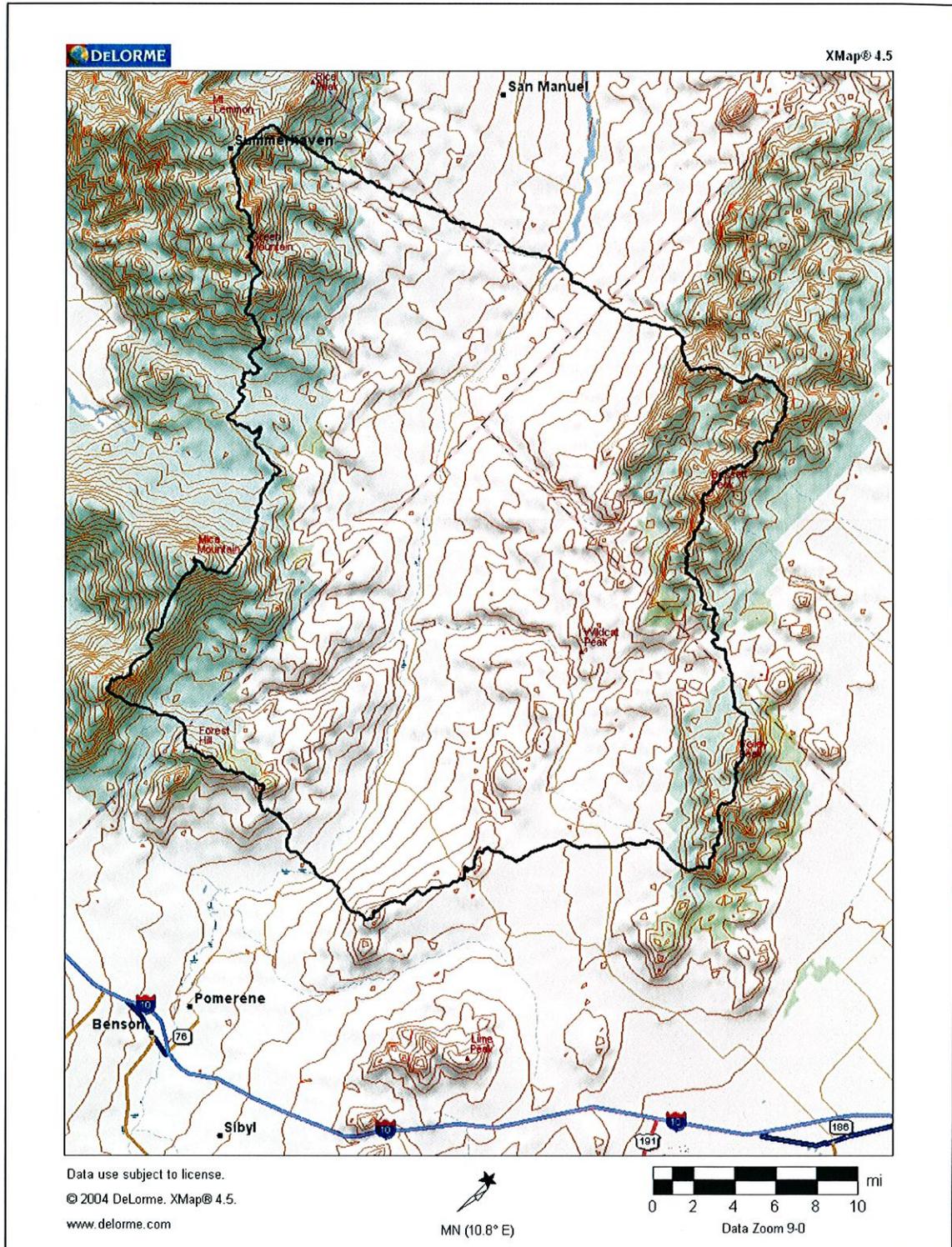


Lower San Pedro Watershed Assessment Project

WPF #00-109

Task 7B

Final Report



ACKNOWLEDGEMENTS

The authors would like to acknowledge the many individuals that contributed to this project.

Bill Brandau, BLM
Emilio Carrillo, NRCS
Jacquie Dale, Redington NRCD
Don Decker, NRCS
Chuck Duncan, USFS
Kristen Egan, NRCS
Patty Jones, Rancher
Jody Latimer, ASLD
Johnny LaVin, Redington NRCD
Dave Mathews, NRCS
Cathy McGuire, NRCS
Bart McGuire, City of Tucson
Malcolm McKenzie, Rancher
Walt Meyer, Winkleman NRCD
Wilma Renken, NRCS
Dan Robinett, NRCS
Bob Rodgers, TNC
Jennifer Ruyle, USFS
Nathan Sayre, UC Berkely
Mike Somerville, NRCS
Bill Svetlik, NRCS
Ralph Ware, NRCS
Andrew Smallhouse
Mary Smallhouse
Heather Young, Redington NRCD
Arizona Game and Fish Department
United States Fish and Wildlife Service
Arizona Department of Environmental Quality
Landowners & Managers of the Lower San Pedro Valley

The Arizona Water Protection Fund Commission has funded all or a portion of this report or Project. The views or findings presented are the Grantee's and do not necessarily represent those of the Commission, the State, or the Arizona Department of Water Resources.

Table of Contents

Executive Summary	1
Abstract	3
Foreword	4
Introduction	5
Description of Watershed	6
Boundaries, Jurisdictions, and Land Ownership	6
General Watershed Description	6
Precipitation during Study	10
Subwatersheds	11
History	14
Bibliography	14
Outreach	15
Procedures	15
Results	16
Summary of Resource Issues	18
Residential Land and Private Farmland Assessment	21
Residential	
Background	21
Procedures	21
Results	21
Discussion	21
Farmland	
Background	24
Procedures	24
Results	25
Acreage	25
Conservation and Irrigation Methods	25
Crops	27
Weeds	27
Discussion	27
Watershed Resource Assessment	28
Background	28
Results	28
Discussion	28
Final Observations and Recommendations	29
<u>Attachments</u>	
Task 3	
A History of Land Use and Natural Resources in the Cascabel – Redington Area of the San Pedro Valley	
Task 4B	
Bibliography of Resource and Other Relevant Information Lower San Pedro Watershed Assessment Project	
Task 5.5	
Lower San Pedro Watershed Assessment Project Comprehensive Watershed Alternatives for Action Plan	

Tables

Table 1. Land Ownership	6
Table 2. Precipitation	10
Table 3. Subwatersheds	13
Table 4. Landowner Participation	16
Table 5. Ranch Participation	17
Table 6. Residential Landowner Concerns	23
Table 7. Acres and Irrigation Methods	26
Table 8. Farm Landowner Concerns	27

Figures

Figure 1. Map Boundaries	7
Figure 2. Land Ownership	8
Figure 3. Subwatersheds	12
Figure 4. Land Ownership	22

**TASK 7B
FINAL REPORT
LOWER SAN PEDRO WATERSHED ASSESSMENT PROJECT
WATER PROTECTION FUND GRANT #00-109**

By

**Lamar Smith, Deborrah Smith, and Stefanie Smallhouse
Cascabel Range Consultants
August 2006**

EXECUTIVE SUMMARY

The Redington Natural Resource Conservation District (District), along with 41 other districts covering the State, was established by the Arizona legislature as an entity of state government for the purpose of providing for conservation of soil, water, and wildlife resources, protecting water rights and the tax base, protecting public lands, and, thereby, promoting the general welfare of the people (ARS 37). Conservation districts are the only entity of state or federal government with a broad mandate to address all types of conservation issues on all classes of land ownership. Districts carry out this mandate by a variety of means including identifying and prioritizing resource problems, coordinating and seeking financial and technical assistance in implementing solutions to those problems, and educational programs to equip local landowners and managers to implement sound resource management. Since private lands make up only about 15% of the District (which is fairly typical for Arizona) it is obvious that management policies, plans and regulations for federal and state lands will have a major effect on what can or cannot be done on private lands. Such effects include not only impacts on resource use, but water rights, property rights, the tax base, and the general welfare of residents. Therefore, the District has legal authority and a legitimate interest in taking a lead in planning resource management and use for all lands in the District, and, in fact, federal agencies are required by law and policy to cooperate with local governments in setting policy and making plans for federal lands and jurisdiction. The Redington NRCD is located in a rural area with limited population and has largely escaped many of the problems associated with increasing population and resource demands occurring in other parts of Arizona. However, change is on the horizon and there is increasing activity by various state and federal agencies and outside organizations that will affect land use policy and the way of life in the District. If the District intends to carry out its responsibilities to local residents, it is necessary to equip itself to be a central player in local resource issues and planning. The District decided that gathering, organizing and analyzing information on local natural resources was needed to support future planning and educational programs. Therefore the District applied for, and was awarded, a Water Protection Fund Grant in 2002 to carry out a watershed assessment of a portion of the Lower San Pedro River watershed.

For purposes of this project the Lower San Pedro watershed includes the portion of the Lower San Pedro watershed from the Narrows downstream to the confluence of Alder Wash (the approximate boundary of the Redington NRCD). The watershed covers 465,458 acres and takes in about 38 miles of the San Pedro River and 20 subwatersheds with headwaters in the Rincon, Catalina, Winchester and Galiuro Mountains. Vegetation ranges from pine forest to desert shrub, with riparian forests along parts of the San Pedro River and tributaries.

The project consisted of the following parts, each of which is briefly described: history, bibliography, outreach, landownership, and watershed assessment.

The San Pedro Valley has a long history of human settlement and land use. This history was described based on various published sources, public records, and extensive interviews with long-time residents of the area. Changing land use and social values were documented. The history helps explain present resource conditions, land ownership patterns, and local attitudes.

An annotated bibliography of over 500 sources was developed related to scientific and other knowledge of the resources specific to the Lower San Pedro watershed or having relevance to that area. This bibliography was used in the watershed assessment and alternative action plans developed for the watershed. It will be available for future educational programs of the District.

Public outreach was carried out at the beginning of the project by a number of public meetings held in the District, and through the use of questionnaires. This process was intended to inform local residents about the project, to seek their help and input, and to identify resource issues of concern by local residents. A second round of meetings was held near the end of the project to inform local residents about the findings and seek further input on management alternatives. In addition, a website was developed for the District that will make all project information available to the local people and general public.

Analysis of landownership patterns and farmed land showed a trend toward increasing fragmentation of land into smaller parcels in certain parts of the District, but overall ranch size has remained stable. Irrigated farm acreage has declined over the past several years.

Upland watershed assessment involved the collection of soil and vegetation data, along with photos, in approximately 250 locations within the watershed. These data, along with existing maps and data, were used to prepare maps showing historic and present vegetation types, ratings of current soil erosion, suitability for prescribed fire, and priority areas for brush treatment to reduce current and future erosion.

The main San Pedro River channel was mapped and divided into about 40 reaches with similar characteristics. Each reach was traversed and the vegetation and channel characteristics recorded. These data were used to classify and map stream types, flow regime, and vegetation type. Photos were taken in each stream reach for future reference. A similar procedure was followed in the main channel of each of the 20 subwatersheds tributary to the San Pedro. In addition a study of macroinvertebrates was done in several reaches of the San Pedro and selected perennial tributaries to indicate water quality.

The main resource issues identified by local residents were: upland vegetation, riparian vegetation, surface water, groundwater, fire, roads, weeds and invasive species, wildlife and endangered species, flood control, upland erosion, bank and gully erosion, and various social issues. Each of these issues was addressed using the information gathered in the watershed assessment and the bibliographic survey. For each issue the extent and nature of the problem was described and alternatives for addressing the issue described.

Finally, recommendations for future monitoring of resource conditions were made that can be undertaken by the District or with District coordination.

The information on and analyses of kind, amount and condition of natural resources in the Redington NRCD provides a valuable starting point for future planning and implementation of resource management and conservation in the District. This will give the District a basis for a leadership role in developing plans, programs, conservation education and policy for all lands within the Redington NRCD.

ABSTRACT

In 2002, the Redington Natural Resource Conservation District was awarded Water Protection Fund Grant #00-109 to carry out an assessment of the Lower San Pedro (LSP) watershed. This is the Final Report of that project. The LSP was defined for this project as all the area tributary to 39 miles of the San Pedro River from the Narrows to the confluence of Alder Wash, an area of 465,468 acres. The project included a number of tasks. Input was sought from local residents through meeting and questionnaires to formulate issues and concerns. Information on landownership patterns and changes, and the history of the area were compiled and reported. An annotated bibliography of published and unpublished studies, data, or other information was compiled and will be maintained by the District. Upland watershed conditions were assessed from existing information and field studies. Data on vegetation, ground cover, erosion, water developments, and roads were obtained, mapped, and analyzed. Photos were taken at selected points to provide a baseline for future study. Stream reaches of the San Pedro River and 20 major tributaries were mapped, and data recorded on their channel characteristics, streamflow, and vegetation. Based on all this information, a report describing and analyzing the major resource issues and outlining possible management actions was prepared.

FOREWORD

This document is a report made to the Redington Natural Resource Conservation District by Cascabel Range Consultants as Task 7B of Water Protection Fund Grant #00-109. The conclusions and interpretations presented in this report are those of the authors and do not represent a consensus viewpoint of the Board of Supervisors of the Redington Natural Resource Conservation District, local residents, or the Arizona Water Protection Fund Commission. The authors relied upon published and unpublished information, field assessment, input from local residents, and their own education and experience in arriving at the interpretations and conclusions presented here.

Lamar Smith has B.S., M.S. and PhD degrees in forestry, range management and soil science from Colorado State University. His area of expertise is in range ecology and management, range inventory and monitoring, and rangeland soils. He has over 40 years of professional experience in teaching, research, extension at Colorado State University and the University of Arizona. He has worked on special projects or consulting in Brazil, Mexico, Ecuador, Spain, and Australia and has private consulting experience in Arizona, California, Nevada, Colorado, Idaho, Oregon, South Dakota and North Dakota. He owned and operated the Banderilla Ranch and lived or worked in the Lower San Pedro (LSP) watershed from 1984 to 2005. He has served as an advisor to and supervisor of the Redington NRCD.

Deborrah Smith has a B.S. degree in range management from the University of Arizona with additional graduate course work in natural resources and animal science, plus 15 years experience in research and consulting in range and animal ecology. She has served as a supervisor and as a business manager of the Redington Natural Resource Conservation District and Education Center, lived in the LSP from 1992 to 2005 and was co-owner and manager of the Banderilla Ranch.

Stefanie Smallhouse has a B.S. in wildlife management from New Mexico State University. She worked for the Bureau of Land management as a student and as a professional wildlife biologist in southern Utah for five years and has been doing part-time consulting work for six years. Stefanie has lived and worked in the LSP since 1999, and is part owner/manager of the Carlink ranch, owned and operated by the same family and located within the LSP for over 120 years. Stefanie has been involved with the Redington NRCD as a supervisor since 2000, and is heavily involved with local work groups and committees for planning open space, and drought mitigation and monitoring.

INTRODUCTION

In 2002, the Redington Natural Resource Conservation District was awarded Water Protection Fund Grant #00-109 to carry out an assessment of the Lower San Pedro (LSP) watershed. This is the Final Report of that project.

The purpose of the project was to gather and analyze information on the natural resources of the Lower San Pedro (LSP) watershed to provide a basis for the Redington Natural Resource Conservation District (District) to carry out its conservation mandate. This mandate includes identification, prioritization, and planning for technical and financial assistance to landowners for implementing on-the-ground resource conservation projects. The project will also supply a large amount of basic information that can be used by the District in educational programs for landowners, schools, and other interested groups. The information will also be useful for developing a general watershed management plan for the LSP should the District decide to do that. Finally, the District can use this information as the basis for taking a pro-active role in land use planning carried out by other federal, state, and local agencies.

The project consisted of several subprojects that were carried out between 2002 and 2006. These included a "public outreach" phase where input was obtained from local residents on issues and concerns and landownership patterns and trends were analyzed. Another task was to write a history of the area based on archival records and interviews with long-time residents. A third major portion was to establish an annotated bibliographic data base for use in the analysis of issues and which can be maintained and updated for future use by the District. Upland vegetation and soils, along with stream channels and riparian vegetation, were classified and mapped. Data were collected on various species composition, ground cover, erosion, streamflow, water sources, water quality, roads and other features. All this information was used to address local issues and to outline alternative solutions to resource problems identified.

Results of all of the studies that were done under this contract are presented in this final report. Most of the information presented in this final report has already been submitted from 2003 to 2006 to the Water Protection Fund in the form of progress reports on specific tasks called for in the contract. For purposes of data collection, analysis and preliminary reporting, the entire watershed was divided into four roughly equal sections (referred to as quadrants). Due to the size of the project, this division facilitated reporting progress to the Watershed Protection Fund. In some cases information previously submitted has been modified or augmented in this final report to incorporate new information and/or improve consistency of maps and interpretations. These changes resulted in minor differences from data previously reported. Generally such differences involved slight changes in acreages or naming of mapping units or stream reaches to make these consistent across the entire watershed. Therefore, the information in the Final Report is to be considered the correct and best information available for the entire project.

DESCRIPTION OF THE WATERSHED

Boundaries, Jurisdictions, and Land Ownership

For purposes of this project, the Lower San Pedro River watershed was defined as the area tributary to the San Pedro River from the Narrows (north of Benson) on the south to the mouth of Alder Wash on the north. The southern boundary coincides with the division used by the Arizona Department of Water Resources (ADWR) to separate the upper and lower San Pedro watersheds and groundwater basins. The north end is approximately the northern boundary of the Redington NRCD. Therefore, the LSP watershed as defined in this project does not include the entire Lower San Pedro watershed or groundwater basin as defined by the ADWR. The LSP watershed does not coincide exactly with the boundaries of the District. A considerable portion of the upper reaches of tributaries on the southeast side of the watershed are outside the District in the Willcox-San Simon NRCD. A small portion of the watershed on the north end is located in the Winkleman NRCD. The Redington NRCD extends beyond the San Pedro watershed into the Santa Cruz drainage in small areas on the west side of the District. The total area of the LSP watershed as used in this project is 465,458 acres. The total area of the Redington NRCD is 290,381 acres. Figure 1 shows a map of the LSP watershed and the Redington NRCD boundaries.

The LSP watershed and Redington NRCD lie primarily in Cochise County and Pima County, with smaller portions falling into Pinal and Graham Counties. Federal lands include Forest Service, National Park Service, and Bureau of Land Management lands. The majority of the area is composed of Arizona State Trust lands. Private lands make up a relatively small portion of the whole watershed (Figure 2). Table 1 indicates the percentages of land ownership within the District.

Table 1. Land ownership in the Redington Natural Resource Conservation District.

Ownership	Acres	Percentages
Bureau of Land Management	2,294	0.80%
State Land Department	168,167	58.40%
United States Forest Service	70,710	24.00%
Saguaro National Park	4,061	1.40%
Private	45,149	15.40%
TOTAL	290,381	100.00%

General Watershed Description

The San Pedro River Valley is a northwest-trending structural trough in the Mexican Highland section of the Basin and Range province. The watershed is bounded on the west by the Rincon and Catalina Mountains. The Little Rincon Mountains extend into the valley and are separated from the Rincons by a high basin called Happy Valley. The boundary to the east is the Galiuro and Winchester Mountains. The Winchester Mountains are separated from the Little Winchesters and Johnny Lyon Hills by a high alluvial basin (Allen Flat). Maximum elevation in the Rincon Mountains is 8,666 feet and the maximum in the Winchester Mountains is 7,631 feet. The valley between the mountains is composed of a thick deposit of alluvial fill that slopes on both sides to the San Pedro River. The San Pedro flows for about 40 miles through the valley bottom, and is generally entrenched 20-30 feet below a pre-1880 floodplain. The elevation of the River where it enters the LSP is 3327 feet and the elevation at the mouth of Alder Wash is 2654 feet, a difference of 673 feet.

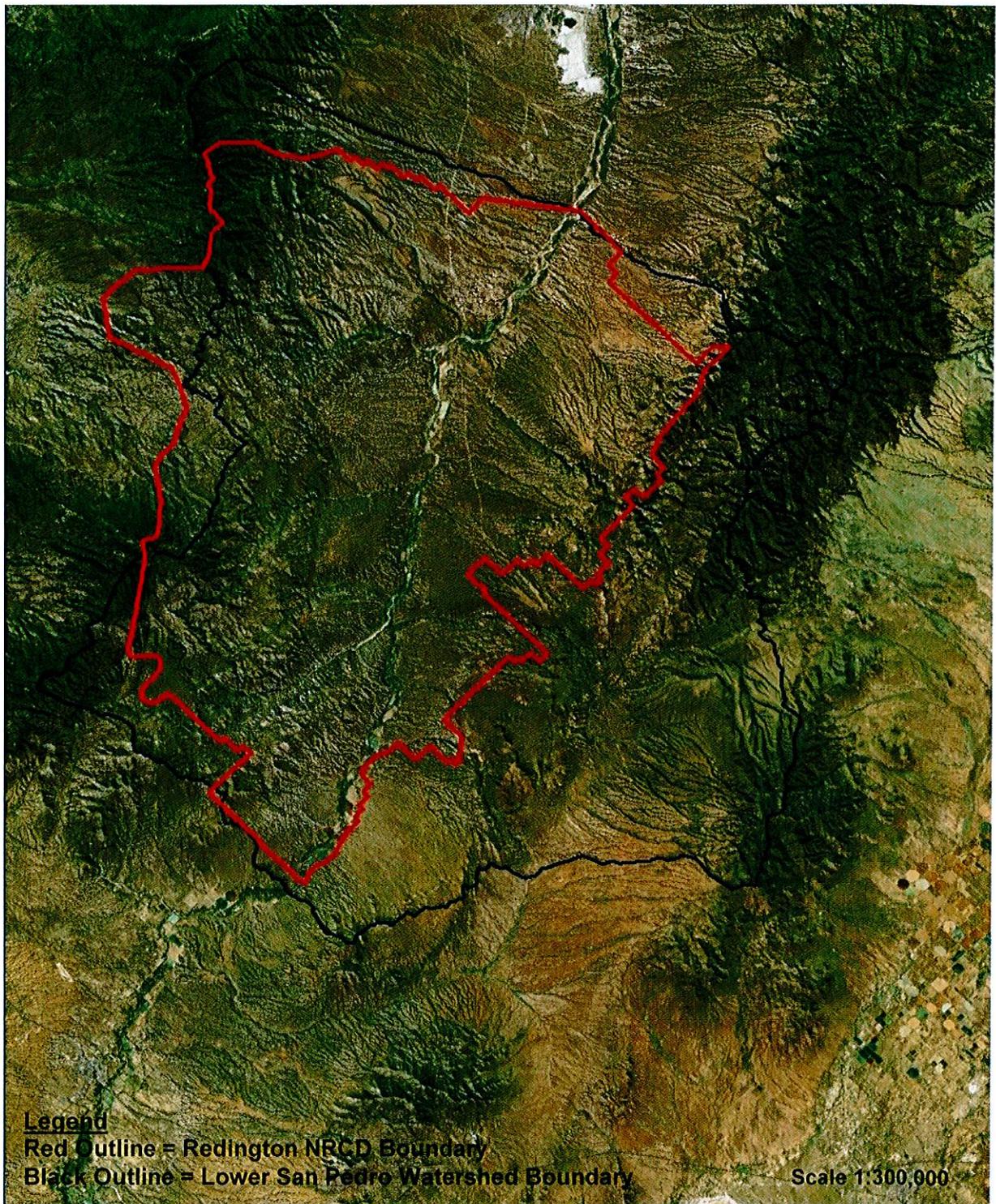
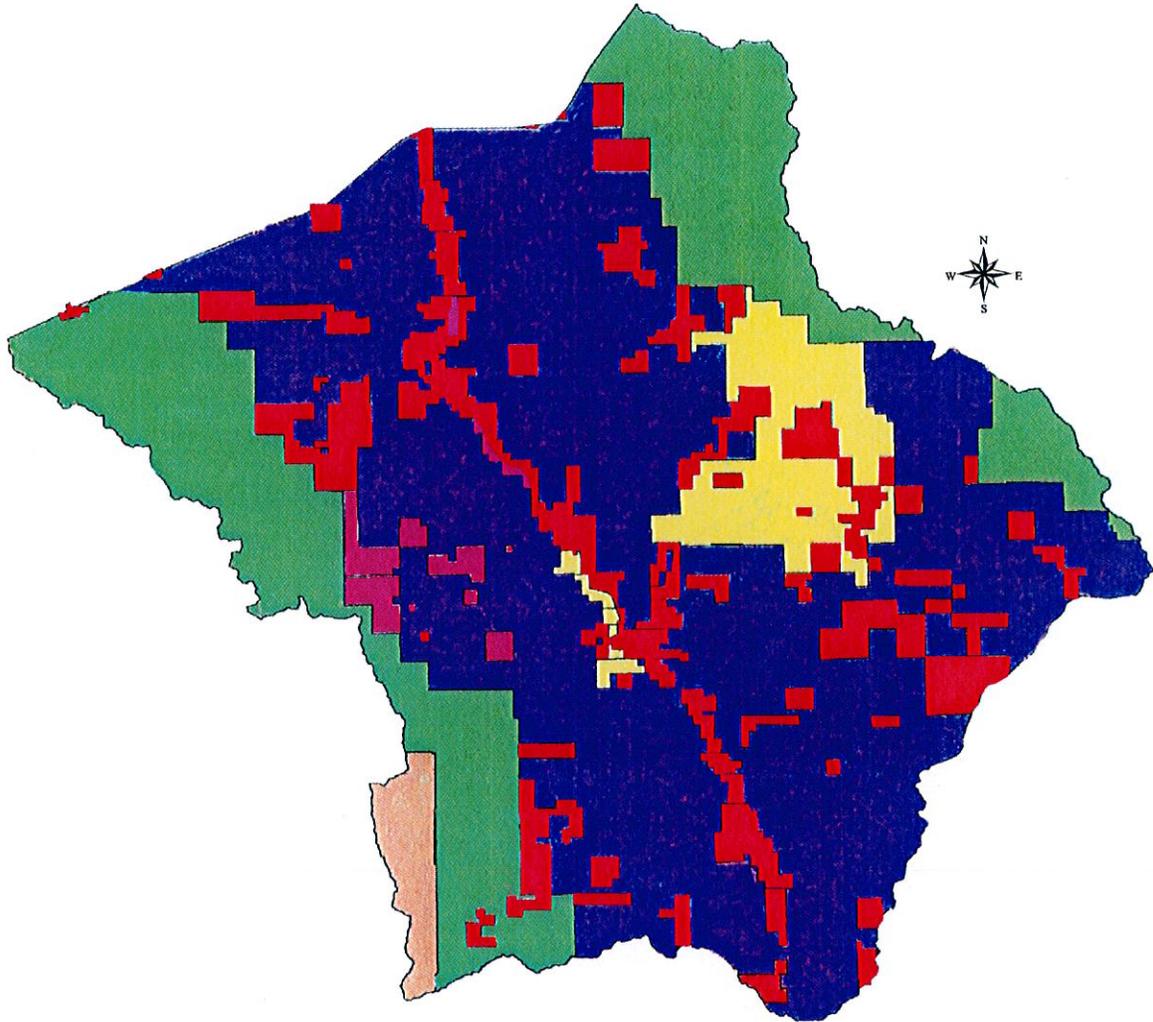


Figure 1. Map boundaries of the Redington NRC D and Lower San Pedro watershed project area.





Legend

Purple = State
Red = Private
Green = Forest Service

Yellow = Bureau of Land Management
Orange = National Park Service
Pink = Pima County

Scale 1:300,000

Figure 2. Land ownership in the Lower San Pedro watershed project area.

The bedrock geology of the watershed is complex and extensively faulted. The Galiuro and Winchester mountains are mainly composed of volcanics, with extensive outcroppings of sedimentary (limestone, sandstone, etc) rocks in the southern Galiuros and in the Teran and Kelsey watersheds. The southeast portion of the watershed near the Johnny Lyon Hills is mainly granite, and this extends across the narrows toward the Rincons. The Rincons and Catalina Mountains, and the Redington Pass area in between, are mainly composed of quartzose granitic rocks, gneiss and schist. Limestone and some volcanic rocks outcrop in the area east of the Rincons and Catalinas, e.g. in the Little Rincons, upper Soza Canyon, Buehman Canyon and upper ends of Edgar and Alder Canyons. Hard conglomerate outcrops near the River in the vicinity of Soza Canyon and downstream.

The alluvial valley fill was deposited in late Tertiary to recent times. During the Pleistocene, several episodes of entrenchment separated by periods of stability occurred. These sequences resulted in several (2-4) different land surfaces being formed, then dissected as erosion and entrenchment occurred. The oldest surfaces date back to about 1-2 million years. (Ely and Baker 1985) Only remnants of these surfaces remain, with the highest surfaces being the oldest. For example, Soza and Davis Mesas probably represent the oldest surfaces along with some older surfaces on the headwaters of Hot Springs Wash and Allen Flat. Soil development (e.g. clay content, caliche layers, and red color) reflect the different ages of these surfaces. (Gile, Hawley et al. 1970) More recently, portions of the LSP valley were filled with a lake from about 30,000 to 12,000 years before the present. (Haynes 1968) The upper elevation of the lake appears to have been about 4100 feet elevation. Gypsum deposits found in parts of the watershed resulted from lake bed deposits. The lake was drained when through drainage to the Gila River was established. There is evidence that the valley was cut below its present level and backfilled, then eroded again prior to deposition of the current recent alluvium that comprises the pre-1880s floodplain (Heindl 1963).

Soils in the watershed largely reflect the influence of parent materials, time of weathering, and erosion/deposition. The upper watershed has soils developed on bedrock. Steep slopes and natural erosion prevent deep soil development on most of these areas. Soils developed on the older, gently sloping alluvial fill surfaces have developed fairly deep profiles often with clay accumulation in the subsoil and hard caliche layers at some depth. Where these old soils have eroded due to natural erosion, the caliche may be near the surface, thus restricting root and water penetration. On the eroded sideslopes of the alluvial surfaces, the soils generally lack much horizon development and also lack the hard caliche deposits. The youngest soils are in the washes and along the River where recent alluvial deposits occur and soil development is minimal.

Average rainfall since 1969 at the Cascabel weather station (located near mouth of Teran Wash) is 13.88 inches, with about 50% occurring in the "monsoon" period from June through September, and the remainder during the "winter" period of October through May. On average July and August are the wettest months and April and May the driest. Summer rains are highly variable spatially. Winter rains tend to be more general over the watershed. Average maximum temperatures approach 100 degrees in summer and average minimums are slightly below freezing in December and January. Minimum temperatures in any given location are highly affected by cold air drainage which can produce freezing temperature in low places, e.g. along the River, while temperatures on the slopes are substantially warmer. Precipitation increases and temperatures generally decrease with altitude. There may be a general tendency to a higher percentage of winter rain in the north end of the valley and higher summer rain in the south end.

Vegetation in the valley is located in a transition zone between the Sonoran Desert and the Chihuahuan Desert. The former is warmer and has a bimodal rainfall distribution. The latter is colder in the winter and tends more to a summer maximum in rainfall. Saguaro, palo verde, and jumping cholla are characteristic Sonoran Desert species that reach more or less the eastern limit of their range within the LSP watershed. Several vegetation zones are found in the watershed depending on altitude and soils. The higher mountain areas generally support forest or woodlands of mixed conifer, pine, or live oak, with some chaparral species. Mid elevations are composed of desert grassland, much of which has been partially replaced with shrubs such as mesquite and whitethorn. Lower elevations are mainly desert shrublands dominated by creosotebush, whitethorn, and paloverde. Vegetation on the pre-1880s floodplain of the San Pedro River is mainly mesquite woodland (sometimes called bosques) where it has not been cleared for fields. The channel and present floodplain of the River supports riparian forests, riparian shrublands, or non-riparian vegetation depending on flow regimes. Vegetation will be described in more detail in later sections.

Wildlife includes deer, javelina, Gambel’s and scaled quail, whitewing, mourning, and ground doves, black-tailed and antelope jackrabbits, cottontails, skunks, raccoons, ground squirrels, coatimundi, bobcats, coyotes, mountain lions, black bears, and many species of birds, including neotropical migrants. Several species of native fish occur in perennial stream reaches.

Precipitation During Study

This project was carried out from 2002-2006. Most of the field work was done in 2003-2005. This period was greatly affected by drought conditions resulting in significant effects on vegetation and also on stream flow conditions. Precipitation data for the period from 1992-93 through 2004-05 are shown in Table 2.

Table 2. Winter (Oct-May) and Summer (June-Sept) precipitation at Cascabel during and prior to the Lower San Pedro watershed assessment project.

YEAR	OCT-MAY	JUNE-SEPT
92-93	13.46*	3.84
93-94	5.71	5.56
94-95	12.72	6.32
95-96	3.19	6.22
96-97	6.03	5.13
97-98	10.56	7.96
98-99	3.12	13.26
99-00	0.94	7.00
00-01	11.49	7.39
01-02	1.53	5.47
02-03	4.78	3.70
03-04	7.46	7.24
04-05	6.40	8.23
69-05 AVG	6.80	6.86

*Green > 125% and red < 75% of average precipitation.

This table indicates summer (June-Sept) and winter (October-May) precipitation for years before and during the assessment period. Amounts shown in green are 125% or more of average values for the period and those shown in red are 75% or less of the average. These were arbitrarily defined as “wet” and “dry” periods. In the 13 years shown, winter rain has been dry during 5 years and wet in 3 years. Summer rain has been wet in only 1 year and dry in 2 years.

It is difficult to quantify the effects of drought years with seasonal totals because the spacing and intensity of rainfall events cannot be accounted for. For example in the wet summer of 98-99, 9 inches of the total 13.26 inches occurred in one month (July). Also, in the wet winter of 00-01, 5 of the 11.5 inches occurred in one month (October). The occurrence of consecutive dry winters in 98-99 and 99-00, and again in 01-02 and 02-03 had serious effects on perennial grasses and shrubs alike. Although, most of the perennial grasses in the watershed are warm-season plants that make most of their growth in July-September, survival of these plants from one growing season to the next can be affected by dry winters. That is especially true for new plants that establish during the summer. Therefore, there has been a substantial decline in perennial grasses over the past several years, especially those that are relatively short-lived and reproduce by seed, e.g. sand dropseed, mesa dropseed, spike dropseed, three awns, plains bristlegrass, and slim tridens. Curley mesquite grass is another that is quite susceptible to dry conditions. Many shrubs have been severely stressed by the dry winters, although it is not clear how much actual mortality has occurred.

The dry conditions have no doubt influenced the estimates that were made of species occurrence and composition, ground cover (litter and vegetation) and streamflow. The effects of the drought should be considered when interpreting the data presented in this report and in any future data interpretation that may be carried out.

Subwatersheds

For purposes of analysis and discussion, the LSP watershed was divided into a number of subwatersheds. Each of these watersheds differs in size and shape, geology, rainfall, soils, and vegetation, and therefore the occurrence of streamflow, erosion, flooding, and other factors is not the same for all of them. The subwatersheds and some of their physical characteristics are described in this section.

The entire watershed was divided into four quadrants, each comprising about ¼ of the area. Within each quadrant the major drainages were identified and their subwatersheds mapped. Between each of the subwatersheds there is a zone that drains directly into the San Pedro River but is not part of the major subwatersheds. These zones range greatly in size and may contain several smaller washes. These inter-watershed zones were called "complexes" and assigned arbitrary names after a local feature. The subwatersheds and complexes are shown in Figure 3. Table 3 gives information regarding the size and elevation range for each of the subwatersheds and complexes.

The San Pedro River is not technically a subwatershed. However, for analysis purposes the River and its floodplain were considered separately. The San Pedro channel is 39.4 miles in length. The difference in elevation from the south end of the LSP to the north end is 673 feet, which gives an average gradient of 0.3%. The approximate acreage within the entrenched floodplain is 2525 acres which includes both the river channel and the floodplain.

In each subwatershed one main channel was selected to follow to the top of the watershed. In most cases the one selected was the one bearing the name of the drainage on the USGS topographic maps. In some cases an alternate was selected that seemed to be the more important tributary, e.g. in Soza Wash the Cherry Creek tributary was considered the main stem of the wash.

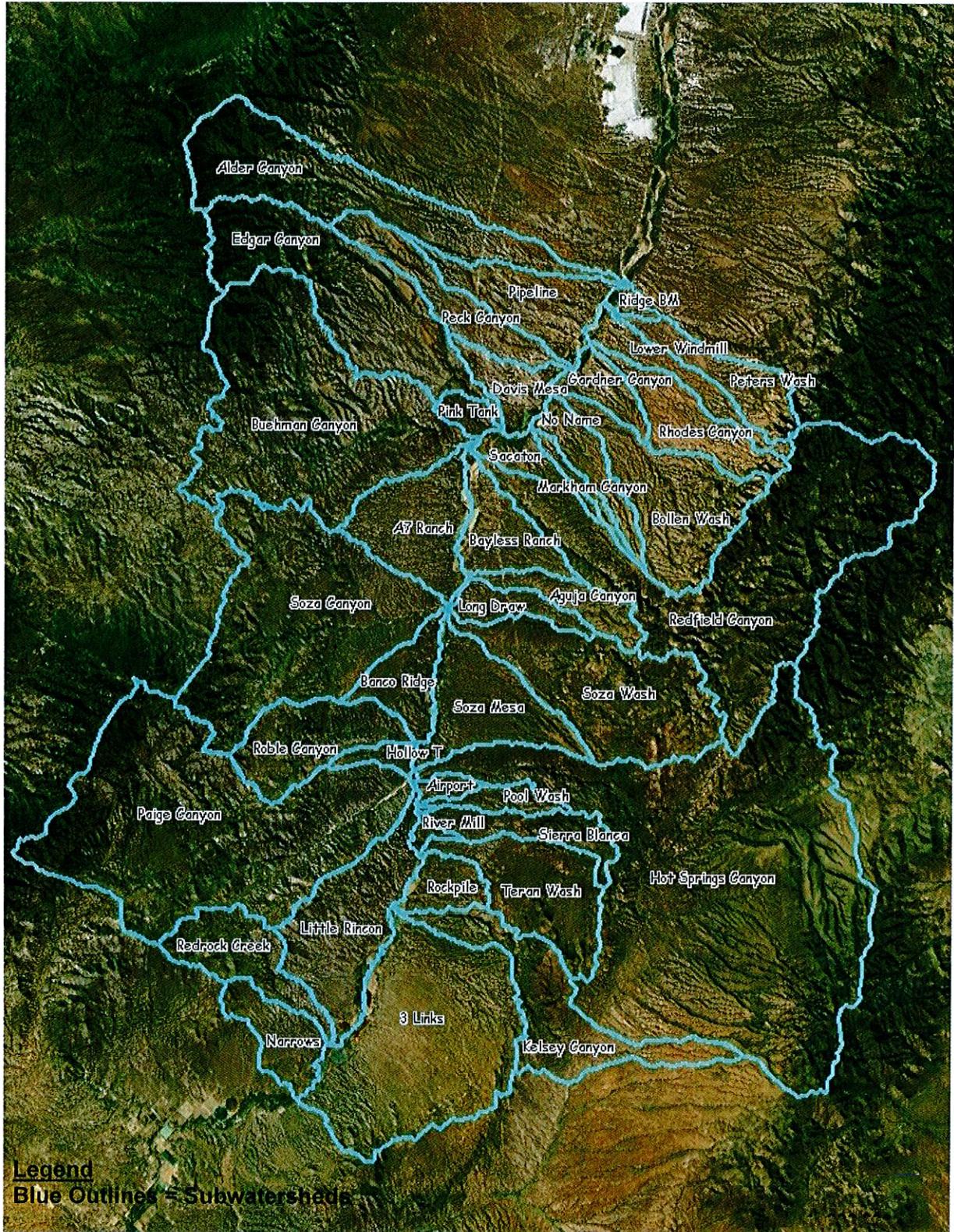


Figure 3. Subwatersheds of the Lower San Pedro River project area.



Table 3. Characteristics of subwatersheds in the Lower San Pedro watershed project area.

NEQ	High Elevation in Ft.	Low Elevation in Ft.	Total Acres
Soza Mesa	█	█	9734
Soza Wash	5380	3000	17702
Long Draw	█	█	3288
Aguja Canyon	4217	2970	3884
Bayless Ranch	█	█	5792
Redfield Canyon	7085	2885	39277
Sacaton	█	█	2624
Markham Canyon	4077	2840	1293
No Name	█	█	4045
Bollen Wash	6080	2774	12941
Gardner Canyon	█	█	3002
Rhodes Canyon	6417	2755	6707
Lower Windmill	█	█	4243
Peters Wash	6736	2730	5555
Ridge BM	█	█	774
NWQ			
A-7 Ranch	█	█	9491
Buehman Canyon	7434	2820	33152
Pink Tank	█	█	1459
Edgar Canyon	8000	2845	19194
Davis Mesa	█	█	3885
Peck Canyon	4271	2784	6669
Pipeline	█	█	8019
Alder Canyon	8146	2660	18048
SEQ			
Three Links	█	█	27334
Kelsey Canyon	5153	3200	12109
Rockpile	█	█	3251
Teran Wash	5268	3200	10611
River Mill	█	█	678
Sierra Blanca	5238	3200	4634
Pool Wash	4200	3200	2086
Airport	█	█	1107
Hot Springs Canyon	7000	3133	71942
SWQ			
Narrows	█	█	4992
Redrock Creek	4800	3280	6957
Little Rincon	█	█	12608
Paige Canyon	8200	3200	42451
Hollow T	█	█	1325
Roble Canyon	5952	3120	8550
Banco Ridge	█	█	4787
Soza Canyon	4595	3120	29254

█ Not applicable because these are complexes of numerous small washes.

HISTORY

A history report based on archival records and interviews with long-time residents was developed by Dr. Nathan Sayre and is included here as report **Task 3**. The compiled history of resource use and conservation for the Lower San Pedro Watershed provided background information for interpreting current conditions and a perspective for future planning

BIBLIOGRAPHY

Part of the Lower San Pedro Watershed Assessment project was to obtain and review information related to the natural resources of the area and other information useful for data interpretation, analysis of resource issues, or future management planning. Sources of information included publications, unpublished materials, electronic sources, data sets, or personal interviews.

Copies of some of the materials were obtained and will be kept in the files of the Redington NRCD . Much of the material can be accessed in libraries or on the internet, thus it was not considered necessary to obtain hard copies of all these materials. Users unable to locate materials from library or electronic sources should contact the Board of Supervisors, Redington Natural Resource Conservation District.

The bibliography is included here as report **Task 4B**. All references found were entered into a bibliographic program called End Note. This program allows references to be sorted by author, date, subject, title, keywords, etc. It also provides for annotation of references. This computer program has been purchased by the Redington NRCD so that the bibliography can be accessed, edited, and augmented over time for use of the District. The bibliography is also available on the District website (<http://www.redingtonnrcd.org>) in PDF format that can be viewed online or downloaded.

Reference materials in this bibliography fall into three general categories:

1. Information specific to the Lower San Pedro Watershed Assessment (LSP) area as used in this project, the watershed tributary to the San Pedro River from the Narrows to the northern boundary of the District (Alder Wash). This includes data, studies, maps or other material that includes the LSP area. These references are identified by LSP in the keyword data field.
2. Information that relates to some other portion of the San Pedro River watershed but contains no information specific to the LSP. Some of this information is directly applicable in the LSP and some is not. These references are identified by SP in the keyword field.
3. Information that does not pertain specifically to the San Pedro River valley but which may be useful for data interpretation, planning, or information sources. These references do not use the keywords, LSP or SP.

All references have additional keywords that can be used to search the bibliography. During the public outreach portion of the LSP Watershed Assessment Project, a number of issues or concerns were identified with input from local residents. These issues, plus an additional one of general resource information, were used as keywords to facilitate sorting references by issues. Each reference has at least one of the issues assigned as a keyword and many references have more than one issue keyword assigned. The **keywords** (bolded) used for issues were as follows:

1. **Resource data** – General information on resources, geologic studies, rainfall data
2. **Upland vegetation** – present/historic vegetation types, grazing management, brush control
3. **Riparian vegetation** – present/historic vegetation, management
4. **Upland erosion** – processes, control
5. **Bank and gully erosion** – processes, arroyo cutting, control
6. **Surface water** – streamflow, increasing water yield, water quality
7. **Groundwater** – water budget, recharge, uses, quality
8. **Fire** – historical occurrence, effects on vegetation/soil, prescribed fire
9. **Weeds** – invasive species, agricultural weeds, weed control
10. **Floods** – occurrence, flood control measures
11. **Roads** – road construction, erosion problems
12. **Irrigated agriculture** – water use efficiency, crops
13. **Water development** – design and value for wildlife, livestock
14. **Wildlife** – non-game, fish, game, predators, endangered species of both plants and animals
15. **Social issues** – planning, economics, land acquisition, property rights

Reference materials were annotated in the bibliography. The annotation occurs in the NOTES field in the End Note program. If the reference is to a set of data or information source, the annotation describes what kind of information is present and may tell how to find the information. If the reference is to a study, whether published or not, the annotation indicates where the study was done, summarizes conclusions reached, and, in some cases, includes comments on the validity or usefulness of the study. For some large studies, only selected information is included in the annotation. Some references only present descriptive results of resources, e.g. geologic mapping, the title adequately describes the content of the reference. Therefore, such references were not annotated. References that appear to be of limited application or that were not actually obtained for review also were not annotated. Finally, references cited in the written reports for various tasks under the WPF grant (e.g. the history section) were included in the bibliography, but may not have been annotated.

This bibliography is not represented to contain all pertinent information available for the LSP watershed area, but it does contain a substantial amount of it. Additional information can be added, and some existing references annotated, by the Redington NRCD as the time and need arise.

OUTREACH

The outreach objectives of this project were to inform landowners and managers about the Lower San Pedro Watershed Assessment, solicit cooperation, and identify issues and concerns (**Tasks 2A&2B**).

Procedures

Information was obtained from each county tax assessor's office to identify landowners within the project area. Each landowner and/or manager was contacted, presented with a description of the WPF project asked for access permission, participation and input on issues of concern. Access agreements obtained are on file with the District. Residents within each sub-watershed boundary were contacted and invited to meetings in groups of approximately ten to twenty. Those residents that were unable to attend a meeting were given the option of a home visit. Landowners that lived outside the watershed boundaries were contacted by phone and/or mail.

Part of the outreach effort included a description of Natural Resource Conservation Districts, how they function, and what assistance they can provide. Another goal of the outreach effort was to determine if the local residents/landowners felt there was a need to form a watershed association.

A confidential watershed survey was given to each resident who wished to fill it out. The survey results helped the District evaluate interests of landowners and if a watershed association was desired. This survey also contained a demographics portion which was used in the history report (Task 3).

Meetings began with PowerPoint presentations describing conservation districts and the watershed project. The final portion of the meetings was to have the group work through an exercise to identify the top five natural resource concerns for the watershed.

Results

A landowner/manager contact database was completed and given to the Redington NRCD Board of Supervisors. Due to privacy issues there is not a public version of this database. The database was useful in helping the project manager and outreach coordinator contact the landowners for participation in the LSP project.

The following results indicate the participation at the beginning of the project. Since data collection was completed and the project concluded properties have been sold and there are new land owners in some portions of the project area. There were a total of 192 landowners in the Lower San Pedro watershed project area. Forty-seven landowners lived in Cochise County. Eighty-seven lived in other portions of Arizona and 23 lived out of state. Forty-eight landowners lived in Pima and Pinal County. Table 5 indicates the number that agreed to participate in the project and answer surveys.

Table 4. Landowner participation.

	Cochise	Other Arizona	Out of State	Pima/Pinal	Total
Yes - Participating	39	28	4	16	87
No	1	0	0	0	1
No Response	4	58	16	26	104
Total	47	87	23	48	192

Ranch participation in the Lower San Pedro watershed project area is listed in Table 5.

Table 5. Ranch participation.

Ranch	Owner	Participating
Saguaro-Juniper	Corbett et al.	Y
River's Edge	Crawford	Y
Cspear	Jones	Y
Banderilla	Smith	Y
Soza Mesa	Hughes	Y
Carlink	Smallhouse	Y
Last Chance	Koedyker	N
Thomas	Thomas	Y
*A7	City of Tucson	Y
VF and HL	Harris	Y
Broken Dipper	Martin	Y
Warbonnet	Todd	Y
J lazy T	Todd	Y
Winchester	Todd	Y
Muleshoc	TNC	Y
Three Links	Dobson	Y
Brown Four Lazy B	Brown	Y
Clopton	Clopton	Y
Goff Six Bar	Goff	Y
Jones	Jones	Y
Kelly M Diamond	Kelly	Y

*Property now under Pima County ownership.

After completing meetings with landowners and managers from all four subwatersheds information gathered was correlated. Landowner's indicated they did not wish a watershed association to be formed.

The top five natural resource concerns were as follows:

- Road Problems.
 - Maintenance, erosion, flooding, dust pollution, engineering etc.
- Water Issues.
 - Consistent supply, recharge, restoration etc.
- Soil Erosion Control.
- Wildlife Habitat.
 - Corridors, improvement.
- Protection of private Property Rights.

Survey results concluded the following:

Top five education programs requested.

- Small and Large Agriculture Production.
- Fire Fuels and Prevention.
- Erosion (Process/Control/Prevention).
- Road Conditions.
- Water Use.

Top five requests for district programs.

- OHV's (Resource problem).
- Fire Management Plan for Watershed.
- Purchase of Development Rights Program.
- Workshops on Completed Programs.
- Newsletter (Preferred information format).

Summary of Resource Issues

Local residents were asked to describe their particular resource issues or concerns at the beginning of the project. These comments were obtained from public meetings and also from questionnaires. Additional public input was sought in a series of public meetings held in July, 2006 where the findings of the project were presented. The reports outlining the findings were also put on the Redington NRC website for people's comments.

The general issues identified by the public input process are listed below. We grouped the specific statements into the major issue topics to facilitate addressing each issue. Under each major topic are listed specific statements made by landowners. Since some of these statements referred to several issues, some of them are repeated under two or more major issues.

Upland Vegetation

- Restore native vegetation – no exotics
- Prescribed burning for woody plant species
- Shrub control
- Restore fire to upland
- Increased vegetative cover
- Improve range condition watershed wide
- Native plant and grass restoration
- Reseeding of native grasses or plants
- Woody plant increase problem on uplands
- Invasive shrub control
- Noxious/exotic weed control
- Improve water infiltration on rangelands

Upland Erosion

- Erosion control watershed wide
- Soil erosion watershed wide/conserves groundwater resources
- Improve range condition watershed wide
- Improve water infiltration on rangelands
- Soil stability – rock dams to curb arroyo cutting

Fire

- Control of fuel loads on federal lands and river banks
- Prescribed burning for woody plant species
- Restore fire to uplands
- Fuel loads for wildfire prevention

Riparian Vegetation

- Control of fuel loads on federal lands and river banks

- Restore native vegetation – no exotics
- Noxious/exotic weed control
- Overpopulation of woody species in riparian areas

Bank and Gully Erosion

- Erosion control watershed wide
- Bank and gully erosion
- Retain and promote natural resource supply in river, erosion control
- Soil stability – rock dams to curb arroyo cutting

Roads

- Well engineered road and maintenance
- Dust/erosion from road conditions
- Dust/erosion, maintenance for main road
- Pave main road
- Safe roads
- Erosion effects of side roads/off-road vehicles
- Water catchments for wildlife from road drainage

Flood Control

- Flood control
- Restoration of natural flow/floodwater drainage

Surface Water and Streamflow

- Consistent water supply
- Water restoration
- Retain and promote natural resource supply in river, erosion control
- Activities to improve infiltration/percolation, i.e. rock dams
- Restoration of natural flow/floodwater drainage
- Water recharge on uplands

Groundwater Supply

- Consistent water supply
- Water use and recharge issues
- Soil erosion watershed wide/conserves groundwater resources
- Low water use crops
- Monitoring of water table and informing residents
- Recharge water flow with dams
- Water recharge on uplands

Control of Noxious and Invasive Plants

- Prescribed burning for woody plant species
- Shrub control
- Restore fire to uplands
- Noxious/exotic weed control
- Identify and control noxious/toxic weeds without chemicals
- Invasive shrub control
- Foxtail control

Wildlife and Fish

- Wildlife corridors and habitat
- Wildlife habitat improvement
- Predator control
- Wildlife corridor monitoring
- Bat habitat improvement
- Water availability for wildlife during droughts
- Wildlife monitoring

Water Developments

- Water developments on uplands for wildlife/livestock
- Water catchments for wildlife from road drainage
- Water developments on farmland
- Water availability for wildlife during droughts
- Water developments for livestock and wildlife for distribution

Irrigation and Crops

- Low water use crops
- Identify and control noxious/toxic weeds without chemicals
- Noxious weed control
- Water developments on farmland

Social Issues

- Protection of private property rights
- Purchase of development rights program
- Encourage diversified local food production
- Preservation of existing rural lifestyle
- Do not discourage agriculture

Educational Programs

- Improvement of communication for land management issues
- Education of landowners on natural resources
- Education of new landowners and improved communication
- Studies of historic/prehistoric land use
- Control of plant parasites on shade trees
- Alternative heating sources
- Create wet areas
- Range management strategies

These issues were used as the basis for the Comprehensive Alternatives for Action Plan (**Task 5-5**) and also as the outline for the interpretation of results of the field assessment and literature review.

RESIDENTIAL LAND AND PRIVATE FARMLAND ASSESSMENT

RESIDENTIAL

The residential land assessment (**Task 4E**) was to obtain estimates of the amount of private lands that are held in residential, non-profit, and commercial agriculture status.

Background

Most of the land in the Lower San Pedro Valley area came into private ownership by homesteading and used for subsistence agriculture. Because these small parcels were not economic units they were consolidated into larger tracts owned by a few people operating ranches, usually with some federal and/or state grazing leases. Over the last two decades some ranches have been sold to developers and private parcels have begun to fragment. There has been an increase in the number of tracts and the number of owners (**Task 3**).

Procedures

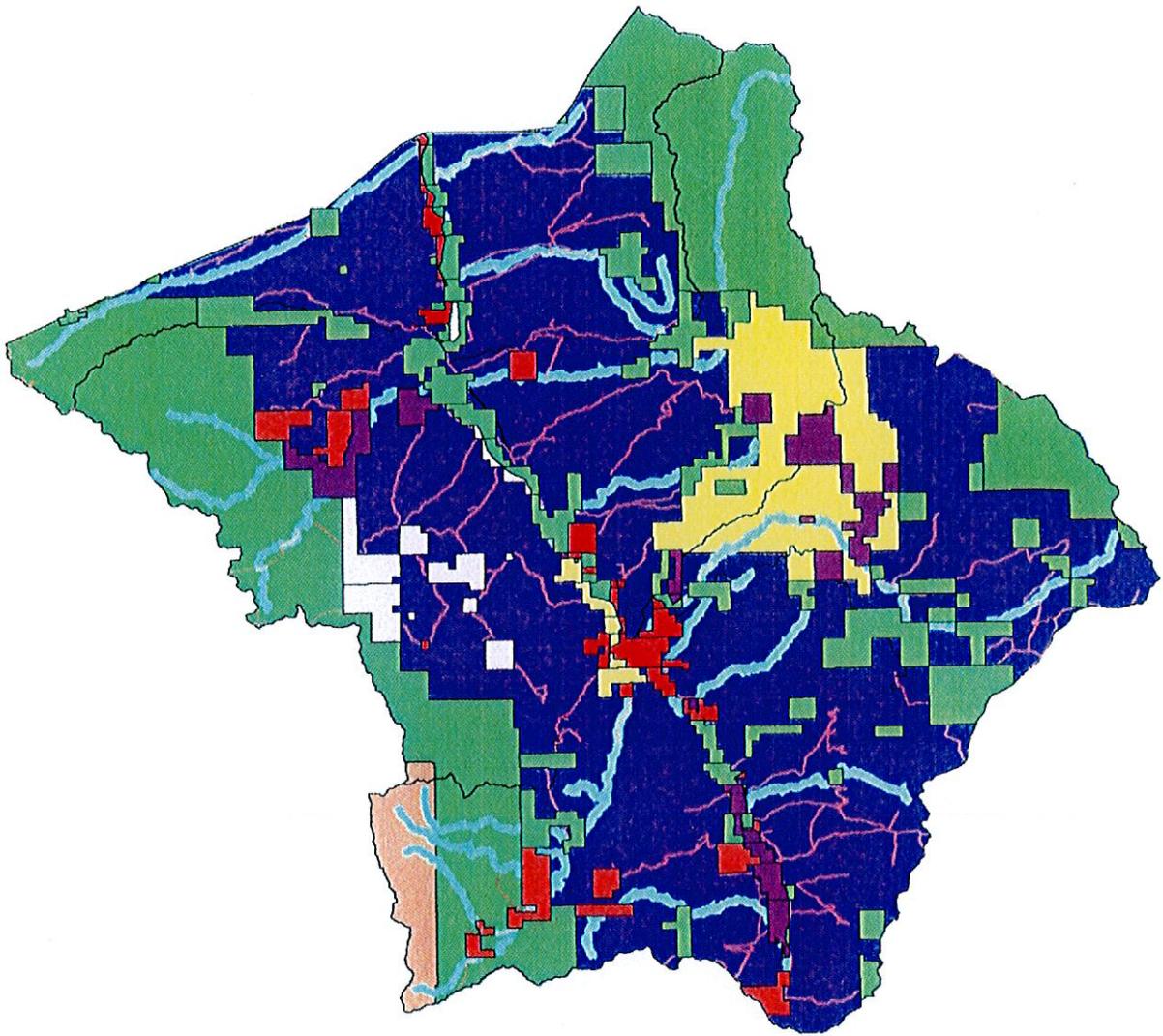
Residential land ownership and use status was determined through research at the tax assessor's office in each county. Each Township that reflected fragmentation was outlined and number of acres and owners determined. An average number of acres per landowner was calculated and included in the assessment. A land ownership status map was produced using a GIS program ARCVIEW. Conservation concerns were documented through conversations and meetings with landowners.

Results

Residential land ownership and use status is reflected in Figure 4. Residential landowner concerns are listed in Table 6.

Discussion

The residential land ownership map reflects four areas (T12R19, T13R19, T13R20, T14R20,) that have concentrated amounts of fragmentation. Some smaller private parcels are involved in local production (i.e. organic farming, pottery, pecans, wood products etc). However lands in commercial agriculture could be defined by tax records while local smaller production could not. Therefore, non-commercial production lands were included with the residential parcels. Knowing who is interested in conservation projects and the types of land use will help define the projects final alternative action plan. Non-profit organizations have been purchasing large tracts of land. It is not clear what will happen to those lands or how such acquisitions will affect the tax base. . The Bureau of Land Management has also publicly announced that the agency will continue to purchase lands to set aside for non-use. The map that was produced is in no way intended to be used as a precise assessment. The lines on the map are approximations. Land is constantly being sold and tax status changed.



Legend

Red = Residential
 Dark Green = Forest Service
 White = Pima County

Green = Commercial Agriculture
 Orange = Pima County
 Purple lines = Roads

Yellow = Bureau of Land Management
 Purple = Non Profit
 Blue Lines = San Pedro & Tributaries

1:300,000

Figure 4. Land ownership and use status Lower San Pedro River Watershed 2002.

Table 6. Residential landowner concerns 2002.

Name	Soil Erosion	Water Conservation	Water Infiltration	Water Flow Restoration	Flooding Problems	Increased Vegetation	Exotic Species	Diseased Vegetation	Invasive Vegetation	Wildlife Water
Baker	X		X				X			
Bell		X								
Bribach				X						
Clark	X		X			X				
Dale	X	X				X		X		
Etshokin	X									
Ffolliott		X								
Ffolliott		X				X				
Foster						X			X	
Gamez		X								
Gamez		X								
Gamez	X									
Gamez	X									
Gamez		X								
Hambly	X	X				X				
Hambly	X	X				X				
Helfrich					X				X	
Helfrich	X				X				X	
Mast	X					X				
Matson	X					X				
McBride						X				
Mott	X							X		X
Omick	X	X				X				
Otter	X	X	X			X				
Prueter	X	X								
Sayre	X									
Smith	X	X								
Taylor	X									
Taylor	X					X				
Troutner					X					
Troutner					X	X				

FARMLAND

The farmland conservation status assessment was to obtain estimates of the amount of irrigated farmland existing within the project area, methods of irrigation employed, problems of erosion or noxious weeds, and water conservation measures used or needed.

Background

All the farmland within the project area occurs in the vicinity of the San Pedro River on recent (in geologic terms) alluvial deposits that represent the floodplain of the River prior to its entrenchment or alluvial fans at the mouths of streams that emptied onto that floodplain. Most of these soils supported mesquite woodlands prior to clearing for irrigation, at least those fields cleared since entrenchment of the river.

All farming done within the project area is based on irrigation; dry farming is not possible on a regular basis. Most of the irrigation involves pumping of ground water. Historically, water was diverted from the San Pedro River to irrigate fields by the Indians and later by European settlers. For the most part, the entrenchment of the River that took place in the early 20th century made this type of irrigation unfeasible, although there are still a few cases where this is done.

Although irrigation has been practiced for centuries along the River, the extent of irrigated land increased during the 1940s-1960s when electric power or other sources of energy for pumping water arrived (**Task 3**). During the decades following World War II, there was considerable effort to develop efficient irrigation practices along the River. These involved land leveling, concrete irrigation ditches to reduce water loss, and flood control structures to prevent flooding and sedimentation problems on irrigated fields.

The amount of irrigated land has declined over the past 20 years or so. That decline is due to partly to high costs of electricity for pumping, new owners that lack interest or resources to irrigate, and purchase by some groups that actively seek to reduced or eliminate irrigation.

Procedures

Land presently cleared and equipped for irrigation was identified and delineated on aerial photos taken in 1996. Some land may have been taken out of irrigation and some other land put into irrigation (or irrigation re-instated) since that time. In some cases, it was not possible to ascertain whether the land will be irrigated or not due to changes in ownership.

Each parcel identified on the aerial photograph was measured to estimate acreage. The kinds of irrigation practices used were determined by contact with the landowners and field observation. The same procedure was used to help identify weed and/or erosion problems.

Results

The approximate acreage of irrigated fields (or in some cases, formerly irrigated fields) and the methods of irrigation used are listed in Table 7. A list of farm landowner concerns of erosion, noxious weeds etc. are listed in Table 8.

Acreage

There are about 3284 acres that could be identified as cleared for farming using aerial photographs. There may be areas that were formerly cleared, but which have been abandoned and grown back into mesquite woodland. The area actually irrigated at the time of the survey (based on 1996 aerial photos and ground truthing in 2003) was approximately 2888 acres.

Conservation and Irrigation Methods

Water conservation for irrigated farming involves reducing the amount of water loss from evaporation, deep seepage, runoff as "tail water", and efficient water distribution. Measures used to achieve these goals include using concrete ditches or pipes for flood irrigation, leveling of fields to improve distribution of flood irrigation, using sprinklers or drip irrigation to reduce loss due to seepage and tail water, controlling the timing of irrigation to reduce evaporation and seepage losses, etc.

Flood irrigation was practiced on approximately 1090 acres of land. All or most of this land has been leveled and borders are used to insure good distribution of water. Water is mainly distributed by concrete ditches or underground pipes with risers to control seepage loss. Flood irrigation generally involves some loss of water from the field due to runoff at the lower end (tail water). However, flood irrigation results in less evaporation loss than sprinklers. Much of the soil along the San Pedro is subject to piping erosion which occurs when water runs into holes in the field and empties out through subterranean channels into the River or other channels. These holes may enlarge into gullies in short time if there is source of surface water. This process occurs not only in cleared fields but also in the mesquite woodlands that border the River. Flooding provides a large amount of available water to promote piping erosion.

Sideroll sprinklers were used on about 1059 acres. Siderolls obtain fairly good water distribution and eliminate loss of water from ditches and tail water. Application rates can be closely controlled. There is less danger of piping erosion-using sprinklers because water is or should be applied at about the rate that the soil can absorb it, thus leaving little surface water to enter holes and create erosion.

Center pivot sprinklers were used on 551 acres. Center pivots have basically the same characteristics as siderolls with respect to soil and water conservation. They provide better distribution of water than siderolls and result in less evaporation loss. Center pivots are more expensive to install, but are much less labor intensive.

About 183 acres were irrigated by a variety of other techniques including "guns" and drip irrigation. "Guns" are large sprinklers that are generally less efficient than siderolls, but involve less labor. Drip irrigation is the most efficient method available, but the expense of installing it limits it to small areas and/or high-value crops.

Owners of irrigated farmland had similar concerns with respect to conservation issues. Erosion, efficient water use, adequate water supply, and invasive plants were the main concerns (Table 8).

Table 7. Estimated Acres Irrigated by Various Methods on Agricultural Parcels Along the Lower San Pedro River in 2003.

Area #	Acres				Uncertain Status
	CP	Sideroll	Flood	Other Types	
1	70 (85)				
2	158 (235)				
3			100		
4	135 (200)				
5	50 (75)				
6			35		
7	50				
8			153		
9	88 (150)				
10					28
11				50	
12			73		
13					23
14				50	
15		20			
16		43			
17		100			
18		40			
19		63			
20		4			
21		100			
22			60		
23				8	
24				20	
25				25	
26					73
27				30	
28		23			
29			25		
29A & 29B		20 & 15			
30			50		
31			35		
32		20			
33			15		
34			113		
35		78			
36			50		
37		30			
38			70		
39			98		
40		133			
41		165			
42		70			
43 & 43A		135	30 (A)		
44			140		
45			43		
46					25
47					45
48					5
49					18
Total	551 (745)	1024	1060	183	217

Table 8. Farm landowner conservation concerns.

Name	Soil Erosion	Water Conservation & Availability	Water Infiltration	Water Distribution & Development	Soil Quality	Increased Vegetation	Invasive Vegetation
Corbett			X			X	X
Crawford	X	X					X
Dillon	X	X				X	
Harris		X		X		X	X
Hawkins	X				X	X	
Hughes		X					
Lavin		X		X			
Looney		X		X		X	X
Monzingo	X	X		X		X	
Schultz	X	X					
Smallhouse	X	X		X			X
Smith	X	X		X		X	X
Thomas	X	X			X	X	
Todd		X	X	X	X	X	

Crops

Most of the irrigated land is used for growing pasture or hay crops. Bermuda grass is commonly used for summer pasture. Fescue, oats, ryegrass, or other cool-season grasses are used for winter –spring grazing. Commonly, cool-season annuals are over-seeded into bermuda grass pasture for winter use. Alfalfa is produced mainly for hay. A limited amount of other crops, such as corn, are produced for grain or silage. There are a few pecan orchards and some irrigation of native plants for wildlife habitat and/or grazing. Because of the variation from one year to another, and the changing land ownership status of some of the farmland, no effort was made to acquire information on the acreage of various crops.

Weeds

Weeds are a problem in most of the irrigated fields. Some of the most common are silverleaf nightshade, cocklebur, bindweed, and mesquite. The landowner survey discussed earlier in this report indicates that weeds are a concern for both commercial agriculture producers and other landowners.

Discussion

The acreage figures for irrigation reported above are based on current or recent irrigation use. Recently, a large section of the irrigated land was purchased by a non-profit corporation and has not been irrigated since. This involves approximately 1,100 acres of land cleared for irrigation and about 860 acres actually irrigated within the past few years. It is not clear at this time how much of that land may be put back into irrigation, but the acreage will probably be substantially reduced. The status of several other parcels is unclear also because of recent or pending changes in ownership, objectives of landowners, economics and other factors.

WATERSHED RESOURCE ASSESSMENT

Background

The Watershed Resource Assessment was carried out as **Task 4** under the WPF Contract. The collection and interpretation of field data on uplands and stream systems was a major portion of the project. This work was carried out in accordance with the methods and procedures, and modifications thereof, approved by the WPF. All of this information has been reported previously to the WPF in the form of progress reports on each quadrant of the San Pedro watershed.

Results and Discussion

The results from **Task 4** and discussion are included here as **Task 5.5**. The results were organized around the main resources issues identified by residents of the Redington NRCD. For each issue, significant data obtained from the field assessment process were presented. These data were interpreted along with pertinent information obtained by review of documents in the bibliography (**Task 4B**) to address the extent and nature of each resource concern and to suggest possible actions that could be taken to address these issues.

FINAL OBSERVATIONS AND RECOMMENDATIONS

This project was undertaken by the Redington Natural Resource Conservation District to provide the District with basic information on the natural resources in the District and the concerns of local residents with regard to conservation and management of those resources. The results have been presented in this final report, and in a number of other reports written during the course of the project. The project took longer than anticipated due to various reasons, some of which are discussed below.

This work will greatly improve the District's ability to analyze and prioritize the needs for resource management and to seek technical assistance and funding to address these problems from government or private sources. In addition, the information will be very useful in carrying out the District's efforts to provide educational programs to cooperators, school groups or other interested people. Finally the information contained in this report will provide a useful baseline for documenting future changes in the type and condition of natural resources within the District or for the preparation of a comprehensive watershed plan should one be desired.

Since 2006 the Redington Natural Resource Conservation District has had access to the information and data resulting from the Lower San Pedro River Watershed Assessment Grant. Although the grant has not been formally finalized, drafts containing finalized data has been available for district planning and activities. Since 2006 the District has referenced the assessment to determine the annual educational workshops based upon the community outreach sections and information gathered in the field and contained within the grant such as water availability and location. Since roads and erosion rated top concern in the district, last fall Redington hosted an intense erosion control workshop focusing on proper road maintenance on ranches and subdivided lands within the district. The District plans to build upon this workshop series with another erosion workshop in the spring of 2009 addressing erosion on a smaller scale in farming and localized washes. During this process Redington NRCD learned that those within the district wanted to learn more about agricultural practices. For three years the district has sponsored an agricultural field day for local school children to learn about agriculture and water conservation practices. The district has also used the grant information as contributions to local agencies when there have been information requests.

Specific district actions have included:

- Bill Zeedyk : A Good Road Lies Easy on the Land
 - Proper Road Construction/Maintenance to decrease erosion
- Redington Conservation Education Center
 - Workshop in cooperation with the NRCS constructing wildlife ramps for livestock waters to benefit wildlife
 - Workshop in cooperation with the AZ Game and Fish Dept. building Bat Houses
 - Ranch Field Day Elementary education: water conservation, farming, livestock husbandry, desert wildlife adaptations, bio-fuel use in farming.

The Department of Water Resources, which administers the Water Protection Fund projects, asked us to make some observations on how the project could have been improved based on our experience. The observations below refer to both the technical procedures used and the management of the project.

1. We underestimated the time and effort required to collect and analyze the field data following the procedures in the plan of work. A large portion of the District proved to be more rugged and inaccessible than we had anticipated, which not only required a lot of additional travel and field time, but also meant that the intensity of field analysis was lower in some areas than in others. However, most of the area that is under the management control of local residents (private and State lands) are relatively accessible and we therefore sampled more intensely than some of the land administered by the Forest Service or Park Service.
2. We recommend that any such project in the future employ GIS/GPS technology to the maximum extent. This project used GPS units to locate all data and photo points, but only started to use a GIS type mapping program after the project was underway, which created some problems of mapping which could have been avoided if GIS had been included in the plan from the start.
3. Most of the field data collection was conducted during very dry conditions. These conditions affect the assessment of resource condition, especially those in riparian areas, and must be considered in interpreting the results. This situation could not be foreseen and, obviously, any field project in Arizona's variable climate will likely encounter conditions drier or wetter than the elusive "average."
4. The completion of the project was delayed due to a computer crash which resulted in the loss of some data, especially photos taken with a digital camera. Some additional field work was required to replace the lost information. The need for routine backup of computer information cannot be overemphasized. We recommend using standard 35 mm cameras and having the photos put on CDs when developed to provide an archive in both digital and hard copy formats.
5. The public outreach portion of the project could have been done more efficiently. Initial contact with local residents should concentrate only on issues and concerns. This could be done with meetings and/or a questionnaire approach. The "public" should again be brought in when the complete report is in draft form. There was no need to have public meetings for each "quadrant" of the District, since the issues and concerns were similar throughout.
6. A major problem that delayed completion of this project was the result of unforeseen changes in the people involved in various parts of the project. The Redington NRCD submitted the project to WPF and was responsible for completion of the project. The Board of Supervisors of the District wrote the project and several members assumed responsibility for certain portions of the project. Some of that effort was to be compensated by the grant and some was donated time. Cascabel Range Consultants had the responsibility to collect and analyze field data; to compile an annotated bibliography of published and unpublished studies relevant to the watershed; and to analyze the type and condition of resources based on both sources. Other portions of the project were to be carried out by other people, including two members of the NRCD Board who had been intimately involved in the planning and submission of the grant proposal and had agreed to take on significant tasks. Unfortunately, these two individuals resigned from the Board on a matter unrelated to the WPF project. However, they not only severed their seat on the Board but also with the project. Thus, the Board had to carry out those portions of the project, a substantial amount of which had been based on volunteer time. Since no one else offered assistance, Cascabel Range Consultants (Lamar and Deborah Smith and Stefanie Smallhouse) took on these tasks in order to get them completed, although they had not planned this time commitment or to donate such a large amount of time to it. This was done based on their feeling of responsibility to the District. Failure to do so would have likely

resulted in cancellation of the project. It seems highly desirable for the Department of Water Resources and for any entity such as a conservation district submitting a proposal for this type of project to give careful consideration of the level of commitment of the individuals involved and how both DWR and the grant recipient will deal with failure of individuals to perform as agreed upon. It is not in the interest either of the grantor or the grantee to have projects fail because of lack of responsibility of key individuals.

7. In summary, this project was a bad situation financially for Cascabel Range Consultants. We underbid our portion of the project partly due to our own underestimate of the time required and partly because we volunteered a lot of time to help out the District. Then, to keep the project from failing, we took on even more of the work which was also based on significant volunteer time.

8. We also believe that DWR personnel are too intimately involved with the details of their projects. They should be less concerned about technical details (e.g. names of tables, report headings, etc) and confine themselves to provisions of the contract. The contracts, especially for a large project, should allow for modification when circumstances dictate a better approach to achieve the objectives than the one originally written in the proposal. We found the contract administrators were generally willing to listen to us and work with us, but the bureaucratic structure tied their hands in dealing with these projects on a common-sense basis.