations, Executive Orders, Policies, and Guidelines that Apply to Nonfederal Oil and Gas Operations	BS–Geology MS-Geology MEPM-Masters of Environmental Policy and Management	NPS-12 yrs Petroleum Geologist, Private Industry-12 yrs Geophysicist and Geologist

Name	Responsibility	Education	Years Related Experience
Roy Zipp	Ch 3, Affected Environment -Vegetation -Fish and Wildlife -Species of Special Concern	BA-Biology/Chemistry MEM-Water and Air Resources	NPS-11 yrs Resource Management Specialist
Carol McCoy	Ch 1, Introduction -Transpark Oil and Gas Pipelines and Activities in Associated Rights-of-Way -NPS Nonfederal Oil and Gas Regulations, 36 CFR 9B Appendix C, Federal Laws, Regulations, EO's, Policies and Guidelines that Apply to Nonfederal Oil and Gas Activities	BA-Environmental Studies MPP-Masters of Public Policy with emphasis on Environmental Management JD	NPS-24 yrs EPA-3 yrs Regulatory Policy Specialist
Pat O'Dell	RFD Scenario Ch 2, Pt II -Overview of 36 CFR 9B Process Ch 2, Pt III, Mitigation Measures Appendix D, Types of Oil and Gas Operations Appendix I, National Park Service Well Plugging Guide for Nonfederal Oil and Gas Wells in the State of Texas	BS-Petroleum Engineering Industry-10 yrs Petroleum Engineer	NPS-14 yrs Petroleum Engineer
Edward Kassman, Jr.	Ch 1, Introduction -NPS Nonfederal Oil and Gas Rights Regulations, 36 CFR 9B Appendix C, Federal Laws, Regulations, EO's, Policies and Guidelines that Apply to Nonfederal Oil and Gas Activities	JD	NPS-12 yrs Regulatory Policy Specialist Private-2 yrs
Mike Martin	Ch 3, Affected Environment -Water Resources -Floodplains	BS-Environmental Geology MS-Watershed Science	NPS-14 yrs Hydrologist
Jim Bradford	Ch 3, Affected Environment -Archeology Ch 4, Environmental Consequences -Cultural Resources	BS-Archeology/ Anthropology	NPS-27 yrs Cultural Resource Mgt. Private Sector-6 yrs
Alexa Roberts	Ch 3, Affected Environment -Ethnography	PhD-Anthropology	NPS-10 yrs Ethnographer Navajo Nation-8 yrs Private Sector-4 yrs
Catherine Colby	Ch 3, Affected Environment -Historic Structures	MA-Architecture	NPS-16 yrs Historical Architect
Jill Cowley	Ch 3, Affected Environment -Cultural Landscapes	M.A-Landscape Architecture	NPS-17 yrs Historical Landscape Architect

Name	Responsibility	Education	Years Related Experience
Bob Valen	Ch 1, Introduction -Local and Regional Economies Ch 3, Affected Environment -Visitor Use and Experience	BA-Geography/ Biology	NPS-27 yrs Resource Management Specialist
D. Brian Mitchell	Ch 3, Affected Environment -Air Quality	BS-Chemistry ME-Environmental Engineering (Air Pollution Control)	NPS-24 yrs Air Resources Division EPA-5 yrs Environmental Engineer
Dave Baker	Ch 3, Affected Environment -Visitor Use and Experience --Night Sky	BS-Outdoor Recreation	NPS-27 yrs Resource Management Specialist
Bob Appling	Ch 3, Affected Environment -Visitor Use and Experience --hunting and trapping	BS-Environmental Resources (Park Administration)	NPS-27 yrs Resource Management Specialist
Mark VanMouwerik	Appendix F, Guideline for the Detection and Quantification of Contamination at Oil and Gas Operations	MS-Environmental Health	NPS-11 yrs Restoration Project Manager
Pete Penoyer	Appendix F, Guideline for the Detection and Quantification of Contamination at Oil and Gas Operations (Update)	MS-Geology Professional Degree-Hydrogeology	NPS-4 yrs Hydrologist COE-7 yrs Geologist/Hydrologist Private-15 yrs
Curtis Hoagland	Ch 3, Affected Environment -Species of Special Concern	MS-Natural Resources and Environmental Science	NPS-1 yr Chief, Resources Fed. Gov't -10 yrs USFWS & COE
Lisa Zygo	Ch 3, Affected Environment -Wetlands	BS-Geology and Environmental Science MS-Geology	NPS/Baylor University Student Partner–4 mos
Sandy Hamilton	Appendix C, Federal Laws, Regulations, EO's, Policies and Guidelines that Apply to Nonfederal Oil and Gas Activities	MS-Ecology JD LLM-Candidate	NPS/University of Denver Student Partner - 7 mos
Madoline Wallace	Ch 1, Introduction -Transpark Oil and Gas Pipelines and Activities in Associated Rights-of-Way	JD-Candidate	NPS/University of Denver Student Partner - 3 mos
Doug Bradley	GIS Development and Maps		NPS-16 yrs GIS Specialist

Name	Responsibility	Education	Years Related Experience
Nancy A.. Shock	GIS Development and Maps	BS-Biology	NPS- 2 yrs 9 mos GIS Specialist USGS-8 yrs Digital Cartographer State of Colorado-5 yrs Biology Technician Private Sector-10 yrs GIS Specialist
Victoria Barela	Ch 1, Introduction -Local and Regional Economies Appendix G, U.S. Fish and Wildlife Service County-by-County Listing Threatened and Endangered Species and Species of Concern Appendix H, Texas Parks and Wildlife Department Special Species List Editing and Formatting		NPS-18 yrs Program Assistant
Carol Garcia	Graphics - Cover and Chapter Dividers		NPS-23 yrs Visual Information Specialist
Veronica Maldonado	Ch 1, Introduction -Local and Regional Economies Contract Copying and Printing Distribution		NPS-13 Program Assistant
Haigler (Dusty) Pate	Ch 3, Tables 3.2, 3.3 and 3.4	BS-Biology	NPS-1 yr Range Technician
Xia Lily Zhou	Ch 3, Tables 3.2 and 3.4	BS-Wildlife and Fisheries Science	NPS-1 mo Environmental Engineering Intern BLM-3 mos Biological Science Technician
The following individuals provided contracted products and services:			
Chris Schenk R. Charpentier R. Corvelli and J.W. Schmoker	Appendix E, Remaining Oil and Gas Resources Beneath Big Thicket National Preserve		USGS, Denver, CO
Nancy Van Dyke	Ch 4, Environmental Consequences -Vegetation -Wetlands -Visitor Use and Experience -Comparative Analysis of the Proposed Action and Alternatives	BA-Biology/Geog. MS-Environmental Sciences	Environmental Consulting-20 yrs President, Van Dyke Environmental, LLC
Sue Winton Moss	Ch 3, Affected Environment -Ethnography	MA-History	Preservation Planning and Consulting

Name	Responsibility	Education	Years Related Experience
Peter Allen	Ch 3, Affected Environment -Soils	PhD-Geology	Professor of Engineering Geology and Hydrology, Baylor University Private Sector-25 yrs

CONSULTANTS

Big Thicket National Preserve
Art Hutchinson, Superintendent

Padre Island National Seashore
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Lake Meredith National Recreation Area/Alibates Flint Quarries National Monument
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Cay Ogden, Threatened and Endangered Species Coordinator

Office of Indian Affairs and American Culture
Dave Ruppert, Cultural Anthropologist, Ethnography Program

Planning and Environmental Quality
Chris Turk, Environmental Quality Officer

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APPENDICES A THROUGH I

BIBLIOGRAPHY

GLOSSARY

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APPENDIX A

ENABLING LEGISLATION FOR BIG THICKET NATIONAL PRESERVE

PUBLIC LAW 93-439,
As amended by: P.L. 94-578, P.L. 98-489, and P.L. 103-46

An Act to authorize the establishment of the Big Thicket National Preserve in the State of Texas, and for other purposes. (88 Stat. 1254) (P.L. 93-439)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) in order to assure the preservation, conservation, and protection of the natural, scenic, and recreational values of a significant portion of the Big Thicket area in the State of Texas and to provide for the enhancement and public enjoyment thereof, the Big Thicket National Preserve is hereby established.

(b) The Big Thicket National Preserve (hereafter referred to as the "preserve") shall include the units generally depicted on the map numbered NBR-BT 91,027 which shall be on file and available for public inspection in the offices of the National Park Service, Department of the Interior, Washington, District of Columbia, and shall be filed with appropriate offices of Tyler, Hardin, Jasper, Polk, Liberty, Jefferson, and Orange Counties in the State of Texas. The Secretary of the Interior (hereinafter referred to as the "Secretary") shall, as soon as practicable, but no later than six months after the date of enactment of this Act, publish a detailed description of the boundaries of the preserve in the Federal Register. In establishing such boundaries, the Secretary shall locate stream corridor unit boundaries referenced from the stream bank on each side thereof and he shall further make every reasonable effort to exclude from the units hereafter described any improved year-round residential properties which he determines, in his discretion, are not necessary for the protection of the values of the area or for its proper administration. The preserve shall consist of the following units:

Big Sandy Creek unit, Polk County, Texas, comprising approximately fourteen thousand three hundred acres;

Menard Creek Corridor unit, Polk, Hardin, and Liberty Counties, Texas, including a module at its confluence with the Trinity River, comprising approximately three thousand three hundred and fifty-nine acres;

Hickory Creek Savannah unit, Tyler County, Texas, comprising approximately six hundred and sixty-eight acres;

Turkey Creek unit, Tyler and Hardin Counties, Texas, comprising approximately seven thousand eight hundred acres;

Beech Creek unit, Tyler County, Texas, comprising approximately four thousand eight hundred and fifty-six acres;

Upper Neches River corridor unit, Jasper, Tyler, and Hardin Counties, Texas, including the Sally Withers Addition, comprising approximately three thousand seven hundred and seventy-five acres;

Neches Bottom and Jack Gore Baygall unit, Hardin and Jasper Counties, Texas, comprising approximately thirteen thousand three hundred acres;

Lower Neches River corridor unit, Hardin, Jasper, and Orange Counties, Texas, except for a one-mile segment on the east side of the river including the site of the papermill near Evadale, comprising approximately two thousand six hundred acres;

Beaumont unit, Orange, Hardin, and Jefferson Counties, Texas, comprising approximately six thousand two hundred and eighteen acres;

Loblolly unit, Liberty County, Texas, comprising approximately five hundred and fifty acres;

Little Pine Island-Pine Island Bayou corridor unit, Hardin and Jefferson Counties, Texas, comprising approximately two thousand one hundred acres;

Lance Rosier Unit, Hardin County, Texas, comprising approximately twenty-five thousand and twenty-four acres;

(c) The Secretary is authorized to acquire by donation, purchase with donated or appropriated funds, transfer from any other Federal agency, or exchange, any lands, waters, or interests therein which are located within the boundaries of the preserve: *Provided,* That any lands owned or acquired by the State of Texas, or any of its political subdivisions, may be acquired by donation only. After notifying the Committees on Interior and Insular Affairs of the United States Congress, in writing, of his intention to do so and of the reasons therefor, the Secretary may, if he finds that such lands would make a significant contribution to the purposes for which the preserve was created, accept title to any lands, or interests in lands, located outside of the boundaries of the preserve which the State of Texas or its political subdivisions may acquire and offer to donate to the United States or which any private person, organization, or public or private corporation may offer to donate to the United States and he may administer such lands as a part of the preserve after publishing notice to that effect in the Federal Register. Notwithstanding any other provision of law, any federally owned lands within the preserve shall, with the concurrence of the head of the administering agency, be transferred to the administrative jurisdiction of the Secretary for the purposes of this Act without transfer of funds.

Sec. 2. (a) The Secretary shall, immediately after the publication of the boundaries of the preserve, commence negotiations for the acquisition of the lands located therein: *Provided,* That he shall not acquire the mineral estate in any property or existing easements for public utilities, pipelines or railroads without the consent of the owner unless, in his judgment, he first determines that such property or estate is subject to, or threatened with, uses which are, or would be, detrimental to the purposes and objectives of this Act: *Provided further,* That the Secretary, insofar as is reasonably possible, may avoid the acquisition of improved properties, as defined in this Act, and shall make every effort to minimize the acquisition of land where he finds it necessary to acquire properties containing improvements.

(b) Within one year after the date of the enactment of this Act, the Secretary shall submit, in writing, to the Committee on Interior and Insular Affairs and to the Committees on Appropriations of the United States Congress a detailed plan which shall indicate:

(i) the lands and areas which he deems essential to the protection and public enjoyment of this preserve,

(ii) the lands which he has previously acquired by purchase, donation, exchange or transfer for administration for the purpose of this preserve, and

(iii) the annual acquisition program (including the level of funding) which he recommends for the ensuing five fiscal years.

(c) It is the express intent of the Congress that the Secretary should substantially complete the land acquisition program contemplated by this Act within six years after the date its enactment.

Sec. 3. (a) The owner of an improved property on the date of its acquisition by the Secretary may, as a condition of such acquisition, retain for himself and his heirs and assigns a right of use and occupancy of the improved property for noncommercial residential purposes for a definite term of not more than twenty-five years or, in lieu thereof, for a term ending at the death of the owner or the death of his spouse, whichever is later. The owner shall elect the term to be reserved. Unless this property is wholly or partially donated to the United States, the Secretary shall pay the owner the fair market value of the property on the date of acquisition less the fair market value, on that date, of the right retained by the owner. A right retained pursuant to this Section shall be subject to termination by the Secretary upon his determination that it is being exercised in a manner inconsistent with the purposes of this Act, and it shall terminate by operation of law upon the Secretary's notifying the holder of the right of such

determination and tendering to him an amount equal to the fair market value of that portion of the right which remains unexpired.

(b) As used in this Act, the term "improved property" means a detached, one family dwelling, construction of which was begun before July 1, 1973, which is used for noncommercial residential purposes, together with not to exceed three acres of land on, which the dwelling is situated and together with such additional lands or interests therein as the Secretary deems to be reasonably necessary for access thereto, such lands being in the same ownership as the dwelling, together with any structures accessory to the dwelling which are situated on such land.

(c) Whenever an owner of property elects to retain a right of use and occupancy as provided in this section, such owner shall be deemed to have waived any benefits or rights accruing under sections 203, 204, 205, and 206 of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (84 Stat. 1894), and for the purposes of such sections such owner shall not be considered a displaced person
as defined in section 101(6) of such Act.

Sec. 4.(a) The area within the boundaries depicted on the map referred to in section 1 shall be known as the Big Thicket National Preserve. Such lands shall be administered by the Secretary as a unit of the National Park System in a manner which will assure their
natural and ecological integrity in perpetuity in accordance with the provisions of this Act and with the provisions of the Act of August 25, 1916 (39 Stat. 535; 16 U.S.C. 1-4), as amended and supplemented.

(b) In the interest of maintaining the ecological integrity of the preserve, the Secretary shall limit the construction of roads, vehicular campgrounds, employee housing, and other public use and administrative facilities and he shall promulgate and publish such rules and regulations in the Federal Register as he deems necessary and appropriate to limit and control the use of, and activities on, Federal lands and waters with respect to:

(1) motorized land and water vehicles;

(2) exploration for, and extraction of, oil, gas, and other minerals;

(3) new construction of any kind;

(4) grazing and agriculture; and

(5) such other uses as the Secretary determines must be limited or controlled in order to carry out the purposes of this Act.

(c) The Secretary shall permit hunting, fishing, and trapping on lands and waters under his jurisdiction within the preserve in accordance with the applicable laws of the United States and the State of Texas, except that he may designate zones where and periods when, no hunting, fishing, trapping or entry may be permitted for reasons of public safety, administration, floral and faunal protection and management, or public use and enjoyment. Except in emergencies, any regulations prescribing such restrictions relating to hunting, fishing, or trapping shall be put into effect onlv after consultation with the appropriate State agency having jurisdiction over hunting, fishing, and trapping activities.

Sec. 5. Within five years from the date of enactment of this Act, the Secretary shall review the area within the preserve and shall report to the President, in accordance with section 3(c) and (d) of the Wilderness Act (78 Stat. 891; 16 U.S.C. 1132 (c) and (d)), his recommendations as to the suitability or nonsuitability of any area within the preserve for preservation as wilderness, and any designation of any such areas as a wilderness shall be accomplished in accordance with said subsections of the Wilderness Act.

Sec. 6. There are authorized to be appropriated such sums as may be necessary to carry out the provisions of this Act, but not to exceed $63,812,000 for the acquisition of lands and interests in lands and not to exceed 7,000,000 for development.

Approved October 11, 1974.

PUBLIC LAW 94-578

An Act to provide for increases in appropriation ceilings and boundary changes in certain units of the National Park System, and for other purposes. (90 Stat. 2732)

Be it enacted by the Senate and House of Representatives of the United States of American in Congress assembled,

TITLE III-MISCELLANEOUS PROVISIONS

BIG THICKET NATIONAL PRESERVE

SEC. 322. Section 3(b) of the Act of October 11, 1974 (88 Stat. 1254); 16 U.S.C. 698(b)), is amended by deleting "detached, one-family dwelling," and inserting in lieu thereof "detached, year-round one-family dwelling which serves as the owner's permanent place of abode at the time of acquisition.

Approved October 21, 1976.

PUBLIC LAW 98-489

An Act to provide for the acquisition of a visitor contact and administrative site for the Big Thicket National Preserve in the State of Texas. (98 Stat. 2267)

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) subsection (c) of the first section of the Act entitled "An Act to authorize the establishment of the Big Thicket National Preserve in the State of Texas, and for other purposes", approved October 11, 1974 (16 U.S.C. 698), is amended by inserting after the first sentence the following new sentence: "The Secretary may also acquire, by any of the above methods, approximately 15 acres of land outside of the boundaries of the preserve in the vicinity of the intersection of United States Highway 69 and State Farm-Market Road 420, in Hardin County, Texas, for purposes of a visitor contact and administrative site.".

(b) Section 6 of such Act is amended by inserting at the end thereof the following new sentence: "Effective October 1, 1984, there is authorized to be appropriated such sums as may be necessary for the acquisition of the visitor contact and administrative site referred to in subsection (c) of the first section of this Act."

Approved October 17, 1984.

PUBLIC LAW 103-46 JULY 1, 1993

An Act to increase the size of the Big Thicket National Preserve in the State of Texas by adding the Village Creek corridor unit, the Big Sandy corridor unit, and the Canyonlands unit. (107 Stat. 229)

Be it enacted by the Senate and House Representatives the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be referred to as the "Big Thicket National Preserve Addition Act of 1993".

SEC. 2. ADDITIONS TO THE BIG THICKET NATIONAL PRESERVE.

(a) ADDITIONS.-Subsection (b) of the first section of the Act entitled "An Act to authorize the establishment of the Big Thicket National Preserve in the State of Texas, and for other purposes", approved October 11, 1974 (16 U.S.C. 698), hereafter referred to as the "Act", is amended as follows:

(1) Strike out "map entitled 'Big Thicket National Preserve'" and all that follows through "Secretary of the Interior (hereafter referred to as the 'Secretary')" and insert in lieu thereof "map entitled 'Big Thicket National Preserve', dated October 1992, and numbered 175-0008, which shall be on file and available for public inspection in the offices of the National Park Service, Department of the Interior, and the offices of the Superintendent of the preserve. After advising the Committee on Energy and Natural Resources of the United States Senate and the Committee on Natural Resources of the United States House of Representatives, in writing, the Secretary of the Interior (hereafter referred to as the 'Secretary') may make minor revisions of the boundaries of the preserve when necessary by publication of a revised drawing or other boundary description in the Federal Register. The Secretary".

(2) Strike out "and" at the end of the penultimate undesignated paragraph relating to Little Pine Island-Pine Island Bayou corridor unit.

(3) Strike out the period in the ultimate undesignated paragraph relating to Lance Rosier unit and insert in lieu thereof ";"

(4) Add at the end thereof the following:

"Village Creek Corridor unit, Hardin County, Texas, comprising approximately four thousand seven hundred and ninety-three acres;

"Big Sandy Corridor unit, Hardin, Polk, and Tyler Counties, Texas, comprising approximately four thousand four hundred and ninety-seven acres; and

"Canyonlands unit, Tyler County, Texas, comprising approximately one thousand four hundred and seventy-six acres."

(b) ACQUISITION.–(1) Subsection (c) of the first section of such Act is amended by striking out the first sentence and inserting in lieu thereof the following: "The Secretary is authorized to acquire by donation, purchase with donated or appropriated funds, transfer from any other Federal agency, or exchange, any lands, waters, or interests therein which are located within the boundaries of the preserve: *Provided*, That privately owned lands located within the Village Creek Corridor, Big Sandy Corridor, and Canyonlands units may be acquired only with the consent of the owner: *Provided further*, That the Secretary may acquire lands owned by commercial timber companies only by donation or exchange: *Provided further*, That any lands owned by the State of Texas, or any political subdivisions thereof may be acquired by donation only."

(2) Add at the end of the first section of such Act the following new subsections:

"(d) Within sixty days after the date of enactment of this subsection, the Secretary and the Secretary of Agriculture shall identify lands within their jurisdiction located within the vicinity of the preserve which may be suitable for exchange for commercial timber lands within the preserve. In so doing, the Secretary of Agriculture shall seek to identify for exchange National Forest lands that are near or adjacent to private lands that are already owned by the commercial timber companies. Such National Forest lands shall be located in the Sabine National Forest in Sabine County, Texas, in the Davy Crockett National Forest south of Texas State Highway 7, or in other sites deemed mutually agreeable, and within reasonable distance of the timber companies' existing mills. In exercising this exchange authority, the Secretary and the Secretary of Agriculture may utilize any authorities or procedures otherwise available to them in connection with land exchanges, and which are not inconsistent with the purposes of this Act. Land exchanges authorized pursuant to this subsection shall be of equal value and shall be completed as soon as possible, but no later than two years after date of enactment of this subsection.

"(e) With respect to the thirty-seven-acre area owned by the Louisiana-Pacific Corporation or its subsidiary, Kirby Forest Industries, Inc., on Big Sandy Creek in Hardin County, Texas, and now utilized as part of the Indian Springs Youth Camp (H.G. King Abstract 822), the Secretary shall not acquire such area without the consent of the owner so long as the area is used exclusively as a

youth camp."

(c) PUBLICATION OF BOUNDARY DESCRIPTION.-Not later than six months after the date of enactment of this subsection, the Secretary shall publish in the Federal Register a detailed description of the boundary of the Village Creek Corridor unit, the Big Sandy Corridor unit, and the Canyonlands unit of the Big Thicket National Preserve.

(d) AUTHORIZATION OF APPROPRIATIONS.--Section 6 of such Act is amended by adding at the end thereof the following new sentence: "Effective upon date of enactment of this sentence, there is authorized to be appropriated such sums as may be necessary to carry out the purposes of subsections (c) and (d) of the first section."

Approved July 1, 1993.

APPENDIX B

NATIONAL PARK SERVICE
NONFEDERAL OIL AND GAS RIGHTS REGULATIONS
36 CFR 9B

Subpart--B--Non-Federal Oil and Gas Rights

AUTHORITY: Act of August 25, 1916, 39 Stat. 535 (16 U.S.C. 1, et seq.); and the acts establishing the units of the National Park System, including but not limited to: Act of April 25, 1947, 61 Stat. 54 (16 U.S.C. 241, et seq.); Act of July 2, 1958, 72 Stat. 285 (16 U.S.C. 410, et seq.); Act of October 27, 1972, 86 Stat. 1312 (16 U.S.C. 460dd, et seq.); Act of October 11,1974, 88 Stat. 1256 (16 U.S.C. 698-698e); Act of October 11, 1974, 88 Stat. 1258 (16 U.S.C. 698f-698m); Act of December 27,1974, 88 Stat. 1787 (16 U.S.C. 460ff et seq.).

SOURCE: 43 FR 57825, Dec. 8, 1978, unless otherwise noted.

§ 9.30 Purpose and scope.

(a) These regulations control all activities within any unit of the National Park System in the exercise of rights to oil and gas not owned by the United States where access is on, across or through federally owned or controlled lands or waters. Such rights arise most frequently in one of two situations: (1) When the land is owned in fee, including the right to the oil and gas, or (2) When in a transfer of the surface estate to the United States, the grantor reserved the rights to the oil and gas. These regulations are designed to insure that activities undertaken pursuant to these rights are conducted in a manner consistent with the purposes for which the National Park System and each unit thereof were created, to prevent or minimize damage to the environment and other resource values, and to insure to the extent feasible that all units of the National Park System are left unimpaired for the enjoyment of future generations.

These regulations are not intended to result in the taking of a property interest, but rather to impose reasonable regulations on activities which involve and affect federally-owned lands.

(b) Regulations controlling the exercise of minerals rights obtained under the Mining Law of 1872 in units of the National Park System can be found at 36 CFR Part 9, Subpart A. In area [sic] where oil and gas are owned by the United States, and leasing is authorized, the applicable regulations can be found at 43 CFR, Group 3100.

(c) These regulations allow operators the flexibility to design plans of operations only for that phase of operations contemplated. Each plan need only describe those functions for which the operator wants immediate approval. For instance, it is impossible to define, at the beginning of exploratory activity, the design that production facilities might take. For this reason, an operator may submit a plan which applies only to the exploratory phase, allowing careful preparation of a plan for the production phase after exploration is completed. This allows for phased reclamation and bonding at a level commensurate with the level of operations approved. However, it must be noted that because of potential cumulative impacts, and because of qualitative differences in the nature of the operations, approval of a plan of operations covering one phase of operations does not guarantee later approval of a plan of operations covering a subsequent phase.
[43 FR 57825, Dec. 8, 1978, as amended at 44 FR 37914, June 29, 1979]

§ 9.31 Definitions.

The terms used in this Subpart shall have the following meanings:

(a) *Secretary.* The Secretary of the Interior.

(b) *Director.* The Director of the National Park Service or his designee.

(c) *Operations.* All functions, work and activities within a unit in connection with exploration for and development of oil and gas resources, the right to which is not owned by the United States, including: gathering basic information required to comply with this Subpart, prospecting, exploration, surveying, preproduction development and production; gathering, onsite storage, transport or processing of petroleum products; surveillance, inspection, monitoring, or maintenance of equipment; reclamation of the surface disturbed by such activities; and all activities and uses reasonably incident thereto performed within a unit, including construction or use of roads, pipelines, or other means of access or transportation on, across, or through federally owned or controlled lands and waters, regardless of whether such activities and uses take place on Federal, State or private lands.

(d) *Operator.* A person conducting or proposing to conduct operations.

(e) *Person.* Any individual, firm, partnership, corporation, association, or other entity.

(f) *Superintendent.* The Superintendent, or his designee, of the unit of the National Park System containing lands subject to the rights covered by these regulations.

(g) *Commercial Vehicle.* Any motorized equipment used in direct or indirect support of operations.

(h) *Unit.* Any National Park System area.

(i) *Owner.* The owner, or his legal representative, of the rights to oil and gas being exercised.

(j) *Regional Director.* The Regional Director, or his designee, for the National Park Service region in which the given unit is located.

(k) *Designated Roads.* Those existing roads determined by the Superintendent in accordance with 36 CFR 1.5 and § 4.19 to be open for the use of the general public or for the exclusive use of an operator.

(1) *Oil.* Any viscous combustible liquid hydrocarbon or solid hydrocarbon substance easily liquifiable on warming which occurs naturally in the earth, including drip gasoline or other natural condensates recovered from gas without resort to manufacturing process.

(m) *Gas.* Any fluid, either combustible or noncombustible, which is produced in a natural state from the earth and which maintains a gaseous or rarefied state at ordinary temperature and pressure conditions.

(n) *Site.* Those lands or waters on which operations are to be carried out.

(o) *Contaminating substances.* Those substances, including but not limited to, salt water or any other injurious or toxic chemical, waste oil or waste emulsified oil, basic sediment, mud with injurious or toxic additives, or injurious or toxic substances produced or used in the drilling, development, production, transportation, or on-site storage, refining, and processing of oil and gas.

(p) *Statement for Management.* A National Park Service planning document used to guide short- and long-term management of a unit; to determine the nature and extent of planning required to meet the unit's management objectives; and, in the absence of more specific planning documents, to provide a general framework for directing park operations and communicating park objectives to the public.

[43 F R 57825, Dec. 8, 1978: 44 FR 37914, June 29, 1979, as amended at 60 FR 55791, 11/3/95; 62 FR 30234, 6/3/97]

§ 9.32 Access.

(a) No access on, across or through lands or waters owned or controlled by the United States to a site for operations will be granted except for operations covered by § 9.33 and, except as provided by § 9.38, until the operator has filed a plan of operations pursuant to § 9.36 and has had the plan of operations approved in accordance with § 9.37. An approved plan of operations serves as the operator's access permit.

(b) No operations shall be conducted on a site within a unit, access to which is on, across or through federally owned or controlled lands or waters except in accordance with an approved plan of operations, the terms of § 9.33 or approval under § 9.38.

(c) Any operator intending to use aircraft of any kind for access to a federally-owned or controlled site must comply with these regulations. Failure of an operator to receive the proper approval under these regulations prior to using aircraft in this manner is a violation of both these regulations and 36 CFR 2.17.

(d) No access to a site outside a unit will be permitted across unit lands unless such access is by foot, pack animal, or designated road. Persons using designated roads for access to such a site must comply with the terms of § 9.50 where applicable.

(e) Any operator on a site outside the boundaries of a unit must comply with these regulations if he is using directional drilling techniques which result in the drill hole crossing into the unit and passing under any land or water the surface of which is owned by the United States. Except, that the operator need not comply in those areas where, upon application of the operator or upon his own action, the Regional Director is able to determine from available data, that such operations pose no significant threat of damage to park resources, both surface and subsurface, resulting from surface subsidence fracture of geological formations with resultant fresh water aquifer contamination, or natural gas escape, or the like.

§ 9.33 Existing operations.

(a) Any person conducting operations on January 8, 1979 in accordance with a Federal or State issued permit may continue to do so as provided by this section. After expiration of such existing permits no operations shall be conducted except under an approved plan of operations, unless access is granted by the Regional Director under § 9.38.

(1) All Federal special use permits dealing with access on, across or through lands or waters owned or controlled by the United States to a site for the conduct of operations within any unit issued

prior to January 8, 1979 shall expire according to their terms and shall not be renewed, unless by the terms of the existing permit it must be renewed.

(2) All operations on a site in a unit access to which is on, across, or through federally owned or controlled lands or waters conducted pursuant to a valid State access permit may be continued for the term of that permit, exclusive of any renewal period whether mandatory or discretionary, if conducted in accordance with the permit.

(b) Any person conducting operations on January 8, 1979 in a unit where Federal or State permits were not required prior to January 8, 1979 may continue those operations pending a final decision on his plan of operations; *Provided,* That:

(1) The operator (within thirty (30) days of January 8, 1979), notifies the Superintendent in writing of the nature and location of the operations; and

(2) Within sixty (60) days after such notification, the operator submits, in accordance with these regulations, a substantially complete proposed plan of operations for those operations;

(3) Failure to comply with § 9.33(b) (1) and (2) shall constitute grounds for the suspension of operations.

(c) At any time when operations which are allowed to continue under § 9.33 (a) and (b) pose an immediate threat of significant injury to federally owned or controlled lands or waters, the Superintendent shall require the operator to suspend operations immediately until the threat is removed or remedied. The Superintendent must, within five (5) days of this suspension notify the operator in writing of the reasons for the suspension and of his right to appeal the suspension under § 9.48 [sic. Should be § 9.49.].

[43 FR 57825, Dec. 8, 1978; 44 FR 37914, June 29, 1979]

§ 9.34 Transfers of interest.

(a) Whenever an owner of rights being exercised under an approved plan of operations sells, assigns, bequeaths, or otherwise conveys all or any part of those rights, he, his agent, executor, or representative must notify the Superintendent within sixty (60) days of the transfer of: the site(s) involved; the name and address of the person to whom an interest has been conveyed; and a description of the interest transferred. Failure to so notify the Superintendent shall render the approval of any previously approved plan of operations void.

(b) The transferring owner shall remain responsible for compliance with the plan of operations and shall remain liable under his bond until such time as the Superintendent is notified of the transfer in accordance with paragraph (a). At that time the Superintendent will prohibit the new owner from operating until such time as the new owner has filed with the Superintendent: (1) A statement ratifying the existing plan of operations and stating his intent to be bound thereby, or a new plan of operations, and (2) a suitable substitute performance bond which complies with the requirements of § 9.48.

§ 9.35 Use of water.

No operator may use for operations any water from a point of diversion which is within the boundaries of any unit unless authorized in writing by the Regional Director. The Regional Director shall not approve a plan of operations requiring the use of water from such source unless the operator shows either that his right to the use of the water is superior to any claim of the United States to the water, or where the operator's claim to the water is subordinate to that of the United States that the removal of

the water from the water system will not damage the unit's resources. In either situation, the operator's use of water must comply with appropriate State water laws.

§ 9.36 Plan of operations.

(a) The proposed plan of operations shall include, as appropriate to the proposed operations, the following:

(1) The names and legal addresses of the following persons: The operator and the owner(s) or lessee(s) (if rights are State-owned) other than the operator;

(2) Copy of the lease, deed, designation of operator, or assignment of rights upon which the operator's right to conduct operations is based;

(3) A map or maps showing the location of the perimeter of the area where the operator has the right to conduct operations, as described in § 9.36(a)(2), referenced to the State plane coordinate system or other public land survey as acceptable to the Superintendent;

(4) A map or maps showing the location, as determined by a registered land surveyor or civil engineer, of a point within a site of operations showing its relationship to the perimeter of the area described in § 9.36(a)(2) and to the perimeter of the site of operations; the location of existing and proposed access roads or routes to the site; the boundaries of proposed surface disturbance; the location of proposed drilling; location and description of all surface facilities including sumps, reserve pits and ponds; location of tank batteries, production facilities and gathering, service and transmission lines; wellsite layout; sources of construction materials such as fill; and the location of ancillary facilities such as camps, sanitary facilities, water supply and disposal facilities, and airstrips. The point within the site of operations identified by registered land surveyor or civil engineer shall be marked with a permanent ground monument acceptable to the Superintendent, shall contain the point's State plane coordinate values, and shall be placed at least to an accuracy of third order, class I, unless otherwise authorized by the Superintendent;

(5) A description of the major equipment to be used in the operations, including a description of equipment and methods to be used for the transport of all waters used in or produced by operations, and of the proposed method of transporting such equipment to and from the site;

(6) An estimated timetable for any phase of operations for which approval is sought and the anticipated date of operation completion;

(7) The geologic name of the surface formation;

(8) The proposed drilling depth, and the estimated tops of important geologic markers;

(9) The estimated depths at which anticipated water, brines, oil, gas, or other mineral bearing formations are expected to be encountered;

(10) The nature and extent of the known deposit or reservoir to be produced and a description of the proposed operations, including:

(i) The proposed casing program, including the size, grade, and weight of each string, and whether it is new or used;

(ii) The proposed setting depth of each casing string, and the amount of type of cement, including additives, to be used;

(iii) The operator's minimum specifications for pressure control equipment which is to be used, a schematic diagram thereof showing sizes, pressure ratings, and the testing procedures and testing frequency;

(iv) The type and characteristics of the proposed circulating medium or mediums to be employed for rotary drilling and the quantities and types of mud and weighting material to be maintained;

(v) The testing, logging, and coring programs to be followed;

(vi) Anticipated abnormal pressures or temperatures expected to be encountered; or potential hazards to persons and the environment such as hydrogen sulfide gas or oil spills, along with plans for mitigation of such hazards;

(11) A description of the steps to be taken to comply with the applicable operating standards of § 9.41 of this subpart;

(12) Provisions for reclamation which will result in compliance with the requirements of § 9.39:

(13) A breakdown of the estimated costs to be incurred during the implementation of the reclamation plan;

(14) Methods for disposal of all rubbish and other solid and liquid wastes, and contaminating substances;

(15) An affidavit stating that the operations planned are in compliance with all applicable Federal, State and local laws and regulations

(16) Background information, including:

(i) A description of the natural, cultural, social and economic environments to be affected by operations, including a description and/or map(s) of the location of all water, abandoned, temporarily abandoned, disposal, production, and drilling wells of public record within a two-mile radius of the proposed site. Where such information is available from documents identified in § 9.36(d), specific reference to the document and the location within the document where such information can be found will be sufficient to satisfy this requirement;

(ii) The anticipated direct and indirect effects of the operations on the unit's natural, cultural, social, and economic environment;

(iii) Steps to be taken to insure minimum surface disturbance and to mitigate any adverse environmental effects, and a discussion of the impacts which cannot be mitigated;

(iv) Measures to protect surface and subsurface waters by means of casing and cement, etc.;

(v) All reasonable technologically feasible alternative methods of operations their costs, and their environmental effects, and

(vi) The effects of the steps to be taken to achieve reclamation;

(17) Any other facets of the proposed operations which the operator wishes to point out for consideration; and

(18) Any additional information that is required to enable the Superintendent to establish whether the operator has the right to conduct operations as specified in the plan of operations; to effectively analyze the effects that the operations will have on the preservation, management and public use of the unit, and to make a recommendation to the Regional Director regarding approval or disapproval of the plan of operations and the amount of the performance bond to be posted.

(b) Where any information required to be submitted as part of a proposed plan of operations has been submitted to the Superintendent in substantially the same form in a prior approved plan of operations, a specific cross-reference to that information contained in the prior approved plan of operations will be sufficient to incorporate it into the proposed plan and will satisfy the applicable requirement of this section.

(c) Information and materials submitted in compliance with this section will not constitute a plan of operations until information required by § 9.36(a) (1) through (18), which the Superintendent determines as pertinent to the type of operations proposed, has been submitted to and determined adequate by the Regional Director.

(d) In all cases the plan of operations must consider and discuss the unit's Statement for Management and other planning documents as furnished by the Superintendent, and activities to control, minimize or prevent damage to the recreational, biological physical, scientific, cultural, and scenic resources of the unit, and any reclamation procedures suggested by the Superintendent.

[43 FR 57825, Dec. 8, 1978; 44 FR 37914, June 29, 1979]

§ 9.37 Plan of operations approval.

(a) The Regional Director shall not approve a plan of operations:

(1) Until the operator shows that the operations will be conducted in a manner which utilizes technologically feasible methods least damaging to the federally-owned or controlled lands, waters and resources of the unit while assuring the protection of public health and safety.

(2) For operations at a site the surface estate of which is not owned by the federal government, where operations would constitute a nuisance to federal lands or waters in the vicinity of the operations, would significantly injure federally-owned or controlled lands and waters; or

(3) For operations at a site the surface estate of which is owned or controlled by the federal government, where operations would substantially interfere with management of the unit to ensure the preservation of its natural and ecological integrity in perpetuity, or would significantly injure the federally-owned or controlled lands or waters; *Provided, however,* That if the application of this standard would under applicable law, constitute a taking of a property interest rather than an appropriate exercise of regulatory authority, the plan of operations may be approved if the operations would be conducted in accordance with paragraph (a)(1) of this section, unless a decision is made to acquire the mineral interest.

(4) Where the plan of operations does not satisfy each of the requirements of § 9.36 applicable to the operations proposed.

(b) Within sixty (60) days of the receipt of a plan of operations, the Regional Director shall make an environmental analysis of such plan, and:

(1) Notify the operator that the plan of operations has been approved or rejected, and, if rejected, the reasons for the rejection; or

(2) Notify the operator that the plan of operations has been conditionally approved, subject to the operator's acceptance of specific provisions and stipulations; or

(3) Notify the operator of any modification of the plan of operations which is necessary before such plan will be approved or of additional information needed to effectively analyze the effects that the operations will have on the preservation, management and use of the unit, and to make a decision regarding approval or disapproval of the plan of operations and the amount of the performance bond to be posted; or

(4) Notify the operator that the plan of operations is being reviewed, but that more time, not to exceed an additional thirty days, is necessary to complete such review, and setting forth the reasons why additional time is required. *Provided, however,* That days during which the area of operations is inaccessible for such reasons as inclement weather, natural catastrophe acts of God, etc., for inspection shall not be included when computing either this time period, or that in subsection (b) above; or

(5) Notify the operator that the plan of operations has been reviewed, but cannot be considered for approval until forty-five (45) days after a final environmental statement has been prepared and filed with the Environmental Protection Agency; or

(6) Notify the operator that the plan of operations is being reviewed, but that more time to provide opportunities for public participation in the plan of operations review and to provide sufficient time to analyze public comments received is necessary. Within thirty (30) days after closure of the public comment period specified by the Regional Director, he shall comply with § 9.37(b) (1) through (5).

(c) The Regional Director shall act as expeditiously as possible upon a proposed plan of operations consistent with the nature and scope of the operations proposed. Failure to act within the time limits specified in this section shall constitute a rejection of the plan of operations from which the operator shall have a right to appeal under § 9.49.

(d) The Regional Director's analysis shall include:

(1) An examination of all information submitted by the operator;

(2) An evaluation of measures and timing required to comply with reclamation requirements;

(3) An evaluation of necessary conditions and amount of the bond or security deposit (See § 9.48);

(4) An evaluation of the need for any additional requirements in the plan;

(5) A determination regarding the impact of this operation and cumulative impacts of all proposed and existing operations on the management of the unit; and

(6) A determination whether implementation by the operator of an approved plan of operations would be a major Federal action significantly affecting the quality of the human environment or would be sufficiently controversial to warrant preparation of an environmental statement pursuant to section 102(2)(c) of the National Environmental Policy Act of 1969.

(e) Prior to approval of a plan of operations, the Regional Director shall determine whether any properties included in, or eligible for inclusion in the National Register of Historic Places or National Registry of Natural Landmarks may be affected by the proposed operations. This determination will require the acquisition of adequate information, such as that resulting from field surveys, in order to properly determine the presence and significance of cultural resources within the areas to be affected by operations. Whenever National Register properties or properties eligible for inclusion in the National Register would be affected by operations, the Regional Director shall comply with Section 106 of the Historic Preservations Act of 1966 as implemented by 36 CFR Part 800.

(f) Approval of each plan of operations is expressly conditioned upon the Superintendent having such reasonable access to the site as is necessary to properly monitor and insure compliance with the plan of operations.

[43 FR 57825, Dec. 8, 1978; 44 FR 37914, June 29, 1979]

§ 9.38 Temporary approval.

(a) The Regional Director may approve on a temporary basis:

(1) Access on, across or through federally-owned or controlled lands or waters for the purpose of collecting basic information necessary to enable timely compliance with these regulations. Such temporary approval shall be for a period not in excess of sixty (60) days.

(2) The continuance of existing operations, if their suspension would result in an unreasonable economic burden or injury to the operator; provided that such operations must be conducted in accordance with all applicable laws, and in a manner prescribed by the Regional Director designed to minimize or prevent significant environmental damage; and provided that within sixty (60) days of the granting of such temporary approval the operator either:

(i) Submits an initial substantially complete plan of operations; or

(ii) If a proposed plan of operations has been submitted, responds to any outstanding requests for additional information.

(b) The Regional Director may approve new operations on a temporary basis only when:

(1) The Regional Director finds that the operations will not cause significant environmental damage or result in significant new or additional surface disturbance to the unit; and either

(2) The operator can demonstrate a compelling reason for the failure to have had timely approval of a proposed plan of operations; or

(3) The operator can demonstrate that failure to grant such approval will result in an unreasonable economic burden or injury to the operator.

[43 FR 57825, Dec. 8, 1978, as amended at 44 FR 37914, June 29, 1979]

§ 9.39 Reclamation requirements.

(a) Within the time specified by the reclamation provisions of the plan of operations, which shall be as soon as possible after completion of approved operations and shall not be later than six (6) months thereafter unless a longer period of time is authorized in writing by the Regional Director, each operator shall initiate reclamation as follows:

(1) Where the Federal government does not own the surface estate. the operator shall at a minimum:

(i) Remove or neutralize any contaminating substances; and

(ii) Rehabilitate the area of operations to a condition which would not constitute a nuisance or would not adversely affect, injure, or damage federally-owned lands or waters, including removal of above ground structures and equipment used for operations, except that such structures and equipment may remain where they are to be used for continuing operations which are the subject of another approved plan of operations or of a plan which has been submitted for approval.

(2) On any site where the surface estate is owned or controlled by the Federal government, each operator must take steps to restore natural conditions and processes. These steps shall include but are not limited to:

(i) Removing all above ground structures, equipment and roads used for operations, except that such structures, equipment and roads may remain where they are to be used for continuing operations which are the subject of another approved plan of operations or of a plan which has been submitted for approval, or unless otherwise authorized by the Regional Director consistent with the unit purpose and management objectives;

(ii) Removing all other man-made debris resulting from operations;

(iii) Removing or neutralizing any contaminating substances;

(iv) Plugging and capping all nonproductive wells and filling dump holes, ditches, reserve pits and other excavations;

(v) Grading to reasonably conform the contour of the area of operations to a contour similar to that which existed prior to the initiation of operations, where such grading will not jeopardize reclamation;

(vi) Replacing the natural topsoil necessary for vegetative restoration; and

(vii) Reestablishing native vegetative communities.

(b) Reclamation under paragraph (a)(2) of this section is unacceptable unless it provides for the safe movement of native wildlife, the reestablishment of native vegetative communities, the normal flow of surface and reasonable flow of subsurface waters, and the return of the area to a condition which does not jeopardize visitor safety or public use of the unit.

§ 9.40 Supplementation or revision of plan of operations.

(a) A proposal to supplement or revise an approved plan of operations may be made by either the operator or the Regional Director to adjust the plan to changed conditions or to address conditions not previously contemplated by notifying the appropriate party in writing of the proposed alteration and the justification therefore.

(b) Any proposed supplementation or revision of a plan of operations initiated under paragraph (a) of this section by either party shall be reviewed and acted on by the Regional Director in accordance with § 9.37. If failure to implement proposed changes would not pose an immediate threat of significant injury to federally-owned or controlled lands or waters, the operator will be notified in writing sixty (60) days prior to the date such changes become effective, during which time the operator may submit comments on proposed changes. If failure to implement proposed changes

would pose immediate threat of significant injury to federally-owned or controlled lands or waters, the provisions of § 9.33(c) apply.

§ 9.41 Operating standards.

The following standards shall apply to operations within a unit:

(a) Surface operations shall at no time be conducted within 500 feet of the banks of perennial, intermittent or ephemeral watercourses; or within 500 feet of the high pool shoreline of natural or man-made impoundments; or within 500 feet of the mean high tide line; or within 500 feet of any structure or facility (excluding roads) used for unit interpretation, public recreation or for administration of the unit unless specifically authorized by an approved plan of operations.

(b) The operator shall protect all survey monuments, witness corners, reference monuments and bearing trees against destruction, obliteration, or damage from operations and shall be responsible for the reestablishment, restoration, or referencing of any monuments, corners and bearing trees which are destroyed, obliterated, or damaged by such operations.

(c) Whenever drilling or producing operations are suspended for 24 hours or more, but less than 30 days, the wells shall be shut in by closing wellhead valves or blowout prevention equipment. When producing operations are suspended for 30 days or more, a suitable plug or other fittings acceptable to the Superintendent shall be used to close the wells.

(d) The operator shall mark each and every operating derrick or well in a conspicuous place with his name or the name of the owner, and the number and location of the well, and shall take all necessary means and precautions to preserve these markings.

(e) Around existing or future installations, e.g., well, storage tanks, all high pressure facilities, fences shall be built for protection of unit visitors and wildlife, and protection of said facilities unless otherwise authorized by the Superintendent. Fences erected for protection of unit visitors and wildlife shall be of a design and material acceptable to the Superintendent, and where appropriate, shall have at least one gate which is of sufficient width to allow access by fire trucks. Hazards within visitor use areas will be clearly marked with warning signs acceptable to the Superintendent.

(f) The operator shall carry on all operations and maintain the site at all times in a safe and workmanlike manner, having due regard for the preservation of the environment of the unit. The operator shall take reasonable steps to prevent and shall remove accumulations of oil or other materials deemed to be fire hazards from the vicinity of well locations and lease tanks, and shall remove from the property or store in an orderly manner all scrap or other materials not in use.

(g) Operators will be held fully accountable for their contractor's or subcontractor's compliance with the requirements of the approved plan of operations.

[43 FR 57825, Dec. 8, 1978; 44 FR 37915, June 29, 1979]

§ 9.42 Well records and reports, plots and maps, samples, tests and surveys.

Any technical data gathered during the drilling of any well, including daily drilling reports and geological reports, which are submitted to the State pursuant to State regulations, or to any other bureau or agency of the Federal government shall be available for inspection by the Superintendent upon his request.

§ 9.43 Precautions necessary in areas where high pressures are likely to exist.

When drilling in "wildcat" territory, or in any field where high pressures are likely to exist, the operator shall take all necessary precautions for keeping the well under control at all times and shall install and maintain the proper high-pressure fittings and equipment to assure proper well control. Under such conditions the surface string must be cemented through its length, unless another procedure is authorized or prescribed by the Superintendent, and all strings of casing must be securely anchored.

§ 9.44 Open flows and control of "wild" wells.

The operator shall take all technologically feasible precautions to prevent any oil, gas, or water well from blowing open or becoming "wild," and shall take immediate steps and exercise due diligence to bring under control any "wild" well, or burning oil or gas well.

§ 9.45 Handling of wastes.

Oilfield brine, and all other waste and contaminating substances must be kept in the smallest practicable area, must be confined so as to prevent escape as a result of percolation, rain high water or other causes, and such wastes must be stored and disposed of or removed from the area as quickly as practicable in such a manner as to prevent contamination, pollution, damage or injury to the lands, water (surface and subsurface), facilities, cultural resources, wildlife, and vegetation of or visitors of the unit.

§ 9.46 Accidents and fires.

The operator shall take technologically feasible precautions to prevent accidents and fires, shall notify the Superintendent within 24 hours of all accidents involving serious personal injury or death, or fires on the site, and shall submit a full written report thereon within ninety (90) days. This report supersedes the requirement outlined in 36 CFR 2.17, but does not relieve persons from the responsibility of making any other accident reports which may be required under State or local laws.

§ 9.47 Cultural resource protection.

(a) Where the surface estate of the site is owned by the United States, the operator shall not, without written authorization of the Superintendent, injure, alter, destroy, or collect any site, structure, object, or other value of historical, archeological, or other cultural scientific importance in violation of the Antiquities Act (16 U.S.C. 431-433 (See 43 CFR Part 3)).

(b) Once approved operations have commenced, the operator shall immediately bring to the attention of the Superintendent any cultural or scientific resource encountered that might be altered or destroyed by his operation and shall leave such discovery intact until told to proceed by the Superintendent. The Superintendent will evaluate the discoveries brought to his attention, and will determine within ten (10) working days what action will be taken with respect to such discoveries.

§ 9.48 Performance bond.

(a) Prior to approval of a plan of operations, the operator shall be required to file a suitable performance bond with satisfactory surety, payable to the Secretary or his designee. The bond shall be conditioned upon faithful compliance with applicable regulations, and the plan of operations as approved, revised or supplemented. This performance bond is in addition to and not in lieu of any bond or security deposit required by other regulatory authorities.

(b) In lieu of a performance bond, an operator may elect to deposit with the Secretary or his designee, cash or negotiable bonds of the U.S. Government. The cash deposit or the market value of such securities shall be at least equal to the required sum of the bond. When bonds are to serve as security, there must be provided to the Secretary a power of attorney.

(c) In the event that an approved plan of operations is revised or supplemented in accordance with § 9.40, the Regional Director may adjust the amount of the bond or security deposit to conform to the modified plan of operations.

(d) The bond or security deposit shall be in an amount:

(1) Equal to the estimated cost of reclaiming the site, either in its entirety or in phases, that has been damaged or destroyed as a result of operations conducted in accordance with an approved, supplemented, plan of operations; plus

(2) An amount set by the Superintendent consistent with the type of operations proposed, to bond against the liability imposed by § 9.51(a); to provide the means for rapid and effective cleanup; and to minimize damages resulting from an oil spill, the escape of gas, wastes, contaminating substances, or fire caused by operations. This amount shall not exceed twenty-five thousand dollars ($25,000) for geophysical surveys when using more than one field party or five thousand dollars ($5,000) when operating with only one field party, and shall not exceed fifty thousand dollars ($50,000) for each wellsite or other operation.

(3) When an operator's total bond or security deposit with the National Park Service amounts to two hundred thousand dollars ($200,000) for activities conducted within a given unit, no further bond requirements shall be collected for additional activities conducted within that unit, and the operator may substitute a blanket bond of two hundred thousand dollars ($200,000) for all operations conducted within the unit.

(e) The operator's and his surety's responsibility and liability under the bond or security deposit shall continue until such time as the Superintendent determines that successful reclamation of the area of operations has occurred and, where a well has been drilled, the well has been properly plugged and abandoned. If all efforts to secure the operator's compliance with pertinent provisions of the approved plan of operations are unsuccessful, the operator's surety company will be required to perform reclamation in accordance with the approved plan of operations.

(f) Within thirty (30) days after determining that all reclamation requirements of an approved plan of operations are completed, including proper abandonment of the well, the Regional Director shall notify the operator that the period of liability under the bond or security deposit has been terminated.

[43 FR 57825, Dec. 8, 1978; 44 FR 37915 June 29, 1979]

§ 9.49 Appeals.

(a) Any operator aggrieved by a decision of the Regional Director in connection with the regulations in this Subpart may file with the Regional Director a written statement setting forth in detail the respects in which the decision is contrary to, or is in conflict with the facts, the law, or these regulations, or is otherwise in error. No such appeal will be considered unless it is filed with the Regional Director within thirty (30) days after the date of notification to the operator of the action or decision complained of. Upon receipt of such written statement from the aggrieved operator, the Regional Director shall promptly review the action or decision and either reverse his original decision or prepare his own statement, explaining that decision and the reasons therefor, and forward the statement and record on appeal to the Director for review and decision. Copies of the Regional

Director's statement shall be furnished to the aggrieved operator, who shall have thirty (30) days within which to file exceptions to the Regional Director's decision. The Department has the discretion to initiate a hearing before the Office of Hearing and Appeals in a particular case (See 43 CFR 4.700).

(b) The official files of the National Park Service on the proposed plan of operations and any testimony and documents submitted by the parties on which the decision of the Regional Director was based shall constitute the record on appeal. The Regional Director shall maintain the record under separate cover and shall certify that it was the record on which his decision was based at the time it was forwarded to the Director of the National Park Service. The National Park Service shall make the record available to the operator upon request.

(c) If the Director considers the record inadequate to support the decision on appeal, he may provide for the production of such additional evidence or information as may be appropriate, or may remand the case to the Regional Director, with appropriate instructions for further action.

(d) On or before the expiration of forty-five (45) days after his receipt of the exceptions to the Regional Director's decision, the Director shall make his decision in writing: provided however, that if more than forty-five (45) days are required for a decision after the exceptions are received, the Director shall notify the parties to the appeal and specify the reason(s) for delay. The decision of the Director shall include: (1) A statement of facts; (2) conclusions; and (3) reasons upon which the conclusions are based. The decision of the Director shall be the final administrative action of the agency on a proposed plan of operations.

(e) A decision of the Regional Director from which an appeal is taken shall not be automatically stayed by the filing of a statement of appeal. A request for a stay may accompany the statement of appeal or may be directed to the Director. The Director shall promptly rule on requests for stays. A decision of the Director on request for a stay shall constitute a final administrative decision.

(f) Where, under this Subpart, the Superintendent has the authority to make the original decision, appeals may be taken in the manner provided by this section, as if the decision had been made by the Regional Director, except that the original statement of appeal shall be filed with the Superintendent, and if he decides not to reverse his original decision, the Regional Director shall have, except as noted below, the final review authority. The only decision of a Regional Director under this paragraph which shall be appealable by the Director is an appeal from a suspension under § 9.51(b). Such an appeal shall follow the procedure of paragraphs (a)-(3) of this section.

[43 FR 57825, Dec. 8, 1978; 44 FR 37915, June 29, 1979]

§ 9.50 Use of roads by commercial vehicles.

(a) After January 8, 1978, no commercial vehicle shall use roads administered by the National Park Service without being registered with the Superintendent. Roads must be used in accordance with procedures outlined in an approved plan of operations.

(1) A fee shall be charged for such registration and use based upon a posted fee schedule. The fee schedule posted shall be subject to change upon sixty (60) days of notice.

(2) An adjustment of the fee may be made at the discretion of the Superintendent where a cooperative maintenance agreement is entered into with the operator.

(b) No commercial vehicle which exceeds roadway load limits specified by the Superintendent shall be used on roads administered by the National Park Service unless authorized in writing by the Superintendent, or unless authorized by an approved plan of operations.

(c) Should a commercial vehicle used in operations cause damage to roads, resources or other facilities of the National Park Service, the operator shall be liable for all damages so caused.

§ 9.51 Damages and penalties.

(a) The operator shall be held liable for any damages to federally-owned or controlled lands, waters, or resources resulting from his failure to comply with either his plan of operations, or where operations are continued pursuant to § 9.33, failure to comply with the applicable permit or, where operations are temporarily approved under § 9.38, failure to comply with the terms of that approval.

(b) The operator agrees, as a condition for receiving an approved plan of operations, that he will hold harmless the United States and its employees from any damages or claims for injury or death of persons and damage or loss of property by any person or persons arising out of any acts or omissions by the operator, his agents, employees or subcontractors done in the course of operations.

(c) Undertaking any operations within the boundaries of any unit in violation of this Subpart shall be deemed a trespass against the United States and shall be cause for revocation of approval of the plan of operations.

(1) When a violation by an operator under an approved plan of operations is discovered, and if it does not pose an immediate threat of significant injury to federally-owned or controlled lands or waters, the operator will be notified in writing by the Superintendent and will be given ten (10) days to correct the violation; if the violation is not corrected within ten (10) days approval of the plan of operations will be suspended until such time as the violation is corrected.

(2) If the violation poses an immediate threat of significant injury to federally-owned or controlled lands or waters, approval of the plan of operations will be immediately suspended until such time as the violation is corrected. The operator will be notified in writing within five (5) days of any suspension and shall have the right to appeal that decision under § 9.48 [sic. Should be §9.49.].

(3) Failure to correct any violation or damage to federally owned or controlled lands, waters or resources caused by such violations will result in revocation of plan of operations approval.

[43 FR 57825, Dec. 8, 1978; 44 FR 37915, June 29, 1979]

§ 9.52 Public inspection of documents.

(a) When a Superintendent receives a request for permission for access on, across or through federally-owned or controlled lands or waters for the purpose of conducting operations, the Superintendent shall publish a notice of this request in a newspaper of general circulation in the county(s) in which the lands are situated, or in such publications as deemed appropriate by the Superintendent.

(b) Upon receipt of the plan of operations in accordance with § 9.35(c) [sic. Should be § 9.36(c).], the Superintendent shall publish a notice in the FEDERAL REGISTER advising the availability of the plan for public review and comment. Written comments received within thirty (30) days will become a part of the official record. As a result of comments received or if otherwise deemed appropriate by the Superintendent, he may provide additional opportunity for public participation to review the plan of operations.

(c) Any document required to be submitted pursuant to the regulations in this Subpart shall be made available for public inspection at the office of the Superintendent during normal business hours, unless otherwise available pursuant to § 9.51(b) [sic. Should be § 9.52(b).]. This does not include

those records only made available for the Superintendent's inspection under § 9.41 [sic. Should be § 9.42.] of this Subpart or those records determined by the Superintendent to contain proprietary or confidential information. The availability of such records for inspection shall be governed by the rules and regulations found at 43 CFR Part 2.

[43 FR 57825, Dec. 8, 1978; 44 FR 37915, June 29, 1979]

APPENDIX C

FEDERAL LAWS, REGULATIONS, EXECUTIVE ORDERS, POLICIES, AND GUIDELINES THAT APPLY TO NONFEDERAL OIL AND GAS OPERATIONS

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This appendix summarizes many, but not all, of the legal and policy mandates that currently govern the exercise of nonfederal oil and gas rights in units of the National Park System. The first three laws pertain specifically to the National Park Service. They are followed by:

- Other federal laws and regulations, organized in alphabetical order,
- Executive orders, arranged in numerical order,
- NPS policies, guidelines, and procedures, and
- Selected Texas law and regulations.

This appendix supplements information presented in Table 1.1 of Chapter 1, and Parts II and III of Chapter 2. The following summaries are intended to acquaint the reader with many of the legal and policy requirements that apply to nonfederal oil and gas operations in the Preserve and are not meant as legal interpretations. They cannot be relied upon to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. Congress may change statutes and agencies may update their regulations and policies. During project planning, operators are responsible for ensuring they have current and complete information on legal and policy requirements for nonfederal oil and gas operations on NPS lands.

NATIONAL PARK SERVICE LAWS

NATIONAL PARK SERVICE ORGANIC ACT OF 1916, as amended, 16 U.S.C. §§ 1 *et seq.*

Resources afforded protection: all resources including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, endangered and threatened species, visitor use and experience, visual resources
Applicable regulation(s): 36 CFR Parts 1-10, 12-14, 20, 21, 25, 28, 30, 34, and 51

Through this Act, Congress established the National Park Service and mandated that it "shall promote and regulate the use of federal areas known as national parks, monuments…by such means and measures as conform to the fundamental purpose of said parks, monuments…which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Section 3 of the Organic Act provides the Secretary of Interior with the authority to adopt rules and regulations to govern the use and the management of park units. Through this provision of the Organic Act, the NPS promulgated regulations governing the exercise of nonfederal oil and gas rights at 36 CFR Part 9, Subpart B. The regulations at 36 CFR Part 9B control all activities during the exercise of rights to oil and gas not owned by the United States where access is on, across or through federally owned or controlled lands or waters within any NPS unit.

NPS does not intend the regulations to result in the taking of a property interest, but rather intends to impose reasonable regulations on activities that involve and affect federally owned lands. NPS designed the regulations to insure that operators conduct oil and gas activities in a manner consistent with the purposes for which Congress created the NPS unit. Likewise, the regulations prevent or minimize damage to the environment and other resource values and insure that all NPS units remain unimpaired for the enjoyment of future generations.

NATIONAL PARK SYSTEM GENERAL AUTHORITIES ACT, 16 U.S.C. §§ 1a-1 *et seq*.

Resources afforded protection: all resources, including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, endangered and threatened species, visitor use and experience, visual resources
Applicable regulation(s): 36 CFR Parts 1-199

This act affirmed that while all national park system units remain "distinct in character," they are "united through their interrelated purposes and resources into one national park system as cumulative expressions of a single national heritage." The purpose of this act was "to include all such areas in the system and to clarify the authorities applicable to the system." The act made it clear that the NPS Organic Act and other protective mandates apply equally to all units of the system. Further, amendments stated that NPS management of park units should not "derogat[e] . . . the purposes and values for which these various areas have been established."

NATIONAL PARK SERVICE OMNIBUS MANAGEMENT ACT of 1998, 16 U.S.C. §§ 5901 *et seq.*

Resources afforded protection: any living or non-living resource
Applicable regulation(s): none

This statute requires the Secretary of Interior to continually improve the NPS's ability to provide management, protection and interpretation of National Park System resources. The statute directs the NPS to manage the units by employing high quality science and information; to inventory the system's resources to create baseline information so that NPS can monitor and analyze future data to determine trends in the resources' conditions; and to use the results of the scientific studies for park management. In the oil and gas context, this requires operators to support their plans of operations with scientific data. Further, it requires the operators to monitor their operations area to ensure that their operations do not adversely impact the park's resources.

PARK SYSTEM RESOURCE PROTECTION ACT, 16 U.S.C. § 19jj

Resources afforded protection: any living or non-living resource that is located within the boundaries of a unit of the National Park System, except for resources owned by a nonfederal entity
Applicable regulation(s): none

The Park System Resource Protection Act makes any person who destroys, causes the loss of, or injures any park system resource strictly liable to the United States for response costs and for damages resulting from such destruction, loss, or injury. A park system resource includes any living

or non-living resource located within the boundaries of a NPS unit, except for resources owned by a non-federal entity. Because the statute imposes strict liability the only defenses arise when an act of god or war caused the damage, a third party who constituted neither an employee or nor an agent of the owner/operator caused solely the damage, or an activity authorized by federal or state law caused the damage.

The Park System Resources Protection Act authorizes the Secretary of the Interior to request the Department of Justice to file a civil action for the costs of replacing, restoring or acquiring the equivalent of a park system resource; the value of any use loss pending its restoration; replacement, or acquisition, the cost of damage assessments; and the cost of response including actions to prevent, to minimize, or to abate injury. Response costs include actions taken by the NPS "…to prevent or minimize destruction, loss of, or injury to park system resources; to abate or minimize the imminent risk of such destruction, loss or injury; or to monitor ongoing effects of incidents causing such destruction, loss or injury."

The Park System Resource Protection Act applies to nonfederal oil and gas activities on National Park System units. Operators need to make sure that they operate within the specifications of their approved 9B plan, comply with all other relevant legal requirements, and take precautions to avoid actions that may damage park system resources.

OTHER APPLICABLE FEDERAL LAWS AND REGULATIONS

AMERICAN INDIAN RELIGIOUS FREEDOM ACT, as amended, 42 U.S.C. §§ 1996 – 1996a

Resources afforded protection: cultural and historic resources
Applicable regulation(s): 43 CFR Part 7

This Act requires the federal government to protect and to preserve Native Americans', Eskimos', Aleuts', and Native Hawaiians' inherent right to believe, to express, and to exercise their traditional religions. It allows them to access, to use, and to possess sacred objects and gives them the freedom to worship through ceremonials and traditional rites. It further directs various federal departments, agencies, and other administrative bodies to evaluate their policies and procedures in consultation with native traditional religious leaders to determine changes necessary to protect and preserve Native American religious cultural rights and practices.

If NPS anticipates a conflict between proposed oil and gas operations and tribal religious rights, it will consult with the tribe as part of the 9B plan approval process. To ensure compliance with this Act, the NPS will consult with tribes during the Plan of Operations approval process.

ANTIQUITIES ACT OF 1906, 16 U.S.C. §§ 431 – 433

Resources afforded protection: cultural, historic, archeological and paleontological resources
Applicable regulation(s): 43 CFR Part 3

As the Archeological Resources Protection Act's forerunner, the Antiquities Act constituted the first general act providing protection for archeological resources. It protects all historic and prehistoric ruins or monuments on federal lands and prohibits their excavation, destruction, injury or appropriation without the departmental secretary's permission. It also authorizes the President of the United States' to proclaim as national monuments public lands having historic landmarks, historic and prehistoric structures, and other objects of historic or of scientific interest. The Antiquities Act also authorizes the President to reserve federal lands, to accept private lands, and to accept relinquishment of unperfected claims for that purpose.

The Act authorizes the departmental secretary to issue permits to qualified institutions to examine ruins, excavate archeological sites, and gather objects of antiquity. Regulations at 43 CFR Part 3 establish procedures for permitting the excavation or collection of prehistoric and historic objects on federal lands. ARPA permits replace Antiquities Act permits.

Operators who excavate, injure, destroy or appropriate any "object of antiquity" while engaging in mineral activities on federal lands without or contrary to an approved plan of operations violate the Antiquities Act and trigger its penalties.

ARCHAEOLOGICAL RESOURCES PROTECTION ACT OF 1979, 16 U.S.C. §§ 470aa – 470mm

Resources afforded protection: archeological resources
Applicable regulation(s): 18 CFR 1312; 32 CFR Part 229; 36 CFR Part 296; 43 CFR Part 7

Congress enacted the Archaeological Resources Protection Act (ARPA) to preserve and protect archeological resources and sites on federal and Indian lands. The law makes it illegal to excavate or to remove from federal or Indian lands any archeological resources without a permit from the federal land manager. It also prohibits the removal, sale, receipt, and interstate transportation of archeological resources obtained illegally (i.e., without permits) from federal or Indian lands.

Agencies may issue permits only to educational or to scientific institutions if the resulting activities will increase knowledge about archeological resources. The law defines archeological resources as material remains of past human life or activities that are of archeological interest and are at least 100 years old. All materials collected on federal lands as a result of permitted activities remain the property of the United States. Those excavated from Indian lands remain the property of the Indian or Indian tribe having rights of ownership over such resources. Congress amended the law to require development of plans for surveying public lands for archeological resources and of systems for reporting incidents of suspected violations.

ARPA also fosters cooperation between governmental authorities, professionals, and the public. The ARPA permit process ensures that individuals and organizations wishing to work with federal resources have the necessary professional qualifications and that these persons follow federal standards and guidelines for research and curation. The process allows the State Historic Preservation Officer (SHPO) to review and comment on ARPA permit applications. Federal agencies do not issue ARPA permits to themselves or to their contractors. The scope of work and contractor’s proposal, which constitute the contract, insures that contractors comply with federal standards and guidelines. The ARPA permit replaces the permit required by the Antiquities Act of 1906.

ARPA imposes severe criminal and civil penalties on anyone who excavates, removes, damages, or otherwise alters or defaces archeological resources without a permit. However, ARPA applies only to lands owned by the United States and lands held in trust by the United States for Indian tribes and individual Indians. ARPA does not apply on the nonfederal surface estate.

A contractor hired by an operator to conduct a cultural resource survey that involves any collection of archeological resources, whether or not excavation or subsurface testing is involved, must obtain an ARPA permit. Operations under an approved 9B plan do not need an ARPA permit for incidental disturbance of archeological resources because these operations occur exclusively for purposes other than excavation or removal of archeological resources. General earth-moving excavations performed under an approved plan of operations do not constitute "excavation or removal" of archeological resources. However, agencies require an ARPA permit before an operator under 36 CFR Part 9B salvages previously unknown archeological resources discovered during operations.

ARPA regulations appear at 43 CFR Part 7, Subparts A and B. Subpart A - "Protection of Archeological Resources, Uniform Regulations," promulgated pursuant to ARPA's section 10(a) jointly by the Secretaries of Interior, Agriculture, and Defense, and the Chairman of the Board of the Tennessee Valley Authority, establishes the uniform definitions, standards, and procedures that all federal land managers must follow when providing protection for archeological resources located on public and on Indian lands. Subpart B - "Department of the Interior Supplemental Regulations," provides definitions, standards, and procedures for federal land managers to protect archeological resources and provides further guidance for Interior bureaus concerning definitions, permitting procedures, and civil penalty hearings. In addition, NPS regulations at 36 CFR §9.47 discuss 9B plans and archeological resources.

Operators who remove, excavate, damage, alter, or deface archeological resources without or contrary to an approved plan of operations, while on federal property violate ARPA and trigger both its civil and criminal penalties.

CLEAN AIR ACT, as amended, 42 U.S.C. §§ 7401 – 7671q

Resources afforded protection: air resources
Applicable regulation(s): 40 CFR Parts 23, 50, 51, 52, 58, 60, 61, 82, and 93; and 48 CFR Part 23

The Clean Air Act (CAA) seeks to "protect and enhance" the quality of the nation's air resources; to promote the public health and welfare and the productive capacity of its population; to initiate and to accelerate a national research and development program to achieve the prevention and control of air pollution; to provide technical and financial assistance to State and local governments for aid in their development and execution of air pollution programs; and to encourage and to assist the development and the operation of regional air pollution control programs.

The Act requires the U.S. Environmental Protection Agency (EPA) to establish national primary standards to protect human health and more stringent national secondary standards to protect human welfare (National Ambient Air Quality Standards or NAAQS). The statute makes states and local governments responsible for the prevention or control of air pollution. NAAQS exist for sulfur dioxide, particulate matter, ozone, nitrogen dioxide, carbon monoxide, and lead.

Divided into air quality control regions, states must submit Implementation Plans for EPA approval. These plans provide strategies for the implementation, maintenance, and enforcement of national primary and secondary ambient air quality standards for each air quality control region.

Other provisions of the Act include: new source review permit programs, standards of performance for new stationary sources (NSPS), motor vehicle emission and fuel standards, national emission standards for hazardous air pollutants (NESHAPS), studies of particulate emissions from motor vehicles, studies of the cumulative effect of all substances and activities that may affect the stratosphere (especially ozone in the stratosphere), programs to Prevent Significant air quality Deterioration (PSD) in areas attaining the NAAQS, and programs to protect visibility in large national parks and wilderness areas.

All sources of air pollution, including publicly or privately owned facilities, must meet all federal, state, and local requirements under the CAA. In most cases, States and local authorities regulate air pollution control. For the National Park Service, the Prevention of Significant Deterioration of Air Quality (PSD) (42 U.S.C. §§ 7470-7475) and the Visibility Protection (42 U.S.C. § 7479) constitute the most important CAA sections.

The PSD provisions establish a classification system for the United States' clean air areas, which include those designated as Class I, Class II or Class III. National Park System units are designated as Class I or Class II areas. This classification indicates the additional increment of air quality

degradation from particulate matter, sulfur dioxide ($S0_2$), nitrogen dioxide (NO_2), allowed in that area. Class I areas may only degrade by a very small increment of new pollution while Class III areas can degrade substantially. There are currently no Class III areas designated in the country.

As part of the Prevention of Significant Deterioration (PSD) program, Congress designated many National Parks and wilderness areas (including U.S. Fish and Wildlife Service and U.S. Forest Service wilderness areas) mandatory Class I areas. Because states may not redesignate these areas, Congress provided those areas with maximum protection from future air quality degradation. EPA designated all other parts of the country where air quality did not violate the national ambient air quality standards Class II areas where moderate pollution increases may occur. States or Indian tribes may reclassify Class II areas as Class III, thus, allowing significant pollution increases. However, no entity can designate certain Class ll areas, such as national monuments and national recreation areas, as Class III but only Class II, or, at the option of the state, Class I.

Generally, the PSD rules apply only to major new or expanding facilities planning to locate or expand operations in clean air areas. An operator of a facility seeking a new source permit for location or for expansion in a clean air area must meet several requirements including National Ambient Air Quality Standards; PSD Classes I, II and III air pollution increments; and, a special "adverse impact determination" for Class I areas.

To protect the scenic value of visibility in National Parks and wilderness areas, Congress established a national visibility goal in section 169A of the CAA. Congress stated the agencies' goals as "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I federal areas which impairment results from manmade air pollution". Under current EPA regulations, the thirty-six states, including Texas, with mandatory Class I areas must assure reasonable progress toward the national visibility goal with respect to impairment reasonably attributed to major stationary sources of air pollution. EPA reviews new major stationary sources under permitting programs (i.e., PSD and nonattainment area new source review) to assure visibility protection of Class I areas from potential future emissions.

These permitting programs also require that new major sources analyze visibility and other air quality impacts in the general area affected by the new source's emissions regardless of the classification of the area as Class I or Class II. If oil and gas development and operations result in major emissions of air pollutants as defined in PSD and nonattainment area permitting provisions, then such major emitting facilities would need to comply with these requirements as well as any other applicable, federal, state, and local air quality rules and regulations. EPA issued new regulations in July 1999 to address visibility impairment caused by regional haze, but implementation of this program will not occur for several more years.

One particular issue that must be addressed concerns conformity with the Texas ozone nonattainment area State Implementation Plan (SIP). The Clean Air Act Amendments of 1990 required EPA to promulgate rules to ensure that federal actions conform to appropriate nonattainment area SIPs. These rules prohibit federal agencies from taking any action that causes or contributes to any new violation of the NAAQS, increases the frequency or severity of an existing violation, or delays the timely attainment of a standard. The NPS will need to make a conformity determination for any oil and gas permitting decisions made under this management plan as it pertains to existing ozone nonattainment SIPs applicable in the area of the parks.

COASTAL ZONE MANAGEMENT ACT OF 1972, as amended, (16 U.S.C. § 1451 *et seq*.)
Resources afforded protection: coastal waters and adjacent shoreline areas, coastal uses and natural resources
Applicable regulation(s): 15 CFR Parts 923, 930, 933

Congress enacted the Coastal Zone Management Act (CZMA) to preserve, protect, develop, and, where possible, restore or enhance the resources of the Nation's coastal zone. The purpose of the Act is to improve the nation's management of coastal resources, which have been irretrievably damaged or lost due to poorly planned development. Specific concerns were the loss of living marine resources and wildlife habitat, decreasing open space for public use, and shoreline erosion. Congress also recognized the need to resolve conflicts between various uses that were competing for coastal lands and waters (USDOC, NOAA, 1988a). The "coastal zone" means the coastal waters and the adjacent shorelands of the United States. It also includes coastal zones of the Great Lakes.

The CZMA establishes a state-federal partnership in which the states take the lead in managing their coastal resources by developing state CZM programs and plans, while the federal government provides financial and technical assistance. In section 109, the CZMA encourages each state, through a Coastal Zone Enhancement Grants Program, to improve continually its CZM program in one or more of eight identified national priority areas:

- coastal wetlands management and protection,
- natural hazards management (including potential sea and Great Lakes level rise),
- public access improvements,
- reduction in marine debris,
- assessment of cumulative and secondary impacts of coastal growth and development,
- special area management planning,
- ocean resource planning, and
- siting of coastal energy and government facilities.

Approved state CZM programs must provide a mechanism for public participation in permitting processes, consistency determinations and other similar decisions. They must also provide a mechanism to ensure that all state agencies will adhere to the program, and contain enforceable policies and mechanisms to implement the applicable requirements of the state's Coastal Nonpoint Pollution Control Program.

The CZMA requires federal agencies to act in a manner consistent with federally approved state management programs. Federal consistency under the CZMA means that federal actions that are reasonably likely to affect any land or water use or natural resource of the coastal zone must be consistent with the enforceable policies of a coastal state's or territory's federally approved coastal management program. In states that do not have a coastal zone management program approved by the Secretary of Commerce, the requirement for a consistency review and state concurrence does not apply.

The National Oceanic and Atmospheric Administration's (NOAA) coastal zone management program regulations (15 CFR 923) require that the boundary of a state's coastal zone must exclude federal lands. Units of the National Park System such as Big Thicket National Preserve are excluded from the boundaries of a state's coastal zone. However, the Coastal Zone Reauthorization Amendments in 1990 declared that all federal agency activities, whether located in or outside of the coastal zone, are subject to the consistency requirements of Section 307(c) of the CZMA if the activities affect natural resources, land uses, or water uses in the coastal zone. Additionally, the Texas Coastal Management Program/Final Environmental Impact Statement, prepared in 1996 by the NOAA's Office of Ocean and Coastal Resource Management and the State of Texas Coastal Coordination Council states that, "While activities on excluded federal lands are not required to

comply with the TCMP goals and policies, an activity that has spillover effects on CNRAs is subject to the federal consistency requirement (Part II, 2-5)".

NPS Management Policies require that the NPS comply with provisions of state coastal zone management plans prepared under the Coastal Zone Management Act when such provisions are more environmentally restrictive than NPS management zoning (NPS Management Policies, Chapter 4:8.1.1). Few mineral rights in National Park System units are located in the coastal zone. Jean Lafitte National Historical Park and a segment of the Beaumont Unit of Big Thicket National Preserve are examples of units that contain nonfederal oil and gas rights located in the coastal zone.

In the event that the NPS is considering issuing an access or surface use permit through the approval of a Plan of Operations, and the proposed nonfederal oil and gas operation may have a spillover effect on CNRAs, the NPS will consult with the Texas General Land Office for a consistency determination. In these cases, the Coastal Coordination Council must refer a consistency certification within 45 days of receipt by the Council Secretary of an administratively complete consistency certification, or the action is conclusively presumed to be consistent.

COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980, as amended, 42 U.S.C. §§ 9601 – 9675

Resources afforded protection: human health and welfare and the environment
Applicable regulation(s): 40 CFR Parts 279, 300, 302, 355, and 373

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), also known as "Superfund," provides for cleanup of sites contaminated by hazardous substances in the United States. CERCLA defines "hazardous substance" as any substance: listed under the Resources Conservation and Recovery Act (42 U.S.C. § 6921) as hazardous waste or having the characteristics identified under that section; listed under the Clean Water Act (33 U.S.C. § 1321(b)(2)(a)) as a hazardous substance or (33 U.S.C. § 1317(a)) as a toxic pollutant; listed under the Clean Air Act (42 U.S.C. § 7412) as a hazardous air pollutant; listed under the Toxic Substances Control Act (15 U.S.C. § 2606) as an imminently hazardous chemical substance or mixture; or listed under CERCLA (42 U.S.C. § 9602) as a hazardous substance.

CERCLA explicitly excludes from the definition of hazardous substance petroleum, including crude oil or any fraction of petroleum that is not otherwise specifically listed or designated as a hazardous substance under statutory provisions listed above. It also excludes natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable as fuel from the definition of hazardous substances. (42 U.S.C. § 9601(14)).

Owners or operators of a facility that stored, treated, or disposed of hazardous substances must notify EPA of the location and of the type of waste at the site. EPA puts the most seriously contaminated sites on a National Priorities List (NPL) and updates it annually. Sites on the NPL are eligible for long-term clean up actions funded by the EPA administered Superfund program.

CERCLA also includes reporting requirements for spills or other releases of hazardous substances. CERCLA requires persons in charge of a vessel or facility to report releases (except federally permitted releases) of hazardous substances into the environment to the National Response Center. If releases constitute less than the reportable quantity established by EPA (40 CFR § 302.4), then it does not have to be reported. Failure to report a reportable quantity release warrants a fine of up to $10,000 and imprisonment not to exceed one year (42 U.S.C. § 9603). "Release" means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, dumping or disposing into the environment. "Release" also includes the abandonment of barrels or containers that contain hazardous substances.

CERCLA directs the president to revise and to publish a National Contingency Plan (NCP) for the cleanup of petroleum and of hazardous waste spills. EPA developed the original NCP under section 311 of the Clean Water Act. The NCP details how the EPA will respond to spills of oil or hazardous substances regulated under CERCLA and/or the Clean Water Act. EPA publishes the plan, called the National Oil and Hazardous Substances Pollution Contingency Plan, at 40 CFR Part 300.

CERCLA authorizes the EPA to clean up sites using the Superfund, to issue administrative orders requiring potentially responsible parties (PRPs) to clean up sites, and to obtain court orders requiring PRPs to clean up sites. If EPA uses the Superfund, then CERCLA authorizes EPA to sue PRPs to recover costs of the cleanup. PRPs who have incurred costs cleaning up may sue other PRP's to recover part of the cost of the cleanup.

Under CERCLA, the EPA tries to find all PRPs, including the present owner or operator of a vessel or facility that released or threatened a release of hazardous substances, past owners or operators of a vessel or facility at the time of disposal of the hazardous substance; persons who arranged for disposal of the hazardous substance at the facility; and persons who transported a hazardous substance to the facility.

However, if the PRP can establish that the release or threatened release and the resulting damages occurred solely by an act of God, an act of war, or an unforeseen act or omission of a third party who neither constituted an agent nor an employee of the PRP, then no liability attaches. CERCLA provides an innocent landowner defense under limited circumstances.

Persons liable under CERCLA remain responsible for all response costs incurred by the United States, a state or an Indian tribe. They may also incur liability for damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing the injury, and for the destruction or loss of natural resources. Furthermore they may be responsible for costs of certain health assessments or studies.

CERCLA imposes strict liability meaning the government does not have to prove that the person intended to release, acted negligently in releasing, or caused the release of a hazardous substance into the environment. Moreover, in most cases, any of the liable parties may be held responsible for the entire cost of the cleanup. To recover part of the cleanup costs, the party then sues other liable parties for contribution.

Operators and their contractors should thoroughly investigate waste disposal sites before sending hazardous substances. They should check to make sure disposal sites have the relevant state and federal permits and that the disposal company has provided enough money to properly close the site. If a release occurs from the disposal site, then the persons who disposed of hazardous substances could incur large cleanup bills.

Operators should avoid releases of hazardous substances. Release of an operator's performance bond required under 36 CFR §9.48 does not affect possible subsequent liability under CERCLA for releases of a hazardous substance into the environment.

ENDANGERED SPECIES ACT OF 1973, as amended, 16 U.S.C. §§ 1531 – 1544

Resources afforded protection: plant and animal species or subspecies and their habitat, which have been listed as threatened or endangered by the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS). Distinct population segments of species of vertebrate fish or wildlife, which interbreed when mature, may also be listed as threatened or endangered, and are afforded protection.

Applicable regulation(s): 36 CFR Part 13; and 50 CFR Parts 10, 17, 23, 81, 217, 222, 225 402, and 450

The Endangered Species Act (ESA) requires federal agencies to ensure that their activities (authorized, funded, or carried out) will not jeopardize the continued existence of any listed threatened or endangered species or result in the destruction or adverse modification of critical habitat of such species. The FWS and NMFS administer the Act. The ESA makes it illegal to "take" an endangered species of fish or wildlife without a permit from the FWS or NMFS. “Taking” includes direct killing, hurting, trapping, or harassing. It also includes disrupting a habitat critical to the species' survival. Protective regulations issued at the time of listing for a threatened species of fish or wildlife may also prohibit or limit taking of the species without a permit.

Other federal agencies must formally consult with the FWS or NMFS when they believe that their own actions (including permitting) may affect a listed or a proposed threatened or endangered (T & E) species. The ESA prohibits agency actions occurring within the United States that jeopardize the continued existence of a T & E species and/or destroy or adversely affect designated critical habitat necessary for the species’ survival.

When an operator submits a proposed plan of operations, the NPS and operators must comply with the requirements of the Endangered Species Act and the regulations FWS and NMFS have promulgated to implement it (50 CFR Part 402). First, the NPS requests the FWS or NMFS to provide a list of proposed or listed species and proposed or designated critical habitat in the proposed operations area.

If the FWS or NMFS advises the NPS that listed or proposed T&E species may be present, then the NPS must prepare a biological assessment (BA). The BA evaluates the potential effects of the action on listed and proposed species and designated and proposed critical habitat. The BA must be included with the environmental assessment as required under the National Environmental Policy Act. The BA should include a list of listed and proposed threatened or endangered species occurring in the project area; impacts the project could have on these species and their habitat; project measures intended to mitigate, or reduce adverse impacts to these species and their habitat; and a description of the formal and informal consultation with the FWS or NMFS.

If the BA indicates that the action will not adversely affect any remaining listed species or designated critical habitat and the FWS or NMFS concurs, then formal consultation is not required. Likewise, if the BA indicates that the action is not likely to jeopardize the continued existence of proposed species or result in the destruction or adverse modification of proposed critical habitat, and FWS or NMFS concurs, then a conference is not required.

However, if the BA indicates that the action will adversely affect a listed species or critical habitat, then the NPS must formally consult with the FWS or NMFS. At the end of the consultation, the FWS or NMFS provides the NPS and the applicant with its "biological opinion." If the opinion finds the proposed action will jeopardize the continued existence of the species or result in the destruction or adverse modification of designated critical habitat, then the FWS or NMFS must suggest reasonable and prudent alternatives to the proposed action. If the FWS or NMFS cannot develop any reasonable and prudent alternatives, then it will indicate that to the best of its knowledge there are no reasonable and prudent alternatives exist. The FWS or NMFS may also formulate conservation recommendations, which will help the NPS reduce or eliminate the impacts the proposed action may have on listed species or designated critical habitat. The NPS will comply with prescribed alternatives when approving the plan of operations or implementing any other related action.

The NPS cannot approve a plan of operations if the FWS or NMFS has found that, no matter how modified, the action will result in "jeopardy” to a listed species or "destruction or adverse modification to habitat" critical to a listed species. Jeopardizing a listed species or habitat critical to a listed species' survival constitutes a "significant injury to federal lands" in the meaning of 36 CFR Part 9B. The 36 CFR Part 9B regulations do not allow the NPS to approve proposed plans that will result in a "significant injury to federal lands."

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT, as amended (commonly referred to as FEDERAL ENVIRONMENTAL PESTICIDE CONTROL ACT OF 1972), 7 U.S.C. §§ 136 *et. seq.*

Resources afforded protection: human health and safety, and the environment
Applicable regulation(s): 40 CFR Parts 152-180, except Part 157

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, regulates pesticides in the United States. FIFRA prohibits the distribution or sale of unregistered pesticides and establishes procedures for registering pesticides with the EPA. EPA has the authority to suspend or to cancel registrations for pesticides, which cause unreasonable adverse effects on the environment. To gain registration approval, a pesticide must meet EPA criteria regarding efficacy, labeling, and environmental safety. The statute makes illegal using a pesticide in a manner inconsistent with its labeling. EPA determines whether it should classify pesticides for general or restricted use. People may only use pesticides classified for restricted use under the direct supervision of a certified applicator or subject to other restrictions imposed by regulation.

FIFRA also requires EPA to establish regulations for storage and disposal of pesticide containers, excess pesticides and pesticides with canceled registration. The Act also outlines penalties, indemnities, and administrative procedures. In addition, EPA may exempt from any provision of Act any federal or state agency, if it determines emergency conditions, requiring such exemption, exist.

The appropriate NPS pesticide specialist must review and approve use of pesticides, including herbicides and rodenticides, before anyone can use them in units of the National Park System, including those where nonfederal oil and gas operations under a 9B plan occur. An NPS Integrated Pest Management Specialist must review and approve the proposed use of herbicides for clearing areas for oil and gas operations. The parks follow Department of the Interior Departmental Manual - 517; Reference Manual – 77, Natural Resources Management; and NPS Procedures for Pesticide Use Requests when considering proposals for pesticide use.

FEDERAL LAND POLICY AND MANAGEMENT ACT OF 1976, 43 U.S.C. §§ 1701 *et seq.*

Resources afforded protection: federal lands and resources administered by the Bureau of Land Management
Applicable regulation(s): 43 CFR Part 2200 for land exchanges and 43 CFR Parts 1700-9000 for all other BLM activities

The Federal Land Policy and Management Act (FLPMA), also known as the “BLM Organic Act”, controls Bureau of Land Management’s (BLM) administration of more than three hundred million acres of federal lands in the western United States and Alaska. FLPMA also contains a land exchange authority (43 U.S.C. § 1716) under which the Secretary of the Interior may exchange federal lands or interests outside National Park System units for nonfederal lands or interests within National Park System units. When appropriate, the NPS and BLM may use this exchange authority to acquire private mineral interests in National Park System units.

BLM regulations at 43 CFR Part 2200 govern federal land exchanges authorized by FLPMA. The regulations describe the appraisal and other procedures BLM uses while conducting land exchanges. However, if the enabling or exchange act for a unit remains inconsistent with these regulations, then the enabling or exchange act applies.

FEDERAL WATER POLLUTION CONTROL ACT OF 1972 (commonly referred to as CLEAN WATER ACT), 33 U.S.C. §§ 1251 *et seq.*
Resources afforded protection: water resources, wetlands, and waters of the U.S.
Applicable regulation(s): 33 CFR 320-330; and 40 CFR Parts 110, 112, 116, 117, 230-232, 323, and 328

Originally titled the Federal Water Pollution Control Act of 1972 (FWPCA) and significantly amended in 1977 and 1987, the Clean Water Act established a federal policy to restore and to maintain the chemical, physical, and biological integrity of the nation's waters; to enhance the quality of water resources; and to prevent, control and abate water pollution.

To achieve this objective, the CWA establishes the ultimate goal of eliminating the discharge of pollutants into navigable waters of the United States and the interim goal of maintaining water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water. The CWA prohibits the discharge of toxic pollutants in toxic amounts; provides federal assistance to construct publicly owned waste treatment works; develops and implements area-wide waste treatment management processes to assure adequate control of source pollutants in each state; makes a major research and demonstration effort to develop technology necessary to eliminate the discharge of pollutants into navigable waters, waters of the contiguous zone, and the oceans; and develops and implements programs for the control of nonpoint sources of pollution to control both point and nonpoint sources of pollution.

As with most environmental programs, the CWA requires that states set and enforce water quality standards to meet minimum federal (EPA) requirements, including: effluent limitations for point sources of pollution; permits for discharges of pollutants into waters of the United States; and permits for discharges of dredged or fill material into waters of the U.S., including wetlands. TNRCC holds the primary responsibility for protecting Texas' water resources.

The following sections of the CWA remain relevant to oil and gas operators in National Park System units: Section 311 - Spill reporting and spill control; Section 401 - state certification of project compliance; Section 402 - National Pollutant Discharge Elimination System (NPDES); Section 404 - Corps of Engineers dredge and fill permits.

<u>Section 311 (33 U.S.C. § 1321)</u>
Under section 311 no person can discharge oil or hazardous substances in harmful quantities into or upon navigable waters of the U.S., into or upon adjoining shorelines, or into or upon waters of the contiguous zone. Likewise, a person cannot discharge in connection with activities under the Outer Continental Shelf Lands Act or the Deepwater Port Act of 1974. For oil, a harmful quantity (i.e., quantity that requires reporting) equals that amount which causes a violation of the applicable water quality standard or that amount which causes a film, sheen, or discoloration of the water surface. Persons who discharge a reportable quantity" must report as soon as possible to the U.S. Coast Guard, EPA, and/or State of Texas, which agency depends on the geographic location of the spill and the type of substance spilled.

Hazardous substances are handled differently. Title 40 CFR Part 116 lists about 300 hazardous substances. Title 40 CFR Part 117 defines the reportable quantities for each substance. The reporting requirements of 40 CFR Part 117 do not apply to permitted discharges. (See Section 402 permits below.) Failure to report a discharge can result in criminal penalties including fines and imprisonment. Section 311 also provides for federal cleanup of the spill and places the costs of cleanup on the entity that caused the spill. The section also protects the person in charge who reports the spill from criminal prosecution, but offers no immunity from civil penalties that may apply.

Under section 311, EPA issued regulations (40 CFR Part 112) to prevent the discharge of oil and hazardous substances into the navigable waters of the United States. These regulations require

that any of the facilities described below prepare a Spill Prevention Control and Countermeasure Plan (SPCCP).

The SPCCP requirement applies to non-transportation related onshore and offshore facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing or consuming oil or oil products. It only applies if the facilities due to their location, could potentially discharge oil in harmful quantities into or on the navigable waters of the United States or the adjoining shoreline. (Note: facilities with an underground storage capacity less than 42,000 gallons, or facilities with an above-ground storage capacity less than 1,320 gallons, are exempt from this requirement.)

Under its regulations at 36 CFR Part 9B, the NPS requires a nonfederal oil and gas operator to submit a plan to deal with oil spills and other environmental hazards. A copy of the SPCCP, if one is required under 40 CFR Part 112, will often meet the requirement for oil spill plans under 36 CFR Part 9B.

Section 401 Water Quality Certification (33 U.S.C. § 1341)
Section 401 requires certification from the state or interstate water control agency that a proposed water resources project complies with established effluent limitations and water quality standards. Applicants for federal permits or licenses must obtain this certification. The TNRCC administers the Section 401 certification program except with respect to oil and gas exploration and production, which is the responsibility of the RRC (TNRCC, 1999).

Section 402 Permits (33 U.S.C. § 1342(I)(2))
Under the National Pollutant Discharge Elimination System (NPDES), the EPA controls the discharges of pollutants from their point source into waters of the United States by using a permitting system. A "point source" could be a tank battery, for example. Any entity proposing to or discharging waste flows into U. S. waters needs a NDPES permit. EPA or states with EPA-approved programs issue NDPES permits.

The NPDES permit sets specific discharge limits. The limits rely on most recent pollution control technology, water quality standards, and government imposed schedules for installation of new pollution control equipment. The permit gives directions to the operator for monitoring and reporting discharges. The regulations provide for individual permits, group permits for like facilities, and general permits.

The Water Quality Act of 1987 amended the CWA to address stormwater runoff from industrial facilities. EPA requires a NPDES stormwater runoff permit for runoff that may touch machinery or contaminated material onsite and cause contamination of adjacent property. Industrial facilities include oil and gas exploration, production and development operations. The EPA published its rule on NPDES permit application regulations for storm water discharges at 55 Fed. Reg. 47990 (November 16, 1990).

The CWA exempts mining and oil and gas operations from the Section 402 stormwater permit requirements if,

> "…discharges of stormwater runoff from mining operations, oil and gas exploration, production, processing, or treatment operations or transmission facilities, [are] composed entirely of flows which are from conveyances or systems of conveyances (including but not limited to pipes, conduits, ditches, and channels) used for collecting and conveying precipitation runoff and…are not contaminated by contact with, or do not come into contact with, any overburden, raw material, intermediate products, finished product, by-product, or waste products located on the site of such operations." (33 U.S.C. § 1342(1)(2))

"Contaminated storm water runoff" includes runoff containing a hazardous substance in excess of reporting quantities established at 40 CFR § 117.3 or 40 CFR § 302.4, containing oil in excess of the reporting quantity established at 40 CFR § 110.3 (e.g., causes a visible sheen), or contributing to a violation of a water quality standard.

Section 404 Permits (33 U.S.C. § 1344)

Under section 404, anyone who discharges dredge or fill material into navigable waters needs a permit from the U.S. Army Corps of Engineers. "Navigable waters" mean "…those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce." (33 CFR 329.4)

A determination of navigability, once made, applies over the entire surface of the waterbody and remains in effect even if later actions or events impede or destroy its navigability.

Section 404 regulates discharges into virtually all surface waters where the use, degradation, or destruction of these waters could affect interstate commerce. It also applies to all tributaries and adjacent wetlands of such waters. The COE defines wetlands as areas"inundated or saturated by surface or ground water at a frequency and duration sufficient to support and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions…" (33 CFR 328.3(b).

The Corps of Engineers may issue individual permits or general permits on a state, regional, or nationwide basis. It issues general permits for certain kinds of similar activities in wetlands that will cause only minimal adverse effects on the environment. General permits do not cover many operators of nonfederal oil and gas properties in National Parks. They must obtain an individual "404" permit to conduct any operations that involve dredging or discharge of fill material into wetlands.

Under the 404 permit program, the COE may issue individual permits or general permits on a state, regional, or nationwide basis. COE uses general permits for certain categories of activities that have only minimal adverse and cumulative effects on the environment. Many operators of nonfederal oil and gas properties in National Parks do not hold general permits. Operators must obtain an individual "404" permit to conduct operations that involve dredging or discharging fill material into wetlands.

Before the issuance of either a NPDES or section 404 permit, the applicant must obtain a section 401 certification. This declaration states that any discharge complies with all applicable effluent limitations and water quality standards.

The NPS cannot waive CWA requirements for oil and gas operators. An operator has full responsibility for obtaining section 402 (NPDES) or/and section 404 (dredge and fill) permits and for reporting spills of oil, or other contaminating and hazardous substances.

HISTORIC SITES, BUILDINGS, AND ANTIQUITIES ACT (HISTORIC SITES ACT OF 1935), 16 U.S.C. §§ 461 – 467

Resources afforded protection: historic sites, buildings and objects
Applicable regulation(s): 18 CFR Part 6; and 36 CFR Parts 1, 62, 63, and 65

This Act establishes a national policy "to preserve for public use, historic sites, buildings, and objects of national significance for the inspiration and benefit" of the American people. The Act authorizes the designation of national historic sites and landmarks, authorizes interagency efforts to preserve historic resources, and establishes fines for violations of the Act. It authorizes surveys of historic and archeological sites, buildings, and objects to determine which remain significant, and provides for the

restoration, reconstruction, rehabilitation, preservation, and maintenance of historic and prehistoric properties of national significance. The Act authorizes the Secretary of the Interior, through the National Park Service, to conduct surveys and studies, to collect information, and purchase significant historic properties. The Secretary may also restore, preserve, maintain, and rehabilitate structures and sites; establish museums; and operate and manage historic sites, and develop educational programs.

LACEY ACT, as amended, 16 U.S.C. §§ 3371 *et seq*.

Resources afforded protection: fish and wildlife, vegetation
Applicable regulation(s): 15 CFR Parts 10, 11, 12, 14, 300, and 904

The Lacey Act prohibits the import, export, transport, sales, receipt, acquisition, or purchase of fish, wildlife, or plants that are taken, possessed, transported, or sold in violation of any federal law, treaty, regulation or Indian tribal law. The act also makes illegal importing, exporting, transporting, selling, receiving, acquiring, or purchasing in interstate or foreign commerce any fish, wildlife or plants taken, possessed, transported or sold in violation of a state law or state regulation (or foreign law for fish and wildlife, but not for plants). The Act also establishes marking requirements for containers or packages containing fish or wildlife.

The 1981 amendments to the Act strengthened federal laws and improved federal assistance to states and foreign governments for enforcement of fish and wildlife laws. The Act has significant civil and criminal penalties for violations and has emerged as a vital tool in efforts to control smuggling and trade in illegally taken fish and wildlife.

The U.S. Fish and Wildlife Service regulations implementing the Lacey Act and other related laws describe the procedures for the assessment of civil penalties (50 CFR Part 11) and for government seizure and forfeiture (50 CFR Part 12).

MIGRATORY BIRD TREATY ACT, as amended, 16 U.S.C. §§ 703 – 712

Resources afforded protection: migratory birds
Applicable regulation(s): 50 CFR Parts 10, 12, 20, and 21

The Migratory Bird Treaty Act (MBTA) implements various treaties and conventions between the United States, Canada, Japan, Mexico, and Russia for the protection of migratory birds. Unless permitted by regulations, under the MBTA a person cannot attempt or succeed at pursuing, hunting, taking, capturing, or killing, possessing, offering to sell, selling, bartering, purchasing, delivering, shipping, exporting, importing, transporting, carrying or receiving any migratory bird, body part (e.g. feathers), nest, egg, or product. The U.S. Fish and Wildlife Service regulations provide procedures for obtaining a migratory bird permit (50 CFR Part 21). Regulations at 50 CFR 20 cover hunting of migratory birds, and regulations at 50 CFR Part 12 cover seizure and forfeiture procedures.

Operators and their employees should avoid actions with respect to migratory birds that could violate the Migratory Bird Treaty Act (e.g. destroying nests and eggs or picking up dead birds).

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, 42 U.S.C. §§ 4321 *et seq.*

Resources afforded protection: the human environment (e.g. cultural and historic resources, natural resources, biodiversity, human health and safety, socioeconomic environment, visitor use and experience)
Applicable regulation(s): 40 CFR Parts 1500-1508

The National Environmental Policy Act (NEPA) mandates that federal agencies assess the environmental effects of a proposed action and engage the public in the analyses of environmental impacts before agencies make decisions affecting the human environment. NEPA requires that federal agencies "utilize a systematic interdisciplinary approach" to ensure the integrated use of resource information in federal decision-making affecting the environment. Federal agencies must complete all analyses, public input, and NEPA documentation in time to aid decision-making. Initiating or completing environmental analysis after making a decision, whether formally or informally, violates both the spirit and the letter of NEPA.

Besides setting environmental planning policy goals, NEPA created the Council on Environmental Quality (CEQ), an agency of the president's office, as the "caretaker" of NEPA. CEQ published NEPA regulations in 1978 (40 CFR Parts 1500-1508). The CEQ regulations apply to all federal agencies and require each agency to "implement procedures to make the NEPA process more useful to agency decision-makers and the public" (40 CFR 1500.2). Agencies must review and update their regulations as necessary. In 1981 CEQ also published a guidance document titled "Forty Most Asked Questions Concerning CEQ's NEPA Regulations" (46 Fed. Reg. 18026, (1981)). Director's Order 12 and Handbook (2001) is the National Park Service's guidance on implementing NEPA.

The NEPA process constitutes an essential component of conservation planning and resource management through the integration of scientific and technical information into management decisions. In order to be effective, agencies cannot fulfill NEPA compliance by conducting an after-the-fact "compliance" effort. A well-crafted NEPA analysis provides useful information about the environmental pros and cons (i.e. impacts) of a variety of reasonable choices (alternatives), similar to an economic cost-benefit analysis, technical planning, or logistical planning. It remains an essential prelude to the effective management of park resources.

NEPA represents a procedural or process-oriented statute rather than a substantive or substance-oriented statute. Other substantive laws may prevent an agency from taking action or components of an action which have "too great" an impact on a particular resource. Within the NPS, the process of environmental analysis under NEPA provides the needed information to make substantive decisions for the long-term conservation of resources.

NEPA has a broad reach. NEPA is triggered regardless of who proposes the action (NPS, private individuals, federal agencies, states, or local governments) or whether the action could have impacts on the human environment. Even though the CEQ regulations give less emphasis to the socioeconomic environment than the physical or natural environment, the NPS considers the socioeconomic environment as an integral part of the human environment. Consequently, NPS will do NEPA analysis even if the impacts remain primarily socioeconomic, including potential impacts on minority and low-income communities (see Executive Order No. 12948, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations).

The National Park Service undertakes its environmental analyses in a number of ways. When the NPS considers taking a "major federal action" such as approving a proposed 9B plan of operations, it prepares an environmental assessment (EA) to assess the impacts of the proposed operation and to determine if the NPS must prepare an environmental impact statement (EIS). If, based on the EA's analysis and public comments, the NPS determines that the proposed action would not significantly affect the human environment, the NPS would prepare a decision document called a

Finding of No Significant Impact (FONSI). Conversely, if NPS determines the proposed action would likely cause significant affects on the human environment, then it prepares an EIS. The NPS may prepare an EIS, without first preparing an EA if the action will likely cause significant environmental impacts. Some actions or types of proposals fall under a NEPA "categorical exclusion" (CE). A categorical exclusion is used where the proposal meets specific criteria defined under Department of the Interior regulations and NPS Director's Order 12, for activities that do not have the potential for measurable impacts on park resources.

NATIONAL HISTORIC PRESERVATION ACT OF 1966, as amended, 16 U.S.C. §§ 470 – 470x-6

Resources afforded protection: cultural and historic properties listed in or determined to be eligible for listing in the National Register of Historic Places
Applicable regulation(s): 36 CFR Parts 60, 63, 78, 79, 800, 801, and 810

The National Historic Preservation Act (NHPA) declared a national policy of historic preservation. It encouraged preservation on the state and the private levels, authorized the Secretary of the Interior to expand and to maintain a National Register of Historic Places, established the Advisory Council on Historic Preservation, and required federal agencies to conduct studies of potential effects of their proposed actions on National Register properties and to provide the Advisory Council opportunities to comment (§ 106). The Advisory Council has promulgated regulations, "Protection of Historic and Cultural Properties," at 36 CFR 800, to implement section 106 and presidential directives issued under it.

The NHPA also required federal agencies to identify, evaluate, and nominate cultural resources for inclusion in the National Register. Likewise, agencies must manage for preservation those National Register eligible or listed properties that under their jurisdiction or control.

In 1980 Congress passed a series of amendments to the NHPA and other preservation legislation. These amendments: codified portions of Executive Order No. 11593, which required inventories of federal resources and federal agency programs to protect historic resources; clarified that federal agencies can exclude inventory and evaluation of resources from the one percent fund limit under the 1974 amendments to the Reservoir Salvage Act; and authorizes federal agencies to charge federal permitees and licensees reasonable costs for protection activities.

The 1992 amendments to the Act explicitly call for Native American consultations when potential traditional cultural properties may be on federal lands. If such properties are discovered through the consultations, they should be evaluated for possible eligibility and/or listing in the National Register of Historic Places.

The NPS must consider the potential effects of any proposed oil and gas activities on cultural resources listed on or eligible for listing on the National Register. This responsibility cannot be delegated to nonfederal parties. NPS regulations at 36 CFR § 9.37(e) state that the Regional Director may not approve a proposed plan of operations until the NPS complies with the NHPA. NPS regulations also require that operators provide the information needed for the NPS to make the determinations required under the NHPA. Operators must submit, as part of the environmental section in a proposed plan of operations, a description of the environment to be affected, including the natural and cultural environment.

In general, the NPS will have surveyed its lands as required by section 110 of the NHPA. The NPS cultural resource survey typically constitutes a careful inspection of the ground surface. The NPS uses standard archeological methodology that may include exploratory subsurface testing. The data from the survey indicate whether the lands fulfill the eligibility requirements for listing on the National

Register. Operators may obtain data gathered during NPS surveys for the environmental section of the proposed plan.

When an operator submits a proposed plan of operations, the NPS reviews the cultural resources section. Based upon that review, the staff's knowledge of the affected area's history and prehistory, and the NPS cultural resource surveys, the Regional Director determines if the operations would affect a property listed or eligible for listing on the National Register.

If the NPS finds that the operations would not affect a property listed or eligible for listing, the NPS consults with the State Historic Preservation Officer (SHPO) to obtain agreement. If the SHPO agrees with the NPS, then the Regional Director may issue an archeological clearance for any ground-disturbing operations on federal park lands.

However, if the NPS finds that operations would affect listed or eligible properties, then the NPS prepares an "Assessment of Effect on Cultural Resources". The NPS then consults with the SHPO to determine what steps to take to protect the site. If the NPS and the SHPO cannot agree on a course of action, then the matter is referred to the Advisory Council on Historic Preservation (ACHP). If the operation may affect a park also designated a National Historic Landmark, then the NPS must automatically consult with the ACHP.

Even if the property is listed on the National Register, private surface owners may take any lawful action they want on their own property. Under the authority of the NPS Organic Act and certain unit enabling legislation directing the NPS to regulate mineral activities to protect natural and cultural resources, the NPS can include stipulations in its plan approval to protect cultural resources on private property inside unit boundaries during the course of mineral operations.

NPS regulations at 36 CFR § 9.47 require operators to stop all operations and to notify the Superintendent if cultural resources are "discovered during operations. For the NPS to meet its obligations under the NHPA and the NPS Organic Act, an operator must notify the NPS of cultural resources that may be destroyed by a NPS-approved oil and gas operation. The notification requirement applies even though the operator may own the cultural resources. Notification gives the NPS an opportunity to judge the historic value of the resources, and, if warranted, acquire them from the owner.

An operator under 36 CFR Part 9B may have to salvage cultural resources discovered in the course of operations. The operator may salvage the resources only after the NPS, in consultation with the SHPO, approves a mitigation and salvage plan and chooses a contractor to do the data recovery.

NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION ACT, 25 U.S.C. §§ 3001 – 3013

Resources afforded protection: Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony
Applicable regulation(s): 43 CFR Part 10

The Native American Graves Protection and Repatriation Act (NAGPRA) protects Native American and Native Hawaiian cultural items and establishes a process for the authorized removal of human remains, funerary objects, sacred objects, and objects of cultural patrimony for sites located on lands owned or controlled by the federal government. The Act also provides for the transfer of ownership of cultural objects to Native American or Native Hawaiian individuals, organizations, or tribes. It addresses the recovery, treatment, and repatriation of Native American and Native Hawaiian cultural items by federal agencies and museums. NAGPRA contains data gathering, reporting, consultation, and permitting provisions. The Act emphasizes consultation with Native

American and Native Hawaiian organizations to ensure that these entities play a major role in the treatment of specific cultural objects.

Regulations at 43 CFR Part 10 address the rights of lineal descendants, Indian tribes, and Native Hawaiian organizations to Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony. They require federal agencies and institutions that receive federal funds to provide information about these items to these people and, upon presentation of a valid request, to dispose of or to repatriate these objects to them. Section 10.4 describes the regulatory requirements under NAGPRA for inadvertent discoveries of human these items.

Appendix R - "NAGPRA Compliance," in NPS Director's Order 28 - Cultural Resources Management, describe NPS-specific guidance for implementing NAGPRA. If NPS anticipates an operation may impact Native American human remains, funerary objects, sacred objects, or objects of cultural patrimony protected by NAGPRA, then it will consult with the appropriate Native American or Native Hawaiian organization as part of the 9B plan approval process.

NOISE CONTROL ACT OF 1972, 42 U.S.C. §§ 4901 – 4918

Resources afforded protection: human health and welfare
Applicable regulation(s): 40 CFR Part 211

The Act establishes a national policy to promote an environment free from noise that jeopardizes the public's health and welfare. To accomplish this, the Act provides for the coordination of federal research and activities to control noise, authorizes the establishment of federal noise emission standards for products distributed in commerce, and provides information to the public respecting the noise emission reduction characteristics of such products.

The Act authorizes and directs that federal agencies carry out the programs within their control in a manner that furthers the Act's policies. Agencies having jurisdiction over any property or facility or engaged in any activity resulting or potentially resulting in increased noise must comply with federal, state, interstate, or local requirements. Agencies must, upon request, furnish information to the EPA regarding the nature, scope, and results of noise research and noise control programs and must consult with EPA in prescribing standards or regulations respecting noise. The Act also provides for citizen lawsuits. Any person may commence civil action against the United States or any government instrumentality or agency that violates any noise control requirement.

Operators must ensure that their facilities, equipment, and operations comply with all applicable federal, state, interstate, or local noise emission requirements. NPS management policies provide that the NPS will strive to preserve the natural quiet and natural sounds associated with the physical and biological resources of the parks (e.g. waves breaking on the shore, wind in the trees, and bird and wildlife sounds). NPS should prevent or minimize unnatural sounds that adversely affect park resources or values or the visitors' enjoyment of them.

OIL POLLUTION ACT, 33 U.S.C. §§ 2701 – 2761

Resources afforded protection: water resources, natural resources
Applicable regulation(s): 15 CFR Part 990; 33 CFR Parts 135, 137, and 150; 40 CFR Part 112; 49 CFR Part 106

The Oil Pollution Act expands the federal role in spill response, estabishes contingency planning requirements for vessels and certain facilities, establishes the Oil Spill Liability Trust Fund, increases liability for spills of oil or hazardous substances from vessels and facilities, creates requirements for double hulls on new tankers, and increases requirements for research and development of spill response technologies.

OPA imposes liability for removal costs and damages resulting from discharge of oil into the U.S.'s navigable waters, its adjoining shorelines, or the exclusive economic zone. Damages incurred include injuries to natural resources, loss of natural resources, and loss of use of natural resources. Natural resources include land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other resources belonging to the United States, state, local, foreign governments or Indian tribes.

Liability does not apply to discharges allowed by a permit issued under a federal, state or local law. In addition, liability does not apply if the responsible party establishes that the discharge, damages, or removal costs occurred solely because of an act of God, an act of war, or a third party who constitutes neither an agent nor employee of the responsible party. However, despite these defenses, the responsible party remains liable if he fails to report the incident, help or cooperate as requested, or comply with certain orders. Also, OPA has increased penalties for regulatory noncompliance, broadened the response and enforcement authorities of the federal government, and preserved state authority to establish law governing oil spill prevention and response.

OPA provides new requirements for government and industry oil spill contingency planning. The "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP) was expanded to encompass a three-tiered approach. The federal government directs all public and private response efforts for certain types of spill events. Area committees, composed of federal, state, and local government officials, must develop detailed, location-specific Area Contingency Plans. Owners or operators of vessels and certain facilities that pose a serious threat to the environment must prepare their own facility response plans.

OPA may require nonfederal oil and gas operations on units of the National Park System to develop contingency plans. Contingency plans developed to meet the requirements of OPA may also satisfy the NPS 9B requirement for a contingency plan. NPS would determine if the OPA required plan meets NPS requirements as part of the 9B plan approval process.

PIPELINE SAFETY ACT OF 1992, 49 U.S.C. §§ 60101 *et seq*.

Resources Afforded Protection: human health and safety, and the environment
Applicable Regulation(s): 49 CFR Parts 190-195

This Act allows the Department of Transportation (DOT) to create and to enforce oil and gas pipeline safety regulations. The act creates design, construction, maintenance, and testing standards for all new, changed, or relocated interstate and intrastate pipelines. DOT's Office of Pipeline Safety regulates interstate pipeline safety but state agencies may also be approved to regulate intrastate pipelines. States that get approval to implement the program may enforce stricter standards than those in the Act. Violations of the Act can lead to civil and criminal penalties. The Act replaced the Hazardous Liquid Pipeline Safety Act of 1979, the Hazardous Materials Transportation Act, and the Natural Gas Pipeline Safety Act of 1968.

Oil and gas pipelines exist within several units of the National Park System, including Big Thicket National Preserve. Operators of oil and gas pipelines crossing NPS units must comply with the Pipeline Safety Act of 1992. NPS regulations at 36 CFR 9B require a 9B plan of operations for the construction or use of oil and gas pipelines (flowlines and gathering lines) in connection with nonfederal oil and gas operations within a NPS unit. Transpark pipelines (those owned and operated by persons or entities exercising rights not tied to the oil and gas ownership within the park boundary) located in rights-of-way that predate the establishment of the park unit do not qualify as an existing operations exempted from a plan of operations by 36 CFR § 9.33. Rather, the NPS will issue a Special Use Permit (SUP) to regulate maintenance activities along the right-of-way corridor, including but not limited to mowing and trimming vegetation, pipeline inspection and testing, removal

of fluids from oil and gas pipelines, and installing, shutting down, or replacing pipelines (36 CFR §1.6).

RESOURCE CONSERVATION AND RECOVERY ACT, 42 U.S.C. §§ 6901 *et seq.*

Resources afforded protection: natural resources, human health and safety
Applicable regulation(s): 40 CFR 240-280; and 49 CFR 171-179

The Resource Conservation and Recovery Act (RCRA) seeks to promote the protection of health and the environment and to conserve valuable material and energy resources. RCRA regulates the management of hazardous waste from generation to final disposal. The law consists of nine subtitles. Two subtitles create significant regulatory programs: Subtitle C establishes a hazardous waste program from generation to disposal; Subtitle D addresses disposal of nonhazardous solid waste. "Solid waste" includes garbage, refuse, and other discarded materials. It includes solids, liquids, and containerized gases.

The requirements of Subtitle C apply if the waste falls under EPA's criteria governing hazardous waste. EPA codified the regulatory criteria for hazardous waste at 40 CFR Parts 260 and 261. EPA codified a list of hazardous wastes (known as listed wastes) in Subpart D of Part 261. Subpart C of Part 261 establishes the criteria for determining whether a solid waste constitutes a hazardous waste by exhibiting a characteristic of corrosivity, reactivity, ignitability, or toxicity (known as characteristic waste). EPA can regulate a solid waste because it either appears on the hazardous waste lists or displays a characteristic of a hazardous waste.

The 1980 amendments to RCRA excluded certain oil, gas, and geothermal drilling and production wastes from the hazardous waste requirements of Subtitle C. The amendments specifically exempt drilling fluids, produced water, and other drilling and production wastes. In 1988, the EPA decided to keep the exemption for oil and gas exploration and production wastes. State agencies regulate the exempted wastes under the less strict Subtitle D governing nonhazardous waste.

Oil field workers must understand how RCRA works because mistakes can be costly for operators. The Act dictates that when Subtitle C and Subtitle D wastes are mixed, the mixture becomes a Subtitle C hazardous waste. It does not matter if the mixture loses all of its hazardous characteristics. For example, if the rig mechanic dumps used motor oil into the reserve pit, the entire volume of drilling muds, cuttings, rig wash, excess cement, and harmless completion fluids becomes a hazardous waste. This remains true even if it does not exhibit hazardous properties.

RCRA provides for strict civil and criminal penalties. Persons who do not comply with RCRA will receive fines of as much as $25,000 per day per violation. It does not matter whether or not EPA first served the person with a compliance order. It is up to the operator to know and comply with RCRA. The operator cannot wait to receive a compliance order and make corrections to avoid a penalty. Also, RCRA's criminal penalties can fine an operator as much as $50,000 and imprison the operator for as many as 2 years if they "knowingly" cause transportation of hazardous materials without a manifest.

In addition, the RCRA exemption from Subtitle C for oil and gas drilling and production waste does not exclude these wastes from the operation of RCRA section 7003. Section 7003 allows EPA to compel any person who contributed or contributes to the handling, storage, treatment, transportation or disposal of the hazardous waste in a manner that causes an imminent and substantial danger to take any action to protect human health and the environment. Because this can include expensive cleanup actions to protect human health and the environment, operators should handle waste from their operations in such a way that it does not contaminate the environment either now or in the future.

Regardless of oil and gas exploration and production wastes' exemption from Subtitle C regulation, the NPS will likely require operators to dispose of all wastes associated with the oil and gas operation outside of the park. NPS requirements for waste disposal in an operator's plan of operations will provide for the strict protection of park resources and values.

RIVERS AND HARBORS ACT OF 1899, as amended, 33 U.S.C. §§ 401 *et seq.*

Resources afforded protection: shorelines and navigable waterways, tidal waters, wetlands
Applicable regulation(s): 33 CFR Parts 114, 115, 116, 321, 322, and 333

Section 10 of the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction or alteration of any navigable waterway of the United States. In order to obstruct or alter the waterway, a person must obtain a permit from the Army Corps of Engineers. Activities requiring a permit include constructing structures in or over any waters of the U.S., excavating material from the water, conducting stream channelization, and depositing materials in such waters.

SAFE DRINKING WATER ACT OF 1974, 42 U.S.C. §§ 300f *et seq.*

Resources afforded protection: human health, water resources
Applicable regulation(s): 40 CFR Parts 141-148

The Safe Drinking Water Act (SDWA) protects the safety of drinking water supplies throughout the United States by establishing national standards enforceable by each state. The Act provides for the establishment of primary regulations to protect human health and of secondary regulations relating to the taste, odor, and appearance of drinking water. Primary drinking water regulations include either a maximum contaminant level (MCL) or a prescribed treatment technique that prevents adverse health effects to humans. A MCL constitutes the permissible level of a contaminant in water delivered to any user of a public water system. States should only use prescribed treatment techniques when a MCL remains uneconomical or technologically infeasible.

The Act's 1986 amendments require EPA to publish a list of contaminants every three years, which EPA knows or anticipates will occur in public water systems.

The most important part of the SDWA as far as the NPS and petroleum operators are concerned is the Underground Injection Control (UIC) permit program. Under the program, the EPA regulates underground injection of wastes or other materials. The EPA has authorized many states to administer the UIC permit program.

Owners of underground injection wells must obtain permits or be authorized by rule under the UIC program to operate the wells. The permit holder must prove to the state or federal permitting agency that, through sound and prudent practice and well construction, the underground injection will not endanger drinking water sources. The NPS will approve a plan of operations involving underground injection only when the wells have valid UIC permits.

The UIC program defines five classes of underground injection wells. Class II wells may relate to oil and gas operations in National Parks. The following fluids may be injected into Class II wells: 1). waste fluids produced by oil and gas operations and that are exempt from the hazardous waste requirements of RCRA, subtitle C (for example, produced brine, recovered treatment fluids, and waste waters from gas plants), 2). fluids used for enhanced recovery of oil and natural gas, and 3). fluids for below ground storage of hydrocarbons.

EXECUTIVE ORDERS

PROTECTION AND ENHANCEMENT OF THE CULTURAL ENVIRONMENT, Exec. Order No. 11593, 36 Fed. Reg. 8921 (1971)

Resources afforded protection: cultural resources

Executive Order No. 11593 instructs all federal agencies to support the preservation of cultural properties. It directs them to identify and nominate cultural properties under their jurisdiction to the National Register. Moreover, the executive order state that federal agencies must "exercise caution…to assure that any federally owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."

FLOODPLAIN MANAGEMENT OF 1977, Exec. Order No. 11988, 42 Fed. Reg. 26951 (1977)

Resources afforded protection: floodplains, human health, safety, and welfare

Executive Order No. 11988 seeks to avoid, where practicable alternatives exist, the short-term and long-term adverse impacts associated with floodplain development. In carrying out agency responsibilities, federal agencies must reduce the risk of flood losses, minimize the impacts of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values served by floodplains. If an agency proposes an action in a floodplain, then the agency must consider alternatives to avoid adverse effects and incompatible development in the floodplain. Agencies must also provide opportunity for early public review of any plans for actions in floodplains.

PROTECTION OF WETLANDS, Exec. Order No. 11990, 42 Fed. Reg. 26961 (1977)

Resources afforded protection: wetlands

Executive Order No. 11990 seeks to avoid adverse impacts on wetlands when there is a practicable alternative. Executive agencies, in carrying out their land management responsibilities, must minimize wetlands destruction, loss, or degradation and preserve and enhance the wetlands' natural and beneficial values.

FEDERAL COMPLIANCE WITH POLLUTION CONTROL STANDARDS, Exec. Order No. 12088, 43 Fed. Reg. 47707 (1978)

Resources afforded protection: natural resources, human health and safety

Executive Order No. 12088 delegates each executive agency head the responsibility for taking all necessary actions to prevent, control, and abate environmental pollution. It gives the EPA authority to conduct reviews and inspections for the purpose of monitoring federal facility compliance with pollution control standards. Section 1-101 requires prevention, control, and abatement of pollution from federal facilities. Section 1-201 requires federal agencies to cooperate with state, interstate, and local agencies to prevent, to control, and to abate environmental pollution.

GOVERNMENTAL ACTIONS AND INTERFERENCE WITH CONSTITUTIONALLY PROTECTED PROPERTY RIGHTS, Exec. Order No. 12630, 53 Fed. Reg. 8859 (1988)

Resources afforded protection: private property rights, public funds

Executive Order No. 12630 seeks the following: to assist agencies in reviewing their actions to prevent unnecessary takings and in proposing, planning, and implementing agency actions with due regard for the constitutional protections provided by the 5th Amendment to the Constitution of the U.S; to account in decision-making for those takings necessitated by statutory mandate; and to reduce the risk of undue or inadvertent burdens on the federal treasury resulting from lawful government action.

When an agency requires a private party to obtain a permit to undertake a specific use of private property, any conditions imposed on the permit must substantially advance the governmental interest that is impacted by the land use. The permitting processes must be kept to the minimum necessary so that the government does not interfere with the use of private property during the process.

FEDERAL ACTIONS TO ADDRESS ENVIRONMENTAL JUSTICE IN MINORITY POPULATIONS AND LOW-INCOME POPULATIONS, Exec. Order No. 12898 (amended by Exec. Order No. 12948, 60 Fed. Reg. 6379 (1995)

Resources afforded protection: human health and safety

This executive order requires that federal agencies incorporate environmental justice into their mission. Environmental justice promotes the fair treatment of people of all races, incomes, and cultures with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment implies that no person or group of people should receive a disproportionate share of the negative environmental impacts from the execution of this country's domestic and foreign policy programs.

INDIAN SACRED SITES, Exec. Order No. 13007, 61 Fed. Reg. 26771 (1996)

Resources afforded protection: Native Americans' sacred sites

To the extent practicable, permitted, and consistent with essential agency functions, all federal land management agencies must accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Consistent with this executive order, if a proposed plan of operations may affect the physical integrity of, the ceremonial use of or the access to these sites by Native American religious practitioners in federally recognized tribes, then the Superintendent will consult with the tribe as part of the 9B approval process.

INVASIVE SPECIES, Exec. Order No. 13112, 64 Fed. Reg. 6183 (1999)

Resources afforded protection: vegetation and wildlife

This executive order seeks to prevent the introduction of invasive species, to provide for their control, and to minimize the economic, ecological, and human health impacts they cause. It outlines federal agency duties, creates a new Invasive Species Council, defines the council's duties, and authorizes the creation an Invasive Species Management Plan. Executive Order No. 13112 also creates a framework for planning and for coordination involving all stakeholders, which it defines as states, tribal entities, local government agencies, academic institutions, scientific communities, and

non-governmental entities such as environmental groups, agricultural groups, conservation organizations, trade groups, commercial interests, and private landowners.

Federal agencies should use the programs and authorities to prevent the introduction of invasive species; detect and respond rapidly to control populations of such species in a cost-effective and an environmentally sound manner; monitor invasive species populations accurately and reliably; provide for restoration of native species and habitat conditions in invaded ecosystems; conduct research on invasive species and develop technologies to prevent their introduction; provide environmentally sound control of invasive species; promote public education on invasive species and means to address them.

The order directs agencies not to authorize, fund, or carry out any action likely to cause or promote the introduction or the spread of invasive species in the United States or elsewhere. However, agencies can determine that the benefits outweigh the potential harm and ensure that they take prudent measures to minimize harm. Federal agencies should consult with the Invasive Species Council and undertake actions consistent with the Invasive Species Management Plan with the cooperation of stakeholders.

RESPONSIBILITIES OF FEDERAL AGENCIES TO PROTECT MIGRATORY BIRDS, Exec. Order No. 13186, 66 Fed. Reg. 3853 (2001)

Resources afforded protection: migratory birds

This executive order defines federal agency responsibilities to protect migratory bird populations, in furtherance of the purposes of the migratory bird conventions, the Migratory Bird Treaty Act (16 U.S.C. §§ 703-711), the Bald and Golden Eagle Protection Acts (16 U.S.C. §§ 668-668d), the Fish and Wildlife Coordination Act (16 U.S.C. §§ 661-666c), the Endangered Species Act of 1973 (16 U.S.C. §§ 1531-1544), the National Environmental Policy Act of 1969 (42 U.S.C. §§ 4321-4347), and other pertinent statutes.

This executive order directs each federal agency taking actions that have, or are likely to have, a measurable negative effect on migratory bird populations to develop and implement, within 2 years, a Memorandum of Understanding (MOU) with the Fish and Wildlife Service that shall promote the conservation of migratory bird populations.

ACTIONS TO EXPEDITE ENERGY- RELATED PROJECTS, Exec. Order No. 13212, 66 Fed. Reg. 28357 (2001)

Protection afforded to: all resources

This executive order establishes an interagency task force to coordinate, monitor, and assist executive departments and federal agencies to expedite the increased production, transmission, and conservation of energy, in a safe and environmentally sound manner. Specifically, it provides for executive departments and federal agencies where appropriate to expedite their review of permits or take other actions as necessary to accelerate the completion of such projects, while maintaining safety, public health, and environmental protections, to the extent permitted by law and regulations.

POLICIES, GUIDELINES AND PROCEDURES

NATIONAL PARK SERVICE MANAGEMENT POLICIES (2001)

Resources afforded protection: all resources including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, endangered and threatened species, visitor use and experience, visual resources

The NPS Management Policies is the service-wide policy document of the National Park Service. These policies provide the overall foundation, set the framework, and provide direction for management decisions within the NPS. Management policy direction may be general or specific; it may prescribe the process through which decisions are made, how an action is to be accomplished, or the results to be achieved. Management Policies guide NPS staff to manage National Park System units consistently and professionally to achieve the Congressional mandate of the National Park System. Adherence to NPS policy is mandatory, unless specifically waived or modified by the Secretary, the Assistant Secretary, or the Director of the NPS.

These policies cover park system planning, land protection, natural resource management, cultural resource management, wilderness preservation and management, interpretation and education, use of the parks, park facilities, and commercial visitor services.

The second tier of NPS policies (level 2 guidance) are Director's Orders which clarify or supplement the NPS Management Policies. As they are completed, Director's Orders will replace existing NPS guidelines and special directives. The most detailed and comprehensive guidance implementing service-wide policy, called level 3 guidance, are handbooks or reference manuals and are a compilation of legal references, operating policies, standards, procedures, general information, recommendations, and examples to assist field staff in carrying out the NPS Management Policies.

Specific language pertinent to NPS minerals management is contained in the following chapters: Chapter 6 – Wilderness – Section 6.4.9 (page 72), Chapter 8 – Use of Parks – Section 8.7 (pages 94-96), Chapter 9 – Park Facilities – Section 9.1.3.3 (page 103).

DEPARTMENT OF THE INTERIOR, DEPARTMENTAL MANUAL, DM 516 – NEPA POLICIES (1980)

Resources afforded protection: all resources including cultural resources, historic resources, natural resources, human health and safety

Section 516 of the Departmental Manual establishes the Department of Interior's policies for implementing the National Environmental Policy Act. It includes policies about initiating the NEPA process, categorical exclusions, and preparing environmental assessments and environmental impact statements.

DEPARTMENT OF THE INTERIOR, DEPARTMENTAL MANUAL DM 517 – PESTICIDES (1981)

Resources afforded protection: human health and safety and the environment

DM 517 establishes Department of the Interior policy for the use of pesticides on the lands and waters under its jurisdiction and for compliance with the Federal Insecticide, Fungicide, and Rodenticide Act.

DEPARTMENT OF THE INTERIOR, DEPARTMENTAL MANUAL DM 519 – PROTECTION OF THE CULTURAL ENVIRONMENT (1994)

Resources afforded protection: archeological, prehistoric resources, historic resources, Native American human remains, and cultural objects

DM 519 describes the policies and responsibilities of the Department of the Interior for managing, preserving, and protecting prehistoric resources, historic resources, Native American human remains, and Native American cultural objects located on Indian and public lands administered by the Department.

NPS DIRECTOR'S ORDER 12 AND HANDBOOK – CONSERVATION PLANNING, ENVIRONMENTAL IMPACT ANALYSIS, AND DECISION MAKING (2001)

Resources afforded protection: all resources including natural resources, cultural resources, human health and safety, socioeconomic environment, visitor use

Director's Order 12 and Handbook sets forth policy and procedures for the NPS to comply with the National Environmental Policy Act, including direction on the analysis process and documentation of environmental impact assessments. The Director's Order and handbook are derived in whole or part from the CEQ regulations or Interior NEPA quidelines, giving them the force of law. Director's Order 12 and Handbook does not conflict with CEQ regulations, but rather includes specific NPS requirements beyond those imposed by CEQ to help facilitate the mandates of the Organic Act, and other laws and policies that guide NPS actions.

NPS DIRECTOR'S ORDER 28 – CULTURAL RESOURCE MANAGEMENT (1998)

Resources afforded protection: cultural, historic, and ethnographic resources

Director's Order 28 is the comprehensive guideline for management of cultural resources in units of the National Park Service. It elaborates on the policies articulated in the "NPS Management Policies" and offers guidance in applying federal laws and the Secretary's Standards to establish, to maintain, and to refine park cultural resource programs. Director's Order 28 also establishes procedures for complying with NHPA sections 10 and 106.

Director's Order 28, Appendix R: NAGPRA Compliance provides direction on complying with the Native American Graves Protection and Repatriation Act. Appendix R requires that an operator who inadvertently discovers human remains, funerary objects, sacred objects, or objects of cultural patrimony immediately notify the park's superintendent first by telephone and then in writing. The operator must stop activity in the area of the discovery for a specified time and make a reasonable effort to protect the human remains or objects. The superintendent will notify the appropriate Native American tribes or Native Hawaiian organizations and begin consultation about the disposition of the items.

DIRECTOR'S ORDER AND REFERENCE MANUAL 53 – SPECIAL PARK USES (2000)

Resources afforded protection: all resources including air resources, cultural and historic resources, natural resources, biological diversity, human health and safety, endangered and threatened species, visitor use and experience, visual resources

DO-53 defines and clarifies legal and policy requirements for special uses in NPS units and describes Special Use Permit (SUP) requirements and provisions. Applicable regulations for Special Use Permits are 36 CFR Parts 1 – 5.

Special park uses are defined as activities that take place in a unit of the National Park System and: provide a benefit to an individual, group or organization, rather than the public at large; require written authorization and some degree of management control from the NPS in order to protect park resources and the public interest; are not prohibited by law or regulation; and are neither initiated, sponsored, nor conducted by the NPS. A special park use may involve either rights or privileges, and may or may not support the purposes for which a park was established.

The NPS applies the Special Use Permit regulations at 36 CFR Parts 1 – 5 and guidance in Director's Order/Reference Manual 53 to control activities within rights-of-way associated with transpark oil and gas pipelines. Mowing and trimming vegetation, inspection or testing pipelines, removal of fluids from oil and gas pipelines and installing, shutting down or replacing pipelines, are common activities in pipeline rights-of-way requiring an approved NPS Special Use Permit. Special Use Permits for transpark pipelines must be approved before these activities can occur. The SUP must include a performance bond and mitigation measures to protect park resources, values, and ensure the protection of public health and safety.

RM 77 – NATURAL RESOURCE MANAGEMENT (2004)

Resources afforded protection: all natural resources

Natural Resource Management Reference Manual #77 offers comprehensive guidance to National Park Service employees responsible for managing, preserving, and protecting the natural resources found in National Park System units. It guides the actions of park managers to ensure that their decisions protect park natural resources and values, and comply with federal law, federal regulation, Department of Interior policy, and National Park Service policy. Natural resources include native plants, native animals, water, air, soils, topographic features, geologic features, paleontologic resources, natural quiet, and clear night skies. Reference Manual 77 covers natural resources management, uses in parks, planning, and program administration and management. A listing of topics included in RM 77 can be found at: http://www.nature.nps.gov/rm77/.

Reference Manual 77 serves as the primary "Level 3" guidance on natural resource management in units of the National Park System, replacing NPS-77, The Natural Resource Management Guideline, issued in 1991 under the previous NPS guideline series. The transition of NPS-77 into Reference Manual #77 is still in progress. The document provides special guidance on a number of in-park uses, like mineral development, that can adversely impact natural resources and values.

NPS DIRECTOR'S ORDER AND PROCEDURAL MANUAL 77-1 – WETLAND PROTECTION (2002)

Resources afforded protection: wetlands

NPS Director's Order 77-1 and Procedural Manual implement Executive Order No. 11990, Protection of Wetlands. They establish policies, requirements, and standards to protect wetlands. Operators must perform a wetlands delineation when proposed operations could potentially cause direct and/or indirect impacts to wetlands. The Corps of Engineers and the NPS review the wetlands delineation for adequacy. When proposed operations cannot avoid direct and/or indirect impacts on wetlands, the operator must compensate for these impacts by restoring a disturbed wetlands area in the unit at a minimum 1:1 compensation ratio. The compensation ratio can be greater if the functional values of the site being impacted are high and the restored wetlands will be of a lower functional value. Operators must perform the compensation before or concurrently with the occurrence of impacts associated with approved oil and gas operations. When operations are completed, the operator must restore the site to its pre-impact wetlands condition.

NPS must comply with Executive Order No. 11990 and the NPS Wetland Protection Guideline (DO 77-1) as part of the 36 CFR 9B procedure for approving a plan of operations for nonfederal oil and gas operations within a unit of the National Park System.

NPS DIRECTOR'S ORDER AND PROCEDURAL MANUAL 77-2 – FLOODPLAIN MANAGEMENT (2003)

Resources afforded protection: floodplains

Director's Order and Procedural Manual 77-2 replaces NPS Special Directive 93-4 and provides NPS policies and procedures for implementing Executive Order No. 11988, Floodplain Management. NPS policy seeks to reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare; and restore and preserve the natural and beneficial values served by floodplains. The NPS will protect and preserve the natural resources and functions of floodplains; avoid the long- and short-term environmental effects associated with the occupancy and modification of floodplains; avoid direct and indirect support of floodplain development and actions that could adversely affect the natural resources and functions of floodplains or increase flood risks; and restore, when practicable natural floodplain values previously affected by land use activities within floodplains. If it is not practicable to locate or relocate development or inappropriate human activities outside the floodplain, the NPS will, prepare a Statement of Findings in accordance with the Procedural Manual 77-2; take all reasonable actions to minimize the impact to the natural resources in floodplains; use nonstructural methods to reduce hazards to human life and property; and ensure that structures and facilities located in floodplains are designed to be consistent with the intent of the standards and criteria of the National Flood Insurance Program (44 CFR Part 60).

The Director's Order requires the NPS to classify proposed actions into one of three action classes - the 100-year (base floodplain), 500-year, or extreme regulatory floodplain. If a preliminary floodplain assessment shows that the area may experience flooding, then the applicable regulatory floodplain must be shown on a map, and information on flood conditions and hazards must be developed.

During project planning, the NPS identifies and evaluates practicable alternative sites for the proposal outside of the regulatory floodplain. If practicable sites are identified, NPS policy gives preference to locating the proposed action at a site outside the regulatory floodplain. If there is no practicable alternative site for the proposal, then the NPS will apply mitigation measures to protect floodplain resources, values, and human life and property.

NPS must comply with Executive Order No. 11988 and the NPS Floodplain Management Guideline as part of the 36 CFR 9B procedure for approving a plan of operations for nonfederal oil and gas operations within a unit of the National Park System.

SECRETARY OF THE INTERIOR'S "STANDARDS AND GUIDELINES FOR ARCHEOLOGY AND HISTORIC PRESERVATION," 48 FR 44716 (1983) (also published as Appendix C OF NPS DIRECTOR'S ORDER 28 – CULTURAL RESOURCE MANAGEMENT)

Resources afforded protection: cultural and historic resources

Prepared under the authority of sections 101(f), (g), and (h) and 110 of the National Historic Preservation Act, the Standards and Guidelines provide basic technical standards, guidelines, and advice about archeological and historical preservation activities and methods. While the standards and guidelines are not regulatory, NPS Director's Order 28 requires the NPS to comply with their substantive and procedural requirements.

GOVERNMENT-TO-GOVERNMENT RELATIONS WITH NATIVE AMERICAN TRIBAL GOVERNMENTS, Presidential Memorandum signed April 29, 1994

Resources afforded protection: Native Americans

In order to ensure that NPS recognizes and respects the rights of sovereign tribal governments, this memorandum instructs each executive department and agency to operate in a government-to-government relationship with federally recognized tribes and to consult with tribal governments prior to taking any action that might affect them. The memorandum directs agencies to assess the impacts of their programs and policies on tribes and to take their rights and concerns into consideration during development of any plan, programs, or projects. NPS must also remove any impediments to working directly with tribal governments in designing agency plans, programs, and projects. Finally, it instructs agencies to try to work cooperatively to carry out the intent of the memorandum and to tailor federal programs to meet the unique needs of tribal communities.

SELECTED TEXAS LAWS AND REGULATIONS

TEXAS NATURAL RESOURCES CODE, TITLE 2, CHAPTER 40 (1991)

Resources afforded protection: human health and safety, natural resources

This chapter codifies the Oil Spill Prevention and Response Act of 1991 for the State of Texas. Section 111 covers oil and gas pipelines and section 117 covers hazardous liquid or CO_2 pipelines. This chapter also provides for liability for natural resources damages from spills.

TEXAS NATURAL RESOURCES CODE, TITLE 3, CHAPTERS 81 THROUGH 85 (1991)

Resources afforded protection: human health and safety, natural resources
Applicable regulation(s): "Rules Having Statewide General Application to Oil, Gas and Geothermal Resource Operations within the State of Texas" (TAC tit. 16, part 1, § 3)

The Railroad Commission of Texas has state responsibility for regulating oil and gas operations. Its rules, regulations, and forms, published in the "Rules Having Statewide General Application to Oil, Gas and Geothermal Resource Operations within the State of Texas," apply to all fields and districts within the state. However, if the "Rules" conflict with the special rules governing any field or district, then the special rules govern.

TEXAS ADMINISTRATIVE CODE, TITLE 16, PART 1 – RAILROAD COMMISSION OF TEXAS, CHAPTER 3 – OIL AND GAS DIVISION

Resources afforded protection: human health and safety, natural resources

The Texas Railroad Commission promulgated the oil and gas rules (regulations) for the State of Texas in 1991. The oil and gas statewide rules implement, interpret, or prescribe law or policy. They also describe the Commission's procedures or practice requirements. The rules emphasize maximizing hydrocarbon production, eliminating wasteful field practices of reserves, protecting human health and safety, protecting natural resources, and reporting requirements, and information collecting requirements.

The following list of statewide rules protects natural resources and human health and safety. Additional statewide rules may apply in conjunction with other relevant legal and policy mandates for oil and gas operations.

§ 3.8 – Water Protection
§ 3.9 – Disposal Wells
§ 3.13 – Casing Cementing, Drilling, and Completion Requirements
§ 3.14 – Plugging
§ 3.20 – Notification of Fire Breaks, Leaks, or Blow-outs
§ 3.21 – Fire Prevention and Swabbing
§ 3.22 – Protection of Birds
§ 3.24 – Check Valves Required
§ 3.36 – Oil, Gas, or Geothermal Resource Operation in Hydrogen Sulfide Areas
§ 3.46 – Fluid Injection into Productive Reservoirs
§ 3.57 – Reclaiming Tank Bottoms, Other Hydrocarbon Wastes, and Other Waste Materials
§ 3.70 – Pipeline Permits Required
§ 3.91 – Cleanup of Soil Contaminated by a Crude Oil Spill
§ 3.93 – Water Quality Certification
§ 3.99 – Cathodic Protection Wells
§ 3.100 – Seismic Holes and Core Holes

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APPENDIX D

TYPES OF OIL AND GAS OPERATIONS

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INTRODUCTION

The petroleum industry is a continuous cycle of searching for new oil and gas reservoirs, developing and producing them, and finally abandoning the property once the hydrocarbons are depleted.

There are four general phases of petroleum development. The phases are (1) exploration, (2) drilling, (3) production, and (4) abandonment/reclamation. Surface uses vary for each phase in terms of intensity and duration. Also, operations related to one or all of the phases may be occurring in the same area at any given time.

To be of interest to the petroleum industry, petroleum deposits must be commercially valuable. There must be a reasonable chance of making a profit on the eventual sale of the oil and gas. Factors such as the market price of oil and gas, the amount of recoverable petroleum, the expected production rates, and the cost of drilling wells, producing, and transporting the product to market all determine the economic viability of developing a deposit once it is discovered.

The following sections are meant to provide the reader with a general understanding of common activities associated with each phase of oil and gas development.

EXPLORATION OPERATIONS

Occurrence of Petroleum

Petroleum deposits are not large underground caverns filled with oil and gas as the term reservoir might suggest. Rather, petroleum accumulates in tiny spaces within the buried rock layers. Most scientists today agree that petroleum was formed from large amounts of very small plant and animal life. These organic materials accumulated in ancient seas, which, over great periods of time, have covered much of the present land area. As time passed, sediments rich in organic matter were buried deeper and deeper. The increased pressure and temperature caused these organic remains to change into oil and natural gas. Once formed, the oil and gas migrated upward until certain forms and shapes of underground rocks halted the upward movement, trapping the hydrocarbons in large quantities. The search for these traps is the focus of the first phase of oil and gas development and exploration.

Geological Exploration

The search for oil and gas often begins with geological exploration. The exploration geologist is looking for clues on the surface that would suggest the possibility of petroleum deposits below. Surface studies comprise the first stage of exploratory fieldwork. Geological surveys of the land surface are made using aerial photographs, satellite photographs, maps of surface outcrops of specific formations or rock types, and geochemical analyses. Field crews map surface attributes and collect surface samples of rock for analysis.

Creating maps of surface outcrops and geochemical analyses requires fieldwork. Little equipment is needed other than surveying gear and rock and soil sampling supplies. These activities require a small field party of two to four persons who can work out of a single vehicle or on foot. Access to remote areas can be gained by a four-wheel-drive vehicle, small all-terrain vehicles, helicopter, pack animals, or by walking. A small boat may access shallow estuarial and near-shore areas. Constructing roads or digging channels for boats in shallow water areas is not required at this early stage.

Geochemical analysis often requires subsurface samples to be taken from a ditch or a shallow corehole. The coreholes are not usually big, but may generate some cuttings.

Geophysical Exploration

Geological exploration can narrow the area being searched, but subsurface geology may or may not be accurately indicated by surface outcrops. Geophysical prospecting extends the search beneath the earth's surface. The surveys identify and map characteristics favorable to oil and gas accumulation deep underground. Geophysical operations include gravitational, magnetic, and seismic surveys. Of these, the seismic survey is most common.

Gravitational and Magnetic Surveys: Gravitational and magnetic field studies yield regional or reconnaissance-type data. These surveys detect variation in gravitational attractions and magnetic fields of the various types of rock below the surface.

Gravity surveys are generally done with small, portable instruments called gravity meters or gravimeters. The number and placement of measurement points in a gravity survey depend on the site's characteristics. These include feasibility of access and the spacing pattern necessary to detail the features selected for mapping. The field party required is not large, usually 3 to 6 people. Travel on foot is possible with the smaller portable gravimeters. Progress, however, is slow, so most surveys use four-wheel-drive vehicles. In marshy areas, the use of special swamp or marsh buggies is quite common with gravity survey crews. Airborne survey operations are not yet practical due to present instrument limitations and the relatively large and rapid changes in altitude and acceleration characteristic to aircraft.

The objective of most surveys can be achieved when gravity stations are confined to existing roads or waterways. Where roads or waterways do not exist, a large level of latitude in positioning stations is possible to account for logistical or environmental constraints. Disturbance of the land surface is minimal when established access is already available. Methods of access to roadless areas are similar to those required for geological explorations described above. The surveying technique itself does not require any physical disturbance of the surface.

Magnetic surveys are often used in place of or to supplement gravity surveys. These surveys are done with relatively small airborne or portable ground instruments called magnetometers. Flight patterns usually consist of a series of parallel lines at 1- to 2-mile intervals.

Airborne surveys require geodetic and ground control points. These must be installed on the ground before the survey can take place, if not already present. A majority of the lower 48 states have been surveyed, so these points are already in place. If not, however, the area must be accessed by overland vehicles or helicopters. The size of the field party required is not large. The access to roadless areas is similar to that required for geological exploration described above. The surveying technique itself does not require any physical disturbance of the surface.

Seismic Surveys: Whereas gravity and magnetic surveys provide regional information, seismic survey can provide enough subsurface detail to locate potential oil and gas traps.

A seismic survey gathers subsurface geological information by recording impulses from an artificially generated shock wave. The energy waves travel downward toward underground formations. A series of sensitive instruments, called geophones, set out at surveyed points on the ground, record the energy waves as they are reflected off the subsurface formations and back to the surface. Cables or radio transmitters transfer information from the geophones to a recorder truck that receives and records the reflected seismic energy. Sophisticated computers analyze the data and generate a "picture" of the rocks underground. Each survey line provides a cross-section of the rock formations beneath it, and many lines may be run to create a complete picture.

In remote areas where there is little known subsurface data, a series of short seismic lines may be required to determine the attitude of the subsurface formations. After this, the pattern of seismic lines or grids is designed to make the final data more accurate and valuable. Although alignment is fairly critical, some source and recording stations may be moved or skipped for environmental or logistical reasons without seriously affecting the results of the investigation.

A more recent technique called 3-D Seismic works on the same principle as conventional seismic, but energy and recording stations are placed at a much denser spaced grid. There may be up to 150 energy source locations and 200 recording stations per square mile on a 3-D seismic project. Surveys commonly exceed a 25-square-mile-area. The 3D-Seismic surveys can provide enough detail to locate traps that have been "missed" by conventional geophysical methods and exploratory drilling. Even in areas that have been heavily explored and developed, 3D-Seismic is helping to optimize new field development and find new targets within producing fields. New life is being brought to areas thought to have been played out.

Seismic methods are usually referred to by the various methods of generating the shock wave. These include weight drop, vibrators, dinoseis, and explosives. No matter what method of generating energy is used, the procedures for preparing the line and recording the data are relatively similar. The procedure for "shooting" a line consists of first surveying and flagging the locations for the geophones and the positions of the energy sources. Second, the geophones and the connecting cable are laid down. The cable is either connected with more cable to the recording truck or to a radio transmitter to send the data to the recording truck. Normally the recording truck will be within a short distance of the transmitter or within line of sight. Once the geophones and ground cable are in place, the energy source is put in place. The detonation of the energy source, whether by truck or by explosive, is controlled by the recording truck. The shock wave is set off, and the seismic signal recorded. Once the signal is recorded, the cable is picked up and the entire process is repeated on the next segment of the line.

The most common energy source in seismic work is explosives placed in holes drilled to depths of up to 200 feet. Explosives may range from ½- to 50-pound charges. Drills can be mounted on trucks, boats, or specially designed airboats or ATVs, depending on the type of access required. In rugged topography, or to reduce surface disturbance associated with access, portable drills are sometimes carried by helicopter or by hand. Other field equipment can include vehicles to carry water for drilling operations, personnel, surveying equipment, recording equipment, and computers.

Existing roads are used if possible, but reaching some lines may require clearing vegetation and loose rock to improve access for the crews and the trucks. Each mile of seismic line cleared to a width of 8 to 15 feet represents disturbance of about an acre of land. A network of low-standard temporary roads and trails can result from these operations. The alignment of these trails usually consists of straight lines dictated by the grid, often with little regard for steep slopes or rough terrain. Level topography with few trees and shrubs would require little or no trail construction. An area with rugged topography or larger vegetative types such as trees and large shrubs would require more trail preparations. Temporary roads and trails are usually constructed with bulldozers.

Seismic crews consist of several surveying people, people for laying and retrieving the cable and geophones, the truck drivers and drillers for the energy source, personnel in the recording truck and miscellaneous water truck drivers, cleanup people, and field crew managers. The size of the seismic crews vary from 15 to 80 people. On most seismic jobs, the people and equipment are transported in trucks or four-wheel-drive vehicles. However, the surveying, cable laying, and sometimes the drilling can be done on foot in some situations.

Under normal conditions, 3 to 5 miles of line can be surveyed each day using the explosive methods. Crews may be in the field for 1 to 4 weeks for an average conventional survey. An average 3-D survey may take several months to complete.

DRILLING AND PRODUCTION OPERATIONS

Stratigraphic Test

Sometimes operators need underground rock samples to further define and confirm data from a geophysical exploration program. A stratigraphic test, commonly called a “strat” test, involves drilling a hole primarily to obtain geological information. Small-diameter holes are drilled to 100 feet or several thousand feet with small, truck-mounted drilling equipment. A space of ½ acre or less may be cleared of vegetation and leveled for the average strat test drill site. A road may be needed to get equipment to the site. As the rock is drilled, the resulting rock chips are brought to the surface by a high-pressure airflow or circulating drilling mud. The geologist analyzes the cuttings in order to correlate this geological and geophysical data to other known subsurface structure in order to prepare a subsurface geological map.

A space of about ½ acre or less is leveled and cleared of vegetation for the average strat test drill site. If air drilling is employed, drill cuttings are blown into a reserve pit next to the drill truck through what is known as a blooey line. If mud is used as a drilling fluid, mud pits may be dug. More commonly, portable mud tanks are used. Usually 1 to 3 days are required to drill the strat test holes, depending on the well depth and the hardness of the bedrock. In areas with shallow, high-pressure, water-bearing zones, casing may be required to keep water out of the hole.

Once the surface and subsurface geological and geophysical information is interpreted and a potential oil or gas trap is located, exploratory wells are drilled to test for the actual presence of oil or natural gas.

Oil and Gas Well Drilling

Classification of Wells: Wells drilled for oil and gas are classified as either exploratory or development wells. An exploratory well is drilled either in search of an as-yet-undiscovered pool of oil or gas (a wildcat well) or to extend greatly the limits of a known pool. Exploratory wells may be

classified as (1) wildcat, drilled in an unproven area; (2) field extension or step-out, drilled in an unproven area to extend the proved limits of a field; or (3) deep test, drilled within a field area but to unproven deeper zones. Development wells are wells drilled in proven territory in a field to complete a pattern of production.

Exploration, or wildcat, well drilling, and the equipment involved are well beyond that of strat test drilling. At a common height of 180 feet, the rig stands as tall as a 12-story building. An average drilling rig needs a level location of about 3 acres. The drilling pad and access road must be capable of supporting thousands of tons of equipment. The access road may need to be widened and upgraded to accommodate heavy loads.

Choosing the Site: Once exploration activities have narrowed the search to specific drilling targets, the operator must select an exact spot on the surface to drill the well. The industry prefers to drill vertically, and usually chooses a drill site directly above the desired bottomhole location. When topographical, geological, or environmental constraints prevent a drill site from being located directly above the bottomhole location, the use of direction drilling can achieve the objective. Reaches of over a mile are common for 10,000-foot-deep wells, and extended reach wells have been drilled with over 2 miles of horizontal departure.

Directional drilling involves deviating a wellbore from its vertical along a predetermined course to a target located at some depth and some horizontal distance away. It is a common practice in the industry today, with a number of uses. Directional drilling techniques can be applied if the target zone lies underneath an inaccessible location such as a heavily urbanized area, mountain, or water body, and the drill rig must be located elsewhere. The technique is most often used in offshore applications to allow many wells to be drilled from one location. It can be used to drill around or through fault planes, salt domes, or obstructions in the hole, and to provide relief to a nearby well that has blown out. More recently, the technique has been used to move surface locations as an environmental protection measure.

While directional drilling allows flexibility in the selection of the drill site, there are technical, physical, and economic constraints on its use. Geological factors such as target depths, formation properties (stability, type, dip angle, etc.), and contemplated horizontal departures physically complicate and restrict the opportunities for using directional drilling. Sophisticated equipment and specialized personnel are needed to monitor and guide the direction of the well as it is being drilled. The cost of using this technique typically ranges from 10 percent to 50 percent higher than the cost of a vertical well. While directional drilling can be applied in a wide variety of situations, project specific conditions must always be taken into account.

Accessing the Site: Wildcat drilling often takes place in remote areas. Preliminary exploration work will not have contributed any new roads to an area, although there may be some cross-country trails. Temporary access roads will have to be constructed. Existing roads may need upgrading to accommodate the heavier loads associated with truck traffic. One lane is usually adequate. Installation of culverts or other engineering structures will be needed in steep terrain or when crossing stream channels. Soil texture, topography, and moisture conditions might dictate that roads be surfaced with material such as gravel, oyster shells, caliche, or ground limestone. Heavy equipment such as graders, bulldozers, front-end loaders, and dump trucks are commonly used in constructing roads. In marshy areas, a roadbed may be laid with heavy boards.

Preparing the Drill Site: To accommodate the rig and equipment, the drill site must be prepared. Site preparation may include extensive clearing, grading, cutting, filling, and leveling of the drill pad using heavy construction equipment. Soil material suitable for plant growth is often removed first and stockpiled for later use in reclamation. The operator may also dig reserve pits to hold large volumes of drilling mud and drill cuttings. In environmentally sensitive areas, such as Alaska and California, a large effort is made not to alter the surface area comprising the drill site more than is necessary. For

example, reserve pits may not be dug. Instead, large steel bins are placed on the site to receive the cuttings and other materials that are normally dumped into the reserve pits. These bins can then be trucked away from the site and the material inside them disposed of properly. Also, even in areas where reserve pits are excavated, they are often lined with thick plastic sheeting to prevent any contaminated water or other materials from seeping into the ground. The drill pad typically occupies about 2 to 3 acres.

Directional drilling may require a larger-sized rig and additional support facilities that may lead to larger pad sizes. For inland water sites, drilling barges that sit on the bottom may be used as a foundation for the drill rig. Some dredging may be done on these sites to create a slip, and protective skirts or pilings may be installed around the barge to prevent erosion by currents and tidal flow. In deeper water, jack-up, submersible and semi-submersible, rigs and drill ships may be used to drill wildcat wells. An offshore platform is required to drill development wells in deep water.

Since a source of freshwater is required for the drilling mud and for other purposes, a water well is sometimes drilled prior to moving the rig onto the location. If other sources are available, the water may be piped or trucked to the site.

At the exact spot on the surface where the hole is to be drilled, a rectangular pit called a cellar is dug, or culvert-like pipe is driven into the ground. If the cellar is dug, it may be lined with boards, or forms may be built and concrete poured to make walls for the cellar. The cellar is needed to accommodate drilling accessories that will be installed under the rig later.

In the middle of the cellar, the top of the well is started, sometimes with a small truck-mounted rig. The conductor hole is large in diameter, perhaps as large as 36 inches or more; is about 20 to 100 feet deep; and is lined with conductor casing, which is also called conductor pipe. If the topsoil is soft, the conductor pipe may be driven into the ground with a pile driver. In either case, the conductor casing keeps the ground near the surface from caving in. Also, it conducts drilling mud back to the surface from the bottom when drilling begins, thus the name conductor pipe.

Usually, another hole considerably smaller in diameter than the conductor hole is dug beside the cellar and also lined with pipe. Called the rathole, it is used as a place to store the kelly when it is temporarily out of the borehole during certain operations. Sometimes on small rigs, a third hole, called the mousehole, is dug. On large rigs, it is not necessary to dig a mousehole because of the rig floor's height above the ground. In either case, the mousehole is lined with pipe and extends upward through the rig floor and is used to hold a joint of pipe ready for makeup.

Rigging Up: With the site prepared, the contractor moves in the rig and related equipment. The process, known as rigging up, begins by centering the base of the rig, called the substructure, over the conductor pipe in the cellar. The substructure supports the derrick or mast, pipe, drawworks, and sometimes the engines. If a mast is used, it is placed into the substructure in a horizontal position and hoisted upright. A standard derrick is assembled piece by piece on the substructure. Meanwhile, other drilling equipment such as the mud pumps are moved into place and readied for drilling.

Other rigging-up operations include erecting stairways, handrails, and guardrails; installing auxiliary equipment to supply electricity, compressed air, and water; and setting up storage facilities and living quarters for the toolpusher and company man. Further, drill pipe, drill collars bits, mud supplies, and many other pieces of equipment and supplies must be brought to the site before the rig can make hole.

Mobilizing the drill rig to the location requires moving 10 to 25 large truckloads of equipment over public highways and smaller roads. In very remote locations, entire drilling crews and service personnel may be temporarily housed onsite. A typical drilling crew consists of five people. Drilling operations are continuous, 24 hours a day and 7 days a week. The crews usually work two 12-hour

shifts. With the drilling crew, geologists, engineers, supervisors, and specialized service providers, there may be anywhere from 5 to over 20 people on a drilling location at any given time. An irregular stream of traffic to and from the rig occurs day and night.

Drilling the Surface Hole: Rotary drilling is used almost universally in modern-day drilling. Drilling is accomplished by rotating special bits under pressure. Starting to drill is called "spudding in" the well. To spud in, a large bit, say 17 ½ inches in diameter as an example, is attached to the first drill collar and is lowered into the conductor pipe by adding drill collars and drill pipe one joint at a time until the bit reaches the bottom. While drilling, the rig derrick and associated hoisting equipment support the drill string's weight. The combination of rotary motion and weight on the bit causes rock to be chipped away at the bottom of the hole.

The rotary motion is created by a square or hexagonal rod, called a kelly, which fits through a square or hexagonal hole in a large turntable, called a rotary table. The rotary table sits on the drilling rig floor and as the hole advances, the kelly slides down through it. With the kelly attached to the top joint of pipe, the pump is started to circulate mud, the rotary table is engaged to rotate the drill stem and bit, and weight is set down on the bit to begin making hole. When the kelly has gone as deep as it can, it is raised, and a joint of drill pipe about 30 feet long is attached in its place. The drill pipe is then lowered, the kelly is attached to the top of it, and drilling recommences. By adding more and more drill pipe, the hole can steadily penetrate deeper.

Large volumes of fluid, generically called drilling mud, circulate down the drill pipe to the drill bit and back to the surface. The mud lubricates and cools the bit and carries drill cuttings to the surface. The composition of the mud system depends on the types of formations being drilled, economics, water availability, pressure, temperature, and many other significant factors. Mud can be as simple as freshwater, or a complex emulsion of water, oil, chemicals, clays, and weighting material. Chemicals added to the mud help drill and protect the hole's integrity. Weighting material is often added to prevent formation fluids from flowing into the well as it is being drilled. Mud systems can be highly toxic or relatively benign. The drilling mud along with cuttings from the well account for the largest volume of waste generated at the wellsite.

The first part of the hole is known as the surface hole. Even though the formation that contains the hydrocarbons may lie many thousands of feet below this point, drilling ceases temporarily because steps must now be taken to protect and seal off the formations that occur close to the surface. For example, freshwater zones must be protected from contamination by drilling mud. To protect them, special pipe called casing is run into the hole and cemented.

Tripping Out: The first step in running casing is to pull the drill stem and bit out of the hole. Pulling the drill stem and bit out of the hole in order to run casing, change bits, or perform some other operation in the borehole is called tripping out. To trip out, the drilling crew uses the rig's hoisting system, or drawworks, to raise the drill stem out of the hole.

Attached to the traveling block is a set of drill pipe lifting devices called elevators. Elevators are gripping devices that can be latched and unlatched around the tool joints of the drill pipe. The crew latches the elevators around the drill pipe, and the driller raises the traveling block to pull the pipe upward. When the third joint of pipe clears the rotary table, the rotary helpers set the slips and use the tongs to break out the pipe. The pipe is usually removed in stands of three joints. Removing pipe in three-joint stands, rather than in single joints, speeds the tripping out process. With the stand of pipe broken out, the crew guides it into position on the rig floor to the side of the mast or derrick.

The derrickman unlatches the elevators from the top of the pipe and stands the pipe back in the derrick. Working as a close-knit team, the driller, rotary helpers, and derrickman continue tripping out until all the drill pipe, the drill collars, and the bit are out of the hole. At this point, the only thing in the hole is drilling mud, because mud was pumped into the hole while pipe was tripped out.

Running Surface Casing: Once the drill stem is out, often a special casing crew moves in to run the surface casing. Casing is large-diameter steel pipe, and is run into the hole with the use of special heavy-duty casing slips, tongs, and elevators. Casing accessories include centralizers, scratchers, a guide shoe, a float collar, and plugs.

Centralizers keep the casing in the center of the hole so that when the casing is cemented, the cement can be evenly distributed around the outside of the casing. Scratchers help remove mud cake from the side of the hole so that the cement can form a better bond. The guide shoe guides the casing past debris in the hole, and has an opening in its center out of which cement can exit the casing. The float collar serves as a receptacle for special cementing plugs, and allows drilling mud to enter the casing at a controlled rate. The plugs begin and end the cementing job, and serve to keep cement separated from the mud so that the mud cannot contaminate the cement. The casing crew, with the drilling crew available to help as needed, runs the surface casing into the hole one joint at a time. Casing is available in joints of about 40 feet. Once the hole is lined from bottom to top with casing, the casing is cemented in place.

Cementing: The cementing of oil well casing annuli is a universal practice done for a number of reasons, depending on casing type. Conductor casings can be cemented to prevent the drilling fluid from circulating outside the casing, causing the very surface erosion the casing was intended to prevent. Surface casings must be cemented to seal off and protect freshwater formations, provide an anchor for blowout preventer equipment, and give support at the surface for deeper strings of casing. Intermediate strings of casing are cemented in order to seal off abnormal pressure formations, effectively isolate incompetent formations that might cause drilling problems unless supported by casing and cement, and shut off zones of lost circulation. Production casing is cemented to prevent the migration of fluids to thief zones, to prevent sloughing of formations that could result in reduced production, and to isolate productive zones for future development.

An oilwell cementing service company usually performs the job of cementing the casing in place. The cement used to cement oilwells is not too different from the cement used as a component in ordinary concrete. Basically, oilwell cement is Portland cement with special additives to make it suitable for various conditions of pumping, pressure, and temperature.

Cementing service companies stock various types of cement and use special trucks to transport the cement in bulk to the well site. Bulk cement storage and handling at the rig location make it possible to mix the large quantities needed in a short time. The cementing crew mixes the dry cement with water, often using a recirculating mixer (RCM). This device thoroughly mixes the water and cement by recirculating part of the already-mixed components through a mixing compartment. Powerful cementing pumps move the liquid cement (slurry) through a pipe to a special valve made up on the topmost joint of casing. This valve is called a cementing head, or plug container. As the cement slurry arrives, the bottom plug is released from the cementing head and precedes the slurry down the inside of the casing. The bottom plug keeps any mud that is inside the casing from contaminating the cement slurry where the two liquids interface. Also, the plug wipes off mud that adheres to the inside wall of the casing and prevents it from contaminating the cement.

The plug travels ahead of the cement until it reaches the float collar. At the collar the plug stops, but continued pump pressure breaks a seal in the top of the plug and allows the slurry to pass through a passageway in it. The slurry flows out through the guide shoe, and starts up the annulus between the outside of the casing and the wall of the hole until the annulus is filled.

A top plug is released from the cementing head and follows the slurry down the casing. The top plug keeps the displacement fluid, usually drilling mud, from contaminating the cement slurry. When the top plug comes to rest on the bottom plug in the float collar, the pumps are shut down and the slurry is allowed to harden. Allowing time for the cement to set is known as waiting on cement (WOC) and varies in length. In some cases, it may be only a matter of a few hours; in other cases, it may be 24

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hours or even more, depending on well conditions. Adequate WOC time must be given to allow the cement to set properly and bond the casing firmly to the wall of the hole. After the cement hardens and tests indicate that the job is good -- that is, that the cement has made a good bond and no voids exist between the casing and the hole -- drilling can be resumed.

Tripping In: To resume drilling, the drill stem and a new, smaller bit that fits inside the surface casing must be tripped back into the hole. The bit is made up on the bottommost drill collar. Then, working together, the driller, floormen, and derrickman make up the stands of drill collars and drill pipe and trip them back into the hole.

When the drill bit reaches bottom, circulation and rotation are begun and the bit drills through the small amount of cement left in the casing, the plugs, the guide shoe, and into the new formation below the cemented casing. As drilling progresses and hole depth increases, formations tend to get harder; as a result, several round trips (trips in and out of the hole) are necessary to replace worn bits.

Controlling Formation Pressure: During all phases of drilling, an important consideration is well control. Well control is preventing the well from blowing out by using proper procedures and equipment. A blowout is the uncontrolled flow of fluids -- oil, gas, water, or all three -- from a formation that the hole has penetrated.

Blowouts threaten lives, property, and pollution of the environment. Rig crews receive extensive training in how to recognize and react to impending blowouts, making them relatively rare events.

The key to well control is understanding pressure and its effects. Pressure exists in the borehole because it contains drilling mud and in some formations because they contain fluids. All fluids -- drilling mud, water, oil, gas, and so forth -- exert pressure. The denser the fluid (the more the fluid weighs), the more pressure the fluid exerts. A heavy mud exerts more pressure than a light mud. For effective control of the well, the pressure exerted by the mud in the hole should be higher than the pressure exerted by the fluids in the formation.

Pressure exerted by mud in the hole is called hydrostatic pressure. Pressure exerted by fluids in a formation is called formation pressure. The amount of hydrostatic pressure and formation pressure depends on the depth at which these pressures are measured and the density, or weight, of each fluid. Regardless of the depth, hydrostatic pressure must be equal to or slightly greater than formation pressure, or the well kicks. The well kicks, formation fluids enter the hole, if hydrostatic pressure falls below formation pressure. Thus, one of the crew's main concerns during all phases of the drilling operation is to keep the hole full of mud whose weight is sufficiently high to overcome formation pressure.

However, unexpectedly high formation pressures can be encountered. Formation fluids can be swabbed, or pulled, into the hole by the piston-like action of the bit as pipe is tripped out of the hole. Also, the mud level in the hole can fall so that the hole is no longer full of mud. Whatever the reason, when hydrostatic pressure falls below formation pressure, crew members have a kick on their hands, and they must take quick and proper action to prevent the kick from becoming a blowout.

Helping the crew keep an eye on the rig's operation are various control instruments located on the driller's console. Some rigs have data processing systems that utilize slave computer display terminals, or CRTs (short for cathode ray tubes), on the rig floor, in the mud logging trailer, in the toolpusher's trailer, and in the company man's trailer. When limits that have been programmed into the system are exceeded, the system goes into an alarm condition.

Whether the kick warning signs come from electronic monitors, a computer printout, or the behavior of the mud returning from the hole, an alert drilling crew detects the signs and takes proper action to shut the well in. To shut a well in, large valves called blowout preventers, which are installed on top of the cemented casing, are closed to prevent further entry of formation fluids into the hole. Once the well is shut in, procedures are begun to circulate the intruded kick fluids out of the hole. Also, weighting material is added to the mud to increase its density to the proper amount to prevent further kicks, and the weighted up mud is circulated into the hole. If the mud has been weighted the proper amount, then normal operations can be resumed.

Running and Cementing Intermediate Casing: At a predetermined depth, drilling stops again in order to run another string of casing. Depending on the depth of the hydrocarbon reservoir, this string of casing may be the final one, or it may be an intermediate one. Intermediate casing is smaller than surface casing because it must be run inside the surface string and to the bottom of the intermediate hole. In general, it is run and cemented in much the same way as surface casing.

Final Depth and Well Evaluation: Using a still smaller bit that fits inside the intermediate casing, the next part of the hole is drilled. Often, the next part of the hole is the final part of the hole unless more than one intermediate string is required. After cementing the intermediate casing, drilling resumes by tripping the new bit and drill stem back in the hole. The intermediate casing shoe is drilled out, and drilling the new hole resumes.

While drilling and once reaching the total depth (TD) of the well, the operator collects information to determine if hydrocarbons have been encountered. To help the operator decide whether to abandon the well or to set a final, or production, string of casing, several techniques can be used. A thorough examination of the cuttings made indicates whether the formation contains sufficient hydrocarbons. A geologist catches cuttings at the shale shaker and analyzes them in a portable laboratory at the well site. He often works closely with a mud logger logger -- a technician who monitors and records information brought to the surface by the drilling mud as the hole penetrates formations of interest.

Well logging is another valuable method of analyzing downhole formations. Using a mobile laboratory, well loggers lower sensitive tools to the bottom of the well on wireline and then pull them back up the hole. As they pass back up the hole, the tools measure and record certain properties of the formations and the fluids (oil, gas, and water) that may reside in the formations. Logging tools can also be run as part of the drill string to measure hole conditions and formation properties as the well is being drilled. This is called “measurement while drilling” or MWD.

If logging results indicate commercial quantities, a drill stem test (DST) may be run. Tools are positioned on the drill pipe to isolate the zone to be flow tested. Downhole formation pressure and fluids enter the tool and activate a recorder. Test may be designed to allow formation fluids to flow to the surface during the test or just to allow a certain volume to enter into the wellbore. In either case, provisions must be made at the surface to separate formation fluids from the mud, and to store and dispose of formation liquids. Natural gas produced during drill stem test is vented or flared. A properly designed and run DST can give excellent indication of the types and volumes of fluid the zone is capable of producing.

In addition to well logging and drill stem testing, formation core samples can be taken from the hole and examined in a laboratory.

Setting Production Casing: After the drilling contractor has drilled the hole to final depth and the operating company has evaluated the formations, the company decides whether to set production casing or plug and abandon the well. If the well is judged to be a dry hole --that is, not capable of producing oil or gas in commercial quantities -- the well will be plugged and abandoned.

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Several cement plugs will be put in the well to seal it permanently. Cement plugs will be designed and placed to protect the zones of usable water from pollution and to prevent escape of oil, gas, or other fluids to the surface or other zones. Plugging and abandoning a well are considerably less expensive than completing it.

On the other hand, if evaluation reveals that commercial amounts of hydrocarbons exist, the company may decide to set casing and complete the well. The services of a casing crew and cementing company will once more be arranged for; and the production casing will be run and cemented in the well.

The drilling contractor nears the end of his job when the hole has been drilled to total depth and production casing has been set and cemented. In some cases, the rig and crew remain on the location to "complete" the well, or make it ready for production. In other cases, the drilling contractor moves his rig, and the operator brings in a smaller, less expensive completion rig and crew to finish up the job.

Well Completion: Completion equipment and methods employed are quite varied. The perforated completion is by far the most popular method of completing a well. Perforating is the process of piercing the casing wall, cement, and rock to provide openings through which formation fluids may enter the wellbore. Perforating is accomplished by placing guns holding special explosive charges opposite the zone to be produced. The charges are shaped so that an intense, directional explosion is formed. The well must have a good cement job and well-designed and well-executed perforation methods to get effective formation flow.

Explosives used in perforating guns are very stable. Accidents are rare as long as the people involved use proper procedures. Perforating guns may be run in the well on tubing or by wireline. Firing is accomplised by applying electric current, pressure, or mechanical force to a firing head located on the perforating gun.

The final string of pipe usually run in a producing well is the tubing. Tubing is a string of relatively small diameter pipe through which the hydrocarbons are produced. Tubing sizes vary from less than 2 inches in diameter up to 4½ inches for large volume producers. In a flowing well, its smaller diameter produces more efficient flow than casing. Also, since it is not cemented in the hole, tubing may be removed when it becomes plugged or damaged. Tubing, when used with a packer, keeps well fluids and formation pressures away from the casing. Well fluids and high pressures can damage casing, necessitating costly repairs.

The packer consists of a pipelike device through which well fluids can flow. Rubber sealing elements form a fluid tight seal around the inside of the casing. Gripping elements, called slips, hold the packer in place. Because the packer seals off the space between the tubing and the casing, produced fluids are forced into and up the tubing.

Another device often installed in the tubing string near the surface is a "subsurface safety valve." The valve remains opened, as long a flow is normal. When the valve senses a loss in pressure or significantly increased flow (such as would occur with a flowline break), the valve closes automatically. Subsurface safety valves can prevent uncontrolled well flow in the event of massive surface equipment failure.

Finally, a tubing head is installed at the top of the well to support the tubing. Valves, gauges, and flow control devices are installed on top of the tubing head. Together, they make up what is commonly called a Christmas tree.

When reservoir pressures are not sufficient for the well to flow on its own, operators employ artificial lift methods. The most common by far is rod pumping. A plunger pump is installed deep in the well and connected by rods to a pumping unit on the surface. The pump jack moves the rods up and down to work the downhole pump. Pump jacks are often driven with electric motors or natural gas engines. The gas lift method works by injecting high-pressure gas into the fluid column of a swell to lighten and raise the fluid by expansion of the gas. Instead of pump jacks, there will be a source of high-pressure gas in the field, usually from a gas compressor. The hydraulic pumping method uses a fluid to drive a downhole motor, which in turns drives a pump that pumps the oil to the surface. Surface equipment for hydraulic pumping includes a high-pressure pump and vessels to separate the hydraulic fluid from produced fluid. Yet another type of artificial lift is electric submersible pumping, usually only used on very high-volume wells. An electric motor attached to a pump is installed downhole. Electric current is supplied to the motor through special heavy-duty armored cable. Surface facilities may just be a small transformer/control box.

The well may be stimulated to enhance flow. Stimulation may be performed before or after the completion equipment is installed. Two common types of stimulation are formation acidization and hydraulic fracturing. Stimulation treatments can improve flow to the point where commercial production is achieved in an otherwise uneconomical well.

Formation acidizing is treating the hydrocarbon-bearing rock with large volumes of acid. The most common types of acid used are hydrochloric (HCl) and hydrofluoric (HF). Oilfield acids contain additives to prevent of delay corrosion of the well's tubulars, inhibit sludging and emulsion reactions with oil in the formation, and make the acid easier to pump. The aim in acidizing is to enlarge the pore spaces and passages by dissolving rock, thus enlarging existing flow channels and opening new ones to the wellbore.

Acid is brought to the well location in tanker trucks and pumped using one or more truck-mounted pumps. Spent acid that is flowed back from the well is often kept separate from field production. The spent acid may be put into temporary tanks until it is trucked off to disposal.

In hydraulic fracturing, fluid is pumped into the formation at high enough pressures and rates to split the rock. Proppants are pumped with the fluid to hold the crack open once pumping stops. Sand and sintered bauxite beads are two common propping agents. Fracturing fluid must not only break down the formation, but also extend and transport the proppant into the fracture. The industry has developed a multitude of complex fluid and proppant systems to achieve the best results in the many varied types of reservoirs.

Many truck-mounted pumps and temporary storage tanks are needed on location to fracture-treat wells. Larger well locations may be needed if hydraulic fracturing is part of a completion procedure.

Field Development: If the wildcat well produces oil or gas in commercial quantities, one or more additional wells are normally drilled to confirm the initial finding and further test and define the extent of the oil or gas reserves. Location of the confirmation wells is dependent upon analysis of discovery well data and any existing seismic surveys. Confirmation progresses by drilling one well after another, each dependent on the results of the previous wells.

With more information in hand, facilities can be designed to handle production from the field. Next, development wells are drilled as needed to efficiently drain the reservoir. The procedures for drilling development wells are about the same as for wildcats, except that there may be a variation in the

amount and type of subsurface sampling, testing, and evaluation. More detailed seismic work may be performed to aid in the location of development wells.

A state Oil & Gas Commission usually establishes the field well spacing pattern. Typical well spacing may be one well every 640, 320, 160, 80, or 40 acres. Completely filled spacing patterns would translate to 1, 2, 4, 8, or 16 wells per square mile, respectively. In general, oil well spacing is denser than for gas wells, and shallow well spacing is denser than for deeper wells.

Access roads to development wells are usually better planned and constructed than those for wildcat wells because these wells tend to have a longer life. Typically a lease area will have one main route, with side roads to each well or multiwell pad location. Change from temporary to permanent roads does not take place until a well has been established as being capable of production. The amount of roadway required per square mile of field is 4 miles, based upon a spacing pattern of 40 acres and a separate pad for each well.

Directional drilling is sometimes used to concentrate the surface locations of two or more wells in one area. This technique minimizes the amount of surface area (roads and well pads) needed to develop a field. Multiple well pads may be used when developing a field inside the limits of a city or in environmentally sensitive areas.

Other surface equipment and support facilities are brought in or constructed during field development. For example, a battery of storage tanks or a pipeline may be required to handle produced oil or gas. Separation and treatment facilities are required to separate gas and water from oil. Storage tanks are required to hold brines produced during oil extraction, and a proper disposal capability, most typically reinjection, must be developed. Natural gas must be properly disposed of (usually flared) or treated to remove impurities if it is to used or sold.

Well Servicing and Workover Operations: Sometimes it is necessary to repair downhole mechanical problems. Workover rigs are often used to repair downhole equipment or assist in large stimulation jobs. The most common well servicing operation is related to artificial lift installation, tubing string repairs, and work on other downhole completion equipment that may be malfunctioning. More involved workover operations might include cleanout of sand, scale, or paraffin deposits that accumulate in the well, casing repair, cementing, perforating new or existing zones of production, or even some limited drilling operations.

Workover rigs are scaled-down drilling rigs. They are usually equipped to stand the pipe in the derrick, rotate pipe while it is in the hole, and circulate workover fluids down and back up the well. Workover rigs are usually self-contained on a truck. They are highly mobile and can be rigged up and rigged down quickly. A well servicing jog to replace a rod pump may last only 1 or 2 days. A major workover operation to change or “recomplete” to another productive zone may last more than a month.

PLUGGING/ABANDONMENT/RECLAMATION

Workover rigs are also used to plug and abandon wells once they are depleted. Plugging operations consist of removing the tubing, packer, and other completion equipment; pumping cement across producing zones; and placing cement plugs at various depths to protect freshwater zones. Finally, a cement plug is set at the surface to cap the well, and wellhead equipment is cut off. A permanent abandonment marker is often placed to identify the well’s location.

The surface owner and regulatory agencies often dictate surface reclamation. Reclamation can range from just removing equipment to reclaiming the area to conditions that existed before drilling the well.

Full-scale reclamation can include the following:

- Removal of structures, equipment, and debris used or generated during operations;
- Removal or remediation of contaminated soils;
- Recontouring of disturbed areas to near original grade;
- Spreading and preparation of topsoil;
- Planting of native vegetation, usually grasses, but sometimes also tree saplings;
- Erosion protection measures such as mulching; and
- Monitoring of revegetation and erosion control efforts.

Reclamation may last a few days or a few years, depending on the degree of contamination on the site and the ability of native species to grow.

APPENDIX E

REMAINING OIL AND GAS RESOURCES BENEATH BIG THICKET NATIONAL PRESERVE ASSESSMENT METHODOLOGY

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Introduction

The Central Energy Team of the USGS was retained by the National Park Service to assess the undiscovered oil and gas resource potential of Big Thicket National Preserve in east Texas. The oil and gas plays of the entire Gulf Coast region were most recently assessed in 1995 (Schenk and Viger, 1996). Big Thicket National Preserve lies along the east Texas Gulf Coast and is within the Western Gulf Province. The oil and gas plays developed in 1995 for the Western Gulf Province formed the basis for this more localized assessment of Big Thicket National Preserve.

The first step in the assessment process was to define hydrocarbon plays that were then assessed for undiscovered oil and gas resources. A play is defined as a set of known or postulated oil and (or) gas accumulations sharing similar geologic, geographic, and temporal properties, such as source rock, migration pathway, timing, trapping mechanism, and hydrocarbon type. The geologic formations that may be productive in the future at Big Thicket National Preserve include the Upper Cretaceous Tuscaloosa Formation, Upper Cretaceous Austin Chalk (Austin Group), the Paleocene-Eocene Wilcox Group, the Eocene Yegua Formation and other sandstones of the Claiborne Group, the Oligocene Vicksburg Formation, and the Oligocene Frio Formation. The two plays developed for this assessment reflect genetic groupings of this stratigraphy.

Following the geologic definition of the plays, the second step involved data allocation and evaluation, which formed the basis of this geologically based field-size assessment. Third, the geologic data from the geologist was entered into a Monte Carlo simulation model to calculate undiscovered oil and gas resources for each of the plays. Finally, in Step 4, the allocations of undiscovered resources to Big Thicket National Preserve were made using an analysis of richness factor.

Step 1. Geologic Play Definition

The oil and gas plays of the 1995 Assessment were developed to assess much larger areas of the Gulf Coast (Schenk and Viger, 1996) than we are interested in for this study. Here, we defined two plays that merge much of the oil and gas field data that was divided stratigraphically for the 1995 Assessment so that the allocation of resources to Big Thicket National Preserve is based on field rather than reservoir data. For example, in the 1995 Assessment the area of Big Thicket National Preserve was underlain by several plays that extended across much of coastal Texas. These plays were combined to make the assessment of the small parcel of land of Big Thicket more manageable.

The two plays developed for this study are the Tertiary Oil and Gas Play and the Upper Cretaceous Gas Play. The Tertiary Oil and Gas Play contains all or parts of the following plays from the 1995 National Assessment (Schenk and Viger, 1996): 4701- Houston Salt Dome Flank Oil and Gas; 4719- Lower Wilcox Fluvial Oil and Gas; 4720- Lower Wilcox Downdip Overpressured Gas; 4722- Upper Wilcox Shelf Edge Gas and Oil; 4723- Upper Wilcox Downdip Overpressured Gas; 4726- Yegua Updip Fluvial-Deltaic Oil and Gas; 4727- Yegua Downdip Gas; 4728- Vicksburg Updip Gas Play; 4735- Frio SE Texas/S. Louisiana Mid-Dip Gas and Oil; and 4736- Frio SE Texas/Louisiana Downdip Gas. The Upper Cretaceous Gas Play contains all or parts of the following plays from the 1995 National Assessment: 4709- Tuscaloosa Deep Sandstone Gas; 4710- Woodbine South Angelina Flexure Oil and Gas; and 4711- Austin Shelf Edge Gas and Oil.

Tertiary Oil and Gas Play

General Description

The Tertiary Oil and Gas Play is bounded to the west by the San Marcos Arch, to the north by the updip extent of Tertiary reservoirs, and to the south by the postulated downdip extent of potential fluvial, deltaic, shoreline, shelf, and shelf-edge deltaic reservoirs. The Tertiary Oil and Gas Play as defined for this assessment is a combination of several more narrowly defined stratigraphic plays for the U.S. National Oil and Gas Assessment (Schenk and Viger, 1996). Big Thicket National Preserve is confined within this play, and represents approximately 0.6% of the total play area (see Figure 1 on page G-8).

The Tertiary stratigraphic section in the Gulf Coast represents episodic sedimentation where major clastic wedges prograded gulfward from north to south (Winker, 1982; Galloway and others, 1991). The major clastic wedges that are important to the assessment of Big Thicket include the Wilcox, the Yegua (Claiborne Group), the Vicksburg, and the Frio. Each of these sedimentary wedges contains significant oil and gas discoveries (Galloway and others, 1983; Kosters and others, 1989), but the Yegua (and associated sandstones) and Frio intervals are the main units underlying the area of Big Thicket, and have the best potential for undiscovered oil and gas in the area.

The play boundary was drawn to encompass fluvial, deltaic, shoreline, barrier, shelf, and shelf-edge deltaic reservoirs in the stratigraphic units from the Wilcox to the Frio. These facies are predicted to form the main reservoirs in undiscovered fields. Other reservoirs may be present, such as slope/fan sandstones in the Wilcox interval.

Reservoirs and Reservoir Quality

Reservoirs in this play are considered to be mainly fluvial, deltaic, shoreline, barrier, shelf, and shelf-edge deltaic sandstones. Published information on reservoir quality of the Wilcox to Frio sandstones shows that in general the fluvial-deltaic-shoreline sandstones exhibit excellent reservoir properties (Bebout and others, 1978; Coleman and Galloway, 1990; Humphrey, 1986; Loucks and others, 1977; Richmann and others, 1980; Taylor and Al Shaieb, 1986). Wilcox sandstones have porosities up to 26%, with permeabilities up to 600 millidarcys (mD). However, permeabilities in potential slope/fan sandstones would be lower, up to 250 mD. Yegua sandstones and other Claiborne Group sandstones such as the Sparta and Queen City have porosities up to 35%, with permeabilities up to 2000 mD. Vicksburg and Frio sandstones exhibit porosities up to 30%, with permeabilities up to 1500 mD.

Source Rocks

Source rocks for the hydrocarbons in this play are not known for certain, which is true for most passive margin deltaic sequences. However, analyses of several of the mudstone intervals in the Tertiary section have shown that the mudstones may have been sources for some of the oil and

gas in Tertiary reservoirs (Tanner and Fuex, 1990). For the area of Big Thicket National Preserve, the predominant undiscovered hydrocarbon is gas rather than oil, given the depths involved in the play, the thermal history, and exploration and production to date.

Traps and Seals

The sedimentary section in this play is cut by several major growth faults, leading to complex structures throughout the section. The growth faults range from the Wilcox fault zone downdip through the Frio growth fault zone. The structures associated with growth faults and salt movement form the structures that are the traps in this play. Structures include faulted rollover anticlines, anticlines, and complexly faulted growth structures. The seals for this play are the marine mudstones that encase the fan sandstones, or encase the slope channel sandstones, or may be from the juxtaposition of mudstones against sandstones along faults. Smaller traps within the play may be stratigraphic.

Exploration

Exploration in the Tertiary Oil and Gas Play has been extensive, leading to the discovery of at least 307 oil fields and 487 gas fields greater than a minimum size of 0.5 million barrels. Given the degree of exploration maturity, the prediction is that median size of undiscovered fields will be smaller in general than in the past. The potential for undiscovered hydrocarbons in the play area is considered good, but that the chance for discovering a large field is small.

Upper Cretaceous Oil and Gas Play

General Description

The Upper Cretaceous Oil and Gas Play was developed for this study to include the assessment of undiscovered resources in the Tuscaloosa Formation, the Austin Chalk, and possibly the Eagle Ford Formation. These stratigraphic units are productive to the north of Big Thicket National Preserve, but predicted extensions of potential reservoirs down dip and beneath Big Thicket forms the geologic basis for this play. We postulate that slope/fan sandstones of the Tuscaloosa Formation have the best potential for undiscovered resources in the area of Big Thicket. However, only a portion of the area of Big Thicket exists within the postulated play boundary. Big Thicket represents approximately 0.32% of the total area of the Upper Cretaceous Gas Play (see Figure 2 on page G-9).

Reservoirs and Reservoir Quality

Reservoirs in the Tuscaloosa (and coeval Woodbine) Formation in the play area are interpreted to be slope-channel sandstones and basin-floor submarine fan sandstones (Siemers, 1978). Porosities in ultra-deep Tuscaloosa sandstones are anomalously high, with porosity in sandstones at 20,000 feet as high as 20% and permeabilities as high as 100 mD. The preservation of such excellent reservoir properties may be partly attributed to early chloritic grain coatings on framework grains that served to inhibit the subsequent formation of porosity-reducing cements (Thomson, 1979). Depths to undiscovered reservoirs may be up to 25,000 feet. The geologic uncertainty in this play is centered on two issues- the distribution of Tuscaloosa slope and fan sandstone facies and the distribution of adequate reservoir porosity within the play area.

Reservoirs in the Austin Chalk and Eagle Ford formations are interpreted to be fractured mudstones and micritic carbonates, similar to reservoirs producing from the shallower Austin trend in Texas. The existence of reservoir quality fractured Austin Chalk in the play area is conjectural at this time, but the possibility for adequate fractured reservoir does exist in the downdip Austin.

Source Rocks

Source rocks for potential gas in the Tuscaloosa Formation sandstones are interpreted to be mudstones of the Tuscaloosa, Austin, and/or Eagle Ford intervals. Source rocks for potential gas in the Austin and Eagle Ford formations are interpreted to be organic-bearing mudstones within these formations, leading to self-sourced reservoirs.

Traps and Seals

Traps for the Tuscaloosa sandstones are interpreted to be mainly stratigraphic, since the sandstones are slope-channel and basin-floor sandstones encased in coeval mudstones. Seals are provided by the enclosing mudstones. Traps in the Austin and Eagle Ford intervals are more subtle, in that fractured intervals are interpreted to be intercalated with non-fractured intervals, providing the traps and seals.

Exploration

The Upper Cretaceous Gas Play contains 16 gas fields larger than a threshold value of 36 bcf. The degree of exploration in this play to date is considered immature. The ultra-deep area of this play, with the potential for Tuscaloosa sandstones reservoirs, is considered to have excellent potential for gas, a conclusion also reached in the 1995 National Assessment (Schenk and Viger, 1996).

Step 2. Oil and Gas Data Allocation and Evaluation

Once the plays were defined geologically, we then organized and allocated all of the pertinent oil and gas information for existing fields for each play using digital techniques.

Data Retrieval and Data Allocations

The oil and gas field data for the play areas were initially retrieved from the Nehring Significant Oil and Gas Field File, a commercially available database. Oil and gas wells for the play areas were retrieved from the Petroleum Information Well History Control One-Line File, another commercially available database. The oil and gas fields and wells for each play were allocated digitally within the play boundaries using Arc/Info.

One of the basic tenets of assessment methodology that we used in this study is that estimates must be available for discovered field size within each play. Field size is the sum of 1) oil and/or gas production to date, 2) calculated reserves, and 3) and estimate of field growth (inferred reserves). The total production and reserves data are from the Nehring database, but we must estimate the amount of growth that may occur in each field within each play.

Field growth is a long-acknowledged phenomenon of oil and gas fields. Basically, the reported size of a field changes with time, with most fields growing with time compared to a field's first reported size, for several reasons. For all fields in a play we must make an estimate of the grown size before we can begin to use plots of the historical data in our assessment process. For the plays defined in this study, we used a growth function that was developed for onshore Gulf Coast fields by Root (1996) for the 1995 National Assessment. All of the historical data plots were constructed using field sizes incorporating field growth.

We assessed the undiscovered oil and gas resource within each play for this study. We did not make a separate assessment of the amount of oil and gas (inferred reserves) that would potentially be available from field growth of existing fields. We only assessed the potential for new field discoveries; if a deeper pool were discovered in an existing salt-dome field, for example, that

pool would fall under the category of reserves in an existing field. This is a critical distinction that must be considered when using the results of this assessment.

Plots of Historic Data

Once grown fields were digitally assigned to each play, then a series of plots of the historic data were constructed that were used as guides in the development of distributions of sizes and numbers of undiscovered accumulations, with the geology of the play being a major constraint. The data plots included numbers of accumulations discovered with time, numbers of fields vs field size, field size vs time, field size vs numbers of exploratory wells, numbers of fields vs exploratory wells, and a series of plots with parameters such as API gravity, gas/oil ratio, and reservoir depth. These plots are used in conjunction with play geology and predictions as to future trends, technologies, and new exploration concepts to estimate a distribution of undiscovered field size and number for each play. Ancillary data, such as gas/liquids ratio and natural gas/liquids ration were included so that we could calculate co-products such as natural gas liquids and associated gas resources.

Data Form

The data form used in the assessment is one that is now standard for assessments by the Central Energy Team. Key input parameters include minimum field size to be assessed; the risk structure for hydrocarbon charge, adequate reservoirs, and timing; distributions of sizes and numbers of undiscovered accumulations, and input for co-product calculations. The form was completed for each play. Following the completion of the data form, a formal review meeting was held during which the geologist presented the geology of each play, and defended the input data on the form to a group comprising the USGS assessment review team. Once the review was completed, the data form was released to the modeler for input in the Monte Carlo process.

Step 3. Quantitative Methodology

The data on the form was input into a Monte Carlo model. The Monte Carlo model produced an estimate of undiscovered resources in each play. Calculations of undiscovered resources were made using a USGS program based on Microsoft Excel and Crystal Ball, a commercial Monte Carlo simulation program that works within Excel. During each iteration of the simulation, a sample taken from the field size distribution gave the number of undiscovered fields within the play. Many independent samples from the field size distribution were taken and summed. A key result from the Monte Carlo simulations is the prediction of the “most likely largest undiscovered field” in the play. Amounts of natural gas liquids and geographic resource allocations were calculated by multiplication of appropriate factors given on the data form. This was redone for a total of fifty thousand iterations, producing relatively smooth output distributions.

Step 4. Allocation of Undiscovered Resources to Big Thicket

To allocate undiscovered resources from the plays to the area of Big Thicket National Preserve, we used a method called “richness-factor analysis” (Crovelli, 1983). The essence of this method is to determine the degree to which undiscovered resources can be reasonably assigned from a larger play to a smaller parcel of land such as Big Thicket, given the percentage of land that Big Thicket occupies within the play and the geographic position of Big Thicket with respect to the petroleum geology of the play. For example, Big Thicket represents about 0.6% of the Tertiary Oil and Gas Play; if undiscovered resources were evenly distributed across the play, then Big Thicket would contain 0.6% of the resources of the play. However, the geology of the play, particularly the distribution of potential Yegua and associated reservoirs, suggests that the amount of resource may be twice (richness factor of 2) that of a one-to-one assessment of Big Thicket. Thus, Big Thicket would be “enriched” relative to the rest of the play. Given the geology of the plays and the

exploration trends and new concepts, we chose a richness factor of 2 for the Tertiary Oil and Gas Play, and a richness factor of 1.5 for the Upper Cretaceous Gas Play.

Assessment Results

Results of the richness-factor allocation of conventional oil and gas resources from the assessment of the two plays are given in Table 1 on page E-7. One result of the Monte Carlo simulation procedure is the estimation of the most likely "largest undiscovered field" in each play. For the Tertiary Oil and Gas Play, the simulation predicted a "most likely largest oil field size" of about 8.7 million barrels, and a "most likely largest gas field size" of 121 bcf. This suggests that within the play boundary, including the area of Big Thicket, there is a probability at the mean for an oil field and a gas field of these sizes. For the Upper Cretaceous Gas Play, the simulation suggested a "most likely largest gas field size" of 1.37 tcf, a field that could partially underlie the area of Big Thicket National Preserve.

The application of the richness factors to the assessment results from the two plays indicate that, at the mean, Big Thicket may contain 1.15 million barrels of oil in undiscovered oil fields, 3.21 bcf of associated gas, 32.92 bcf of gas in undiscovered gas fields, and approximately 1 million barrels of condensate in undiscovered gas fields as allocated from the Tertiary Oil and Gas Play; Big Thicket may contain 33.98 bcf in undiscovered gas fields, and approximately 1 million barrels of condensate in undiscovered gas fields as allocated from the Upper Cretaceous Gas Play. Assuming perfect positive correlation between the plays, the results by fractile can be summed as follows for Big Thicket; 1.15 million barrels of oil in undiscovered oil fields, 3.21 bcf gas in oil undiscovered oil fields, 66.90 bcf gas in undiscovered gas fields, and 2.01 million barrels of condensate in gas and oil fields.

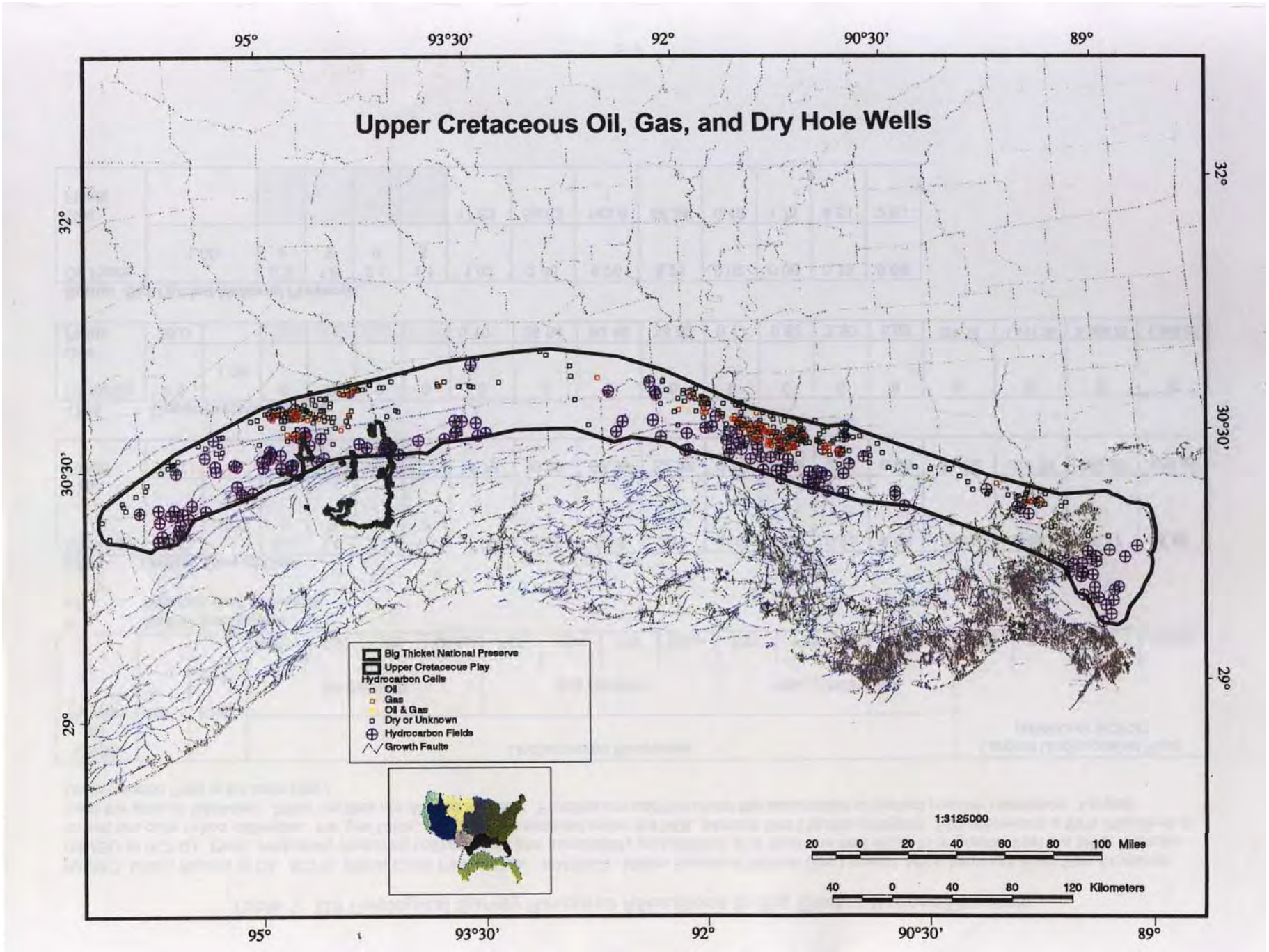
These values of undiscovered resources of oil and gas for Big Thicket National Preserve represent resources in potential new field discoveries, not inferred reserves from the growth of existing fields. With the proliferation of new technologies such as 3-D seismic the potential for growth of existing fields in the area of Big Thicket is high. In many areas of the U.S. the potential for field growth is higher than the potential for new field discoveries. The assessment of inferred reserves in existing fields was not a component of this study.

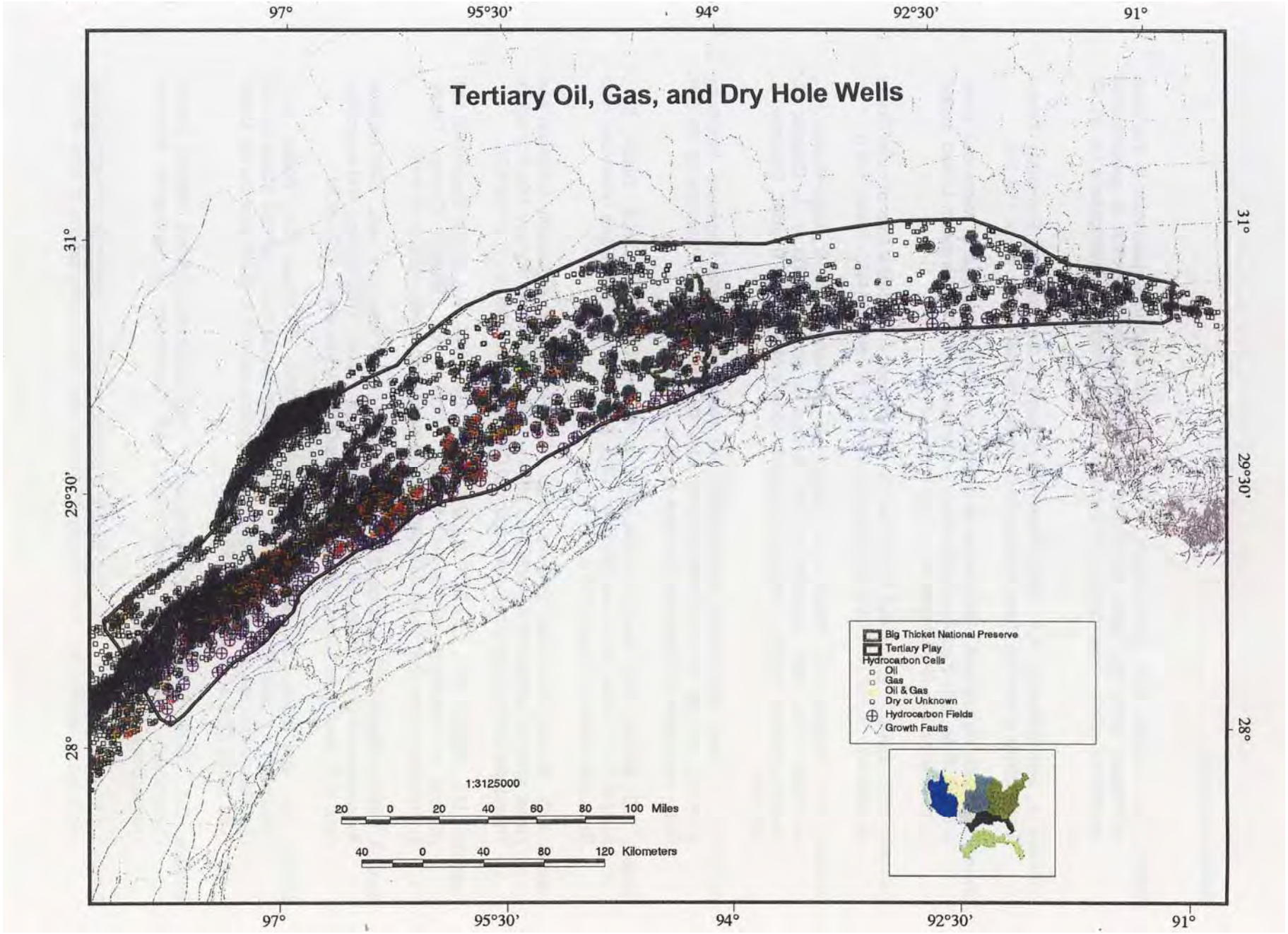
Table 1. U.S. Geological Survey Assessment Results for Big Thicket National Preserve

MMBO – Million Barrels of Oil
BCFG – Billion Cubic Feet of Gas
MMBNGL – Million Barrels of Natural Gas Liquids

For gas fields, all liquids are included under the NGL (Natural Gas Liquids) category.
F95 represents a 95% chance of at least the amount tabulated. Other fractiles are defined similarly. Fractiles are additive under the assumption of perfect positive correlation.

USGS ID Number	Undiscovered Resources																		Largest Undiscovered Field (MMBO or BCFG)					
	Oil (MMBO)						Gas (BCFG)						NGL (MMBNGL)											
	F95	F75	F50	F25	F5	Mean	F95	F75	F50	F25	F5	Mean	F95	F75	F50	F25	F5	Mean	F95	F75	F50	F25	F5	Mean
6	**Gulf Coast Region**																							
47	**Western Gulf Province**																							
4754	**Tertiary Oil and Gas**																							
Oil Fields	0.39	0.75	1.09	1.48	2.10	1.15	1.02	2.00	2.96	4.15	6.26	3.21	0.02	0.04	0.06	0.08	0.13	0.06	3.93	6.05	8.08	10.87	15.27	8.66
Gas Fields							11.73	20.73	30.09	42.59	63.35	32.92	0.32	0.59	0.88	1.27	2.01	0.99	65.70	92.64	117.53	147.37	185.63	120.69
4755	**Upper Cretaceous Gas**																							
Oil Fields	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
Gas Fields							6.10	15.85	28.54	46.79	80.46	33.98	0.17	0.45	0.83	1.39	2.50	1.02	329.10	689.82	1,111.36	1,778.39	3,369.78	1,366.05
Sums:	**Big Thicket National Preserve**																							
Oil Fields	0.39	0.75	1.09	1.48	2.10	1.15	1.02	2.00	2.96	4.15	6.26	3.21	0.02	0.04	0.06	0.08	0.13	0.06						
Gas Fields							17.83	36.58	58.63	89.38	143.81	66.90	0.49	1.04	1.71	2.66	4.51	2.01						


Upper Cretaceous Oil, Gas, and Dry Hole Wells
95°
93°30'
92°
90°30'
89°
32°
30°30'
29°
Big Thicket National Preserve
Upper Cretaceous Play
Hydrocarbon Cells
Oil
Gas
Oil & Gas
Dry or Unknown
Hydrocarbon Fields
Growth Faults
1:3125000
20 0 20 40 60 80 100 Miles
40 0 40 80 120 Kilometers


Tertiary Oil, Gas, and Dry Hole Wells
97°
95°30'
94°
92°30'
91°
31°
29°30'
28°
Big Thicket National Preserve
Tertiary Play
Hydrocarbon Cells
Oil
Gas
Oil & Gas
Dry or Unknown
Hydrocarbon Fields
Growth Faults
1:3125000
20 0 20 40 60 80 100 Miles
40 0 40 80 120 Kilometers

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APPENDIX F

GUIDELINE FOR THE DETECTION AND QUANTIFICATION OF CONTAMINATION AT OIL AND GAS OPERATIONS

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I. WHAT IS THE PURPOSE OF THIS DOCUMENT?

This document is to be used as a guideline for collecting samples at sites within National Park Service (NPS) units where there are oil or gas operations. Samples will indicate whether or not contamination exists at the site as a result of an operation.

It is important that specific contaminants are tested for and that specific methodology is used so that contamination is accurately defined and so that results taken at different times by different people at the same site can be reliably compared. This guideline presents methodology for analyzing soil, sediment, groundwater, and surface water.

Specifically, guidelines are presented for: 1) when owner/operators must collect samples, 2) what contaminants to test for, 3) how to collect samples, 4) quality assurance/quality control, 5) how to analyze samples in the laboratory, 6) required detection limits and choosing environmental benchmarks, and 7) sample plan and reporting requirements.

Note that in this guideline “Superintendent” refers to the Superintendent and/or members of his/her staff who will represent him/her on these issues. In many cases, the Superintendent's actual involvement may be only that of approving the recommendations of the staff member(s).

II. WHEN AND WHERE TO COLLECT SAMPLES

The Superintendent can require sampling by an operator at a site if it has recently experienced a release, has a history of releases, or the facility is operated in a manner that poses a risk of releasing crude oil, natural gas condensates, produced water, or any other “contaminating substance” associated with an oil or gas operation.

Sampling can occur at any time during or after an operation. ("After" refers to when an owner/operator sells the operation, transfers its leasing rights, or closes the operation and abandons the site.) In most instances, sampling by the operator should be conducted under the direction of a Sampling and Analysis Plan that has been approved by the Superintendent to ensure all work will be performed in a professional manner, meets the resource protection needs of the park, and with the knowledge of the appropriate Park staff.

Sampling will be biased, not random, focusing on areas where contamination is obvious (visible) or suspected (such as near production or storage facilities). The exact sample locations and number of samples collected are site-specific and will be determined by the Superintendent, or proposed by the site operator in a Sampling and Analysis Plan or Work Plan submitted to the Superintendent for review and approval. Owner/operators are responsible for sample collection, sample analyses, and reporting of results, not NPS.

Sample data from a nearby (but off-site) "clean" location will be needed to determine "background" concentrations at the site for the contaminants of concern. A comparison of the contaminated site data with "background" data will allow resource managers to determine how contaminated the site is. If the site has been remediated, comparisons of sample data with "background" data can indicate if the clean-up met the Superintendent's remediation goals for the site.

Note that incoming owner/operators at new or existing oil or gas operations may wish to test the site for contamination before they begin operations. If they choose to do so, it is strongly suggested they test for the contaminants and use the methodology given in this guideline so that if samples are required during or after the operation for any reason, all data can be reliably compared.

III. WHAT CONTAMINANTS TO TEST FOR

Contaminating substances that can be found at oil and gas sites are primarily crude oil, natural gas condensate, produced water, drilling mud, lube (motor) oil, and solvents. The individual contaminants found in these substances are listed in Table 1. Though other contaminants also are found in these substances, those in Table 1 were chosen because of their greater environmental toxicity and because they are good indicators of the presence of the contaminating substance(s) of interest.

When contamination of a site by one of these six contaminating substances is being investigated, sampling and analyses for some or all of the individual contaminants found in that contaminating substance should occur. Two lists of contaminants were compiled and are designated as "Tier I" (the smaller group, indicated by "xx" in Table 1) and "Tier II" (the more comprehensive group, indicated by both "xx" and "x"). Having two tiers to choose from allows the Superintendent flexibility in what contaminants he/she requires that the operator test for. The Tier I contaminants are included in the Tier II contaminants and therefore will always be tested for.

Tier I sampling should be conducted when basic information is needed. For instance, if contamination at a site is suspected but not known, testing for Tier I contaminants will confirm this; it will also give an idea of the severity of contamination. Tier I sampling might also be conducted where Park natural resources (like groundwater, vegetation, or surface water) are at low/no risk.

Table 1: Contaminants to test for when investigating various types of contamination at oil and gas sites. Contaminants that should be tested for during Tier I sampling are indicated by "xx", while those with either an "x" or "xx" should be tested for during Tier II sampling.

contaminant	where found: soil/sediment = S groundwater/ surface water = W	Contaminating substances individual contaminants are associated with: crude oil	condensate [i]	produced water	drilling mud	lube (motor) oil	solvents [k]
PAHs [a]	S, W	x	x	x	x	x	x
TPH [b]	S, W	xx	xx	x	x	xx	xx
BTEX [c]	S, W	x	xx	x	x	x	xx
metals [d]							
arsenic	S, W	x		x	x	x	
barium	S, W	x		xx	xx	x	
cadmium	S, W	x		x	x		
chromium	S, W	x		x	xx	x	
copper	S, W	x		x	x	x	
iron	S, W		x				
lead	S, W	x		x	x	xx	
magnesium	S, W	x		x	x	x	
mercury [e]	S, W	x		x	x		
nickel	S, W	xx		x		x	
selenium	S, W	x			x		
strontium	S, W	x		xx			
vanadium	S, W	xx		x	x		
zinc	S, W	x		xx	x	xx	
ammonia [f]	W	x		x			
calcium	W			x	x	x	
chloride	S, W			xx			
potassium	W	x		x	x		
sodium	S, W				xx	xx	xx
sulfates	W			x			
gross alpha emissions [g]	W			x			
radium-226 [g]	S			xx			
pentachlorophenol	S, W				x		
surfactants	S, W				x		
pH	S, W	x	x	x	x		
conductivity/salinity [h]	S, W		x	xx	xx		
TDS	W			x	x		
grain size	S	x	x	x	xx	x	
total organic carbon	S	x	x	x	x	x	x
percent moisture [i]	S	xx	xx	xx	xx	xx	xx
static water level [j]	W	xx	xx	xx	xx	xx	xx
temperature	W	xx	xx	xx	xx	xx	xx

a = Polycyclic Aromatic Hydrocarbons. The lab analysis required in this guideline detects approximately 38 individual compounds including the priority pollutant “parent” compounds and their alkylated homologs. See Table 2 for a full list of these. Note that these 38 compounds are measured with a single analytical test (i.e. there is not a separate test for each compound). When testing water for PAHs, do for groundwater only unless ongoing surface water contamination from adjacent contaminated soil, sediment, or aquifer is suspected.

b = Total Petroleum Hydrocarbons. Certain "ranges" of hydrocarbons should be analyzed for, depending on the contaminating substance. For crude oil, a “full range” or “wide range” TPH scan should be conducted; for natural gas condensate a “lighter end” TPH scan, like for “gasoline range organics” (GRO) or total volatile petroleum hydrocarbons (TVPH) C_6-C_{10} should be conducted; and for diesel fuel a TPH scan for “diesel range organics” (DRO) or total extractable petroleum hydrocarbons (TEPH) C_{11}-C_{34} should be conducted. See section VI.A for details.

c = Benzene, Toluene, Ethylbenzene, Xylene. Only test for these in soil, sediment, or surface water if contamination is very recent and sampling is for initial (preliminary) assessment purposes.
d = analyze all metals for the “total recoverable” fraction

e = analyze soil (or sediment) for mercury only if mercury manometers are suspected to have been used on-site in the past (natural gas operations only)

f = report both the “total” and “unionized” fractions

g = note that if gross alpha in water exceeds a certain level, further testing for radioactive elements may be required. Radium-226 analyses must use gamma spectroscopy; this test takes approx. 30 days. At sites where produced water contamination may be more recent (in the last 10 yrs), gamma ray emissions in the soil can be preliminarily measured in the field (e.g. with a MicroRmeter) to determine if the radium-226 soil analyses are necessary.

h = salinity can be calculated from conductivity measurements

i = percent moisture is necessary to calculate the required dry weight and wet weight units

j = for groundwater only

k = can be from a gas production facility or a gas pipeline

l = various solvents can be used on-site (e.g. benzene, toluene, ethylbenzene, xylene, various petroleum products, etc.). Analyte tested for depends on the particular solvent used on-site.

Table 2: Polycyclic aromatic hydrocarbons (PAHs) detected by the recommended “expanded scan” analysis for PAHs (see section VI.A). These compounds include the so-called priority pollutant “parent” compounds plus their alkylated homologs. Note that the 38 compounds below are measured with a single analytical test (that is, there is not a separate analytical test for each compound).

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(e)pyrene

Benzo(a)pyrene
Biphenyl
Chrysene
Chrysene, C1-
Chrysene, C2-
Chrysene, C3-
Chrysene, C4-
Dibenzo(a,h)anthracene
Dibenzothiophene
Dibenzothiophene, C1-
Dibenzothiophene, C2-
Dibenzothiophene, C3-
Fluoranthene
Fluoranthenes/Pyrenes, C1-
Fluorene
Fluorene, C1-
Fluorene, C2-
Fluorene, C3-
Ideno(1,2,3,c,d)pyrene
Naphthalene
Naphthalene, C1-
Naphthalene, C2-
Naphthalene, C3-
Naphthalene, C4-
Perylene
Phenanthrene
Phenanthrenes/Anthracenes, C1-
Phenanthrenes/Anthracenes, C2-
Phenanthrenes/Anthracenes, C3-
Phenanthrenes/Anthracenes, C4-

Tier II sampling should be conducted when more detailed information is needed. For instance, if clean-up activities at a site have been completed, testing for Tier II contaminants will confirm if all (or nearly all) the contaminants have, in fact, been removed. Tier II sampling might also be conducted at sites where important Park natural resources are at a higher risk of being exposed to contaminants and where more stringent cleanup standards than those promulgated by a State regulatory body may be appropriate..

The Superintendent will determine whether Tier I or II is needed. Some combination of the two may also be used. He/she may also choose to omit or add contaminants to the Tier I or II lists should the situation warrant it.

Note that Table 1 does not include all possible contaminants associated with oil or gas operations. Other contaminating substances involved are: caustic solutions used in natural gas sweetening (these can contain sodium, pH, amines, and EDTA contaminants); glycols used in natural gas dehydration; and surfactants, acidizing agents, corrosion inhibitors, solvents, biocides, etc. used in oil or gas well workover and completion. The Superintendent may require that contaminants associated with these substances be tested for if they are suspected of having been released on-site.

IV. HOW TO COLLECT SAMPLES

A. Sample Locations

1. Soil

Background samples should be collected from an area as close to the site as possible where it is certain no contaminating substances from the site could have reached (from surface runoff, off-site dumping, migration from wind, etc.).

For soils that are known to be contaminated, samples should be collected from the spot and depth where contamination appears to be highest. For sites where soils are suspected of being contaminated, seek out areas near production facilities, storage tanks, valves, etc., and adjacent low points in the topography where contaminated runoff may have passed over or "puddled up" and concentrated. Collect sample at a depth where contamination would be highest: in most cases probably the top one to two inches. Note that releases in very porous (e.g. sandy) soil may percolate down and pool immediately above deeper, less porous soil layers (e.g. clay or silt strata, particularly if saturated), pool at the water table, or concentrate in highly organic layers..

For sites where removal of contaminated soils has already occurred, a sample should be collected in the top inch or so of the newly exposed soil to insure that all the contaminants that percolated down into the soil were, in fact, removed. (Note: At hydrocarbon release sites, screening of soils at the base of the excavation for volatile organic compounds/VOCs with a photo-ionization detector could improve the confidence that Tier II sample selection is sufficient to confirm a site is clean.)

All samples will be grab samples. (As a rule, composite samples should not be collected.) Where contamination is suspected but not known, the sampling device probably should be some type of tube or auger in order to capture equal amounts of soil over the depth of the profile; depending on the properties of the soil (like how hard or rocky it is), however, other devices (like a trowel) may work better. Sample collectors may have to communicate with the laboratory to ensure that enough soil is collected for the various analyses.

For BTEX samples, see section B.1. below.

The total number of samples to be collected will be site-specific and determined by the Superintendent. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

2. Sediment

Background samples should be collected from sediment adjacent to the sediments in question, but where it is reasonably certain no contaminating substances from the site (or other sites in the area) could have reached (from surface runoff, off-site dumping, etc.).

As with soils, sediments known to be contaminated should be sampled from the spot and depth where contamination appears to be highest. For sediments suspected of being contaminated, seek out areas near production facilities, storage tanks, valves, etc., and adjacent areas where potentially contaminated sediment in runoff could have settled out. Sample the sediment that has accumulated since the spill/release began. In some cases this may be the top ¼ inch, in others it may be the top several inches.

For sites where removal of contaminated sediments has already occurred, samples should be collected in the newly exposed sediment to insure that all contaminants were, in fact, removed.

All samples will be grab samples. (As a rule, composite samples should not be collected.) Where contamination is suspected but not known, or the layer of contaminated sediment is more than a couple inches thick, the sampling device probably should be some type of tube or auger in order to capture equal amounts of sediment over the depth of the profile; depending on the properties of the sediment (like how rocky it is) and the depth of the water, however, other devices may work better. Sample collectors may have to communicate with the laboratory to ensure that enough sediment is collected for the various analyses.

The total number of samples to be collected will be site-specific and determined by the Superintendent. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

3. Groundwater

Groundwater samples should be collected if the Superintendent determines that hydrogeological conditions at the site are such that groundwater resources under or near the site are reasonably at risk. Samples can be collected either via established monitoring wells or with "push" technology (such as Geoprobe®).

It is critical that: a) sampling occurs in the right areas (for example, one location must be upgradient of the potential point of impact and at least two must be downgradient); and b) wells are screened at the appropriate depths to intercept any contaminant plume(s). (This will require knowledge of the local hydrogeology and the contaminants involved and their environmental fate characteristics). If "push" technology is used to collect soil samples for lab analysis or for on-site screening of various media (soil, ground water) for contaminants and samples are collected on more than one occasion, care must be taken to sample the exact same locations and at the same depths in the aquifer. Typically, once contamination is found in ground water using screening methodologies, monitoring wells are required by State regulatory agencies to ensure sample quality and integrity is sufficient to base regulatory decisions.

"Low-flow" sample collection methods should be used as per the EPA guidance document in IV.B.3 below.

Groundwater samples should not be filtered.

For BTEX samples, see section B.3. below.

All samples will be grab samples. (As a rule, composite samples should not be collected.) Sample collectors may have to communicate with the laboratory to ensure that enough sample is collected for the various analyses.

The total number of samples to be collected will be site-specific and determined by the Superintendent or through his/her approval of the owner/operator's Sampling and Analysis Plan after consultation with Park resource staff. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

4. Surface Water

Background samples should be collected upstream of any possible inputs of contaminated water (e.g. surface runoff or shallow groundwater) from the site.

Where contamination is obvious, such as in a surface sheen, collect samples right at the surface, avoiding any scum, algae, or other detritus on the water surface if possible (and note in fieldbook if present). Where a contaminating substance such as chlorinated solvents (dense nonaqueous phase liquids , or DNAPLs) was released or is suspected at the bottom of an aquifer (e.g. above a clay layer or aquitard), then collect samples at a depth immediately above the base of the aquifer, the depth of the first fine-grained layer below the water table, or both. For surface water suspected of being contaminated but it is unknown whether the contaminants are "floaters" or "sinkers," collect samples at a depth of 3-12 inches.

For BTEX samples, see section B.4. below.

Again, all samples will be grab samples. (As a rule, composite samples should not be collected.) Sample collectors may have to communicate with the laboratory to ensure that enough sample is collected for the various analyses.

The total number of samples to be collected will be site-specific and determined by the Superintendent. Factors such as flow, depth, and the size of the water body are important here. Enough samples should be collected and analyzed to meet the Tier I or Tier II sampling objective (see section III).

B. Sample Collection Methodologies

Acceptable sampling methodology must be used so that results are as representative as possible. Sample collection can be complex and should be conducted by experienced professionals (typically a contractor). This could also help if the values or methods are challenged by one of the interested parties involved (State regulatory agency, Park, owner/operator etc.). Furthermore, experienced professionals are also trained in the appropriate precautions to protect the health and safety of the sample collector(s) from exposure to potentially harmful contaminants or hazardous situations that could develop.

Methodologies that should be used are typically those accepted/sanctioned by the appropriate State regulatory agency or are found in publications of widely recognized organizations (e.g. EPA, NOAA) that conduct environmental research.. Acceptable methodologies are listed below for each environmental media (soil, sediment, etc.). In general, the State is authorized as the lead regulatory agency and should be the initial contact for appropriate sampling methodologies to employ when various environmental media are believed contaminated. In site-specific situations where a sensitive Park resource is threatened and more stringent cleanup than that required by a State agency may be appropriate, Park staff should consult WASO support offices as needed for appropriate criteria prior to discussion of more stringent cleanup levels with the owner/operator. If sample collection methodologies other than the above are used, they must contain the following to be acceptable: 1) Applicability of the procedure, 2) Equipment required, 3) Detailed description of procedures to be followed in collecting the samples, 4) Common problems encountered and corrective actions to be followed, and 5) Precautions to be taken. The methodology to be used must be cited in the sample plan. A basic description of collection methodology should be included in the report to the Superintendent (section VIII).

1. Soil

Methods from source documents published by the following organizations are acceptable:
-State Governing Regulatory Agency
-U.S. EPA
-American Society for Testing and Materials
-U.S. Department of the Interior

-American Petroleum Institute

Note that when collecting soil samples for BTEX analysis, specialized equipment and collection methods are necessary. Use a coring device such as the EnCore™ sampler or disposable plastic syringes. For detailed guidance, see section 4.1 and method 5035 in Chapter 4 of EPA's SW-846, Update III (full reference in section VI.A. below).

2. Sediment

Methods from source documents published by the following organizations are acceptable:
- State Governing Regulatory Agency
-U.S. EPA
-American Society for Testing and Materials
-U.S. Department of the Interior
-American Petroleum Institute

3. Groundwater

Use: Environmental Protection Agency. 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance. EPA/530/R-93-001. Office of Solid Waste, EPA, Washington, D.C.; or Publications of State Governing Regulatory Agency (DEQ, DEM, State EPA etc.)

"Low-flow" sampling should be conducted; for guidance, see:
Puls, R.W. and M.J. Barcelona. 1996. Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. EPA/540/S-95/504. Office of Solid Waste and Emergency Response, EPA, Washington, D.C.

Note that when collecting water samples for BTEX analysis, specialized equipment and collection methods are necessary. For detailed guidance, see section 4.1 and method 5030B in Chapter 4 of EPA's SW-846, Update III (full reference in section VI.A. below).

4. Surface Water

Methods from source documents published by the following organizations are acceptable:
-State Governing Regulatory Agency
-U.S. EPA
-American Society for Testing and Materials
-U.S. Department of the Interior
-American Petroleum Institute

Also recommended is this NPS guidance: Stednick, J.D. and D.M. Gilbert. 1998. Water quality inventory protocol: Riverine environments. National Park Service, Water Resources Division, Technical Report no. NPS/NRWRD/NRTR-98/177. Fort Collins, CO, 103 pp.

Note that when collecting water samples for BTEX analysis, specialized equipment and collection methods are necessary. For detailed guidance, see section 4.1 and method 5030B in Chapter 4 of EPA's SW-846, Update III (full reference in section VI.A. below).

C. Sample Containers, Preservation, Storage

Refer to documents listed in sections VI.A. below and IV.B. above for specific guidance, including 40 CFR Part 136, if necessary. EPA's SW-846, Update III is especially helpful.

Note that sediment samples should not be acidified for metals and that neither groundwater nor surface water samples should be filtered. Remember special conditions when sampling for BTEX (see section 4.1 and methods 5030 and 5035 in Chapter Four of SW-846, Update III) and for any metals requiring unusually low detection limits.

D. Chain of Custody

Proper chain-of-custody procedures must be used in sample handling (collection, shipping, storage, analysis). For examples, see Standard Methods for the Examination of Water and Wastewater for general guidance, and SW-846, Update III, Chapter 9, section 9.2.2.7 for detailed guidance.

V. QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control (QA/QC) plans or Quality Assurance Project Plans (QAPPs) ensure that the data generated are scientifically valid, defensible, and of known precision and accuracy. Some of the basic elements of QA/QC or QAPP plans are:

- data quality objectives (DQO)
- field operating procedures (such as sample management, decontamination, equipment calibration, etc.)
- field QA/QC requirements (such as data handling, collection of control samples like blanks, spikes and duplicates, etc.)
- lab operating procedures (such as sample management, equipment calibration, etc.)
- lab QA/QC procedures (such as data handling, control samples, etc.).

A QA/QC plan should be in place before any sampling begins. Basic QA/QC procedures to be followed should be described briefly in the sample plan (section VIII). If a certain QA/QC guidance document is used, it should be cited in the sample plan. Many guidance documents are available—several through EPA—including the following, recommended here:

> Environmental Protection Agency. 1997. Test methods for evaluating solid waste, physical/chemical methods (SW-846), 3rd edition, Update III, Chapter One. EPA Office of Solid Waste and Emergency Response, EPA, Washington, D.C.

Adherence to the QA/QC plan should be documented throughout the project and demonstrated in the final report to the Superintendent.

Aspects of quality assurance that may be helpful can be found in:

> Environmental Protection Agency. 1996. The volunteer monitor's guide to quality assurance project plans. EPA Office of Wetlands, Ocean and Watersheds 4503F. EPA publication number: EPA 841-B-96-003. Also available at: http://www.epa.gov/owow/monitoring/volunteer/qappcover.htm

VI. HOW TO ANALYZE SAMPLES IN THE LABORATORY

A. Analytical Methods

Metals analyses must use the methods in EPA's SW-846, Update III (or more recent). This applies to soil, sediment, groundwater, and surface water samples. Groundwater and surface water methods can also include EPA's 200 series for metals, or the 1600 series where extremely low (state-of-the-art) detection limits are desired. The full reference for the SW-846 document is:

> Environmental Protection Agency. 1997. Test methods for evaluating solid waste, physical/chemical methods (SW-846), 3rd edition, Update III. EPA Office of Solid Waste and Emergency Response, EPA, Washington, D.C.

Polycyclic aromatic hydrocarbon (PAH) analyses must use a modification of method 8270 in EPA's SW-846, Update III. Developed by the National Oceanic and Atmospheric Administration (NOAA), this method is referred to as "GC/MS method 8270 in selective ion mode (SIM)", and is informally referred to as the "expanded scan" for PAHs. Consult the following for a detailed explanation of methodology:

> Lauenstein, G.G., and A.Y. Cantillo (1998). Sampling and analytical methods of the National Status and Trends Program Mussel Watch Project: 1993-1996 update. NOAA Technical Memorandum NOS ORCA 130. 233 pp.

Total petroleum hydrocarbons (TPH) analyses will be for certain "ranges" of hydrocarbons, depending on the contaminating substance present. For crude oil, a **"wide range" or "full range" TPH scan** should be conducted to measure the heavier fractions. For natural gas condensate a "lighter end" TPH scan, such as for **"gasoline range organics" (GRO)**, should be conducted. For diesel fuel, a TPH scan for **"diesel range organics" (DRO)** should be conducted to measure the mid-range fractions. Although many analytical methods are available for TPH, samples should be analyzed using only GC/FID (gas chromatograph/flame ionization detection) methodology. Method 8015B in EPA's SW-846, Update III is highly recommended.

Benzene, toluene, ethylbenzene, and xylene (BTEX) analyses should use method 8260B in EPA's SW-846, Update III. Analysis for BTEX compounds is typically done in place of a TPH analysis when a refined product is released as opposed to crude oil.

Ammonia analyses should use EPA method 350.1 (or equivalent APHA method 4500-NH3 H, or USGS method 4523-85). Samples should not be filtered.

For all other contaminants in Table 1, use methods approved in 40 CFR Part 136 (EPA, Standard Methods for the Examination of Water and Wastewater (latest edition), ASTM, or USGS). Methods in the NPS, Water Resources Division "Water quality inventory protocol" (section IV.B.4 above) can also be used.

B. Laboratories

Samples must be sent to an experienced lab that can: 1) perform the above analytical methods; 2) achieve the required detection limits (section VII below); 3) perform the required QA/QC procedures (section V above); and 4) provide the information required in the sample plan and the final report to the Superintendent (section VIII below).

Note that in regards to the PAH analytical method (as specified in VI.A. above), only a few labs nationwide (perhaps a dozen) currently can perform this analysis. Many of these same labs can also "fingerprint" samples; that is, by analyzing hydrocarbon-contaminated samples, they can identify the type and source of the petroleum product at the site. A partial list of these labs follows (no government endorsement implied):

Arthur D. Little, Inc.
25 Acorn Park
Cambridge, MA. 02140
(617) 498-5000

Battell Marine Science Lab
1529 West Sequim Bay Rd.
Sequim, WA 98382
(360) 683-4151

Geochemical and Environmental Research Group
Texas A&M University
833 Graham Rd.
College Station, TX. 77845
(409) 862-2323 ext. 115

Woods Hole Group, Environmental Laboratories
375 Paramount Drive, Suite B
Raynham, MA 02767-5154
(508) 822-9300 or 563-5030

VII. DETECTION LIMITS

Note: The term "detection limit" used herein refers to what is commonly called the "reporting limit" and occasionally called the "quantitation limit. A detection limit is what a lab (using a particular instrument in some combination with analytical method and skill level of operator) can quantify low levels of a contaminant substance with acceptable confidence. It does not refer to the sometimes much lower "instrument detection limit" or "method detection limit" where how well the value obtained represents the true value may be of low confidence. Also note that detection limits should not be confused with cleanup standards or cleanup criteria. Required cleanup levels/criteria are usually set by State regulatory authorities as the acceptable contaminant residue (usually well above detection limits) that may remain in some environmental media after a remedial effort has occurred. NPS is authorized to require more stringent cleanup criteria on a case-by-case basis, particularly in site-specific situations where sensitive ecological resources could be threatened. Widely accepted, peer-reviewed research may then be used to support the NPS position that State criteria are not sufficiently protective and lower cleanup criteria are warranted.

Labs should achieve the detection limits (DLs) provided in Table 3 below. These DLs are below federal (and presumably state) standards and most other criteria currently in the literature. Therefore, analytical methods that achieve these DLs will be able to indicate if most standards and criteria are being met. Note, however, that the DLs for two contaminants—PAHs and mercury—are above some of the more strict standards or criteria that exist. This is because many labs cannot achieve DLs this low, and the DLs in the table were chosen so that most experienced and well-equipped labs could achieve them. Lower DLs are achievable for PAHs and mercury at some labs that have the expertise and special instrumentation (see section VI.B. above for examples).

If the natural resources at or near the site are particularly sensitive, pristine, or important to the Park, the Superintendent may wish to choose the strictest available standard or criteria as the remediation goal. He/she would then have to request some lower DLs (lower than those in Table 3) from the lab for PAHs and mercury.

For the contaminants in Table 1 that are not listed in Table 3, commonly reported DLs are acceptable.

Table 3: Maximum acceptable detection limits ("reporting limits") for surface water, groundwater, soil, and sediment samples. Lower detection limits are also acceptable.

Contaminant	Detection limit for surface water and groundwater samples	Detection limit for soil and sediment samples (dry weight)
PAHs	10 ppt [a]	1 ppb [c]
TPH	50 ppb	0.1 ppm
benzene	1 ppb	25 ppb
toluene	5 ppb	25 ppb
ethylbenzene	5 ppb	25 ppb
xylene	5 ppb	25 ppb
ammonia	0.05 ppm	--
arsenic	5 ppb	0.5 ppm
barium	1 ppb	1 ppm
cadmium	0.5 ppb	0.2 ppm
chromium	3 ppb	1 ppm
copper	5 ppb	1 ppm
iron	0.1 ppm	10 ppm
lead	1 ppb	5 ppm
mercury	0.2 ppb [b]	0.2 ppm [d]
nickel	5 ppb	5 ppm
selenium	1 ppb	1 ppm
strontium	10 ppb	5 ppm
vanadium	10 ppb	1 ppm
zinc	10 ppb	5 ppm

water units:
ppm = parts per million = milligrams per liter = mg/L
ppb = parts per billion = micrograms per liter = ug/L
ppt = parts per trillion = nanograms per liter = ng/L

soil/sediment units:
ppm = parts per million = milligrams per kilogram = mg/kg = micrograms per gram = ug/g
ppb = parts per billion = micrograms per kilogram = ug/kg = nanograms per gram = ng/g

a - DLs as low as 1 ppt may be achievable
b - DLs as low as 0.1 ppb, or even 10 ppt, may be achievable
c - DLs as low as 0.25 ppb may be achievable
d - DLs as low as 25 ppb, or even 1 ppb, may be achievable

For an extensive list of federal standards and other published environmental criteria for most of the contaminants in Table 1, consult NPS Water Resources Divisions' "Environmental Contaminants Encyclopedia" at the website http://www.aqd.nps.gov/toxic. Note that there may be state standards, other criteria, or in some cases, updated federal standards that are not listed in this Encyclopedia.

VIII. SAMPLE PLAN AND REPORTING REQUIREMENTS

A. Sample Plan

The owner/operator should submit a Sampling and Analysis Plan to the Superintendent for approval before samples are collected. The plan must include:

- sampling objectives (such as, “identify contaminants and concentrations involved,” “determine spatial extent of spill,” “determine if remediation is complete,” etc.)
- the contaminating substances being investigated (such as crude oil, natural gas condensate, produced water, etc.)
- list of individual contaminants that will be tested for (see Table 1)
- analytical methods to be used (see section VI. A.)
- type of samples to be collected (such as soil, sediment, groundwater, or surface water)
- citation and brief description of sample collection methodology to be used (see section IV. B.)
- specific sample locations and number of samples at each (Superintendent will walk the site and choose exact locations; this information may not be available until the time when samples are actually collected)
- total number of samples (this information may not be available until the time when samples are actually collected)
- acknowledgment that detection limits (that is, “reporting limits”) specified herein (section VII) will be achieved
- brief description of QA/QC procedures to be followed and citation of any guidance document used (see section V)
- acknowledgment that proper chain-of-custody procedures will be initiated and followed

B. Reporting Requirements

Upon completing sample collection and analyses, the owner/operator shall submit a report to the Superintendent. This report shall include:

- sample ID number/name
- description of sample locations (include maps, sketches, or photos)
- sample depth
- brief description of spill area (apparent extent of spill, topography, vegetation, surface water features, apparent soil conditions, etc.)
- date and time of sampling
- name of sample collector
- information pertinent to the sample collection methodology used (sampling devices used, how samples were collected, etc.)
- sample containers used, any preservation methods, and storage conditions of samples
- date and time of analyses
- name of chemist/technician performing analyses
- type of sample (soil, sediment, groundwater, or surface water)
- sample fraction measured (such as “total”, “total recoverable”, etc.)
- analytical results and units (mg/kg, µg/L, etc.)
- percent moisture (for soil/sediment samples)
- wet weight *and* dry weight units (for soil/sediment samples)
- analytical methods used
- detection limits (that is, “reporting limits”) achieved
- method detection limits (MDL) for the analytical methods used
- indication of analyses done in the field (such as pH, conductivity, etc.)
- field observations made while collecting samples
- lab and field QA/QC results and procedures followed
- name of analytic equipment used
- appropriate chain-of-custody forms

VIII. SPILL RESPONSE AND NOTIFICATION PROCEDURE FOLLOWING RELEASE OF A CONTAMINATING SUBSTANCE FROM A NONFEDERAL OIL AND GAS OPERATION IN A PARK UNIT

A. Initial Park Staff Actions Following Discovery of a Release

1. Secure the area to protect human health and safety

2. Notify operator of the release and immediate need to control the source and contain the release, and obtain information of the released substance

3. Initial site assessment to identify park resources potentially as risk from the release (surface water, wetlands, cultural resources, etc.), and quantity of released substance

4. Direct operator during initial spill containment actions to protect natural and cultural resources at risk, and to protect human health and safety

5. Notify Regional Spill Response Coordinator and relay all pertinent information

6. Obtain 5 liter sample of released substance (Note: need preservation and storage guidance for park staff) and initiate chain of custody documentation

7. Continue to oversee operator containment actions and maintain security

8. Park Superintendent advises operator that the operation is immediately "suspended" pursuant to NPS regulations at 36 CFR §9.51(c)(2)

9. Park staff prepares a detailed Case Incident Report on the spill event

B. Regional Spill Response Coordinator Notification Duties

1. Contact National Response Center to advise of release and obtain case number

2. Notify Environmental Quality Division (Dan Hamson), Geologic Resources Division (Jim Woods), Regional Minerals Coordinator (Linda Dansby), and Water Resources Division (Matt Hagermann) if release threatens water resources

3. Coordinate a conference call with above technical offices and park staff to define appropriate course of action relative to spill containment, public health and safety, site assessment, damage assessment, and operator responsiveness and capability

4. Notify pertinent state regulatory agencies and state trustees

C. Coordination of Response, Clean-up and Damage Assessment

1. All involved NPS staff track time and all other expenditures associated with the spill event

2. Park Superintendent prepares formal suspension notice for Regional Director's signature in accordance with NPS regulations at 36 CFR §9.51(c)(2)

3. Park staff coordinates with designated On Scene Coordinator (EPA, Coast Guard, or NPS staff expert if EPA or Coast Guard does not dispatch a coordinator) and state regulatory agencies to oversee operator spill response and initial clean-up actions

4. Park staff coordinates with On Scene Coordinator (OSC) and state trustee agencies in the conduct of resource damage assessment (Note: operator may contract with approved consulting firm/laboratory to conduct assessment work)

5. All involved NPS offices evaluate site assessment results and reach consensus on additional remediation actions and reclamation goals, and communicate recommendations to park Superintendent. (Note: NPS regulations at 36 CFR §9.39(a)(1)(i) and §9.39(a)(2)(iii) require operators to remove or neutralize any contaminating substance)

6. Park staff coordinates with OSC and state trustee agencies in monitoring remediation and reclamation actions

7. Park Superintendent and NPS technical working group evaluates final remediation/reclamation success and determines if further legal action against the operator is required (Note: operators are liable for any damages to federally-owned or controlled lands, waters or resources pursuant to 36 CFR §9.51(a).

APPENDIX G

U.S. FISH AND WILDLIFE SERVICE COUNTY-BY-COUNTY LISTING THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN

(AUGUST 2004)

E = Federally listed as endangered	T = Federally listed as threatened
C = Candidate Taxon, Ready for Proposal	AD = Proposed Delisting

HARDIN COUNTY		
E	RED-COCKADED WOODPECKER	*Picoides borealis*
E	TEXAS TRAILING PHLOX	*Phlox nivalis ssp. texensis*
JASPER COUNTY		
AD, T	BALD EAGLE	*Haliaeetus leucocephalus*
T	LOUISIANA BLACK BEAR	*Ursus americanus luteolus*
E	NOVASOTA LADIES'-TRESSES	*Spiranthes parksii*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Louisiana pine snake	*Pituophis ruthveni*
JEFFERSON COUNTY		
E, T	GREEN SEA TURTLE	*Chelonia mydas*
E	HAWKSBILL SEA TURTLE	*Eretmochelys imbricata*
E	KEMP'S RIDLEY SEA TURTLE	*Lepidochelys kempii*
E	LEATHERBACK SEA TURTLE	*Dermochelys coriacea*
T	LOGGERHEAD SEA TURTLE	*Caretta caretta*
E, T	PIPING PLOVER	*Charadrius melodus*
ORANGE COUNTY		
AD, T	BALD EAGLE	*Haliaeetus leucocephalus*
LIBERTY COUNTY		
AD, T	BALD EAGLE	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
POLK COUNTY		
AD, T	BALD EAGLE	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
E	TEXAS TRAILING PHLOX	*Phlox nivalis ssp. texensis*
TYLER COUNTY		
AD, T	BALD EAGLE	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
E	TEXAS TRAILING PHLOX	*Phlox nivalis ssp. texensis*
C	Louisiana pine snake	*Pituophis ruthveni*

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APPENDIX H

TEXAS PARKS AND WILDLIFE DEPARTMENT SPECIAL SPECIES LIST

The Texas Biological

and Conservation Data System

The Texas Biological and Conservation Data System (TXBCD), established in 1983, is the Department's most comprehensive source of information on rare, threatened, and endangered plants and animals, exemplary natural communities, and other significant features. Though it is not all-inclusive, the TXBCD is constantly updated, providing current or additional information on statewide status and locations of these unique elements of natural diversity.

The TXBCD gathers biological information from museum and herbarium collection records, peer reviewed publications, experts in the scientific community, organizations, qualified individuals, and on-site field surveys conducted by TPWD staff on public lands or private lands with written permission. TPWD staff botanists, zoologists, and ecologists perform field surveys to locate and verify specific occurrences of high-priority biological elements and collect accurate information on their condition, quality, and management needs.

The TXBCD can be used to help evaluate the environmental impacts of routing and siting options for development projects. It also assists in impact assessment, environmental review, and permit review.

Given the small proportion of public versus private land in Texas, the TXBCD does not include a representative inventory of rare resources in the state. Although it is based on the best data available to TPWD regarding rare species, these data cannot provide a definitive statement as to the presence, absence, or condition of special species, natural communities, or other significant features in any area. Nor can these data substitute for on-site evaluation by qualified biologists. The TXBCD information is intended to assist the user in avoiding harm to species that may occur.

Please use the following citation to credit the TXBCD as the source for this county level information:

> Texas Biological and Conservation Data System. Texas Parks and Wildlife, Wildlife Diversity Branch. County Lists of Texas' Special Species. [county name(s) and revised date(s)].

For information on obtaining a project review form or a site-specific review of a project area for rare species, and for updated county lists, please call (512) 912-7011.

Last Revised Date: 21 Nov 2003

Notes for County Lists of Texas' Special Species

The Texas Parks and Wildlife (TPWD) county lists **include**:

Vertebrates, Invertebrates, and Vascular Plants on the special species lists of the Texas Biological and Conservation Data System. These special species lists are comprised of all species, subspecies, and varieties that are federally listed; proposed to be federally listed; have federal candidate status; are state listed; or carry a global conservation status indicating a species is imperiled, very rare, or vulnerable to extirpation.

Colonial Waterbird Nesting Areas and Migratory Songbird Fallout Areas are contained on the county lists for coastal counties only.

The TPWD county lists **exclude**:

Natural Plant Communities such as Little Bluestem-Indiangrass Series (native prairie remnant), Water Oak-Willow Oak Series (bottomland hardwood community), Saltgrass-Cordgrass Series (salt or brackish marsh), Sphagnum-Beakrush Series (seepage bog).

Other Significant Features such as non-coastal bird rookeries, migratory bird information, bat roosts, bat caves, invertebrate caves, and prairie dog towns.

These lists will never be all inclusive for all rare species distributions. In order to keep the lists to a reasonable length, historic ranges for some state extirpated species, full historic distributions for some extant species, accidentals and irregularly appearing species, and portions of migratory routes for particular species are not included.

The **revised date** on each county list reflects the last date any changes or revisions were made for that county and reflects current listing statuses and taxonomy.

Species that appear on county lists do not all share the same probability of occurrence within a county. *Some species are migrants or wintering residents only. Additionally, a few species may be historic or considered extirpated within a county. Species considered extirpated within the state are so flagged on each list.*

This information is for your assistance only; due to continuing data updates, **please do not reprint or redistribute the information, instead refer all requesters to our office to obtain the most current information available.**

Last Revised Date: 21 Nov 2003

Federal Status | State Status

HARDIN COUNTY

******* DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*******
UNDER CONSTRUCTION *** SPECIES MAY BE ADDED/DELETED WITH QUALITY CONTROL**

*** AMPHIBIANS ***

Pig Frog (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

*** BIRDS ***

American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bachman's Sparrow (*Aimophila aestivalis*) - inhabits mature open pine forests with grassy understory, regenerating pine clear-cuts (1-7 years post re-planting), or open habitats with a dense ground cover of grasses and forbs, or palmetto scrub; in Texas, known to occur only in the far eastern portion of the state; most abundant in forests south of Angelina National Forest		T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Red-cockaded Woodpecker (*Picoides borealis*) - cavity nests in older pine (60+ years); forages in younger pine (30+ years); prefers longleaf, shortleaf, & loblolly	LE	E
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
Wood Stork (*Mycteria americana*) – forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T

	Federal Status	State Status
*****FISHES*****		
Blue Sucker (*Cycleptus elongatus*) - usually inhabits channels and flowing pools with a moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T
Creek Chubsucker (*Erimyzon oblongus*) - small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks		T
Paddlefish (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir		T
Western Sand Darter (*Ammocrypta clara*) - clear to slightly turbid water of medium to large rivers that have moderate to swift currents, primarily over extensive areas of sandy substrate		
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T
Plains Spotted Skunk (*Spilogale putorius interrupta*) - catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Prairie Vole (*Microtus ochrogaster taylori*) - extreme northern Panhandle of Texas (specimen records from Lipscomb and Hansford counties) and western Panhandle of Oklahoma; formerly known from southeastern Texas, as well; tall-grass prairie; colonial; create series of shallow, underground burrows and surface runways under vegetation; breeding habits not well known, but probably breed throughout the year		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) (extirpated) - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		

	Federal Status	State Status
***** REPTILES *****		
Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Louisiana Pine Snake (*Pituophis ruthveni*) - mixed deciduous-longleaf pine woodlands; breeds April-September	C1	T
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Sabine Map Turtle (*Graptemys quachitensis sabinensis*) – Sabine River system; rivers and related tributaries, ponds and reservoirs with abundant aquatic vegetation; basks on fallen logs and exposed roots; eats insects, crustaceans, mollusks, and aquatic plants; breeding and egg-laying March-May, with hatchlings appearing in early fall		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T
***** VASCULAR PLANTS *****		
Chapman's orchid (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August		
Long-sepaled false dragon-head (*Physostegia longisepala*) – moist, acid loams in the fire-maintained transition zone between pine flatwoods and coastal prairies; also, wet, borrow ditches along roadsides and moist areas in manmade clearings in pine woodlands; flowering early May to late June		
Texas screwstem (*Bartonia texana*) - sandy soils in dry mesic pine or mixed pine-oak forests and forest borders; usually in fire-maintained longleaf pine savannas, but also in more mesic habitats; flowering (June-?)		
Texas trailing phlox (*Phlox nivalis* ssp. *texensis*) - endemic; deep sandy soils in fire-maintained openings in upland longleaf pine savannas or bluejack oak woodlands; flowering March-early April	LE	E
White firewheel (*Gaillardia aestivalis* var. *winkleri*) – endemic; deep, loose, well-drained sands in openings in pine-oak woodlands and along unshaded margins, principally of the Village Creek watershed; flowering late spring (May-June) and sporadically through early fall		

Status Key:

LE, LT	-	Federally Listed Endangered/Threatened
PE, PT	-	Federally Proposed Endangered/Threatened
E/SA, T/SA	-	Federally Listed Endangered/Threatened by Similarity of Appearance
C1	-	Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened
DL, PDL	-	Federally Delisted/Proposed for Delisting
NL	-	Not Federally Listed
E, T	-	State Listed Endangered/Threatened
"blank"	-	Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

	Federal Status	State Status

JASPER COUNTY

******* DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*******
UNDER CONSTRUCTION ** SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL**

*** AMPHIBIANS ***

Pig Frog (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

*** BIRDS ***

American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bachman's Sparrow (*Aimophila aestivalis*) - inhabits mature open pine forests with grassy understory, regenerating pine clear-cuts (1-7 years post re-planting), or open habitats with a dense ground cover of grasses and forbs, or palmetto scrub; in Texas, known to occur only in the far eastern portion of the state; most abundant in forests south of Angelina National Forest		T
Bald Eagle (*Haliaeetus leucocephalus*) – found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Red-cockaded Woodpecker (*Picoides borealis*) - cavity nests in older pine (60+ years); forages in younger pine (30+ years); prefers longleaf, shortleaf, & loblolly	LE	E
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T

FISHES

Blue Sucker (*Cycleptus elongatus*) - usually inhabits channels and flowing pools with a moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T

JASPER COUNTY cont.	Federal Status	State Status
Creek Chubsucker (*Erimyzon oblongus*) – small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks		T
Paddlefish (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir		T
Western Sand Darter (*Ammocrypta clara*) - clear to slightly turbid water of medium to large rivers that have moderate to swift currents, primarily over extensive areas of sandy substrate		
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) (extirpated) - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Louisiana Pine Snake (*Pituophis ruthveni*) - mixed deciduous-longleaf pine woodlands; breeds April-September	C1	T
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Sabine Map Turtle (*Graptemys quachitensis sabinensis*) – Sabine River system; rivers and related tributaries, ponds and reservoirs with abundant aquatic vegetation; basks on fallen logs and exposed roots; eats insects, crustaceans, mollusks, and aquatic plants; breeding and egg-laying March-May, with hatchlings appearing in early fall		

JASPER COUNTY cont.

	Federal Status	State Status
Texas Horned Lizard (*Phrynosoma cornutum*) - most likely introduced; open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March- September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

*** VASCULAR PLANTS ***

Bog coneflower (*Rudbeckia scabrifolia*) - hillside seepage bogs and associated broadleaf semi-evergreen acid seep forests; usually on Catahoula Formation or near the Catahoula-Willis contact; flowering late summer-fall		
Long-sepaled false dragon-head (*Physostegia longisepala*) – moist, acid loams in the fire-maintained transition zone between pine flatwoods and coastal prairies; also, wet, borrow ditches along roadsides and moist areas in manmade clearings in pine woodlands; flowering early May to late June		
Navasota ladies'-tresses (*Spiranthes parksii*) – endemic; margins of and openings within post oak woodlands in sandy loams along intermittent tributaries of rivers; flowering late October-early November	LE	E
Nodding yucca (*Yucca cernua*) - hardwood forests on brownish acid clays of the Redco Series; flower/fruiting June-November		
Texas screwstem (*Bartonia texana*) – sandy soils in dry mesic pine or mixed pine-oak forests and forest borders; usually in fire-maintained longleaf pine savannas, but also in more mesic habitats; flowering (June-?)		
Texas trillium (*Trillium pusillum* var. *texanum*) - acid hardwood bottoms and lower slopes, often in or downslope from acidic sphagneous hillside seeps; flowering March-mid April		

Status Key:

LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
E/SA, T/SA	- Federally Listed Endangered/Threatened by Similarity of Appearance
C1	- Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened
DL, PDL	- Federally Delisted/Proposed for Delisting
NL	- Not Federally Listed
E, T	- State Listed Endangered/Threatened
"blank"	- Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

	Federal Status	State Status

JEFFERSON COUNTY

******* DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*******
UNDER CONSTRUCTION ** SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL**

*** AMPHIBIANS ***

Pig Frog (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

*** BIRDS ***

American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Brown Pelican (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks	LE	E
Henslow's Sparrow (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Piping Plover (*Charadrius melodus*) - wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	LT	T
Reddish Egret (*Egretta rufescens*) - resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Snowy Plover (*Charadrius alexandrinus*) – wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats		
Sooty Tern (*Sterna fuscata*) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July		T
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T

JEFFERSON COUNTY cont.	Federal Status	State Status
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T

*** BIRDS-RELATED ***

Colonial waterbird nesting areas - many rookeries active annually

Migratory songbird fallout areas - oak mottes and other woods/thickets provide foraging/roosting sites for neotropical migratory songbirds

*** MAMMALS ***

Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) (extirpated) - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		

*** REPTILES ***

Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Atlantic Hawksbill Sea Turtle *(Eretmochelys imbricata*) - Gulf and bay system	LE	E
Green Sea Turtle *(Chelonia mydas*) – Gulf and bay system	LT	T
Gulf Saltmarsh Snake (*Nerodia clarkii*) - saline flats, coastal bays, & brackish river mouths		
Kemp's Ridley Sea Turtle *(Lepidochelys kempii*) - Gulf and bay system	LE	E
Leatherback Sea Turtle *(Dermochelys coriacea*) - Gulf and bay system	LE	E
Loggerhead Sea Turtle *(Caretta caretta*) - Gulf and bay system	LT	T

JEFFERSON COUNTY cont.

	Federal Status	State Status
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) - coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

*** VASCULAR PLANTS ***

Chapman's orchid (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August

Status Key:

LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
E/SA, T/SA	- Federally Listed Endangered/Threatened by Similarity of Appearance
C1	- Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened
DL, PDL	- Federally Delisted/Proposed for Delisting
NL	- Not Federally Listed
E, T	- State Listed Endangered/Threatened
"blank"	- Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

	Federal Status	State Status

LIBERTY COUNTY

******* DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*******
UNDER CONSTRUCTION *** SPECIES MAY BE ADDED/DELETED WITH QUALITY CONTROL**

*** AMPHIBIANS ***

Houston Toad (*Bufo houstonensis*) - endemic; species sandy substrate, water in pools, ephemeral pools, stock tanks; breeds in spring especially after rains; burrows in soil when inactive; breeds February-June; associated with soils of the Sparta, Carrizo, Goliad, Queen City, Recklaw, Weches, and Willis geologic formations	LE	E

*** BIRDS ***

American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bachman's Sparrow (*Aimophila aestivalis*) - inhabits mature open pine forests with grassy understory, regenerating pine clear-cuts (1-7 years post re-planting), or open habitats with a dense ground cover of grasses and forbs, or palmetto scrub; in Texas, known to occur only in the far eastern portion of the state; most abundant in forests south of Angelina National Forest		T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Red-cockaded Woodpecker (*Picoides borealis*) - cavity nests in older pine (60+ years); forages in younger pine (30+ years); prefers longleaf, shortleaf, & loblolly	LE	E
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T

*** BIRDS-RELATED ***

Colonial waterbird nesting areas - many rookeries active annually

	Federal Status	State Status
***** FISHES *****		
Creek Chubsucker (*Erimyzon oblongus*) - small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks		T
Paddlefish (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir		T
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) (extirpated) - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Louisiana Pine Snake (*Pituophis ruthveni*) - mixed deciduous-longleaf pine woodlands; breeds April-September	C1	T
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) - coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

Status Key:

LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
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	Federal Status	State Status

ORANGE COUNTY

******* DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*******
UNDER CONSTRUCTION ** SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL**

*** AMPHIBIANS ***

Pig Frog (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

*** BIRDS ***

American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Brown Pelican (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks	LE	E
Henslow's Sparrow (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Piping Plover (*Charadrius melodus*) - wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	LT	T
Reddish Egret (*Egretta rufescens*) - brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Snowy Plover (*Charadrius alexandrinus*) – wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats		
Sooty Tern (*Sterna fuscata*) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July		T
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T

ORANGE COUNTY cont.	Federal Status	State Status
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
***** BIRDS-RELATED *****		
Colonial waterbird nesting areas - many rookeries active annually		
Migratory songbird fallout areas - oak mottes and other woods/thickets provide foraging/roosting sites for neotropical migratory songbirds		
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) (extirpated) - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Gulf Saltmarsh Snake (*Nerodia clarkii*) - saline flats, coastal bays, & brackish river mouths		
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Sabine Map Turtle (*Graptemys quachitensis sabinensis*) – Sabine River system; rivers and related tributaries, ponds and reservoirs with abundant aquatic vegetation; basks on fallen logs and exposed roots; eats insects, crustaceans, mollusks, and aquatic plants; breeding and egg-laying March-May, with hatchlings appearing in early fall		

ORANGE COUNTY cont. Federal Status | State Status

Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) - coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide

Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September — State Status: T

Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto — State Status: T

*** VASCULAR PLANTS ***

Chapman's orchid (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August

Long-sepaled false dragon-head (*Physostegia longisepala*) – moist, acid loams in the fire-maintained transition zone between pine flatwoods and coastal prairies; also, wet, borrow ditches along roadsides and moist areas in manmade clearings in pine woodlands; flowering early May to late June

Status Key:
- LE, LT - Federally Listed Endangered/Threatened
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POLK COUNTY

	Federal Status	State Status
***** BIRDS *****		
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bachman's Sparrow (*Aimophila aestivalis*) - open pine woods with scattered bushes or understory, brushy or overgrown hillsides, overgrown fields with thickets and brambles, grassy orchards; nests on ground against grass tuft or under low shrub		T
Bald Eagle (*Haliaeetus leucocephalus*) – found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) - wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Red-cockaded Woodpecker (*Picoides borealis*) - cavity nests in older pine (60+ years); forages in younger pine (30+ years); prefers longleaf, shortleaf, & loblolly	LE	E
Swallow-tailed Kite (*Elanoides forficatus*) – lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T
*****FISHES*****		
Creek Chubsucker (*Erimyzon oblongus*) – small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks		T
Paddlefish (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir		T
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T

POLK COUNTY cont.	Federal Status	State Status
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		

*** REPTILES ***

Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Louisiana Pine Snake (*Pituophis ruthveni*) - mixed deciduous-longleaf pine woodlands; breeds April-September	C1	T
Texas Horned Lizard (*Phrynosoma cornutum*) - most likely introduced; open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

*** VASCULAR PLANTS ***

Texas screwstem (*Bartonia texana*) – sandy soils in dry mesic pine or mixed pine-oak forests and forest borders; usually in fire-maintained longleaf pine savannas, but also in more mesic habitats; flowering (June-?)		
Texas trailing phlox (*Phlox nivalis* ssp. *texensis*) - endemic; deep sandy soils in fire-maintained openings in upland longleaf pine savannas or bluejack oak woodlands; flowering March-early April	LE	E

Status Key:
LE,LT - Federally Listed Endangered/Threatened
PE,PT - Federally Proposed Endangered/Threatened
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	Federal Status	State Status

TYLER COUNTY

*** AMPHIBIANS ***

Pig Frog (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

*** BIRDS ***

American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bachman's Sparrow (*Aimophila aestivalis*) - inhabits mature open pine forests with grassy understory, regenerating pine clear-cuts (1-7 years post re-planting), or open habitats with a dense ground cover of grasses and forbs, or palmetto scrub; in Texas, known to occur only in the far eastern portion of the state; most abundant in forests south of Angelina National Forest		T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Henslow's Sparrow (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Red-cockaded Woodpecker (*Picoides borealis*) - cavity nests in older pine (60+ years); forages in younger pine (30+ years); prefers longleaf, shortleaf, & loblolly	LE	E
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T

FISHES

Blue Sucker (*Cycleptus elongatus*) - usually inhabits channels and flowing pools with a moderate current; bottom type usually consists of exposed bedrock, perhaps in combination with hard clay, sand, and gravel; adults winter in deep pools and move upstream in spring to spawn on riffles		T

TYLER COUNTY cont.	Federal Status	State Status
Creek Chubsucker (*Erimyzon oblongus*) - small rivers and creeks of various types; seldom in impoundments; prefers headwaters, but seldom occurs in springs; young typically in headwater rivulets or marshes; spawns in river mouths or pools, riffles, lake outlets, upstream creeks		T
Paddlefish (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir		T
Western Sand Darter (*Ammocrypta clara*) - clear to slightly turbid water of medium to large rivers that have moderate to swift currents, primarily over extensive areas of sandy substrate		
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - within historical range in eastern Texas; inhabits bottomland hardwoods and large tracts of undeveloped forested areas; dens in tree hollows, rock piles, or under brush piles	LT	T
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) (extirpated) - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Louisiana Pine Snake (*Pituophis ruthveni*) - mixed deciduous-longleaf pine woodlands; breeds April-September	C1	T
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T

TYLER COUNTY cont.

	Federal Status	State Status
Texas Horned Lizard (*Phrynosoma cornutum*) - most likely introduced; open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March- September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

*** VASCULAR PLANTS ***

Chapman's orchid (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August		
Long-sepaled false dragon-head (*Physostegia longisepala*) – moist, acid loams in the fire-maintained transition zone between pine flatwoods and coastal prairies; also, wet, borrow ditches along roadsides and moist areas in manmade clearings in pine woodlands; flowering early May to late June		
Navasota false foxglove (*Agalinis navasotensis*) – sparsely vegetated sandy soils on outcrop of the calcareous sandstone Oakville Formation; flowering September-October		
Southern lady's-slipper (*Cypripedium kentuckiense*) – the only *Cypripedium* in east Texas; dry to mesic forests in various topographic positions; flowering April-June		
Texas screwstem (*Bartonia texana*) - sandy soils in dry mesic pine or mixed pine-oak forests and forest borders; usually in fire-maintained longleaf pine savannas, but also in more mesic habitats; flowering (June-?)		
Texas trailing phlox (*Phlox nivalis* ssp. *texensis*) - endemic; deep sandy soils in fire-maintained openings in upland longleaf pine savannas or bluejack oak woodlands; flowering March-early April	LE	E
White firewheel (*Gaillardia aestivalis* var. *winkleri*) – endemic; deep, loose, well-drained sands in openings in pine-oak woodlands and along unshaded margins, principally of the Village Creek watershed; flowering late spring (May-June) and sporadically through early fall		

Status Key:
- LE, LT - Federally Listed Endangered/Threatened
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APPENDIX I

NATIONAL PARK SERVICE WELL PLUGGING GUIDE FOR NONFEDERAL OIL AND GAS WELLS IN THE STATE OF TEXAS

Prepared by
Pat O'Dell, Petroleum Engineer
Geologic Resources Division
National Park Service
Denver, Colorado
March 2004

I. INTRODUCTION

When plugging wells in National Parks in the State of Texas, operators have to follow both the Railroad Commission of Texas (RCT) and National Park Service (NPS) regulations. This guide is intended to help operators plan the downhole aspects of plugging operations that will meet both RCT and NPS requirements.

The guide focuses on the downhole aspects of permanently plugging and abandoning a well.

II. REGULATIONS

National Park Service

The National Park Service (NPS) regulates[1] plug and abandonment operations for all wells in National Park Units that are reached by crossing Federal property. Even wells that have been exempt[2] from NPS regulatory requirements often lose their exempt status when they are to be plugged and abandoned. An operation loses its exempt status when there is a change in operations that requires a new State or Federal permit. Texas requires a plugging permit thus triggering the NPS plan and bonding requirements.

For operators that are used to working on federal onshore leases, it is useful to know that the NPS uses the minimum standards of the *Department of Interior's Onshore Oil and Gas Order Number 2, Section III.G., Drilling Abandonment for Plugging Wells in Parks* (from *Federal Register*, Vol. 53, No. 223, Friday, November 18, 1988, pages 46810 and 46811). The plugging requirements of Onshore Order No. 2 were written specifically for plugging newly drilled wells. However, the same standards may be applied to the permanent abandonment of exhausted producers or service wells.

[1]The regulations at Title 36 of the Code of Federal Regulations, Part 9, Subpart B (36 CFR 9B) cover nonfederal oil and gas operations in units of the National Park System.

[2]See 36 CFR 9.33, "Existing Operations."

The NPS regulations require operators to submit a plan of operations (plan) for approval. Once approved, the plan serves as the operator's permit from the NPS. The plan details all activities of an oil and gas operation, describes how reclamation will be completed, and is the basis for setting performance bond amounts.

Texas

The Railroad Commission of Texas (RCT) regulates the plugging and abandonment of wells associated with oil, gas, and geothermal resource operations. The plugging rules are found in the Statewide Rules, Rule 14, Plugging. A guidance manual entitled "Well Completion and Plugging Procedures Reference Manual" is also available from the Railroad Commission.

III. WELL PLUGGING GOALS

Texas and the NPS have the same goals in plugging a well. They are:

- to protect the zones of usable water from pollution, and
- to prevent escape of oil, gas, or other fluids to the surface or other zones.

The following well plugging objectives serve to accomplish these goals.

1) Set cement plug(s) to isolate all formations bearing oil, gas, geothermal resources, and other prospectively valuable minerals.
2) Set cement plug(s) to isolate all formations bearing usable-quality water.
3) Set a cement plug to isolate the surface casing from open hole below the casing shoe.
4) Finally set a cement plug to seal the well at the surface.

The NPS is not responsible for protecting private mineral interests. Where plugs are set solely to protect nonfederal mineral resources such as oil, gas, coal, potash, etc., the NPS will defer to the state requirements.

IV. GENERAL REQUIREMENTS

The plugging procedure needs to include the following general requirements to meet Texas and NPS requirements. When NPS standards differ from Texas, the more stringent would apply.

Cement Quality

All cement for plugging shall be an approved API oil well cement without volume extenders and shall be mixed in accordance with API standards. Slurry weights shall be reported on the cementing report. In special situations such as when high temperature, salt sections, or highly corrosive sections are present, specific cement compositions may be required.

Reference: Texas Rule 14, §3.14(d)(4)
Onshore Order No. 2, § III (G)(7)

Cement Volumes

All cement plugs except the surface plug shall have sufficient slurry volume to fill at least 100 feet of hole, plus an additional 10 percent of slurry for each 1,000 feet of depth. No plug, except the surface plug, shall be less than 25 sacks with prior approval. This requirement addresses the ability to mix and place uncontaminated cement at depth. The cement and workover fluids tend to mix at the lead and tail end of the cement slurry as it is pumped downhole. The clean cement in the middle provides the plug's integrity. An additional washout factor may be applied when plugging openhole sections.

Reference: Texas Rule 14, § 3.14(d)(11)
Onshore Order No. 2, § III (G)(1)(ii) & (iii) & (G)(2)

Cement Placement

Cement plugs must be placed by the circulation or squeeze method through tubing or drill pipe.

The dump bailer method may be used only to place cement caps above a bridge plug or retainer.

Reference: Texas Rule 14, § 3.14(d)(3)
Onshore Order No. 2, § III (G)(2)(iii)

Plugging Fluid

Each of the intervals between plugs must be filled with mud having sufficient density to exert hydrostatic pressure exceeding the greatest formation pressure encountered while drilling.

In the absence of known data, the Federal regulations require a minimum mud weight of 9.0 pounds per gallon. Texas regulations require a minimum mud weight of 9.5 pounds per gallon. Unless a specific waiver is granted by the RCT, the NPS will require use of 9.5 pound per gallon mud.

Reference: Texas Rule 14, § 3.14(d)(9)
Onshore Order No. 2, § III (G)(9)

Uncemented Annular Space

Whenever a cement plug is required at a depth in cased hole where the annular space is not cemented, the uncemented annular section must be cemented by perforating the casing and pumping cement into the annular space. At shallow depths, small diameter pipe can be run in the annular space and cement circulated in place.

Reference: Texas Rule 14, § 3.14(f)(2) & (g)(2)
Onshore Order No. 2, § III (G)(9)

V. REQUIRED PLUGS

The following sections summarize where cement plugs need to be placed in a well to meet the goals outlined in Section II and satisfy the requirements of TRC Rule 14 and Federal Onshore Order No. 2

Zones of Production

The RCT requires a 100-foot long placed immediately above each perforated interval. The NPS requires cement to be placed across each perforated interval and extend at least 50 feet below the bottom perforations (except where limited by total depth) and 50 above the top perforations.

To meet both standards, the operator should place a cement plug from 50 feet below the bottom perforation to 100 feet above the top perforation.

Instead of the cement plug, a bridge plug or retainer can be set above the perforations and capped with cement. The bridge plug method can be used if there is no exposed open hole below the perforations. The RCT requires the bridge plug to be placed "immediately" above the perforations and capped with at least 20 feet of cement. The NPS requires the bridge plug to be no further than 100 feet above the perforations and capped with 50 feet of cement. If a bailer is used to place cement on top of the bridge plug, then 35 feet is enough.

When using bridge plugs to abandon perforated intervals, the operator would follow the more conservative 50-foot cement cap standard (or 35-foot cement cap if a bailer is used) to satisfy both the RCT the NPS.

The NPS is not responsible for protecting private mineral interests. For plugs set solely to protect nonfederal mineral resources such as oil, gas, coal, potash, etc., the NPS will defer to the state requirements.

Reference: Texas Rule 14, § 3.14(g)(3)
Onshore Order No. 2, § III (G)(2)

Zones Containing Liquid or Gas with the Potential to Migrate

Any zone that contains liquid or gas with the potential to migrate requires a plug extending from at least 50 feet below its bottom to at least 50 feet above its top. <u>This NPS requirement pertains only to abandonment of an open hole section or an uncemented cased hole section where there are no cement plugs scheduled between the zone containing liquid or gas with the potential to migrate and the base of the deepest usable quality water zone.</u>

Reference: Onshore Order No. 2, § III (G)(1)(i)(a)

Usable-Quality Water Zones

The RCT and Federal regulations require that zones of usable-quality water be protected. The Texas Commission on Environmental Quality determines the depth to which usable-quality water must be protected. Whenever a cement plug is the only isolating medium for a zone of usable water quality, the NPS standard is to test that plug by tagging with the drill string. Both Texas and the NPS have the option to require testing of any plug to ensure its integrity. So when designing the well plugging procedure, operators should plan for testing of plugs set to isolate zones of usable quality water.

Reference: Texas Rule 14, § 3.14(d)(1) & (7)
Onshore Order No. 2, § III (G) Introduction & (G)(6)

The Surface Casing Shoe

The RCT and Federal requirements for placing a plug across the shoe of the surface casing are the same.

If the inner casing string(s) have been cemented across the shoe of the surface casing, then a 100-foot plug is placed with its center at the surface casing shoe depth.

If the inner casing string(s) are not cemented, the operator has choices. The operator can choose to cut and recover casing so that a plug can be set directly across the surface casing shoe. The operator can also choose to perforate the casing and circulate cement behind the inner casing string across the surface casing shoe.

If casing is removed, the NPS will require a cement plug to be placed to extend at least 50 feet above and below the stub. It may be beneficial for operators to cut the casing at a depth so that one plug could be set to meet requirements for both the casing stub and the exposed casing shoe.

Reference: Texas Rule 14, § 3.14(e), (f)(2), &(g)(2)
Onshore Order No. 2, § III (G)(3) & (4)

The Surface Plug

The RCT requires a 10-foot surface plug for all inland wells. The Federal standard is a 50-foot surface plug. The operator would follow the more conservative Federal standard to satisfy both the RCT and the NPS. The cement plug must extend at least 50 feet. The plug is placed in the smallest casing and all annuli that extend to the surface. The top of the plug is placed as close to the eventual casing cutoff point as possible.

Reference: Texas Rule 14, § 3.14(d)(8)
Onshore Order No. 2, § III (G)(8)

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GLOSSARY

Abandonment: The termination of oil and gas production operations, removal of facilities, plugging of the well bore, and reclamation of surface disturbances.

Access: Any way, means, or method of entering or traversing on, across, or through federally owned or controlled lands or waters (36 CFR § 9.30(a)), including but not limited to: vehicle, watercraft, fixed-wing aircraft, helicopter, offroad vehicle, mobile heavy equipment, snowmobile, pack animal, and foot.

Action: Any federal activity including, but not limited to, acquiring, managing, and disposing of federal lands and facilities; facilitating human occupation or visitation; providing federally undertaken, financed, or assisted construction and improvements; and conducting federal activities and programs affecting land use, including, but not limited to, water and related land resources planning, and regulating and licensing activities.

Affected Environment: Surface or subsurface resources (including social and economic elements) within or adjacent to a geographic area that could potentially be affected by oil and gas activities. The environment of the area to be affected or created by the alternatives under consideration (40 CFR § 1502.15).

Aggradation: The natural building up of the earth's surface by deposition, such as the raising of a streambed by deposition of sediment to establish or maintain uniformity of grade or slope.

Alternative: A combination of management prescriptions applied in specific amounts and locations to achieve a desired management emphasis as expressed in goals and objectives. One of several policies, plans, or projects proposed for decision-making.

Alternative, No-Action: An alternative that maintains established trends or management direction.

American Petroleum Institute: Founded in 1920, this national oil trade organization is the leading standardizing organization on oil field drilling and producing equipment. It maintains departments of transportation, refining, and marketing in Washington, D.C., and a department of production in Dallas.

Aquifer: A water-bearing rock, rock formation, or group of formations. Aquifers can be either unconfined or confined.

Barrel: A measure of volume for petroleum products. One barrel is the equivalent of 42 U.S. gallons or 0.15899 cubic meters. One cubic meter equals 6.2897 barrels.

Base Flood: That flood which has a one percent chance of occurring in any given year (also known as the 100-year flood). This term is used by the National Flood Insurance Program to indicate the minimum level of flooding to be used by a community in its floodplain management regulations.

Base Floodplain: The 100-year floodplain.

Billion Cubic Feet (BCF): Measurement of gas at standard pressure and temperature, measured in billion cubic feet of gas.

Biological Diversity: The variety of life and the processes that govern life. There are four major components of biological diversity: **genetic**—variation of genes within a species; **species**—

variation of the kinds of plants and animals; **community/eco-system**—variation of the ways in which the many species of plants and animals aggregate into interacting groups; and **process**—variation in the physical, chemical, and biological forces to which genes, species, communities, and ecosystems respond.

Blowout: An uncontrolled explosion of gas, oil, or other fluids from a drilling well. A blowout or "gusher" occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid and when blowout prevention equipment is absent or fails.

Blowout Preventer (BOP): One of several valves installed at the wellhead to prevent the escape of pressure either in the annular space between the casing and drill pipe or in open hole (i.e., hole with no drill pipe) during drilling or completion operations.

Brine: Water containing relatively large concentrations of dissolved salts, particularly sodium chloride. Brine has higher salt concentrations than ordinary ocean water.

Cement Casing: To fill the annulus between the casing and hole with cement to support the casing and prevent fluid migration between permeable zones.

Christmas Tree: The control valves, pressure gauges, and chokes assembled at the top of a well to control the flow of oil and gas after the well has been completed.

Completion: The activities and methods to prepare a well for production. Includes installation of equipment for production from an oil or gas well.

Conditions of Approval (COAs): Provisions or requirements under which a Plan of Operations is approved.

Contaminating Substance: Those substances, including, but not limited to, salt water or any other injurious or toxic chemical; waste oil or waste emulsified oil; basic sediment; mud with injurious or toxic substances produced or used in the drilling, development, production, transportation, or on-site storage, refining, and processing of oil and gas (36 CFR § 9.31(n)).

Council on Environmental Quality (CEQ): An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews federal programs for their effort on the environment, conducts environmental studies, and advises the President on environmental matters.

Critical Habitat: (1) The specific areas within the geographical area occupied by the species…on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations protection; and (2) specific areas outside the geographical area occupied by the species…upon a determination by the Secretary that such areas are essential for the conservation of the species.

Cultural Landscape: A cultural landscape is a geographic area, including both cultural and natural resources and the wildlife and domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. There are four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes.

Cultural Resource: Cultural resources include archeological sites; historic sites, buildings, and districts; cultural landscapes; and traditional cultural properties.

Drilling Fluid ("Mud"): Circulating fluid, one function of which is to force cuttings out of the wellbore and to the surface. While a mixture of clay, water, and other chemical additives is the most common drilling fluid, wells can also be drilled using air, gas, or water as the drilling fluid.

Development Concept Plan (DCP): The Development Concept Plan bridges the gap between the General Management Plan and the comprehensive or preliminary design, providing guidance for the development and use of a particular geographic area within a park.

Directional Drilling: Intentional deviation of a wellbore from the vertical (90 degrees). Although wellbores are normally drilled vertically, it is sometimes necessary or advantageous to drill at an angle from the vertical.

Dry Hole: Any well incapable of producing oil or gas in commercial quantities. A dry hole may produce water, gas, or even oil, but not enough to justify production.

Ecotone: An ecological community of mixed vegetation formed by the overlapping of adjoining communities.

Edaphic: Of or pertaining to soil, especially as it affects living organisms.

Effects: see Impacts

Endangered Species: Any species that is in danger of extinction throughout all or a significant portion of its range.

Environmental Assessment (EA): A concise public document prepared to provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a Finding of No Significant Impact. An EA includes a brief discussion of the need for a proposal, the alternatives considered, the environmental impacts of the proposed action and alternatives, and a list of agencies and individuals consulted.

Environmental Impact Statement (EIS): A document prepared to analyze the impacts on the environment of a proposed project or action and released to the public for comment and review. An EIS must meet the requirements of NEPA, CEQ, and the directives of the agency responsible for the proposed project or action.

Exploration: The search for deposits of useful minerals or fossil fuels; prospecting; preparatory to development.

Extirpate: To destroy the whole of; exterminate.

Federally Owned and Controlled Lands: Land that the United States possesses fee title through purchase, donation, public domain, or condemnation. It also includes land that the United States holds any interest, such as a lease, easement, rights-of-way, or cooperative agreement.

Federally Owned and Controlled Waters: All surface waters in the boundaries of a National Park System unit without regard to whether the title to the submerged lands lies with the United States or another party.

Floodplain: The lowland and relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, and including at a minimum, that area subject to temporary inundation by a regulatory flood.

Flowlines and Gathering Lines: Lines that transport petroleum and natural gas or other associated products from under the park, from the wellhead to storage and treatment facilities, from treatment and storage facilities to pipelines, or from the wellhead to pipelines.

Fragipan: A natural subsurface layer that has a very low organic content, high bulk density and/or high mechanical strength relative to the overlying and underlying layers (horizons); is very hard (seems cemented) when dry, but shows a moderate to weak brittleness when moist. The layer typically has a very low permeability to water, and restricts the penetration of roots.

Gas: Any fluid, either combustible or noncombustible, which is produced in a natural state from the earth, and which maintains a gaseous or rarefied state at ordinary temperature and pressures (36 CFR § 9.31(m)).

General Management Plan (GMP): The GMP is the major planning document for all National Park System units. The GMP sets forth the basic philosophy for managing a unit, and provides strategies for resolving issues and achieving identified management objectives over a 5 to 10-year period. The GMP includes an environmental impact assessment and other required compliance documentation.

In a GMP, the National Park Service should prescribe general strategies for managing nonfederal oil and gas exploration and development if such activity is an issue in a unit. Pertinent information that might be included in a GMP includes:

- where and when nonfederal oil and gas operations may occur under statutory or regulatory authorities;
- impacts of exploration and development on unit resources and values;
- location of nonfederal oil and gas rights in relation to areas planned for park-related development, preservation, or interpretation; and
- existing or potential impacts from nonfederal oil and gas activity conducted on lands adjacent to the unit.

The GMP also establishes "management zones" in a unit according to criteria and procedures contained in DO-2 (NPS Director's Order, Planning Process). Management zoning is prescriptive, based on surface resources and visitor-related values.

Geophysical Exploration: Geophysical exploration primarily consists of 3-D seismic operations and typically involves selective cutting of vegetation along source and receiver lines, drilling shot holes along source lines, placing explosives at the bottom of each shot hole, placing cables and other recording equipment along receiver lines, and detonating explosives.

Hydrocarbons: Organic compounds consisting of hydrogen and carbon, such as petroleum, crude oil or natural gas, whose densities, boiling points, and freezing points increase as their molecular weights increase. The smallest molecules of hydrocarbons are gaseous; the largest are solids. Petroleum is a mixture of many different hydrocarbons.

Hydraulic and Hydrologic Hazards: Hazards to human life or property caused by the conditions of flow (deep water, high velocities, debris loads, etc.) or by the characteristics of flooding (rate of flood rise, rapidity of response to causative events, etc.).

Hydroperiod: Number of days per year that an area of ground is covered with water.
Hydrophyte: A plant that grows in and is adapted to an aquatic or very wet environment.

Impacts: ***Direct Impacts*** are caused by the action and occur in the same place and at the same time as the action. ***Indirect Impacts*** are caused by the action and are later in time or farther removed in distance, but are still anticipated. ***Cumulative Impacts*** are the impacts on the

environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions (in the NPS, major actions are synonymous with significant actions) taking place over a period of time (see 40 CFR Part 1508.7). The degree or intensity of impact (i.e., negligible, minor, moderate, or major) can be beneficial or adverse, and can be further described by duration of impact (i.e., short-term or long-term).

Impermeable: Preventing the passage of fluid. A formation may be porous yet impermeable if there is an absence of connecting passages between the voids within it.

Lease: A legal document executed between a landowner, as lessor, and a company or individual, as lessee, that grants the right to exploit the premises for minerals or other products.

Long-term: Describes impacts that would occur over a 20-year period, or longer.

Management Policies: National Park Service Management Policies is the basic Servicewide policy document of the National Park Service and will be revised at appropriate intervals to consolidate servicewide policy decisions. The management of the National Park System and NPS programs is guided by the U.S. Constitution, public laws, proclamations, executive orders, rules and regulations, and directives of the Secretary of the Interior and the Assistant Secretary for Fish and Wildlife and Parks. Other laws, regulations, and policies related to the administration of federal programs, although not cited, may also apply.

Mesic: Of, pertaining to, or adapted to an environment having a balanced supply of moisture.

Midden: A trash deposit.

Mitigation: "Mitigation," is defined in NPS Director's Order 12 as a "modification of the proposal or alternative that lessens the intensity of its impact on a particular resource. The definition references 40 CFR § 1508.20, which states:

1. Avoiding the impact altogether by not taking a certain action or parts of an action.
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectifying the impact of repairing, rehabilitating, or restoring the affected environment.
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
5. Compensating for the impact by replacing or providing substitute resources or environments.

The term "mitigation" is used interchangeably in this Final Plan/EIS with other terms, including "mitigation measure," "mitigation techniques," and "mitigation strategies."

Monocline: A geologic formation in which all strata are inclined in the same direction.

National Environmental Policy Act of 1969 (NEPA): Public Law 91-190. The National Environmental Policy Act of 1969 (NEPA) as amended, is landmark environmental protection legislation establishing as a goal for federal decision making a balance between use and preservation of natural and cultural resources. NEPA requires all federal agencies to (1) prepare in-depth studies of the impacts of and alternatives to proposed "major federal actions," (2) use the information contained in such studies in deciding whether to proceed with the actions, and (3) diligently attempt to involve the interested and affected public before any decision affecting the environment is made.

National Register of Historic Places (NRHP): A listing of architectural, historical, archeological, and cultural sites of local, state, or national significance, established by the Historic Preservation Act of 1966 and maintained by the National Park Service.

Natural Floodplain Values: Attributes of floodplains which contribute to ecosystem quality, including soils, vegetation, wildlife habitat, dissipation of flood energy, sedimentation processes, ground water (including riparian ground water) recharge, etc.

Natural Gas: A highly compressible, highly expandable mixture of hydrocarbons having a low specific gravity and occurring naturally in a gaseous form. Besides hydrocarbon gases, natural gas may contain appreciable quantities of nitrogen, helium, carbon dioxide, and contaminants.

No Surface Use (NSU): Access across the surface or use of the surface for nonfederal oil and gas operations would be limited or not permitted in Special Management Areas (SMAs). Operations include, but are not limited to: gathering information for development of a plan of operations; geophysical exploration; construction or use of roads or other means of access; construction or use of drilling pads and well pads, well completion and production; use of production equipment and facilities; well servicing and workover operations, construction or use of flowlines and gathering lines; transport or processing of petroleum products; and inspection, monitoring or maintenance of wells and equipment. Under this constraint, operators may produce and develop the oil and gas resources beneath the Preserve by directionally drilling from sites outside the NSU area. NSU is also used with an offset or distance stipulation, or timing stipulation.

Offset: An area between two different land uses that is intended to resist, absorb, or otherwise preclude developments or intrusions between the two use areas.

Oil: Any viscous, combustible liquid hydrocarbon or solid hydrocarbon substance easily liquefiable on warming, which occurs naturally in the earth, including drip gasoline or other natural condensates recovered from gas without resort to manufacturing processes**.**

Operations: Defined as "all functions, work and activities within a unit in connection with exploration for and development of oil and gas resources" (36 CFR § 9.31(c)). Operations include, but are not limited to:

- reconnaissance to gather natural and cultural resources information;
- line-of-sight surveying and staking;
- geophysical exploration;
- exploratory drilling;
- production, gathering, storage, processing, and transport of petroleum products;
- inspection, monitoring, and maintenance of equipment;
- well "work-over" activity;
- construction, maintenance, and use of pipelines;
- well plugging and abandonment;
- reclamation of the surface; and
- construction or use of roads, or other means of access or transportation, on, across, or through federally owned or controlled lands or waters.

If an operator desires to conduct nonfederal oil and gas operations in a National Park System unit, and operations require access on, across, or through federally owned or controlled lands or waters, the 36 CFR Part 9B regulations require that the operator:

- possess a right to the nonfederal oil and gas in the unit (36 CFR § 9.36(a) (2)),
- file a plan of operations with the NPS and receive approval from the Regional Director prior to commencing operations (36 CFR § 9.32(a)), and
- submit a performance bond or security deposit to the NPS (36 CFR § 9.48(a)).

Operator: Person(s) who may have rights to explore and develop nonfederally owned oil and gas in NPS units, including:

- Owners: individuals, corporations, local and state governments, Indian tribes (when the tribe owns the oil and gas in fee), etc.;
- Lessees: individuals or corporations that lease oil and gas from the owner; and
- Contractors: individuals or corporations under contract with the owner, lessee, or operator.

Organic Act: Congress formally established the National Park Service by the Act of August 25, 1916, which is commonly called the National Park Service Organic Act. The Organic Act mandates the Service ". . .to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 U.S.C. §§ 1 *et seq.).* This unambiguous statement of purpose for the National Park System directs that preservation and public enjoyment of the natural, scenic, and cultural resources in a manner that leaves them unimpaired is the fundamental purpose of all national parks, monuments, and other reservations.

The Organic Act authorized the Secretary of the Interior to promulgate rules and regulations necessary for the management of the national parks, monuments, and other reservations under the Secretary's jurisdiction (16 U.S.C. § 3). This authority, among others, provides the basis for the regulations in 36 CFR Chapter 1, including the NPS regulations in 36 CFR Part 9, governing mining claims and nonfederally owned oil and gas.

Paleoindian: Paleoindians are people who hunted now-extinct animals prior to 6,000 years ago.

Palustrine: Nontidal wetlands dominated by trees, shrubs, or persistent emergents.

Permeability: The capacity to transmit fluids or gases through soil or rock materials; the degree of permeability depends upon the size and shape of the pore spaces and interconnections, and the extent of the interconnections.

Pipelines: Oil and gas lines that have their point of origin and end point outside the park and for the most part are not supporting nonfederal oil and gas operations in the park.

Plan of Operations: Application submitted by an operator describing how proposed oil and gas operations would be conducted in a unit of the National Park System pursuant to the NPS's Nonfederal Oil and Gas Rights Regulations, 36 CFR 9B, and containing information requirements pertinent to the type of operations being proposed (36 CFR §§ 9.36(a) through (d)).

Practicable: Capable of being done within existing constraints. The test of what is practicable depends upon the situation and includes consideration of the pertinent factors such as environment, cost, or technology (excerpted from NPS Director's Order 77-2 - Floodplain Management).

Production: The phase of mineral extraction where minerals are made available for treatment and use.

Reclamation: The process of returning disturbed land to a condition that will be approximately equivalent to the pre-disturbance condition in terms of sustained support of functional physical processes, biological productivity, biological organisms, and land uses.

Record of Decision: The document that is prepared to substantiate a decision based on an EIS. It includes a statement of the decision made, a detailed discussion of decision rationale, and the reasons for not adopting all mitigation measures analyzed, if applicable.

Recovery Plan: A plan required for each listed threatened/endangered species and generated by a task force under the leadership of the U.S. Fish and Wildlife Service. The plan describes the specific management actions necessary to restore the threatened or endangered species to recovery status, including the estimated cost and time involved. The FWS coordinator oversees implementation of the plan.

Regional Director: There are seven geographic regions under which the units of the National Park System are organized. Big Thicket National Preserve is located within the Intermountain Region of the National Park Service. The Regional Director is the chief decision-maker.

Regulatory Floodplain: The specific floodplain which is subject to regulation by Executive Order 11988, "Floodplain Management," and the NPS's Floodplain Management Guideline (DO77-2). For Class I Actions, the Base Floodplain (100-year) is the regulatory floodplain; for Class II Actions, the 500-year return period floodplain is the regulatory floodplain; for Class III Actions, the Extreme floodplain is the regulatory floodplain.

Revegetation: The reestablishment and development of self-sustaining plant cover. On disturbed sites, this normally requires human assistance, such as seed bed preparation, reseeding, and mulching.

Scoping Process: An early and open public participation process for determining the scope of issues to be addressed in an Environmental Impact Statement, and for identifying significant issues related to a proposed action.

Seismic hole or shot hole: Any hole drilled for the purpose of securing geophysical information to be used in the exploration or development of oil, gas, or other mineral resources.

Shut-in well: An oil and gas well in which the inlet and outlet valves have been shut off so that it is capable of production but is temporarily not producing.

Special Management Area (SMA): Areas that include park resources and values that are particularly susceptible to adverse impacts from oil and gas geophysical exploration and drilling and production operations. These areas are formally proposed under Alternatives B and C; and specific operating stipulations are proposed for each of these SMAs to protect them from adverse impacts from oil and gas operations.

Split Estate: Refers to the situation where the mineral estate is owned or controlled by a party other than the owner of the land surface in the same area.

Statement for Management (SFM): A National Park Service planning document used to guide short- and long-term management of a unit; to determine the nature and extent of planning required to meet the unit's management objectives; and, in the absence of more specific planning documents, to provide a general framework for directing park operations and communicating park objectives to the public.

Succession: The natural replacement of one biotic community by another.

Superintendent: The Superintendent (or his/her designee) of the unit of the National Park System containing lands subject to the rights covered by the Nonfederal Oil and Gas Rights Regulations, 36 CFR 9B.

Taking: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Threatened Species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Timing Limitation (Seasonal Restriction): Constraint that prohibits surface use during specified time periods. This constraint does not apply to the operation and maintenance of production facilities unless analysis demonstrates that such constraints are needed and that less stringent, project-specific constraints would be insufficient.

Vertical Drilling: Drilling of a well vertically (90 degrees) to reach a target zone straight underneath the surface location.

Wetlands: Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominantly undrained hydric soil; and 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year. (Classification of Wetlands and Deepwater Habitats of the United States (Cowardin *et al*. 1979))

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