CAMPOMOCHO SACATON WATERSHED IMPROVEMENT PROJECT

PHASE I FINAL REPORT

ADEQ PROJECT NO. 3-005

SUBMITTED BY: Coronado Resource Conservation & Development Area
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SUBMITTED TO: Arizona Department of Environmental Quality
1110 West Washington Street
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August 18, 2005

Contributions to the activities outlined in this report were received from a variety of local, state and federal partners. None of the contributions from federal partners were used as part of the required local match for funding.

TABLE OF CONTENTS

I. ABSTRACT

Local partners in the Willcox Playa watershed came together in 2000 to address water quality and quantity issues impacting the area. One of the major concerns was runoff from 42,000 acres of rangeland north of the City of Willcox, Arizona that was generating sediment at a rate of 2 Tons per acre per year. Water carrying heavy sediment loads was causing scouring of channel banks, picking up more sediment and creating a downward trend in watershed health as moisture ran off and was unavailable for plant life. In addition to sediment being generated and deposited on rural residences and farmland, excessive water invaded rural septic systems, and agricultural fields with pesticides and fertilizer. Any of these contaminants carried by the water had the potential to enter the City of Willcox on its path to the Willcox Playa.

To address the non point source pollution issue in the watershed, the group developed a Watershed Based Plan with implementing Best Management Practices on the 13,000 acre Campomocho-Sacaton sub watershed emerging as the highest priority. This area was contributing 26,000 Tons per year of sediment to downstream areas. The BMPs selected were ripping and seeding in the lower elevations and sediment control structures in the upper reaches.

Natural Resources Conservation Service (NRCS) staff assisted the watershed project group in developing a plan to address sheet and rill erosion in the lower elevations by contour ripping and seeding of 5500 acres of rangeland. To remediate gully erosion in the uplands, Cochise County donated engineering staff time to assess the hydrology and locate the nine sediment control structures that were installed. Structure designs used were a Bureau of Land Management standard design for a silt free reservoir that was adapted to the area by NRCS. Basins were designed to be multiple purpose structures and provide sediment retention, livestock water and runoff control for the City of Willcox. The Arizona Department of Water Resources, the permitting agency for water storage did not have a system in place to facilitate the request, causing a significant delay. The project timeline was extended for two years to accommodate this. Structures were constructed in the fall of 2004 and spring of 2005. The combination of structures, and ripping and seeding had a profound impact on sediment production. Before the project implementation, each 1-2 inch rainfall event would leave Nichols Road impassable with 1-2 feet of sediment deposited over a two mile stretch of road. After the project, no sediment has reached Nichols Road. Using calculations derived from the Revised Universal Soil Loss Equation (RUSLE), it is estimated that practice installation resulted in a 70% reduction in sediment production over the project area.

The ranchers developed grazing management plans on their private and state lease land under the guidance of the US Forest Service for the allotments in the uplands and NRCS and the Arizona State Land Department. These plans called for grazing deferment during the project period and long term management to maintain maximum vegetative cover on the watershed.

The USDA Agriculture Research Service has adopted this as one of their long–term watershed monitoring projects and will continue to use it to gather watershed, erosion and sediment data. Information from this project will be used to educate others on the benefits of watershed restoration to address non point source pollution.

II. PROJECT GOALS/OBJECTIVES AND METHODOLGOY

The goal of this project was to improve water quality by addressing non point source pollution in the form of sediment off the Campomocho-Sacaton sub-watershed of the Willcox Playa in southeastern Arizona. The area covers 42,000 acres of rangeland and according to a 1977 Santa Cruz-San Pedro River Basin Report compiled by the Soil Conservation Service in cooperation with the Arizona Water Commission; sediment was being generated at a rate of 2 Tons per acre per year. Upland areas of the watershed were producing sediment from sheet, rill and gully erosion with topsoil being eroded away and deposited on the valley bottoms. Water carrying heavy sediment loads caused additional scouring of channel banks, picking up more sediment and leaving little moisture available to support vegetation. This perpetuated a downward trend in watershed health and water quality. In addition to sediment carried downstream, floodwater from runoff events invaded rural septic systems, and agricultural fields with pesticides and fertilizer. Any contaminants carried by the water and sediment, entered the City of Willcox on its path to the Playa.

Local residents, Cochise County, NRCS and the City of Willcox had been exploring alternatives in dealing with runoff for several years but funding and lack of landowner cooperation in the uplands had prevented the implementation of any projects. In early 2000, the Hook Open A Ranch came under new ownership and the owner of the Red Tail Ranch invited all interested parties to meet and develop a plan that included the cooperation of both ranches and the farm in the Campomocho-Sacaton Watershed.

The development of a Watershed Based Plan began with an assessment of the current watershed conditions. Physical and climatic dynamics of fifty or more years ago had left the upper watershed devoid of perennial herbaceous cover, allowing erosion to move the sandy loam topsoil from the higher elevations in the watershed and deposit it as sediment in the lower areas. The volume of water moving across the watershed initiated a cycle of picking up and depositing sediment that continued from the top of the watershed, through the City of Willcox and on to the Willcox Playa. Although the watershed was in an active state of erosion, the exposed clay subsoil had not yet been colonized by invasive species making this project timely and feasible for restoring watershed health.

The first step in implementation was to address sheet and rill erosion in the lower, flatter areas of the watershed. Cochise County repaired existing water spreader dikes on the watershed as a matching contribution to the project. These reduce water velocity and cause it to spread across broad areas providing water for plant life, reducing channeling and allowing sediment to fall out.

To also trap sediment from sheet flow erosion in the lower areas, 5,500 acres of land was impacted by deep ripping to a depth of 30 inches on 50 foot centers on the contour and seeded to native grasses in the spring of 2003. These rips created roughness that slowed runoff, increased water infiltration and captured sediment behind them, creating a microclimate that allowed grass to germinate and become established. The ripped and grass strips will be barriers that will continue to reduce sheet and rill erosion on a long term basis.

Cochise County donated the services of an engineer to conduct the hydrologic studies and assist with the assessment. Over time, large gullies had begun to transect the watershed, creating outlets for rapid runoff and accelerated erosion. To address this, a series of nine sediment retention structures were designed to capture large volumes of sediment on the upper watershed, heal the larger eroded gullies and reduce the velocity of the water. A Bureau of Land Management standard design for a silt free reservoir was used for the structures and adapted to the sites by NRCS staff. This design was chosen based on the fact that they had proven to be effective in separating out the upper ranges of sediment sizes (sand and gravel) that cause downstream channel degradation. These basins were constructed in severely eroded channels during the August 2004 to July 2005 time period. They consist of a round pond built in the center of the channel with a pipe inlet. Water is slowed when it reaches the dike of the pond, allowing sediment to settle and drop out as water is forced through a pipe into a pond. The pond itself serves as a settling basin for sediment before allowing water to exit the other end through an outlet pipe. Water will leave all basins and structures at a less erosive rate.

The USDA Agriculture Research Service adopted this project for their long-term watershed monitoring studies and will quantify sediment captured in relation to rainfall and overall watershed health. (Refer to Appendix B for baseline data)

El Paso Natural Gas Company donated $50,000 in cash match for structures that will protect their pipeline from gully erosion. NRCS provided engineering, construction inspection and assistance with planning and monitoring. The Arizona State Land Department provided leadership and assistance in obtaining permits and clearances and with onsite monitoring. Vegetative monitoring was led by University of Arizona Extension and NRCS Rangeland Management Staff. The Arizona Game and Fish Department worked with the project partners and provided input on factors necessary to improve habitat for increasing the population of antelope in the area. The Willcox-San Simon Natural Resource Conservation District reviewed the project monthly, participated in the watershed group meetings and all outreach efforts, hosting field days and project tours. Coronado RC&D, coordinated and administered the project.

III. RESULTS OF PROJECT

As a result of project implementation, it is expected that sediment moved off the watershed and onto downstream areas will be reduced by 18,200 tons per year.

The following Best Management Practices and actions (illustrated in photos in Appendix C) were implemented as part of this project:

A. Contour ripping and seeding on 5,500 acres of rangeland. This was done to a depth of 30 inches on 50 foot centers and seeded to native grass. Grass species used: Sideoats gramma (*Boutelous curtipendula*), Blue gramma (*Bouteloua gracilis*), Yellow bluestem (*Bothriochloa ischaemum*) Green sprangletop (*Leptochloa dubia*) and Galleta (*Pleuraphis jamesii*).

B. Repair of three water spreader dikes and one breached structure.

Results of Project (continued)

C. Grazing management plans developed on two participating ranches (45,000 acres)

D. Deferred grazing on project area

E. Monitoring plan implementation (Appendix B)

- Vegetative monitoring conducted by the University of Arizona, Extension, NRCS and the Hook Open A and Redtail Ranches. Permanent transects were installed in the project area. Areas monitored were: 1) Ripped and seeded area 2) Ripped but not seeded 3) Non disturbed area. These areas were monitored annually for vegetation composition and amount of cover
- Rainfall Monitoring- Five rain gauges were read over the project period. Two in the remote areas were vandalized leading to an absence of data for some of the reporting periods.

- Sediment- 1) The Agricultural Research Service selected three structures to use to monitor sediment, runoff and watershed health. They set benchmarks at each of these structures and surveyed in baseline cross sections. No significant rains were received during the structure construction phase of this project so there has been no data gathered to date on actual sediment captured. They will use these sites in the future and apply information to Phase 2 of the project and for their watershed research. 2) Nichols Road was the original outlet point for runoff from the project area. Before the project implementation, each 1-2 inch rain produced sediment that accumulated on Nichols road to a level of two feet deep. After the project implementation, there was no significant sediment delivery to Nichols road, or runoff into lower areas.

- Photo monitoring- Photos were taken each time the vegetation monitoring transects were read and through each phase of the project implementation.

F. Outreach Plan (Appendix D-Materials)

- A power point presentation was developed that highlights the key features and chronology of the project as well as EPA/ADEQ as the funder. This presentation was used to inform the Willcox City Council, the Southeast Arizona Resource Managers, Cochise Graham Cattle Growers and for a presentation to the public at Southeast Arizona Ag Day in Willcox.

- Newsletter articles: 7 newsletter articles were used to inform partners and the public about the project progress and benefits.

- Field Days and tours: Two field days/tours were conducted, one for technical staff monitoring training and one for the public and partners. A total of 70 individuals learned about the project and non point source pollution during the tours.

- Handouts- Two different handouts were developed to inform the public about the project. These were distributed at AG Day, field tours and in the Coronado RC&D newsletter. (1300 distributed)

- Photo Display at Ag Day (250 in attendance)

IV. IMPLICATIONS AND RECOMMENDATIONS

A project of this magnitude requires a large number of partners and a large commitment of time and resources from each. There are multiple long term benefits from watershed rehabilitation.

Cochise County was an active partner in the project and will realize economic benefits in the future in reduced cost of road maintenance and sediment removal as well as in reduced safety hazards caused by sediment and flood water.

Ranchers will benefit from improved rangeland condition and facilities that provide management tools.

The City of Willcox will have improved flood control which will mean less water quality concerns due to flood water carrying contaminants into town.

Downstream landowners will have less sediment and flood water to deal with in wells, septic tanks and on roads.

El Paso Natural Gas will have reduced cost of maintenance and protection for their pipeline as water and sediment are contained upstream.

Wildlife benefits from increased cover, food and water on the watershed.

This project has the potential to provide long term education to researchers and residents on the benefits of implementing these types of practices for water quality improvement. It will serve as a research site for ARS and an education site for the Willcox-San Simon Natural Resource Conservation District.

RECOMMENDATIONS

The greatest challenge in implementing this project was the delays caused by the necessity of obtaining water rights for the structures through the Arizona Department of Water Resources (ADWR). That delay came about because ADWR did not have a permitting process that adequately addressed multiple use structures. The structures in this project were to serve as sediment retention/flood control and livestock water basins. The applications submitted by the ranches necessitated a thorough review of how these structures fit into the ADWR water rights application process. Preliminary queries gave no indication that there would be a problem with water rights so it was an unforeseen challenge.

This type of project is best implemented through a broad partnership or watershed group so that the actual source of the pollutant can be addressed rather than treating symptoms of the problem. Individuals working alone would also have greater challenges in finding funding and in navigating the permitting process. For example to do the archeological survey on 5500 acres, it took 10 people 5 days of walking 50 feet apart to clear the entire area. This required a large infusion of help from trained personnel from several state and federal agencies. An individual may have had to hire this done at considerable cost.

This project is an excellent example of using a watershed approach to address non point source pollution. It applied Best Management Practices at the top of the watershed and integrated them moving toward the lower elevations.

Part VI - Budget

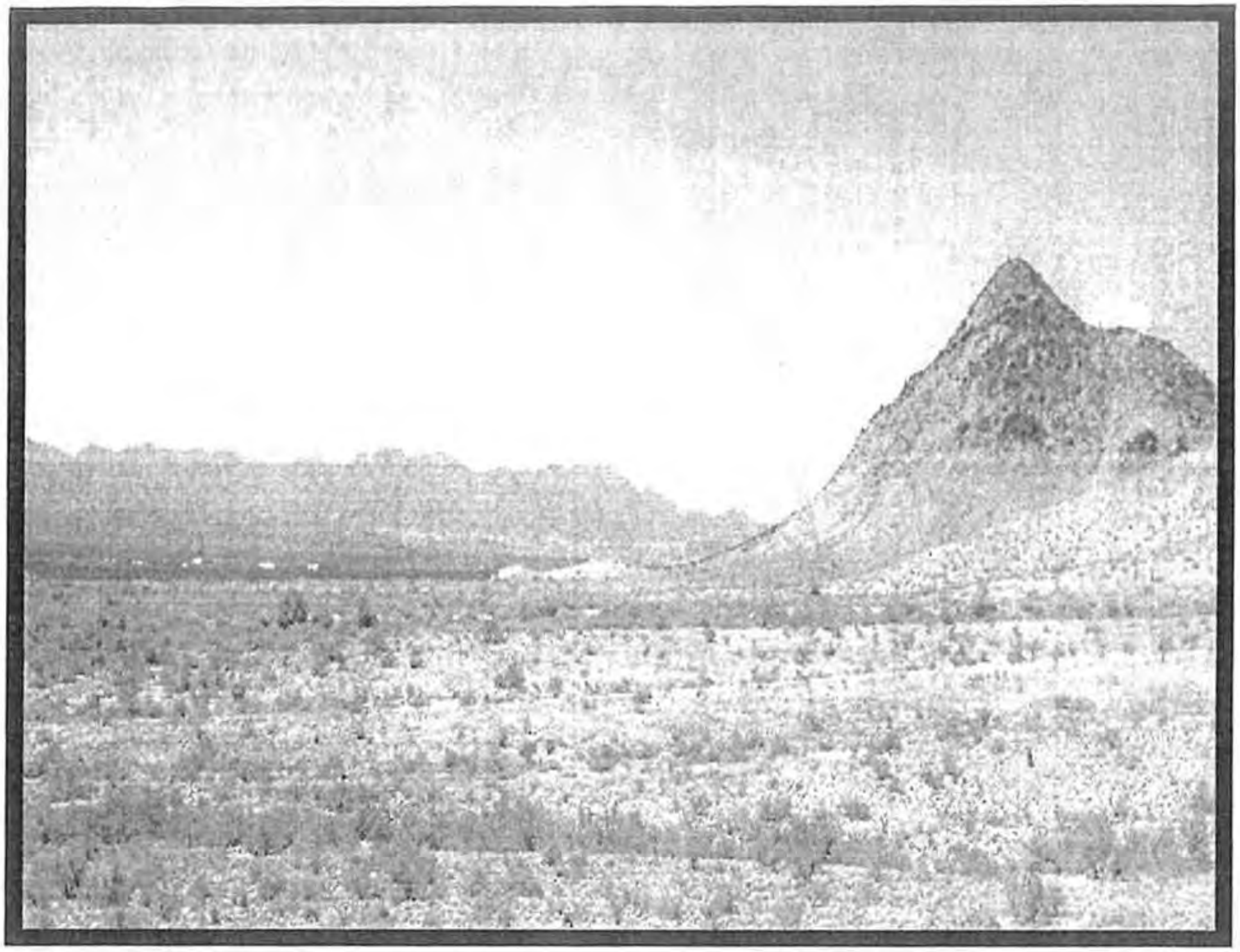
ADEQ Grant Award # 3-005 Project Title: Campomocho-Sacaton Phase 1 Final Report

Time Period Through 7/24/05

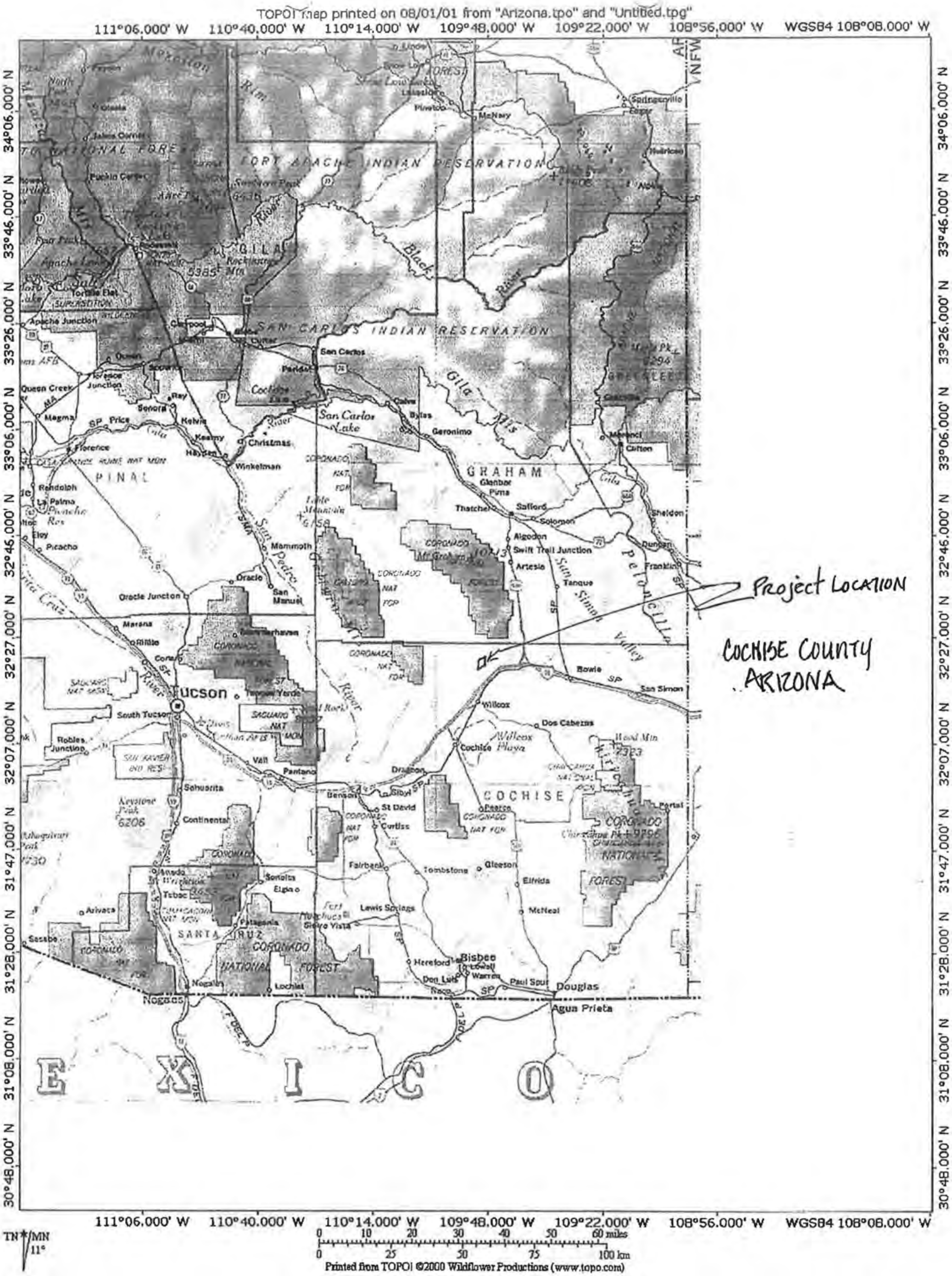
Grant Expenditures	Original Budget	Prior Expenditures	Current Expenditures	Cumulative Expenditures	Budget Remaining
Admin. Costs (10% Max)					
Coronado RC&D	$15,000.00	$15,000.00	$0.00	$15,000.00	$0.00
				$0.00	$0.00
Direct Costs					
				$0.00	$0.00
Equipment				$0.00	$0.00
				$0.00	$0.00
Supplies				$0.00	$0.00
				$0.00	$0.00
Other				$0.00	$0.00
Contractual	$285,000.00	$276,285.05	$8,714.95	$285,000.00	$0.00
				$0.00	$0.00
				$0.00	$0.00
Personnel					
Salaries				$0.00	$0.00
				$0.00	$0.00
Sub-Total Grants	$300,000.00	$291,285.05	$8,714.95	$300,000.00	$0.00
Verify Totals (This number should be the same as the Sub-Total Budget Remaining cell above)					$0.00

Match Expenditures	Original Budget	Prior Expenditures	Current Expenditures	Cumulative Expenditures	Budget Remaining
Admin. Costs (10% Max)					
	$15,000.00	$17,500.00	$0.00	$17,500.00	-$2,500.00
				$0.00	$0.00
Direct Costs					
				$0.00	$0.00
Equipment				$0.00	$0.00
				$0.00	$0.00
Supplies	$7,198.00	$3,962.78		$3,962.78	$3,235.22
Other				$0.00	$0.00
Contractual	$198,242.00	$144,979.42	$34,125.00	$179,104.42	$19,137.58
Travel	$2,000.00	$4,779.36	$0.00	$4,779.36	-$2,779.36
Personnel					
Salaries	$73,235.00	$94,561.85	$2,406.88	$94,561.85	-$21,326.85
				$0.00	$0.00
Sub-Total Match	$295,675.00	$265,783.41	$36,531.88	$299,908.41	-$4,233.41
Verify Totals (This number should be the same as the Sub-Total Budget Remaining cell above)					-$4,233.41

Totals	Original Budget	Prior Expenditures	Current Expenditures	Cumulative Expenditures	Budget Remaining
Grand Total	$595,675.00	$557,068.46	$45,246.83	$599,908.41	-$4,233.41



A. Watershed Map With Practice Locations



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33°26.000' N
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32°46.000' N
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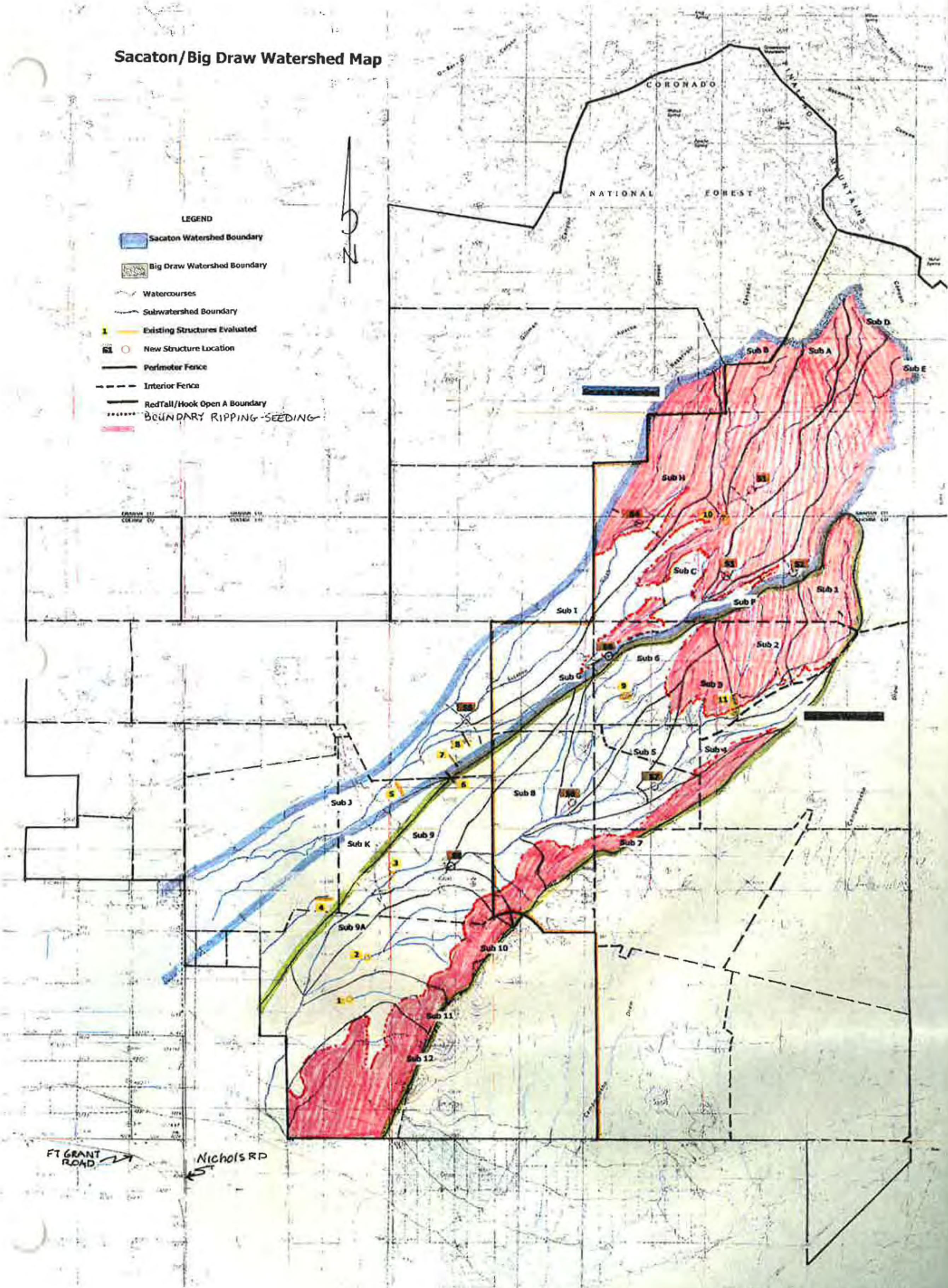
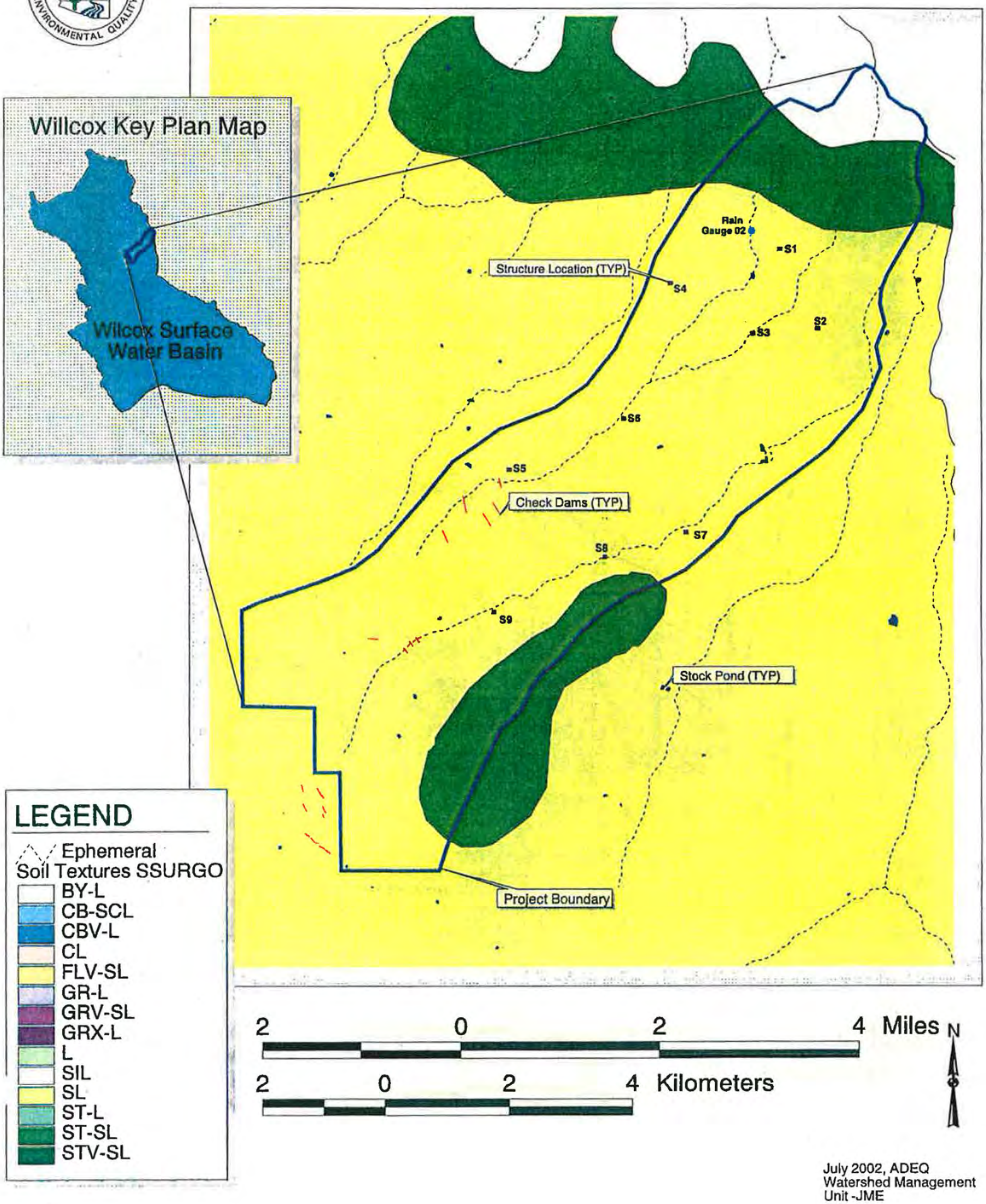
FORT APACHE INDIAN RESERVATION
SAN CARLOS INDIAN RESERVATION
PINAL
GRAHAM
COCHISE
SANTA CRUZ
Tucson
Willcox
Bowie
San Simon
Safford
Benson
Tombstone
Bisbee
Douglas
Nogales
Agua Prieta
MEXICO
Project Location
COCHISE COUNTY ARIZONA
TN MN 11°
0 10 20 30 40 50 60 miles
0 25 50 75 100 km
Printed from TOPO! ©2000 Wildflower Productions (www.topo.com)

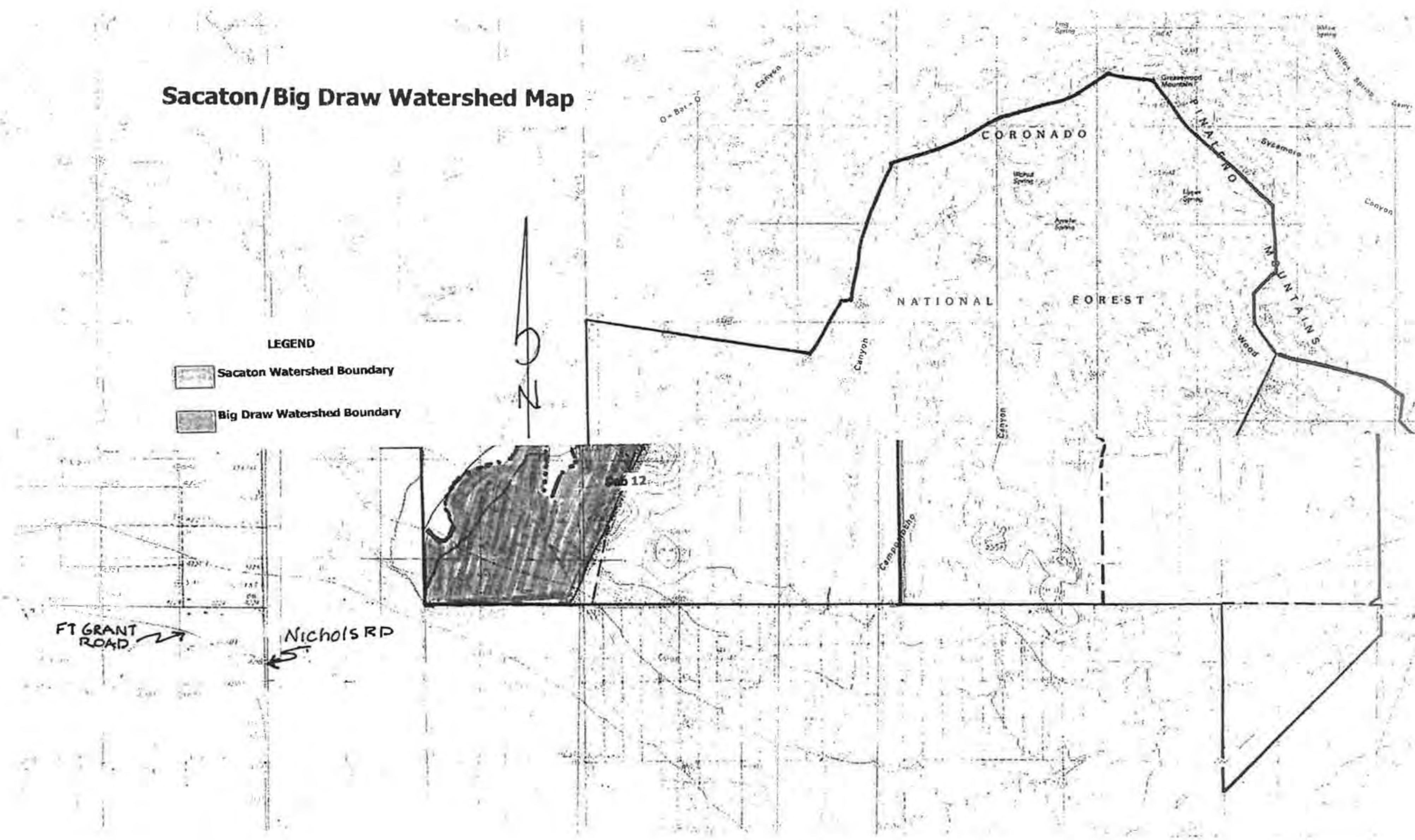


BMP IMPLEMENTATION LOCATION MAP
CAMPOMOCHO SACATON WATERSHED PROJECT
ADEQ PROJECT NO 3-005

Figure 2. Soil Texture Types in the Campomocho-Sacaton Watershed Stormwater Runoff Control Project

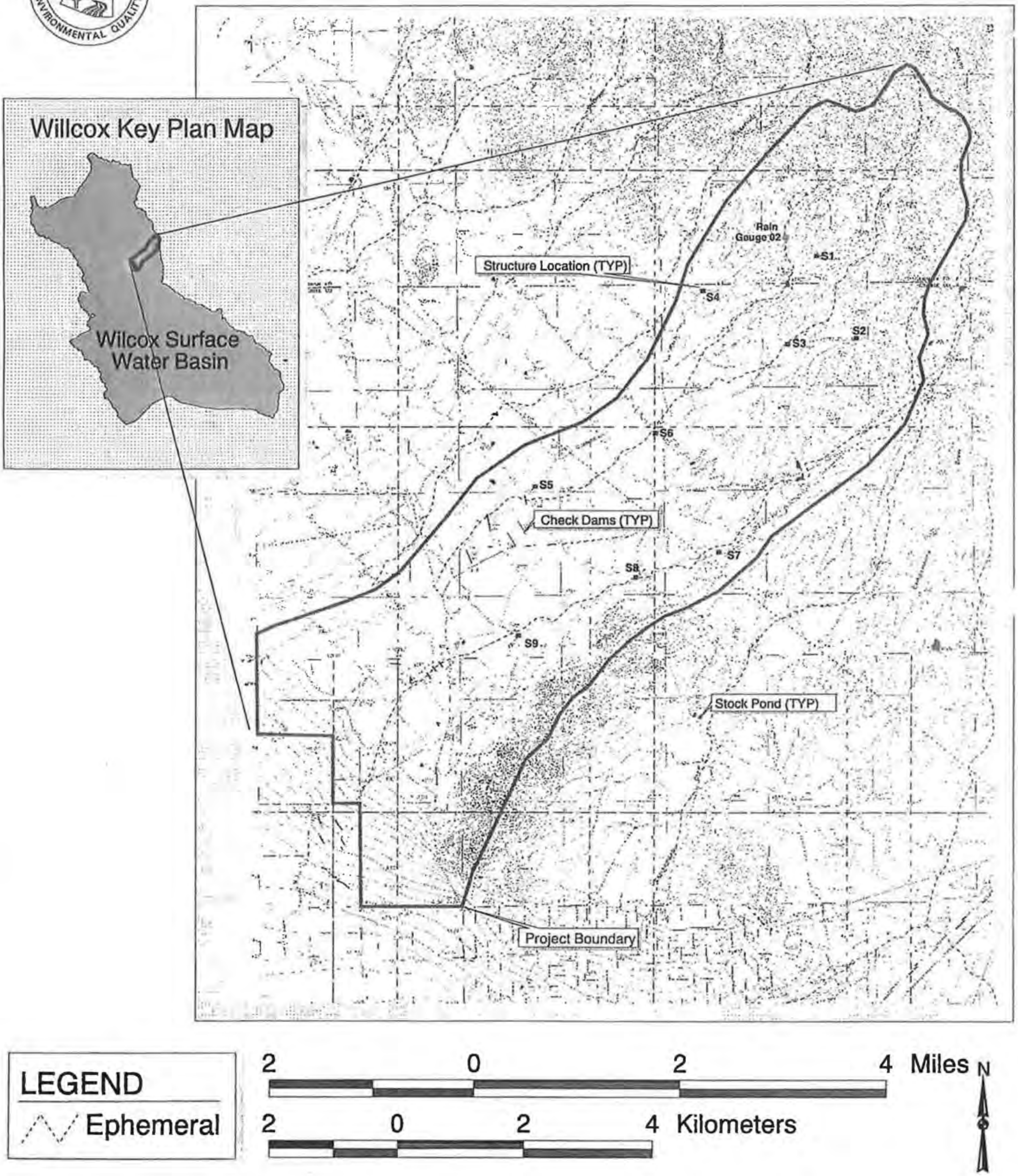


July 2002, ADEQ
Watershed Management
Unit -JME



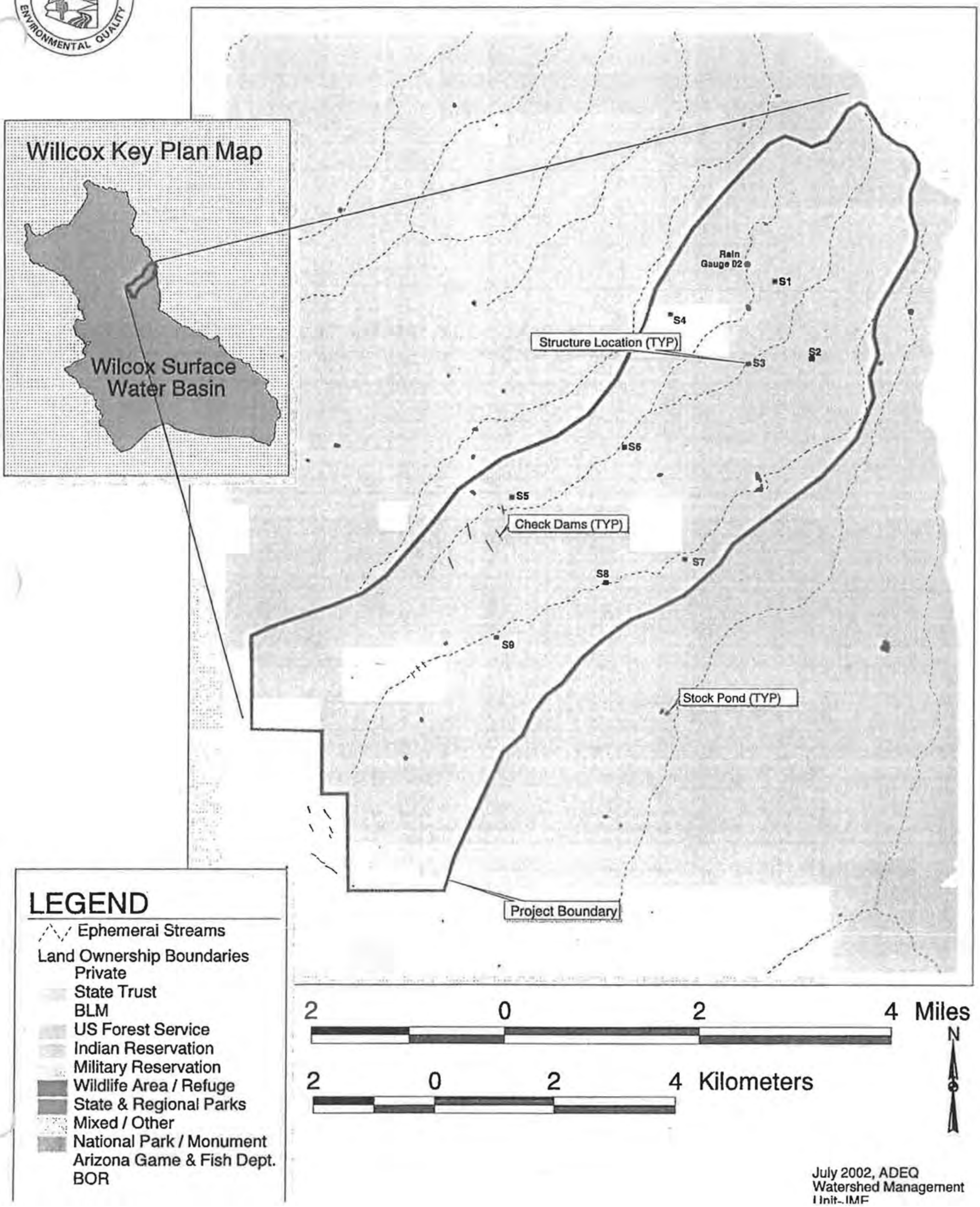
BMP IMPLEMENTATION LOCATION MAP
CAMPOMOCHO SACATON WATERSHED PROJECT
ADEQ PROJECT NO 3-005

Figure 1. USGS Topographic Maps for the Campomocho-Sacaton Watershed Stormwater Runoff Control Project



July 2002, ADEQ
Watershed Management

Figure 3. Land Ownership for the Campomocho-Sacaton Watershed Stormwater Runoff Control Project



August 2005 - Report 1
Submitted by Mary Nichols

Baseline surveys to characterize erosion control structure sites

Three newly constructed erosion control structures were selected to quantify sediment accumulation and reduction in downstream sediment delivery in association with rangeland treatments on the Campmocho-Sacaton Watershed near Willcox, Arizona.

The three structures (Table 1 and overview map on page 2) were selected considering 1) sub-watershed location (to represent lower, middle, and upper watershed), 2) site accessibility, and 3) feasibility of conducting an accurate survey based on site specific topography and vegetation.

Table 1. Erosion control structure locations (NAD83 UTM 12N)

Structure ID*	Northing (m)	Easting (m)	Elevation (m)
CMS 1 (6)	3586075	611930	1400
CMS 2	3587605	614960	1465
CMS 3(8)	3583869	611625	1365

*Note: Structure ID was created for this survey and will be updated to be consistent with original ID numbers established for the structures

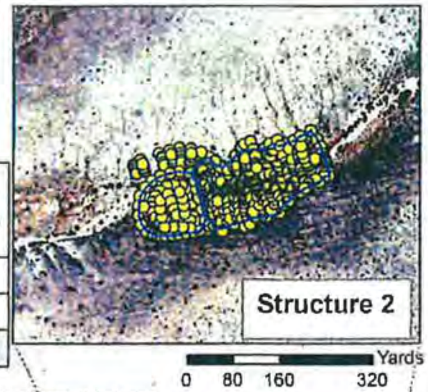
Topographic surveys were completed at CMS 1 and 2 on July 14 and 15, 2005; and at CMS3 on July 21, 2005 using a Trimble 5700 Real Time Kinematic (RTK) GPS system. The surveys were conducted prior to the 2005 runoff season and will be used to quantify the baseline topographic condition of each site. Three survey control benchmarks (aluminum capped rebar) were established at each of the three structures to provide horizontal and vertical control for these and future surveys. At each site, specific measurements included spillway elevation and the elevation of the inlet and outlet pipe for the overflow pond. . In addition, the spillway geometry, overflow pond geometry, erosion control berm , and catchment topography above each structure to an elevation equal to the spillway elevation were surveyed. Surveys consisted of collecting point coordinate measurements that were used to create topographic surface models and generate contour maps. Topographic point accuracy was approximately 1-2 cm horizontal and 2-3 cm vertical. Pond and catchment volumes were calculated based on the respective surveyed outlet elevations. Volumes and outlet elevations are summarized in Table 2 which can be found on the attached overview map (English units). Contour detail for each site overlain on a 1996 orthophoto can be found on subsequent pages (Metric units). These data represent preliminary calculations.

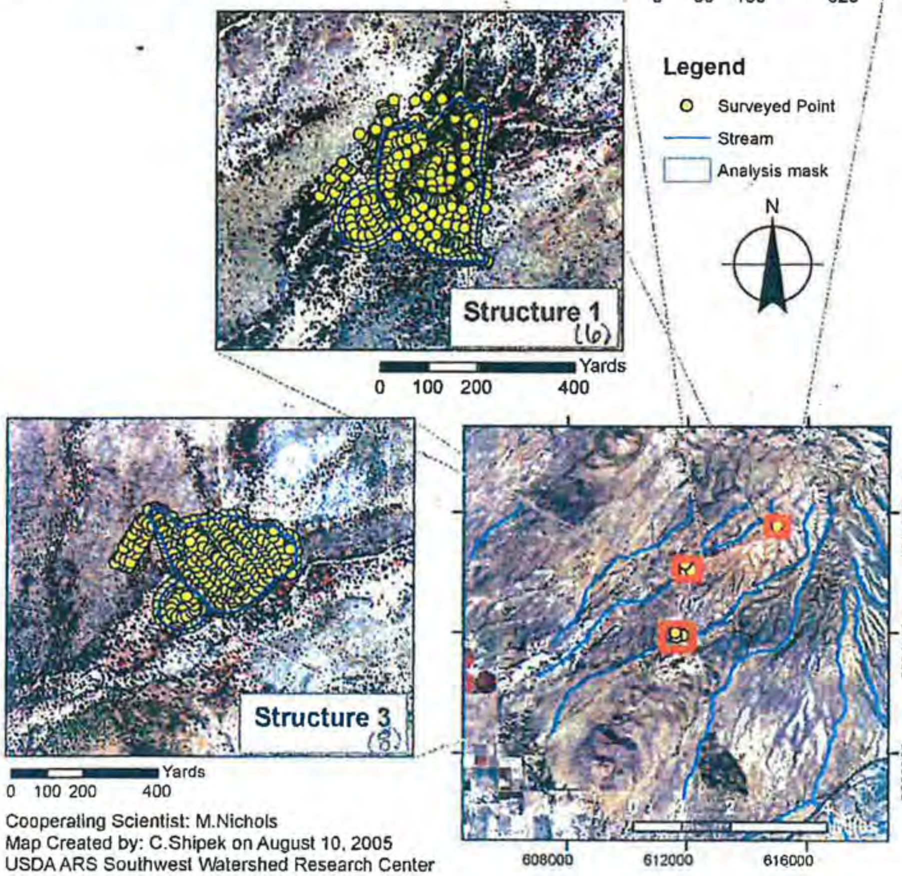
Each structure will be resurveyed following monsoon runoff seasons in 2005, 2006, and 2007. The successive surveys will be used to quantify sediment accumulation as well as changes in channel cross section geometry and profiles. These measurements will be used to quantify the impact of the erosion control structures on reducing downstream sediment delivery.

Campomocho - Sacaton Survey Overview

Table 2. Summary of ponds and upper areas

Structure ID	Upper Volume (ac-ft)	Pond Volume (ac-ft)	Spillway Outlet Elevation (feet)	Pond Outlet Elevation (feet)
CMS 1 (6)	21	11	4600	4595
CMS 2	7	8	4806	4799
CMS 3 (8)	22	10	4482	4475





Structure 1: Campomocho - Sacaton

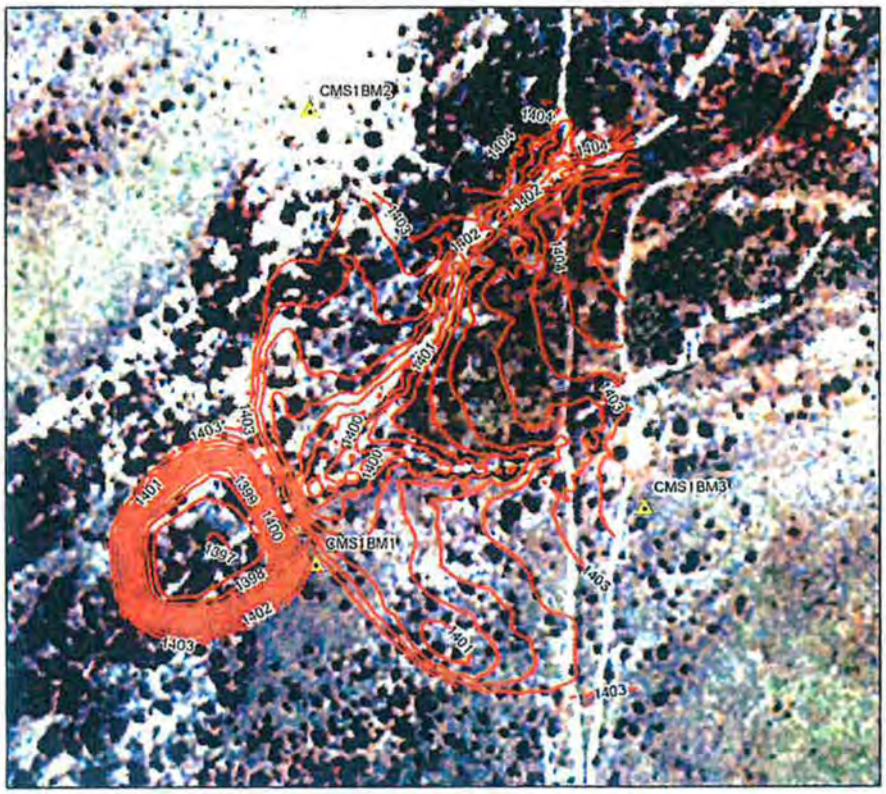
(6 RCID & ADEQ RECORDS)

Table 3. Coordinates of established benchmark points.

Benchmark ID	Northing (m)	Easting (m)	Elevation (m)
BM1	3586075.70	611929.97	1403.33
BM2	3586310.86	611927.23	1403.54
BM3	3586104.68	612101.61	1404.13

Benchmark

Contour (half meter)



Meters

0 25 50 100

N

Cooperating Scientist: M.Nichols
Map Created by: C.Shipek on August 10, 2005
USDA ARS Southwest Watershed Research Center

Structure 2: Campomocho - Sacaton

Table 4. Coordinates of established benchmark points.

Benchmark ID	Northing (m)	Easting (m)	Elevation (m)
BM1	3587604.67	614958.79	1467.27
BM2	3587492.94	614971.25	1468.16
BM3	3587517.29	615049.45	1470.18

Benchmark

Contour (half meter)

Meters
0 25 50 100

N

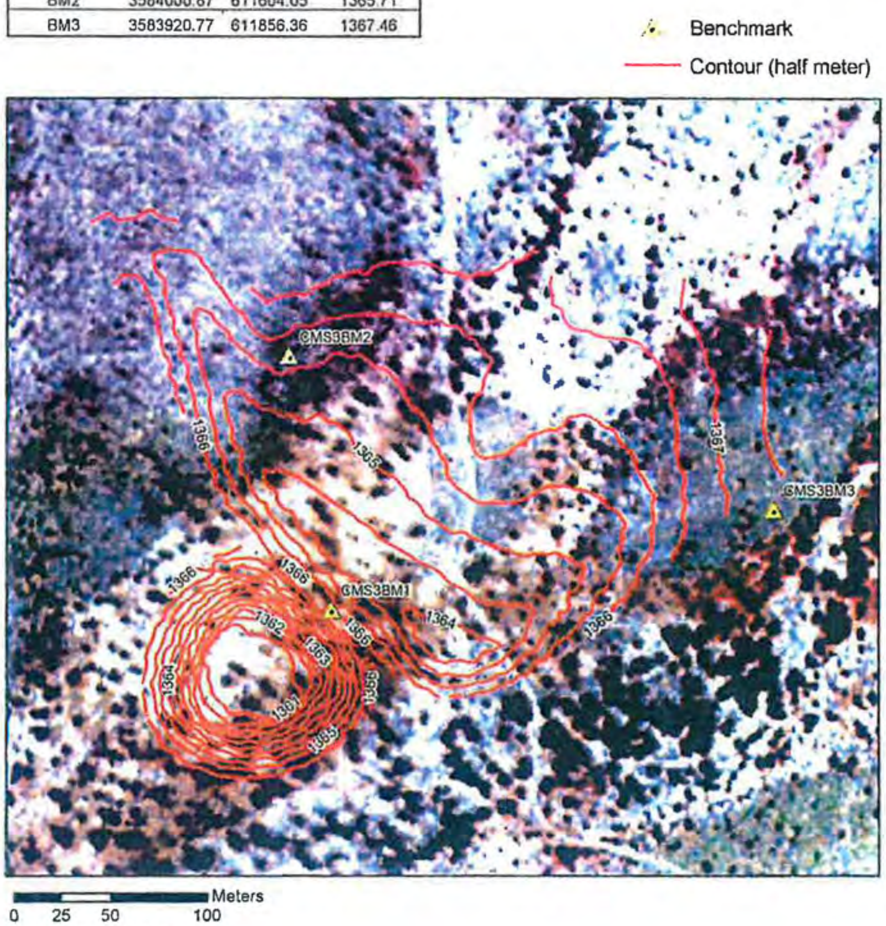
Cooperating Scientist: M.Nichols
Map Created by: C.Shipek on August 10, 2005
USDA ARS Southwest Watershed Research Center

Structure 3: Campomocho - Sacaton

(8 RC'D FADED RECORDS

Table 5. Coordinates of established benchmark points.

Benchmark ID	Northing (m)	Easting (m)	Elevation (m)
BM1	3583868.80	611625.77	1367.46
BM2	3584000.87	611604.05	1365.71
BM3	3583920.77	611856.36	1367.46



Cooperating Scientist: M.Nichols
Map Created by: C.Shipek on August 10, 2005
USDA ARS Southwest Watershed Research Center

Campomocho-Sacaton Watershed Stormwater Runoff Control

Final Monitoring Report Vegetation & Soil

July 2005

Final Vegetation & Soil Monitoring Report
Campomocho/Sacaton Project - Phase 1
2005

Transect Site Summary

Key Area	GPS (NAD27 CONUS)	Photo	Cover	Freq	Fetch
F2	12S 0609064 UTM 3581259	Y	Y	Y	Y
F3	12S 0610962 UTM 3584240	Y	Y	Y	Y
Rip 1	12S 0610489 UTM 3584780	Y			
Rip 2	12S 0610622 UTM 3584659	Y			
Rip 3	12S 0610860 UTM 3584925	Y			
Rip 4	12S 0607687 UTM 3581891	Y			
Rip 5	12S 0608490 UTM 3579468	Y			

General Information

Transects for Key Areas F2 and F3 were read during the fall of the year. Initial readings were taken prior to land treatment. Photo sites at Rip 1-5 were established and photographed in July, 2003. These were established following treatment for proper locations within and outside of treatment areas. They were re-photographed in November, 2003 and April, 2005.

Methods

Ground Cover

Ground cover is the amount of surface area comprised of bare ground, perennial plant bases, litter, gravel or rocks. Ground cover data, each soil protection category expressed as a percentage of total hits, reflect the amount of litter, vegetative root bases, gravel and rocks available to intercept raindrop impact before reaching the soil and of bare ground exposed to climatic elements. Cover data were collected with each quadrat placement. A single point from the quadrat was consistently the focal point for cover category classification.

Ground cover ground rules established prior to data collection were:

- One ground cover hit is recorded per quadrat placement. The total number of ground cover hits equals the total number of quadrat placements.
- Litter is dead plant material directly covering the ground, dead perennial vegetative bases, or animal material. If a small stem or piece of litter is not considered large enough to intercept raindrop impact, the hit is the ground covering below it.
- Bare ground is soil with particles up to 1/4" in size; gravel are particles 1/4"-3"; and rocks are $\geq$3".

Pace Frequency

Pace frequency is the number of times a plant species is present within a given number of uniformly sized sample quadrats (plot frames placed repeatedly across a stand of vegetation). Plant frequency is expressed as percent presence for each species encountered within total number of quadrat placements, therefore, frequency reflects the probability of encountering a particular plant species within a specifically sized area (quadrat size) at any location within the key area. The total number of frequency hits among all species will not equal the total number of quadrat placements and frequency is insensitive to the size or number of individual plants. Frequency is a very useful monitoring method but does not express species composition, only species presence. Frequency is an index that integrates species' density and spatial patterns.

A 40 x 40 cm. (0.16 m^2) quadrat is used for pace frequency. Ground rules are:

- Species present within the bounds of the sample quadrat are recorded with a single tally.
- If no species are present, no frequency data are recorded.
- Perennial or annual grasses and forbs must be rooted within the quadrat to be counted.
- A grass or forb plant base present under the quadrat frame is considered "in."
- Annual plants, grasses and forbs, are counted whether green or dried.
- Tree/shrub canopy and basal hits are recorded separately. Over time, these parameters can indicate changes in tree/shrub size (canopy) or plant numbers (basal).
- A canopy hit is any part of the tree or shrub that overhangs the quadrat (enters an imaginary vertical projection of the plot frame).
- Quadrat placements are placed at one-pace intervals (2-steps), patterned in transects (straight lines) and are run parallel to each other, generally contouring slope, within the area of one ecological site (vegetation and soil type).

Fetch

Fetch is the distance from the nearest perennial plant base within 360 degrees of the quadrat's ground cover point. This is an experimental method being tested in southeastern Arizona. Fetch, reported with descriptive statistics, relates to plant distribution and watershed characteristics. Perennial plant cover can reduce soil erosion by creating an obstruction, slowing the rate of overland flow. A shorter distance between perennial plant bases lessens the opportunity for flowing water to acquire the necessary energy to remove soil and litter from a site. Overtime, fetch data can be used to assess changes in the spatial distribution and connectivity of vegetation patches plus document trends in the fragmentation of plant cover for rangeland health evaluation. One-hundred distances were measured in conjunction with pace frequency as baseline data for future monitoring.

Photo Sites

Five sites were selected for long term photo monitoring. They were selected based on differing soil types, treatment vs. no treatment, and differing grazing strategies. Photos were taken in the four cardinal directions at each site along with observational notes.

Results and Discussion

Key Area F2

Table 1. Percent Ground Cover, F2.

	2001	2003	2004
Ground Cover	(%)	(%)	(%)
Bare Ground	49.0	74.0	56.5
Rock	2.5	0.0	0.0
Litter	47.5	25.5	43.0
Vegetation	1.0	0.5	0.5

Bare ground increased from 2001 to 2003, while litter decreased the same years. This may have been due to annuals having been swept away by winds prior to monitoring. Dead annual grasses and forbs do count as litter if they meet the criteria listed in the methods section. The trend in bare ground and litter reversed itself from 2003 to 2004. There has been no change in the percent cover of vegetation base.

Table 2. Percent Frequency, F2.

	2001	2003	2004
Species	(%)	(%)	(%)
Perennial Grasses			
Bush muhly	13.5	10.0	7.0
Plains bristlegrass	10.0	1.5	2.5
Blue grama	0	0.5	0.5
Sand dropseed	1.5	0	0
Three-awn	4.5	0	1.5
Lehmann lovegrass	17.5	5.5 *	18.0
Arizona cottontop	0.5	0	0
Sacaton	0.5	0	0.5
Perennial Forbs			
Silverleaf nightshade	0	1.0	2.5
Trees and Shrubs			
Burroweed	34.0	33.0	35
Mesquite	42.5	25.5 *	24
Snakeweed	2.5	2.0	5.5
Catclaw acacia	1.0	0	0
Desert zinnia	0	0	0.5
Annual Forbs	10.5	14.5	14.5
Annual Grasses	24.5	51.5	78.5

* denotes change at P = 0.95; 200 quadrats. Note: Frequency values from 1-10% and 90-100% only indicate species presence; therefore change at these levels was not evaluated. Caution is applied when interpreting change between levels of 10-20% and 80-90%. These cautions are due to the sensitivity of the method used.

Two significant changes were found in 2003. Lehmann lovegrass decreased from 17.5% to 5.5% frequency and mesquite decreased from 42.5% to 25.5%. The Lehmann lovegrass increased again in 2004 to match the 2001 level and shows an overall stable trend for that species. However, in the case of mesquite, the percent frequency remained at the lower percentage rate which indicates a significant decrease in this species. This is a positive outcome directly tied to the ripping treatment on this site. Changes in annual forbs and grasses are for information only. Significant changes in these categories are dependent on the local climate conditions and vary greatly from year to year. They are not indicators of long term trend.

Photo 1. Key Area F2, November 18, 2004, Hook Open A Ranch.

Key Area F3

Table 3. Percent Ground Cover, F3.

	2001	2003	2004
Ground Cover	(%)	(%)	(%)
Bare Ground	57.5	93.5	64.5
Rock	12.5	2.0	18.5
Litter	24.0	4.0	16.0
Vegetation	6.0	0.5	1.0

Similar to Key Area F2, bare ground increased significantly during 2003. Again, there is a correlation between having less litter recorded that particular year which may have been due to annuals being removed by winds. The decrease in basal vegetation cover, while not significant, is most likely due to the decrease in frequency of black grama (which is significant).

Table 4. Percent Frequency, F3.

	2001	2003	2004
Species	(%)	(%)	(%)
Perennial Grasses			
Black grama	70.0	35.5 *	32.5
Blue grama	2.0	0	3.0
Hairy grama	0.5	0	0
Green sprangletop	0	0	0.5
Three-awn	0	0	0.5
Perennial Forbs	0	1.0	1.0
Silverleaf nightshade	0	4.5	7.5
Globemallow	0	0	1.5
Trees and Shrubs			
Shrubby buckwheat	11.5	3.5	7.5
Burroweed	18.5	17.5	21
Snakeweed	14.0	7.0 *	12.0
Mesquite	6.5	0.5	2.5
Soaptree yucca	0.5	0.5	1.0
Wolfberry	0	0	0.5
Annual Forbs	69.5	11.5	21.5
Annual Grasses	24.0	16.0	42.5

* denotes change at P = 0.95; 200 quadrats. Note: Frequency values from 1-10% and 90-100% only indicate species presence; therefore change at these levels was not evaluated. Caution is applied when interpreting change between levels of 10-20% and 80-90%. These cautions are due to the sensitivity of the method used.

Two significant changes were found in 2003. Black grama decreased from 70% to 35.5% frequency and snakeweed decreased from 14% to 7%. The snakeweed increased again in 2004 to match the 2001 level and shows a stable trend for that species. However, in the case of black grama, the percent frequency remained at the lower percentage rate which indicates a significant decrease in this species. This may be attributed to the prolonged drought that southeastern Arizona has been experiencing. Similar decreases can be found on other ranches in the area. This is a key species that will need to be watched during future monitoring. Changes in annual forbs and grasses are for information only. Significant changes in these categories are dependent on the local climate conditions and vary greatly from year to year. They are not indicators of long term trend.

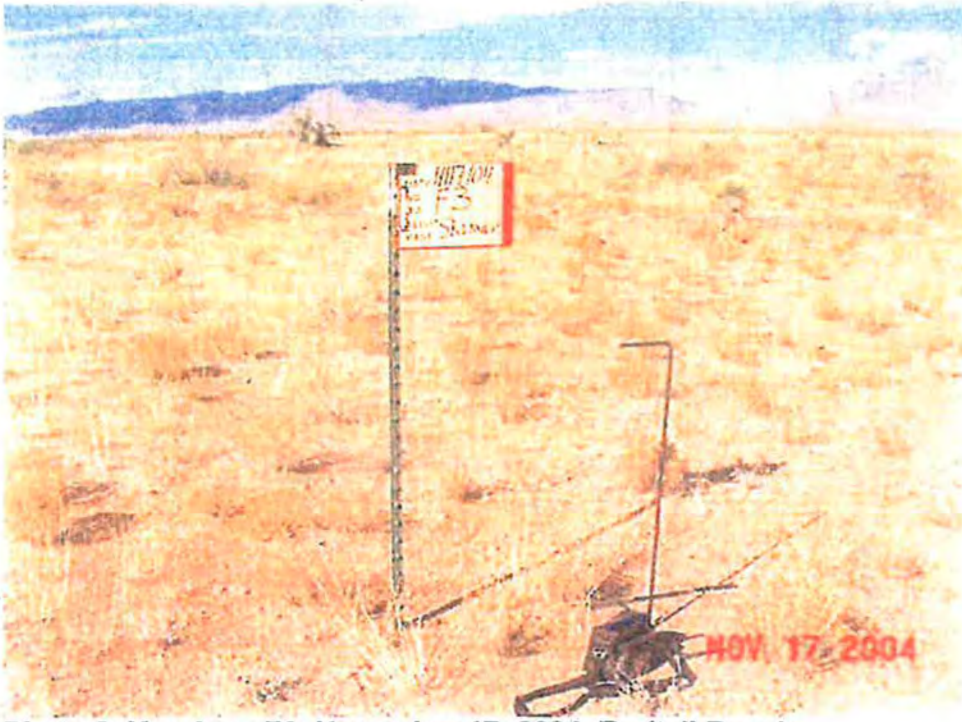
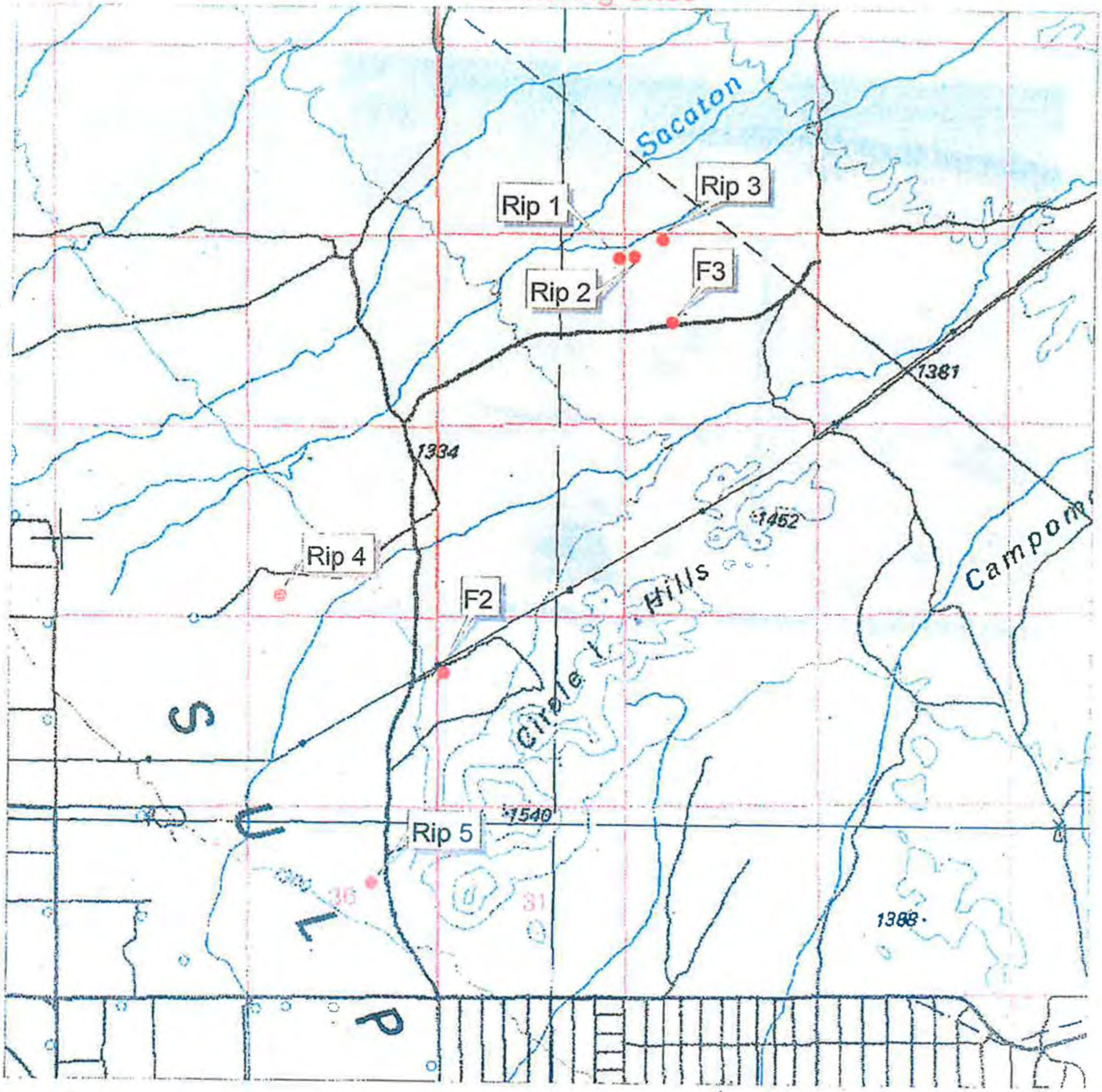


Photo 2. Key Area F3, November 17, 2004, Redtail Ranch.

Monitoring Sites



LOCATION MAP

Scale 47713.8

1 0 1 Miles

1 0 1 Kilometers

LAND STATUS LEGEND

Private

State

Species List - Campomocho/Sacaton Project
(alphabetical by common name)

Common Name	Scientific Name	Symbol
Grasses & Grass-like		
Arizona cottontop	*Digitaria californica*	Dica
bush muhly	*Muhlenbergia porteri*	Mupo
black grama	*Bouteloua eriopoda*	Boer
blue grama	*Bouteloua gracilis*	Bogr
hairy grama	*Bouteloua hirsuta*	Bohi
Lehmann lovegrass	*Eragrostis lehmanniana*	Erle
green sprangletop	*Leptochloa dubia*	Ledu
plains bristlegrass	*Setaria macrostachya*	Sema
sacaton	*Sporobolus wrightii*	Spwr
sand dropseed	*Sporobolus cryptandrus*	Spcr
threeawn	*Aristida* spp.	ARIS
Perennial Forbs		
globemallow	*Sphaeralcea ambigua*	Spam
silverleaf nightshade	*Solanum elaeagnifolium*	Soel
Shrubs & Trees		
burroweed	*Haplopappus tenuisectus*	Hate
catclaw acacia	*Acacia greggii*	Acgr
desert zinnia	*Zinnia acerosa*	Ziac
mesquite	*Prosopis juliflora*	Prju
shrubby buckwheat	*Eriogonum wrightii*	Erwr
snakeweed	*Gutierrezia sarothrae*	Gusa
soaptree yucca	*Yucca elata*	Yuel
wolfberry	*Lycium pallidum*	Lypa

Ripped Areas

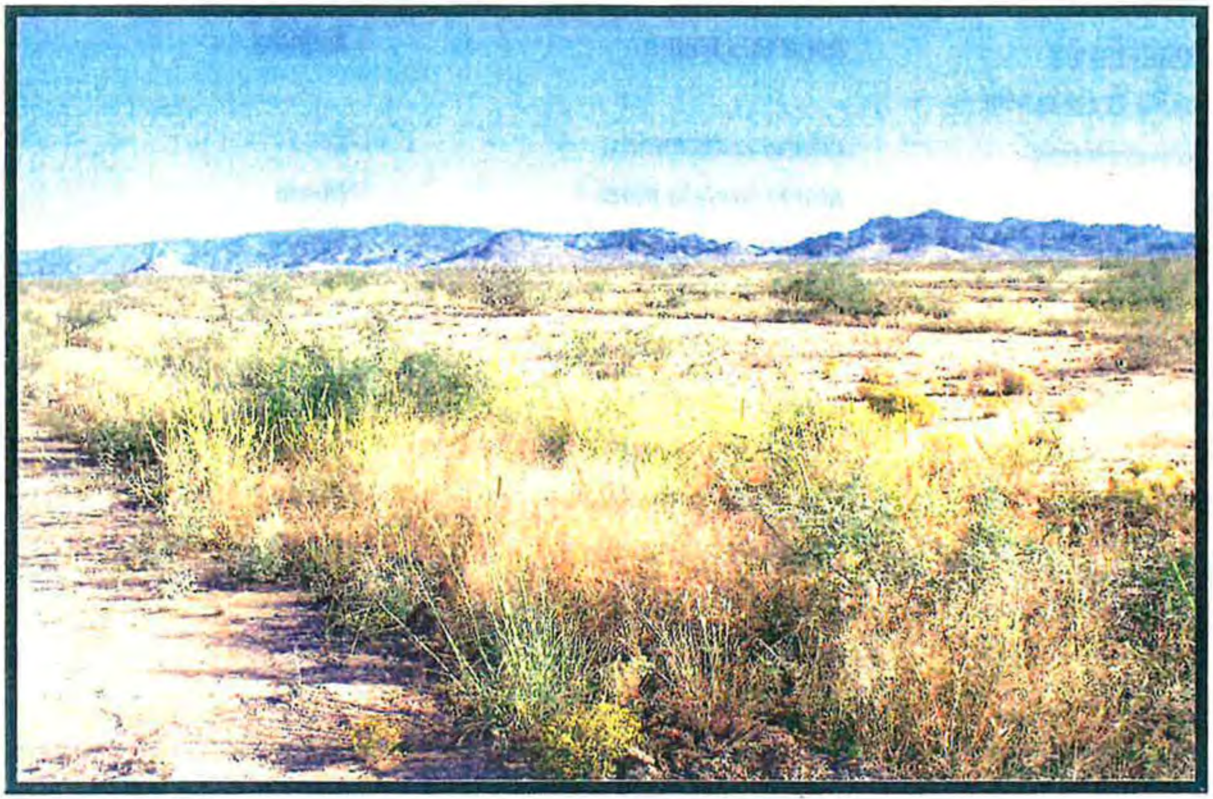


Photo 1

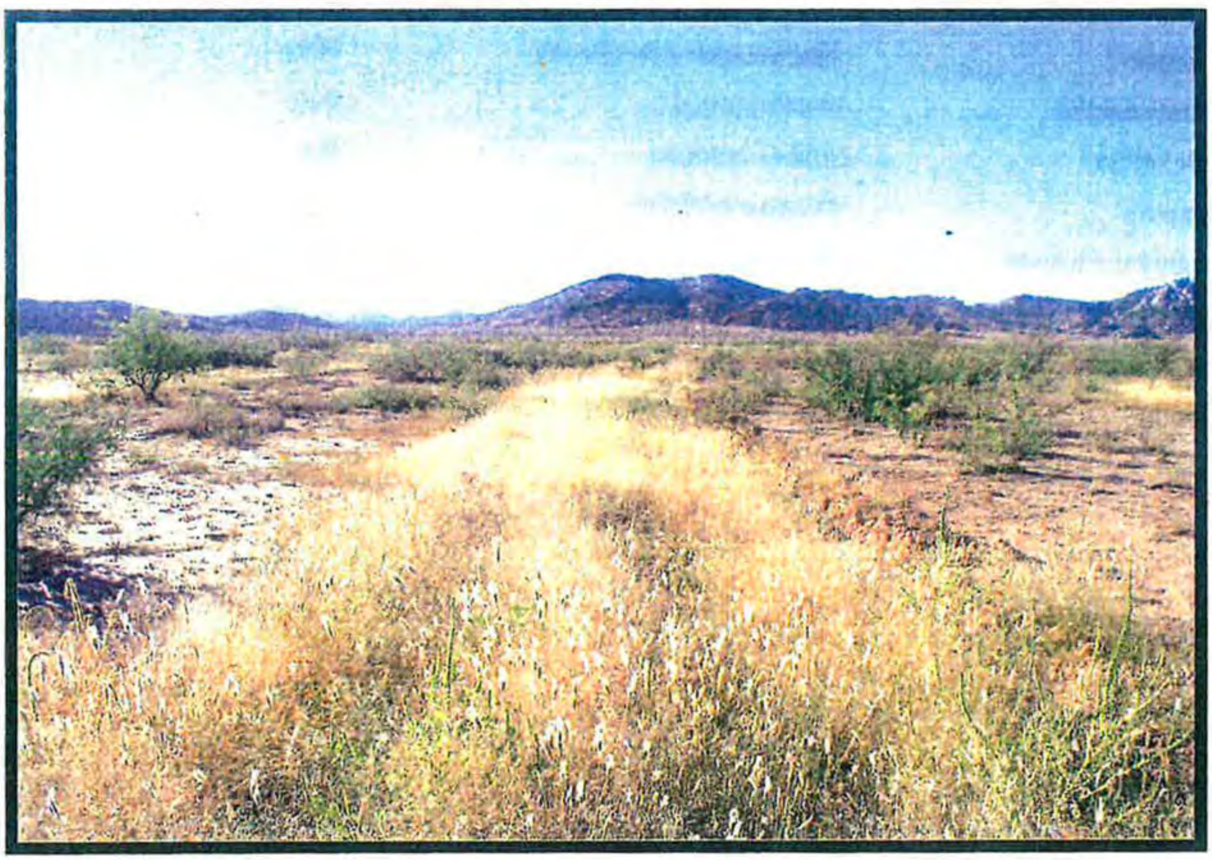


Photo 2

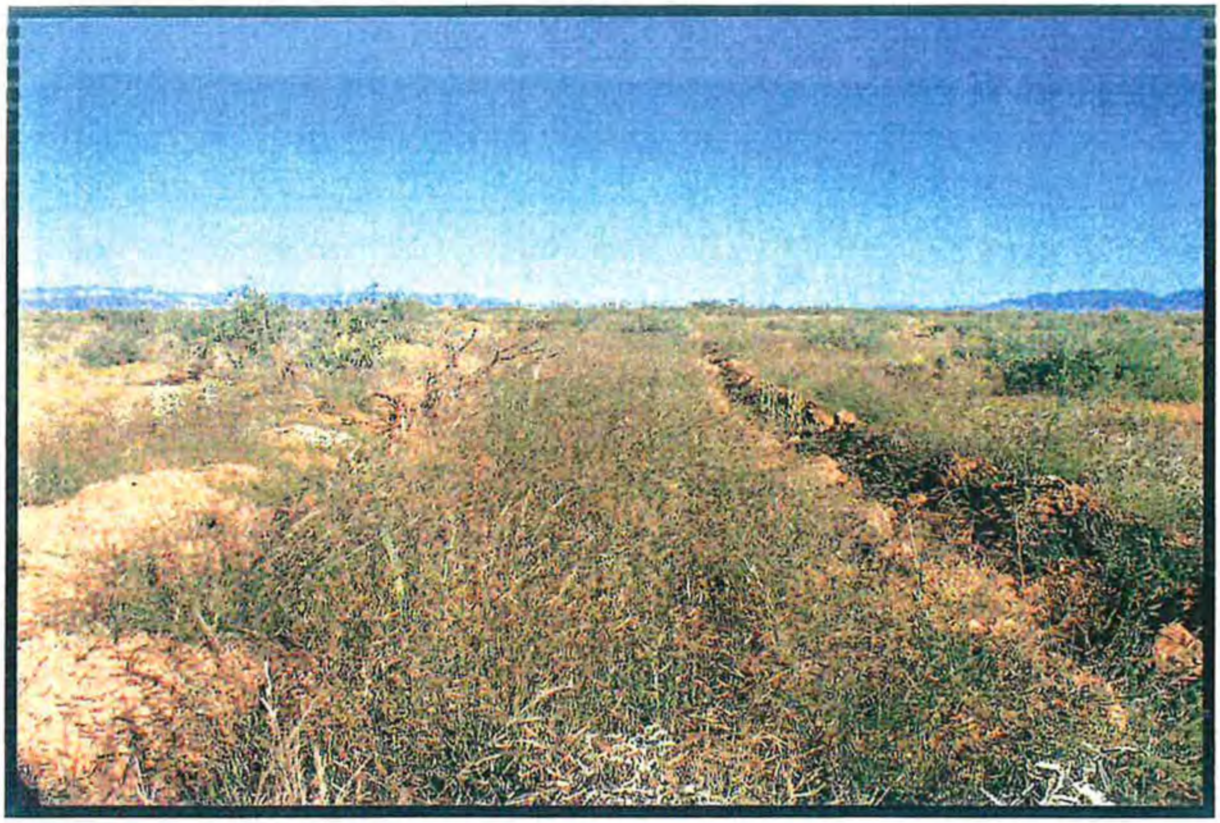


Photo 3

Photo 4

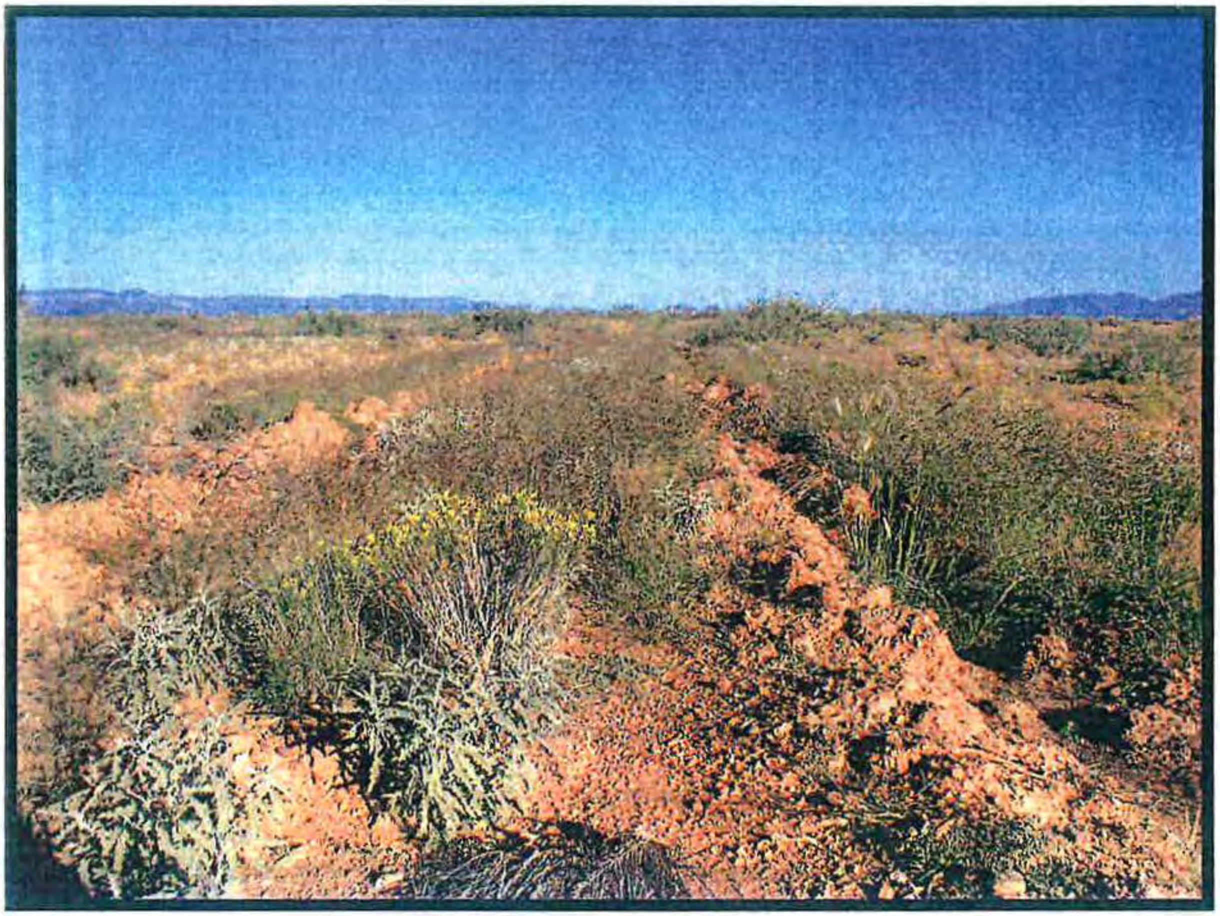


Photo 5