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ENVIRONMENTAL ASSESSMENT
AUGUST 2002 DRAFT

AGUA FRIA CREEK RESTORATION PROJECT
EL MALPAIS NATIONAL MONUMENT
NEW MEXICO

ENVIRONMENTAL ASSESSMENT

for the project

DEVELOP A COMPREHENSIVE RESTORATION PLAN FOR AGUA FRIA CREEK

El Malpais National Monument, Grants, New Mexico
National Park Service

Water Resources Division, Fort Collins, Colorado
National Park Service

Colorado State University
Fort Collins, Colorado

AUGUST 2002 DRAFT

PUBLIC COMMENT

If you wish to comment on this environmental assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days. Please note that the names and addresses of people who comment become part of the public record. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment. We will make all submissions from organizations, businesses, and individuals identifying themselves as representatives or officials of organizations or businesses available for public inspection in their entirety.

Superintendent, El Malpais National Monument,
123 East Roosevelt Avenue, Grants, NM 87020.

Cover photograph: Flooding in Agua Fria Creek in springtime, 1998.

SUMMARY

This environmental assessment reviews the proposed project "Develop a Comprehensive Restoration Plan for Agua Fria Creek, in El Malpais National Monument, NPS." The National Monument is located in the west-central part of New Mexico, near Grants and is administered by the National Park Service; the Monument includes 114,277 acres. The proposed project area lies in the northwest corner of the Monument.

The project proposes to treat 5 sites along Agua Fria Creek, comprising about 22 acres total within an area about one-quarter mile wide and 5 miles long paralleling the northern boundary of the Monument. Much of the proposed creek restoration project falls in an area that is popular with visitors, who come to view cave and volcanic sites, observe bats or wildlife, or hike.

During the 1930's to 1960's, earthen dams, ditches, ponds, and diversion structures were constructed along and near Agua Fria Creek. Today, these eroding structures divert and disrupt the creek, contributing to flooding, damage to roads, flooding of caves, silting of lava tubes, and impacts on riparian habitat. Part of the creek also was diverted from its original channel, causing additional flooding in what is now the El Calderon Parking Lot area.

The goal of the project analyzed in this report is to restore the natural hydrologic functions and ecologic conditions of Agua Fria Creek within the Monument by removal or modification of old dikes, ponds, and ditches. This would help restore an approximation of the creek's original, natural condition.

Three alternative restoration actions are evaluated in this report. Alternative A would be no action. Alternative B (the preferred action) would fill two ponds, breach two dikes, return a reach of the creek to its original channel, and conduct other restoration actions as detailed in the project recommendation report (Kunkle and Inglis, 2002). Alternative C, an elaboration of the preferred action, would include some deeper channeling and extra berming in one area.

None of the alternatives would have major environmental consequences. Alternative A (no action) would allow the flooding and other impacts to continue. Either Alternative B (preferred action) or C would be beneficial compared to no action. The preferred alternative would be expected to reduce flooding damage and benefit riparian habitats. Therefore, the preferred alternative should provide moderate positive environmental benefits.

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1. PURPOSE AND NEED

1.1. PURPOSE

This environmental assessment reviews the proposed project to "Develop a Comprehensive Restoration Plan for Agua Fria Creek, El Malpais National Monument, NPS." The project proposes to treat 5 sites along the creek comprising about 22 acres total within an area about one-quarter mile wide and 5 miles long paralleling the northern boundary of the Monument. The project area is located about 20 miles southwest of Grants, New Mexico.

The goal of the project analyzed in this report is to restore the natural hydrologic functions and ecologic conditions of Agua Fria Creek within the El Malpais National Monument, by removal or modification of artificially constructed earthen dams, dikes, and ditches in the Monument; this would include some reshaping of sites back to an approximation of the original contours. The proposed project's basic purpose therefore is to:

- return the creek's flow to its natural, historic channel;
- reduce flooding partially caused by old structures;
- restore riparian areas and enhance regrowth of native vegetation along channel and meadow areas; and
- reduce erosion below and around the old structures.

The creek restoration project reviewed in this environmental assessment therefore supports the Monument's overall mission of resource protection and management, including a goal to restore habitats to natural conditions.

A prime mission of the El Malpais National Monument is to protect and manage natural resources. Public Law 100-225 of December 31, 1987, established El Malpais National Monument and authorized the National Park Service to preserve the natural, scenic, cultural, recreational, and other resources within the Monument, with a view to managing these resources for the perpetual use and enjoyment of the American people (El Malpais NM, 1989). The project therefore is in harmony with the Monument's mission of conservation.

El Malpais NM established guidelines for resource protection, as well as for visitor use. The Monument's Land Protection Plan, General Management Plan, and Resource

Management Plan provide frameworks and set priorities for managing resources in the Monument; these guidelines also allow for actions to restore or rehabilitate degraded resources, as discussed in the creek restoration project of this report. The NPS abides by the National Environmental Policy Act (NEPA) and other laws and regulations to promote resource protection (El Malpais NM, 1989; El Malpais, 1990).

1.2. NEED

Agua Fria Creek has been diverted, impounded, eroded, or otherwise disrupted for decades. During the 1930's to 1960's, ranchers, the Highway and Transportation Department, and others constructed earthen dams, ditches, dikes, ponds, and diversion structures along or near Agua Fria Creek within the National Forest lands of that time –now part of the National Monument (Figure 1.1). A Highway and Transportation Department diversion dike constructed in the late 1950's (called "Pine Dike" in this report) continues to divert about two miles of the creek, exerting a significant impact by flooding Monument roads, a parking lot, cave entrances, and trails.

By far the most visible structure of the project area is a large dam about 900 feet across and 15-20 feet tall (Figure 1.1), located on a small tributary of the creek. This dam apparently was constructed as a public works conservation project during the late1930's. The dam's old feeder ditch, which runs along a hillside, is breached; consequently the dam collects very little water and its storage area of about 40 acres never fills. The dam's hydrologic impact is essentially nil.

Today none of the stock ponds, ditches, or other structures are maintained or managed, and all but one (Pine Dike) are breached and out of order. All are eroding. These structures disrupt the natural flow regime of the creek, contributing to problems including: safety hazards from flooding and mud; flooding damage to the El Calderon Parking Lot; water and sediment impacts on caves, silting of lava tubes and other geologic features; and disruption of riparian habitats and meadow ecosystems. The photographs of Figure 1.2 provide scenes of the periodic flooding in the proposed project area.

During 2001-2002, El Malpais National Monument received NPS, Water Resources Division (WRD) funding to: (1) investigate the hydrologic impacts and history of these old structures and (2) to develop recommendations for restoration work, with a goal of reducing the hydrologic and environmental impacts.

The broader goal of the proposed restoration work is to return the area to its natural hydrologic functions and to rehabilitate riparian habitats, in keeping with the National Park Service's philosophy to protect natural ecosystems.

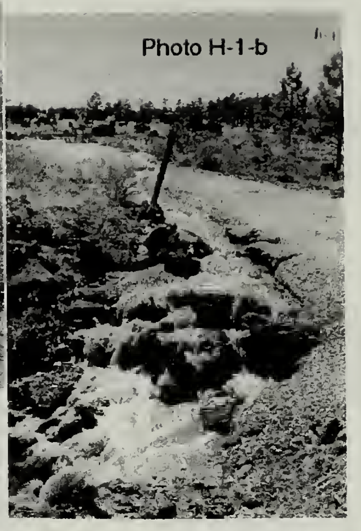
1. Looking east along the crest of Dam 30. This dam was constructed in the 1930's, apparently as a public works project. It is about 900 ft long by 15-20 ft high, on a small tributary of Agua Fria Creek. It was originally fed by a diversion ditch; however, the old ditch is breached, so the dam remains dry.

2. Looking northwest along "Pine Dike" from its southwest end.

3. A view looking south into Stock Tank 28

4. A view of the tall pines growing along "Pine Dike," looking northwest. The pines sprouted after the dike was constructed. The dike was constructed in 1957 according to aerial photographs, coring of the pines for age, and construction records obtained from the highway department.

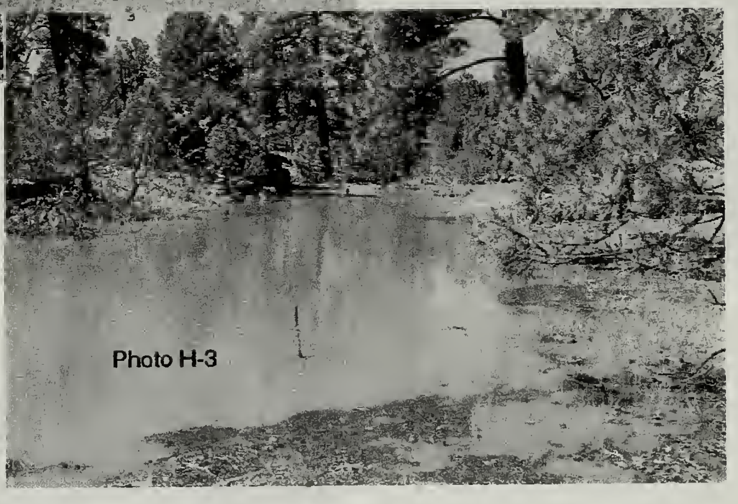
Figure 1.1.Views of old structures in the project area.



To the left, springtime flooding from the north flows into the west edge of the El Calderon Parking Lot area.

On the right, the flooding flows along the El Calderon Parking Lot road.

To the left (#H-2), Stock Tank 28, holds springtime flood waters.



To the right (#H-3), the springtime runoff flows behind "Pine Dike."

Figure 1.2. Flooding in the project area in 1998 (photos by El Malpais Chief Ranger Herschel Schulz, 1998).

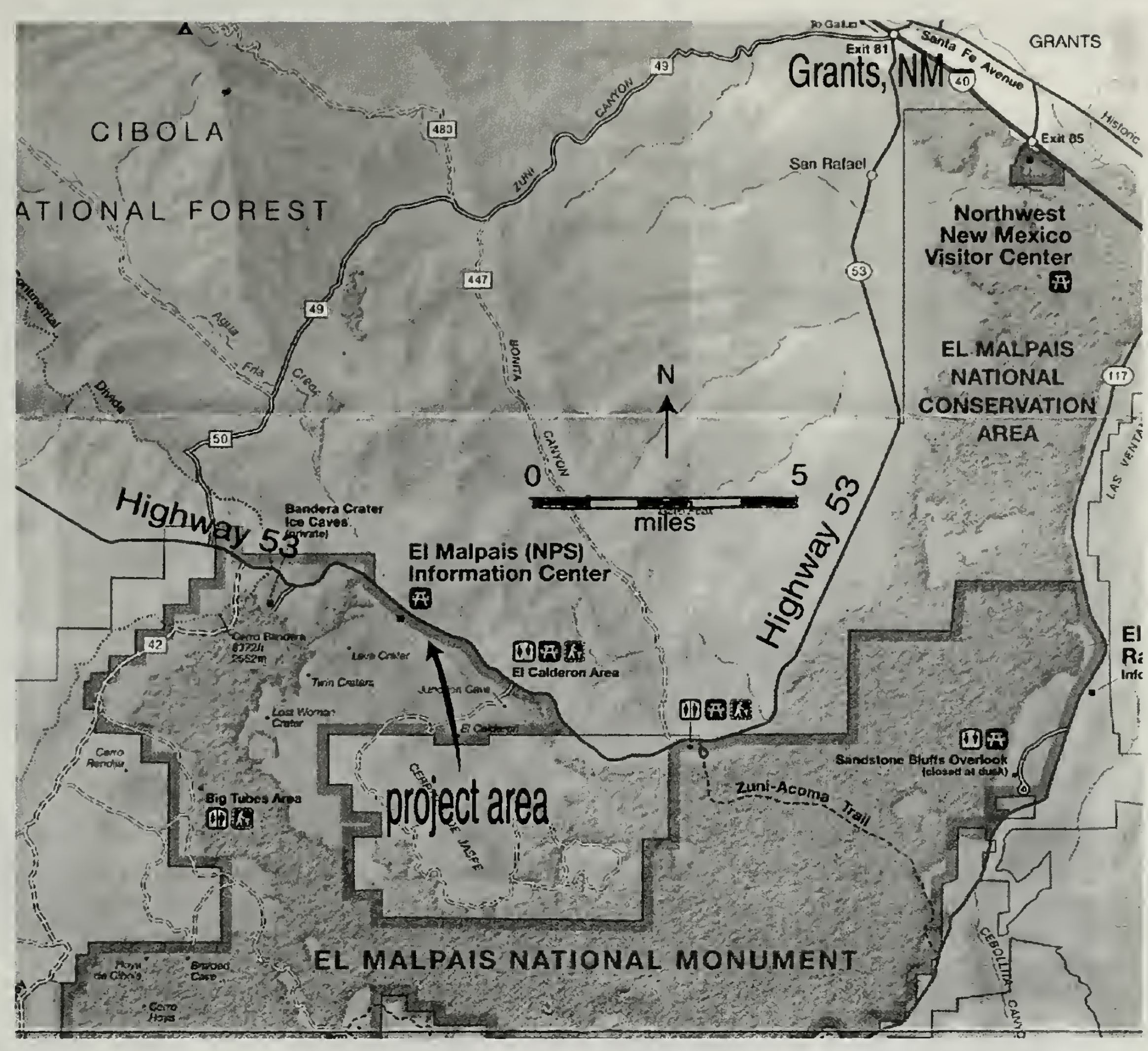


Figure 1.3. Overview of the proposed project area and its location in the National Monument. The project lies near State Highway 53, along the northern boundary of El Malpais National Monument, about 20 miles SW of Grants, NM. The project area is near the El Malpais Information Center and El Calderon area, both popular with visitors. The headwaters of Agua Fria Creek lie to the north of the project area, mostly in the Cíbola National Forest.

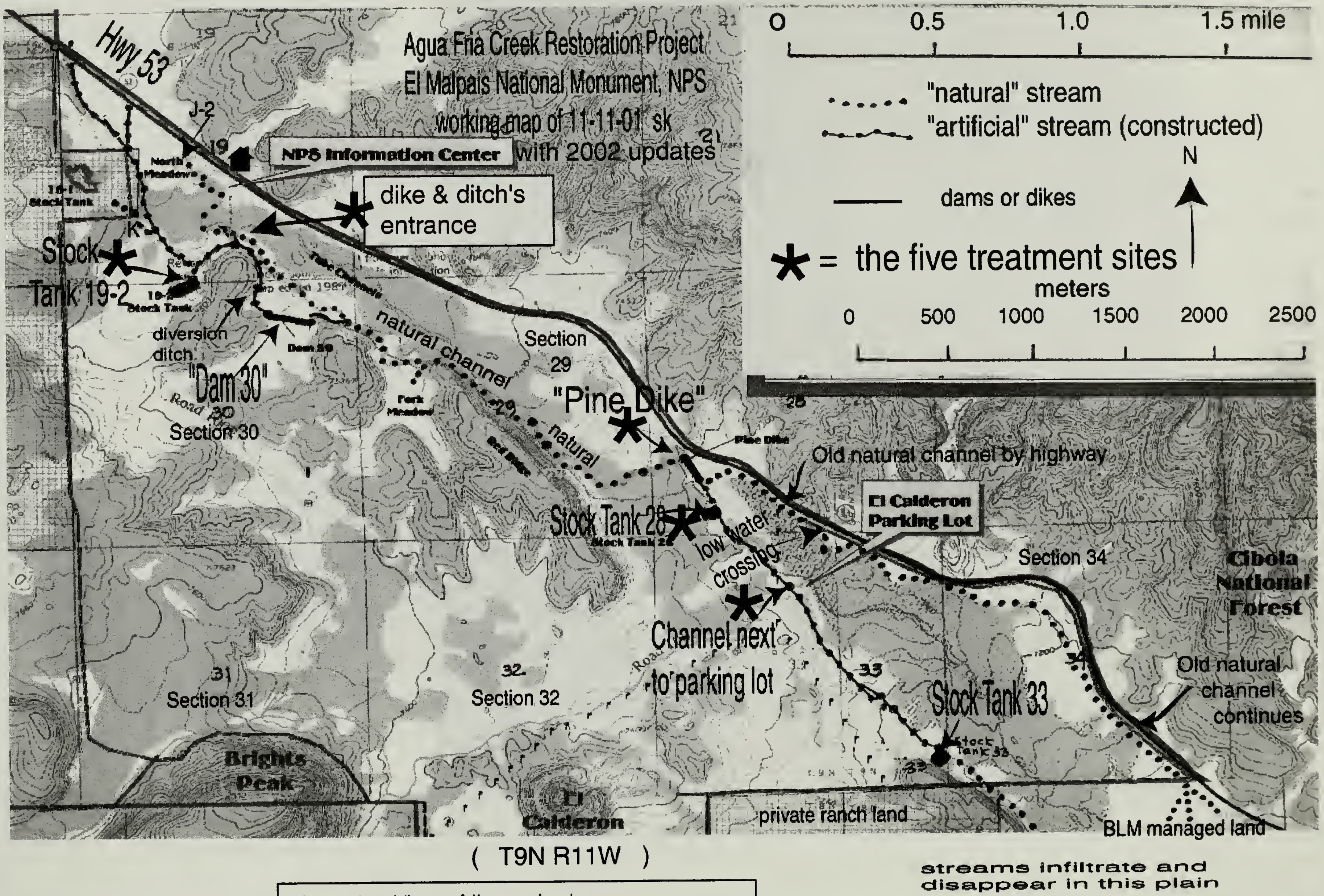


Figure 1.4. View of the project area.

In February, 2002, Colorado State University (WRD's contractor) presented El Malpais National Monument with their report, "Recommendations on the Project to Develop a Comprehensive Restoration Plan for Agua Fria Creek" (Kunkle and Inglis, 2002). The report:

- analyzed the flow patterns and hydrologic history of the area;
- reviewed the hydrologic impacts occurring; and
- recommended specific actions for removal of old structures and restoration of the creek to approximate its original configuration.

The environmental assessment presented here supplements the February 2002 creek restoration recommendations by analyzing the potential environmental impacts of the proposed restoration work.

1.3. DESCRIPTION OF THE PARK

El Malpais National Monument (Figure 1.3) lies in the high arid and semi-arid lands south of Interstate 40, about midway between Gallup and Albuquerque, in west-central New Mexico. The monument, administered by the National Park Service (NPS), covers 114,277 acres (El Malpais NM, 2001; BLM and NPS, 2001, El Malpais NM, 2000). The Monument is largely surrounded by the 262,100 acre El Malpais National Conservation Area, managed by the Bureau of Land Management (BLM). The NPS and BLM units were established concurrently in 1987 by Public Law 100-225 (El Malpais NM, 2001).

El Malpais (or El Malpaís, Spanish for "badlands") describes the rugged volcanic features of the area, which includes lava flows, cinder cones, pressure ridges, and complex lava tube systems dominating the landscape. The Monument encompasses some 10 major volcanic vents (mostly in the form of cinder cones), 7 contiguous lava flows, and some of the longest lava tube systems in the country. Several ice caves located within the National Monument attracted early Native Americans, as well as troops from nearby Fort Wingate, as early as the 1860's. These ice cave features were formed from fractures and voids in the flows, containing small perched water tables that have frozen; they support unique flora and fauna (BLM and NPS, 2001; El Malpais NM,1990).

The El Malpais area also contains diverse natural environments and an extensive evidence of American Indian as well as European history. The contemporary Indian groups living in the surrounding area include the Puebloan peoples of Acoma, Laguna, Hopi, and Zuni, and the Ramah Navajo.

The monument receives approximately 110,000 visitors per year. Popular activities include driving for pleasure, hiking, and visiting natural features --such as bluffs, arches, and lava tubes. Two designated wilderness areas buffer the monument on the east and west. Trails provide scenic back country opportunities, including the Continental Divide Trail, which passes directly through the middle of the proposed project described in this report (El Malpais NM, 2001; Kunkle and Inglis, 2002).

Climatic extremes determine a complex variety of vegetation and wildlife distributions, since water availability can vary from sparse to relatively abundant over the course of a year. Precipitation ranges from 11 to 24 inches a year and the median is about 16 inches annually in the project area. The "monsoon" or wet season --from July through October-- brings about 60% of the years' total; August is the wettest month, with an average of 2.5 inches. April-May is the driest period (0.35-0.42 inches per year). Temperatures also are variable; the average summer temperature is 70°F and the lowest daily average occurs in January at 32°F (BLM and NPS, 2001; Lightfoot et al, 1994; El Malpais NM data, 2002). Streams and arroyos around the project area are all ephemeral, flowing during the springtime snowmelt season or summer thunderstorm period. Section 3.7 reviews the hydrology of the area in more detail.

The National Monument supports a variety of plant associations, but the main ones found in the proposed project area are:

- piñon-juniper woodlands;
- ponderosa with piñon (or piñon-ponderosa-juniper) woodlands;
- some malpais types --where special plants grow on lava or cinder areas, and are adapted to the particular conditions; and
- grassy meadow areas in the flatter areas basically along the creek channels environs, where sedimentation occurs, allowing grasses to thrive (Marron and Wilson, 1994; Lightfoot et al., 1994). Section 3.6 provides details on the vegetation.

Two hundred twenty-two species of vertebrate animals can occur within the general El Malpais area, including bats, bears, elk, raccoons, skunks, badgers, coyotes, mountain lions, bobcats, squirrels, prairie dogs, chipmunks, gophers, rabbits, mule deer, and antelopes. A number of the species are migratory (Marron and Wilson, 1994). Further details appear in Sections 3.4 (T&E Species) and 3.8 (Wildlife).

The proposed project area and a radius for miles around are very sparsely populated. In the past, the area mainly supported grazing, recreation, and fuel-wood harvesting (Marron and Wilson, 1994). The economy of the surrounding area is based on ranching, lumbering, agriculture, tourism, and coal and uranium mining (Marron and Wilson, 1994).

1.4. DESCRIPTION OF THE PROJECT AREA

Figure 1.4 magnifies the segment of Figure 1.3 labeled “project area.” As seen in the figure, the project area lies along the northwestern boundary of El Malpais National Monument and consists of about 22 acres of treatment scattered within a larger area that is roughly a one-quarter mile wide and 5 miles long.

The proposed project area parallels the south side of State Highway 53. In fact, three of the five treatment areas are within a few hundred yards of Highway 53, so are easily accessible; the other two sites are found less than a half mile behind the Information Center. All of the proposed treatment areas are accessible by a highway vehicle with moderate clearance (Figure 1.4). The topography within the proposed restoration area is slightly rolling, posing no challenge of access.

Much of the proposed creek restoration project lies in or near the El Calderon area; this is a volcanic area that includes Junction Cave and Bat Cave (a summer habitat of a large colony of Mexican free-tailed bats) (El Malpais NM, 1990). The El Calderon Parking Lot is well used by visitors coming to see cave and volcanic sites. The Continental Divide Trail passes through the El Calderon area as well. Vault toilets but no water are provided at the parking area. The proposed creek restoration project would be expected to help protect the parking lot against periodic flooding, erosion, and silting.

An NPS Information Center is located about three miles west of the El Calderon Parking Lot and near the northwest end of the proposed project area, as shown in Figure 1.4. The Center provides drinking water, indoor toilets, information, parking, access to hiking, and limited souvenir sales.

1.5. SUMMARY OF ENABLING LEGISLATION AND PRIMARY LAWS

Public Law 100-225 of December 31,1987 established El Malpais National Monument, to be managed by the National Park Service and the adjacent El Malpais National Conservation Area, to be managed by the Bureau of Land Management. Compliance with the National Environmental Policy Act (NEPA) and other laws and regulations regarding natural and cultural resource protection are addressed by the National Monument in its operations and planning.

Land protection planning is guided primarily by the Department of the Interior statement of May 7, 1982 (47 FR 19784). More specifically, El Malpais NM has prepared General and Natural Resources Plans (El Malpais NM,1990, and pers. com., Chief Ranger, 2002) as well as a Land Protection Plan (El Malpais NM, 1989); all of these concern resource protection. Table 1.5 lists the principal regulations and laws guiding El Malpais NM resource management.

Table 1.5. Impact Topics for the creek restoration project, with relevant regulations or policies at El Malpais National Monument (table format adapted from (El Malpais NM, 2001)

Resource or Impact	Relevant Regulations or Policies
(the numbers on the left of this table correspond to section numbers of this report)	
(3.3.) Air quality	Federal Clean Air Act (CAA), CAA Amendments of 1990 (CAAA), NPS Management Policies
(3.4.) Endangered or threatened	Endangered Species Act; NPS Management

species and their habitats	Policies
(3.5.) Soils and geology	NPS Management Policies
(3.6.) Vegetation	NPS Management Policies
(3.7.) Water quality and hydrology	Clean Water Act, Executive Order 12088, NPS Management Policies
(also 3.7.) Wetlands and floodplains	Executive Order 11988, Executive Order 11990, Rivers and Harbors Act, Clean Water Act, NPS Management Policies
Wilderness	Wilderness Act, Director's Order 41, NPS Management Policies
(3.8.) Wildlife	NPS Management Policies
(3.9.) Cultural Resources	Section 106; National Historic Preservation Act; 36 CFR 800; National Environmental Policy Act; Executive Order 13007; Director's Order 28; NPS Management Policies
(3.10.) Economics	40 CFR 1500 Regulations for Implementing NEPA
(3.11.) Park operations	NPS Management Policies
(3.11.) Public health and safety	NPS Management Policies
(3.12.) Visitor use and experience	Organic Act; NPS Management Policies

1.6. THE PROJECT'S RELATION TO OTHER PLANS AND ASSESSMENTS

The proposed Agua Creek Restoration Project is philosophically in harmony with the goals of the El Malpais National Monument to promote the conservation and sustainable management of natural resources (El Malpais 1989; and El Malpais,1990).

Table 1.6 lists three environmental assessments (EAs) carried out in the proposed creek restoration project area or its immediate vicinity in recent years. These three EAs are key references in the preparation of the EA presented in this report.

Table 1.6 also lists two cultural surveys, one (item 4) being the sub-contract of the creek restoration project, conducted in May 2002 by SWCA Inc, Albuquerque (Polk, 2002). Item five is a cultural survey underway in the summer of 2002 as part of the proposed fuels management project. The fuels management project's area of concern overlaps with the southeastern end of the proposed creek restoration project area; therefore, items 4 and 5 together provide a survey of the archaeological or historical objects or sites of cultural significance in the proposed creek restoration project area.

Table 1.6. Key environmental assessments and other surveys relevant to the proposed Agua Fria Creek restoration project and the EA presented in this report.

REPORT OR ACTIVITY	AUTHOR(S) AND TITLE	COMMENTS
1. 2001 EA : fuels management at El Malpais NM	El Malpais NM. August, 2001. "Environmental Assessment: Wildland-Urban Interface Fuels Management, El Malpais NM, New Mexico" by Parsons Co., Denver. 83 pp.	This EA is relevant since its area of concern overlaps with the proposed creek restoration project area and since it is recent.
2. 2001 EA: Fire mgmt plan for the BLM and NPS at El Malpais NCA and NM	BLM and NPS. June, 2001. "Fire management plan for the BLM El Malpais National Conservation Area and NPS El Malpais NM, New Mexico. 216 pp.	This fire EA is relevant since its broad area of concern includes the proposed creek restoration project area and since it is recent.
3. 1994 EA: improvements to State Highway 53 (the highway paralleling Agua Fria Creek)	Marron and Wilson Companies. August 1994. "An EA for proposed improvements to portions of NM 53. " Albuquerque. 94 pp + 40 pp appendices.	This highway construction is relevant since the highway area of concern passes immediately adjacent to the proposed creek restoration project, and topics of interest overlap.
4. May 2002 Cultural resources survey for the project area of this EA	Polk, Harding. May, 2002 . "Agua Fria Creek Restoration Project...: Cultural Resources Survey." SWCA Environmental Consultants, Albuquerque. 34 pp draft.	The Polk cultural survey was sub-contracted by the preparers of this EA in spring, 2002 to survey the proposed project area for archaeological or historical objects or sites of significance --as an input to the EA of this report.
5. May-June 2002 Cultural resources survey_ for the Fuels Management Project	El Malpais NM (H. Schulz, Chief Ranger). Contract underway in conjunction with NPS Support Office, Santa Fe, to provide cultural information.	A survey underway in spring-summer 2002 to survey the area planned for prescribed burning along Highway 53 and the El Calderon Parking Lot to observe archaeological or historical objects or sites of significance.

1.7. IMPACT TOPICS

The impacts covered in this report are:

Air quality	Threatened and endangered species	Soils/ geology
Vegetation	Water/ wetlands	Park visitation
Wildlife	Culture	Economics
Park operations	Public health	

These impact topics are essentially the same as those covered in the Monument's 2001 environmental assessment on fuels management (El Malpais NM, 3001) in the same general area of the Monument,[1] (but with some variation to reflect the creek restoration project's focus on hydrology). The impact topics listed in Table 1.5 follow Director's Order #12 and Handbook (NPS-Washington, 2001).

This report dismisses certain impact topics as either irrelevant or not in need of study, and Table 1.7 summarizes these dismissed items.

Table 1.7. Individual impact topics dismissed as not relevant to this project or not in need of study.

Topic	Comment or rationale
Ecologically critical areas	None designated at El Malpais NM
Prime agricultural lands	None present in the area
Environmental justice	No minorities or low-income populations living within the project site or immediate vicinity
Indian trust resources	Do not occur within El Malpais NM
Sustainability	The principles are incorporated into various sections of the report and discussed under Hydrology, but not as a separate section.

1.8. OBJECTIVES

The proposed creek restoration project in this environmental assessment agrees with the National Monument's overall mission to protect and maintain natural habitats. The basic purpose of the proposed creek restoration project is to restore the natural hydrologic functions of the creek, but the project would incorporate some complementary objectives, as listed in Table 1.8.

Table 1.8. Specific and complementary objectives of the proposed project.

Specific Creek Restoration Project Objectives	Complementary Project Objectives
Return the creek to much of its original, natural channel and restore natural hydrologic functions	Restoring the natural hydrologic functions and reducing ground-water drawdown in meadows (caused by the old ponds or dikes) would enhance soil moisture conditions; this could enhance vegetative growth and improve wildlife habitat.
Help reduce flooding (partially caused by the old structures)	Reduction of flooding is important for public safety and would reduce disruptions to visitor enjoyment of the park caused by parking lot flooding. Flood control could help protect cultural and geologic features in the area (archaeological sites, the caves, tubes, etc).
Bring original vegetation types back to channel and	Removing ponds and dikes would help spread the moisture over meadows and channel areas and thereby encourage regrowth of native vegetation in those areas that have been deprived of moisture.

[1] The preburn cultural survey covers a swath about ¼ to ½ mile wide along Highway 53 that includes Pine Dike, Stock Tank 28, and the El Calderon Parking Lot areas in the SE part of the creek restoration project, but not Stock Tank 19-2, the diversion ditch, or Dam 30 in the NW part of the creek restoration project (Figure 1.4 shows these features).

meadow areas	
Reduce erosion below and around old structures	Stabilizing old ponds would reduce sedimentation impacts on roads and the parking lot, saving the cost of sediment cleanup and channel cleaning. Plugging the old diversion ditch would stop the erosion occurring below its breach area.

1.9. SCOPING

The project scoping process includes interactions or correspondence with the public and various agencies, including the State Historic Preservation Office, the U.S. Fish and Wildlife Service, the NM Highway and Transportation Department, and American Indian tribes and pueblos in the area. Copies of letters and responses received appear/will appear in Appendix B. The concerns identified as a result of the scoping for the project are/will be listed in Appendix B.

2. ALTERNATIVES CONSIDERED

2.1. INTRODUCTION

During 2001, the project principal investigator (PI) and Co-PI [2] worked with staff from the NPS Water Resources Division, Fort Collins; the NPS Geologic Resources Division, Denver; the El Malpais NM ; NPS in Santa Fe; and other organizations or individuals to produce a set of recommendations for creek restoration, including alternatives. These specialists supported the PI to conduct stream surveys, map the area, analyze watersheds for flow patterns, study the geology, review riparian habitats, and research the history of the structures.

The team reviewed various alternatives for treatment at the five individual sites in the project area, in the field, and the recommendations report (Kunkle and Inglis, 2002) was an outgrowth of the brainstorming. This recommendations report presented three alternatives, described briefly as Alternatives in Table 2.1.a. and fleshed out with more specifics in Table 2.1.b.

Table 2.1.a. Synopsis of the three recommendation alternatives.

- Alternative A: Status quo, or no action.
- Alternative B (the preferred action): Pond filling, dike breaching, and other actions as prescribed in the Kunkle and Inglis, 2002 recommendations report.
- Alternative C (the large-channel action): An alternative with deeper channeling and berming around the parking lot (detailed in Table 2.1.b).
- Considered but Rejected: 1. Removal of Dam 30 (not causing problems and too vast to remove); 2. filling of Stock Tank 33 (not

[2] The CSU Co-Principal Investigator in 2001-02 was Sam Kunkle, the WRD Co-Principal Investigator in Fort Collins was Rick Inglis.

causing problems, downstream, remote, with few visitors); and 3. complete removal of the Pine Dike (simply breaching the dike's lower end would serve the same purpose hydrologically as expensive removal of the entire structure).

Table 2.1.b. A summary of the alternatives considered for treatment at the sites. The table is presented in upstream-downstream progression. Compare to Figure 1.4 to view locations. Sections 2.2 to 2.5 provide more details.

TREAT-MENT SITES (from upstream to downstream)	ALTERNATIVES/ ACTIONS	COMMENTS
Treatment Site # 1. **Stock Tank 19-2**	Alt. A. No action	Problem: The tank draws down the meadow's ground water, depriving the meadow below of this ecologically beneficial water.
	Alt B. Preferred action. Fill in the tank; reseed the area	Filling would benefit the meadow. Enough fill material is available for filling the tank and small gullies in the meadow below. Contouring and re-seeding would follow.
	Alt C. The large-channel action	(Alternative C: not relevant to this site)
Treatment Site # 2. **Ditch entry – diversion dike area**	Alt A. No action	Problem: This diversion dike degrades the historic meadow area below, --similar to Stock Tank19-2's effect.
	Alt B. Preferred action. Breach the dike; plug the ditch's entrance; reseed the area.	It would take only a minor expense to remove this small dike, which would re-wet about 15 acres of meadow area along several hundred yards in the reach below the dike. The action would reduce erosion along the old ditch where breaching is occurring. The cost-benefit ratio of the proposed work is good (i.e, minor work for good benefit). Extra fill from the dike could fill gullies in the meadow below ST-19-2 and upstream from the dike.
	Alt C. The large-channel action	(not relevant to this site)
Dam 30	Considered but Rejected: Any treatment of historic Dam 30	No treatment of Dam 30 has been recommended. Rationale: (1) It is historic according to the project's aerial photograph research in 2001 (apparently a CCC or WPA project from the 1930's); (2) it would be very expensive to remove Dam 30, given its size; (3) it has no significant hydrologic effect (since its feeder ditch is breached); and (4) it is on a small tributary, not the main creek, so receives too little water to be a safety hazard. Dam removal would only allow water from a small sub-watershed to pass, so not worth the cost. Although no safety issues are apparent, the dam should be added to the NPS dam safety list [charles_karpowicz@nps.gov, 202 565-1249 needs to receive information on the lat/long or UTM, length/height, name, ownership, etc of the dam].

Treatment Site # 3. Pine Dike	Background	Project research in 2001 showed that the Pine Dike was constructed by the NM Highway & Trans Dept in 1957 (+/- a year), according to road designs, air photos, & tree coring. Pine Dike diverts Agua Fria Creek from one of its historic, natural channels along the highway, routing all of the creek flow into the Junction Cave/ El Calderon Parking Lot area, increasing flooding at that site.
	Alt A. No action	Problem: will allow floods to continue at the parking lot/Junction Cave area –which is not the historic natural channel.
	Alt B. Preferred action. Breach the lower end of Pine Dike	The lower end of the dike is eroding in any event. Complete removal of the dike would not be needed in order to allow the flow to go in two directions. This would spread the flow into two forks, and cause less flooding at the El Calderon area. The Monument would need to work with the NM Highway & Trans Dept; they may wish to add extra rock protection along the highway. As spelled out in the recommendations report, a "splitter device" made of gabion, concrete, or simply piled rock construction would split the flood flows between the "original natural channel" along the highway and the branch going past the El Calderon Parking Lot area (Figure 1.4).
	Alt C. The large-channel action	It would be possible to construct a large channel from the Pine Dike area and take all the flood water down one fork --either along highway area or along the El Calderon area— in other words, take all the water down one fork. From a flooding perspective, it would be better to split the flow and share it between the two forks (as in the project recommends).
Treatment Site # 4 Stock Tank 28	Alt A. status quo	The same as ST 19-2, the stock tank deprives a meadow area of moisture and affects wildlife habitat.
	Alt B. Preferred action. Fill in ST-28	Cut and fill for the area are about equal, and filling would be a minor job. Contouring and re-seeding would be needed.
Treatment Site # 5. **El Calderon Parking Lot area**	Alt A. No action –status quo	Taking no action would allow flooding impacts to continue.
	Alt B. Preferred action. Pine Dike work + improve drainage	Improve the drainage channel in the parking lot area and drainage by the entrance road to the parking lot area (in conjunction with the flow diversion work up at Pine Dike).
	Alt C. The large-channel option	This option would construct a large channel to take flood water past the El Calderon area. The water would flow in the present channel, but the channel would be enlarged and bermed. In addition, the parking lot would be raised by a foot, by filling in gravel. This larger channel option was rejected, since from a flooding perspective, it would be better and less expensive to split the flow up at the Pine Dike and send the flood waters down two forks from the Pine Dike.
(Stock Tank 33)	Considered but rejected: Any treatment of ST 33	As seen in Figure 1.4., this pond lies at the far downstream end of the park boundary, below the area where floods are a concern, away from the visitors, and not in position to cause flooding problems to people below it. No action is recommended at this site.

2.2. ALTERNATIVE A: STATUS QUO; NO ACTION

Continuation of the present conditions (no action) is the yardstick against which the other alternatives may be compared. Without a restoration project, one can assume that the old structures would continue to affect the local hydrology. At present, none of the stock ponds or other structures is functioning properly or maintained. They are breached, eroding, or silted, except for the Pine Dike (and its lower end is eroding). Therefore, with no action, the old structures could be expected to:

- continue to disrupt the natural flow regime of the creek;
- add to flooding problems along the Continental Divide Trail in the area;
- draw down ground water of three meadow areas (affecting the ecosystems);
- present possible safety hazards from flooding, mud, road erosion;
- bring flooding to the El Calderon parking lot, disrupting visitation;
- impact caves, "mud rooms," lava tubes, or other geologic features; and
- disturb the natural hydrology of riparian habitats, meadow ecosystems, thereby affecting vegetation patterns (hence also affecting wildlife habitat) by draining ground water and changing natural flow regimes.

2.3. ALTERNATIVE B: THE PREFERRED ACTION

The preferred action evolved from the team's effort throughout 2001 to devise a creek restoration prescription that would be effective, affordable, and environmentally acceptable, as spelled out in the PI's recommendations report (Kunkle and Inglis, 2002). The team of geologists, hydrologists, Monument staff, and other advisers met in eight field sessions of various combinations of people during spring to fall, 2001 (Section 3.2 and Table 3.2, Methodology, lists the experts).

The team and Monument staff decided that restoration work would be most feasible and cost effective at the five sites listed in Table 2.3, also shown in Figure 1.4. The proposed treatment at each of the five sites is detailed in the project's recommendations report, which provides descriptions of the actions needed.

The preferred alternative would fill and contour two ponds, at least partially breach two dikes, fill and smooth some gullies, improve channels to allow better flow, and re-seed disturbed sites (Table 2.3).

Table 2.3. A brief summary of the recommendations for actions under the preferred alternative. Figure 1.4 shows the treatment sites. Photographs of most of the sites appear in Figures 1.1 and 1.2.

- Stock Tank 19-2: fill in the pond and repair small gullies in the meadow below. Contour and re-seed the area (proposed $ 11,000 at 4 acres around pond; 4 acres in meadow).

- The Diversion Dike/ Ditch Entrance area: breach the dike and plug the ditch's entry. Contour and re-seed the area (proposed $2,500 at 2 acres).

- The "Pine Dike" : breach the end of the dike and construct a "flow splitter," to divide creek flow in two forks (see Figure 1.4) to reduce flooding at the El Calderon Parking Lot area below (proposed $13,700 at 4 acres).

- Stock Tank 28: fill in the pond; contour and re-seed the area (proposed $3000 at 3 acres).

- El Calderon Parking Lot: improve the channel flow in the area with low-water crossings (proposed $9,200 at 5 acres).

2.4. ALTERNATIVE C, THE LARGE-CHANNEL ACTION

Alternative C is similar to preferred Alternative B. The two stock ponds would still be filled, the ditch entrance work would still be conducted, and efforts would be made to protect the parking lot area. However, Alternative C has a major difference; it would not breach Pine Dike, but instead let all the creek discharge continue to flow past the El Calderon Parking Lot (as at present). This would necessitate installation of a larger channel and berming to protect the parking lot and Junction Cave against the flood waters. Alternative C also would raise the parking lot with a foot of gravel, to further help protect against flooding.

Alternative C was rejected since: (1) the larger channel and berming at the parking could be more disruptive to the El Calderon and cave area; (2) raising the parking lot with a foot of gravel would be expensive; and (3) the action would be artificial. The old fork by the highway is where the creek ran before Pine Dike diverted the flow in 1957. Therefore, it would be in keeping with NPS philosophy to let the stream return to its natural, original channel (preferred Alternative B), rather than to enlarge an artificial channel (Alternative C).

2.5. ALTERNATIVES CONSIDERED BUT REJECTED

Two major actions were review, discussed, and rejected as not feasible, desirable, or affordable, as described below.

Dam 30 Removal: It was decided that Dam 30, by far the largest of all the structures, would not be treated. Rationale: (1) Dam 30 is officially "historic," according to the PI's aerial photographic research in 2001 (photos from the 1930's); (2) it would be too expensive to remove Dam 30, given its size; (3) perhaps most important, the dam has no hydrologic effect, since its feeder ditch is breached; (4) it lies on a tributary, not the main creek, so receives too little water to be a safety hazard or a hydrologic concern; (5) the Continental Divide Trail runs right along the dam, so it is a "story" for the visitors. For these reasons, no treatment was recommended at Dam 30. (The dam will be added to the NPS dam safety list in any event [charles_karpowicz@nps.gov; 202 565-1249, to provide the routine information on the lat/long, length/height, name, and ownership of the dam, for NPS records].

Stock Tank 33 (ST 33) Removal: As seen in Figure 1.4., this pond lies at the far edge of the National Monument land and well below the parking lot and other areas where floods are a concern and where visitors often come. ST 33 is near the point where the floodwaters generally disappear in any event, so hydrologically it is not a significant structure. Therefore no action was recommended for the site; treatment would not be cost-effective.

Pine Dike –Complete Removal: Pine Dike is an unnatural structure, but its complete removal was not seriously considered, since: (1) it is large, so removal would be expensive; (2) breaching only the lower end would be just as adequate hydrologically, i.e., would allow floodwaters to pass; complete removal would add no advantage; (3) the dike has an attractive pine tree cover and is in sight of the road; it is not necessary to destroy the trees.

2.6. ENVIRONMENTALLY PREFERRED ALTERNATIVE

As stated in Director's Order #12 and Handbook (NPS, Washington, 2001), the environmentally preferred alternative promotes the national environmental policy as expressed in the National Environmental Policy Act (Sec. 101 (b)). Among other concerns, a preferred alternative therefore will:

- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable ... consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage...
- Enhance the quality of renewable resources...

The preferred alternative should cause the least damage to the biological and physical environment and protect, preserve, and enhance historic, cultural, and natural resources (El Malpais NM, 2001, originally from Council on Environmental Quality excerpts of 1981).

The preferred alternative of the proposed creek restoration project is in harmony with the concepts of resource protection, human safety, and resource management expressed above.

2.7. SUMMARY OF IMPACTS

Table 2.7. summarizes the effects of the three alternatives on the impact topics reviewed in this report. Details on the effects of each alternative appear in Chapter 3 on "Affected Environment and Environmental Consequences."

Table 2.7. Comparison of impacts of the alternatives.

IMPACT TOPIC	ALTERNATIVE A NO ACTION	ALTERNATIVE B PREFERRED ACTION	ALTERNATIVE C LARGER CHANNEL ACTION
Air quality	Present creek conditions have negligible relations to air quality. Minor erosion could produce negligible dust in local areas.	Emissions and dust from earth moving machinery could produce minor, short-term effects on air quality at the immediate project area while the work is in progress.	Emissions and dust from earth moving machinery could produce minor, short-term effects on air quality at the immediate project area while the work is in progress.
Endangered or threatened species	No listed species occur in the treatment area	No listed species occur in the treatment area	No listed species occur in the treatment area
Soils and geology	Long-term, minor to moderate adverse effects of the old structures would continue, including local erosion, siltation, effects on nutrient cycling in meadows by ponds, reduced productivity of meadow soils.	Some temporary, localized erosion would occur due to earth moving activities. Localized compaction from equipment would have short-term effect on meadow areas and at some access points.	More local erosion would occur with this alternative than with Alternative B, since earth moving activities for the larger channel would be greater. Localized compaction from equipment could affect meadow areas and some access points.
Vegetation	Long-term effects of the old structures would continue, including drowdown of ground water in the meadow areas below ponds --which would reduce vegetative productivity and diversity in these areas.	Minor, short-term, local adverse impacts to vegetation would result from equipment impacts. Long-term beneficial effects would include increased vegetative growth in meadows where structure influences on ground water would be eliminated.	Minor, short-term, local adverse impacts to vegetation would result from equipment impacts. Long-term beneficial effects would include increased vegetative growth in meadows where structure influences on ground water would be eliminated.
Water and hydrology	Long-term significant impacts would continue, including: disruption of the creek's natural flow; flooding problems; drawdown of ground water of meadow and riparian areas (affecting their ecosystems); safety hazards from flooding, mud, road erosion; flooding at the parking lot; water impacts on caves and other geologic features; and disturbance of riparian habitats.	Direct and indirect effects on creek flow would occur. Effects would be beneficial and help: restore the natural flow of the creek; return of the creek to its natural channel; restore native riparian and meadow vegetation (& enhance habitat); reduce unnatural flooding of caves; and encourage natural streamflow patterns.	Direct and indirect effects on creek flow would occur. Some beneficial effects would occur, to help: restore the natural flow of the creek; return the creek to its natural channel; restore native riparian and meadow vegetation (& enhance habitat); reduce unnatural flooding of caves; and encourage natural streamflow patterns.
Wilder-ness	The wilderness area is too far removed to be affected by continuation of status quo.	The wilderness area is too far removed to be affected by the proposed project activities.	The wilderness area is too far removed to be affected by the proposed project activities.
Wildlife	Indirect adverse impacts would occur, namely: the ponds and dikes would continue to affect ground water and flow patterns,	Minor, localized, short-term, adverse effects would occur from equipment disturbance of wildlife. Long-term beneficial impacts would occur as various	Minor, localized, short-term, adverse effects would occur from equipment disturbance of wildlife. Long-term beneficial impacts would

	which would affect meadow and riparian areas, which would affect vegetative growth, hence affecting wildlife habitat.	structure removal improves the ground-water recharge regime, thereby improving meadow and riparian moisture conditions and wildlife habitat.	occur as pond removal improves the ground-water recharge regime, thereby improving meadow moisture conditions and wildlife habitat below ponds 19-2 and 28.
Cultural resources	Minor or negligible direct and indirect adverse impacts on archaeological resources could occur whenever floodwaters cause erosion of some areas.	Direct and indirect negligible impacts to archeological, historical, and ethnographic would be expected from equipment working at the 5 treatment sites.	Direct and indirect negligible impacts to archeological, historical, and ethnographic would be expected from equipment working at the treatment sites.
Economic effects	Long-term minor to moderate effects would result from the continued periodic flooding on the parking lot, roads, and trails and the cost of cleanup and repair.	Long-term, moderate, beneficial effects would result from the reduced flooding damage on the parking lot, roads, and trails. Local employment for earth movement would provide beneficial short-term, minor effects to the local economy.	Long-term, moderate, beneficial effects would result from the reduced flooding damage on the parking lot, roads, and trails. Local employment for earth movement would provide beneficial short-term, minor effects to the local economy.
Park operations	Long-term minor to moderate effects would result from the continued periodic flooding on the parking lot, roads, and trails and the need for staff to repair these damages.	Long-term beneficial effects would result from the reduced flooding damage on the parking lot, roads, and trails, so park staff could avoid dedicating time to repairs and the handling of flood effects.	Long-term beneficial effects would result from the reduced flooding damage on the parking lot, roads, and trails, so park staff could avoid dedicating time to repairs and the handling of flood effects.
Public health & safety	Periodic flooding of the El Calderon Parking Lot and nearby roads and trails would present safety hazard to visitors and staff. Water in old ponds would be an attractive nuisance, so another possible safety hazard.	Periodic flooding of the El Calderon Parking Lot and nearby roads and trails would be alleviated, avoiding that safety hazard. Water in old ponds no longer would be an attractive nuisance.	Periodic flooding of the El Calderon Parking Lot and nearby roads and trails would be alleviated, avoiding that safety hazard. Water in old ponds no longer would be an attractive nuisance.
Visitor use	Visitation would be disrupted --at times at a significant level-- when periodic floods would affect the parking lot, trails, and roads in the El Calderon area.	Visitation could continue at the caves and along the trails without or with less disruption by flooding.	Visitation could continue at the caves and along the trails without or with less disruption by flooding.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1. REGULATIONS AND POLICIES

The NPS abides by the National Environmental Policy Act (NEPA) and other laws and regulations to promote resource protection. The Monument's Land Protection Plan, General Management Plan, and Resource Management Plan provide frameworks for managing resources in the Monument and for actions to rehabilitate degraded resources(El Malpais NM, 1989; El Malpais NM, 1990). The basic regulations guiding El Malpais NM resource management was listed in Table 1.5.

3.2. METHODOLOGY

This assessment report describes each topic's affected environment and evaluates the effects the proposed project could have on that environment. The analyses compare the level and duration of various impacts, direct versus indirect effects, and short, long, or cumulative effects. Effects also are identified as beneficial or adverse. In cases mitigation measures are identified.

The impact analyses presented here are based largely on the field observations and field discussions of a team of specialists in 2001-2002. In terms of affiliation, the team included the principal investigator (Colorado State University), co-principal investigator (NPS Water Resources Division), two Monument staff, various National Park Service advisers (Denver and Santa Fe), and short-term, contracted specialists from the academic and private sectors. The specialists and their roles are summarized in Table 3.2.

In terms of technical roles, the visiting experts and cooperators on the project site in 2001 included: two geomorphologists, a hydrologist, a botanist/wetlands specialist, a GIS specialist, an archaeologist, a riparian specialist, a local rancher, and a wildlife specialist. The principal investigator also made contacts in Santa Fe, Albuquerque and Grants at the Forest Service, Natural Resources Conservation Service, the University of NM, the NM Highway and Transportation Department, and other organizations, to collect maps, photographs, data, and reports, and to conduct interviews. Chapter 4 of this report lists persons or organizations contacted during the project work.

The team conducted watershed analyses, interpretation, as well as the discussions at the project site during the PI's approximately monthly trip to the Monument during the period March to November, 2001. The National Monument staff provided the team with GIS maps, topographic maps, GPS assistance, photographs, excerpts of relevant reports, and other materials to backstop the team's work, and met with them about monthly during spring-fall, 2001.

The project team and Monument staff prepared a Geographic Information System (GIS, ArcView) map of the area, interpretation of the area's hydrology, and an overview of the structures' history from old aerial photographs. The map information is summarized in the recommendations report (Kunkle and Inglis, 2002) and in maps available at the Monument.

The team also surveyed detailed topographic maps of each of the five treatment sites, using a "Total Station" instrument, importing the data into Computer Assisted Design (CAD) software to prepare contours, cross sections, and earth movement volumes for each site. The maps and calculations provided designs for earth work and cut-fill volumes for the recommendations report. Figure 3.2 is an example copied from a section of one of the site topographic maps.

Table 3.2. Overview of the roles of team members, visiting experts, and some key contacts. A general list of other contacts and cooperators appears in Chapter 4, Table 4.1.

TEAM MEMBER OR ADVISER	COMMENTS ON ROLE, OR CONTRIBUTION
Sam Kunkle, principal investigator and watershed specialist	Former natural resource specialist with the NPS, now CSU Research Scientist. Coordinated the project overall with monthly visits and field work in 2001. Worked with Monument GIS specialist et al to prepare maps. Principal author of recommendations report. Researched aerial photographs. Reviewed literature. Studied history of area. Visited technical agencies.
Rick Inglis, co-principal investigator and hydrologist	Hydrologist with the Water Resources Division, NPS, Fort Collins. Analyzed the project area since 1997. Led topographic mapping of the treatment sites. Interpreted hydrology of the area during 5 visits. Researched stream discharge. Met with most of the experts in the field. Assisted survey of the original, ancient creek channel.
Herschel Schulz, Chief Ranger, El Malpais NM	Key person with local information, including photographs of floods, personal knowledge and observations on the ground, including flooding observations of the creek. Provided insights on local ecology, vegetation, history, and wildlife from years in the project area.
Jeanne Ratlief, Ranger/ GIS, El Malpais NM	GIS and natural resource specialist in ArcView, mapping, and GPS. Assisted PI on GPS protocol and procedures. Converted field GPS data into ArcView and prepared maps.
William Zeedyk, riparian specialist	NM Riparian Council and former Forest Service wetlands/riparian person. Consultant specializing in riparian restoration work for streams in the Southwest. Background also in wildlife ecology. Worked as part of team in the field to advise on hydrology, channels, riparian habitat, and restoration alternatives.
Esteban Muldavin, vegetation specialist	University of NM senior specialist on vegetation in the Southwest and New Mexico. Wetlands specialist for State projects. Conducted field review of the area with the PI to assess if wetland or T&E plants seen. Reviewed vegetation patterns.
Steve Fettig wildlife specialist	Senior NPS wildlife specialist at Bandelier National Monument. Met with the PI in the field to review wildlife habitats, vegetation, riparian areas, and general ecology. Discussed threatened and endangered species questions.

Hal Pranger geologist	Geologist with the NPS in Denver. Visited the project area to interpret the geology, fluvial geomorphology, and flow patterns and to review question of the original, ancient channel, the diverted creek features, and natural channels.
Dave Steensen, geologist	Geologist with the NPS in Denver. Visited the project area to assess the fluvial features in relation to lava tubes and caves within the Agua Fria Creek channel, to assess the impacts (and possible mitigation measures) of disturbed lands along the creek resulting from the proposed restoration project, and to advise on restoration techniques.
Eric Prince graduate student, CSU	Assisted the PI and Co-PI to prepare AutoCad topographic contour maps of the five treatment sites of the project and to calculate cut-fill volumes of earth movement for use in preparing the recommendations report.
Ron Clawson local rancher	Long-term resident in the area, and Forest Service technician. Met with the PI and visiting Archaeologist on the ground to review history of the ponds, dikes, and other features from his knowledge.
Harding Polk II archaeologist	Archaeologist with SWCA, Inc, Albuquerque. Surveyed the project area and prepared a cultural resources survey report (excerpts used in this report). Advised the PI and Chief Ranger on cultural aspects.
Michael Welsh, historian	Historian, University of No. Colorado, Greeley. Studied records at the National Archive Center in Denver to probe the history of Dam 30 to seek to information on its origin and builder.
Cathy Spude, archaeologist	Supervisory archaeologist with the Santa Fe support office, NPS. Visited the project on the ground with the PI to develop concepts and advice for the cultural surveys the project would need for an EA. Helped line up consultants Polk and Welsh.
Linda Popelish, archaeologist	Archaeologist, Forest Service, Grants. Provide maps and details on land ownership and history in the project area (which was formerly FS land).
Doug Bradley, GIS specialist	GIS/ remote sensing specialist, NPS, Albuquerque. Provided maps, data, and advice. Assisted with GPS mapping and advice on aerial photographs.
Jeff Fredine, Dennis Slifer, environmental specialists	NM Highway & Transportation Dept Environmentalists, Santa Fe (among several persons met at the H& T Dept to discuss the Pine Dike question and environmental topics). Provided maps, reports, and design on Pine Dike, plus information on the Highway 53 EA they had conducted in the mid-90's.
Dave Pawelek, hydrologist	Cibola NF Hydrologist, Forest Service, Albuquerque. Provided PI with data, reports, literature, and advice on hydrology of the Agua Fria Creek headwaters in the nearby National Forest.
Pam Benjamin, vegetation specialist	Vegetation specialist, NPS, Denver. Met with PI & C0-PI to provide advice on seeding and planting for the restoration work.
Laura Gleasner, remote sensing specialist	Geographic data specialist, Univ of NM, Earth Data Analysis Center (EDAC), Albuquerque. Worked with the PI to research aerial photographs of the project area from the 1930's to later, to determine age of the structures (Table 3.2.1).
Joel Wagner, wetlands specialist	Senior wetlands scientist, NPS, Denver. Provided review of project information, telephone advice, and discussion of the wetland and riparian topic.

3.2.1. Cultural Resource Analysis Method

In April-May, 2002, Harding Polk II, SWCA Environmental Consultants, Albuquerque conducted a cultural survey at the project and prepared a 35-page *Cultural Resource Survey* for the project (Polk, 2002). The analysis was conducted to comply with the requirements of the National Environmental Policy Act (NEPA) and Section 106 of the National Historic Preservation Act, to assess the effect of implementing the proposed alternative on cultural resources. Cultural resources were surveyed to review any features that are listed or eligible to be listed in the national Register of Historic Places

SWCA studied maps at the Archaeological Records Management Section, N.M. Historic Preservation Division, Santa Fe, for previously recorded sites within 1.0 mile (1.6 km) of the project, and checked the online listings for the National Register of Historic Places and State Register of Cultural Properties for registered projects in or adjacent to the survey areas. SWCA also checked with the Chief Ranger for previously recorded sites within the area. Aerial photographic information also was useful (Table 3.2.1.)

Table 3.2.1. Aerial photographs of the project area, from Earth Data Analysis Center, University of NM, Albuquerque, NM, 2001, as studied by Kunkle in conjunction with Gleasner of the University of NM to determine the history of structures in the proposed project area.

Feature	1935 or 1936 photo	1945 photo	1952 photos (both May and June flights)	1958 photos	1966 photos
Stock Tank 19-2	No	yes	yes (has water in May photo)	yes	Yes
Dam 30	No	yes	yes (feeder ditch is not breached)	yes (feeder ditch is not breached)	yes (feeder ditch is not breached)
Pine Dike	no	no	No	yes –very "fresh"[1] like under construction	yes
Stock Tank 28	No	no	No	yes–very "fresh"[2] like under construction	yes
Stock Tank 33	No	no	No	no	yes

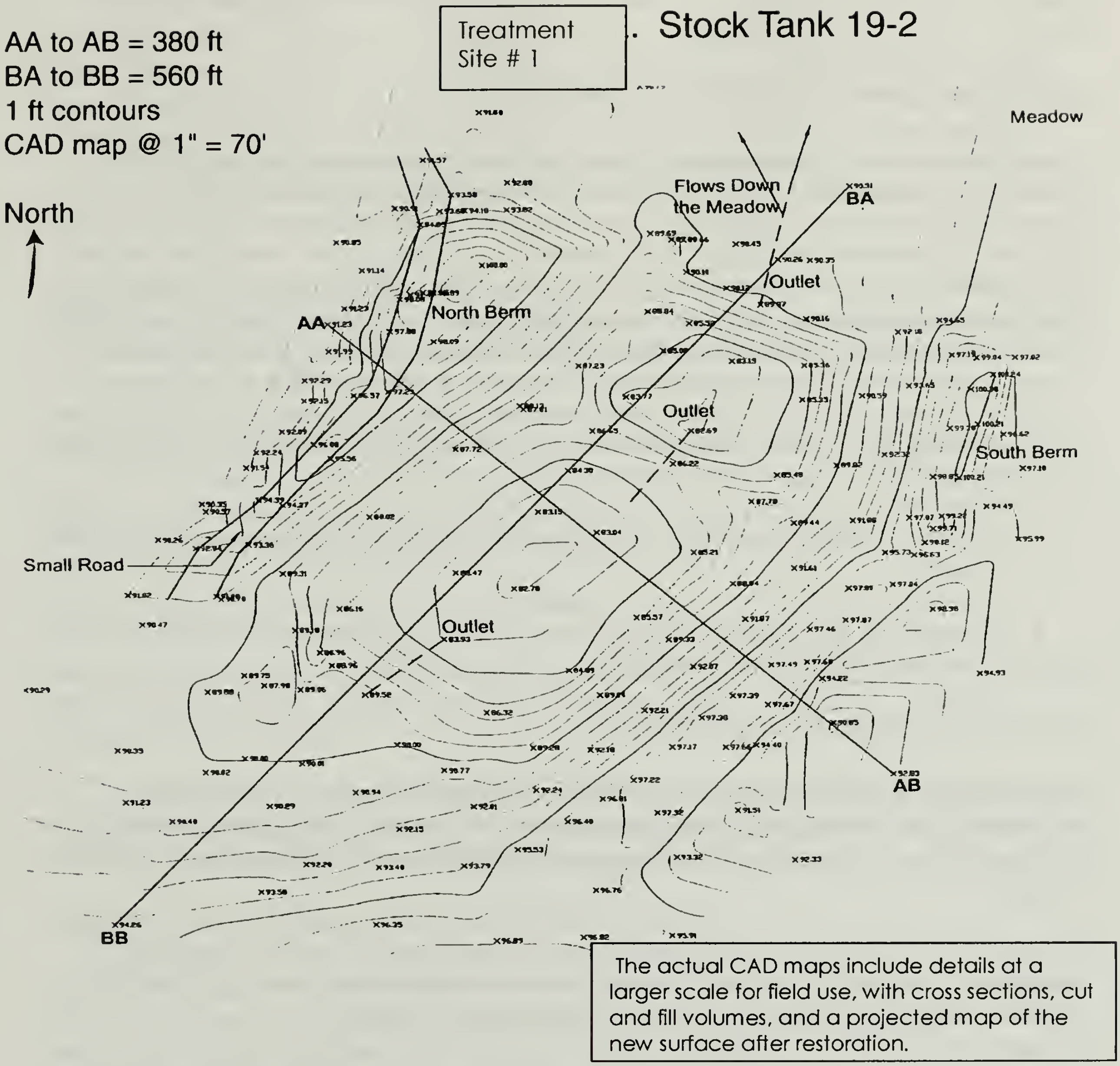


Figure 3.2. Example extracted from one of the CAD maps prepared for each of the five treatment sites.

Polk's field survey then was conducted to (1) locate and record any archaeological remains of an apparent or likely age of 50 years or more, as well as any standing historical buildings or structures within or next to the survey areas; and (2) record and assess several identified historic water control devices within the general project area.

3.2.2. Cumulative Effects Analysis Method

Under the National Environmental Policy Act, proposed federal projects should conduct an assessment of the cumulative effects of the proposed actions. Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (El Malpais, 2001, re: 40 CFR 1508.7, from CEQ, 1978). Cumulative effects were considered for each impact topic. Actions which have the potential to produce a cumulative effect include:

- Actions by the Forest Service in headwaters of the creek (e.g., should a dam be built);

- Fire management activities or wildfires in the upstream area (could increase runoff);

- Future work on Highway 53 (e.g., new culverts, rock work, or straightening of road sections near the creek).

3.2.3. Impairment Analysis Method

National Park Service Management Policies (NPS, Washington, 2001) requires analysis of the potential effects of a project to determine if the actions would impair park resources or values. NPS managers should seek ways to avoid or minimize such impacts.

The impairment determination concept was considered for each of the impact analyses in Sections 3.3 to 3.12, to identify a particular impact that might have an adverse effect on a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the National Monument;
- Key to the natural or cultural integrity of the Monument or to opportunities for enjoyment of the Monument; or
- Identified as a goal in the Monument's general management plan or other relevant NPS planning documents.

3.3. AIR QUALITY

3.3.1. Affected Environment

The quality of the air in the monument is good to excellent, and the quality of the area in terms of both visibility and public health is among the highest in the nation. Short periods of regional haze can come in from outside the immediate area from forest fires and other sources, but smoke is generally a temporary phenomenon. Most prescribed fires occurring in the area are of several days' duration, and the ventilation is generally good (BLM and NPS, 2001). Prevailing winds are from the west and south.

El Malpais is designated as a Class II airshed under the 1977 Clean Air Act (42 U.S.C. 7401 et seq.). The project area is within a New Mexico State designated Air Quality Control Region (AQCR), and falls into the Prevention of Significant Deterioration (PSD) program of the Clean Air Act as a SPD Class I designation. These are areas with pristine air, where almost no increase in air contamination is allowed (Marron and Wilson, 1994). This is valuable for tourism in the area. New Mexico requires that a permit for fires be obtained, and application to the State for a prescribed burn also must include a plan for emission management (El Malpais NM 1990; Marron and Wilson, 1994; El Malpais NM, 2001).

3.3.2. Impacts of Alternative A, No Action

Leaving the stock ponds and other structures in place, or continuation of the status quo, would be expected to have no effect on air quality in the area, either immediate or cumulative.

> Conclusion. The choice of Alternative A, i.e., no action, would not produce adverse impacts on visibility, air particulates, air chemistry, or other aspects of air quality resources or impair the integrity of the Monument.

3.3.3. Impacts of Alternative B, the Preferred Action

Air quality impacts from the preferred alternative would be "negligible" (defined as an action causing a change in the natural resource that would not be of measurable or perceptible consequence to the viewshed or airshed (from criteria in BLM and NPS, 2001 and El Malpais NM, 2001, based on EPA guides).

A major source of air pollution in the project area now is particulate matter generated from dust storms or dust from small roads. During the proposed project, short-term dust emissions would be produced by the construction machinery. Mitigation measures could include mulching of disturbed areas after planting to reduce dust sources and production. No burning would be necessary; brush and slash therefore could be used for mulching.

Cumulative Effects. Any air quality effects from the proposed project would be short termed, mainly dust from machines working, with no cumulative effects.

Conclusion. The choice of Alternative B, the preferred action, would not be expected to produce significant adverse impacts on visibility, air particulates, air chemistry, or other aspects of air quality and would not impair the integrity or role of the Monument.

3.3.4. Impacts of Alternative C, the Large-Channel Alternative

Air quality impacts from Alternative C would be the same as that of preferred Alternative B. Impacts would be "negligible" (an action causing a change in the natural resource that would not be of measurable or perceptible consequence to the viewshed or airshed, (BLM and NPS, 2001; El Malpais NM, 2001).

Short-term, localized dust emissions could be produced by the construction machinery. Mitigation measures could include mulching of disturbed areas after planting to reduce dust sources and production.

Conclusion. Alternative C, the large-channel action, would not be expected to produce adverse impacts on visibility, air particulates, air chemistry, or other aspects of air quality resources or impair the Monument.

3.4. THREATENED OR ENDANGERED SPECIES

3.4.1. Affected Environment

Contact was made with the New Mexico Department of Game and Fish (NM DG&F) for advice on obtaining lists of species for Cibola County. Lists used to build Table 3.4.1 were taken the NM DG&F and New Mexico Natural Heritage Program's "Bison-M" site, and from the species list of the Southwest Region Ecological Services of the U.S. Fish and Wildlife Service. Table 3.4.1 shows seven federally listed threatened or endangered species and six listed by New Mexico.

Three specialists also walked the project area with the Principal Investigator to observe and comment on wildlife habitats, plants, possible nesting sites, water patterns and other characteristics (Dr Esteban Muldavin, riparian/wetland specialist and botanist, University of NM; Steve Fettig, wildlife biologist and bird specialist, Bandelier NM, National Park Service; and Bill Zeedyk, wildlife biologist and riparian specialist, NM Riparian Council). Information also was drawn from the Monument's biology files and references.

Table 3.4.1. Species or habitats listed in Cibola County, NM as threatened (T), Endangered (E), critical habitat (CH), extirpated (EX), candidate (C), sensitive (S), considered for delisting (D).

Name	Scientific Name	Status, Federal	Status, State
Bald eagle *	*Haliaeetus leucocephalus*	T, AD	T
Black-footed ferret N*	*Mustela nigripes*	E, EX	
Gray vireo	*Vireo vicinior*		T
Mexican spotted owl N*	*Strix occidentalis lucida*	T, CH	
Mountain plover *	*Charadrius montanus*	T	
Pecos (=puzzle, =paradox) sunflower N*	*Helianthus paradoxus*	T	
Perigrine falcon, American N*	*Falco pergrinus anatum*		T
Southwestern willow flycatcher N*	*Empidonax traillii extimus*	E, CH	E
Spotted bat N*	*Euderma maculatum*		T
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	C	
Zuni bluehead sucker *N	*Catostomus discobolus yarrowi*	C	E
Zuni fleabane N*	*Erigeron rhizomatus*	T	S

The following are species of concern:

- Townsends big-eared bat (*Plecotus townsendii pallescens*) (has been observed within the lava tube caves of the Monument) *
- Acoma fleabane (*Erigeron acomanus*)*
- Cinder phacelia (*Phacelia serrata*)*
- Wright's fishhook cactus (*Mammillaria wrightii*) under review for delisting*(BLM and NPS, 2001),

* = known to occur in the general area or county
N* = not documented in the Monument (BLM and NPS, 2001)

3.4.2. Impacts of Alternative A, No Action

Alternative A, no action, would be expected to have no significant effect on the status of threatened or endangered species in the area. The habitats for animals or the growing conditions for plants should continue essentially as they are at this time.

3.4.3. Impacts of Alternative B, the Preferred Action

Under this alternative, the direct, short-term or long-term impacts would not be expected to affect listed or proposed species or their designated critical habitats; no significant effects would be expected on endangered and threatened species.

Some species or habitats are not present in the project area or the monument, for example, the southwestern willow flycatcher or Mexican spotted owl and impact would not be a concern. In other cases, a species occurs in the general area, but the project would not be expected to affect it, for example, the Cinder Phacelia plant. The preferred alternative would not be anticipated to impair the integrity or overall goals of the Monument.

The paragraphs below highlight possible impacts for each of the species listed in Table 3.4.1.

American Bald Eagle (*Haliaeetus leucocephalus*): Documented sightings have occurred in and adjacent to the monument, but the eagles are believed to be migrating individuals passing through, mainly in the winter(El Malpais NM, 1997). Nesting or summering areas associated with sandstone cliffs or bluffs are key habitat however the project would not affect such areas (Marron and Wilson, 1994).

Black-footed Ferret *(Mustela nigripes)*: No documented sightings of black-footed ferrets have occurred in the monument, and they have been extirpated from the state of New Mexico, according to the NM Department of Game and Fish. They are believed to be extinct in this region (El Malpais NM, 1997; El Malpais NM, 2001).

Gray Virio (*Vireo vicinior*): This species prefers woodland areas near permanent or semi-permanent water (Marron and Wilson, 1994); the project area does not provide such habitats.

Mexican Spotted Owl (*Strix occidentalis lucida*): No documented sightings have been reported. Forested mountains and canyons are habitat for the Mexican spotted owl, i.e., habitat not present within the proposed project area. In the view of biologists, the conifer and ponderosa pine habitat within the Monument does not have the species composition, density, or aspect for the owl, since in general it prefers mature canopy. (El Malpais NM, 2001; BLM and NPS, 2001; El Malpais NM, 1997).

Mountain Plover (*Charadrius montanus*) Mountain plovers have been observed in a corner of the monument, but not in the project area. Park biologist Alexander (El

Malpais NM, 1997) believed that the area does not contain the shortgrass prairie habitat needed by this species, and that birds observed in the region were probably migrating between winter range in the Southwest and breeding range in the western plains. Lightfoot et al (1994) observed this species in the southwest portion of the Monument, probably migrating.

Pecos sunflower(Helianthus paradoxus): The Pecos sunflower (Helianthus paradoxus) can be found near Grants, New Mexico, some 20 miles away and drier, but no plants or suitable habitat are known to exist within the proposed project area. Therefore, the proposed project would have no effects on this species (El Malpais NM, 2001). University botanist Muldavin has seen the Pecos sunflower in southeast New Mexico, along perennial streams, but during his field visit to the project area, he saw no habitat suitable for the plant (Esteban Muldavin field observations at the project site, 2001).

Perigrine falcon (*Falco peregrinus anatum*): No peregrine falcons have been observed in the monument, although there are records for Cibola County. The Monument biologist surveyed the area for peregrine activity or nest remnants and found none. Possibly peregrine falcons are absent from this area because of human activity along the highway (El Malpais NM, 1997).

SW Willow Flycatcher (*Empidonax traillii extimus*): No suitable habitat is present within the treatment area for this species, in the view of the wildlife and riparian specialists visiting the project area in 2001. This species inhabits thickets, riparian woodlands, pastures, and brushy areas. There have been no documented sightings. (El Malpais NM, 2001; BLM and NPS, 2001; opinions of biologists Muldavin and Fettig at the project area, 2001).

Spotted Bat (*Euderma maculatum*): Documented sightings have occurred in Cibola county but not in the Monument (El Malpais NM, 1997). This bat occurs in several National Forests in New Mexico, mainly in remote areas, selecting specialized roosting sites. Not much is known about the natural history and habitat requirements (Marron and Wilson, 1994). Park biologist Alexander noted that the presence of streams and nearby cliffs or steep hillsides with loose rocks may be habitat for this bat, but the proposed project sites do not offer these features (El Malpais NM, 1997).

Western yellow-billed cuckoo (*Coccyzus americanus occidentalis):* This species is not present in the park (NPS, 1994 park fauna list).

Zuni bluehead sucker (*Catostomus discobolus yarrowi):* This species is not included in the Monument's list of plants (Bleakly, 2000).

Zuni fleabane (*Erigeron rhizomatus)*: No suitable habitat is present within the treatment area for the Zuni fleabane. The species has not been recorded in the area (El Malpais NM, 2001)

Townsends big-eared bat (*Plecotus townsendii pallescens*): This species of concern occupies lava tubes and occurs in the general area (BLM and NPS, 2001). The project proposed should not adversely affect the species or its habitat, and could favorably affect the bat, by protecting lava tubes from flooding.

Cinder Phacelia (*phacelia serrata*): This is a species of concern and rare plant found growing on cinders in the Bandera crater area. It was previously known only in the San Francisco volcanic field area of Arizona (El Malpais NM, 1997). The species is restricted to areas of loose cinder substrate and hence has a highly restricted range. (Marron and Wilson, 1994). The proposed project would not affect such habitats.

Acoma fleabane (*Erigeron acomanus*): This is a species currently known from a few locations in McKinley and Cibola counties, occurring on deep, sandy soils, usually near the base of sandstone cliffs in pinyon-juniper woodland. It appears on the New Mexico State Sensitive Plant Species List (Marron and Wilson, 1994). The proposed project area does not contain suitable habitat.

Wright's Fishhook Cactus (*Mammillaria wrightii wrightii or Sclerocactus wrightiae*) This small cactus is found on sandy and alluvial soils, including along upper NM Highway 53 at the west Zuni-Acoma trailhead. This cactus is found only in New Mexico and is susceptible to poaching (Marron and Wilson, 1994). The plant is normally found in dense grama grassland, and was recently discovered in El Malpais National Conservation Area. Probably it is not present in the proposed project area, and was not observed at the treatment sites during field visit of botanist Muldavin.

Cumulative Effects. The proposed project impacts would be short termed and localized, therefore not expected to affect or interact with surrounding areas or produce any cumulative effects over a longer time frame.

Conclusion. The choice of Alternative B, the Preferred Action, would not be expected to produce adverse impacts on threatened or endangered species and should not impair the basic integrity or goals of the Monument.

3.4.4. Impacts of Alternative C, the Large-Channel Action

The impact of Alternative C, the Large-Channel Action on threatened and endangered species would be identical to that of Preferred Alternative B. described above. Alternative C would simply direct more of the creek's flow by the El Calderon Parking Lot area, so the difference between the alternatives is only one of hydrology, and plant or animal species would be expected to be affected the same.

Cumulative Effects. The proposed project impacts would be short termed and localized, therefore not expected to affect or interact with surrounding areas or produce any cumulative effects over a longer time frame.

Conclusion. The choice of Alternative C, the Large-Channel action would not be expected to produce adverse impacts on threatened or endangered species or harm the integrity of the Monument.

3.5. GEOLOGY AND SOILS

3.5.1. Affected Environment

El Malpais National Monument is geologically a unique place. The combination of geologic surface features and lava tubes presents one of the most interesting volcanic terrains in North America. The Monument contains 10 major volcanic vents (most in the form of cinder cones), 7 contiguous lava flows, and some of the longest lava tube systems in the country, plus several ice caves. Lava flows cover about 95 percent of the monument's surface, with numerous flows having occurred over the past million years. These geologic features are an important scientific resource, therefore shape the direction of planning as well as the types of projects that take place in the Monument (El Malpais NM, 1990; BLM and NPS, 2001).

The lava flows in the project area are relatively recent compared to the older flows at Mount Taylor (north of the monument), where the flows range in age from about 2.9 to 3.7 million years. The lava flows covering most of the monument are listed in Table 3.5.1. Lava flows in the proposed project area, near El Calderon, are about 100,000 years of age. In places, the El Calderon flow also has been covered by subsequent flows of different ages (Lightfoot et al, 1994).

TABLE 3.5.1. APPROXIMATE AGES OF EL MALPAIS LAVA FLOWS (FROM LIGHTFOOT ET AL, 1994).

LAVA FLOW NAME	APPROXIMATE AGE, YEARS
OLD BASALT	150,000 TO OLDER
EL CALDERON	100,000 YEARS
TWIN CRATERS	16,000
HOYA (DE CIBOLA)	NO ESTIMATES
BANDERA	10,000
MCCARTYS	3,000

Lava tubes are another important geomorphic feature in the project area. Tubes form in the flows when lava cools and hardens. A tube can stay intact as a cave, or its roof may collapse, creating an open depression or collapsed structure. Both tubes and collapsed structures are common in the proposed project area. Some are periodically flooded. The artificial Pine Dike upstream (Figure 1.4) diverts Agua Fria Creek down toward the El Calderon Parking lot, where caves and collapsed structures can be flooded. Figure 1.2's Photo H-1b shows flood waters pouring into open tubes near the El Calderon Parking Lot.

The park and its lava flows are contained within a closed basin, and the creek channel disappears into the ground below the project area, as shown in Figure 1.4 and as observed in the field by the project team hydrologists. Precipitation falling in the area is either used by vegetation or sinks into the lava tubes and enters the ground water system (BLM and NPS, 2001).

Lava formations strongly affect stream flow patterns in the area. These patterns were observed in the field by a geologist on the project team (Hal Pranger, NPS, Denver). In Pranger's impression, the original stream channel was covered with the highway after Pine Dike was constructed to divert the stream. Below are excerpts from his field observations in summer, 2001.

> "General development of the valley: before the lava flows, Agua Fria Creek likely was an incised arroyo with dissected side tributary valleys. Lava erupted from the west and south from approximately 115,000 BP (El Calderon) to at least 11,000 BP (Bandera) and flowed down and filled the main stem of Agua Fria Creek... The lava flows blocked off streamflow for the main stem and tributaries, causing a substantial deposition of alluvium in relatively flat plains (essentially lava dams). This process resulted in the creation of the ... Stock Tank 19-2, Dam 30, and Pine Dike meadow areas.
>
> With the many surface manipulations and diversions in these areas, it would be very difficult to determine with certainty if there were a single dominant channel in these two areas. However, downstream of Pine Dike, the remnant channel fragments that were not destroyed by highway construction tend to indicate that a single channel flowed along and/or under Highway 53 and past the El Calderon parking lot entrance.
>
> Collapsed lava tubes and tube entrances could have had substantial natural surface flows into them (particularly by El Calderon Parking Lot), but most are perched on the mid-flow ridge in the center of the Agua Fria valley.
>
> From Fork Meadow to Pine Dike (see Figure 1.4.), Agua Fria creek is essentially based in bedrock... Bedrock geology consists of Permian red siltstone and sandstone ridges comprising the southwestern valley edge, dipping at approximately 10 degrees to the southwest, and granite to the north and east toward the Zuni mountains. Lava is in the valleys; ... with cinder cones, lava tubes, caves and collapse features" (Pranger, 2001).

The surfaces of the most recent volcanic flows have little or no soil. Relatively deeper soils are found in the valley bottoms --often sandy loams or gravelly loams in most valley bottoms of the area (Marron and Wilson, 1994). In the project map of Figure 1.4, the relatively deeper soils are present in the meadow-like areas at Stock Tank 19-2, behind Dam 30, and in the Fork Meadow area. On the other hand, soils are shallow at sites where lava or bedrock is near or at the surface, including the El Calderon Parking Lot, much the area downstream from the El Calderon Parking Lot, and the area paralleling the highway northwest from the Pine Dike (marked "tube channels" in Figure 1.4). Some meadow areas, for example below Stock Tank 19-2, have a developed soil profile, albeit a shallow profile. Soils in these lava areas have good drainage and are generally not highly erodible (El Malpais, 1990 plus team observations). Soils along bluffs are generally shallow, and soils at the base of bluffs are loose silt and sand eroded from the hills above. These soils are erodible.

3.5.2. Impacts of Alternative A, No Action

The principal geologic impact from Alternative A, no action, would be on the caves and lava tubes; they would continue to be affected by periodic flooding and sedimentation, especially around the El Calderon Parking Lot area. The impacts would be "moderate," that is, long-term, and could change the character of the caves and tubes, i.e., impair the geologic integrity of the area (a principal reason the Monument exists).

Alternative A would be expected to have "minor" effects on the general status of soils in the area. Erosion of the old structures would continue to contribute sediment to the creek, and water flowing through the old ditch would continue to cause rill and sheet erosion in the meadow area below the breach in the ditch. Erosion around the El Calderon Parking Lot would continue to be "moderate," with periodic road erosion and sediment loading into the lava tubes nearby.

> Cumulative Effects. The no action alternative would be expected to allow continuing erosion of the meadow areas and periodic flooding and sedimentation of caves and lava tubes. The flooding and sediment would be expected to affect the appearance of these special features of the Monument over the long-term.
>
> Conclusion. The no action alternative would most likely allow erosion of old structures and resulting sedimentation to continue, producing long-term moderate, negative effects on the unique geology of caves and lava tubes, impairing this aspect of the Monument's integrity. Erosion damage to some meadow areas as well as road and parking lot erosion would be expected to continue.

3.5.3. Impacts of Alternative B, the Preferred Action

Alternative B, the Preferred Action, would have moderate, long-term, positive effects on the geology of the area. Stabilization of the old structures would decrease the sediment production occurring in those areas. Restructuring of Pine Dike and the other restoration work of the project would spread flood waters and reduce flood peak levels at the El Calderon Parking Lot area, meaning less flooding and sedimentation of the caves and lava tubes would be expected in that area.

The Alternative would have moderate positive effects on the soils of the area; the effects would be apparent and long-term. Erosion would be reduced in the meadow area below the ditch breach, and erosion of the old structures would be stabilized. Spreading of the flood waters at Pine Dike would be expected to reduce channel bank erosion in the Stock Tank 28 and El Calderon Parking Lot areas.

The alternative could have negligible, short-term adverse effects immediately after the restoration work, since localized erosion could occur on disturbed soil until new vegetative cover takes over.

Cryptobiotic soils are present in isolated places around the monument; these are black crusts that hold water. The proposed treatment sites are mostly in grassy areas where cryptobiotic soils should not be a concern. However, as pointed out in the Monument's environmental assessment on fire management (El Malpais, 2001), the project would need to be alert to possible cryptobiotic soils and mitigate against damage. The project should not allow vehicles off approved roadways and should educate field crews about how to identity and avoid cryptobiotic soils.

Cumulative Effects. The preferred alternative would control the erosion of the meadow areas and would be expected to significantly reduce the periodic flooding and sedimentation of caves and lava tubes. Over time, major reduction of the flooding and sedimentation should allow the cave and lava features of the Monument to resume their natural condition, functions, and integrity.

Conclusion. The preferred alternative would most likely have a moderate positive impact by controlling soil erosion of the meadow areas, stopping soil erosion at the old structures, and significantly reducing periodic flooding and sediment impacts on caves and lava tubes. This should allow these caves and tubes --special geologic features of the Monument-- to resume their natural condition and ecological role. This is part of the Monument's integrity. The alternative would be expected to have negligible, short-term adverse effects immediately after the restoration work, since localized erosion could occur on disturbed soil until new vegetative cover is in place.

3.5.4. Impacts of Alternative C, the Large-Channel Action

Alternative C, the large-channel action would simply convey more water past the El Calderon Parking Lot area via a larger channel, instead of splitting the flow at the Pine Dike, as in Alternative B. From a geologic and soils standpoint, one would anticipate that the impacts of the large-channel action would be identical to that of Alternative B.

3.6. VEGETATION

3.6.1. Affected Environment

Lightfoot, Bleakly, Parmenter, and Gosz prepared a comprehensive report, "The vegetation and wildlife inventory of El Malpais NM" in 1994 and found 424 species of vascular plants, 167 species of cryptogams, 36 species of mammals, 109 species of birds, 15 species of reptiles, 2 species of amphibians, and 354 species of arthropods in the entire Monument (Lightfoot et al, 1994), drawing heavily on Bleakly's MS thesis work during 1991-94. Bleakly has continued to return to the Monument periodically, to update and supplement his original work. The latest, most complete list has been entered into the "NP flora and NP fauna" databases of the National Park Service, which is shown in Appendix A. Bleakly also has conducted studies of the plant life on lava in the area. In 2000, he prepared a condensed, user-friendly plant brochure of "common, conspicuous, interesting, introduced, and rare plants," printed by the Southwest Parks and Monuments Association, suitable for visitors (Bleakly, 2000). In this brochure, he groups the plants by Ferns & Spikemoss, Trees & Shrubs, Grasses & Grasslike Plants, and Forbs & Wildflowers. This version of his work is available from the

Monument. The basic vegetation communities found in the park are described by Muldavin (who visited the project area as adviser in 2001) in his book "Handbook of wetland and vegetation communities of New Mexico" (Muldavin et al, 2000). Table 3.6.1 summarizes the broad vegetation types.

Table 3.6.1. An overview of the general vegetation communities found in the proposed project area (based on Lightfoot et al., 1994 plus field observations by the project team).

1. Mid-low elevation ponderosa pine woodland *(Pinus ponderosa)*: Younger ponderosas are growing well in the area, for example, on the Pine Dike (Figure 1.1). Good examples of large ponderosas are found throughout the project area (note report cover photo). This type of forest has a well developed grass understory. Much of the proposed project area is a mixture of the ponderosa pine and piñon woodland (#2 group, below).

2. Piñon/Juniper woodland (*Pinus edulis and Juniperus deppeana, monosperma, and scopulorum*), with understory of blue grama grassland, snakeweed, and rabbitbrush. This blends into the ponderosa type (above) in many areas. Various deciduous trees and shrubs are found in all of these vegetative types, for example, Gambel oak (*Quescus gambelii*) and New Mexico olive *(Forestiera pubescens)*.

3. Juniper savanna: Open blue grama grassland with scattered piñon or juniper trees. The meadow areas around the stock tanks tend to be this more meadow-like form.

4. Lava flow areas: The project area has lava flow areas nearby, often in sight. Some of these lava flow edges provide an environment, where species such as aspen *(Populus tremuloides)*, Douglas fir *(Pseudotsuga menziesii)*, and other higher elevation vegetation can find a special niche and grow.

5. Lava tubes and caves: These are unusual, cooler environments, and many species of flora and fauna are found in these microenvironments. Unique cryptogams and animals are observed.

Historically, grazing was the greatest human-caused influence on the vegetation of the Monument area. Since phasing out grazing a few years ago, grasses and other vegetation have been able to recover. The areas around the old ponds and other structures now generally have a healthy cover of grasses, forbs, and shrubs.

Fire suppression from the late 1800s until recent years --in conjunction with grazing-- caused a shift in wildfire frequency from once every few years to a longer interval. The Monument's present fuels management program aims to reduce the risk of wildfires by fuel reduction actions (e.g., trimming brush along the Monument boundary and along the highway). Fire is still a key factor affecting the vegetative cover.

The old ponds and dikes affect the vegetative cover by depriving meadows downstream from them of the soil moisture they once had, changing the species of vegetation. The vegetative cover upstream from the diversion dike/ditch areas or natural meadows can be seen to be different (more moist types) from that seen downstream from structures. Vegetation specialist Muldavin and the project PI walked along the areas receiving relatively more moisture, namely, the "natural channels," meadows (vegas), and stock tank bottoms. These areas revealed species indicative of relatively more moisture, such as NM olive (*Forestiera neomexicana*), iris spp, cinquefoil (*Potentilla spp)*, gumweed (*Grindelia nuda*), Indian tobacco, and bindweed (*Convolvulus spp)*. On the other hand, the original channel areas cut off by structures or diversions contained relatively drier indicators such as prickley pear, rabbitbrush, and other upland species, plus an ingrowth of new ponderosa pines.

3.6.2. Impacts of Alternative A, No Action

Alternative A –no action-- would most likely continue to allow moderate impacts on vegetation of the area (moderate being measurable with noticeable but more localized consequences).

One would anticipate the alternative to allow: (1) the continued loss of vegetation in certain areas where erosion is occurring; and (2) the impact on vegetative cover where old structures deprive meadows below them of soil moisture and affect the vegetative species. Erosion also would continue in the meadow below the breach in Dam 30's feeder ditch. Stock Tank 19-2 and the diversion dike/ditch would be expected to continue to deprive the meadow areas downstream from them of moisture for plants, thereby degrading wildlife habitat in those areas.

> Cumulative Effects. The cumulative effects of the old structures would most likely continue to modify the vegetative species composition in certain meadow areas, and over the years continue to replace vegetation more valuable for wildlife with less valuable, drier species.
>
> Conclusion. The alternative would be expected to allow continuation of minor to moderate impacts on vegetative species composition in areas below structures and continuation of minor to moderate erosion impacts. This would not impact the basic integrity of the Monument.

3.6.3. Impacts of Alternative B, the Preferred Action

Short-term adverse impacts on vegetation would most likely be "minor" (small and localized only). One would expect temporary loss of vegetative cover on the approximately 22 acres where the ponds, dikes, and diversion would be filled or removed. Re-vegetation of these temporarily disturbed sites would be part of the project effort. The 22 acres of temporarily disturbed vegetation and soils would amount to less than 0.1 percent of the Monument's area.

Long-term impacts on vegetation would be expected to be positive and "moderate" (measurable with noticeable consequences at local sites). The positive vegetative impact would likely include an improvement in the vegetation and wildlife habitat in meadow areas downstream from the old structures. Removal of the structures would allow return of natural moisture conditions once more to these meadow areas, causing a change from drier vegetative type (e.g., prickly pear cactus, piñon, juniper) back to the grass, forb, and shrub cover more attractive to wildlife. These benefits would be expected below Stock Tank 19-2, below the diversion dike/ditch area, north of the Pine Dike, and around and below Stock Tank 28.

Mitigation. Mitigation for erosion control would be needed to return the disturbed 22 acres back to a good vegetative cover. Pam Benjamin, plant specialist with the NPS, Denver, visited with the PI to review the project and provided recommendations for revegetation. She recommended seeding with a mixture of grass and forbs, including fescue, western wheat, blue gram, and buffalo grasses, with penstemon, saltbush, and other forbs. Planting some native shrub plugs also would be advised (for example, plugs of saltbrush and rabbitbrush could be gathered at the project sites before the earth work is done). Also, rabbitbrush (aka as chamisa), which is common in the area and a very prolific seeder, would move in on its own. Straw would be "crimped in" after seeding as mulch and for erosion control. Seeding would work best in the monsoon season of July-August. Details on her recommendations have been provided to the Monument.

Cumulative Effects. The cumulative effect of the project's action would most likely be moderate and beneficial on a long-term basis to the native vegetation below the old structures. Over time, moisture conditions would be expected to improve in the meadow areas no longer impacted by the presence of the old structures, allowing return of a better vegetative cover.

Conclusion. From a vegetation viewpoint, the proposed project would most likely exert a *minor* adverse effect at local sites, due to disturbance of soils and vegetation on those 22 acres. However, the project would be expected to have a moderate beneficial effect on meadow areas below the old structures, since removal of the structures should allow return of normal moisture conditions to these meadow areas. None of this work should impair the basic integrity of the Monument.

3.6.4. Impacts of Alternative C, the Large-Channel Action

Alternative C, the large-channel action would simply convey more water past the El Calderon Parking Lot area via a larger channel (instead of splitting the flow at the Pine Dike, as in preferred Alternative B).

From a vegetation standpoint, the impacts of Alternative C (the larger-channel action) would be identical to that of Alternative B (the preferred action). Under

Alternative C, soil and vegetation would be disturbed at the El Calderon Parking Lot to install the larger channel and berm, whereas Pine Dike would be left intact. Conversely, under Alternative B, Pine Dike would be disturbed; however, the El Calderon Parking Lot would be impacted much less. In other words, both Alternative B and C would disturb approximately the same amount of ground, but in different sites; so from a vegetative viewpoint the two alternatives would be anticipated to have the same degree of impact.

3.7. WATER RESOURCES

3.7.1. Affected Environment

Agua Fria Creek is a valuable asset to the Monument's natural resources, providing for a wider diversity of terrestrial habitats. The creek also may play a role not presently understood in the unusual volcanic terrain and lava features that the Monument is mandated to protect. Perhaps there is a critical connection to be discovered between streams that disappear into lava terrain and the unique function that ice caves and cave ecosystems need for perennial moisture and coolness in the arid environment of the Southwest. Concern has arisen that disturbance of the natural creek channel by the artificial structures is interrupting the ecology of the lava trench and tube system (Inglis,1997). There also is a concern that the changed flow regime is causing a change of soil moisture, erosion and flooding that determine the meadow habitats. The proposed restoration plan would strive to return the creek to its natural hydrologic functions.

Management has to consider possible future damage and risk to visitors from flooding, erosion, and sedimentation, as well as the attractive nuisance presented by old ponds. The structures may pose some risk to people, and the proposed restoration plan would seek to reduce these water-related risks.

THE PROJECT'S TEAM: During the spring to fall of 2001, a team of water resource specialists studied the creek and its flow, as described in Section 3.2, "Methodology" and listed in Table 3.2. The team met in the field on several occasions to conduct channel surveys, watershed analysis, and interpretations of the creek's history, and to develop recommendations.

CHARACTERISTICS OF THE WATERSHED: Agua Fria Creek originates about 10-11 miles northwest of the El Malpais National Monument boundary, having a total drainage area of about 65 square miles, mostly in the Cibola National Forest, with a smaller portion in private ranchlands. The creek's southern, final five miles traverses about 6,000 acres of watershed in the northwestern corner of the National Monument, before disappearing into the ground. No known or obvious drainages exist that connect Agua Fria Creek to the Rio San Jose. Figure 1.3 shows a corner of the Cibola NF in relation to the Monument, and Figure 1.4 illustrates the creek's final 5 miles in the Monument and shows where the stream finally disappears. Table 3.7.1.a summarizes the basic watershed dimensions.

Table 3.7.1.a Aqua Fria Creek watershed dimensions and haracteristics(Inglis, 1997-98).

Watershed area = 65 sq miles
Elevation at site = 7,260 feet
Top of watershed = 9,000 feet
Mean watershed elevation = 8,087 feet
Channel length = 15.2 miles
10-year 24-hour precipitation = 2.0 inches

Project team members also visited the headwaters of the creek, to better understand the flow and sediment sources. The headwaters are largely forested with ponderosa pine, and the soils are granitic, as opposed the volcanic soils that dominate the Monument. Forestry and livestock grazing are the principal land uses in the National Forest headwaters, along with numerous second homes on interspersed private property. In places the creek banks are eroding, but much of the headwaters and tributary channels appeared to be stable. Well developed riparian zones in places were indicative of the more favorable moisture upstream, due to higher elevations, greater precipitation, and cooler temperatures.

In 1994, Forest Service hydrologist F. Jackson had a more negative impression of the headwaters' history. He noted that during the last 150 years, extreme overgrazing, drought, increase in intensity of short duration storms, and extensive clearcutting of forests led to downcutting of existing channels and headward expansion of the channels, with more and more gullies. He considered grazing pressure on riparian areas as still severe (Jackson, 1994).

About every five years the Monument experiences flooding, as seen on the report cover and in the Figure 1.2 photographs. Agua Fria Creek has been known to flow for six weeks (El Malpais, 1990). A heavy summer rainstorm also may produce runoff in the creek, but such summer discharges are rare. The creek's springtime discharge usually originates as snowmelt in the Zuni Mountains, in the National Forest. Major water losses then occur into the fractures, seams and lava tubes of the Monument

The Monument is covered by porous, fractured lava that absorbs water and takes it to deeper aquifers; however, areas immediately adjacent to the margins of the lava flows may pond temporarily during heavy rain (El Malpais, 1990). Sediment eroded from 5-10 miles upstream comes into the Monument and is deposited to form meadows; this process is similar to the formation of alluvial fans or deltas. Deep soils are still uncommon in this area of extensive lava, since bedrock often is near the surface. Given the abundance of hard rock in the area, major gullies are not common.

THE GEOHYDROLOGY OF THE AREA: National Park Service geomorphologist Hal Pranger visited the proposed project area as part of the project team and offered the following observations (excerpts):

Bedrock geology consists of Permian red siltstone and sandstone ridges comprising the southwestern valley edge, dipping at approximately 10 degrees to the southwest, and granite to the north and east toward the Zuni Mountains. Lava is found in the valleys, along with occasional cinder cones, lava tubes, caves and collapse features.

With the many surface manipulations and diversions in these areas, it would be very difficult to determine with certainty if there were a single dominant channel...
From Fork Meadow to Pine Dike (see Figure 1.4), the creek is ... in bedrock; a sharp jog in the surface pattern (of the creek) is likely a result of lava flow. Lava probably

redirected flow and could have resulted in the development of the alluvial area around Pine Dike and Stock Tank 28.

(Some) collapsed lava tubes and tube entrances could have had substantial natural surface flows into them (particularly those by El Calderon Parking Lot). Junction Cave, near El Calderon Parking Lot likely has had surface runoff into it, but probably primarily from just the ~2+ square-mile watershed to the southwest (note other team members believe Agua Fria Creek also has likely flooded the cave). Some time after the Pine Dike area lava dam filled with alluvium, flows could have spilled from the Pine Dike area toward the collapsed El Calderon lava tube. If not, that lava tube could have received overbank flows from the other "main" channel identified in the field (Pranger, 2001).

CLIMATE OVERVIEW: The weather patterns at ELMA are typical of most of New Mexico, with at least half the year's precipitation falling during the summer months. In the summer, two high pressure cells, one located off California and the other in the Atlantic (the Bermuda High) force the jet streams far to the north, away from the Southwest. The weather then is strongly influenced by warm, moist tropical air masses. Concurrently, a continental low develops over the southwestern United States and northwestern Mexico which allows convective storms or "monsoons" to develop (#23, Lightfoot et al 1994).

During 1992-2001, the precipitation in the proposed project area ranged from about 11 to 24 inches per year, so was highly variable. Table 3.7.1.b shows these data. Monthly variation also is enormous, as seen in Figure 3.7.1.a.

Table 3.7.1.b Precipitation in inches during the past decade at the El Malpais Information Center, Highway 53, located on the edge of the proposed project area.

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Jan	1.24	3.85	0.57	2.41	1.05	2.47	0.7	0.37	0.5	1.69
Feb	1	1.54	0.95	0.4	1.06	0.46	1.43	0.15	0.49	0.65
Mar	1.79	1.12	1.46	0.36	0.46	0.05	3.89	0.76	1.53	0.29
Apr	0.08	0.05	0.84	0.68	0.26	2.78	1.69	0.55	0.15	0.68
May	4.01	0.7	1.51	0.67	0	0.87	0.01	1.11	0	0
Jun	0.19	0.1	1.6	0.32	1.71	1.61	0.04	2.12	0.83	0.43
Jul	1.9	0.79	1.17	0.48	2.66	3.06	3.44	4.22	1.84	2.23
Aug	2.7	3.94	2.1	3.33	1.7	3.16	3.33	4.74	2.58	2.56
Sep	1.02	0.5	1.66	1.72	3.44	3.12	1.33	1.33	0.22	0.84
Oct	1.12	1.35	2.48	0	2.38	1.55	2.7	0.1	3.04	0.14
Nov	1.19	0.7	1.51	0.48	3.76	1.96	0.7	0	0.79	1.01
Dec	2.07	0.09	0.79	0.5	0.09	2.77	1.47	0.14	1.13	0.5
Sum	18.31	14.73	16.64	11.35	18.57	23.86	20.73	15.59	13.1	11.02

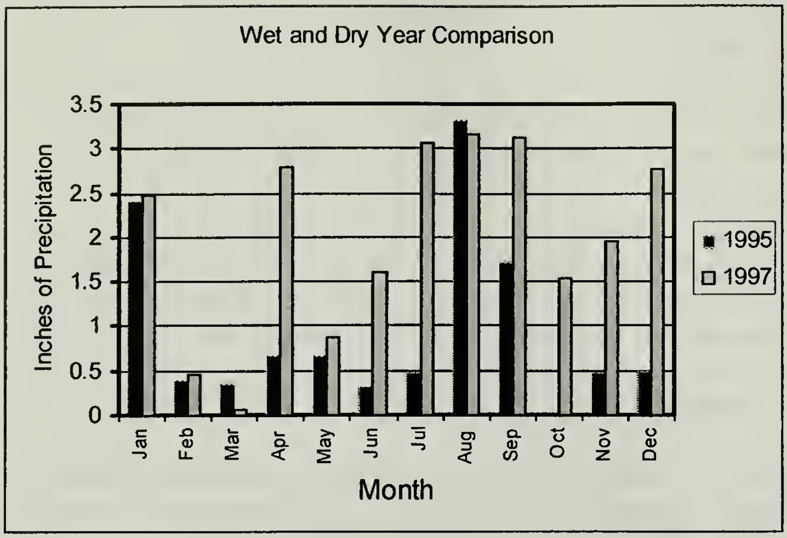


Figure 3.7.1.a Comparison of the wettest ('97) and driest year ('95) in the 1992-2001 decade in the proposed project area (data from the Information Center, immediately adjacent to the proposed project).

During the 1992-2001 decade, summer maximum temperatures were typically in the 90's °F, but occasionally over 100 °F. The highest temperature observed for the 1992-2001 period was 108 °F. Nights are cool, even in the summer down into the 30s and 40s °F. Winter minimums are most often in the teens or twenties, but on occasion fall to a few degrees below zero. The coldest temperature recorded in the decade was a -16 °F.

GROUND WATER: The major ground-water aquifer in the Monument is the San Andres-Glorieta, which lies about 500 ft below the surface in consolidated sedimentary rocks beneath alluvium and basalt. No springs occur inside the Monument. Ice caves have shallow pools in them in the summer, something believed to be critical to resident wildlife. The bottoms of the artificial stock tanks are lower than the surrounding meadow's surface (both for ST 19-2 and ST 28); therefore, the tanks probably serve as a sort of drainage ditch, to draw down the shallow ground water (Schulz, 2002, pers. com; El Malpais NM, 1990).

DISCHARGE ESTIMATES IN THE WATERSHED National Park Service hydrologist Inglis studied photographs of flooding and collected field measurements in the project area on channel dimensions and other features, then created one-foot contour topographic maps. He calculated cross-sections, to estimate stage and discharge relationships of the channel and ditches (applying Manning's equation). Inglis also used the U.S. Geological Survey (USGS) publication "Analysis of the Magnitude and Frequency of Peak Discharge and Maximum Observed Peak Discharge in New Mexico" to estimate discharges at specific return periods. The USGS regional flood frequency equations produced flood discharges of about 600 cfs and 2,500 cfs for the 5-year and 100-year return period, respectively (Inglis, 1997-98). Marron and Wilson (1994) prepared an environmental assessment for the nearby Highway 53, and found that "during a 100-year event the Agua Fria Creek drainage (where it goes under the highway) will reach a peak discharge of 2441 cfs, or basically the same as the Inglis calculation. Forest Service hydrologist Jackson (1994) calculated unit peak flows (5-year recurrence) in Zuni headwaters at 15 cubic feet per second per square mile with the Waltmeyer method and found 4-20 cfs/sq mi with USGS calculations (vs 9 cfs/sq mi for Inglis values further downstream in the project area). Flows per square mile are higher in the wetter headwaters, as one would expect.

WETLANDS: In the summer of 2001, Este Muldavin of the University of New Mexico and senior author of the "Handbook of wetland vegetation communities of New Mexico" visited the project area to observe the vegetation and see if wetlands or rare riparian species were in evidence (Muldavin et al, 2000). *Note that wetlands basically are ecosystems where water saturates the area for a significant period of time each year, where some plant species reflect the periodic inundation or wetting, and "hydric" soils bear evidence of the periodic wetting.* Muldavin and the project PI reviewed vegetation lists for the Monument from Bleakly (1996) and Lightfoot et al. (1994) in the field to confirm that the vegetative descriptions match what appears on the ground in the project area. Several of Lightfoot et al's sampling plots fell inside or very near the proposed project treatment sites.

Muldavin observed in the field that areas one would expect to be relatively more moist, namely, creek channel areas, meadows (vegas), and stock tank bottoms contained species needing relatively more moisture. These include New Mexico olive (*Forestiera neomexicana*), Iris spp, cinquefoil (*Potentilla spp)*, gumweed (*Grindelia nuda*), Indian tobacco, and bindweed (*Convolvulus spp).* Conversely, ancient creek channels cut off from water, below the diversion structures, contained species common to a relatively drier habitat, such as prickley pear cactus (*Opuntia spp*), rabbitbrush/ aka chamisa (*Chrysothamnus nauseosus*), and other upland species, plus an ingrowth of ponderosa pine (*Pinus ponderosa*).

Meadows (or vegas) in the El Malpais sense refers to open, relatively flat areas of grasses, herbs, forbs, in cases with a scattering of shrubs and trees, having generally better soil and moisture conditions than surrounding hillsides. Several of the meadows are subject to flooding during spring snowmelt of certain years. Muldavin found no plants, soil conditions, or habitat that would indicate "wetland" by definition. Steve Fettig, National Park Service wildlife specialist from Bandelier National Monument, visited the proposed project area two weeks after Muldavin and also saw no habitat that he would call "wetland."

The NM Highway and Transportation Department conducted a wetland determination on the Agua Fria Creek area where it crosses under NM Highway 53 (adjacent to the proposed project area). Although the site is periodically inundated, they concluded that it failed to meet all the requirements to quality as a "jurisdictional wetland" (Marron and Wilson, 1994).

A HYDROLOGY TOUR: GOING UPSTREAM TO DOWNSTREAM ALONG THE CREEK

1. NORTH MEADOW: "North Meadow," at the extreme NW end of the Monument, attenuates the incoming floods of Agua Fria Creek and allows sediment to deposit. Flow from this meadow area splits into two channels, one east, behind the NPS Information Center and the other flowing further west into Stock Tank 19-2 (Figure 1.4). The east fork appears to be a natural channel; whereas, the west channel looks to have been manipulated in the past, presumably for the purpose of filling Stock Tank 19-2.

2. STOCK TANK 19-2: This is a partially-filled, eroding pond of several acres that the proposed project recommends to fill. After filling, the area would be planted to native grasses and forbs. Although partially breached, the pond can still hold several acre-feet of water during flood periods. A small channel drains out of the tank's old dam, passing through the meadow below and goes to the "diversion dike and ditch entrance" area (Figure 1.4).

3. DIVERSION DIKE AND DITCH ENTRANCE AREA: This dike (Figure 1-4) was constructed in the late 1930's as a feeder ditch for Dam 30; the ditch and dam were probably a Civilian Conservation Corps project (pers. comm. with State of NM library; Polk, 2002). The dike captures floodwaters from the creek channel and diverts them into the ditch, then around the hillside to fill Dam 30 (Figure 1-4). The ditch entry to dam distance is about a quarter mile. For the last few decades (according to project air photo research by the PI) the ditch has been breached about half way along. Therefore, flow going into the ditch leaks out through the breach and returns back to the old channel before reaching Dam 30. Some erosion is occurring in the meadow below the breach. The restoration project proposes to breach the dike, plug the ditch's entrance, and allow the creek to return to its original channel.

4. AT DAM 30: This large reservoir is perched on a side tributary and fed by its feeder ditch. The dam was intended to store flows from Agua Fria Creek during the floods every five or so years, presumably for cattle watering. One can speculate that such a large dam, in a small tributary watershed and in a sparsely inhabited area must have been a "job creation" project during the 1930's depression, since it does not appear to be a justifiable water storage facility.

Dam 30 is about 900 feet long by 15-20 feet tall, with a potential storage of at least 40 acres or up to 350 acre feet. The vegetation in the bottom of the reservoir has not been affected by standing water, and upland species sagebrush and rabbitbrush is common there. The dam, spillway, and gate mechanism are in good shape for their ages.

The creek restoration project will notify the National Park Service office dam inspector of the existence of Dam 30, so they can confirm it is not a hazard. No hazard is expected, since: (1) the feeder ditch is breached, so cannot fill the dam; and (2) the dam is sited on a small side watershed with very little natural runoff area. Therefore, the chance of the dam filling is negligible to nil, presenting a negligible hazard. The restoration project plans no action on this large, dry dam.

5. REACH OF NATURAL CHANNELS IN THE MIDDLE OF THE PROJECT AREA: The channel downstream from Dam 30 is almost entirely a natural channel of lava rock or boulders, and stable for a reach of over a mile to Pine Dike (Figure 1-4).

6. THE "ANCIENT CHANNEL" STORY: Project team research in 2001 showed that what the project named "Pine Dike" was constructed by the NM Highway and Transportation Department in 1957 (or possibly 1958), according to: (1) road designs from their office; (2) old aerial photographs from 1952 (no Pine Dike) and 1958 (fresh-

looking Pine Dike; no trees), and 1966 (the dike with many pines growing), and (3) coring of trees for age.

Figure 1.4 shows the ancient, natural channel by the highway and its relation to Pine Dike and parking lot. Note that the parking lot road entrance is at the point labeled "low water crossing" on the map.

Pine tree corings conducted by university botanist Muldavin and the project PI in 2001 helped confirmed the Pine Dike's age. Based on their corings, the trees germinated during in the early to mid 1960's. This helps indicate the dike age, since the even-aged thicket of pines on the dike could only have geminated after the dike was constructed.

Pine Dike apparently was constructed to divert Agua Fria Creek from its historic, natural channel (now partly under the highway) and to route the creek flows down toward what is now the El Calderon Parking Lot area. Team member and geomorphologist Hal Pranger noted in the field in 2001:

> *...downstream of Pine Dike, the remnant channel fragments that were not destroyed by highway construction tend to indicate that a single channel flowed along and/or under Highway 53 and past the El Calderon parking lot entrance (at the highway) (Pranger, 2001).*

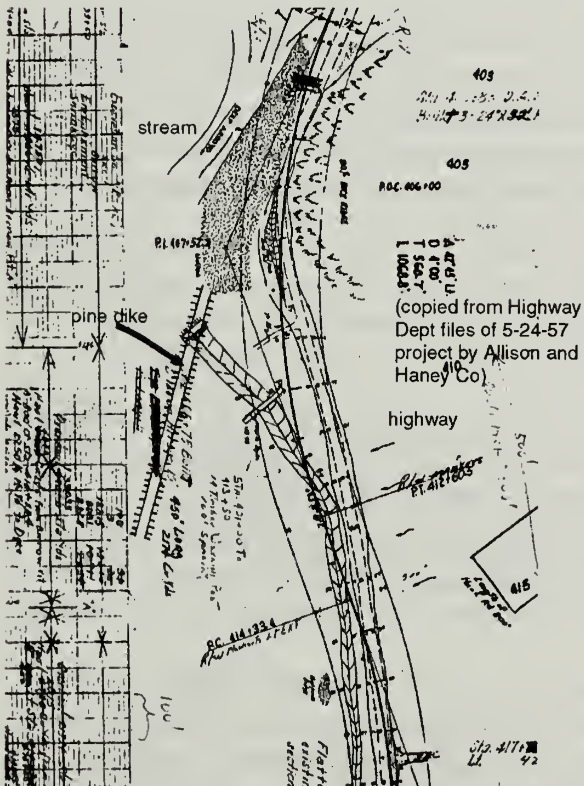


Figure 3.7.1.b, copied courtesy of the NM Highway and Transportation Department, from their microfilms of Highway 53 construction projects. The design matches topographic and other maps of the area, confirming that Pine Dike construction was part of a road improvement project of 1957, presumably built as a measure to protect the road. In the figure, Pine Dike is the elongated structure on the center left of the drawing. The fishbone feature in the center illustrates the original channel of the creek.

Today, Pine Dike diverts floods down toward the parking lot and Junction Cave area away from the highway. Prior to Pine Dike's construction, flooding must have been lower in what is now the parking lot/cave area, since originally much of the flooding could have gone along the ancient channel that is now mostly covered by the highway.

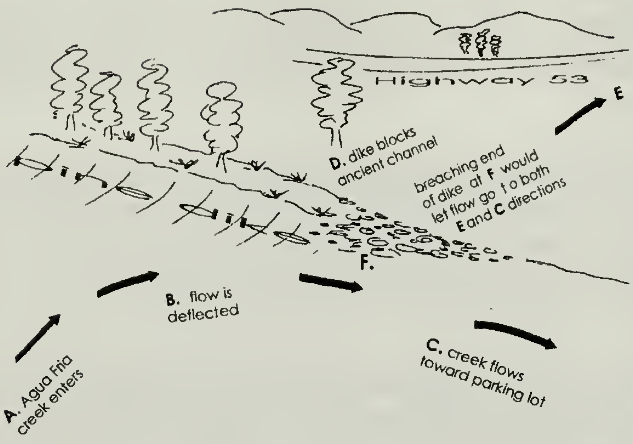


Figure 3.7.1.c. A three-dimensional sketch of Pine Dike and its function to divert the creek from its original channel (which is now largely under the highway) and direct it in the direction of what is now the El Calderon Parking Lot. The sketch also shows how the flow would return to the original channel, at the highway, if the dike were breached.

7. STOCK TANK 28: This is another earthen stock tank, probably built to support grazing. This tank has little effect on the flow of the creek, but is an attractive nuisance immediately adjacent to the Continental Divide Trail. The project proposes to fill, contour, and seed this old structure.

8. THE EL CALDERON PARKING LOT AREA: Flooding at the El Calderon Parking Lot has been a problem about every five years when springtime runoff fills the creek. Figure 3.7.1.d provides an overview of the flooding (note that Figure 1.2 shows photographs of the area in flood). Ditching near the parking lot was added at some time in the past, but the ditches and culverts in the parking lot area do not have adequate capacity for the floods.

Figure 3.7.1.d. Drawing of flooding at the parking lot (to scale).

The culvert at the beginning of the primitive road and ditching on the west side of the parking lot also has a channel capacity of less than 50 cfs (Figure 3.7.1.d). So when floods exceed the capacity of the ditch, overflows can go into nearby cave openings, lava tubes, and onto the parking lot.

When Agua Fria Creek flooded in 1993, the parking lot and access road were damaged, and flows went into the nearby lava trench. Any large flow event reaching the parking lot area will probably cause a repeat of the previous damage, due to the undersized culvert and existing topography of the area.

9. STOCK TANK 33: Another pond, Stock Tank 33, is found on the far edge of Monument's land. The project has no recommendations to treat this site.

10. DOWNSTREAM FROM THE PROPOSED PROJECT: About a quarter mile below the El Calderon area entrance road, the runoff follows the ancient channel, by the highway, and the channel becomes larger, more distinct, and in places eroded. Through the upper two-thirds of Section 34 (Figure 1.4) the ancient channel has eroding banks, in places cut 6-8 ft deep. This is generally in an area of decomposed granite. In the lower third of Section 34, the channel substrate is predominately granite boulders and lava, and is stable. Finally, the channel leaves the Monument, goes into Bureau of Land Management land, and Agua Fria Creek disappears into the plain. The channel coming from Stock Tank 33 also disappears in the same general area, as illustrated in Figure 1.4.

3.7.2. Impacts of Alternative A, No Action

The no action or status quo alternative would allow the existing impacts from the old structures to continue, namely:

- eroding of structures, which produces sediment;
- flood damage to the El Calderon and Junction Cave parking lot area, which interferes with the visitation to this popular area --and could pose a hazard;
- possible impacts on the caves, lava tubes, and other geologic features, due to unnatural cave flooding and water diversion; and
- flooding disturbance of the riparian habitat and biological diversity that is associated with the lava/sandstone interface; and
- ground-water drainage and other hydrologic disruptions caused by the structures.

Inglis (1997-98) modeled flow information for the parking lot area, and found that even relatively small flows from 5-year return periods can exceed the small channel's capacity and flood the area (most channel capacities are under 50 cfs, or about a tenth of a predicted 5-year return period). Therefore, under Alternative A floods would be expected to produce water depths at the parking lot of over 2 feet deep for the 5 year flood and over 3 feet deep for the 100 year flood.

Cumulative Effects. Erosion, flooding, and ecological disturbances to caves and meadow habitats would most likely continue for several decades --until all the old structures erode away. Where erosion were severe, scars to the landscape would last for many decades, before the landscape would recover.

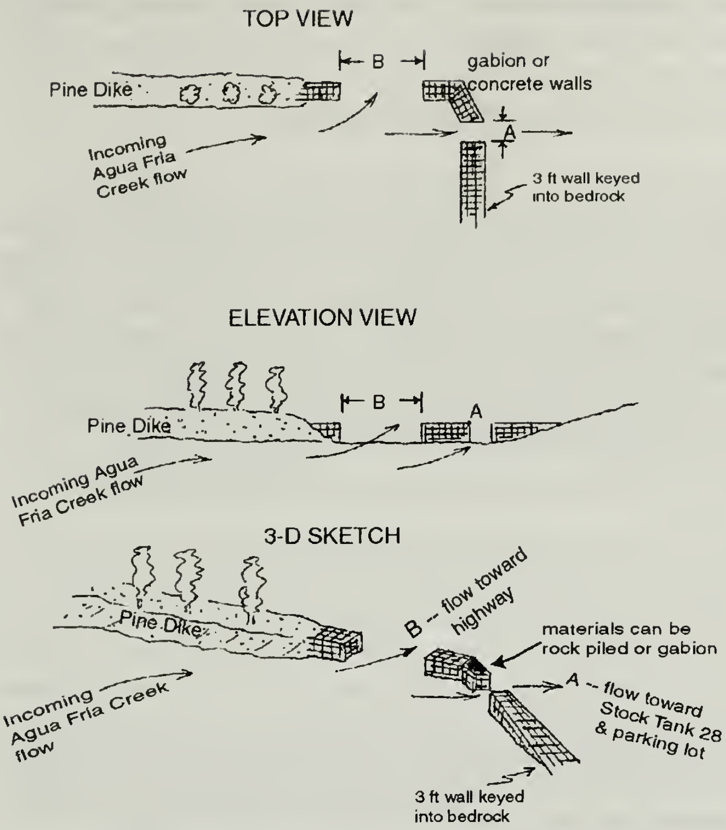
Conclusion. Alternative A, no action, would be anticipated to allow continuation of significant erosion, sedimentation, flooding, habitat disruption, and other impacts associated with the old ponds and other structures -- particularly in the El Calderon and Junction Cave area.

3.7.3 . Impacts of Alternative B, the Preferred Action

The proposed project would be expected to reduce the main problem, namely the flood problems at the El Caderon Parking Lot and the Junction Cave area impacts. The treatment would split the flow at Pine Dike area, to reduce the flows coming into the parking lot area to about 60 cfs (Figure 3.7.3). This would make the channel size passing by the parking lot about 2 X 15 ft, to carry the 60 cfs. The project also would replace the small culvert at the west edge of the parking lot (Figure 3.7.1.d.) with a cobble or concrete lined, low-water crossing (about 1 X 30 ft or 2 X 15, cobbled). This is a minor, basically 4-wheel drive road, so presumably such a crossing would be acceptable.

Significant, moderate environmental benefits would be anticipated from the preferred alternative, including:

- Elimination of the eroding structures as sediment sources;
- Reduction of flooding damage along the Continental Divide Trail;
- Lowering of flooding impacts on the caves, lava tubes, and other geologic features; and
- Reduction of disturbances to riparian and meadow habitats associated with the flooding, drainage, and other hydrologic disruptions stemming from the old structures.



Use of an opening width ratio A B of 1:10 would allow a 5-year flow to deliver 60 cfs to the parking lot area (600 cfs is the creek's 5-year flow) The 60 cfs could be handled at the parking lot area (see discussion on this).

Figure 3.7.3. The proposed project would hold the flows coming into the parking lot area to about 60 cfs by splitting the flow upstream at Pine Dike.

In the short term, negative impacts anticipated from the preferred alternative would include:

- minor or negligible erosion at the restored areas per se in the first 1-2 years, until vegetative cover is restored; and
- minor or negligible disturbance of soils by machinery along some of the access points and roads.

Cumulative Effects. The problems of erosion, flooding, and the ecological disturbances to caves and meadow habitats would be expected to diminish after the proposed project, and these benefits should extend into coming decades.

Conclusion. Alternative B, the preferred alternative, would be expected to significantly reduce environmental impacts of the old pond and dike impacts, to help reduce periodic flooding, sediment, and the long-term impacts on meadow habitats caused by the structures. The preferred alternative would be anticipated to significantly lower flood disruptions in the El Calderon and

Junction Cave area, and have minor to moderate positive effects at the other treatment sites. Some short, negligible effects could include localized erosion in the first year, until disturbed soils are stabilized with new vegetation.

3.7.4. Impacts of Alternative C, the Large-Channel Action

The environmental effects of this alternative would be very similar to Alternative B, the preferred alternative. However, with Alternative C more flow would be routed past the Junction Cave and El Calderon Parking Lot area by construction of a larger channel and some berming. The channel construction would involve some more soil movement than in Alternative B. Therefore, Alternative C would be expected to produce a negligible to minor amount of erosion on the short term, slightly more than for Alternative B. On the other hand, Alternative C would route less water by the highway area, reducing the possibility of erosion there. In general, the environmental benefits would be the same as those listed under the bullets in Alternative B.

3.8. WILDLIFE

3.8.1. Affected Environment

In 1994, a University of New Mexico (UNM), Department of Biology team of David Lightfoot, David Bleakly, Robert Parmenter, and James Gosz prepared a 496-page comprehensive report on "The vegetation and wildlife inventory of El Malpais NM" (Lightfoot et al., 1994). Bleakly and others from the university conducted follow-up wildlife and vegetation activities in the 90's in the area as well as in unique lava sites, and provided the basic information to build the "NPFauna and NPFLora" database for the Monument. This is a listing of the Monument's vegetative and animal species; it appears in Appendix A.

The Monument's biologist and other resource specialists also conducted or cooperated in wildlife activities, including the Monument's preparation of a "check list of birds" in 2000 (Alexander, 2000). Information came from cooperation with the Bureau of Land Management as well, since BLM's adjacent areas contain most of the same flora and fauna (BLM and NPS, 2001).

The variety of ecotypes represented in BLM and NPS lands in the area support diverse populations of animals, including: over 30 species of mammals; more than 295 species of birds for at least part of the year; and many species of reptiles, amphibians, and invertebrates (BLM and NPS, 2001). In the proposed project area, water resources are limited and no wetlands are present; therefore, wildlife species are limited to animals that are either highly mobile, or well adapted to arid conditions (El Malpais NM, 2001).

Western Bluebirds are the most common bird species seen in the Monument. Other frequently observed birds included common ravens, violet-green swallows, piñon jays, red-tailed hawks, rock wrens, Western wood-peewees, ash-throated flycatchers, American robins, common nighthawks, dark-eyed juncos, and black-capped chickadees. The cordilleran flycatcher (western flycatcher) have been found exclusively in lava tube collapse structures. Other birds include band-tail pigeon, mourning dove, quail, and turkey (El Malpais NM, 2001; BLM and NPS, 2001; Lightfoot et al., 1994;). The birds and other animal species are listed in Appendix A.

Mammals in the Monument include: Colorado chipmunks, rock squirrels, mule deer, whitetail prairie dogs, coyotes, cliff chipmunks, cottontail rabbits, piñon mice, deer mice, Abert squirrels, rock mice, cliff chipmunks, rock mice, rock squirrels, and Mexican woodrats. Some species, such as whitetail prairie dogs, cottontail rabbits, kangaroo rats, silky pocket mice, and pocket gophers are found in areas with deep loam or sandy soils (the meadowlike areas in some of the proposed creek restoration project have a few feet of soil). Elk, black bear, bobcat, and mountain lion can occur in the general area (Marron, 1994; Lightfoot et al., 1994; NPS, 2001; BLM and NPS, 2001).

The University of NM surveys found eight species of bats in the Monument, also in lava tube caves. The most ubiquitous bats seen were the Mexican free-tail bats, which have a large summer colony in Bat Cave (about a half mile from the east edge of the proposed project area, not affected by the creek). The canyon treefrog was the most frequently encountered amphibian in the Monument, and is also found in lava tube areas. The university surveys found eastern fence lizard, tree lizards, whiptail lizards, gopher snakes, lesser earless lizards, and Western rattlesnakes (Lightfoot et al., 1994).

The University of New Mexico listed the ground dwelling arthropods observed, namely ants, spiders, crickets, grasshoppers, darkling beetles, ground beetles, jumping bristletails, springtails, and millipedes, and a list of these species is available at the Monument.

3.8.2. Impacts of Alternative A, No Action

Continuation of the present condition, with no treatment, would allow the present impacts on wildlife and wildlife habitat to continue. These would be expected to include:

- A minor impact on the meadow area habitats below structures (e.g., Stock Tank 19-2 and Pine Dike) where presence of the structure has reduced moisture in the area and thereby reduced the diversity and quality of plant species. This degrades the wildlife habitat generally and reduces forage species in the areas affected.

- A minor impact in lava tubes and cave areas, as floods periodically inundate some of these areas and bring in sediment, which could degrade these specialized habitats are used by birds, mammals, and other animals.

- Some reduction in the quality of wildlife habitat in areas where erosion removes productive soil and vegetation, for example in the meadow area below the breach in the feeder ditch for Dam 30.

Cumulative Effects. The impacts of erosion, sedimentation, drainage, and flooding on wildlife habitats in the area would be anticipated to continue for decades. Erosion and sedimentation from upstream areas would move downstream to affect the lava tubes, caves, and creek area habitats by depositing sediment or by localized erosion.

Conclusion. Periodic floods in the El Calderon Parking Lot and Junction Cave area would be expected to produce localized erosion or sediment deposition, affecting wildlife habitat along the creek area, in lava tubes, and in caves. Periodic flooding of the creek could erode riparian areas, thereby reducing the diversity of riparian plant species available for wildlife feeding. The old structures (e.g., Pine Dike and Stock Tank 19-2) would presumably continue to deprive meadow areas below them of moisture, decreasing the plant abundance, growth, and diversity, thereby degrading habitat for wildlife in general.

3.8.3. Impacts of Alternative B, the Preferred Action

Wildlife impacts can be both direct and indirect. Generally wildlife are sensitive to disturbances, including: loss of habitat; impacts on their reproduction; effects on their nesting or denning; effects on their food chain; or effects on their migration (Marron and Wilson,1994).

The long-term, cumulative effects of the project on wildlife would be expected to be positive:

- Reducing floods in the El Calderon Parking Lot and Junction Cave area would be expected to diminish localized erosion and sediment deposition -- an action that should help protect the wildlife habitat along the creek area, in lava tubes, and the cave.

- Removal of the old structures (e.g., Pine Dike, the dike/ditch entry area, and Stock Tank 19-2) should allow re-watering of the meadow areas below them that are now deprived of moisture by the structures. This additional moisture in the meadow areas would then improve the plant abundance, growth, and diversity, resulting in minor improvement of wildlife habitat (PI's personal communications in the field with biologist Zeedyk and botanist Muldavin).

In the season following the earth work, new vegetation would most likely return, and the young plant growth would be attractive for wildlife species.

Temporary, localized, minor impacts on wildlife would be expected in the areas where soils are exposed and plants destroyed during the process of leveling the old dams and dikes and replanting the areas. In those areas of disturbance, local wildlife would lose some of their habitat for a season.

Some wildlife would no doubt be sensitive to the machinery and traffic noise, and minor effects on wildlife breeding would be expected near construction sites. Some mammals would temporarily leave the work areas. As a mitigation measure, the project work could be scheduled to help reduce effects on the major nesting season.

Cumulative Effects. The impacts of the preferred alternative should be beneficial to wildlife over the long term. Control of erosion, sedimentation, and flooding over time would be expected to allow wildlife habitats to return to natural conditions.

Conclusion. Implementation of the preferred alternative would be expected to disturb wildlife and habitat on a short-term basis with minor, localized negative impacts. Birds and animals generally would be anticipated to leave treatment sites during construction. However, over the long term the actions should provide minor positive benefits for wildlife. The control of flooding, erosion, and sedimentation by the project would help protect cave, lava tubes, and riparian habitats; and the removal of old structures should return more moisture in the meadow areas below them, thereby improving vegetative diversity, hence wildlife habitat.

3.8.4. Impacts of Alternative C, the Large-Channel Action

From a wildlife perspective, Alternative C, the large-channel action would be expected to produce almost identical impacts as Alternative B, the preferred alternative. The amount of earth disturbance, machinery noise, and other negative effects should be about the same. The area of wildlife habitat improved by removing old structures also should be about the same. The flood protection of lava tubes and caves should be about the same.

3.9. CULTURAL RESOURCES

3.9.1. Cultural Aspects: The Background and Methodology

The National Park Service Support Office in Santa Fe provided advice to the Monument on cultural resources. In July, 2001 Catherine H. Spude of that office visited the project to view the proposed project area and to advise the project principal investigator on procedures for conducting a cultural survey for the environmental assessment (Spude, 2001). Local rancher and Forest Service employee Ron Clawson, who has lived many decades in the area, also participated in the visit to discuss local history. The local Forest Service District Archaeologist, Linda Popelish, was helpful in providing overviews on land ownership history in the project area.

Through Colorado State University, the project contracted with SWCA Environmental Consultants in Albuquerque to conduct a cultural resources survey for the proposed project area. In April, 2002 Harding Polk II and his team from SWCA surveyed the access roads and four of the five treatment areas for the proposed project, drawing on information for the fifth site from another environmental assessment in preparation at the time and from prior studies in the area. Polk and team surveyed 14.6 ha (36.0 acres) in all.

Prior to his fieldwork, Polk completed a check at the Archaeological Records Management Section, N.M. Historic Preservation Division, Santa Fe for previously recorded sites within 1.0 mile (1.6 km) of the survey areas. He checked the online listings for the National Register of Historic Places and State Register of Cultural Properties for registered projects in or adjacent to the survey areas. SWCA also checked with the Chief Ranger at El Malpais NM for previously recorded sites within the areas to be surveyed.

The goals of the Polk fieldwork were: (1) to locate and record archaeological remains of an apparent or likely age of 50 years or more, as well as any standing historical buildings or structures within or next to the survey areas; and (2) to record and assess several identified historic water control devices within the survey areas.

In addition, the project contracted with Historian Michael Welsh of the University of Northern Colorado, Greeley, who visited the Rocky Mountain Region branch of the National Archives and Records Administration in Denver to search for any records relating to construction in of Dam 30 or Stock Tank 19-2 during the 1930's. Welsh's observations were provided in correspondence to the Principal Investigator; excerpts appear below.

SWCA presented its May 31, 2002 report "Agua Fria Creek restoration project: El Malpais National Monument: Cultural Resources Survey," by Harding Polk II, SWCA Project No. 5946-024, 35 pp, illustrated (Polk, 2002). [NMCRIS Activity No. 78765; SWCA Project No. 5946-024; SWCA Cultural Resources Report No. 02-237]. The report is available from El Malpais NM. Key extracts from the report appear below.

3.9.2. Affected Environment

OVERVIEW OF ARCHAEOLOGY AND HISTORY: Polk's survey work provides an overview of the area's archaeology. He summarizes that the Paleoindian period probably lasted from about 10,000 to about 5500 B.C in the area. The Archaic occupation (5500 B.C.–A.D. 400) locally was probably one of seasonal wandering in search of wild foods, combined with reuse of base camps. Later, Ceramic period settlements likely appeared in the El Malpais area as part of the Acoma Culture province (from about AD 800's to later). The earliest Spanish documents from the 1500's indicate a continuation of these archaeologically defined settlement patterns, along with new Spanish influences of the time. The Acoma and Zuni both view El Malpais as traditional use areas, and shrines for both tribes are found in the general area. There were several trails between Zuni and Acoma, one or more of which probably traversed the immediate project area. The Navajo use area focused on the Mt Taylor and the northern lava flows near Grants; however, the use area may have ventured down to the proposed project area on occasion (Polk, 2002).

Old World livestock were introduced to New Mexico in 1598, and the importance of this industry is shown by the fact that woolen goods were one of New Mexico's main exports (perhaps *the* main export) for the next two centuries or more. The livestock industry in New Mexico began shifting from sheep to cattle in the 1920s. One result of the 1900s shift from sheep to cattle is the proliferation of range improvements such as dirt water tanks, windmills, and fences (Polk, 2002).

PRIOR STUDIES IN THE AREA: Polk reviewed various prior studies in the area, noting:

- In 1973, The Museum of New Mexico surveyed a proposed AT&T buried cable route between Clovis and Zuni New Mexico (the cable route extended along NM 53).

- In 1989, the New Mexico State Highway and Transportation Department conducted a survey along NM Hwy 53, prior to roadside tree clearing.

- A 1994 survey by Zuni Cultural Resource Enterprise preceded NM 53 highway improvements. They found several sites within 1 mile (1.6 km) of the current survey areas. However, none of the sites found is close enough to the proposed creek restoration work to be affected by that work.

- In 1995, Cibola National Forest surveyed a road easement on the north side of NM 53, about 1 mile (1.6 km) east of the Pine Dike survey area. Neither site is close enough to be affected by the proposed stream restoration work.

- In 1996, Bureau of Land Management surveyed part of the Continental Divide Trail. The survey corridor began at the El Calderon parking lot and headed southeast. At its closest, the survey was only 0.8 km (0.5 mile) from Pine Dike. No archaeological sites were revisited or discovered during the BLM survey.

- In 2001 and 2002, the National Park Service surveyed the El Calderon parking lot area for a prescribed burn; this covered 600 acres in two parcels and identified 32 sites and 12 isolated occurrences. The northwest end of the NPS survey overlapped with Polk's survey coverage, including the southern portion of Pine Dike and all of Stock Tank 28. Of the 32 sites found by the NPS, 15 are within 1 mile (1.6 km) of the current Pine Dike survey area. Reference Cited by Polk: *Corey, Chris 2002 Trip Report, El Malpais National Monument, Cibola County, New Mexico. March 18 to 28, 2002. Western Archaeological and Conservation Center, Tucson, Arizona* (Polk, 2002).

STOCK TANK 19-2
Based on historical research of aerial photographs, summarized in Table 3.2.1, Stock Tank 19-2 was built between 1936 and 1945 and is therefore of historical age (50+ years). The stock tank was treated as an archaeological property and recorded (by Polk) as one locus of LA 135589. The SWCA field crew focused on finding artifacts or other evidence to corroborate the age determined from archival sources, and on recording any details that reflected on the site's archaeological values. Aside from

the stock tank itself, no archaeological materials were found at this location (excerpts from Polk, 2002).

DAM 30
Based on previous historical research (Kunkle and Inglis 2002), Dam 30 was built between 1936 and 1945 and is therefore of historical age. Dam 30 was treated as a second locus of LA 135589, as it was probably built at the same time. As Dam 30 will not be affected by the proposed stream restoration project, the pool behind the dam was not surveyed. The Continental Divide Trail courses along the top of the entire length of the dam (excerpts from Polk, 2002).

Re: the Dam 30 area, Polk concluded:

> LA 135589 is of historical age, but is not known to be associated with important events or persons in history. Given the age of the site, the stock tank, ditch and dike, and dam may have been built as part of a federal relief program such as the CCC—but that association is purely speculative, unsupported by distinctive design qualities or historical records. Instead, LA 135589 is indistinguishable from thousands of similar 1900s water control features dotting the New Mexico landscape. Similarly, the water control features do not stand out in any way as historically important examples of rural agricultural design. Finally, further study of the water control features is unlikely to yield important information on local history. Given its lack of historical associations, lack of important historical design qualities, and lack of information potential, LA 135589 does not appear to be eligible for the National Register of Historic Places.

DIVERSION DITCH AND DIKE
According to aerial photographs, the Diversion Ditch and Dike were built between 1936 and 1945 and is therefore of historical age. It was included as a third locus of LA 135589, as the tie that binds Stock Tank 19-2 and Dam 30. No archaeological materials were found in association with the ditch and dike. The Continental Divide Trail extends along most of the top of the dike (excerpts from Polk, 2002).

PINE DIKE
Pine Dike was probably built in 1957 or 1958. The dike is thus not a historical feature and not recorded as an archaeological site. Polk noted no other archaeological features or artifacts at Pine Dike.

ACCESS ROADS
Access Road 1 forms the last leg of the Continental Divide Trail, between the Diversion Ditch and Dike and the NPS visitor center. At present this is not a vehicle road, but appears to been used by vehicles from time to time. It is likely very recent. Polk found a Cibola White Ware sherd (possibly Red Mesa Black-on-white) on this road (Polk observations).

Access Road 2 is an extant two-track road designated Road 100E. This limited access road is used only by National Park Service personnel and by crews responding to forest fires. Portions of the road are depicted on the USGS Ice Caves quadrangle, which was published in 1952, so the road is at least 50 years old (Polk, 2002).

STOCK TANK 28

This area is part of the present project but was not surveyed during the present survey. The area was previously surveyed in 2001 by the National Park Service for a prescribed burn and the discovered sites were recorded in 2002. A preliminary report of the survey's results was prepared by Chris Corey of the National Park Service's Western Archaeological and Conservation Center in Tucson, Arizona (Polk, 2002).

In brief, one site, LA 135923 (ELMA 140), is located 40m southeast of Stock Tank 28. The site is a roughly triangular alignment of local vesicular basalt cobbles. There is some doubt as to whether the site is cultural or not. It is not considered eligible for inclusion to the NRHP. A second site, ELMA 141, is located about 200m southwest of Stock Tank 28. The site is a road feature but was not recorded or assessed for eligibility to the NRHP. These sites will be affected by the proposed stream restoration activities; therefore no recommendations for treatment are necessary (Polk, 2002).

EL CALDERON PARKING LOT

This area is part of the present project but was not surveyed during the present survey, since the area already was surveyed in 2001 by the National Park Service for a prescribed burn, and the discovered sites were recorded in 2002. A preliminary report of the survey's results was prepared by Chris Corey of the National Park Service's Western Archaeological and Conservation Center in Tucson, Arizona (Corey 2002). Site ELMA 112 is located along the access road to the El Calderon parking lot. The site was determined to be modern and not eligible to the NRHP. Site LA 135922 (ELMA 139) is located about 350 m southwest of the El Calderon parking lot. The site is a prehistoric stone circle with associated lithic artifacts and is considered eligible for inclusion to the NRHP. These sites will not be affected by the proposed stream restoration activities; therefore no recommendations for treatment are necessary.

SUMMARY OF POLK'S 2002 CULTURAL SURVEY

Polk's survey of the proposed stream restoration work area and two access roads did not locate any listed historic properties or standing historical buildings or structures within or adjacent to the survey areas. The survey did not identify any previously recorded archaeological sites within the survey areas. The survey defined one archaeological site (consisting of three former water control features), as well as four isolated occurrences of archaeological remains along the proposed access roads. None of the archaeological remains appears to be eligible for the National Register of Historic Places. He did not recommend any further study or treatment of cultural resources, prior to the proposed work in the surveyed areas.

SUMMARY OF WELSH'S 2002 STUDIES
Michael Welsh, Historian, suspected the Civilian Conservation Corps (CCC) would be the most likely agency of record, and consulted the federal government for the years 1933-1940, namely: RG 95, US Forest Service; RG 79, National Park Service: RG 115, US Bureau of Reclamation; RG 114, Soil Conservation Service; and RG 49, US Grazing Service (Department of the Interior). Upon review of camp files in each record group, Welsh decided that the CCC had not conducted work in the proposed project area, but instead, most likely the Works Progress Administration (WPA) would have done the projects. However, there were no records of the WPA in the Denver branch of the NARA. Welsh noted that the only place where WPA records are housed is Washington, DC. (Further research could be conducted with the WPA's microfilmed records, but no finding guides were available at the Denver NARA to indicate where one might find the rolls in Colorado; the Denver NARA had no copies). (Personal communications, M. Welsh, 2002).

3.9.3. Impacts of Alternative A, No Action

Continuation of the present condition, with no treatment, would allow the present impacts on certain cultural features to continue; however, the impacts would be negligible to minor, since Polk's survey of the proposed stream restoration work area and two access roads found: (1) no listed historic properties or standing historical buildings or structures within or adjacent to the survey areas and (2) no previously recorded archaeological sites within the survey areas.

The effects could be expected to include the following:

- A minor impact on small cultural features in lava tubes or cave areas could occur, as floods continue to periodically inundate some of these areas, bringing in sediment. This could potentially wash away, erode, or cover certain minor artifacts or cultural features.

- Negligible to minor impacts could occur in areas where erosion would remove artifacts, namely, below the breach in the ditch en route to Dam 30 or in erosion around the El Calderon Parking Lot area.

Cumulative Effects. The effects of erosion, sedimentation, drainage, and flooding on cultural features in the area would continue, and over time lava tubes, caves, and creek area habitats could be affected in a minor to negligible way by sediment and localized erosion.

Conclusion. Periodic floods in the El Calderon Parking Lot and Junction Cave area would allow minor localized erosion or sediment deposition to take place, possibly affecting the cultural features of the creek area in a negligible to minor way in lava tubes, and caves. Periodic flooding of the creek could erode and affect riparian areas at a negligible to minor level.

3.9.4. Impacts of Alternative B, the Preferred Action

The proposed project is intended to reduce flooding in the El Calderon Parking Lot and Junction Cave area and should diminish localized erosion and sediment deposition in these areas. This would provide negligible to minor positive benefits in protecting cultural features, since (1) no listed historic properties or standing historical buildings or structures within or adjacent to the survey areas and (2) no previously recorded archaeological sites within the survey areas (Polk, 2002).

Temporary, localized, minor impacts would be expected in the areas where soils are exposed during the process of leveling the old dams and dikes and replanting the areas. In those areas of disturbance, negligible impacts on cultural features would be expected.

As a mitigation measure, Polk advised that if previously unknown archaeological remains are encountered during the proposed stream restoration work, activity in that area should be halted and El Malpais National Monument staff notified immediately.

Cumulative Effects. Control of erosion, sedimentation, and flooding over time, as proposed by the project, could generally help protect against disturbing any cultural resources over the long term in caves, lava tubes, and riparian areas in the project area.

Conclusion. Implementation of the preferred alternative would help control flooding, erosion, and sedimentation in the area and generally help protect minor cultural resources that might be found in the area. The proposed project area contains no significant cultural or historic features; therefore, no impacts of significance on cultural resources would be expected from the project. On a short-term, local basis minor, localized negative impacts could occur as soils are disturbed during removal of dikes and ponds, followed by smoothing of the areas.

3.9.5. Impacts of Alternative C, the Large-Channel Action

From a cultural perspective, Alternative C, the large-channel action would be expected to produce essentially identical impacts as Alternative B, the preferred alternative. The total amount of earth disturbance and other negative effects would be about the same. The area disturbed by removing old structures should be about the same. The flood protection of lava tubes and caves should be about the same.

3.10. Socio-Economic Effects

3.10.1. Affected Environment

Recreation and tourism play a distinct role in the economy of the area in and near the El Malpais National Monument. The once important uranium industry of the past has greatly declined, while agriculture and industry are not major factors as they are to the east in the Rio Grande Valley and Albuquerque areas. Small businesses in the Grants area are significantly dependent on income from travelers, nature recreation, and visitors from Albuquerque and other urban areas. The City of Grants supports more than 30 restaurants, service stations, gift shops, a museum, and small stores that depend on tourism as a major source of their income (BLM and NPS, 2001).

Median annual household income in Cíbola County is only $23,700 (vs $30,000 for the State's average); unemployment was 15 percent in the 2000 census. Thirty-seven percent of Cíbola County residents consider themselves to be Hispanic and about 40 percent of the county are Native American (BLM and NPS, 2001; National Park Service, 2001; Marron and Wilson, 1994).

The land around the proposed project area is nearly all Federal. Rural residents are sparse in the immediate project area, and basically no inhabitants are close enough to be disturbed by the noise or activities of the proposed project. Rural populations are generally on the rise in the broader area, as people develop second homes, ranchettes, or other rural retreats.

3.10.2. Impacts of Alternative A, No Action

Continuation of the status quo, or no treatment, would offer no discernible, short-term benefits or impacts in terms of the local society and economy. As a minor, indirect, negative impact, the local populace would not have an opportunity to participate in the proposed project as short-term employees or contractors; there would be no injection of project funds into the local economy. The no action alternative would provide no benefits to the local economy.

3.10.3. Impacts of Alternative B, the Preferred Action

Implementation of Alternative B, the preferred action, would have no significant negative impacts on the local society and would provide minor positive inputs into the local economy.

The proposed project would offer the local populace an opportunity to participate as short-term employees or to serve as contractors. Therefore, the project would be expected to provide a minor injection of project funds into the local economy in terms of supply purchases, contracts for earth moving, or short-term jobs as laborers.

The Monument has good relations with neighbors; therefore, there would be no expectation that nearby rural residents would object to the proposed project. To the contrary, inhabitants in the general area would likely view the project as an opportunity for sales or contracting.

As a mitigation measure, the project work schedule could be adjusted slightly to reduce effects on park visitation, for example, by avoiding weekend operation of machinery along the Continental Divide Trail and at the El Calderon Parking Lot.

Cumulative Effects. The long-term, cumulative effects of the project should be a minor positive benefit to the local economy over the years. Reducing the floods in the El Calderon Parking Lot and Junction Cave area would help reduce the times of closures to visitation, thereby helping to reduce disruption to visitation. Visitation has a positive and significant impact on the local economy.

Minor improvement of wildlife habitat offered by the project over the long term would improve the attractiveness of the area for bird and wildlife watching in minor terms, thereby helping to enhance visitation appeal.

Conclusion. Implementation of the preferred alternative should offer minor, short-term economic input into the local economy in terms of jobs, contracts, and sales of materials. Helping to reduce flooding at the El Calderon Parking Lot and Continental Divide Trail areas would be expected to have a long-term effect in helping to maintain visitation in the park; visitation has a positive effect on the local economy. The proposed project should produce no negative impacts on the local society and economy. Since the proposed project area is remote and removed from local inhabitants, the proposed project should have no negative effects on local residents.

3.10.4. Impacts of Alternative C, the Large-Channel Action

From a socio-economic perspective, Alternative C, the large-channel action, would be expected to produce basically identical impacts as Alternative B, the preferred alternative. The number of possible jobs, contracts, or other inputs into the local economy should be the same. Protection of lava tubes and caves against flooding should be about the same for either Alternative B or C.

3.11. PARK OPERATIONS, PUBLIC HEALTH, AND SAFETY

3.11.1. Affected Environment

The El Malpais Information Center and nearby maintenance facility are located on Highway 53 at the northwest edge of the proposed project area, only a few hundred yards from two of the proposed treatment sites (Stock Tank 19-2 and the Diversion Dike) and a short drive to the other three sites (Figures 1-3 and 1-4). The Information Center serves as the main focal point for park operation, management, and public contact in the area, providing public facilities, emergency services, routine maintenance activities, information to protect the public, interpretation, environmental education, supply/equipment storage, some staff housing, communications facilities, and other routine aspects of park operations and protection of the public.

A second gathering point in the proposed project area is the El Calderon Parking Lot. This area serves as a point of contact with the public and a park manger's entry point for maintenance, protection, fire management, and management of the roads, parking, trails, rest rooms, signs, and other features associated with Junction Cave, Bat Cave, the Continental Divide Trail, and other hiking trails in this part of the Monument (Figures 1-3 and 1-4). The parking lot is within sight of or a short walk to three of the proposed treatment sites (Stock Tank 28, Pine Dike, and the Parking Lot).

The proposed project is situated in a section of the Monument that is attractive to visitors looking for nature appreciation, geologic study, bird or wildlife watching, hiking (both day and longer-term), and environmental education. The area is managed for these nature-oriented activities as well as for the general protection of the Monument's natural and cultural resources and the protection of the health and safety of visitors.

Park rangers and other staff provide law enforcement, emergency services, public health protection, safety warnings, environmental interpretation, fire protection, routine park maintenance and management, resource management, and resource protection, and routinely work in close cooperation with other governmental and private organizations to accomplish these tasks.

Floods present a public safety hazard. As covered in detail in Section 3.7 (on hydrology), in some years flooding covers parts of the Continental Divide Trail, in the area behind the Information Center, and next to the El Calderon Parking Lot area. The floods pose a hazard to public safety from the rushing waters, isolated deeper holes, mud, and erosion of roads and trails. In addition, the old stock ponds, ditches, dams, and lava tubes in the proposed project area are flooded, posing a hazard as an attractive nuisance. It is important to underscore that all of the ponds, dikes, ditches, and other features in the proposed project are located immediately on the Continental Divide Trail, near it, or in areas popular with visitors (e.g., Junction Cave), so none of the sites are remote from people. During and after flooding along Agua Fria Creek, the rangers and other staff will need to provide public warnings, watch out for flooding safety concerns, attend to road and parking lot repairs, and handle the other chores necessitated by the flooding.

3.11.2. Impacts of Alternative A, No Action

Continuation of the status quo, or no treatment, would offer no benefits or advantages in terms of park operations or in respect to the protection of public health and safety. Conversely, continuation of the existing condition, or no treatment, would be expected to present disadvantages or negative impacts, mainly:

- Flooding of roads, trails, and the parking lot would continue to occur at the same level every several years, posing the safety hazards described under affected environment above; flooded ponds and ditches would continue to be attractive nuisances.

- Rangers and other staff would continue to be occupied with the flooding problems, detracting from other park operation work and requiring time to warn visitors of the hazards. Monument staff time and funds would need to go into cleaning up debris, erosion, and other problems of the flooding; rangers would spend time making certain that visitors are not in harm's way along the Continental Divide Trail.

- Regular park operations would be interrupted periodically as floods close off parking lot or roads and demand park staff time for the repairs and cleanup. Some expense would be incurred for the repairs.

Cumulative Effects. The long-term, cumulative effects of Alternative A, no action, would be a minor to moderate negative effect over years. Continued flooding in the El Calderon Parking Lot and Junction Cave area at the same level would be anticipated to continue causing periodic closures to visitation and safety hazards. Some of the old farm ponds would continue to be attractive nuisances to visitors, until natural erosion finally fills them.

Conclusion. Continuation of the status quo or no action would be expected to allow the present problems of flooding, sedimentation, and erosion along Agua Fria Creek to continue. The floods would periodically affect visitation in the El Calderon Parking Lot area. Flooded ponds and ditches would present an attractive nuisance and safety hazard. The problems likely would continue for decades.

3.11.3. Impacts of Alternative B, the Preferred Action

Implementation of Alternative B, the preferred action, would most likely have only negligible negative effects on park operations and the related concerns of visitor safety and health; some negligible to minor, short-term risks to visitors as well as some disruptions in park operations would occur during the construction period. The Monument staff would need to assure that hikers and other visitors are not put at risk, by appropriate warning signs or other mitigation. Machinery operators would need to watch for hikers and other visitors near their area of work.

The project work schedule could be adjusted slightly to reduce effects on operating the park for visitation, for example, by avoiding weekend operation of machinery along the Continental Divide Trail and at the El Calderon Parking Lot.

From the park operations and safety perspective, the preferred action, or Alternative B, would some advantages and benefits over the status quo. Lowering of the flood levels through Alternative B would be expected to reduce the hazard and public safety concerns related to the rushing waters, mud, flooded lava tubes, wet caves, and eliminate the attractive nuisance of filled ponds and ditches. This would reduce Monument staff time needed to warn the public of the flooding and to clean up and repair flooding damages, especially in the El Calderon Parking Lot area.

Cumulative Effects. The long-term, cumulative effects of the project would most likely be a minor to moderate positive benefit to park operations over the years. Reducing the periodic flooding in the El Calderon Parking Lot and Junction Cave area would help reduce closures to visitation and also reduce the time that Monument staff need to spend on attending the flooding problems and cleaning up the flood damages.

Conclusion. Implementation of the preferred alternative would be expected to help to reduce flooding at the El Calderon Parking Lot and Continental Divide Trail areas and eliminate flooding in the ponds and ditches in the proposed project area. These actions would have a significant moderate effect in terms of public safety and health.

These actions also would be expected to reduce the time that rangers and other staff dedicate to flooding problems and flood area cleanup and repair. Therefore, the preferred action Alternative B should be beneficial from the park management and operations perspective.

3.11.4. Impacts of Alternative C, the Large-Channel Action

The application of Alternative C, the large-channel action versus Alternative B, the preferred action would simply mean a tradeoff in terms of flood water routing. In the case of Alternative B, more waters would flow by the highway (in the original creek channel); whereas, in the case of Alternative C more of the flow would pass in a channel dug by the El Calderon Parking Lot. From a park operation, public health, or safety perspective the two alternatives should be the same. Both alternatives would attempt to reduce flooding problems. Both would fill in the ponds and ditches. Both would require essentially the same amount of park staff time. Both would improve safety by lowering flooding and sedimentation. In conclusion, from a park operation, park management, public health, or safety perspective, Alternative C would be expected to have the same impacts and benefits as Alternative B.

3.12. Park Visitation

3.12.1. Affected Environment

The Monument offers a unique experience for visitors from New Mexico as well as from around the United States and other countries. Visitors most often come for a day or two, and their interests include: nature appreciation; geologic study; bird, bat, and wildlife watching; hiking; picnicking; camping; photography; solitude; and caving. The Continental Divide Trail runs directly through the proposed project area and is attractive to longer distance hikers. Annual visitation to the entire Monument is about 110,000 per year, and several thousand a year visit the proposed project area.

The El Malpais Information Center, located at the northwest edge of the proposed project, provides the visitors restrooms, emergency services, information, communications, and interpretation. This Center lies close to two of the treatment sites (Figures 1-3 and 1-4). A second point attracting visitors is the El Calderon Parking Lot area, next to Junction Cave, Bat Cave, the Continental Divide Trail, and a popular local hiking trail loop (Figures 1-3 and 1-4). Three of the proposed treatment sites fall within a short walk of the parking lot.

Floods disrupt visitor use and experience, since the flooding covers parts of the Continental Divide Trail, the area behind the Information Center, the El Calderon Parking Lot, the parking lot entry road, and access to Junction Cave. Flooding poses a hazard to visitors, who could encounter isolated deeper holes of water, mud, erosion of trails, and inundation of the parking lot and road. Temporary closures can be necessary at times. The ponds, dikes, ditches, and other features in the proposed project are located near these areas popular with visitors.

3.12.2. Impacts of Alternative A, No Action

Continuation of the status quo probably would offer no benefits in terms of visitor use and experience. On the other hand, continuation of the existing situation would most likely produce short-term, moderate, negative impacts during flood years. Flooding of roads, the Continental Divide Trail, other trails, and the El Calderon Parking Lot would occur, temporarily disrupting visitor access through closures of parking, trails, lava tube areas, or caves. Rangers and other staff occupied with the flooding and cleanup would have less time to serve visitors with interpretation, information, or other services.

Cumulative Effects. The long-term, cumulative effects of Alternative A, no action, would most likely be a moderate negative effect on visitors over the decades by the continued flooding in the El Calderon Parking Lot, Continental Divide Trail, and Junction Cave areas.

Conclusion. Continuation of the status quo, no action, would be expected to allow flooding, sedimentation, and erosion along Agua Fria Creek to continue for decades. The floods would periodically disrupt visitation in the El Calderon Parking Lot, Junction Cave, and Continental Divide Trail areas, causing short-term, moderate disruptions in visitor use and experience. Flooded ponds and ditches would continue to present an attractive nuisance to visitors and pose a minor safety hazard.

3.12.3. Impacts of Alternative B, the Preferred Action

Implementation of Alternative B, the preferred action, in all probability would have negligible to minor, short-term negative effects on visitation. Some disruptions in visitation would occur during the construction period; hikers would need to detour around construction sites; and parking would be disrupted temporarily.

The project work schedule could be adjusted to reduce the project's effects on visitation, for example, by avoiding weekend operation of machinery along the Continental Divide Trail and at the El Calderon Parking Lot.

Overall, the preferred action Alternative B would be expected to offer moderate, long-term advantages and benefits to visitors:

- Lowering of flood levels by preferred action Alternative B should reduce the periodic El Calderon Parking Lot area inundation, decrease mud in general, and reduce flooding of lava tubes and caves in the area (popular with visitors).

- Reduction of flood levels would be expected to reduce erosion and flooding along about two miles of the Continental Divide Trail, in the middle of the project area --where the trail essentially follows the creek. The project actions also would be expected to enhance aesthetics by removing old, broken structures.

Cumulative Effects. The long-term, cumulative effects of the project should be a moderate positive benefit to park visitation over the years, by reducing periodic flooding at the El Calderon Parking Lot, Continental Divide Trail area, and Junction Cave in the years to come.

Conclusion. Implementation of the preferred alternative would be expected to help reduce flooding at the El Calderon Parking Lot, Junction Cave, and Continental Divide Trail areas and eliminate flooding in the ponds and ditches in the proposed project area. Filling the ponds would remove attractive nuisances, improving visitor safety. These actions would have a moderate positive effect for park visitors by reducing the necessity of area closures during flooding.

3.12.4. Impacts of Alternative C, the Large-Channel Action

From a park visitor's perspective, Alternatives B and C would be the same, since the difference in Alternative B versus C is largely a difference in flood water routing. With preferred Alternative B, much of the creek water would flow by the highway (after breaching Pine Dike). With large-channel Alternative C, more water would flow by the El Calderon Parking Lot (in a channel excavated for that purpose). So both alternatives would be expected to reduce flooding problems. Both alternatives would fill in the ponds and ditches, thereby reducing hazards to visitors. In conclusion, the benefits of large-channel Alternative C in terms of park visitation and experience would match those of preferred Alternative B, described above.

3.13. Energy Requirements and Conservation Potential

Alternative A, no action, would require no energy resource inputs. However, the status quo would allow continued flooding and flood damages. Energy would be needed for the equipment to carry out the flooding repair and cleanup work, probably about every five years.

Implementation of Alternative B, the preferred action, would require petroleum fuel up front to move earth, transport vegetation, dig channels, and transport workers. The energy demand would be for the operation of about two tractors and two trucks over a period of about three weeks. However, the preferred alternative's action is designed to reduce future flooding and ultimately would save the energy costs of the periodic flood cleanups.

3.14. Conflicts between the Action and Land Use Plans or Policies

As covered on page one, in Section 1.8, and in Section 2.6 of this report, the proposed project's preferred alternative is consistent with National Park Service and El Malpais National Monument land management plans and environmental policies. The proposed project's goals are in harmony with the National Park Service's philosophy to prefer a natural environment over a manipulated one.

3.15. Natural or Depletable Resource Requirements and Conservation

The preferred action would require use of petroleum fuel for tractor and truck operation. However, as noted in 3.13 above, the project is small, and fuel demand would be for about two trucks and two tractors for approximately three weeks. However, since the proposed project would help control floods, in the long term the project should help conserve the fuel resources needed for post-flood cleanups.

3.16. Impairment

None of the alternatives would be expected to produce major negative impacts on the resources or values that are:

- necessary to fulfill specific purposes identified in the establishing legislation of the monument;
- key to the natural or cultural integrity of the monument or opportunities for enjoyment of the monument; or
- identified as a goal in the monument's general management plan or other NPS planning documents (El Malpais NM, 2001).

Consequently, there would is no expectation that these resources or values would be harmed as a result of implementation of the preferred alternative.

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5. PROJECT TEAM, CONSULTATION, AND COORDINATION

5.1. Preparers of the Report

This report was prepared by Sam Kunkle, Colorado State University in close cooperation with Herschel Schulz, Chief Ranger, El Malpais NM, and Rick Inglis, Hydrologist, NPS, Fort Collins. Section 3.9 of this report, on cultural resources, was extracted from the cultural survey prepared by Harding Polk II of SWCA, Albuquerque (Polk, 2002) and paragraphs provided by Michael Welsh, Historian, University of Northern Colorado, Greeley.

5.2. Project Team and Cooperators

The team members who provided inputs, advice, discussion, mapping, or other information for writing this environmental assessment appear in Table 3.2, Section 3.2, Methodology. Other persons visited by the project team members or contacted for information are included in the more general list of Table 5.2 below.

Special appreciation is extended to a number of persons outside the project who graciously volunteered information, reports, or suggestions, including: Doug Bradley, Ron Clawson, Greg Cody, Jeff Fredine, Laura Gleasner, Art Gomez, Shelly Herbst, Art Ireland, Dave Pawekek, Linda Popelish, Dennis Slifer, Brenda Simpson, Joe Sovick, and Russ Suminski.

Table 5.2. A list of team members, principal contacts, and cooperators during the design phase of the proposed project and during preparation of the environmental assessment.

[√ = indicates that team member (usually the PI) conversed with the person; √√ = indicates that project team member (usually the PI) visited with the person; √√√ = indicates this person met with project team members on the ground at the project site or otherwise was involved at the project site. (PTM) = "Project team members," i.e., the principal persons or persons most directly involved in the project during 2001-2002].

NAME	ROLE/ORGANIZATION		COMMENTS
Benjamin, Pam	NPS	√√	NPS vegetation specialist. Advised on vegetation and provided recommendations for reseeding at treatment sites.
Bradley, Doug	NPS, Albuquer-que	√√	NPS GIS specialist. Advised on GIS, GPS, and remote sensing.
Bureau of Reclamation	BOR, Denver	√	Bruce Muller at BuRec in Denver responded that he had no record of Dam 30 (303) 445-2764.
Clawson, Ron	FS/ local rancher	√√√	Local Forest Service biotech and senior local rancher, visited the project area to offer impressions of the ponds' history. Mt

			Taylor District, Cibola National Forest, 1800 Lobo Canyon Rd, Grants, NM 87020 Hm (505) 783-4585
Corps of Engineers			See Rosenau
EDAC	UNM remote sensing group, Albuquer-que	√√	Remote sensing specialists. Provided aerial photographs of the project area. Assisted on interpretation. Laura Gleasner, Geographic Data Specialist. Earth Data Analysis Center (EDAC), UNM, Bandelier West, Room 111, UNM, Albuquerque, NM, 87131-6031. (505) 277-3622 X 230
Fettig, Steve (PTM)	NPS & project team, Los Alamos	√√√	NPS biologist. Advised on wildlife. Bandelier NM. (505) 672-3861 X 546 HCR1 Box 1, Suite 16, Los Alamos, NM, 87544
Forest Service	FS		See: Pawelek, Popelish, Clawson, Suminski.
Fredine, Jeff	NM Hwy & Trans Dept, Santa Fe	√√	Environmental specialist. Provided information on Highway & Trans Dept EA nearby. Jeff Fredine, Highway Environmentalist II, Environmental Section, NM Highway & Trans Dept, PO Box 1149, Santa Fe, NM 87504-1149 (505) 827-5252
Gleasner, Laura	UNM remote sensing	√√	See EDAC
Hackler, John	NM Hwy & Trans Dept, Santa Fe	√√	Highway specialist. Provided information on highway in area. 827-5182 NM Highway & Trans Dept, PO Box 1149, Santa Fe, NM 87504-1149
Inglis, Rick (PTM; project Co-PI)	NPS, Fort Collins	√√√	Project Co-Principal Investigator and hydrologist. Water Resources Division, NPS, 1201 Oak Ridge Drive, Fort Collins, CO 80525 rick_inglis@nps.gov (970) 225-3517
Ireland, Maryana	El Malpais NM	√√√	Interpretation specialist. Contact on interpretation questions. Area Mgr, SW Parks & Monuments Assc. 11000 Ice Cave Rd, Grants, NM 87020 (505) 783-4774.
Kendrick, James W	El Malpais NM	√√√	Archaeologist. Contact on archaeology questions. Archaeologist, El Malpais NM, 123 E. Roosevelt Ave, Grants, NM 87020 505 285-4641 x40 jim_kendrick@nps.gov
Kunkle, Samuel H. (PTM; project PI)	CSU, Fort Collins	√√√	Project Principal Investigator and hydrologist. 140 Camino Real, Fort Collins, CO 80524 kunkle@earthlink.net (970) 484-1901
Laki, Ben	CSU, Fort Collins	√√	Accountant. (970) 491-2339 CSU budget person on the project blaki@cnr.colostate.edu
Lujan, John	El Malpais NM	√√√	Superintendent, El Malpais National Monument (505) 285-4641
Marron & Associates	Consulting Co, Albu-querque	√	Environmental writer. Provided EA work for the highway dept in the project area. Shelly Herbst at (505) 898-8848 Marron & Assoc., 4th St NW, Albuquerque, NM 87107
Montoya, Richard	NRCS, Grants	√	Conservationist. See NRCS
Muldavin, Esteban (PTM)	UNM & NM NHP, Albu-querque	√√√	Riparian vegetation & wetland specialist assisting on the project. (505) 277-3822 X 228 NM Natural Heritage Program. Ecology Group Coordinator, Castetter Hall 167, UNM, Albuquerque, NM, 87131 muldavin@sevilleta.unm.edu
Muller, Bruce	US BuRec, Denver	√	Engineer. Found no record of Dam 30 in their "national inventory of dams." U.S. Bureau of Reclamation, Mail Code D-6600, PO Box 25007, Denver, CO, 80225-0007. Bmuller@do.usbr.gov (303) 445-3238.
Murphy, John	SHPO, Santa	√	Historian. Discussed Dam 30. State Architect Historian with

	Fe		SHPO. 827-3990
Natural Resources Conservation Service	NRCS, Grants	√√	Conservationist and staff. Discussed history of the area and use of stock ponds. (505) 287-4045 Richard Montoya (√), Brenda Simpson (√√) and Cynthia Spidle (√√) . 117 Silver Ave, Grants, NM 87020.
NM Highway & Transporation Dept	NM State Hwy & Trans Dept, Santa Fe	√√	Highway environmental specialists and engineers. Contacted for information on nearby EA work: State Highway & Transportation Dept, PO Box 1149, Santa Fe, NM 87504 Henry Chavez √√= Surveys, in Preliminary Design Bureau (827-5419); James Samsell √√ Aerial Photographer (827-5619); Manuel Sanchez & Cecelia Herrera √√ in Archives (old project files); Jeff Fredine √√ (Environmental Section) Highway Environmentalist (827-5253); Dennis Slifer √√ (Environmental Section) Highway Environmentalist (827-0373); Farshad Omidvaran, PE, Drainage Section √√ (827-5331).
Pawelek, Dave	USDA-FS, Albuquer-que	√√	Hydrologist. Provided info and copies of reports on streamflow, erosion, and general hydrology in the Agua Fria Cr headwaters in the National Forest. Cibola National Forest, 2113 Osuna Rd, Albuquerque, NM
Polk, Harding (PTM)	SWCA consultant, Albuquer-que	√√√	Archaeologist. Provided the cultural survey for input into the EA. (505) 254-1115. SWCA, 7001 Prospect Place NE, Suite 100, Albuquerque, NM 87110 archaeologist with SWCA company (lives near Grants) hpolk@swca.com
Popelish, Linda	FS, Grants	√√	Archaeologist. Advised on history of land ownership in the project area. (505) 287-8833 Mt Taylor District, Cibola National Forest, 1800 Lobo Canyon Rd, Grants, NM 87020
Pranger, Harold (Hal) (PTM)	NPS, Denver	√√√	Geomorphologist. Visited project area as adviser, providing input into recommendations. hal_pranger@nps.gov (303) 969-2014 NPS Geologic Resources Division, NPS, PO Box 25287, Denver, CO, 80225. (303) 987-6923
Prince, Eric (PTM)	CSU, Fort Collins	√√	Watershed student. Assisted with CAD drawings for the topo maps. (CSU grad student)
Ratlief, B. Jeanne (PTM)	El Malpais NM	√√√	GIS and ArcView person and GPS adviser on the project team. (505) 285-4641 X21 Park Ranger, El Malpais NM, NPS, Box 939, Grants, NM 87020. Jeanne_ratlief@nps.gov
Reber, John	NPS, Denver	√√	Coordinator for the water resource projects for the Intermountain Region of NPS.303 969-2418 Denver john_reber@nps.gov NPS
Revitte, Marion	NRCS, Albuquer-que	√	Archaeologist for NM & UT (she found no state record on Dam 30 and no Soil Conservation Service records on any of the structures in the project area).761-4423 marion.revitte.nm.usda.gov NRCS archaeologist for NM & UT
Rosenau, Andy	USA COE, Albuquer-que	√	COE water resource specialist. Regulatory branch; handles permits for dams; had no record of Dam 30. (505) 342-3282
Schulz, Herschel E. (PTM)	El Malpais NM	√√√	Principal park contact and key project team member in the park. (505) 285-4641 X25 Chief Ranger, El Malpais NM, NPS, Box 939, Grants, NM 87020. Herschel_schulz@nps.gov
SHPO			See Murphy
Simpson, Brenda	NRCS, Grants	√√	See NRCS
Slifer, Dennis	NM Hwy & Trans Dept, Santa Fe	√√	Highway Environmentalist II. Provided information on EA work nearby, Environmental Section, NM Highway & Trans Dept, PO Box 1149, Santa Fe, NM 87504-1149 (505) 827-0373
Sovick, Joe	NPS, Santa Fe	√√	Contact for general information. (505) 988-6006 SW Support Office, NPS, P.O. Box 728, Santa Fe, NM 87504
Spude, Cathy	NPS, Santa	√√√	Visited project site and provided overall assessment and

	Fe		advice on cultural resources. Supervisory Archaeologist, NPS, P.O. Box 728, Santa Fe, NM 87504 (2968 Rodeo Park Dr W) (505) 988-6831 [Note, Bob Powers and Art Ireland in the same office also offered assistance with photos].
State Library	State Library, Santa Fe	√√	Provided look at old files, maps, documents (505) 476-9700 in the Archives section
Steensen, Dave (PTM)	NPS, Denver	√√√	Visited project area as a geologic and restoration adviser. (303) 969-2014 NPS Geologic Resources Division, NPS, PO Box 25287, Denver, CO, 80225 dave_steensen@nps.gov
Suminski, Russ	FS, Grants	√√	Range and natural resources. Mt Taylor District, Cibola National Forest, (505) 287-8833
Wagner, Joel	NPS, Denver	√√	Provided project advice on wetlands. (303) 969-2955 Water Resources Division, NPS, PO Box 25287, Denver, CO 80225-0287 NPS wetlands coordinator (also Mark Flora in the same office at 303 969-2956).
Welsh, Michael	Univ of No. CO, Greeley	√	(970) 351-2223 History Dept, Campus Box 116, 501 20th St, University of No. Colorado, Greeley, CO, 80639 mewelsh@bentley.unco.edu
Wohlenberg, Charles	State Eng Office, Albuquerque	√	505 841-9480 x111 841-9485 121 Tijeras NE Ste 2000 Albq
Zeedyk, William (PTM)	Consultant, Albuquerque area	√√√	Key riparian specialist on the team on short-term basis. Much experience in restoration, active NM Riparian Council. (505) 281-9077 cell 505 220-6367

5.3. List of Recipients to Receive this EA

El Malpais National Monument will mail this report to a number of persons or organizations, including those listed below.

Federal Agencies	State and Local Agencies
Forest Service Forest Service, Cibola NF Mt Taylor Ranger District Rocky Mt Forest and Range Exp Station National Park Service Bandelier NM El Morro NM Geologic Resources Division Support Office, Santa Fe (Natural Res.) Support Office, Santa Fe (Cultural Res.) Intermountain Region (Compliance) Intermountain Support Office US Environmental Protection Agency USFWS Southwestern Regional Office US Geological Survey US Department of the Interior	Cibola County Golden State Park Grants Public Library NM Bureau of Mines NM Forestry and Resources Division NM Highway and Transportation Dept NM State Forestry State of New Mexico Indian Tribes Apache White Mountain Tribe Pueblo Acoma Laguna Zuni Ramah Navajo Chapter

Organizations	Individuals

APPENDIX A FLORA AND FAUNA IN THE MONUMENT

Bird Species in the Park

Accipitridae	
Accipiter cooperii	Cooper's Hawk
Accipiter gentilis	Northern Goshawk
Accipiter striatus	Sharp-shinned Hawk
Aquila chrysaetos	Golden Eagle
Buteo jamaicensis	Red-tailed Hawk
Buteo regalis	Ferruginous Hawk
Buteo swainsoni	Swainson's Hawk
Circus cyaneus	Northern Harrier
Haliaeetus leucocephalus	Bald Eagle
Aegithalidae	
Psaltriparus minimus	Bushtit
Alaudidae	
Eremophila alpestris	Horned Lark
Alcedinidae	
Ceryle alcyon	Belted Kingfisher
Anatidae	
Anas acuta	Northern Pintail
Anas americana	American Wigeon
Anas clypeata	Northern Shoveler
Anas crecca	Green-winged Teal
Anas cyanoptera	Cinnamon Teal
Anas discors	Blue-winged Teal
Anas platyrhynchos	Mallard
Anas strepera	Gadwall
Aythys valisineria	Canvasback
Bucephala albeola	Bufflehead
Bucephala clangula	Common Goldeneye
Oxyura jamaicensis	Ruddy Duck
Apodidae	
Aeronautes saxatalis	White-throated Swift
Ardeidae	
Ardea herodias	Great Blue Heron
Bubulcus ibis	Cattle Egret
Egretts thula	Snowy Egret
Nycticorax nycticorax	Black-crowned Night-heron
Bombycillidae	
Bombycilla cedrorum	Cedar Waxwing
Caprimulgidae	
Caprimulgus vociferus	Whip-poor-will
Chordeiles minor	Common Nighthawk
Phalaenoptilus nuttallii	Common Poorwill O

Cathartidae	
Cathartes aura	Turkey Vulture
Certhiidae	
Certhia americana	Brown Creeper
Charadriidae	
Charadrius montanus	Mountain Plover
Charadrius vociferus	Killdeer
Collumbidae	
Columba fasciata	Band-tailed Pigeon
Columba livia	Rock Dove
Zenaida asiatica	White-winged Dove
Zenaida macroura	Mourning Dove
Corvidae	
Aphelocoma coerulescens	Scrub Jay
Corvus brachyrhynchos	American Crow
Corvus corax	Common Raven
Cyanocitta stelleri	Steller's Jay
Gymnorhinus cyanocephalus	Pinyon Jay
Nucifraga columbiana	Clark's Nutcracker
Cuculidae	
Geococcyx californianus	Greater Roadrunner
Emberizidae	
Agelaius phoeniceus	Red-winged Blackbird
Aimophila ruficeps	Rufous-crowned Sparrow
Amphispiza belli	Sage Sparrow
Calamospiza melanocorys	Lark Bunting
Chondestes grammacus	Lark Sparrow
Dendroica coronata	Yellow-rumped Warbler
Dendroica graciae	Grace's Warbler
Dendroica nigrescens	Black-throated Gray Warbler
Dendroica pensylvanica	Chestnut-sided Warbler
Dendroica petechia	Yellow Warbler
Dendroica townsendi	Townsend's Warbler
Euphagus cyanocephalus	Brewer's Blackbird
Geothlypis trichas	Common Yellowthroat
Guiraca caerulea	Blue Grosbeak
Icteria virens	Yellow-breasted Chat
Icterus galbula	Northern Oriole
Icterus parisorum	Scott's Oriole
Junco hyemalis	Dark-eyed Junco
Melospiza lincolnii	Lincoln's Sparrow
Melospiza melodia	Song Sparrow
Molothrus ater	Brown-headed Cowbird
Oporornis tolmiei	Macgillivray's Warbler
Passerculus sandwichensis	Savannah Sparrow
Passerina amoena	Lazuli Bunting
Passerina cyanea	Indigo Bunting
Pheucticus ludovicianus	Rose-breasted Grosbeak
Pipilo chlorurus	Green-tailed Towhee

Pipilo erythrophthalmus	Rufous-sided Towhee
Pipilo fuscus	Canyon Towhee
Piranga flava	Hepatic Tanager
Piranga ludoviciana	Western Tanager
Pooecetes gramineus	Vesper Sparrow
Quiscalus mexicanus	Great-tailed Grackle
Quiscalus quiscula	Common Grackle
Seiurus noveboracensis	Northern Waterthrush
Setophaga ruticilla	American Redstart
Spizella breweri	Brewer's Sparrow
Spizella passerina	Chipping Sparrow
Sturnella magna	Eastern Meadowlark
Sturnella neglecta	Western Meadowlark
Vermivora virginiae	Virginia's Warbler
Wilsonia pusilla	Wilson's Warbler
Xanthocephalus xanthocephalus	Yellow-headed Blackbird
Zonotrichia albicollis	White-throated Sparrow
Zonotrichia leucophrys	White-crowned Sparrow
Falconidae	
Falco columbarius	Merlin
Falco mexicanus	Prairie Falcon
Falco peregrinus	Peregrine Falcon
Falco sparverius	American Kestrel
Fringillidae	
Carduelis pinus	Pine Siskin
Carduelis psaltria	Lesser Goldfinch
Carduelis tristis	American Goldfinch
Carpodacus cassinii	Cassin's Finch
Carpodacus mexicanus	House Finch
Coccothraustes vespertinus	Evening Grosbeak
Loxia curvirostra	Red Crossbill
Hirundinidae	
Hirundo pyrrhonota	Cliff Swallow
Hirundo rustica	Barn Swallow
Progne subis	Purple Martin
Riparia riparia	Bank Swallow
Tachycineta bicolor	Tree Swallow
Tachycineta thalassina	Violet-green Swallow
Laniidae	
Lanius excubitor	Northern Shrike
Lanius ludovicianus	Loggerhead Shrike
Laridae	
Larus delawarensis	Ring-billed Gull
Mimidae	
Dumetella carolinensis	Gray Catbird
Mimus polyglottos	Northern Mockingbird
Oreoscoptes montanus	Sage Thrasher
Toxostoma bendirei	Bendire's Thrasher

Motacillidae	
Anthus rubescens	American Pipit
Muscicapidae	
Catharus guttatus	Hermit Thrush
Myadestes townsendi	Townsend's Solitaire
Polioptila caerulea	Blue-gray Gnatcatcher
Regulus calendula	Ruby-crowned Kinglet
Regulus satrapa	Golden-crowned Kinglet
Sialia currucoides	Mountain Bluebird
Turdus migratorius	American Robin
Paridae	
Parus gambeli	Mountain Chickadee
Parus inornatus	Plain Titmouse
Passeridae	
Passer domesticus	House Sparrow
Phasianidae	
Callipepla squamata	Scaled Quail
Meleagris gallopavo	Wild Turkey
Picidae	
Colaptes auratus	Northern Flicker
Melanerpes formicivorus	Acorn Woodpecker
Melanerpes lewis	Lewis' Woodpecker
Picoides pubescens	Downy Woodpecker
Picoides villosus	Hairy Woodpecker
Sphyrapicus thyroideus	Williamson's Sapsucker
Sphyrapicus varius	Yellow-bellied Sapsucker
Ptilogonitidae	
Phainopepla nitens	Phainopepla
Rallidae	
Fulica americana	American Coot
Porzana carolina	Sora
Rallus limicola	Virginia Rail
Recurvirostridae	
Recurvirostra americana	American Avocet
Scolopacidae	
Actitis macularia	Spotted Sandpiper
Calidris minutilla	Least Sandpiper
Catoptrophorus semipalmatus	Willet
Limnodromus scolopaceus	Long-billed Dowitcher
Numenius americanus	Long-billed Curlew
Phalaropus tricolor	Wilson's Phalarope
Tringa solitaria	Solitary Sandpiper
Sittidae	
Sitta canadensis	Red-breasted Nuthatch
Sitta carolinensis	White-breasted Nuthatch

Sitta pygmaea	Pygmy Nuthatch
Strigidae	
Aegolius acadicus	Northern Saw-whet Owl
Asio otus	Long-eared Owl
Athene cunicularia	Burrowing Owl
Bubo virginianus	Great Horned Owl
Glaucidium gnoma	Northern Pygmy-owl
Otus flammeolus	Flammulated Owl
Otus kennicottii	Western Screech-owl
Sturnidae	
Sturnus vulgaris	European Starling
Threskiornithidae	
Plegadis chihi	White-faced Ibis
Trochilidae	
Archilochus alexandri	Black-chinned Hummingbird
Eugenes fulgens	Magnificent Hummingbird
Selasphorus platycercus	Broad-tailed Hummingbird
Selasphorus rufus	Rufous Hummingbird
Stellula calliope	Calliope Hummingbird
Troglodytidae	
Catherpes mexicanus	Canyon Wren
Cistothorus palustris	Marsh Wren
Salpinctes obsoletus	Rock Wren
Thryomanes bewickii	Bewick's Wren
Troglodytes aedon	House Wren
Tyrannidae	
Contopus borealis	Western Wood-pewee
Empidonax difficilis	Pacific-slope Flycatcher
Empidonax hammondii	Hammond's Flycatcher
Empidonax oberholseri	Dusky Flycatcher
Empidonax wrightii	Gray Flycatcher
Myiarchus cinerascens	Ash-throated Flycatcher
Sayornis nigricans	Black Phoebe
Sayornis saya	Say's Phoebe
Tyrannus verticalis	Western Kingbird
Tyrannus vociferans	Cassin's Kingbird
Vireonidae	
Vireo gilvus	Warbling Vireo
Vireo solitarius	Solitary Vireo

Plant Species in the Park

Anacardiaceae	
Rhus trilobata var. anisophylla	Ill-scented Sumac
Asteraceae	
Achillea millefolium ssp. lanulosa	Common Yarrow
Baileya multiradiata	Showy Desert-marigold
Chrysothamnus nauseosus	Rubber Rabbitbrush or chamisa

Cirsium ochrocentrum	Yellow-spine Thistle
Gutierrezia sarothrae	Kindlingweed
Hymenoxys richardsonii	Colorado Rubberweed
Tetradymia canescens	Spineless Horsebrush
Zinnia grandiflora	Little Golden Zinnia
Brassicaceae	
Lepidium montanum	Mountain Pepperwort
Capparaceae	
Cleome serrulata	Rocky Mountain Beeplant
Chenopodiaceae	
Atriplex canescens	Four-wing Saltbush
Atriplex confertifolia	Shadscale
Eurotia lanata	Winterfat
Sarcobatus vermiculatus	Greasewood
Fabaceae	
Lotus wrightii	Scrub Bird's-foot-trefoil
Fagaceae	
Quercus turbinella	Shrub Live Oak
Hydrophyllaceae	
Nama hispidum	Sandbells
Liliaceae	
Allium cernuum	Nodding Onion
Yucca baccata	Banana Yucca
Oleaceae	
Forestiera neomexicana	Stretchberry
Fraxinus cuspidata var. macropetala	Fragrant Ash
Pinaceae	
Pinus edulis	Two-needle Pinyon
Pinus ponderosa	Ponderosa Pine
Pseudotsuga menziesii	Douglas-fir
Poaceae	
Agropyron smithii	Western-wheat Grass
Andropogon gerardi	
Andropogon scoparius	Little False Bluestem
Distichlis stricta	Coastal Salt Grass
Festuca arizonica	Arizona Fescue
Hilaria jamesii	James' Galleta
Koeleria cristata	Prairie Koeler's Grass
Lycurus phleoides	Common Wolf's-tail
Muhlenbergia montana	Mountain Muhly
Muhlenbergia torreyi	Ringed Muhly
Oryzopsis hymenoides	Indian Mountain-rice Grass
Piptochaetium fimbriatum	Pinyon Spear Grass
Poa pratensis	Kentucky Blue Grass
Sitanion hystrix	Western Bottle-brush Grass

Sporobolus airoides	Alkali-sacaton
Polemoniaceae	
Ipomopsis aggregata	Scarlet Skyrocket
Ipomopsis longiflora	White-flower Skyrocket
Rhamnaceae	
Ceanothus fendleri	Fendler's Buckbrush
Rosaceae	
Cercocarpus montanus	Alder-leaf Mountain-mahogany
Fallugia paradoxa	Apache-plume
Physocarpus monogynus	Mountain Ninebark
Salicaceae	
Populus tremuloides	Quaking Aspen
Saxifragaceae	
Ribes aureurn	Golden Currant
Ribes cereum	White Squaw Currant
Scrophulariaceae	
Penstemon barbatus	Beard-lip Beardtongue
Verbascum thapsus	Great Mullein
Solanaceae	
Lycium pallidum	Pale Desert-thorn
Tamicaceae	
Tamarix pentandra	Five-stamen Tamarisk
Verbenaceae	
Verbena ciliata	Dakota Mock Vervain
Mammal Species in the Park	
Bovidae	
Antilocapra americana	Pronghorn
Canidae	
Canis latrans	Coyote
Urocyon cinereoargenteus	Gray Fox
Cervidae	
Cervus elaphus	Wapiti
Odocoileus hemionus	Mule Deer
Erethizontidae	
Erethizon dorsatum	Porcupine
Felidae	
Felis concolor	Mountain Lion
Lynx rufus	Bobcat

Geomyidae	
Thomomys bottae	Botta's Pocket Gopher
Heteromyidae	
Dipodomys ordi	Ord's Kangaroo Rat
Dipodomys spectabilis	Banner-tailed Kangaroo Rat
Microdipodops megacephalus	Dark Kangaroo Mouse
Perognathus flavescens	Plains Pocket Mouse
Perognathus flavus	Silky Pocket Mouse
Leporidae	
Lepus californicus	Black-tailed Jack Rabbit
Sylvilagus floridanus	Eastern Cottontail
Molossidae	
Tadarida brasiliensis	Brazilian Free-tailed Bat
Muridae	
Microtus montanus	Montane Vole
Microtus pennsylvanicus	Meadow Vole
Neotoma albigula	White-throated Woodrat
Neotoma mexicana	Mexican Woodrat
Neotoma micropus	Southern Plains Woodrat
Neotoma stephensi	Stephens' Woodrat
Onychamys torridus	Southern Grasshopper Mouse
Peromyscus boylii	Brush Mouse
Peromyscus difficilis	Rock Mouse
Peromyscus truei	Pinon Mouse
Reithrodontomys megalotis	Western Harvest Mouse
Mustelidae	
Mephitis mephitis	Striped Skunk
Mustela nigripes	Black-footed Ferret
Taxidea taxus	Badger
Procyonidae	
Bassariscus astutus	Ringtail
Procyon lotor	Raccoon
Sciuridae	
Cynomys gunnisoni	Gunnison's Prairie Dog
Sciurus aberti	Abert's Squirrel
Spermophilus variegatus	Rock Squirrel
Tamias dorsalis	Cliff Chipmunk
Tamias quadrivittatus	Colorado Chipmunk
Tamiasciurus hudsonicus	Red Squirrel
Ursidae	
Ursus americanus	Black Bear
Vespertilionidae	
Antrozous pallidus	Pallid Bat
Eptesicus fuscus	Big Brown Bat
Lasionycteris noctivagans	Silver-haired Bat
Lasiurus cinereus	Hoary Bat

Myotis evotis	Long-eared Myotis
Myotis leibii	Small-footed Myotis
Myotis lucifugus	Little Brown Bat
Myotis thysanodes	Fringed Myotis
Myotis volans	Long-legged Myotis
Pipistrellus hesperus	Western Pipistrelle
Plecotus townsendii	Townsend's Big-eared Bat
Reptile Species in the Park	
Colbridae	
Coluber constrictor	Racer
Hypsiglena torquata	Night Snake
Masticophis taeniatus	Striped Whipsnake
Pituophis melanoleucus	Pine Snake
Thamnophis cyrtopsis	Black-necked Garter Snake
Crotaphytidae	
Crotaphytus collaris	Collared Lizard
Gambelia wislizenii	Long-nosed Leopard Lizard
Phrynosanatidae	
Holbrookia maculata	Lesser Earless Lizard
Phrynosoma douglasii	Short-horned Lizard
Sceloporus undulatus	Eastern Fence Lizard
Urosaurus ornatus	Tree Lizard
Uta stansburiana	Side-blotched Lizard
Scincidae	
Eumeces multivirgatus	Many-lined Skink
Eumeces obsoletus	Great Plains Skink
Teiidae	
Cnemidophorus exsanguis	Chihuahuan Spotted Whiptail
Viperidae	
Crotalus atrox	Western Diamondback Rattlesnake
Crotalus viridis	Western Rattlesnake
Amphibian Species in the Park	
Ambystomatidae	
Ambystoma tigrinum	Tiger Salamander
Bufonidae	
Bufo cognatus	Great PLains Toad
Bufo punctatus	Red-spotted Toad
Bufo woodhousii	Woodhouse's Toad
Pelobatidae	
Spea hammondii	Western Spadefoot
Ranidae	
Rana pipiens	Northern Leopard Frog

APPENDIX B.

B.1 List of Principal Concerns Raised
B.2 Letters and Other Coordination Documentation