



MEMORANDUM

Director's Office
Regional Flood Control District



DATE: September 4, 2007

TO: C. H. Huckelberry
County Administrator

FROM: Suzanne Shields, P.E.
Director and Chief Engineer

SUBJECT: Tortolita Fan Preserve

On March 7, 2007, you directed staff to delineate the areas of greatest hazard in the Tortolita piedmont north of Tucson. In addition, you directed me to form an interdepartmental and interagency team to define the best possible boundaries for a proposed Tortolita Fan Preserve.

A draft report on the designation of a Tortolita Fan Preserve is attached for your review. Contributors to the report include Linda Mayro of Cultural Resources, Julia Fonseca, Lynn Orchard, Neva Connolly, Evan Canfield and Annette Plicato of the Regional Flood Control District, and Kerry Baldwin and Steve Anderson of Natural Resources, Parks and Recreation. At this time, Marana has not seen the report; however, we have exchanged GIS map layers and information.

This report demonstrates that the potential for a national preserve designation for the Tortolita Fan rests largely upon the combination of extensive Hohokam-era archeological sites combined with its intact watershed hydrology; the two are intrinsically linked. The Hohokam occupants exploited the floodwaters and rushed down across the fan surface for their farm fields and constructed settlements near arroyos. "Rockpile fields" upon the uplands still hold cobble mulches, contour terraces and check dams for plantings of drought-resistant agave. It is suggested that the name of the preserve include the fan designation to draw attention to the geomorphic features that were exploited by these early residents. This landscape has lessons for modern communities learning to adjust their footprints to varying conditions of drought and flood. Staff recommends exploring a *National Register* designation for an archeological district encompassing approximately 50 square miles linking the Tortolita Fan Preserve to the Los Morteros site.

Staff recommends that the local jurisdictions play a significant role, if not the primary role, in the actual implementation of long-range management objectives for the future preserve. Staff has reviewed the recommended preserve boundaries prepared by the Town of Marana (shown in pink on the attached map). The proposed preserve boundaries overlap with the 1997 proposed Tortolita Mountain Park boundaries approved by the Board of Supervisors, but not with the existing Mountain Park (shown in green). Please advise whether adjustments to the planning boundaries are needed. Staff would recommend that the more mountainous portions of any acquired lands be administered by Pima County as part of the Mountain Park.

SS/TJH/jf
Attachment

cc: John Bernal, Deputy County Administrator – Public Works
Rafael Payan, Director – Natural Resources, Parks and Recreation
Linda Mayro, Cultural Resources Manager
Thomas Helfrich, Manager – Water Resources Division
Julia Fonseca, Environmental Planning Manager – Water Resources Division

Tortolita Alluvial Fan Potential Designation of a Preserve for Natural and Cultural Resources

September 4, 2008

Historical Overview

Conservation of the Tortolita Alluvial Fan landscape has been promoted by Pima County and Town of Marana through a series of actions over the past two decades. In the 1980s, Pima County recognized the uniqueness of the Tortolita areas and acquired land for the Tortolita Mountain Park. The County also realized the special flood hazards posed by the distributary flow paths of watercourses in the piedmont of the Tortolita Mountains. In the 1980's and 1990's, Pima County Regional Flood Control District (District) commissioned innovative flood studies that attempted to map these hazards. Additional studies by Arizona Geological Survey improved our understanding of flood risks using soil data to define areas of active flow.

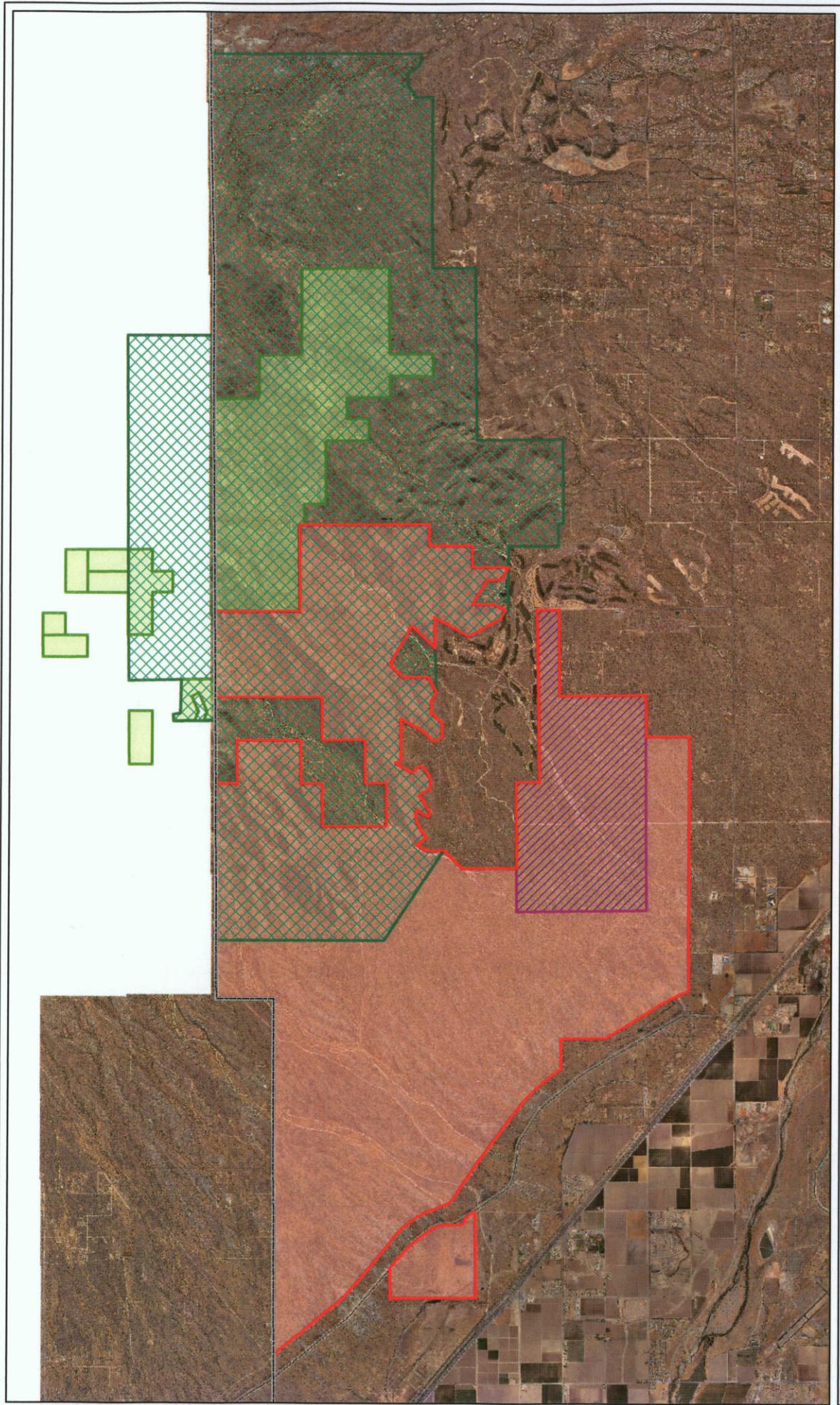
During the mid-1990s Pima County and Marana developed a tacit understanding that much of the piedmont should not be developed due to the excessive cost of providing infrastructure to the area. In 1999, Town of Marana sought the designation of an Ironwood National Monument for the entire area west of Interstate-10; however, this effort was never completed. The Town Manager sought the consolidation of these lands under aegis of the U.S. Bureau of Land Management. Currently, the Town leases the 2,399 acre Tortolita Preserve from State Land Department under a 99-year lease. The area is used for environmental education, recreation and preservation.

The Coalition for Sonoran Desert Protection proposed creation of a preserve on the Tortolita Fan for the benefit of the cactus ferruginous pygmy-owl and other wildlife species. In 2003, the Arizona State Land Department reclassified to conservation status 4,519 acres of State Trust Land surrounding the Tortolita Mountain Park.

Current Study

An interdepartmental team from Pima County and the Town of Marana was formed to evaluate flood and debris flow hazards on the Tortolita Alluvial Fan and the potential to create an expanded Tortolita Fan Preserve (see Appendix 1). The area of the study is located east of the Central Arizona Project (CAP) canal, and north of Moore Road, at the foot of the Tortolita Mountains north of Tucson (Figure 1). The area includes an existing preserve, comprised of 2,399 acres directly west of Dove Mountain on state land leased by Town of Marana,

This report provides an overview of the alluvial fan characteristics and evaluates information on the significance of the biological and cultural resources of the Tortolita Alluvial Fan to determine if the area meets the criteria to create a federal preserve.



**TORTOLITA MOUNTAIN PARK/
TORTOLITA RESERVE
BOUNDARY OVERLAP**

Figure 1: Study Area
for the Tortolita Alluvial Fan

-  Existing Tortolita Preserve (Marana)
-  Proposed Tortolita Reserve
-  Tortolita Mountain Park Board Adopted 1997
-  Tortolita Mountain Park County-Owned Land



Y:\Woods\11662006_project\Tortolita_Planning_BoundaryOverlap.mxd © Tortolita 2/2007

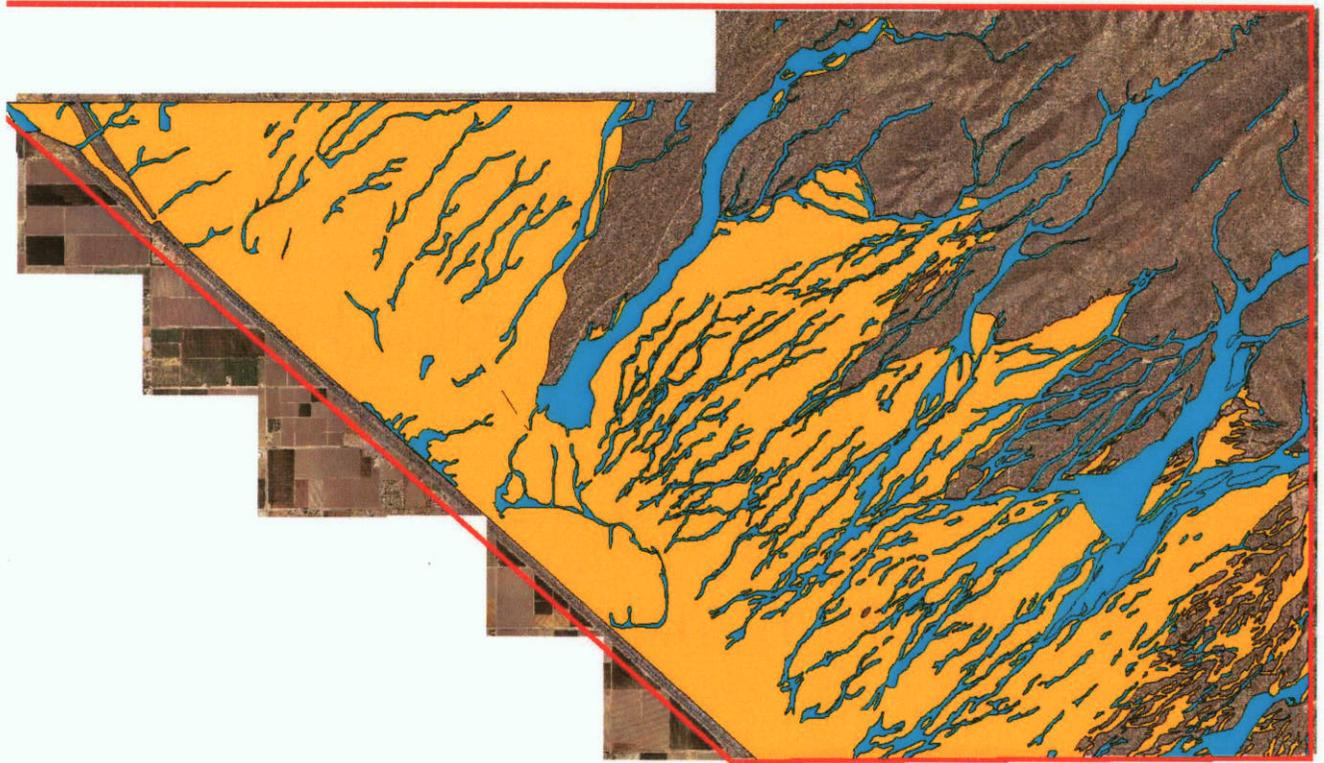
Hydrology and Geomorphology

The Tortolita Alluvial Fan is a classic example of a mountain-front desert piedmont sloping west from the Tortolita Mountains towards the Santa Cruz River. Desert piedmonts are typically covered with alluvial (stream) deposits derived from the nearby mountains and may contain areas of active alluvial channels. The piedmont west of the Tortolita Mountains is comprised of dozens of coalescing alluvial fans of various ages and degrees of geomorphic activity (Pearthree, 1992).

As streams leave the steep mountain channels and enter the piedmont area they encounter a relatively shallow slope. The change in slope causes streams to slow down and deposit the sediment they are transporting. This deposition may occur gradually creating the characteristic alluvial fan or in large storm events, more violently, as a debris flow. As channels fill with sediment, the stream will often change course, which allows sediment coming out of the mountains to be distributed in many different directions, and the 'fan' structure is created.

Mapping by the Arizona Geological Survey (House, 1991 and Pearthree, 1992) indicates that much of the Tortolita Alluvial Fan is developed on materials less than 2,000 years old. The relative lack of topography prevents the stream from being confined to any particular area of the fan, and as a result, areas that are seemingly far from active stream channels can rapidly become active flooding areas. Channels tend to be distributary in nature, splitting and coming back together as flows move down slope. The channels on the center and lower portions of alluvial fans tend to be too small to carry the flow and sheet flood conditions occur.

Flood hazards in alluvial fan areas are difficult to define and flooding and erosion problems can be substantial and nearly impossible to adequately address from an engineering standpoint. Figure 2 is a composite map showing the relative flood hazards on the Tortolita Fan.



Project limits.shp
High flood hazard area
Moderate flood hazard area

Tortolita Fan Flood Hazard Areas



Figure 2: Tortolita Fan Flood Hazard Areas. Yellow is moderate flood hazard and blue shows the higher flood hazard associated with active channels.

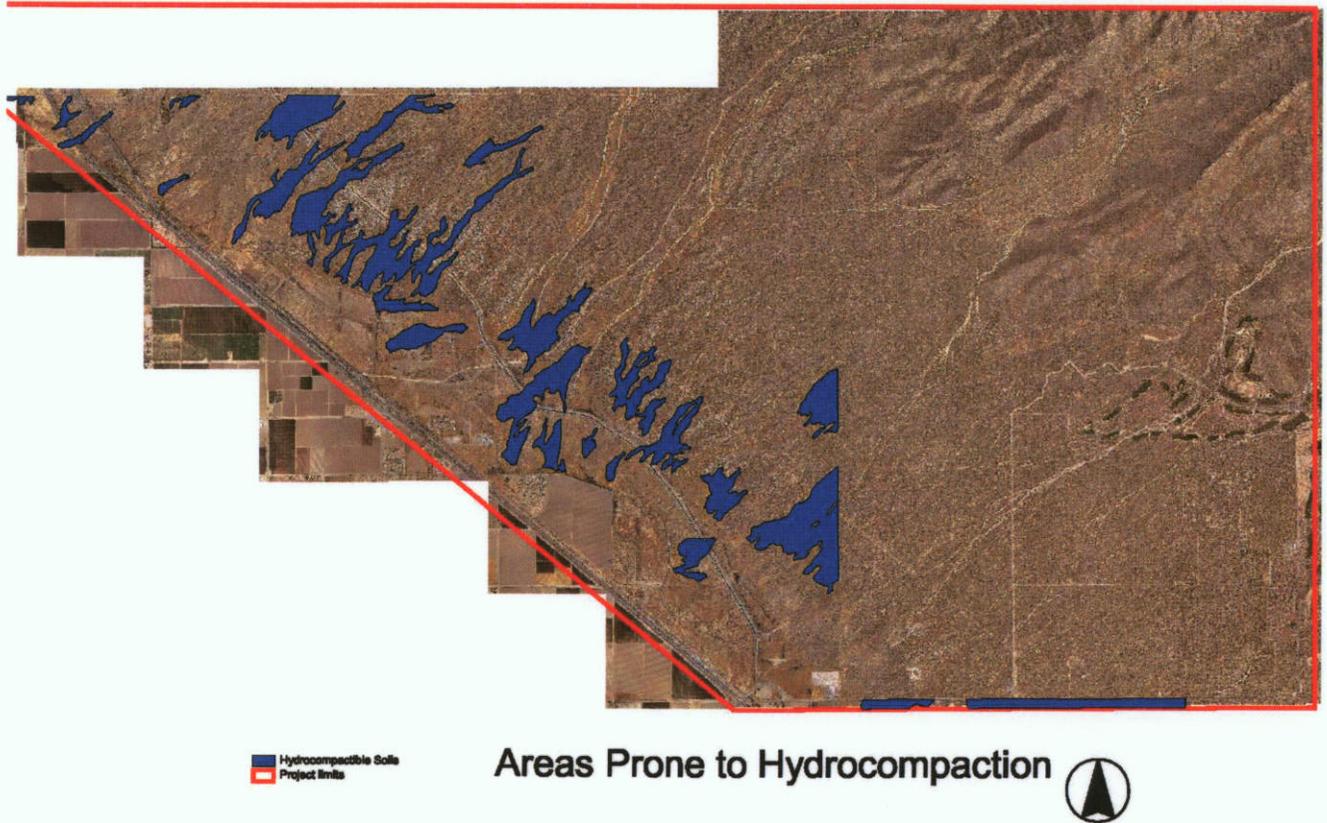


Figure 3. Areas with soils that are prone to hydrocompaction.

In addition to flood hazards, alluvial fans in arid regions are often susceptible hydrocompaction. Hydrocompaction is a condition where water action causes reorientation of clay and silt grains and allows coarser particles supported in the silt/clay matrix to settle into a more compact configuration. Hydrocompaction along the Tortolita Fan became apparent in the mid-eighties during the construction of the Central Arizona Project (Slaff, 1986). The soil groups associated with hydrocompaction along the Tortolita Fan were identified and are shown on Figure 3. While the presence of hydrocompactible soils does not preclude development, it does require geotechnical engineering evaluations for structures built in these environments.

The proposed Tortolita Fan Preserve will protect the core area of the prehistoric Marana Community, a key set of Hohokam archaeological sites, along with the land and natural resources that sustained its inhabitants. After A.D. 750, the Hohokam typically organized their settlements into territorial units that archaeologists call “communities.” These communities consisted of a larger central village with public buildings surrounded by smaller outlying settlements, fields, and zones with natural resources. Because Hohokam communities are sizeable and tend to coincide with favorable locations for modern land use, they are seldom preserved or archaeologically recorded in their entirety.

The 55 square mile Marana Mound Community, named after today’s nearby town, is unique in southern Arizona because the sites within it have largely escaped the destructive effects of vandalism, mechanized agriculture, and urban development until recently (Figures 4).

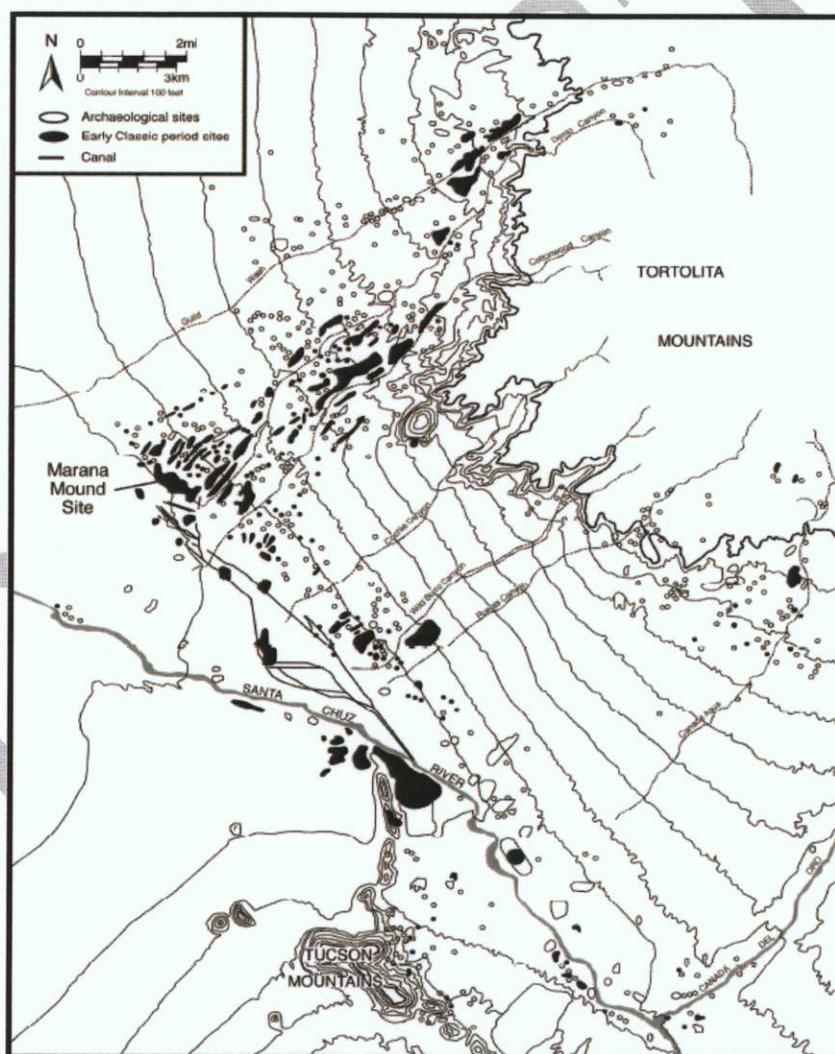


Figure 4. The Marana Mound Community on the Tortolita Fan

The Marana Community as a whole is an especially valuable cultural resource because intensive survey has comprehensively located the archaeological remains within its boundaries. Ongoing study is yielding important insights into how the Hohokam sustained an evolving agricultural society over many centuries in desert basin environments.

Well preserved Marana Community patterns of residence and farming that span the Tucson Basin demonstrate the diversity and productivity of Hohokam farming and other subsistence strategies in response to the opportunities and challenges of their Sonoran Desert setting. Remnants of canals show that irrigators transported water for crops and domestic supplies over six miles from headings on the Santa Cruz River.

Farmers of the settlements clustered near arroyos and alluvial fans practiced floodwater farming with the rushing flows from summer storms. Intact “rockpile fields” on dry mid-basin slopes still

hold the piled cobble mulches, contour terraces, and check dams for plantings of drought-resistant agave. The revelation of agave’s major role in Hohokam food and fiber production, in addition to the better known crops of corn, beans, squash and cotton, stems from the Marana Community’s unparalleled evidence for ancient agriculture on a landscape scale (Figure 5).

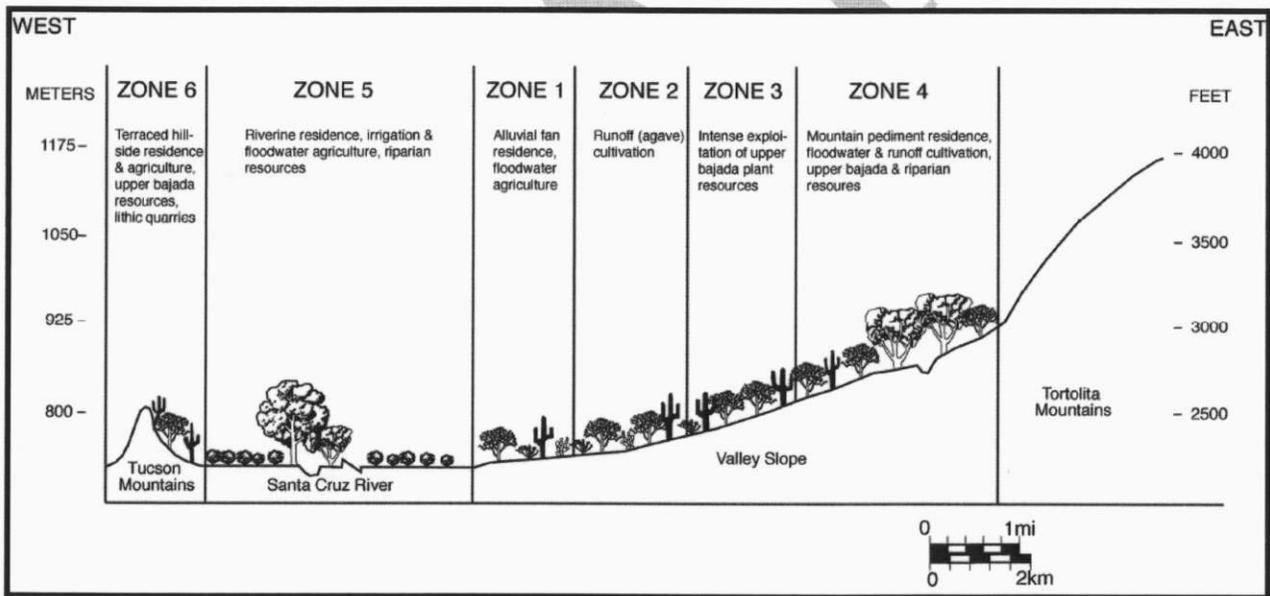


Figure 5. Tortolita Fan Zones used by the Marana Mound Community

The central village, the Marana Mound site, represents a further unique aspect of the community. This center was established after A.D. 1150, during the Hohokam Classic period when local

population was at its height. Roughly 1000 persons lived in 35 to 40 walled adobe compounds, each enclosing the houses of up to five or six households (Figure 6).

Because this square-mile sized central village has never been substantially disturbed, its layout can be mapped in rare detail. Equally rare is the current condition of its raised earthen platform mound, four adobe structures on its summit, and several other adjacent buildings.



Figure6. Walled Adobe Compound in the Marana Mound Community

As the ceremonial and civic heart of the community, the mound precinct holds critical clues to trends toward social differentiation and complexity in Classic period Hohokam society. Mound center residents produced more ornaments and other craft goods than did their neighbors at outlying locations, indicating a degree of economic specialization among community members.

The interrelated sites of the Marana Community, together with their natural settings across the Tortolita slopes, gain in irreplaceable scientific and historical value as urban development advances north of Tucson. The Tortolita Fan Preserve offers a unique and perhaps only opportunity in this area to conserve in its entirety the societal and environmental context of Hohokam solutions to a long-enduring Sonoran Desert lifestyle.



Figure 7. Artist's Rendering of the Platform Mound and Residential Compounds of the Marana Community

Tortolita Fan Ecology

The Tortolita Fan area has a high degree of biological integrity, and is notable for the diversity and quality of the natural resources that exist there. Primarily undeveloped Sonoran Desert bajada with large tracts of ironwood forests, the Tortolita Fan also contains stands Sonoran mixed cacti and palo verde, mesquite and xeroriparian areas with native grasses and shrubs and has a minimal number invasive species (see attached Plant List, Appendix 2).

The ironwood tree is a keystone species, a species that has a disproportionate influence over its surroundings. The ironwood acts as a nurse tree, harboring a great variety of plant and animal species (see Appendix 3). These trees provide safe sites for seed dispersal, seedling and sapling protection, and act as prey refugia for reptiles and small mammals. One study found that the

presence of ironwood in desert scrub can increase the number of bird species by 63 percent (ASDM, 2000).

The Tortolita fan area contains significant habitat for the recently delisted cactus-ferruginous pygmy owl, as well as important habitat for several bat species, including the federally endangered lesser long-nosed bat, and the Sonoran desert tortoise.

Priority vulnerable species with habitat in the Tortolita Fan area include the Tucson shovel-nosed snake, and the ground snake, both facing threats due to habitat loss. The Tucson shovel-nosed snake has been petitioned for protection under the Endangered Species Act, and has high valued habitat along the western edge of the Tortolita Fan.

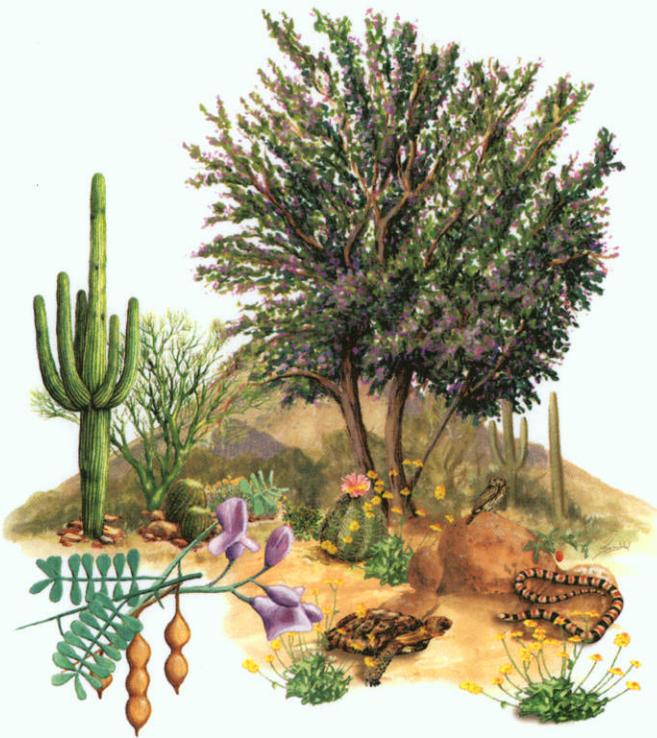


Figure 8. Examples of Tortolita Fan Habitat

Other species found in the proposed preserve area include the peregrine falcon, mountain lion, javelina, mule deer, and a wide array of birds and reptiles (Pima County, 1999). Several species of arid-adapted snails are found in the area (Bequaert, 1973). The Tortolita Mountains are also home to a small herd of wild horses.

Recreation

The Tortolita Fan area and the western portion of the Tortolita range are rich in recreational resources. The area is popular with hikers, mountain bicyclists and equestrians. Off-highway vehicle users (ATVs and motorcycles) and recreational shooters are also active in the area.

Key recreational features in the area include:

Tortolita Mountain Park. Immediately east of the proposed preserve is Pima County's Tortolita Mountain Park, which was established in 1986. Now 3,500 acres in size, the park was master planned in 1996-97, and is planned to grow to encompass more than 20,000 acres. A sizable portion of the Tortolita range is located in southern Pinal County, which provides opportunities for the park to grow to the 50,000 acre mark and beyond. Pinal County's new open space and trails plan includes a large expansion of the park into Pinal County. Pima County is presently working to prepare a new trails plan for Tortolita Mountain Park, which will create a wide range of outstanding new opportunities for non-motorized trail users, and could link into the new preserve. The existing master plan would utilize Cochie Canyon Road as a motorized access.

Marana Tortolita Preserve. This 2,400-acre preserve owned by the Town of Marana is located in the southeast portion of the alluvial fan area and includes a shared-use trail system that is popular with equestrians, hikers and mountain bicyclists. The Preserve will be linked to the regional trail system via the Wild Burro Wash Trail.

Eastern Pima County Trail System. A number of trails and proposed trails pass through the proposed preserve area. These trails include:

The CAP National Recreation Trail (Trail #3). The CAP canal right-of-way also includes a National Recreation Trail, the CAP Trail, which was designated by the U.S. Secretary of the Interior in 2003. When constructed, the trail will follow the CAP canal through Pima County and north into Pinal County and beyond. Opportunities to create additional recreational loop trails also exist within the federal "green-up" areas of natural open space located immediately east of the canal, some of which are in excess of 1,000' in width.

Tortolita Foothills Trail, Trail #167. This proposed trail extends 16 miles from west to east across the southern foothills of the Tortolita Mountains. Its feasibility is unlikely given the large amount of private property in this part of the range, but segments of the trail are possible and may link to other trails inside Tortolita Mountain Park.

Cottonwood Wash Trail, Trail #32. The Cottonwood Wash Trail is 4.5 miles in length, and connects the CAP Trail to the Tortolita Mountains.

Wild Burro Wash Trail, Trail #36. When constructed, the Wild Burro Wash Trail will be approximately 5.5 miles in length, and will stretch from the CAP Trail to Wild Burro Canyon and the Tortolita Mountains.

Power Line Trail, Trail #179. The Power Line Trail is 9.9 miles long, and extends from I-10 approximately 1.5 miles south of Tangerine Road to the Pima-Pinal county line and beyond.

Wild Burro Road, Trail #178. This road right-of-way trail is one mile long, and stretches from Moore Road north to the Tortolita foothills.

Moore Road alignment, Trail #171. The six-mile long segment of the Moore Road right-of-way trail extends from La Canada Drive on the east to Wild Burro Drive on the west.

Tangerine Greenway. A shared-use greenway corridor approximately 12 miles long intended to serve walkers, hikers, roller bladers, equestrians, and bicyclists is planned for the north side of Tangerine Road. The greenway will be developed to the County's dual-path Divided Urban Pathway Standard, and will link with the CAP Trail.

Dove Mountain Trail System. The 6,200-acre Dove Mountain development, situated in the southwestern foothills of the Tortolita Mountains, has developed a recreational trail system in conjunction with the Town of Marana in and around Wild Burro Canyon. These trails will ultimately be linked to the regional trail system and Tortolita Mountain Park.

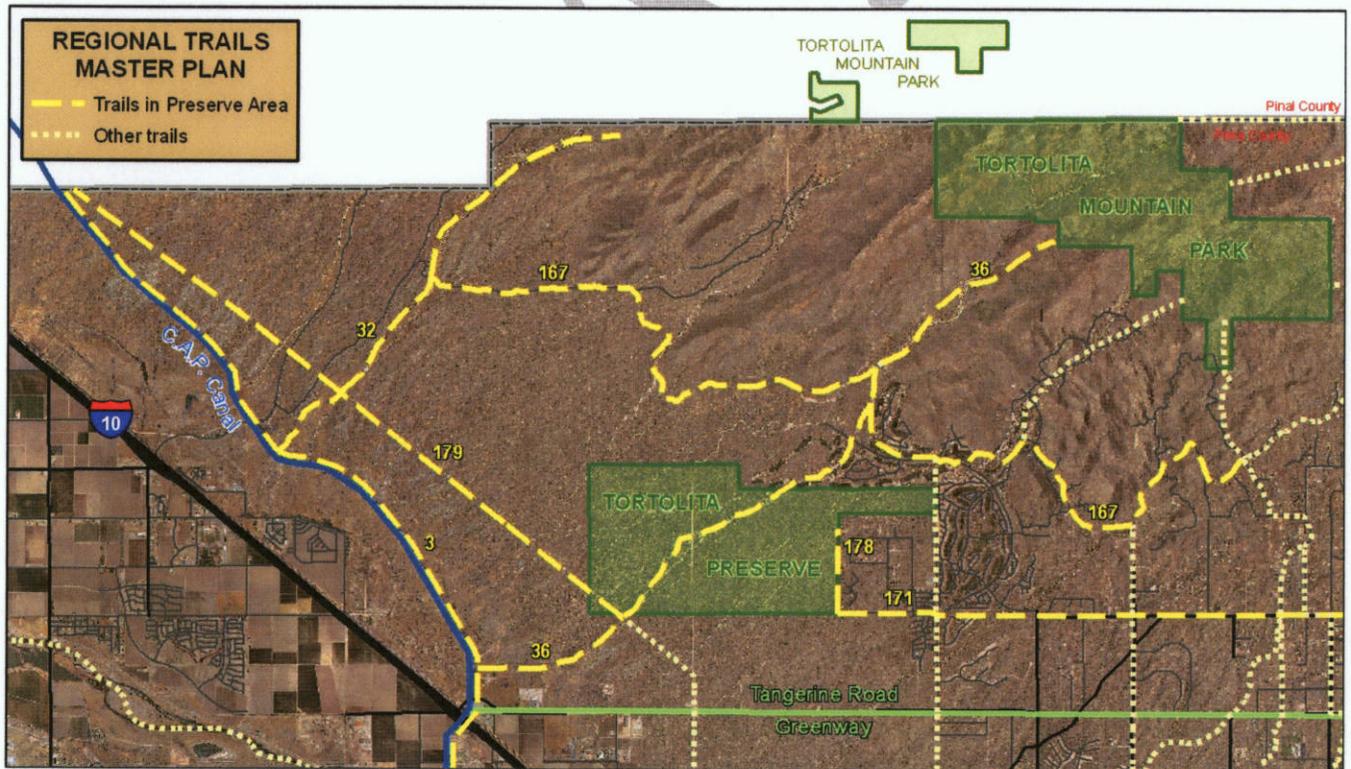


Figure 9. Regional Trails Master Plan, with trail numbering system.

Potential Public Preserve Designation

To be eligible for consideration as part of the National Park System, an area must possess significant natural, cultural or recreation resources as well as be suitable and feasible to manage. The four criteria necessary to demonstrate a national significance are:

- Outstanding example of a particular resource.
- Exceptional quality illustrating, or interpreting, natural and cultural themes.
- Opportunities for recreation for public use and enjoyment, or scientific research.
- Retains a high degree of integrity as an unspoiled example of the natural or cultural resources.

The Tortolita Alluvial Fan contains a number of significant archeological and historic resources including the Marana Mound. These cultural and historic resources form a cohesive, distinctive landscape shaped by the geography of the alluvial fan and drainage patterns. The Tortolita area also has a high degree of unspoiled biological integrity.

The potential for a national preserve designation for the Tortolita area rests largely upon the combination of extensive Hohokam-era archeological sites combined with its intact watershed hydrology. The two are intrinsically linked. The Hohokam occupants exploited the floodwaters that rushed down across the fan surface for their farm fields, and constructed settlements near arroyos. "Rockpile fields" upon the uplands still hold cobble mulches, contour terraces and check dams for plantings of drought-resistant agave.

Designation Options

There are a variety of special federal designations available to expand and secure the Tortolita Fan Preserve. These include Presidential designations such as a National Monument, made under the authority of the Antiquities Act of 1906. In addition, there are many kinds of Congressional designations (Appendix 4). Of these, a National Conservation Area is probably most appropriate. Such designation could be recommended to U. S. Bureau of Land Management through the Resource Management Plan process now underway. Given that the land is wholly owned by the State Trust, a land trade or purchase would be needed to assure protection.

Changing the ownership of the land is essential. There is no conservation mechanism for State Trust lands. Federalizing the ownership would be a significant conservation benefit toward Marana's Habitat Conservation Plan under Section 10 of the Endangered Species Act. Although the pygmy-owl is not currently a listed species, the area is used by the endangered Lesser Long-nosed bat. Additionally, future federal listings may occur.

There would be substantial public support for a Tortolita Fan Preserve, as evidenced by the Coalition for Sonoran Desert Protection's 2003 proposal for a preserve located in the Tortolita Piedmont (Their proposal is accessible on the web at <http://www.sonorandesert.org/coalition-reports/tortolita-fan-preserve-may-2003>). The Coalition consists of 39 member groups. Those

Pima County has also supported the SCVNHA to facilitate the development of sustainable tourism in the Santa Cruz Valley focused on its natural and cultural assets and traditional land uses including ranching. Creation of the Tortolita Fan Preserve and Congressional designation of the SCVNHA would be entirely consistent with this goal and create economic opportunities that do not conflict with the goals of conservation.

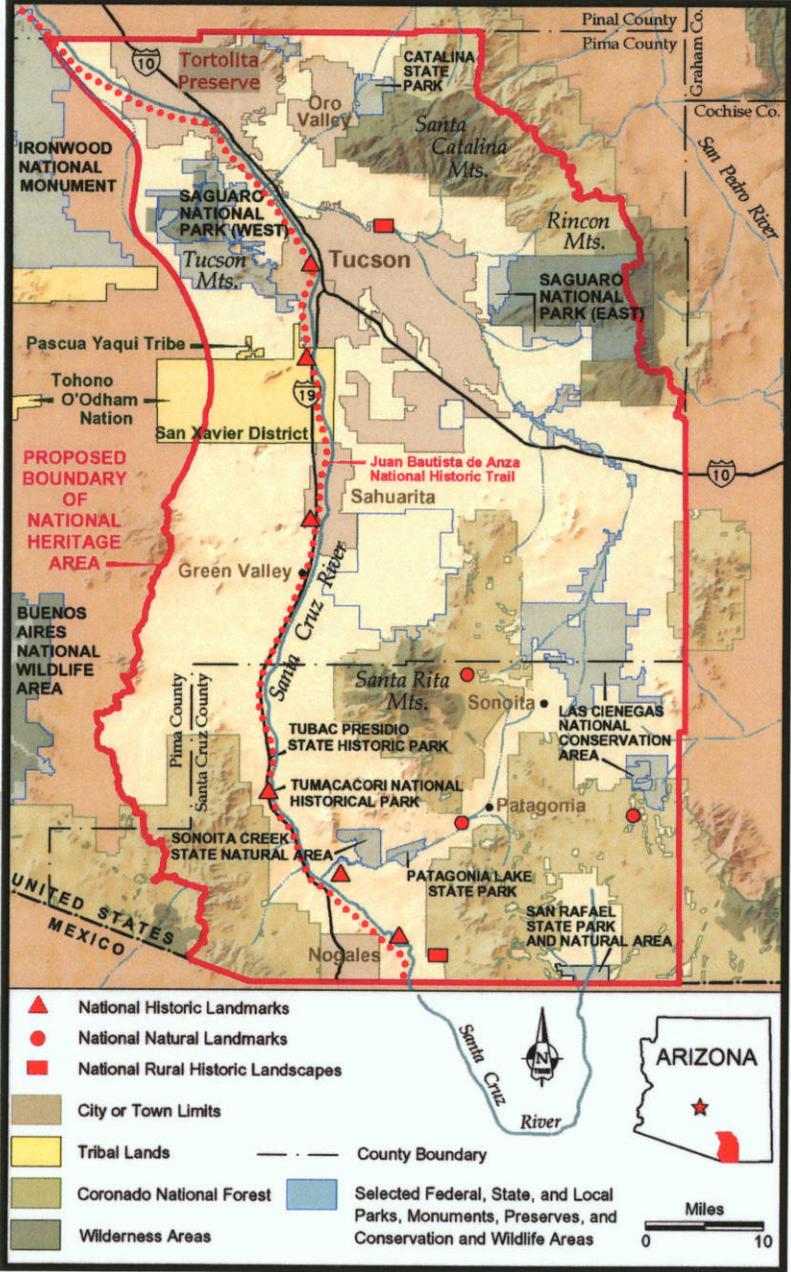


Figure 11. Proposed Santa Cruz Valley National Heritage Area Management Potential

The foregoing sections demonstrate ample values supporting conservation and protection of the area. In addition, the area is of sufficient size and appropriate configuration to ensure long-term protection of the resources and to accommodate public use. The Tortolita Fan has the potential for efficient administration at a reasonable cost. A portion is already administered by Town of Marana, and the adjacent Tortolita Mountain Park is managed by Pima County.

That being said, current access and diverse traditional and current public uses the area will present future management challenges. As with any park or preserve, a strategy of just designating it as a "protected" area will not be enough. Concurrent with any designation has to be establishing a viable management structure.

Staff recommends that the local jurisdictions play a significant role, if not the primary role, in the actual implementation of long-range management objectives. The Federal government has scarce funding and overtaxed staff. When they have been more successful it can often be directly traced back to the strong role and commitment of the local partners.

The CAP corridor may offer a management model. The CAP corridor is federally owned; however U. S. Bureau of Reclamation has delegated management responsibility to Central Arizona Water conservation District, a state entity that operates the canal. While the use of the CAP is primarily for water supply, other considerations, such as conservation/ecological values and public recreation, are also elements of its management program.

For the Tortolita Fan Preserve, local partners could consider local solutions to assist in the management and conservation of the land's ecological and cultural values. To ensure these lands are well-monitored and managed on a day to day basis, it may be desirable to enter into a cooperative agreement with a rancher. The Tortolita Fan Preserve lands are currently comprised of a number of grazing leases, and infrastructure exists to continue this land use.

Recommendations

It is recommended that Marana and Pima County pursue a nomination to the National Register of Historic Places for an approximately 50 square mile archeological district due to the significant and extensive archaeological remains of the Marana Mound Community throughout the Tortolita Fan and its relationship to Los Morteros along the Santa Cruz River.

Congressional designation of the Tortolita Fan as a National Conservation Area is also recommended. Such designation could be recommended to U. S. Bureau of Land Management through the Resource Management Plan process now underway. Given that the land is wholly owned by the State Trust, a land trade or purchase would be needed to assure protection.

References

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- Wiens, J., C.D. Bertelson, and J.A. Emmett. 2007. Partial Tortolita Mountains Plant Inventory. Tortolita Mountains; NW bajadas, canyons, & slopes; Cottonwood & Dry Canyons, 11/16/91 (w/ C.D. Bertelsen); Derrio Canyon; 12/98, 1/10/99; & upper Wild Burro Canyon, 2006-2007 (w/ J.A. Emmett); J. F. Wiens; updated 7/3/2007.

Preparers

Contributors to the text include Linda Mayro, Cultural Resources; Julia Fonseca, Lynn Orchard, Neva Connolly and Evan Canfield, Pima County Regional Flood Control District; and Kerry Baldwin and Steve Anderson of Pima County Natural Resources, Parks and Recreation Department. Annette Plicato assisted in compiling the report and John Regan and others at Pima County Geographic Information Systems assisted with spatial data needs. Bill Singleton, Graphic Design, provided illustrations for the report. John Wiens, of Arizona-Sonora Desert Museum, kindly contributed his unpublished plant list for the area.

DRAFT



Appendix 1

MEMORANDUM

Date: March 5, 2007

To: Suzanne Shields, Director
Regional Flood Control District

From: C.H. Huckelberry
County Administrator *CHH*

Re: **Attached Letter from the Town of Marana Regarding the Potential Development of a Public Preserve Encompassing Much of the Tortolita Alluvial Fan Floodplain**

As you know, much of the northwest area near the Tortolita Mountains is within the Tortolita Fan Alluvial Floodplain. This floodplain has been defined by flood insurance mapping of the Federal Emergency Management Agency and other local and Corps of Engineers studies. In addition, we now have specific knowledge related to the devastating effect of debris flows from the flooding of July 31, 2006. It would be appropriate to restudy the Tortolita Alluvial Fan Flood Area to clearly delineate those areas of greatest hazard for possible identification and set-aside as a public preserve through either annexation into Saguaro National Park, or creation of another monument in Arizona. Such would then provide the opportunity for a federal and state land exchange wherein the Bureau of Land Management or national park agency would gain control and ownership of the property and manage it for national park or national monument purposes. This is a very important planning endeavor that I would like to begin in consultation with the Town of Marana.

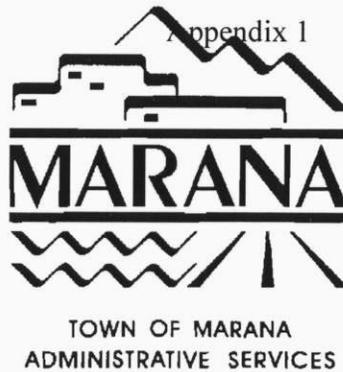
I would appreciate your forming an appropriate interdepartmental and interagency group to define the best possible boundaries for such a public preserve. I would suggest that staff of the Natural Resources, Parks and Recreation Department, our Cultural Resources Office, and Marana Town officials be involved in developing this proposal. It must be performed expeditiously to timely develop a request to Congress through our Congressional delegation for such an action. I would appreciate your developing an appropriate integrated and coordinated work plan with all those involved to develop such a proposal in an expedited manner.

In addition, I am assigning Nicole Fyffe of my office to coordinate those activities that may be necessary with the Congressional delegation and federal agencies in the development of this option. We will also discuss the matter with the Arizona State Land Department at the appropriate time.

CHH/jj

Attachment

c: Mike Reuwsaat, Town Manager, Town of Marana
John Bernal, Deputy County Administrator - Public Works
Rafael Payan, Natural Resources, Parks and Recreation Director
Linda Mayro, Cultural Resources Manager
Nicole Fyffe, Executive Assistant to the County Administrator



February 22, 2007

Mr. Chuck Huckelberry, Administrator
Pima County
130 W. Congress, 10th Floor
Tucson, Arizona 85701

Dear Chuck:

The preservation of the Tortolita Fan, specifically the area of the Tortolita Fan north of Tangerine Road and east of the CAP canal, is a high priority for Pima County and the Town of Marana. Besides its superb biological habitat values, the Tortolita Fan also has significant impediments to development primarily in the area of flood control. Pima County prepared the Tortolita Fan Flood Study several years ago. At that time it was determined that the cost to develop in the Tortolita Fan flood prone areas would be very expensive. Perhaps we should revisit that study to update the cost estimates.

The Town of Marana will continue to encourage the Saguaro National Park and the Ironwood National Monument to incorporate this area of the Tortolita Fan into one of their boundaries. Thanks for all your work, cooperation, support and leadership as we work towards preserving this part of the Sonoran Desert.

Sincerely,

Michael A. Reuwsaat
Town Manager

Cc: Marana Mayor and Council Members
Gilbert Davidson, Deputy Town Attorney
Jim DeGroot, Assistant Town Manager
Jennifer Christelman, Environmental Engineer Manager

Appendix 2 Plant List

Tortolita Mountains; NW bajadas, canyons, & slopes; Cottonwood & Dry Canyons, November 16, 1991 (w/ C.D. Bertelsen); Derrio Canyon; December, 1998, January 10, 1999; & upper Wild Burro Canyon, 2006-2007 (w/ J.A. Emmett); J. F. Wiens; updated July 3, 2007.

FERNS & ALLIES

Adiantaceae

Adiantum capillus-verneris
Astrolepis sinuata
Astrolepis standleyi
Cheilanthes lindheimeri
Cheilanthes wootoni
Cheilanthes wrightii
Pellaea truncata
Pityrogrammis triangularis

Selaginellaceae

Selaginella arizonica

GYMNOSPERMS

Ephedraceae

Ephedra nevadensis

ANGIOSPERMS-DICOTS

Acanthaceae

Anisacanthus thurberi
Carlowrightia arizonica
Justicia californica
Siphonoglossa longiflora

Amaranthaceae

Amaranthus fimbriatus
Amaranthus cf. palmeri
Tidestromia lanuginosa

Anacardiaceae

Rhus aromatica

Apiaceae

Bowlesia incana
Daucus pusillus
Spermolepis echinata

Apocynaceae

Haplophyton cimcidium

Aristolochiaceae

Aristolochi watsoni

Asclepiadaceae

Cynanchum arizonicum
Matelea producta
Sarcostemma cynanchoides

Asteraceae

Acourtia wrightii
Ambrosia ambrosoides
Ambrosia confertiflora
Ambrosia deltoidea
Artemisia ludoviciana
cf. Aster
Baccharis salicifolia
Baccharis sarothroides
Baileya multiradiata
Bebbia juncea
Brickellia californica
Brickellia coulteri
Chrysolepis villosa
Circium neomexicanum
Dyssodia porophylloides
Encelia farinosa
Ericameria cuneata
Ericameria laricifolia
Erigeron divergens
Eupatorium solidaginifolium
Gnaphalium wrightii
Hymenoclea monogyra
Hymenoclea salsola
Isocoma tenuisecta
Machaeranthera pinnatifida
Machaeranthera gracilis
Perityle lemmoni
Porophyllum gracile
Psilostrophe cooperi
Senecio lemmoni
Senecio sp.
Stephanomeria pauciflora
Trixis californica
Viguiera deltoidea
Zinnia acerosa

Bignoniaceae

Chilopsis linearis

Boraginaceae

Amsinckia sp.
Cryptantha cf. nevadensis
Cryptantha pterocarya
Lappula redowskii
Pectocarya recurvata

Brassicaceae

Arabis perennans
Caulanthus lasiophyllus
Descurainia pinnata
Draba cuneifolia
Lepidium lasiocarpum
Sisymbrium irio
Thysanocarpus curvipes

Cactaceae

Carnegiea gigantea
Cylindropuntia bigelovii
Cylindropuntia fulgida
v. fulgida
Cylindropuntia fulgida
v. mammillata
Cylindropuntia leptocaulis
Cylindropuntia versicolor
Echinocereus fendleri
v. robustus
Ferocactus wislizeni
Mammillaria grahamii
Opuntia chlorotica
Opuntia engelmannii
Opuntia phaeacantha
v. laevis
Opuntia phaeacantha
v. major

Campanulaceae

Nemacladus glanduliferus
Triodanis holzingeri

Caryophyllaceae

Plantago fastigiata
Plantago patagonica
Silene antirrhina

Chenopodiaceae

Atriplex canescens
Atriplex elegans
Chenopodium murale
Chenopodium
neomexicanum
Salsola tragus

Cleomaceae

Polanisia dodecandra
ssp. trachysperma

Convolvulaceae

Evolvulus alsinoides

Crossosomataceae

Crossosoma bigelovii

Cuscutaceae

Cuscuta cf. indecora

Euphorbiaceae

Ditaxis lanceolata
Ditaxis neomexicana
Euphorbia arizonica
Euphorbia capitellata
Euphorbia melanadenia
Euphorbia micromera
Euphorbia polycarpa
Euphorbia setiloba
Jatropha cardiophylla

Fabaceae

Acacia angustissima
Acacia constricta
Acacia greggii
Astragalus arizonicus
Astragalus lentiginosus
Calliandra eriophylla
Coursettia glandulosa
Dalea pringlei
Galactia wrightii
Lupinus sparsiflorus
Marina parryi
Mimosa biuncifera
Olneya tesota
Parkinsonia florida
Parkinsonia microphylla
Prosopis velutina
Rhynchosia senna
Senna covesii

Fouquieriaceae

Fouquieria splendens

Geraniaceae

Erodium cicutarium
Erodium texanum

Hydrophyllaceae

Eucrypta chrysanthemifolia
Phacelia ambigua
Phacelia distans

Krameriaceae

Krameria grayi

Lamiaceae

Hyptis emoryi
Salvia columbarae
Stachys coccinea

Malpighiaceae

Janusia gracilis

Malvaceae

Abutilon abutiloides
Abutilon incanum
Herissantia crispa
Hibiscus coulteri
Sphaeralcea ambigua
Sphaeralcea laxa

Nyctaginaceae

Allionia incarnata
Boerhavia coccinea
Boerhavia intermedia
Commicarpus scandens
Mirabilis bigelovii

Oleaceae

Fraxinus velutina
Menodora scabra

Onagraceae

Camissonia californica

Pedaliaceae

Proboscidea althaeifolia

Plantaginaceae**Polemoniaceae**

Eriastrum diffusum
Linanthus bigelovii

Polygonaceae

Eriogonum abertianum
Eriogonum sp.
Eriogonum trichopes
Eriogonum wrightii
Rumex sp.

Portulacaceae

Claytonia perfoliata

Ranunculaceae

Anemone tuberosa
Delphinium scaposum

Rhamnaceae

Condalia warnockii
v. kearneyana
Ziziphus obtusifolius

Rosaceae

Vauquelinia californica

Rubiaceae

Galium microphyllum
Galium stellatum

Salicaceae

Populus fremontii
Salix exigua
Salix gooddingii

Sapindaceae

Clematis drummondii
Dodonaea viscosa
v. angustifolia
Sapindus drummondii

Scrophulariaceae

Maurandya antirrhiniflora
Mimulus floribundus
Mimulus guttatus
Penstemon parryi
Penstemon subulatus

Simmondsiaceae

Simmondsia chinensis

Solanaceae

Datura discolor
Datura wrightii
Lycium berlandieri
Lycium fremontii
Nicotiana trigonophylla
Physalis crassifolia
Physalis pubescens

Sterculiaceae

Ayenia compacta

Tamaricaceae

Tamarix ramosissima

Ulmaceae

Celtis pallida

Urticaceae

Parietaria hespera

Verbenaceae

Aloysia wrightii
Glandularia gooddingii
Verbena neomexicana

Viscaceae

Phorodendron californicum

Zygophyllaceae

Larrea divaricata
 ssp. tridentata

MONOCOTS**Agavaceae**

Dasyilirion wheeleri
Yucca arizonica

Cyperaceae

Carex sp.

Liliaceae

Dichelostemma pulchellum
Milla biflora

Poaceae

Aristida adscensionis
Aristida parishii
Aristida purpurea v. nealleyi
Aristida ternipes
 v. gentilis
Aristida ternipe v. ternipes
Bothriochloa barbinodis
Bouteloua aristidoides
 v. aristidoides
Bouteloua curtipendula
Bouteloua hirsuta
Bouteloua repens
Bouteloua rothrockii
Bromus carinatus
Bromus rubens
Bromus carinatus
Cynodon dactylon
Digitaria californica
Eragrostis cilianensis
Eragrostis curvula
Eragrostis intermedia
Eragrostis lehmanniana.
Eragrostis pectinacea
Erioneuron pulchellum
Heteropogon contortus
Hilaria belangeri
Leptochloa dubia
Leptochloa panicea
 ssp. mucronata
Muhlenbergia microsperma
Muhlenbergia porteri
Muhlenbergia rigens
Pennisetum ciliare
Pennisetum setaceum
Polypogon monspeliensis
Schismus barbatus
Setaria leucopila
Setaria macrostachya
Sporobolis contractus
Stipa speciosa
Vulpia microstachys
 v. ciliata
Vulpia octoflora

Typhaceae

Typha sp.

Appendix 3

Plants Found Under Ironwood

Appendix excerpted from Arizona Sonoran Desert Museum. 2000. Desert Ironwood Primer Biodiversity and Uses Associated with Ancient Legume and Cactus Forests in the Sonoran Desert. Published in collaboration with the U. S. Department of Interior and Pima County.

Family	Species
Acanthaceae	Anisacanthus thurberi
	Berginia virgata
	Carlowrightia arizonica
	Justicia californica
	Justicia longii
	Ruellia californica
Achatocarpaceae	Phaulothamnus spinescens
Agavaceae	Agave datylio
Amaranthaceae	Amaranthus sp.
	Amaranthus fimbriatus
	Amaranthus palmeri
	Tidestromia lanuginosa
Apocynaceae	Matelea cordifolia
Aristolochiaceae	Aristolochia watsonii
Asclepiadaceae	Sarcostemma cynanchoides
Asteraceae	Acourtia wrightii
	Ambrosia ambrosioides
	Ambrosia confertifolia
	Ambrosia cordifolia
	Ambrosia deltoidea
	Ambrosia dumosa
	Ambrosia ilicifolia
	Aplopappus spinulosus
	Baccharis salicifolia
	Baccharis sarothroides
	Bebbia juncea
	Brickellia coulteri
	Chaenactis stevoides
	Conzya coulteri
	Coreocarpus parthenioides
	Encelia farinosa
	Encelia farinosa var. phenicodonta
	Encelia frutescens
	Hymenoclea monogyra
Hymenoclea salsola	
Hymenothrix wislizenii	

Family	Species
	Isocoma acradenia
	Isocoma tenuisecta
	Machaeranthera coulteri
	Palafoxia linearis
	Parthenium incanum
	Pectis papposa
	Perityle emoryi
	Porophyllum gracile
	Psilostrophe cooperi
	Stephanomeria pauciflora
	Thymophylla concinna
	Trisix californica var. californica
	Zinnia acerosa
Bignoniaceae	Chilopsis linearis
Boraginaceae	Cryptantha augustifolia
	Cordia parvifolia
Brassicaceae	Brassica sp.
	Colanthus sp.
	Descurainia pinnata
	Lepidium lasiocarpum
	Lepidium perfoliatum
	Lyrocarpa coulteri
	Thelypodium sp.
Burseraceae	Bursera hindsiana
	Bursera laxiflora
	Bursera microphylla
Cactaceae	Carnegiea gigantea
	Echinocereus fendleri robustus
	Echinocereus spp.
	Echinomastus erectocentrus
	Ferocactus cylindraceus var. cylindraceus
	Ferocactus diguetii
	Ferocactus emoryi
	Ferocactus wislizenii
	Lophocereus schottii
	Mammillaria grahamii
	Mammillaria mainae
	Mammillaria tetrancistra
	Mammillaria thornberi
	Opuntia acanthocarpa
	Opuntia arbuscula
	Opuntia bigelovii
	Opuntia cholla
	Opuntia ciribe
	Opuntia phaeacantha/engelmannii

Family	Species
	<i>Opuntia fulgida</i>
	<i>Opuntia leptocaulis</i>
	<i>Opuntia violacea</i>
	<i>Pachycereus pringlei</i>
	<i>Peniocereus greggii</i>
	<i>Peniocereus striatus</i>
	<i>Stenocereus gummosus</i>
	<i>Stenocereus thurberi</i>
Capparidaceae	<i>Atamisquea emarginata</i>
	<i>Forchammeria watsonii</i>
Celastraceae	<i>Castela peninsularis</i>
	<i>Maytenus pyllanthoides</i>
Chenopodiaceae	<i>Atriplex barclayana</i>
	<i>Atriplex canescens</i>
	<i>Atriplex linearis</i>
	<i>Atriplex polycarpa</i>
	<i>Chenopodium murale</i>
	<i>Salsola australis</i>
	<i>Suaeda moquinii</i>
Commelinaceae	<i>Commelina erecta</i>
Convolvuceae	<i>Cuscuta</i> spp.
	<i>Ibervillea sonorae</i>
	<i>Ipomoea</i> sp.
	<i>Jacquemontia abutiliodes</i>
	<i>Jaquinia pungens</i>
	<i>Merremia palmeri</i>
Cucurbitaceae	<i>Apodathera undulata</i>
	<i>Cucurbita digitata</i>
	<i>Tumamoca macdougalli</i>
Euphorbiaceae	<i>Acalypha californica</i>
	<i>Chamaesyce polycarpa</i>
	<i>Croton sonorae</i>
	<i>Ditaxis lanceolata</i>
	<i>Ditaxis neomexicana</i>
	<i>Euphorbia florida</i>
	<i>Euphorbia magdalenae</i>
	<i>Euphorbia miseria</i>
	<i>Euphorbia polycarpa</i>
	<i>Euphorbia xantii</i>
	<i>Jatropha cardiophylla</i>
	<i>Jatropha cinerea</i>
	<i>Jatropha cordata</i>
	<i>Jatropha cuneata</i>
	<i>Pedilanthus macrocarpus</i>
	<i>Sapium biloculare</i>

Family	Species
Fabaceae	Acacia angustissima
	Acacia constricta
	Acacia greggii
	Caesalpinia palmeri
	Caesalpinia pannosa
	Caesalpinia pumila
	Calliandra californica
	Coursetia glandulosa
	Dalea spp.
	Desmanthus covillei
	Desmanthus fruticosus
	Hoffmanseggia intricata
	Lupinus arizonicus
	Marina evanescens
	Marina parryi
	Mimosa biuncifera
	Mimosa laxiflora
	Nissolia schottii
	Olineya tesota
	Parkinsonia floridum
	Parkinsonia microphylla
	Parkinsonia peninsulare
	Phaseolus filiformis
	Pithecellobium confine
	Prosopis glandulosa
	Prosopis velutina
	Psoralea emoryi
	Senna covesii
	Tephrosia palmeri
	Vallesia glabra
Fouquieriaceae	Fouquieria columnaris
	Fouquieria diguetii
	Fouquieria splendens
	Fouquieria macdougalli
Hydrophyllaceae	Nama hispidum
	Phacelia ambigua
Kramariaceae	Krameria erecta
	Krameria grayi
Lamiaceae	Hyptis emoryi
	Salvia columbiarum
Loasaceae	Mentzelia adherens
Loranthaceae	Sruthanthus palmeri
	Psittacanthus sonora
Malpighiaceae	Janusia californica
	Janusia gracilis

Family	Species
	<i>Janusia linearis</i>
	<i>Herissantha crispa</i>
	<i>Mascagnia macroptera</i>
Malvaceae	<i>Abutilon californicum</i>
	<i>Abutilon incanum</i>
	<i>Hibiscus denundatus</i>
	<i>Horsfordia newberryi</i>
	<i>Sphaeralcea ambigua</i>
Nyctaginaceae	<i>Allionia incarnata</i>
	<i>Boerhavia sp.</i>
	<i>Commicarpus scandens</i>
	<i>Mirabilis bigelovii</i>
Onagraceae	<i>Camissonia claviformis</i>
Passifloraceae	<i>Passiflora foetida</i>
Phytolaccaceae	<i>Stegnosperma halmifolium</i>
Plantaginaceae	<i>Plantago insularis</i>
	<i>Plantago purshii</i>
Poaceae	<i>Aristida adscensionis</i>
	<i>Aristida ternipes</i>
	<i>Bouteloua aristidoides</i>
	<i>Digitaria californica</i>
	<i>Heteropogon contortus</i>
	<i>Muhlenbergia microsperma</i>
	<i>Muhlenbergia porteri</i>
	<i>Panicum hirticaule</i>
	<i>Pennisetum ciliare</i>
	<i>Setaria liebmanii</i>
	<i>Setaria macrostachya</i>
	<i>Schismus barbatus</i>
	<i>Vulpia sp.</i>
Polygonaceae	<i>Antigonon leptopus</i>
	<i>Chorizanthe sp.</i>
	<i>Eriogonum fasciculatum</i>
	<i>Eriogonum inflatum</i>
	<i>Eriogonum trichopes</i>
	<i>Eriogonum wrightii</i>
	<i>Tephrosia palmeri</i>
Portulaccaceae	<i>Talinum paniculatum</i>
Rhamnaceae	<i>Colubrina glabra</i>
	<i>Colubrina viridis</i>
	<i>Karwinskia parviflora</i>
	<i>Ziziphus obtusifolia</i>
Rubiaceae	<i>Gallium stellatum</i>
	<i>Randia obcordata</i>
Sapindaceae	<i>Cardiospermum corindum</i>

Family	Species
Schrophulariaceae	Castilleja exserta
Simaroubaceae	Castela peninsularis
Simmondsiaceae	Simmondsia chinensis
Solanaceae	Datura discolor
	Lycium andersonii
	Lycium berlandieri
	Lycium exsertum
	Lycium fremontii
	Lycium parishii
	Physalis sp.
	Solanum eleagnifolium
	Solanum hindsianum
Sterculiaceae	Melochia tomentosa
Ulmaceae	Celtis pallida
Umbelliferae	Daucus pusillus
Verbinaceae	Lantana horrida
	Lippia palmeri
Viscaceae	Phoradendron californicum
Zygophyllaceae	Fagonia californica
	Guaiacum coulteri
	Larrea tridentata
	Viscainoa geniculata

Appendix 4

DRAFT

Special Designations

Presidential Designations (outside the scope of an RMP)

National Monument - An area designated by the President, under the authority of the Antiquities Act of 1906, to protect objects of scientific and historical interest that are located on federal lands. Criteria for a National Monument can be found in the legislation (June 8, 1906, c. 3060, Section 2, 34 Stat. 225).

Congressional Designations (Can be recommended through the RMP process)

National Conservation Area - An area designated by Congress to provide for the conservation, use, enjoyment and enhancement of certain natural recreational, paleontological, and other resources, including fish and wildlife habitat.

National Wilderness Area - An area designated by Congress and defined by the Wilderness Act of 1964 as a place “where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.” Designation is aimed at ensuring that these lands are preserved and protected in their natural condition. Wilderness areas, which are generally at least 5,000 acres or more in size, offer outstanding opportunities for solitude or a primitive and unconfined type of recreation; such areas may also contain ecological, geological, or other features that have scientific, scenic, or historical value. Criteria for lands to be designated by BLM as Wilderness Study Areas and subsequently considered by Congress for designation as a National Wilderness Area can be found in the Wilderness Inventory and Study Procedures Manual (H-6310-1).

National Wild and/or Scenic Rivers - A river or river section designated by Congress or the Secretary of the Interior, under the authority of the Wild and Scenic Rivers Act of 1968 (WSRA), to protect outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values and to preserve the river or river section in its free-flowing condition. Criteria for National Wild and Scenic Rivers can be found at: BLM Manual, Wild and Scenic Rivers -- Policy & Program Direction for Identification, Evaluation, and Management (H-8351).

Definitions for River Classifications:

Wild river areas: Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines largely undeveloped, but accessible in places by roads.

Scenic river areas: Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines large undeveloped, but accessible in places by roads.

Recreational river areas: Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

National Scenic Trail - Designated by Congress under the National Trails System Act of 1968, an extended trail that offers maximum outdoor recreation potential and provides enjoyment of the various qualities - scenic, historical, natural, and cultural – of the areas through which these trails pass. Criteria for National Scenic Trails can be found at: 16 United States Code, Chapter 27, National Trails System, 1241-1251.

National Historic Trail - Designated by Congress under the National Trails System Act of 1968, a type of extended trail that follows as closely as possible, on federal land, the original trails or routes of travel with national historic significance. Designation identifies and protects historic routes and their historic remnants and artifacts for public use and enjoyment. A designated trail must meet certain criteria, including having a significant potential for public recreational use or interest based on historic interpretation and appreciation. Criteria for National Historic Trails can be found at: 16 United States Code, Chapter 27, National Trails System, 1241-1251.

Administrative Designations (Within the scope of an RMP)

Wilderness Study Area (WSA) - An area designated by a federal land management agency (Bureau of Land Management, Forest Service, National Park Service, or the Fish and Wildlife Service) as having wilderness characteristics, thus making it worthy of consideration by Congress for wilderness designation. While Congress considers whether to designate a WSA as permanent wilderness, the federal agency managing the WSA does so in a manner as to prevent impairment of the area's suitability for wilderness designation. Criteria for Wilderness Study Areas can be found at: Wilderness Inventory and Study Procedures Manual (H-6310-1). WSA's are managed under the Interim Management Policy for Lands under Wilderness Review (H-8550-1).

Areas of Critical Environmental Concern (ACEC) - Areas of special concern where special management attention is required to protect and prevent irreparable damage to important historic, cultural or scenic values, fish and wildlife resources or other natural systems or processes, or to protect life and safety from natural hazards. Criteria for ACEC can be found at: BLM Manual 1613 and 43 CFR 1610.7-2(b).

Outstanding Natural Areas (ONA) - An area with high scenic values that has been little altered by human impact. Under current BLM policy, outstanding natural areas must meet the relevance and importance criteria of ACEC's and are designated as ACEC's. Criteria for ONA's can be found at: BLM Manual 1613 and 43 CFR 1610.7-2(b).

Research Natural Area (RNA) - An area where natural processes are allowed to predominate and which is preserved for the primary purposes of research and education. Under current BLM policy, RNA's must meet the relevance and importance criteria of ACEC's and are designated as ACEC's. Criteria for RNA's can be found at: BLM Manual 1613 and 43 CFR 1610.7-2(b).

Special Recreation Management Areas (SRMA) - Areas where recreation is one of the principal management objectives; where intensive recreation management is needed and which require more than minimal recreation-related investments. Recreation activities in these areas are generally more concentrated, structured and regulated than in ERMA's. Criteria for SRMA's can be found at: BLM Manual 8300.

Extensive Recreation Management Areas (ERMA) - Areas where recreation is unstructured and dispersed with minimal regulatory constraints and where minimal recreation-related investments are required. The ERMA's include all public land exclusive of Special Recreation Management Areas. Criteria for ERMA's can be found at: BLM Manual 8300.