ORPI GIS PLAN - DRAFT

Introduction and List of Project Statements
(GIS Program Summary)

I. Introduction

I.A. Need and Purpose

In August of 1991 the first Organ Pipe Cactus National Monument Geographic Information System (GIS) Plan was approved and implemented. This first GIS Plan grew out of a need to have a framework and set of computer tools to manage, analyze, and archive the diverse sets of spatial data related to resource management programs within the monument. In particular, GIS was identified as an essential and central component of the Ecological Monitoring Program (EMP), a comprehensive inventory and monitoring program initiated at the monument in the late 1980's. While the main needs for GIS in the monument were seen to lie in the area of resource management, the 1991 plan included components covering all monument operations, and numerous GIS applications were identified in other areas of monument management including maintenance, visitor protection, and interpretation. While the plan identified specific application areas, it also provided detailed recommendation regarding GIS hardware and software purchases, data acquisition, and staffing needs.

Since 1991, considerable progress has been made in fulfilling the objectives of the original GIS plan. A baseline GIS 1:24,000 scale database containing pertinent themes such as vegetation, soil elevation, hypsography, hydrography, transportation and cultural features has been captured; A UNIX-based workstation and associated GIS software have been purchased and are in place; a GIS Specialist position to manage the GIS program has been established; and several GIS applications have been completed and several others have been initiated. Unforeseen in the original GIS plan were the rapid advancements in Global Positioning Systems (GPS) technology. Since the 1991 plan, GPS technology has become relatively inexpensive and accessible, and the monument purchased a GPS datalogger and Community basestation. Using this equipment, GPS has been integrated into the overall GIS program as a tool to obtain spatial coordinates for monument features that have not been previously mapped. In terms of fulfilling the goals of the original 1991 plan, the GIS program at the monument has been highly successful.

The GIS plan revision presented here offers continued direction for development of GIS at the monument. This document will accomplish four objectives:

1. Establish a revised project boundary.
2. Describe accomplishments completed under the 1991 GIS plan.
3. Present a series of project statements that will outline future work related to the GIS program.
4. Prioritize project statements into a 2-year work plan which will direct their order and timing.

This plan covers all aspects of operations including natural and cultural resources,

management, interpretation, visitor protection, and maintenance. Initial implementation will focus on natural and cultural resources, with other applications being incorporated as funds become available and as application priorities are developed.

The format of this plan is meant to dovetail with the Resources Management Plan (RMP). More specifically, the format of the project statements is designed so that statements can easily be added directly to the RMP. This revision is intended to integrate the use of GIS into the basic operations of the resources management division specifically and the monument in general.

IB. Project Boundary

In the original GIS plan the project boundary was stated as application dependent, ranging from one to twenty miles outside of the monument boundary. Since that time, it has become clear that Organ Pipe Cactus National Monument is part of a much larger area of interdependent administrative areas which collectively have been termed the Northern Sonoran Desert Ecological Management Area (NSDEMA). This area is bounded roughly by Interstate 10 on the North, Yuma to the West, Tucson to the East and Caborca, Mexico to the South. Administratively, this area contains Organ Pipe Cactus National Monument (National Park Service), The Cabeza Prieta, Kofa and Buenos Aires National Wildlife Refuges (Fish and Wildlife Service), The Barry Goldwater Range (U.S. Air Force), The Lower Gila Resource Area (Bureau of Land Management), The Tohono O'odham Reservation, The Pinacate and Cienega de Santa Clara Biosphere Reserves in Mexico, and the local communities of Ajo, Why and Lukeville, Arizona and Sonoyta, Mexico. It has become increasingly apparent from an ecosystem management standpoint that these separate administrative areas often need to be viewed in a more unified manner, and that many management concerns need to be addressed on a regional basis. With this in mind, the GIS program at Organ Pipe has expanded its boundary of interest to reflect this regional perspective on resources management. This larger boundary will provide regional perspective to several critical resource issues, including water draw-down, agricultural development, scenic-visibility values, wildlife management, cultural resource management, non-native plant control, wilderness management, and the Man and the Biosphere Program.

I.C. ORPI GIS Program to Date

At present, several events are occurring that will have a significant effect on the GIS program at ORPI. The resources management division has recently expanded their office space by 100 percent. Approximately half of this new space has been designated for GIS and Information Management. In addition to this increase in office space, a new information management position has been funded through the NPS Natural Resources Professionalization Initiative. This position will be responsible for managing the Resources Management Division's

information management and GIS programs. It is expected that these changes will positively affect the GIS program at ORPI.

In addition to general progress related to office space and personnel, large strides have been taken in implementing the ORPI GIS Plan of 1991. The 1991 Plan listed four major objectives in leading toward the establishment a GIS program at the monument:

1. Purchase and install GIS hardware and software.
2. Develop a basic GIS database.
3. Develop GIS applications
4. Train monument personnel on GIS software, database development and application procedures.

Since approval of the 1991 Plan, significant progress has been made toward the achievement of these objectives. To a large extent this was accomplished through a series of cooperative agreements with the National Biological Service Cooperative Park Studies Unit, University of Arizona (NBS/CPSU/UA) and the University of Arizona, Advanced Resource Technology Program (UA/ART). Because of this initial work done in cooperation with these partners, the GIS program at the monument has become increasingly self-sufficient. While most GIS functions can now be accomplished in the monument, it is expected and desirable that established external partnerships will continue. These outside will provide wide variety skills and expertise that are not ever likely be available within the monument itself. A more detailed discussion of accomplishments that relate directly to the achievement of the objectives outlined in the 1991 GIS plan is seen in the following four sections:

1. Purchase of GIS Hardware and Software
What follows is a basic list of GIS related hardware and software purchased since adoption of the 1991 GIS Plan:

Two UNIX-based GIS workstations with the following components:

Hardware
Sun Sparcstation IPX with 16" color monitor
Sun Sparcstation Model 20 with 19" monitor
Andataco 2 Gbyte data storage disk drive
Andataco 4 Gbyte data storage disk drive
Andataco SCSI CD-ROM drive
National Peripherals DAT tape drive

Software
ARC/INFO
ArcView
GRASS

Two DOS based PC suitable for GIS functionality with the following components:

Hardware
Transource 486DX-33
Transource Pentiumx75

Software

IDRISI
AUTOCAD
Trimble Pathfinder Pro GPS
Trimble Geoexplorer

A DOS based PC running a GPS basestation with the following components

Hardware

Transource 486DX-33
Trimble Pathfinder Pro - PFCBS - GPS receiver and antenna

Software
Trimble GPS Pathfinder Community Basestation (PFCBS)

GIS data capture/input devices:
Calcomp 9500 series Digitizing Tablet with pedestal
Hewlett Packard ScanJet IIc small format scanner
Cannon RC-570 Still Video Camera and Cannon FV-540 video floppy drive

GIS data output device:
Hewlett Packard DesignJet 650C E-size Plotter

GPS Rover Field Unit:
Trimble Pathfinder Professional - receiver, antenna and fieldpack
Two Trimble GeoExplorers

The above equipment provide all the components of a basic GIS program. The basic pieces are in place to capture spatial data, manipulate it and perform analysis, and then produce hardcopy output in the form of plotted maps.

2. Develop a Basic GIS Database
Development of a basic GIS database was accomplished largely through cooperative agreements with the NBS/SPSU/UA and UA/ART. The full cooperative agreement is seen in Appendix 1. In general, the accomplishments resulting from this agreement encompassed creating GIS themes for topography, hydrography, cultural features, transportation, soil and vegetation. This data was captured from 1:24,000 scale maps. The agreement also involved the purchase of a basic GIS UNIX based workstation on which the GIS database and GIS software were installed. This entire package was transferred to Organ Pipe Cactus in September of 1994.

3. Develop GIS Applications
Several GIS applications have been developed for Organ Pipe Cactus National Monument. These include an analysis of endangered snake mortality along highway 85 in the monument; development of a GIS database and maps related to the Ajo Mountain Drive Revegetation Project; creation of GIS maps related to the general locations of Ecological Monitoring Program (EMP) sites; and prototyping of a method for creating detailed GIS themes for EMP Sites.

Besides the work mentioned above, at this time, a considerable amount of effort is involved in projects that are currently in progress. These projects will be discussed in detail in the next section - "Current GIS Work".

4. Train Monument Personnel on GIS Software, Database Development and Application Procedures

Training of monument personnel, has been accomplished by sending employees to several GIS related conferences and training sessions. monument personnel have participated in an IDRISI training workshop at the University of Arizona in 1991, and MOSS training at the Bureau of Land Management. During 1993 several resources management staff were sent to the University of Arizona where they participated in several 3 day self-paced GIS training exercises. Personnel have also attended a variety of GIS related conferences, including the 1994 GRASS users Conference, NPS-GIS 94, and NPS-WRO GIS Working Group. In addition, in November of 1993, ORPI hired a GIS specialist to fill the vacant Geographer GS-09 position in the resources management division. The GIS specialist has developed a short "Introduction to GIS" course for all interested employees.

I.D. Current GIS Work

Since the basic infrastructure of a GIS program was put in place at Organ Pipe, several GIS related projects have been initiated. Many of these projects are cooperative efforts with federal and state entities; others are being completed exclusively by monument staff:

1. Northern Sonoran Desert Ecological Management Model (NSDEMM)
2. Ecological Monitoring Program Database Management System
3. Regional Profile of GIS Data
4. Airborne Video Ecological Monitoring System
5. Digital Conversion of ORPI Geology Map
6. Creation of a Sonoran Desert Tortoise GIS Database
7. GIS Site Maps of EMP Sites
8. Digital Conversion of Maintenance Utility Maps

These current projects are briefly described below.

1. Development of the Ecological Management Model

The Northern Sonoran Desert Ecological Monitoring Model (NSDEMM) is being developed using the existing inventory and monitoring data and GIS database to make predictions on the status of plant and animal resources in unsurveyed areas within ORPI. NSDEMM, when ground truthed, will be used to establish future study/monitoring sites and to make comparisons and assessments of the condition of ecological resources throughout the region.

2. Development of a Database Management System

Currently ORPI maintains a number of ecological databases. The Database Management System being developed will integrate the diverse sets tabular data produced by the inventory and monitoring activities into a single integrated system. In general, these diverse databases contain data relating to birds, mammals, reptiles, amphibians, insects and vegetation. The database system will, in turn, be directly linked to the existing GIS database and NSDEMM to improve their assessment and analysis capabilities.

3. Regional GIS Profile

The Regional GIS Profile seeks to compile a regional collection of GIS data and a regional resources profile that encompasses the Sonoran Desert Biosphere Reserve. A collection of regional GIS data will assist in providing an understanding of resource management alternatives in the region and will enhance collaboration among resource managers, residents and other concerned organizations.

The activities that will be accomplished during this project are: An inventory and analysis of the status of mapped (digital and non-digital) information relating to the natural, cultural and economic resources of the region. Preparation of a report identifying known information relating to the regional resources including detailed regional thematic maps (i.e. land use, vegetation etc..). Production of a catalog of regional spatial data resource information sources. Archiving of pertinent regional digital GIS data to a single location where it will be available for use with on-going planning, management and research in the region. Identification of gaps in the existing regional database and provide recommendations regarding future data acquisition.

4. Airborne Video Monitoring System

The Airborne Video Resource Monitoring System (AVRMS) is being developed to evaluate the use of remote sensing methods to inventory, monitor and update dynamic segments of the ORPI GIS database. During the development of AVRMS, video imagery will be compared to aerial photography in terms of image quality and speed of processing.

AVRMS will provide large scale visual displays to assist with mapping and evaluating resource conditions. This type of data will support and enhance existing resources monitoring and research projects on the Barry M. Goldwater Range, Cabeza Prieta National Wildlife Refuge and Organ Pipe Cactus National Monument. The feasibility of using airborne video combined with geographical information systems technology in lieu of conventional aerial photography as a means of providing imagery for assessing the status of natural resources is unknown. If feasible, airborne video/geographic information systems (GIS) will offer substantial savings over traditional techniques and will provide a host of derivative products that are not directly available from conventional film.

5. Digital Conversion of ORPI Geology Map

Currently the ORPI GIS database does not contain a layer for geology. The main reason for this is that a high resolution published geologic map that encompasses the entire monument does not exist. However, an unpublished map does exist. A project is currently underway that involves digitizing this map to create a GIS layer. A bi-product of this digital conversion is an effort to simultaneously take the map through the USGS peer review and publishing process. The final products will include: a GIS layer, a published peer reviewed map, and published simplified interpretive map.

6. Creation of a Sonoran Desert Tortoise GIS Database

Organ Pipe Cactus National Monument recently received NRPP funding for inventory and monitoring of the Sonoran Desert Tortoise. As part of this project, monument personnel will build a Sonoran Desert Tortoise GIS database. This database will contain all applicable historical spatial. data related to the desert tortoise. As the project progresses, GPS referenced inventory and monitoring records will be included in the database. Also, a Sonoran Desert Tortoise habitat map will be constructed with the GIS that will directly relate to historical observations, inventory and monitoring data, and general scientific knowledge of tortoise habitat. In relation to this habitat is the construction of a mines inventory and assessment GIS theme. This data layer will contain information about all known mines in the monument and will contain information about mitigation measures, such as capping that relate directly to desert tortoise protection. In general, the information in this database will be used to make management decisions that promote the health, safety and longevity of the desert tortoise community within the monument.

7. GIS Site Maps of EMP Sites

GPS data is being collected to create maps of the eighteen (EMP) sites located within the monument. This data will be converted to a GIS format and maps of each site will be created. These maps will be integrated into the existing GIS database. Plots will be produced that show EMP site features that overlay other features such as vegetation, topography and surface hydrology.

8. Digital Conversion of Maintenance Utility Maps

Plans relating to the water, sewer and electrical utilities within the monument are currently maintained as hand drawn, penciled lines on blue-line base maps. By converting these plans to a digital format, utility maps will be easily reproduced at a variety of scales and changes can be easily made.

I.E. Future GIS Work

Current GIS work at ORPI has been focused geographically on areas within the monument and thematically on solving specific resource management problems. In the future, GIS work accomplished at the monument will expand to include a larger region (The Northern Sonoran

Desert Ecological Management Area) and will address management issues including and outside of resources management. It is hoped that GIS can become a tool to address larger regional management concerns that involve both the monument and its surrounding neighbors. Also, GIS should become increasingly useful to other divisions within the monument (maintenance, visitor protection, and interpretation).

Possible GIS projects at the monument are diverse. Specific statements delineating some of the projects are given in the next section. Following this list of project statements is a two year timetable for accomplishing some of the projects.

Another area of concern in the future of GIS at ORPI is the implementation of metadata standards for GIS data. On April 11, 1994 President Clinton issued an executive order calling for the creation a National Spatial Data Infrastructure which is designed to enhance the utilization of geospatial data. As part of this order, all federal agencies are required to create and maintain "metadata" related to all spatial data that is created by these same agencies. Metadata is basically a summary of the type, quality, scale, source and history of the geospatial data in question. Once the metadata are collected, it can be placed at network nodes to facilitate data inquiries and requests. Plans at ORPI to implement these standards consist of using a metadata template that will be available with Arc/Info rev. 7.02. Once these metadata have been collected they will be distributed over the internet by placing them at a network node at the National Biological Service, Cooperative Park Studies Unit, University of Arizona.

I.F. Two Year Work Plan

Work plan will select projects from the Project Statement section and set down a two year time table to accomplish them. This section may be an appendix, or appear after the project statements.

ORPI - GIS PLAN: Project Statements

ORPI-I-501	Develop a Geographic Information System Component for Water
ORPI-I-502	Conduct Geographic Information System/Airborne Video Monitoring Research
ORPI-I-503	Develop Custom Geographic Information System Automated Quad Indexing System
ORPI-I-504	Implement Metadata Standards for All Monument GIS Data
ORPI-I-505	Implement Global Positioning System Data Acquisition
ORPI-I-506	Incorporate and Integrate New Data into the Information Management and Geographic Information Systems.
ORPI-I-507	GIS Theme of the ORPI Wilderness Boundary
ORPI-I-508	GIS theme for Geomorphology
ORPI-I-509	GIS Theme for Photopoints.
ORPI-I-510	GIS theme for Climate Stations
ORPI-I-511	GIS theme for Wells
ORPI-I-512	GIS theme for Abandoned Mines
ORPI-I-513	GIS Theme for Public Land Survey and Benchmarks
ORPI-I-514	Integration of Quitobaquito GIS data into Monument GIS database
ORPI-I-515	Mapping of Major Utility Lines in the Monument Boundary
ORPI-I-516	GIS Theme for Riparian Areas
ORPI-I-517	Expand GIS Theme for Roads and Trails
ORPI-I-518	Evaluate Paper Maps in the Monument's Library for Digital Conversion.
ORPI-I-519	Develop a Method for Adding a Spatial Component to Wildlife Observations

Ecological Monitoring Program (EMP)

ORPI-I-520	Create Georeferenced Digital Map of Ecological Monitoring Program (EMP) Sites
ORPI-I-521	Develop an Acuna Cactus, *Echinomastus erectocentrus* var. *acunensis*) Predictive Model
ORPI-I-522	GIS Database for Senita Cactus (***Lophocereus schottii***) **Populations and** Monitoring Sites.
ORPI-I-523	GIS Database for Organ Pipe Cactus *(Stenocereus thurberi*) Monitoring Sites
ORPI-I-524	GIS Theme for Night Sky Brightness.

Wildlife Management

ORPI-I-525	Desert Bighorn Sheep Database and Habitat Map
ORPI-I-526	Sonoran Desert Tortoise GIS Database and Habitat Map (TO WILDLIFE)

ORPI-I-527	Sonoran Pronghorn GIS Database and Habitat Map
ORPI-I-528	Lesser Long-Nosed Bat Database and Habitat Map
ORPI-I-529	Endangered Reptile Habitat Maps and GIS Database

Vegetation Management

ORPI-I-530	GIS Theme for Revegetation Projects
ORPI-I-531	GIS Theme for Non-Native Vegetation Species.
ORPI-I-532	GIS Theme Related to Monitoring and Mitigation of Woodcutting

Archeology/Cultural

ORPI-I-533	Archeological Base Map/Database in GIS
ORPI-I-534	Archeological Site Predictive Model
ORPI-I-535	GIS Database of Historical Structures and Link to Digital Still Video Imagery

Boundary Issues

ORPI-I-536	GIS Database Related to Landuse in Sonoyta, Mexico
ORPI-I-537	GIS Database Related to Fence Maintenance.
ORPI-I-538	GIS / Remote Sensing Analysis of Boundary Differences.

Interpretation

ORPI-I-539	Develop an Interpretive Geology Map
ORPI-I-540	GIS Database for Backcountry Zones.
ORPI-I-541	Develop a GIS Theme for Backcountry Hiking.

Maintenance

ORPI-I-542	GIS Database for Facilities at Twin Peaks Development Area (TPDA)
ORPI-I-543	GIS Database for Monument Facilities.
ORPI-I-544	Conduct Feasibility Study to Link the Geographic Information System with the Maintenance Management System

Visitor Protection

ORPI-I-545	GIS Database for Visitor Protection.

Current GIS/Information Management Cooperative Agreement Projects

1. Development of the Ecological Management Model
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5. Use of Remote Sensing Techniques to Define Sonoran Pronghorn Habitat.
Use Satellite imagery to classify vegetation and other habitat characteristics related to pronghorn habitat (desert pavement, riparian, lower bajada). The final product will allow for definition of habitat on a regional scale. This project is in the initial stages of definition and development.