

National Park Service
U.S. Department of the Interior

Intermountain Region
Southern Arizona Office
Phoenix, Arizona



Protocol Development of a Framework for Monitoring Border Impacted Cultural Resources: Technical Assistance for Database and GIS Development

DSCESU Report for Cultural Resources Border Impacts Project

March 2006



**Protocol Development of a Framework for Monitoring Border Impacted Cultural Resources:
Technical Assistance for Database and GIS Development**

DSCESU Report for the Cultural Resources Border Impacts Project

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Denver, Colo.

Introduction:

Parks located along the U.S./Mexico border have experienced dramatic increases in illegal cross-border traffic in recent years. Recent estimates based on field data indicate that more than 1,500 illegal entrants per day passed through Organ Pipe Cactus National Monument (ORPI) in 2005. Anecdotal evidence suggests illegal migrant use is similar at Coronado National Memorial (CORO) though proportionate to the smaller area of this park. As with other border parks, migrants and smugglers typically utilize backcountry areas of ORPI and CORO (including designated wilderness) to avoid detection. Most of this traffic is on foot following installation of vehicle barriers in both units beginning in 2002. However, off road driving still occurs on occasion as the barriers are circumvented. The result is a spiderweb of unofficial trails and roads replete with discarded water bottles, clothing, food, and other refuse.

Efforts to control illegal activities have focused largely on the apprehension of undocumented immigrants (UDIs) and narcotics smugglers. However, documentation and monitoring of cultural and natural resource impacts in these areas has received very little attention. With the exception of one year of monitoring data that has been collected at Organ Pipe Cactus National Monument (ORPI), none of the border parks have been successful in systematically collecting quantitative resource information specific to migrant impacts. Quantitative resource data are critical for designing and evaluating resource management and protection in border parks, and could serve as the foundation for continued specific threat-based monitoring of migrant impacts.

Prior research has partially filled this knowledge gap; high-resolution remote sensing technology has been evaluated for monitoring border impacts at ORPI and CORO (Drake et al. 2003), and ORPI, CORO, and Amistad (AMIS) have ongoing field based assessment tools in development. In addition, the Southern Arizona Office (SOAR) has been leading a multi-park assessment of impacts to cultural resources in all 11 U.S./Mexico border parks, and is currently developing a long-term assessment strategy for cultural resources at risk. Inadequate and poorly organized base geographic information system (GIS) products have greatly limited these efforts in the 11 U.S./Mexico border parks (Table 1, Figures 1 and 2).

Table 1. U.S./Mexico border parks

Park Name	Park Code	State
Amistad National Recreation Area	AMIS	Texas
Big Bend National Park	BIBE	Texas
Chamizal National Memorial	CHAM	Texas
Chiricahua National Monument	CHIR	Arizona
Coronado National Memorial	CORO	Arizona
Fort Bowie National Historic Site	FOBO	Arizona
Organ Pipe Cactus National Monument	ORPI	Arizona
Padre Island National Seashore	PAIS	Texas
Palo Alto Battlefield National Site	PAAL	Texas
Saguaro National Park	SAGU	Arizona
Tumacacori National Historic Park	TUMA	Arizona



Figure 1: NPS Parks in Vicinity of the Sonora, Mexico-Arizona, USA Border



Figure 2: NPS Parks in Vicinity of the Mexico-Texas, USA Border

Project Focus:

This cooperative technical assistance project addressed significant spatial and tabular data management problems by systematically evaluating, organizing, reprocessing, and where necessary, generating new products for all 11 border parks. This project was completed to support a comprehensive assessment of border-related impacts on cultural resources in the 11 U.S./Mexico border parks under the direction of the National Park Service Southern Arizona Office (NPS-SOAR) Cultural Resources Program.

Methods:

During the early stages of the project, Geographic Information System (GIS) directories were established for each of the parks involved. All available base-datasets including Digital Orthophoto Quarter Quads (DOQQs), Digital Elevation Model (DEM) Digital Raster Graphic (DRG) topographic maps (1:24,000) were collected and imported. The NPS GIS Clearinghouse provided other available datasets for each park,

including roads, trails, infrastructure, and vegetation maps. All shapefiles, coverages and images were imported into individual ArcMap projects.

Using these ArcMap projects in combination with the National Geographic TOPO! ArcGIS extension, maps were designed for each park to be displayed on the Border Impacts website. These maps displayed major features of each park (park boundary, headquarters, major roads, political boundaries) overlaid on shaded topographic maps of the surrounding area. Large maps were plotted of selected parks, to be used during the field component of the project.

Several database searches were performed to assess the availability of satellite information and to collect archeological information for the border impacts parks. A database was created to document all available Quickbird archival high-resolution satellite imagery for the parks and surrounding areas. Another database was established to store information on cultural sites in each of the parks. This database includes information collected from Arizona's Cultural Resources Inventory (AZSITE), NPS Archaeological Sites Management Information System (ASMIS), the Texas Archaeological Research Laboratory (TARL) and Texas Archaeological Site Atlas.

Products of the Technical Assistance:

The products of this technical assistance are (1) electronic, relational databases (MS-Access) and; (2) accurate and documented GIS and remote sensing products for all 11 U.S./Mexico border parks. Example maps are included in this report to familiarize the reader with the study area (Appendix A); however, the actual databases and GIS files (with metadata documentation) reside with the SOAR Cultural Resources Program, with some GIS files also housed at the Sonoran Desert Network I&M Program, for use in the broader border impacts assessment program. Applicable products will be distributed to the 11 park units as part of the overall border assessment project. In addition, base cartographic layers will be routed to the NPS GIS Data Clearinghouse (an NPS intranet data server) for general resource management and protection activities.

Spatial Information:

Corrected ArcGIS shapefiles, images, and coverages for each of the 11 parks were generated for base cartographic and topographic layers (Table 2). New ArcGIS layers containing cultural resources were generated based on database queries of known features and derived information from park staff interviews. All cultural resources with spatial information were incorporated into additional ArcGIS

layers. All spatial files are located on the NPS Sonoran Desert Network I&M servers and will be uploaded to the NPS GIS Clearinghouse as appropriate.

Table 2. ArcGIS shapefiles, images, and coverages for U.S./Mexico Border Parks

Park Code	Layers
AMIS	Park boundary, park facilities, major roads, political boundary, topographic, DOQQ, water quality, mines, and hydrology
BIBE	Park boundary, park facilities, major roads, political boundary, topographic, DOQQ, developed areas, and hydrology
CHIR	Park boundary, park facilities, major roads, topographic, DOQQ, DEM, trash, and cultural resource sites
CORO	Park boundary, park facilities, major roads, topographic, DOQQ, DEM, Quickbird, graveyard, water quality, historic buildings, historic markers, fences, political boundary, and cultural resource sites
FOBO	Park boundary, park facilities, major roads, political boundary, topographic, DOQQ, DEM, hydrology, soils, stock tanks, vegetation plots, wells, cultural resource sites
ORPI	Park boundary, park facilities, major roads, political boundary, topographic, DOQQ, DEM, hydrology, wilderness, historic buildings, and cultural resource sites
PAIS	Park boundary, park facilities, topographic, and cultural resource sites
PAAL	Park boundary, park facilities, topographic, battlefield location, and cultural resource sites
SAGU	Park boundary, park facilities, major roads, topographic, DOQQ, DEM, hydrology, non-native plants, fires, mines, wilderness, historic buildings, and cultural resource sites
TUMA	Park boundary, park facilities, DOQQ, and DEM

Tabular Information:

Two MS-Access tabular databases were generated to manage (1) existing remote sensing imagery information for the 11 border parks and; (2) relevant cultural resource information from state and federal cultural resource authorities. These databases follow the NPS database template and are intended to serve as reference resources for each of the 11 border parks.

Data Documentation and QA/QC:

Final GIS products meet all applicable Federal Geographic Data Committee (FGDC) and National Park Service standards for spatial information. In addition, metadata documentation was generated for all spatial and tabular data.

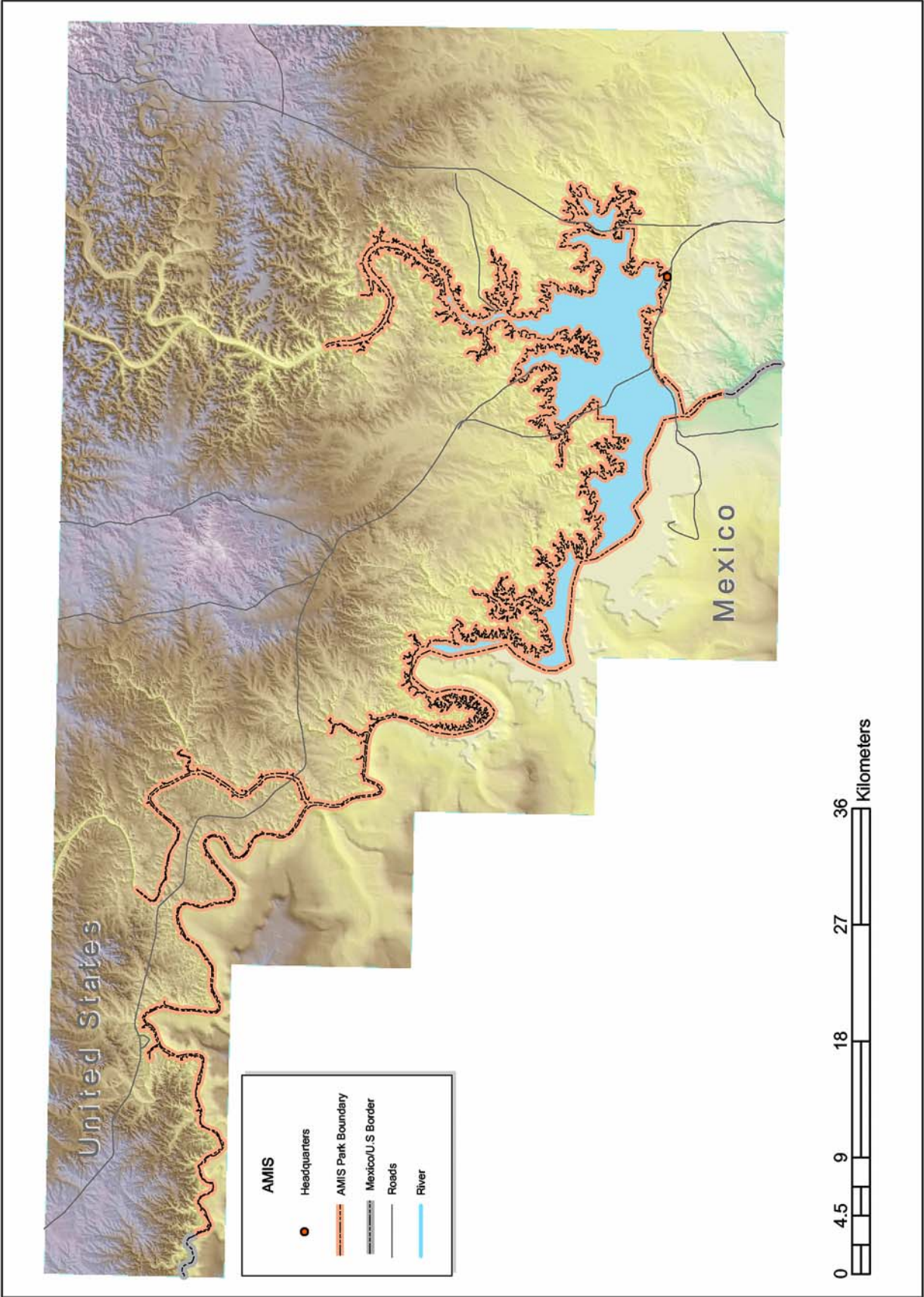
Supplemental Information:

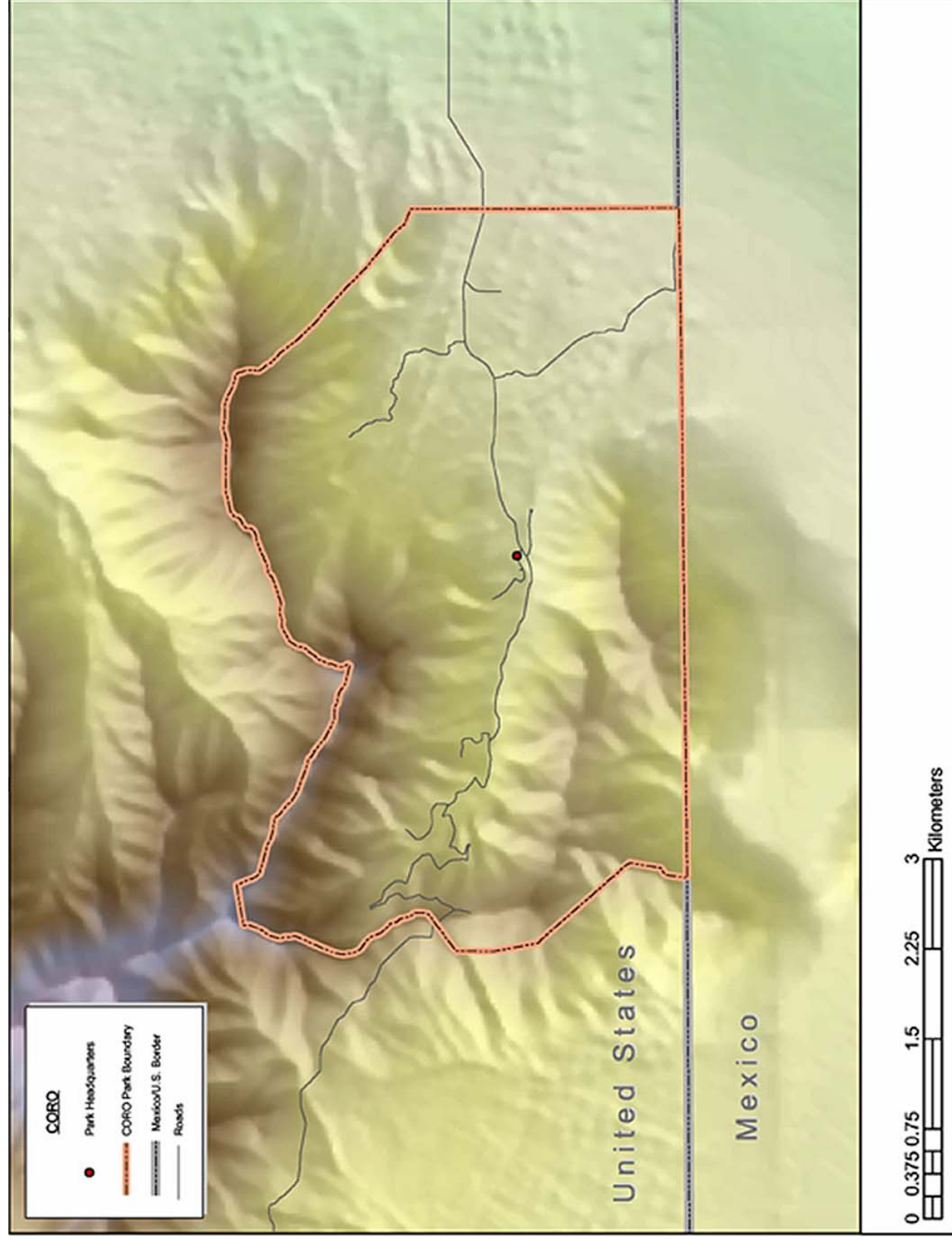
The Regional Monitoring Partnership (RMP), focusing on the Huachuca Mountains Grassland Valley Complex, which extends from the Rincon Mountains south into Mexico and is bounded by the San Pedro watershed to the east and the Santa Cruz watershed to the west. The RMP is a forum for information

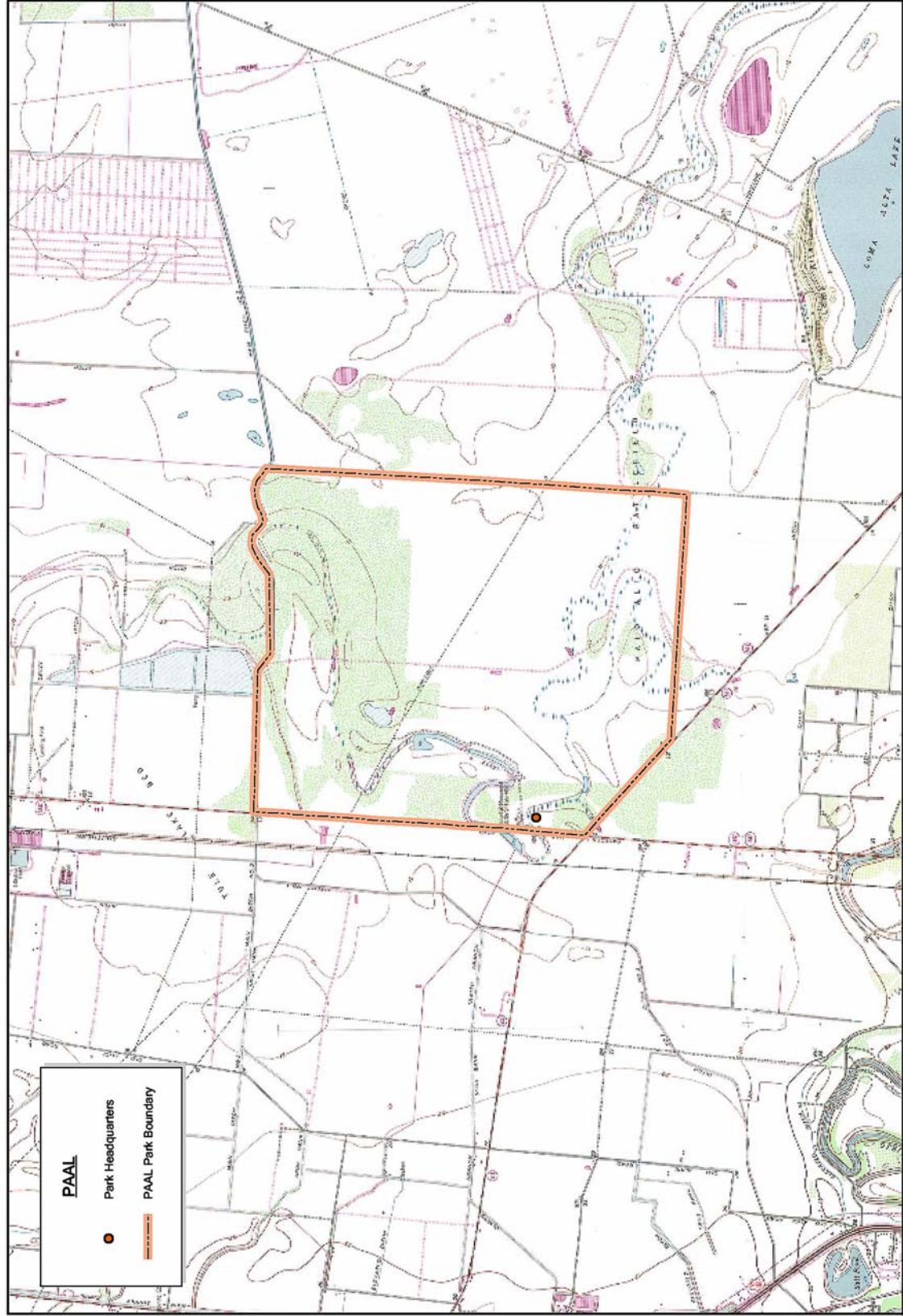
sharing and collaboration on mutual, priority land management issues. In the March 2005, a RMP meeting focused exclusively on border impacts and the ways agencies and organizations can collaborate to improve the information collected, share existing data, and make management decisions based on a more detailed data collection and analysis of border impacts. As part of the follow up to this meeting on border impacts, a survey was conducted among all the participating agencies to determine the data available and compatibility of existing data. Results of this survey are in Appendix B.

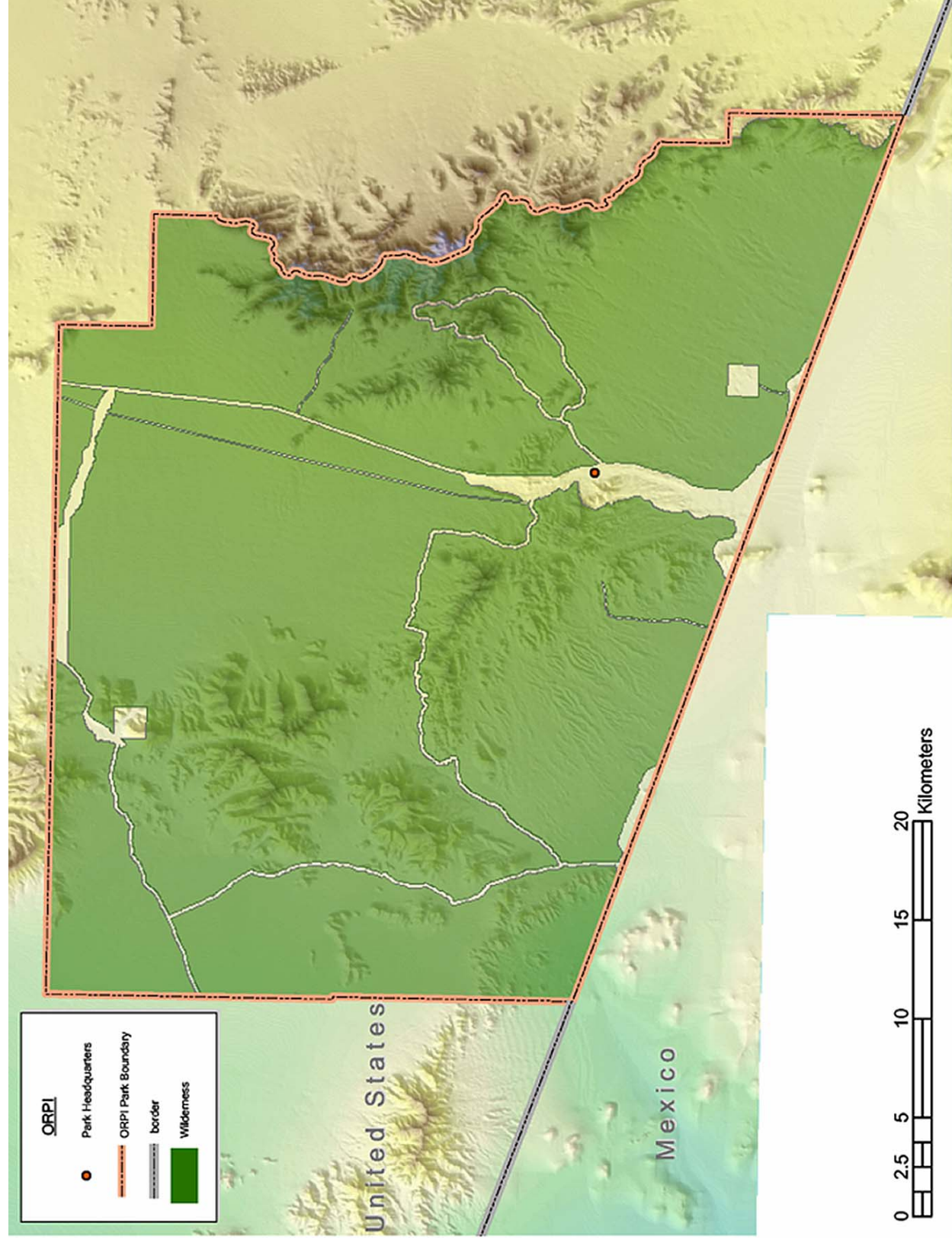
Over sixty pieces of literature were collected that are relevant to the impacts on the U.S./Mexico border. They include federal, state, local, and non-profit reports; academic writings and studies; and mainstream media news stories. Appendix C lists the references of the literature collection.

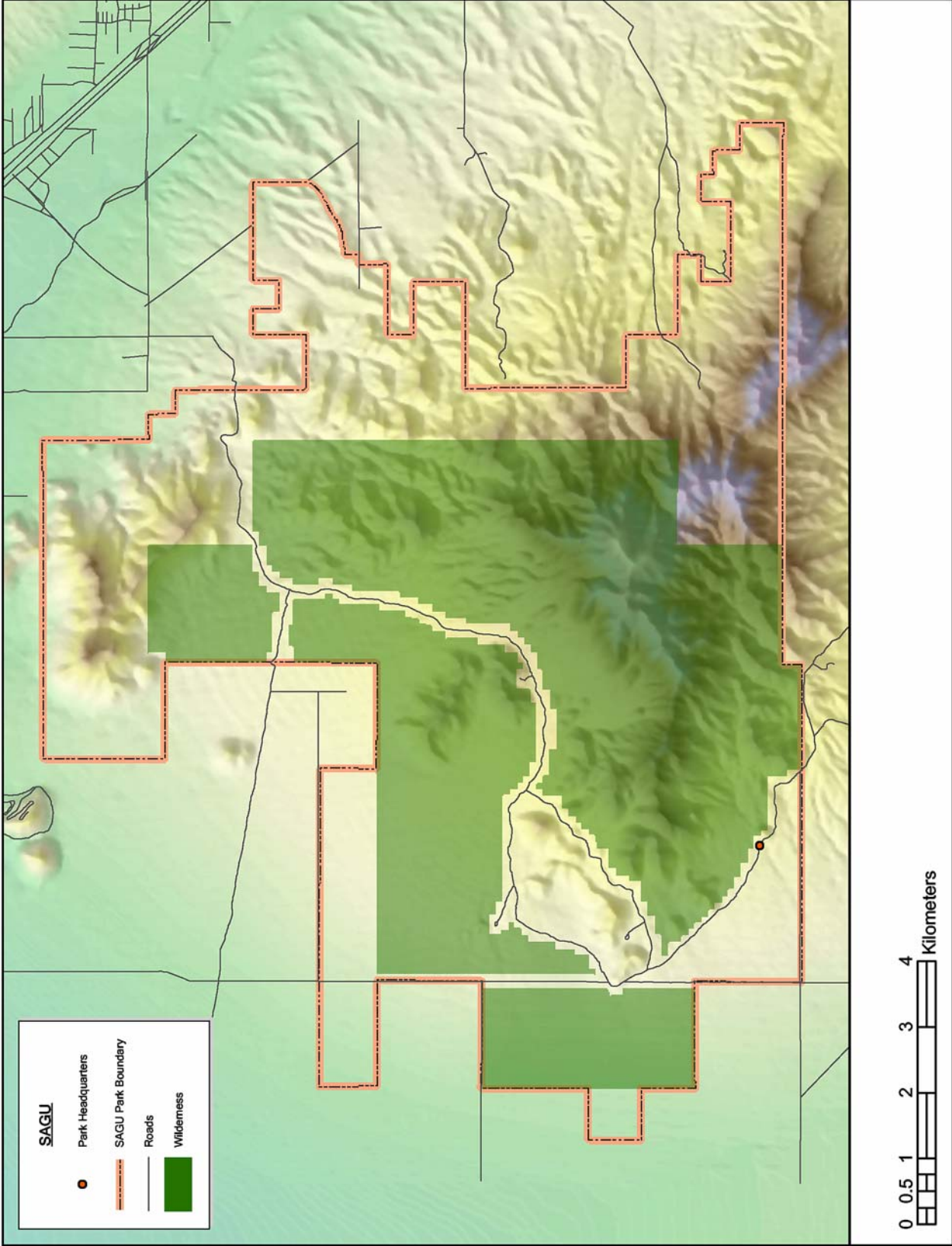
Appendix A

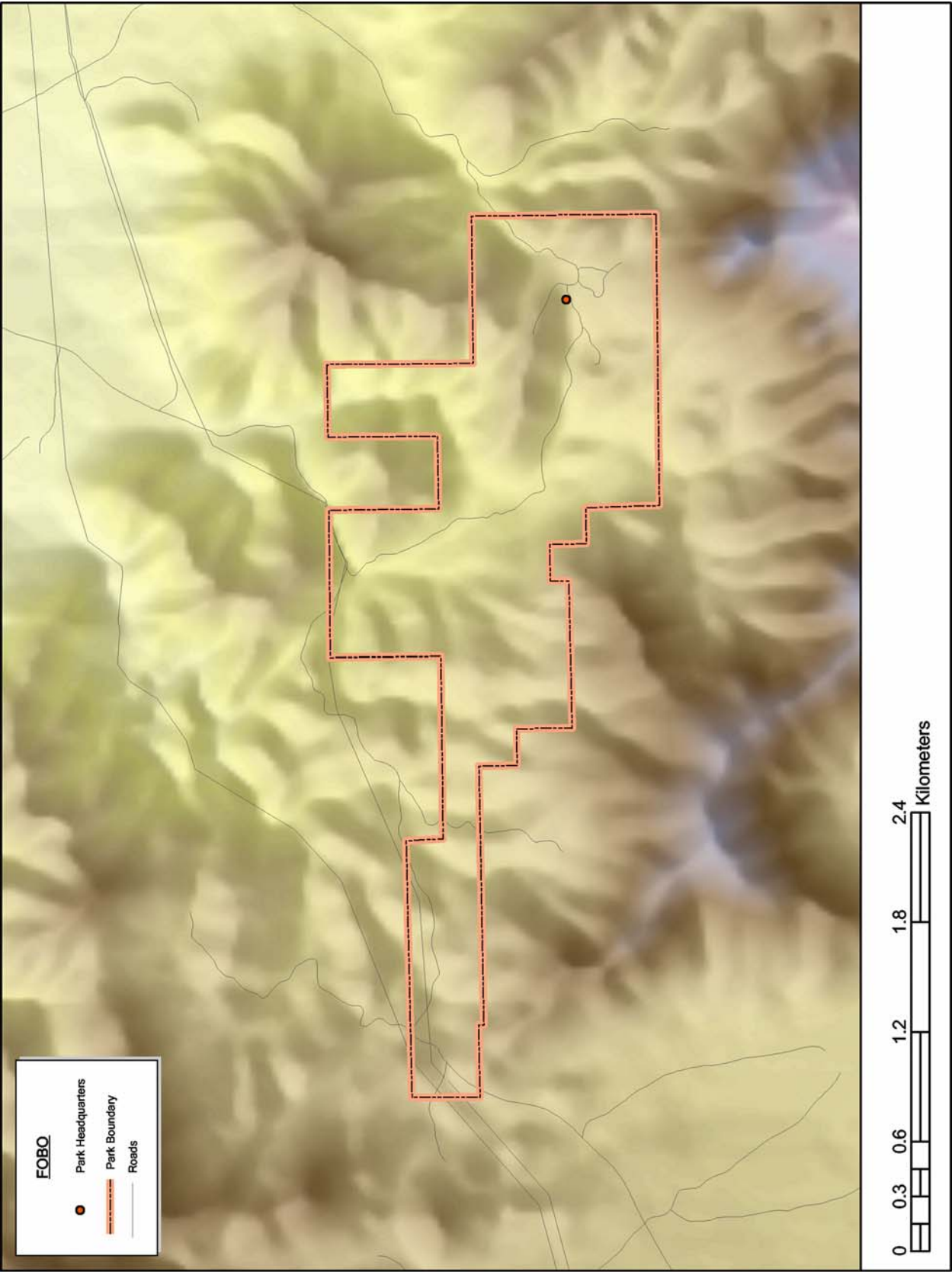


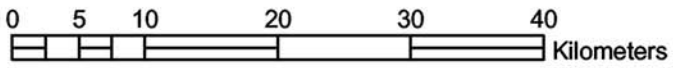
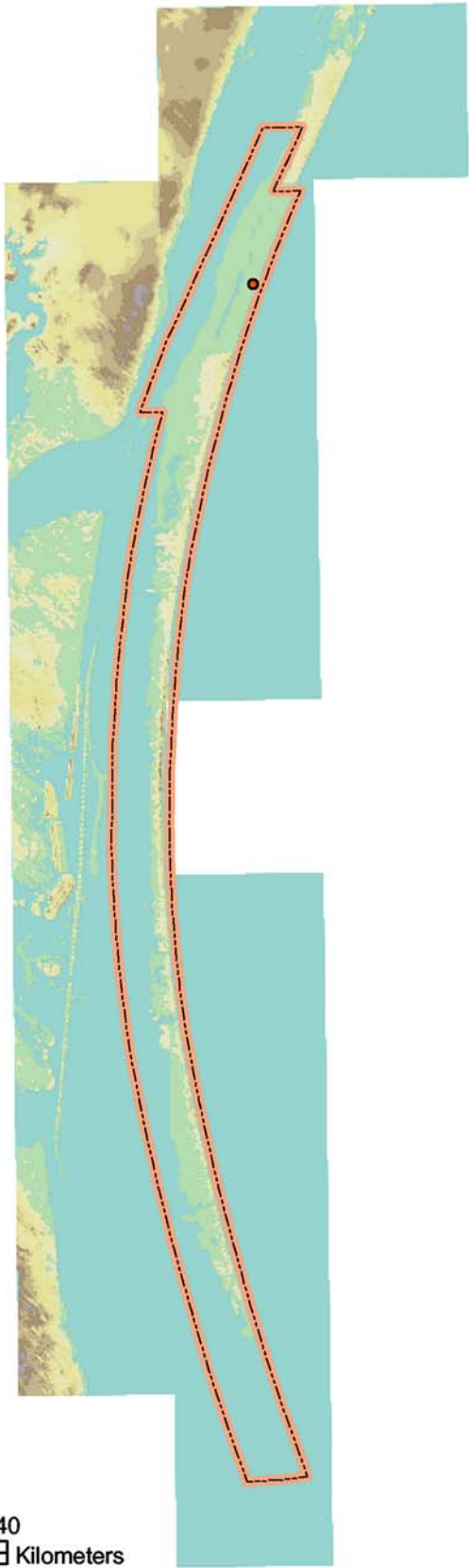
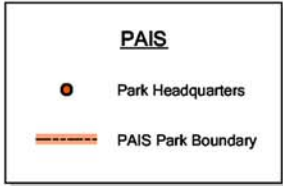


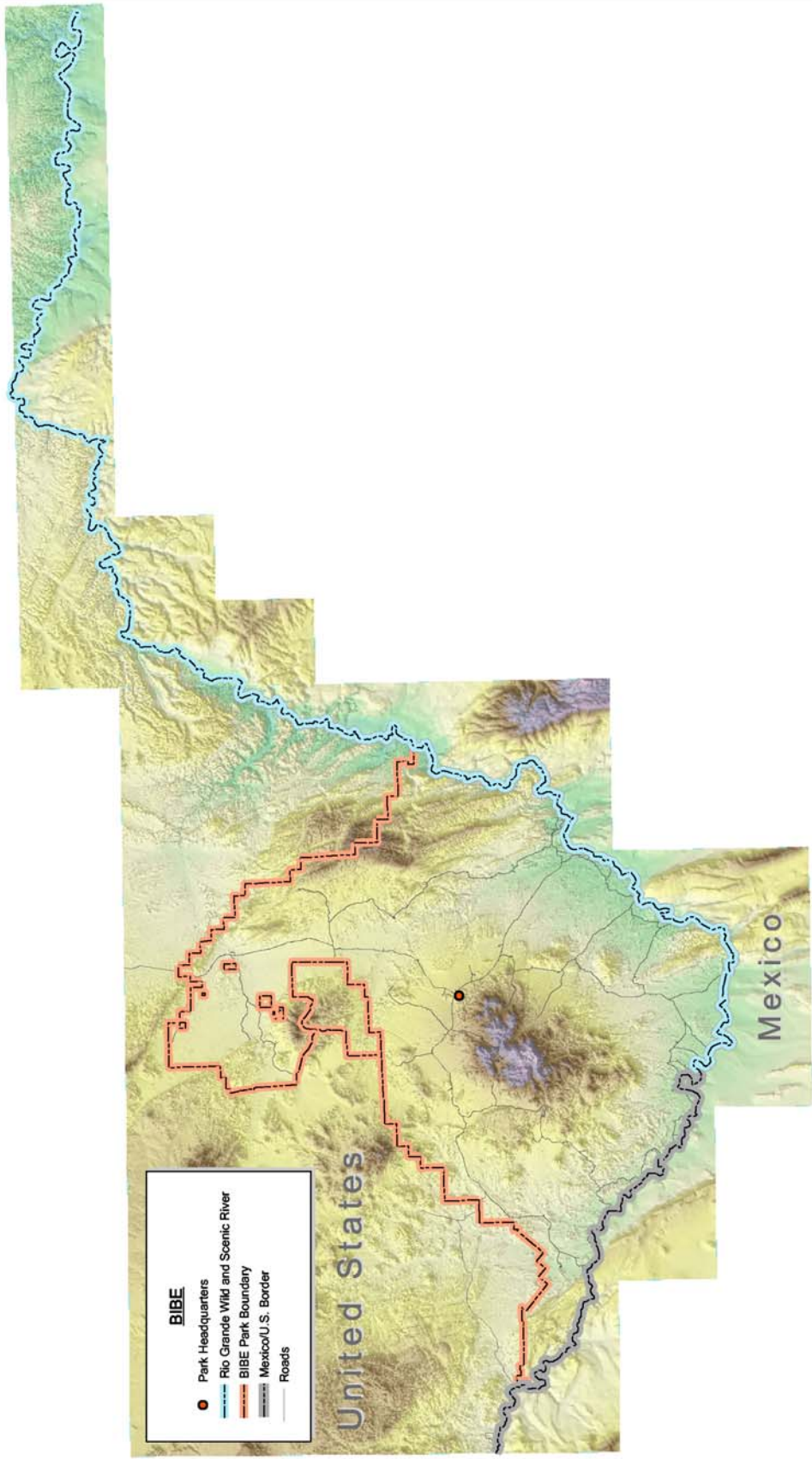












- BIBE**
- Park Headquarters
 - Rio Grande Wild and Scenic River
 - - - BIBE Park Boundary
 - - - Mexico/US Border
 - Roads



Appendix B

Regional Monitoring Partnership Border Impacts Data Survey Compiled Results (March 2005)

All the answers expressed here are respondents' opinions and NOT those of their Institution or Country. These are not official comments.

1. Respondents:

- National Park Service (NPS), Coronado National Memorial (CORO)
- National Park Service (NPS), Organ Pipe Cactus NM (ORPI)
- Comisión Nacional de Areas Naturales Protegidas (CONANP), El Pinacate y Gran Desierto de Altar Biosphere Reserve (PINA)
- U.S. Fish and Wildlife Service (USFWS), Ecological Services
- San Rafael Ranch State Park, Arizona State Parks (ASP)
- National Park Service (NPS), Southern Arizona Office (SOAR)
- National Park Service (NPS), Saguaro NP (SAGU)
- National Park Service (NPS), Organ Pipe Cactus NM (ORPI)
- Arizona Game and Fish Department (AGFD)
- National Park Service (NPS), Coronado National Memorial (CORO)
- U.S. Fish and Wildlife Service (USFWS), Cabeza Prieta National Wildlife Refuge (CPNWR)
- Arizona State Parks (ASP)
- Fort Huachuca/Colorado State University (ARMY)
- Bureau of Land Management (BLM), Las Cienegas National Conservation Area (LCNCA)
- National Park Service (NPS), Saguaro NP (SAGU)
- Arizona State Parks (ASP)

Border Impacts

2. Are there impacts that your land unit is experiencing as a result of illegal drug trafficking, illegal migrants, or law enforcement activities? Check one.

Yes	No	Unknown
AGFD ARMY ASP BLM CORO CPNWR ORPI PINA SAGU SOAR		USFWS

3. How much (on a scale from 1 to 10) are the illegal traffic and law enforcement responses contributing to impacts to your resources? Circle one:

0 (not at all)	1 (low)	2	3 SAGU	4 PINA	5 BLM	6	7 ARMY	8 CORO ORPI USFWS	9	10 (high) AGFD CPNWR SOAR
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4. At any time over the last five to ten years, have you documented evidence of persons crossing the border or of law enforcement responses in any of the following ways? Check all that apply.

Category	Dated, digital photos	Narrative descriptions	Aerial diagrams	GPS points	Remote sensing	GIS layers	Other (describe)
a. Trails	CORO CPNWR ORPI PINA SOAR	ASP CPNWR ORPI SOAR	CPNWR ORPI SOAR	ARMY CORO CPNWR ORPI	CORO CPNWR	ARMY CORO CPNWR ORPI	
b. Roads	ASP BLM CPNWR ORPI PINA SOAR	ASP BLM CPNWR ORPI PINA SAGU SOAR	CPNWR ORPI PINA SOAR	BLM CPNWR ORPI	CPNWR	CPNWR ORPI	
Category	Dated, digital photos	Narrative descriptions	Aerial diagrams	GPS points	Remote sensing	GIS layers	Other (describe)
c. Law enforcement infrastructure:	CPNWR	CPNWR	CPNWR	CPNWR	CPNWR	CPNWR	
i. Lights							
ii. Camera towers	CORO			CORO			
iii. Other infrastructure	CORO ORPI	CORO ORPI		CORO ORPI		CORO	CORO-Sensors ORPI-Beacons
d. Trash sites	ASP	ASP	PINA	BLM		CPNWR	CORO-cubic

	BLM CORO CPNWR ORPI PINA SOAR	BLM ORPI PINA SOAR	SOAR	CORO CPNWR ORPI		ORPI	yards collected
e. Campfires	CPNWR ORPI PINA SOAR	ORPI SOAR	SOAR	CORO CPNWR ORPI		CORO CPNWR ORPI	CORO- Montezuma Fire
f. Human waste	PINA SOAR	PINA SOAR	SOAR				
g. Abandoned cars / car parts	ASP BLM CPNWR ORPI PINA SOAR	ASP CORO (LE reports) CPNWR ORPI PINA SAGU SOAR	CPNWR ORPI SOAR	BLM CPNWR ORPI		CPNWR ORPI	
h. Other: search and rescues	CPNWR	CPNWR		CPNWR		CPNWR	
h. Other: UDA apprehensions	CORO	CORO (LE reports)					CORO-UDA apprehensions
h. Other: vegetation damage and trenched roads	PINA		PINA	PINA			PINA- vegetation damage
h. Other: wildfires that may have originated from immigrant campfires	BLM			BLM			BLM fire reports (some GIS layers)
Category	Dated, digital photos	Narrative descriptions	Aerial diagrams	GPS points	Remote sensing	GIS layers	Other (describe)
h. Other: vandalism to historic and cultural resources	BLM CORO			BLM			BLM law enforcement reports
h. Other: woodcutting, endangered species habitat destruction	BLM			BLM			
h. Other: impacts associated with rehab, vehicle removal, etc	BLM			BLM			

h. Other: Car chases and fence removal	ASP	ASP					ASP-incident reports
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Monitoring and Protocols

5. Do you have a regular monitoring program in place to assess border impacts?

Yes	No	Unknown
CPNWR ORPI	AGFD ARMY ASP BLM CORO PINA SAGU SOAR USFWS	

IF NO, skip to Question 6.

a. How is monitoring conducted? Check all that apply.

Category	X
Foot transects	CPNWR ORPI
Drive-bys	CPNWR ORPI
Aerial surveys	
Remote sensing	
Other: Trash accumulation Road transects Mapping vehicle tracks with GPS	ORPI

b. Who conducts the monitoring? Check all that apply.

Category	X
Unit staff	CPNWR ORPI
Volunteers	CPNWR ORPI
Other _____	

c. What are the time intervals for specific parts of the monitoring program (e.g., trails twice a year, roads weekly, known trash sites annually); and what geographic area or transect (e.g., the whole unit, easily accessible sections) used in monitoring?

	Monitoring category	Frequency	Area/transect covered
CPNWR ORPI	transects E-W foot transects	1/yr 1/yr in late spring	3 transects entire width of ORPI; 1 km N of S border, central, and northern
CPNWR	Road surveys	2/month	
ORPI	Road surveys	4 times/year	Vehicle tracks that intersect public-use roads are mapped & monitored quarterly. Roadside damage is also mapped and monitored quarterly. Entire length of public roads throughout the monument.
ORPI	Motorized Wilderness Incursions	As needed	Vehicle tracks that are related to law-enforcement efforts are mapped throughout the monument.

6. If a border impacts monitoring program is not in place, or your current monitoring is not adequate to your needs, please describe the type of program that you would like to see. Please be specific as possible.

Data Availability

7. In general, are copies of your border impacts documentation and monitoring data (see questions 4 and 5) available to share with the Regional Monitoring Partnership?

Yes	No	Unknown
ARMY BLM CPNWR PINA SAGU SOAR	ASP CORO ORPI	USFWS

8. Is access to any of these monitoring data restricted or sensitive?

Yes	No	Unknown
BLM CORO ORPI SAGU USFWS	ARMY ASP CPNWR PINA SOAR	

9. GIS Data

a. Are any of your border impacts data stored in GIS layers?

Yes	No	Unknown
AGFD ARMY CORO CPNWR ORPI	ASP BLM PINA SAGU USFWS	

b. Do you have and use any of the following ESRI products? Check all that apply.

Category	X
ArcView 3.x	ASP BLM CPNWR ORPI PINA SAGU SOAR
ArcGIS 8.x	CPNWR ORPI SOAR
ArcGIS 9.x	AGFD ARMY ASP CORO ORPI SAGU
ArcInfo	ARMY ASP BLM CORO SAGU

- c. In what projection and datum are most of your relevant GIS layers stored? Check all that apply.

Projection	X
UTM, Zone 12	AGFD ARMY ASP BLM CORO CPNWR ORPI PINA SAGU
Projection	X
Latitude/Longitude	AGFD
Decimal degree	
Unknown	
Other: _____	
Datum	X
WGS 1984	ARMY ASP
NAD27	AGFD ASP BLM PINA
NAD83	AGFD ARMY ASP BLM CORO CPNWR ORPI SAGU
Unknown	
Other:	

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d. Do you keep metadata files for your GIS layers?

Yes	No	Unknown
ARMY ASP BLM CORO CPNWR ORPI PINA SAGU	CPNWR	

e. If so, is there a metadata standard for your agency that the data follows?

Yes	No	Unknown
ARMY BLM CORO CPNWR ORPI SAGU	ASP	PINA

f. Which of the following spatial data sources do you have for your unit? Check all that apply?

Category	X
DRGs (Digital Raster Graphics)	ARMY ASP BLM CORO CPNWR ORPI PINA SAGU
DOQQs (Digital Orthophoto Quarter Quads)	ARMY ASP

	BLM CORO CPNWR ORPI SAGU
10-m DEMs (Digital Elevation Models)	ARMY CORO SAGU
30-m DEMs (Digital Elevation Models)	BLM CPNWR ORPI SAGU
unrectified aerial photographs	ASP BLM CORO CPNWR SAGU
Unknown	
Other: Satellite imagery: IKONOS: 16 scenes covering entire monument, captured 2002-2003 Quickbird: scenes covering about 1km strip paralleling the internat. boundary	ORPI

g. Do you have any GPS units?

Yes	No	Unknown
AGFD ARMY ASP BLM CORO CPNWR ORPI PINA SAGU SOAR		

h. Does your staff know how to use GPS units for data collection?

Yes	No	Unknown
AGFD ARMY ASP BLM CORO CPNWR		

ORPI PINA SAGU SOAR		
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- i. Can your staff process GPS data to create a GIS layer?

Yes	No	Unknown
AGFD ARMY ASP BLM CORO ORPI PINA SAGU SOAR	CPNWR	

10. Do your digital photos have associated metadata (e.g., date, description, location, photographer, etc.)?

Yes	No	Unknown
ASP BLM ORPI* SAGU SOAR	ARMY CORO CPNWR ORPI* PINA	

*some photos are well documented, others are not

11. Other site data

- a. Does your land unit have access any other site data from its resource staff, law enforcement staff, or other sources that might help address border impacts (e.g., critical habitat data, water sources, law enforcement incident reports)?

Yes	No	Unknown
ARMY ASP BLM CORO ORPI SAGU USFWS	CPNWR	PINA

- b. Which of the following types of data do you have access to; and in what format (e.g., Access XP, Access 97, Excel, ArcView, ArcInfo, paper, other)? Check all that apply.

Category	GPS points	GIS layers (specify ArcView, ArcInfo, other)	Database (specify Access version, Excel, other)	Paper based data	Report	Other (describe)
i. Critical habitat data	ASP BLM CORO ORPI	AGFD ARMY ASP BLM CORO-ArcGIS ORPI SAGU USFWS(ArcView)	CORO-Access	ASP BLM CORO ORPI	AGFD ASP BLM CORO	
ii. Wildlife corridors data		AGFD ARMY		AGFD	AGFD	
iii. Data on surface water sources	ASP BLM CORO ORPI PINA	ARMY ASP BLM CORO ORPI SAGU	BLM CORO (Excel)	ASP BLM CORO	ASP CORO ORPI	CORO-photos of wildlife use
iv. Wilderness areas	ORPI PINA	AGFD ARMY BLM CPNWR ORPI SAGU			AGFD	
v. Law enforcement incident data	BLM ORPI PINA	ORPI	BLM ORPI	ORPI PINA	ASP	CORO, SAGU (LE Incident reports)
vi. Other: Wildlife Sightings	CORO		CORO-Access	CORO		CORO-photos, some digitized
vi. Other: Large Cat Scat	CORO		CORO-Excel	CORO		CORO-DNZ analysis, some

						photos
vi. Other: cultural sites from AZ site database, data available to professional archaeologists only	CORO	BLM CORO	CORO (Access)	CORO	CORO	

Category	GPS points	GIS layers (specify ArcView, ArcInfo, other)	Database (specify Access version, Excel, other)	Paper based data	Report	Other (describe)
vi. Other: Cultural resources NPS infrastructure Soils Vegetation	ORPI	ORPI		ORPI	ORPI	

- c. In general, are copies of these data available to share with the Regional Monitoring Partnership?

Yes	No	Unknown
ASP BLM CORO CPNWR ORPI* SAGU USFWS	ORPI*	ARMY PINA

*some data can be shared, other data are sensitive

- d. Is access to any of these data restricted or sensitive?

Yes	No	Unknown
ARMY BLM CORO ORPI SAGU USFWS	ASP CPNWR	PINA

12. Do you have any other comments or suggestions?

All the answers expressed here are respondents' opinions and NOT those of their Institution or Country. These are not official comments.

Appendix C

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