APPENDICES

APPENDIX A
PUBLIC SCOPING

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[ALB]UQUERQUE, NM 87109
PHONE: 505-822-8200
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Project: Middle Rio Grande Bosque Restoration Reconaissance Study
Project #: DACW47-00-D-000 delivery order 017
SSW Project #: 02041 / 03049

Confirmation Notice # 7
Date: 2/6/03
Time: 8:00
Place: US Army Corps

This form serves to document decisions during formal meetings or phone conversations. It may also be used unilaterally as a memo of understanding for the record. Confirmation Notice can be initiated by anyone. They will be numbered and filed by the Project Manager. Please make any corrections or clarifications to the discussion in the space provided.

☒ MEETING ☐ TELEPHONE CONFERENCE ☐ INFORMATION ☐ OTHER

PEOPLE INVOLVED IN THE MEETING OR COMMUNICATION:

NAME:	WITH	TEL	FAX
See attached sign in sheets			
Fritz Blake			
cc. Lynette Giesen			
George Radnovich			
Gordon Walwood			

DISCUSSION

The purpose of this meeting was to present what the sponsor team has developed thus far by compiling information from the various resources, including community input, synthesizing it and creating maps depicting the results. The second part of the meeting was to gather input from the stakeholders on key components of the reconnaissance phase of the project before presenting the information to the public and completing this phase of the project.

Fritz Blake welcomed everyone and had them introduce themselves. He gave a summary of the three bosque projects

- Albuquerque Tingley Beach/Biopark – Now in the feasibility phase and due to begin construction in Fall/ Winter 2003
- Bosque Revitalization at Route 66 – Does not require congressional approval, Feasibility Report due Fall 2003, Construction to begin 2005
- Bosque Restoration – A 10 year project, funds may amount to $50-$70 million dollars, Project Management Report due March 2003

(additional notes attached)

FOLLOW-UP CORRECTIONS OR CLARIFICATIONS TO DISCUSSION:

☐ No change ☐ Change in Scope ☐ Change in Cost ☐ Change in Size

ORIGINATOR: ______________ SIGNED: [signature]

Attachments: ______________ Page ______ of ______

ADDITIONAL DISCUSSION NOTES - DECISIONS REACHED

George Radnovich described the process to be followed at the meeting. He described each of the maps that were on display:

Community input on restoration

Community input on recreation and educational/interpretational

Proposed restoration strategies and enhancements

Vegetation structure

Hydrologic features

Ongoing restoration and monitoring projects in the bosque

Vegetation Types

Proposed access and priority areas

Proposed bosque restoration priority areas

Proposed recreational and educational/interpretational areas

There were five foci for the breakout groups; Bosque restoration, Hydrology, Wildlife, Recreation/Education/Interpretation, Real estate and Land Use. Attendees typically began the session with the area of their expertise, but then migrated to other groups throughout the 'oted time since there is a great deal of interrelation between the areas. Below are the comments from the facilitators after the breakout sessions and the larger group reconvened. The maps will be modified, when appropriate, to reflect the suggestions.

Hydrology

The river is sediment-starved, the solution should include adding sediment-perhaps from excavations

70 cfs is the minimum flow, what effects will the San Juan-Chama water projects have on the river and the flow requirements?

Perhaps we shouldn't rush in to intervene after a fire, in some instances, and see how the bosque responds on its own-just add water

The hydrology map did not contain the most recent data and should be updated to show all the jetty jacks, including those already removed, the spoil bank levees and the engineered levees should be differentiated on the map

There should be a contingency for creating levee protection at a later date if necessary, such as rip-rap

A 50' buffer along the levee should be created at project locations

Every effort should be made to re-calibrate and update the various models (e.g. URGWOM) used.

This is a floodway, what will the capacity be?

'lans should be made for maintaining the side channels once established--perhaps train Open Space personnel to do this

What are the procedures for permitting regarding the proposed uses for the water, (overbanking, wetland construction, and channelization)

Include all wells, including monitoring wells such as BEMP and Nature Center sites

ADDITIONAL DISCUSSION NOTES - DECISIONS REACHED

Study impact of sediment on downstream structures, ie: irrigation and AMAFCA structures and activities

hat happens to structures within floodway during overbank operations?

Restoration/Wildlife

The aquatic habitats that are created should be for the silvery minnow

The native vegetation stands should be protected from any activities

What effect will the San Juan-Chama water project have on the restoration efforts?

There should be more areas that are restricted access, i.e. protected from human disturbance

Look into fuel reduction research pertaining to the impact of removal of understory on neo-tropical migrants. Additional studies may be necessary to assess impact on other wildlife.

Goal: to create a dynamic mosaic of vegetation structure and habitat types in the Study Area.

Use Bosque del Apache as a model and look into various strategies they have come up with.

Projects should continue to be coordinated with those of other agencies

Considerations should be made for the waterfowl usage along the river-flow/season. May want to restrict some overall river use.

hat will be the impact of water recreation upon the waterfowl and other wildlife?

Digitized wildlife habitat maps should be included in presentation.

Recreational/Interpretational Enhancements

Add parking facilities at Montano (west) and La Orilla to the map

The Bernalillo County Parks and Open Space areas should be differentiated from the City Parks and Open Space, and the missing information should be filled in (Bachechi Property, Atrisco Property, Durand Property, Larrazolo Park and Community Center, Little League facilities, and potential future park at Poco Loco Road and Rio Bravo), as well asconnections to trails and trails that are perpendicular to the river

Suggestion to really think about the boat put-ins and take-outs and the impact they would have on wildlife

Show the MRCOG Bikeway Masterplan

Provide appropriate areas for mountain bike acitivites

Obtain easements to ditch trails so they can continue to be used even after irrigation function has ceased to exist

ncrease educational potential for schools/public participation

he Rio Grande Valley State Park/ Nature Center is updating their management plan and will include more educational/ interpretation opportunities

Make use of the Bosque education guide and set aside locations and plan/design restoration for educational groups to do some of their exercises along the river.

ADDITIONAL DISCUSSION NOTES - DECISIONS REACHED

)sque Restoration

Restoration efforts in the area of the Diversions for the San Juan-Chama water project should wait until the effects are realized

Ground water seeps should be added to the maps as potential wetland restoration areas.

Add the burn site in the Corrales bosque.

Funding for restoration should include monitoring activities. More monitoring is recommended and should be set up prior to any restoration interventions.

Outfalls from AMAFCA should be considered places for wetland restoration, to filter water and trap trash.

The Rio Grande Nature Center should be a first priority site for education/interpretation/participation activities-a demonstration site

Adjacent Land Use/Real Estate

Land use adjacent to the river creates its own set of issues that impact the Bosque: fire danger, impermeable surfaces and polluted runoff that drains into the river, uncontrolled access through private land, trash dumping.

As part of the Bosque Consortium, MRGCOG led a task force that drafted a model Bosque Protection Overlay Zone ordinance for land adjacent or within 500 feet of the levees. Particularly relevant for Valencia County, which has much undeveloped land within that definition.

Main thrust of ordinance: encourage low density, rural development along the Rio Grande to serve as transitional buffer between natual habitat of Bosque and urban development of valley.

RGCOG is willing to revive ordinance and rework if the project thinks this wothwhile (contact Joe Quintana at MRGCOG)

One issue: defining the boundary of an overlay zone. Suggested check buffer recommendations in Bosque Management Plan

Even with low density, there could still be centers with higher density along the river (overlay zone could designate);
For example, development on the west side bluffs and a well-designed restaurant/boardwalk to connect to Bosque and river near Central, perhaps on west side.

Restaurant concept:: 4,000 sf, informal but nice, "crab shack", (no fast food), similar to one on top of Sandia Crest. Observation deck to watch sunset, bike racks, loop destination, restrooms, phones, terminus of westside trail?

Overlay zone could help designate areas for development and for preservation, eg. the Oxbow

AMAFCA is very concerned about land being developed within the levees as it will constrain the river and create more bottlenecks. It should be prevented by purchasing private land in this zone. Eg: Lands of Joel Taylor recently submitted as sketch plat for 98 units? (see Bosque map). Original Atrisco and Black Ranch grants went to the middle of the river.

Recommendation: The CORE fund a title search of valid owners of land within the levees and buy out critical pieces.

To address lack of access to Bosque on east side between Montano and Paseo del Norte: Los Ranchos has proposed two connections where there are easements: 1) end of Ranchitos to the canal, and 2) Tinnin Farm. Could create a loop. Need the project to build necessary bridges. Ranchitos has street parking for 30-40 cars/ could consider parking lot purchase later if needed. This will help Los Ranchos acquire better emergency access, also.

Los Ranchos is planning to reduce Rio Grande Boulevard to 10' wide (consistent with 25 mph speed limit) by striping, and adding 4'bike lanes on either side.

Proposed transit stops at Alameda, Montano, and the Nature Center (Candelaria and Rio Grande?). Transit stops should be ordinated with other elements (educational, recreation) proposed by the project.

Los Ranchos favors minimal development in the Bosque. Concerned about visual impact of drinking water project.

Trash issue: sweeps into Bosque from the diversion channels. AMAFCA uses funds from the bond issue to remove trash from the tributaries of the Rio Grande. Meet all stream standards except fecal coliform. No standards for trash. Proposes a public relations campaign, especially after the drinking water project: "Out the car window and into your mouth. "

Exotic vegetation on adjacent land: Should there be a program to eradicate salt cedar on adjacent land? Surveys show 7 of 10 landowners would accept removal.

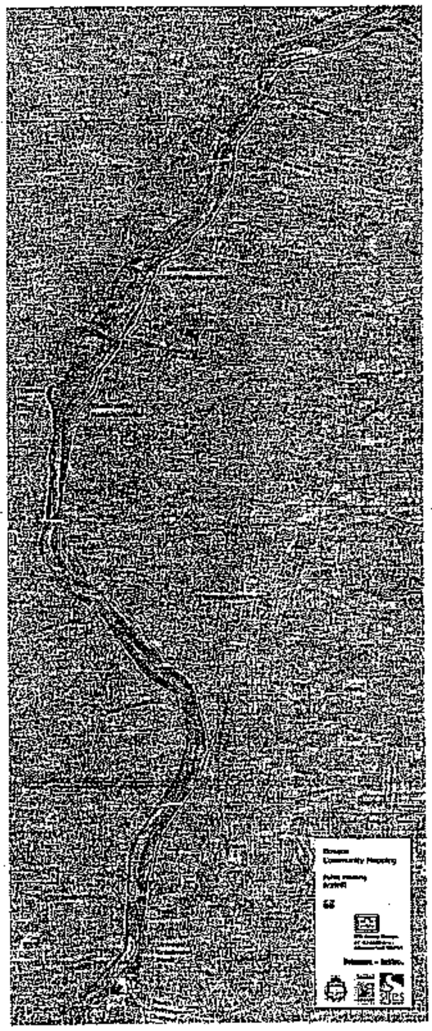
ADDITIONAL DISCUSSION NOTES - DECISIONS REACHED

MIDDLE RIO GRANDE BOSQUE ECOSYSTEM RESTORATION PROJECTS

BOSQUE RESTORATION

PUBLIC MEETING COMMENT SHEET

We would like to hear from you about the Bosque Restoration Projects. Please list any comments, questions or concerns in the space provided below and return at the meetings or mail to Fritz Blake, US Army Corps of Engineers, 4101 Jefferson Pl. NE Albuquerque, NM 87109. Feel free to refer to the map. All of the input received will be considered by the Army Corps of Engineers in revitalizing the Bosque. Thank you!



There is a soil biologist by the name of Michael [illegible] who runs "Trees that Please" in Los Lunas. He knows more than most what native species populated this Rio Grande Valley historically & he knows so very much about soil & species of plant. [illegible] I do hope you will consult with him before selecting your trees & shrubs and also your [illegible] to help what you do plant survive. You won't be disappointed!

phone 866-5027

I took a class from him last year & it has transformed my soil & the plants & trees that were struggling but now healthy & vital with no chemicals!

Name and Address (optional):

US Army Corps of Engineers® Albuquerque District

CONSERVANCY DISTRICT

SITES southwest

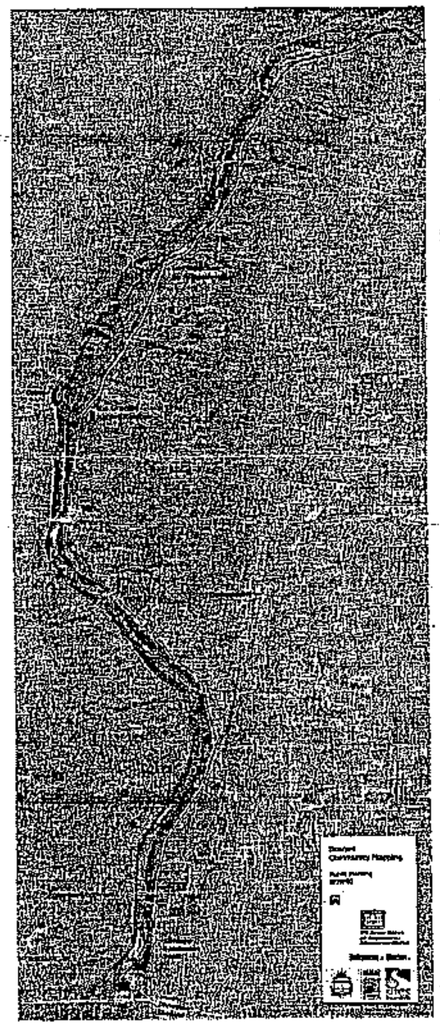
Bohannan ▲ Huston

MIDDLE RIO GRANDE BOSQUE ECOSYSTEM RESTORATION PROJECTS

BOSQUE RESTORATION

PUBLIC MEETING COMMENT SHEET

We would like to hear from you about the Bosque Restoration Projects. Please list any comments, questions or concerns in the space provided below and return at the meetings or mail to Fritz Blake, US Army Corps of Engineers, 4101 Jefferson Pl. NE Albuquerque, NM 87109. Feel free to refer to the map. All of the input received will be considered by the Army Corps of Engineers in revitalizing the Bosque. Thank you!



I strongly support the Objectives of the Bosque Restoration.

It is important to arrange for Spring Flooding of all the Restored Bosque.

Natural methods should be used as this will will reduce costs and maintenance.

A Restored Bosque will result in citizens feeling wonderfull. People who feel wonderful do NOT committe crimes. They also rarely get sick. Restoring the bosque is cost effective

Name and Address (optional):

US Army Corps of Engineers
Albuquerque District

CONSERVANCY DISTRICT

SITES southwest

Bohannan Huston

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APPENDIX B
FEASIBILITY STUDY
(see separate file)

APPENDIX C
TREATMENT PRESCRIPTION

A. Tree Removal

Remove all non-native trees except for those designated as “elective” trees to remain by Corps staff (see trees listed at the end of this Prescription for species) and retain all native tree and shrub species.

1. Prescription Areas
    a. The cutting unit boundary will be designated in advance by Corps staff and will be marked with an appropriate flagging that is clearly visible to the equipment operators.
    b. Flagged cutting unit boundaries shall be maintained to prevent public access into the work site. The work site area shall also be marked with caution signs informing the public of the presence of heavy equipment and other related hazards.
    c. The Corps Albuquerque District will provide maps to the contractor.

2. Manually and mechanically extract or mulch non-native trees in the contracted area in the following manner:
    a. Manually treat non-native trees in sensitive areas as designated by Corps staff (adjacent to native vegetation or designated preserve locations). Flagging for protection should mark “Leave trees”.
    b. Mechanically extract or cut down non-native trees that may be present in existing bosque forest. When extracting trees, all root material must be removed as well (root ripping). Equipment or personnel must not damage native vegetation. “Leave trees” should be marked by flagging for protection.
    c. Mechanically mulch or chip removed trees on-site. Mulched material left on site must not exceed 3 inches in diameter and any single piece may not exceed 6 inches in length.
    d. If using extraction method, contractor shall ensure that any resulting holes will be backfilled to original grade.
    e. Trees removed manually (prescriptive cutting or cut-stump method) will be cut as close to the ground as possible. No stumps may be left higher than 8 inches above the ground surface (except when “high-stumping” as needed—see C.1.b/C.3.b below).
    f. All stumps greater than 1 inch in diameter and any stems less than 1 inch in diameter will be treated as described in the Herbicide section of this prescription.
    g. Trees within the levees or within 30 feet of the toe of the slope should remain unless otherwise directed.

3. On sites where applicable, cut and remove dead and down wood (including ‘jackstraw’ trees lodged in jetty jacks) to achieve total average dead and down fuel depths of 10 tons per acre or less.

1. If fuel wood removal applies to the specific site, the woody material cut greater than 6 inches small-end diameter will be treated as fuel wood. Fuel wood must be cut into lengths not to exceed 4 feet and be stacked separately from slash pile(s) at a location(s) specified by the Corps Albuquerque District.

2. Dead and down rotting logs may be left on the ground surface for wildlife habitat. An average of five to ten large logs, brush piles, or small piles of logs per acre is recommended. Three to five logs of 12 inches or greater diameter should be left per acre for wildlife habitat. This is in addition to rotting logs. If dead and down logs are not present in areas, some trunks of larger diameter non-native trees would be left on the ground intact. Logs may be broken up or stacked to facilitate machinery operations. Any finished operation may not have high concentrations of logs, piled brush, or woody debris that will add significant fuel loading to the cleared site. Dead and down wood and slash more than 4 inches diameter should be moved outside the driplines of cottonwoods and other native trees where possible or at least ten feet from the base of the trees to see how it may affect fire behavior. Contractors should also rake piles of chips and duff away from the base of native trees to avoid heat kill in a fire.

3. Where they exist, the contractor will leave a minimum of five snags (standing dead trees) of 12 inch or greater diameter per acre, preferably with bark intact, for wildlife habitat. This prescription applies primarily to burn areas. Larger diameter trees that do not overhang trails, roads, or gathering areas will be retained. All cottonwood snags along the bank of the river will remain.

4. The Contractor will use directional felling to prevent damage to native trees and shrubs and will avoid damaging any research equipment or other designated areas on site.

A. <u>Slash and Downed Material Treatments</u>

1. For techniques using hand-work such as chain-saws and chippers, all slash less than 3 inches in diameter will be chipped. Contractor is encouraged to chip slash as it is generated. If chipping lags behind cutting, slash will be placed in piles no larger than 6 feet in diameter and no higher than 3 feet to be chipped.

2. All slash will be cut into lengths of no more than 4 feet for fire wood.

3. Chips will be spread out over the ground surface so that a thickness of no more than 2 inches in depth covers the ground surface. If material generated is greater than this amount then chips will be hauled to an approved site.
4. To the extent possible, mechanical mulching operations will be performed uniformly over the project site. This will allow mechanical operations to distribute mulched material uniformly over the ground surface.

5. If large mobile chipping machinery (such as horizontal grinders) is used for wood disposal, chipped material may be temporarily stockpiled but must be spread over the ground surface or removed before completion of the project.

6. On sites with excessive downed material (between 4 inches small-end diameter and 10 inches small-end diameter), the downed material shall be chipped or mulched to reduce fuel loading of the site. If excessive chipped or mulched material is anticipated to exceed 2 to 3 inches in depth, considerations must be made to remove the material from site.

B. <u>Herbicide Treatment</u>

Treat all cut stumps and/or whips according to the following methods:

1. Cut stumps greater than 1 inch in diameter (if using Garlon® at the specification of the contracting agency):
    a. Apply Garlon® 3A in a 50% Garlon®/50% water mixed with blue pigment dye within 15 to 20 minutes of the original cutting in a sufficient amount to completely cover the cut surface.
    b. Individual and/or groups of stumps can be left "high-stumped" and then re-cut and sprayed later to facilitate herbicide uptake.

2. Whips less than 1 inch in diameter (if using Garlon® at the specification of the contracting agency):
    a. Apply Garlon® 4 in a 30% Garlon®/70% vegetable oil mixed with blue pigment dye.
    b. Apply mix directly to stem between 2" and 18" above the ground surface.

3. Cut stumps greater than 1 inch in diameter (if using Arsenal® at the specification of the contracting agency):
    a. Apply Arsenal®/Round-Up® in 30% or greater concentration mixed with blue pigment dye within 15 to 20 minutes of the original cutting in a sufficient amount to completely cover the cut surface.
    b. Individual and/or groups of stumps can be left "high-stumped" and then re-cut and sprayed later to facilitate herbicide uptake.

4. Whips less than 1 inch in diameter (if using Arsenal® at the specification of the contracting agency):
    a. Apply Arsenal®/Round-Up® in 30% or greater concentration mixed with blue pigment dye.
    b. Apply mix directly to stem between 2" and 18" above the ground surface.

5. Contractor will be required to re-treat stumps and whips that are missed during initial herbicide treatment following site inspection by the contracting agency.

6. Contractor will be responsible for follow-up herbicide treatment or mechanical removal of any root sprouts that occur as a result of using extraction method.

C. <u>Other Instructions</u>

1. Contractor or the Corps shall obtain appropriate Special-Use Permits from the City of Albuquerque Open Space Division, Rio Grande Nature Center State Park and licenses from the Middle Rio Grande Conservancy District and Reclamation to perform work. Contractor shall adhere to stipulations of permits or licenses, including vehicle control and access control.

2. Equipment access to the work site must be done using existing roads to the extent possible. Prior approval must be granted by the contracting agency or land-owner to transport equipment down any levee road or gain access to the levee. If the levee road is the only access due to jetty jacks being on the site location during treatment, the equipment must enter one time and exit one time to avoid ruts being created on the levee slope. Any significant damage to the levee slope, as determined by the contracting agency, must be repaired.

3. As part of the Smoking Policy within the Rio Grande Valley State Park, no smoking will be allowed in any open area. Smoking shall be confined to inside of vehicles. No exceptions shall be granted, and fines will be imposed for violations of the above by City of Albuquerque Open Space Division law enforcement.

4. No vehicles may be parked on levee roads at any time to ensure roadways are open for emergency vehicles and law enforcement.

5. Contractors shall observe a 15 m.p.h. speed limit on the levee roads and safely yield to all public trail users.

6. All gates must be closed and locked after each entry into the work site.

7. If any transient camp or shelter is found within the work site, the Contractor shall inform Corps staff. Officials will inspect the area and make determinations as to any further course of action. Contractor and contracting agency will be authorized to continue treatment operations based upon law enforcement decisions.

8. All construction activities would be in compliance to all applicable Federal, State, tribal and local regulations. All appropriate permits as described in the documentation above would be obtained.

D. Species Lists

Native Woody Species include:

Rio Grande Cottonwood	*Populus deltoides* var. *wizlesnii*
Black Willow/Goodding's Willow	*Salix gooddingii*
Peach-leaf Willow	*Salix amygdaloides*
New Mexico Olive	*Foresteria neomexicana*
Coyote Willow	*Salix exigua*
Seepwillow	*Baccharis salicina*
Golden currant	*Ribes aureum*
Wolfberry	*Lycium andersonii*
Skunkbush	*Rhus trilobata*
Silver Buffaloberry	*Shepherdia argentea*
False indigo bush	*Amorpha fruticosa*
Virginia creeper	*Parthenocissus inserta*

Non-Native Tree Species include:

Saltcedar	*Tamarix* spp.
Russian Olive	*Eleagnus angustifolia*
Siberian Elm	*Ulmus pumila*
Tree-of-Heaven	*Ailanthus altissima*
Catalpa	*Catalpa* spp.

"Elective" Tree and Shrub Species include:

Russian Mulberry	*Morus alba* var. *tataria*
Black Locust	*Robinia pseudoacacia*
Honey Locust	*Gleditsia triacanthos*
Osage Orange	*Maclura pomifera*
Russian Olive (healthy young adults)	*Eleagnus angustifolia*
Maple	*Acer* spp.
Ash	*Fraxinus* spp.
Wild cherry	*Prunus* spp.
Apple	*Malus* spp.
Oregon grape	*Mahonia* spp.
Honeysuckle	*Lonicera* spp.

APPENDIX D
MATERIAL SAFETY DATA SHEETS

MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

GARLON* 3A HERBICIDE

Effective Date: 11/24/03
Product Code: 38321
MSDS: 004422

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Garlon* 3A Herbicide

COMPANY IDENTIFICATION:
Dow AgroSciences LLC
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Triclopyr ((3,5,6-trichloro-2-pyridinyl)oxy)acetic acid), triethylamine salt	CAS # 057213-69-1	44.4%
Inert Ingredients, Total, Including		55.6%
Ethanol	CAS # 000064-17-5	
Triethylamine (N,N-Diethylethanamine)	CAS # 000121-44-8	
Ethylenediaminetetraacetic Acid (EDTA)	CAS # 000060-00-4	

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW

Hazardous Chemical. Light purple-pink liquid, ammonia-like odor. May cause eye irritation with corneal injury. May cause skin irritation. LD_{50} for skin absorption is >5000 mg/kg. Oral LD_{50} is 1847-2574 mg/kg. Toxic and irritating gases may be formed during fire conditions.
EMERGENCY PHONE NUMBER: 800-992-5994

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects, which could occur if this material is not handled in the recommended manner.

EYE: May cause severe irritation with corneal injury which may result in permanent impairment of vision, even blindness. Chemical burns may occur Vapor of amines may cause swelling of the cornea resulting in visual disturbances such as blurred or hazy vision. Bright lights may appear to be surrounded by halos. Effects may be delayed and typically disappear spontaneously. When tested on animals, dilutions of this material were less irritating to eyes than the undiluted products.

SKIN: Prolonged or repeated exposure may cause skin irritation, even a burn. When tested on animals, dilutions of this material were less irritating to skin than the undiluted product. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals. With the dilute mix, no allergic skin reaction is expected. Prolonged skin contact is unlikely to result in absorption of harmful amounts. The LD_{50} for skin absorption in rabbits is >5000 mg/kg.

INGESTION: Low toxicity if swallowed. The oral LD_{50} for rats is 2574 mg/kg (male) and 1847 mg/kg (female). Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. Swallowing may cause gastrointestinal irritation or ulceration.

INHALATION: Brief exposure (minutes) is not likely to cause adverse effects.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Excessive exposure may cause liver or kidney effects.

CANCER INFORMATION: Triclopyr did not cause cancer in laboratory animal studies. This material contains ethanol. Epidemiology studies provide evidence that drinking of alcoholic beverages (containing ethanol) is associated with cancer, and IARC has classified alcoholic beverages as carcinogenic to humans.

TERATOLOGY (BIRTH DEFECTS): For triclopyr, birth defects are unlikely. Even exposures having an adverse effect on the mother should have no effect on the fetus. Ethanol has been shown to cause birth defects and toxicity to the fetus in laboratory animal tests. It has also been shown to cause human fetotoxicity and/or birth defects when ingested during pregnancy.

REPRODUCTIVE EFFECTS: For triclopyr, in laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals. Ingestion of large amounts of ethanol has been shown to interfere with fertility in human males.

MATERIAL SAFETY DATA SHEET

Dow AgroSciences

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GARLON* 3A HERBICIDE

Effective Date: 11/24/03
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4. FIRST AID:

EYES: Wash immediately and continuously with flowing water for at least 30 minutes. Remove contact lenses after the first 5 minutes and continue washing. Obtain prompt medical consultation, preferably from an ophthalmologist.

SKIN: Wash skin with plenty of water.

INGESTION: Do not induce vomiting. Give one cup (8 ounces or 240 ml) of water or milk if available and transport to a medical facility. Do not give anything by mouth to an unconscious person.

INHALATION: No emergency medical treatment necessary.

NOTE TO PHYSICIAN: Due to irritant properties, swallowing may result in burns/ulceration of mouth, stomach & lower gastrointestinal tract with subsequent stricture. Aspiration of vomitus may cause lung injury. Suggest endotracheal/esophageal control if lavage is done. If burn is present, treat as any thermal burn, after decontamination. Exposure to amine vapors may cause minor transient edema of the corneal epithelium (glaucopsia) with blurred vision, blue haze & halos around bright objects. Effects disappear in a few hours and temporarily reduce ability to drive vehicles. No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIRE FIGHTING MEASURES:

FLASH POINT: 110°F (43°C)
METHOD USED: TCC
FLAMMABLE LIMITS
LFL: Not determined
UFL: Not determined

EXTINGUISHING MEDIA: Alcohol foam and CO_2.

FIRE & EXPLOSION HAZARDS: Toxic, irritating vapors may be formed or given off if product is involved in fire. Although product is water-based, it has a flash point due to the presence of small amounts of ethanol and triethylamine.

FIRE-FIGHTING EQUIPMENT: Use positive-pressure, self-contained breathing apparatus and full protective clothing.

6. ACCIDENTAL RELEASE MEASURES:

ACTION TO TAKE FOR SPILLS/LEAKS: Contain small spills and absorb with an inert material such as clay or dry sand. Report large spills to Dow AgroSciences at 800-992-5994.

7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: **HANDLING:** Keep out of reach of children. Causes irreversible eye damage. Harmful if inhaled or absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic skin reaction in some individuals. Avoid contact with eyes, skin, clothing, breathing vapor, or spray mist. Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
STORAGE: Store above 28°F or agitate before use. Store in original container. See product label for handling/storage precautions relative to the end use of this product.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where the potential for exposure exists. Emergency conditions may require additional precautions.

EXPOSURE GUIDELINE(S):
Ethanol (ethyl alcohol): ACGIH TLV and OSHA PEL are 1000 ppm. ACGIH classification is A4.
3,5,6-Trichloro-2-pyridyloxyacetic acid (Triclopyr), triethylamine salt: Dow AgroSciences Industrial Hygiene Guideline is 2 mg/M^3 as acid equivalent; Skin.
Triethylamine: ACGIH TLV is 1 ppm TWA, 3 ppm STEL, Skin. OSHA PEL is 10 ppm TWA, 15 ppm STEL.

A "skin" notation following the exposure guideline refers to the potential for dermal absorption of the material including mucous membranes and the eyes either by contact with vapors or by direct skin contact. It is intended to alert the reader that inhalation may not be the only route of exposure and that measures to minimize dermal exposures should be considered.

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

EYE PROTECTION: Use chemical goggles. Eye wash fountain should be located in immediate work area. If exposure causes eye discomfort, use a NIOSH approved full-face respirator.

SKIN PROTECTION: When prolonged or frequently repeated contact could occur, use chemically protective clothing resistant to this material. Selection of specific items such as face shield, gloves, boots, and apron or full-body suit will depend on operation.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use a NIOSH approved air-purifying respirator.

APPLICATORS AND ALL OTHER HANDLERS: Refer to the product label for personal protective clothing and equipment.

9. PHYSICAL AND CHEMICAL PROPERTIES:

BOILING POINT: Not determined
VAPOR PRESSURE: Not determined
VAPOR DENSITY: Not applicable
SOLUBILITY IN WATER: Miscible
SPECIFIC GRAVITY: 1.135 (68/68°F)
APPEARANCE: Light purple/pink liquid
ODOR: Ammonia-like odor

10. STABILITY AND REACTIVITY:

STABILITY: (CONDITIONS TO AVOID) Avoid sources of ignition if temperature is near or above flash point.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Any oxidizing agent. Consult manufacturer for specific cases.

HAZARDOUS DECOMPOSITION PRODUCTS: Nitrogen oxides and hydrogen chloride may be formed under fire conditions.

HAZARDOUS POLYMERIZATION: Not known to occur.

11. TOXICOLOGICAL INFORMATION:

MUTAGENICITY: For triclopyr and ethanol: in-vitro genetic toxicity studies were negative. For triclopyr: animal genetic toxicity studies were negative. For ethanol: animal genetic toxicity studies were negative in some cases and positive in other cases.

12. ECOLOGICAL INFORMATION:

ENVIRONMENTAL FATE:

MOVEMENT & PARTITIONING: Based largely or completely on information for triclopyr. Bioconcentration potential is low (BCF <100 or Log Pow <3).

DEGRADATION & PERSISTENCE: Biodegradation under aerobic static laboratory conditions is high (BOD20 or BOD28/ThOD >40%). The 20-Day biochemical oxygen demand (BOD20) is 0.30 p/p. Theoretical oxygen demand (ThOD) is calculated to be 0.75 p/p.

ECOTOXICOLOGY: Material is slightly toxic to aquatic organisms on an acute basis (LC_{50} or EC_{50} is between 10 and 100 mg/L in most sensitive species).
Acute EC_{50} for shell deposition inhibition in Eastern oyster *(Crassostrea virginica)* is 56-87 mg/L.
Acute LC_{50} for rainbow trout *(Oncorhynchus mykiss)* is 400 mg/L.
Acute LC_{50} for channel catfish *(Ictalurus punctatus)* is 446 mg/L.
Acute LC_{50} for pink shrimp *(Penaeus duorarum)* is 895 mg/L.
Growth inhibition EC_{50} for green alga *(Selenastrum capricornutum)* is 45 mg/L.

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHOD: Do not contaminate food, feed, or water by storage or disposal. Excess wastes are toxic. Improper disposal or excess wastes are a violation of federal law. If wastes resulting from the use of this product cannot be disposed of according to label instructions, dispose of these wastes at an approved facility. Contact your state pesticide or environmental control agency, or the hazardous waste representative at the nearest EPA regional office for guidance.

14. TRANSPORT INFORMATION:

U.S. DEPARTMENT OF TRANSPORTATION (DOT) INFORMATION:

For non-bulk shipments by land:
This material is not regulated for transport.

For bulk shipments by land:
COMBUSTIBLE LIQUID, N.O.S. (TRIETHYLAMINE, ETHANOL)/COMBUSTIBLE LIQUID/NA1993/PGIII

For shipments by air or vessel:
FLAMMABLE LIQUIDS, N.O.S. (TRIETHYLAMINE, ETHANOL)/3/UN1993/PGIII

15. REGULATORY INFORMATION:

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

U.S. REGULATIONS

SARA 313 INFORMATION: This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

CHEMICAL NAME	CAS NUMBER	CONCENTRATION
N,N-Diethylethanamine	000121-44-8	3%

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard
A fire hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

GARLON* 3A HERBICIDE

Effective Date: 11/24/03
Product Code: 38321
MSDS: 004422

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
Ethylenediamine Tetraacetic Acid	000060-00-4	NJ3 PA1 PA3
Ethanol	000064-17-5	NJ1 NJ3 PA1
N,N-Diethylethanamine	000121-44-8	NJ1 NJ3 PA1 PA3

NJ1=New Jersey Special Health Hazard Substance (present at > or = to 0.1%).
NJ3=New Jersey Workplace Hazardous Substance (present at greater than or equal to 1.0%).
PA1=Pennsylvania Hazardous Substance (present at > or = to 1.0%).
PA3=Pennsylvania Environmental Hazardous Substance (present at > or = to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD: This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

CATEGORY	RATING
Health	3
Flammability	2
Reactivity	0

COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND): This product contains the following substance(s) listed as "Hazardous Substances" under CERCLA which may require reporting of releases:

Chemical Name	CAS Number	RQ	% in Product
Triethylamine	000121-44-8	5000	3%
Ethylenediaminetetra-acetic Acid (ETDA)	000060-00-4	5000	2.3%

RCRA Categorization Hazardous Code:
Triethylamine = U404

16. OTHER INFORMATION:

MSDS STATUS: Revised Section: 3, 4, 8, 11 & 14
Reference: DR-0121-6064
Replaces MSDS dated: 1/17/01
Document Code: D03-101-003
Replaces Document Code: D03-101-002

The Information Herein Is Given In Good Faith, But No Warranty, Express or Implied, Is Made. Consult Dow AgroSciences for Further Information.

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MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 2/22/02
Product Code: 38322
MSDS: 004788

GARLON* 4 HERBICIDE

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Garlon* 4 Herbicide

COMPANY IDENTIFICATION:
Dow AgroSciences
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Triclopyr ((3,5,6-trichloro-2-pyridinyl)oxy) acetic acid, butoxy ethyl ester	CAS# 064700-56-7	61.6%
Other ingredients, total, including:		38.4%
Kerosene	CAS# 008008-20-6	
Proprietary surfactants		

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW
Hazardous Chemical. Amber liquid. Combustible. Kerosene-like odor. May cause eye and skin irritation The LD_5 for skin absorption is >2000 mg/kg (rabbits) and >5000 mg/kg (rats). Oral LD_{50} for rats is 1581 mg/kg (males) and 1338 mg/kg (females). Toxic to aquatic organisms.
EMERGENCY PHONE NUMBER: 800-992-5994

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects, which could occur if this material is not handled in the recommended manner.

EYE: May cause slight temporary eye irritation. Corneal injury is unlikely.

SKIN: Prolonged or repeated contact may cause skin irritation. Prolonged or frequently repeated skin contact may cause allergic skin reactions in some individuals. With the dilute mix, no allergic skin reaction is expected. Prolonged skin contact is unlikely to result in absorption of harmful amounts. Repeated skin contact may result in absorption of harmful amounts. The LD_5 for skin absorption is >2000 mg/kg (rabbits) and >5000 mg/kg (rats).

INGESTION: Low toxicity if swallowed. The oral LD_{50} for rats is 1581 mg/kg (males) and 1338 mg/kg (females). Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. Aspiration into the lungs may occur during ingestion or vomiting, causing lung damage or even death due to chemical pneumonia.

INHALATION: Excessive exposure may cause irritation to upper respiratory tract (nose and throat). Kerosene may cause central nervous system effects.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Triclopyr BEE, in animals, effects have been reported on the following organs: blood, kidney, and liver.

CANCER INFORMATION: Triclopyr BEE did not cause cancer in laboratory animals. In a lifetime animal dermal carcinogenicity study, an increased incidence of skin tumors was observed when kerosene was applied at doses that also produced skin irritation. This response was similar to that produced in skin by other types of chronic chemical/physical irritation. No increase in tumors was observed when non-irritating dilutions of kerosene were applied at equivalent doses, indicating that kerosene is unlikely to cause skin cancer in the absence of long-term continued skin irritation. In long-term animal studies with ethylene glycol butyl ether, small but statistically significant increases in tumors were observed in mice but not rats. The effects are not believed to be relevant to humans. If the material is handled in accordance with proper industrial handling, exposures should not pose a carcinogenic risk to man.

TERATOLOGY (BIRTH DEFECTS): For triclopyr BEE, birth defects are unlikely. Exposures having no effect on the mother should have no effect on the fetus. Did not cause birth defects in animals; other effects were seen in the fetus only at doses which caused toxic effects to the mother.

REPRODUCTIVE EFFECTS: Triclopyr BEE, in laboratory animal studies, effects on reproduction have been seen only at doses that produced significant toxicity to the parent animals.

*Trademark of Dow AgroSciences

4. FIRST AID:

EYES: Flush eyes thoroughly with water for several minutes. Remove contact lenses after initial 1-2 minutes and continue flushing for several minutes. If affects occur, consult a physician, preferably an ophthalmologist.

SKIN: Wash skin with plenty of water.

INGESTION: Do not induce vomiting. Call a physician and/or transport to emergency facility immediately.

INHALATION: Move to fresh air. If not breathing, give artificial respiration. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

NOTE TO PHYSICIAN: The decision of whether to induce vomiting or not should be made by a physician. If lavage is performed, suggest endotracheal and/or esophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIRE FIGHTING MEASURES:

FLASH POINT: 147°F (64°C)
METHOD USED: TCC

FLAMMABLE LIMITS
LFL: Not determined
UFL: Not determined

EXTINGUISHING MEDIA: Water fog, foam, CO_2, and dry chemical.

FIRE & EXPLOSION HAZARDS: Combustible. Toxic, irritating vapors may be produced if product is involved in fire.

FIRE-FIGHTING EQUIPMENT: Use positive pressure self-contained breathing apparatus and full protective clothing.

6. ACCIDENTAL RELEASE MEASURES:

ACTION TO TAKE FOR SPILLS/LEAKS: Keep out of streams and domestic water supplies. Absorb small spills in inert material such as sand. For large spills, dike the area and contact Dow AgroSciences at 800-992-5994.

7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Keep out of reach of children. Do not use near heat or open flame. Harmful if swallowed, inhaled, or absorbed through skin. Avoid contact with eyes, skin and clothing. Avoid breathing mists and vapors. Avoid contamination of food. Store above 28°F or agitate before use. Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. For handling relative to end-use of this product, read the product label for further information concerning the use of personal protective equipment (PPE) under the Worker Protection Standard of 1993. Store in the original container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where a potential for exposure exists. Emergency conditions may require additional precautions.

EXPOSURE GUIDELINE(S):
3,5,6-Trichloro-2-pyridinyloxyacetic acid, Dowanol EB ester: Dow AgroSciences Industrial Hygiene Guide is 2 mg/M^3 as acid equivalent, Skin.
Kerosene: Dow AgroSciences Industrial Hygiene Guide is 10 mg/M^3.

A "skin" notation following the exposure guideline refers to the potential for dermal absorption of the material. It is intended to alert the reader that inhalation may not be the only route of exposure and that measures to minimize dermal exposures should be considered.

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

MATERIAL SAFETY DATA SHEET

Dow AgroSciences

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 2/22/02
Product Code: 38322
MSDS: 004788

GARLON* 4 HERBICIDE

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guidelines. When respiratory protection is required for certain operations, use a NIOSH approved air-purifying respirator.

SKIN PROTECTION: Use protective clothing chemically resistant to this material. Selection of specific items such as faceshield, gloves, boots, apron, or full body suit will depend on operation. Remove contaminated clothing immediately, wash skin area with soap and water, and launder clothing before reuse or dispose of properly.

EYE/FACE PROTECTION: Use safety glasses.

APPLICATORS AND ALL OTHER HANDLERS: Refer to the product label for personal protective clothing and equipment.

9. PHYSICAL AND CHEMICAL PROPERTIES

BOILING POINT: >302°F (150°C) initial
VAPOR PRESSURE: 0.1 mm @ 37.8°C (kerosene)
VAPOR DENSITY: >1
SOLUBILITY IN WATER: Emulsifies
SPECIFIC GRAVITY: 1.08
APPEARANCE: Amber liquid
ODOR: Kerosene-like

10. STABILITY AND REACTIVITY:

STABILITY: (CONDITIONS TO AVOID) Combustible. Avoid sources of ignition if temperature is near or above flash point. Stable under normal storage conditions.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Acid, base, and oxidizing material.

HAZARDOUS DECOMPOSITION PRODUCTS: Nitrogen oxides, hydrogen chloride, and phosgene may result under fire conditions.

HAZARDOUS POLYMERIZATION: Not known to occur.

11. TOXICOLOGICAL INFORMATION:

MUTAGENICITY: For triclopyr BEE, in-vitro and animal mutagenicity studies were negative.

12. ECOLOGICAL INFORMATION:

ENVIRONMENTAL FATE:

MOVEMENT & PARTITIONING: Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5). Measured log octanol/water partition coefficient (Log Pow) is 4.09. Log air/water partition coefficient (Log Kaw) is -4.0.

DEGRADATION & PERSISTENCE: Biodegradation under aerobic static laboratory conditions is moderate (BOD20 or BOD28/ThOD between 10 and 40%).

ECOTOXICOLOGY: Material is highly toxic to aquatic organisms on an acute basis (LC_{50}/EC_{50} is between 0.1 and 1 mg/L in most sensitive species).
Acute LC_{50} in rainbow trout *(Oncorhynchus mykiss)* is 0.8 – 4.9 mg/L.
Acute LC_{50} for fathead minnow *(Pimephales promelas)* is 2.2 - 6.3 mg/L.
Acute LC_{50} for water flea *(Daphnia magna)* is 2.2 mg/L.
Acute LC50 in bluegill (Lepomis macrochirus) is 2.1 mg/L.
Growth inhibition EC_{50} in green alga *(Selenastrum capricornutum)* is 13.3 - 16.8 mg/L.

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHOD: Excess wastes that cannot be used according to label instructions must be disposed of according to all applicable federal, state, or local procedures.

*Trademark of Dow AgroSciences

MATERIAL SAFETY DATA SHEET

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Dow AgroSciences

Effective Date: 2/22/02
Product Code: 38322
MSDS: 004788

GARLON* 4 HERBICIDE

14. TRANSPORT INFORMATION:

U.S. DEPARTMENT OF TRANSPORTATION INFORMATION

FOR ALL PACKAGE (NON-BULK) SIZES SHIPPED BY AIR, LAND OR WATER:
Material is not regulated for transportation.

FOR BULK SHIPMENTS BY LAND:
COMBUSTIBLE LIQUID, N.O.S. (CONTAINS KEROSENE)/COMBUSTIBLE LIQUID/NA1993/PGIII

15. REGULATORY INFORMATION:

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

<u>**U.S. REGULATIONS**</u>

SARA 313 INFORMATION: To the best of our knowledge, this product contains no chemical subject to SARA Title III Section 313 supplier notification requirements.

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard
A fire hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
Proprietary Ingredient	Proprietary	PA1 NJ3
Kerosene	008008-20-6	PA1 NJ3

NJ3=New Jersey Workplace Hazardous Substance (present at greater than or equal to 1.0%).
PA1=Pennsylvania Hazardous Substance (present at greater than or equal to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD: This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

Health	2
Flammability	2
Reactivity	1

COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND): To the best of our knowledge, this product contains no chemical subject to reporting under CERCLA.

16. OTHER INFORMATION:

MSDS STATUS: Revised Sections: 3, 4, 7, 8, 10, 12, & 14
Reference: DR-0196-5102
Replaces MSDS dated: 9/9/99
Document Code: D03-102-002
Replaces Document Code: D03-102-001

The Information Herein Is Given In Good Faith, But No Warranty, Express or Implied, Is Made. Consult Dow AgroSciences for Further Information.

APPENDIX E
CULTURAL RESOURCES COORDINATION

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

October 2, 2008

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Honorable Levi Pesata
President, Jicarilla Apache Nation
Post Office Box 507
Dulce, New Mexico 87528

Dear President Pesata:

The U.S. Army Corps of Engineers (Corps), Albuquerque District, is planning an ecosystem restoration project in coordination with numerous other Federal, State, Tribal, and local entities. The project, entitled Middle Rio Grande Bosque Ecosystem Restoration Project, is being conducted under the authority that is derived from a series of Congressional actions authorizing projects on the Rio Grande, particularly in the Middle Rio Grande Valley. These authorizations began with the basic flood control authorization for the Middle Rio Grande Public Law No. 228, 77th Congress, 1st Session, H.R. 4911 dated 18 August 1941. The most recent legislation is in Section 401 of the Water Resources Development Act of 1986 (Public Law 99-662) dated 17 November 1986, that authorized the Middle Rio Grande Flood Control Project from Bernalillo to Belen, New Mexico. Additional authorization is contained in the 2002 House of Representatives Resolution 107-258. The Corps is the Lead Federal Agency for the proposed project and the Middle Rio Grande Conservancy District is the local sponsor.

The Middle Rio Grande Bosque Ecosystem Restoration Project is located within the Rio Grande Floodway (within the flood control levees) in Bernalillo and Sandoval Counties, New Mexico, beginning at a location south of Bernalillo and proceeding downstream to the north boundary of the Pueblo of Isleta. The proposed work will occur in the floodplain of the bosque. The project is located on lands under the joint jurisdiction of Federal, State, Tribal, and City agencies. Most of the land is managed by the Middle Rio Grande Conservancy District under permit from the U.S. Bureau of Reclamation. Project land is also within the Rio Grande Valley State Park that is jointly managed by the City of Albuquerque's Open Space Division and the Middle Rio Grande Conservancy District. Some work will occur on Pueblo of Sandia land; the Corps is working closely with Sandia Pueblo.

The proposed Middle Rio Grande Bosque Ecosystem Restoration Project, similar to the Corps' Ecosystem Revitalization @ Route 66, Albuquerque, New Mexico, Section 1135 Project and the Bosque Wildfire Project, is planning ecosystem restoration activities such as removing existing jetty-jacks and post-and-cable retards (jetty fences) that are no longer necessary for flood protection; removing invasive and exotic plant species such as the tamarisk (salt cedar) and Russian olive; thinning bosque vegetation and removing dead-and-down plant debris that poses a fire hazard; creating swales (moist soil depressions) and high-flow channels within the bosque to enhance habitat diversity; replanting with preferred vegetation species; and providing for recreational trails within the bosque, some of which will meet Americans with Disabilities Act accessibility standards.

The Corps is seeking input for consideration during planning for the project. The purpose of this scoping letter is to provide you with the opportunity to submit any concerns or comments you may have regarding potential effects. Specifically, any concerns you may have regarding the environment such as natural, biological, or cultural resources; wildlife, vegetation, and special status species; air, water, or sound quality; aesthetics; or health and safety in the project area. Your input will be used in preparing environmental documentation to comply with the National Historic Preservation Act of 1966, as amended, and the National Environmental Policy Act.

If you have concerns regarding the proposed Middle Rio Grande Bosque Ecosystem Restoration Project, please provide comments to the above address. If you have any questions or require additional information, please contact Ondrea Hummel, Biologist at (505) 342-3375 (ondrea.c.hummel@usace.army.mil), Gregory D. Everhart, Archaeologist at (505) 342-3352 (gregory.d.everhart@usace.army.mil), or myself, at (505) 342-3281.

Sincerely,

Julie Alcon,
Chief Environmental Resources
Section

Enclosures

Copies furnished w/ enclosures:

Ms. Lorene Willis
Director, Cultural Resources Preservation
Jicarilla Apache Nation
Post Office Box 507
Dulce, New Mexico 87528

Tribal Mailing List 2008
For both BERNALILLO and SANDOVAL Counties

Cochiti Pueblo
Comanche Indian Tribe
Hopi Tribe
Isleta Pueblo
Jemez Pueblo
Jicarilla Apache Nation
Laguna Pueblo
Navajo Nation
Ohkay Owingeh Pueblo
San Felipe Pueblo
San Ildefonso Pueblo
Sandia Pueblo
Santa Ana Pueblo
Santa Clara Pueblo
Santo Domingo Pueblo
White Mountain Apache Tribe
Ysleta del Sur Pueblo
Zia Pueblo

Honorable Ernest Sanchez
Governor, Pueblo de Cochiti
Post Office Box 70
Cochiti Pueblo, New Mexico 87072

cf:
Mr. Gilbert Herrera
NAGPRA Representative
Pueblo de Cochiti
Post Office Box 70
Cochiti Pueblo, New Mexico 87072

Mr. Donald Suina
Environmental Department
Pueblo de Cochiti
Post Office Box 70
Cochiti Pueblo, New Mexico 87072

Honorable Wallace Coffey
Chairman, Comanche Nation of Oklahoma
Post Office Box 908
Lawton, Oklahoma 73502

cf:
Mr. Jimmy Arterberry
THPO/NAGPRA/EOP Director

Comanche Nation of Oklahoma
Post Office Box 908
Lawton, Oklahoma 73502

Honorable Benjamin Nuvamsa
Chairman, Hopi Tribal Council
Post Office Box 123
Kykotsmovi, Arizona 86039

cf:
Mr. Leigh Kuwanwisiwma
Director, Cultural Preservation Office
Hopi Tribe
Post Office Box 123
Kykotsmovi, Arizona 86039

Honorable Max Zuni
Lt. Governor, Pueblo of Isleta
Post Office Box 1270
Isleta Pueblo, New Mexico 87022

Mr. Ben Lucero
Historic Preservation
Pueblo of Isleta
1621A, State Highway 314
Albuquerque, New Mexico 87105

Mr. Henry Walt
Cibola Research Consultants
Pueblo of Isleta
508 Hermosa, SE.
Albuquerque, New Mexico 87108

Honorable Paul Chinana
Governor, Pueblo of Jemez
Post Office Box 100
Jemez Pueblo, New Mexico 87024

cf:
Mr. Chris Tafoya
Cultural Resources Specialist
Pueblo of Jemez
Post Office Box 100
Jemez Pueblo, New Mexico 87024

Honorable Levi Pesata
President, Jicarilla Apache Nation
Post Office Box 507
Dulce, New Mexico 87528

cf:
Ms. Lorene Willis, Director
Cultural Resources Preservation
Jicarilla Apache Nation
Post Office Box 507
Dulce, New Mexico 87528

Honorable John Antonio, Sr.
Governor, Pueblo of Laguna
Post Office Box 194
Laguna Pueblo, New Mexico 87026

cf:
Mr. Robert Mooney
NAGPRA Representative
Pueblo of Laguna
Post Office Box 194
Laguna Pueblo, New Mexico 87026

Honorable Earl Salazar
Governor, Ohkay Owingeh
Post Office Box 1099
San Juan Pueblo, New Mexico 87566

Mr. Herman Agoyo
NAGPRA Representative
Ohkay Owingeh
Post Office Box 1099
San Juan Pueblo, New Mexico 87566

Honorable Joe Shirley, Jr.
President, Navajo Nation
Post Office Box 9000
Window Rock, Arizona 86515

cf:
Alan S. Downer, Ph.D.
Tribal Historic Preservation Officer
Navajo Nation Historic Preservation Department
Post Office Box 4950

Window Rock, Arizona 86515

Honorable Ronald L. Tenorio
Governor, Pueblo of San Felipe
Post Office Box 4339
San Felipe Pueblo, New Mexico 87001

cf:
Mr. Ted Garcia
Tribal Administrator
Pueblo of San Felipe
Post Office Box 4339
San Felipe Pueblo, New Mexico 87001

Felice Lucero
Coordinator, Department of Natural Resources
Pueblo of San Felipe
Post Office Box 4339
San Felipe Pueblo, New Mexico 87001

Honorable Leon T. Roybal
Governor, Pueblo of San Ildefonso
Route 5, Box 315-A
Santa Fe, NM 87506

cf:
Mr. Myron Gonzales
NAGPRA Representative
Pueblo of San Ildefonso
Route 5, Box 315-A
Santa Fe, NM 87506

Honorable Stuart Paisano
Governor, Pueblo of Sandia
481 Sandia Loop
Bernalillo, New Mexico 87004

cf:
Mr. Sam Montoya
NAGPRA Representative
Pueblo of Sandia
481 Sandia Loop
Bernalillo, New Mexico 87004

Honorable Ulysses Leon

Governor, Pueblo of Santa Ana
2 Dove Road
Bernalillo, New Mexico 87004

cf:
Mr. Ben Robbins
Tribal Resource Administrator
Pueblo of Santa Ana
2 Dove Road
Bernalillo, New Mexico 87004

Honorable J. Michael Chavarria
Governor, Pueblo of Santa Clara
Post Office Box 580
Espanola, New Mexico 87532

cf:
Mr. Jason Garcia
NAGPRA Representative
Land Claims Department
Pueblo of Santa Clara
Post Office Box 580
Espanola, New Mexico 87532

Honorable Shisto Quintana
Governor, Pueblo of Santo Domingo
Post Office Box 99
Santo Domingo Pueblo, New Mexico 87052

Kenny Pin
Tribal Planner
Pueblo of Santo Domingo
Post Office Box 99
Santo Domingo Pueblo, New Mexico 87052

Honorable Ronnie Lupe
Chairman, White Mountain Apache Tribe
Tribal Council
Post Office Box 700
Whiteriver, Arizona 85941

cf:
Mr. Mark Altaha
Historic Preservation Office
White Mountain Apache Tribe

Post Office Box 507
Fort Apache, Arizona 85926

Honorable Frank Paiz
Governor, Ysleta del Sur Pueblo
Post Office Box 17579 – Ysleta Station
El Paso, Texas 79917

cf:
Mr. Jacob Massoud
Environmental Management Director
Ysleta del Sur Pueblo
Post Office Box 17579 – Ysleta Station
El Paso, Texas 79917

Honorable Ivan Pino
Governor, Pueblo of Zia
135 Capitol Square Drive
Zia Pueblo, New Mexico 87053-6013

cf:
Mr. Celestino Gachupin
NAGPRA Respresentative
Pueblo of Zia
135 Capitol Square Drive
Zia Pueblo, New Mexico 87053-6013

White Mountain Apache Tribe Heritage Program
PO Box 507 Fort Apache,AZ 85926
1 (928) 338-3033 Fax: (928) 338-6055

To: Gregory D. Everhart, U.S. Army Corps of Engineer.
Date: October 6, 2008
Proposed Project: Middle Rio Grande Bosque Ecosystem Restoration Project.

The White Mountain Apache Historic Preservation Office (THPO) appreciates receiving information on the proposed project, dated October 2, 2008 In regards to this, please attend to the checked items below;

► ***There is no need to send additional information unless project planning or implementation results in the discovery of sites and/or items having known or suspected Apache Cultural affiliation.***

☐ The proposed project is located within an area of probable cultural or historical importance to the White Mountain Apache Tribe (WMAT). As part of the effort to identify historical properties that maybe affected by the project we recommend an ethnohistorical study and interviews with Apache Elders. The Cultural Resource Director, ***Mr. Ramon Riley*** would be the contact person at (928) 338-4625 should this become necessary.

☐ The proposed project is located within or adjacent to a known historic property of cultural concern and/or historical importance to the White Mountain Apache Tribe and will most likely result in adverse affect to said property. Considering this, please refrain from further steps in project planning and/or implementation.

► Please refer to the attached additional notes in regards to the proposed project:

We have received and reviewed information regarding U.S. Army Corp's proposed Middle Rio Grande Bosque Ecosystem Restoration Project, and we have determined the Area of Potential Effect ***will not have an adverse effect*** to the White Mountain Apache tribe's Traditional Cultural Properties and/or possible Historic Properties that may be in the Area of Potential Effect (APE). The project may proceed as planned.

We look forward to continued collaborations in the protection and preservation of places of cultural and historical significance.

Sincerely,

MTA

Mark T. Altaha
White Mountain Apache Tribe
Historic Preservation Officer
Email: markaltaha@wmat.nsn.us

Office of:
The Governor
The Secretary
The Treasurer

PUEBLO OF LAGUNA
P.O. BOX 194
LAGUNA, NEW MEXICO 87026

(505) 552-6598
(505) 552-6654
(505) 552-6655

October 9, 2008

Rec'd 10-20-2008
GDE

Ms. Julie Alcon
Chief Environmental Resources Section
Department of the Army
Albuquerque District, Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435

Dear Ms. Alcon:

RE: Middle Rio Grande Bosque Ecosystem Restoration Project located within the Rio Grande Floodway.

The Pueblo of Laguna appreciates your consideration to comment on the possible interest your project may have on any traditional or cultural properties.

The Pueblo of Laguna has determined that the undertaking WILL NOT have a significant impact at this time. However, in the event that any new archaeological sites are discovered and any new artifacts are removed, we request to be notified to review items. We also request photographs of items. According to our unpublished migration history, our ancestors journeyed from the north through that area and settled for periods of time before traveling to our present location. Therefore, the possibilities of some findings may exist.

We thank you and your staff for the information provided.

Sincerely,

John E. Antonio, Sr.
Governor, Pueblo of Laguna

THE HOPI TRIBE

Benjamin H. Nuvamsa
CHAIRMAN

Todd Honyaoma, Sr.
VICE-CHAIRMAN

October 14, 2008

Julie Alcon, Chief, Environmental Resources Section
Attention: Gregory D. Everhard, Archaeologist
Department of the Army, Corps of Engineers, Albuquerque District
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Ms. Alcon,

Thank you for your correspondence dated October 2, 2008, regarding the Corps planning the Middle Rio Grande Bosque Ecosystem Restoration Project.

Because the Hopi Tribe claims cultural affiliation to prehistoric cultural groups in New Mexico, and the Hopi Cultural Preservation Office supports the identification and avoidance of archaeological sites and Traditional Cultural Properties, we appreciate your continuing solicitation of our input and efforts to address our concerns.

The Hopi Cultural Preservation Office considers the archaeological sites of our ancestors to be Traditional Cultural Properties. Therefore, if prehistoric sites are identified that may be adversely affected by project activities, please provide us with copies of the cultural resources survey of the area of potential effect and any proposed preservation, testing, or data recovery plans for review and comment.

Should you have any questions or need additional information, please contact Terry Morgart at the Hopi Cultural Preservation Office. Thank you again for your consideration.

Respectfully,

T Morgart for
Leigh J. Kuwanwisiwma, Director
Hopi Cultural Preservation Office

xc: New Mexico State Historic Preservation Office

THE NAVAJO NATION

JOE SHIRLEY, JR.
PRESIDENT

BEN SHELLY
VICE-PRESIDENT

October 16, 2008

Recd 10-22-2008
ODE

Ms. Julie Alcon, Chief
Environmental Resources Section
Department of the Army
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Subject: Tribal Consultation Request. Proposing to conduct an ecosystem restoration project in coordination with numerous other federal, state, tribal and local entities, Department of the Army, Albuquerque District, New Mexico.

Dear Ms. Alcon:

Our apology for an oversight and missing the deadline date of our response to your request, please note that in reference to your letter of October 02, 2008, the Historic Preservation Department – Traditional Culture Program (HPD-TCP) received a request for consultation regarding the above undertaking and/or project. After reviewing your consultation documents, HPD-TCP has concluded the proposed undertaking/project area **will not impact** any Navajo traditional cultural properties or historical properties.

However, if there are any inadvertent discoveries made during the course of the undertaking, your agency shall cease all operations within the project area. HPD-TCP shall be notified by telephone within 24 hours and a formal letter be sent within 72 hours. All work shall be suspended until mitigation measures/procedures have been developed in consultation with the Navajo Nation.

The HPD-TCP appreciates your agency's consultation efforts, pursuant to 36 CFR Pt. 800.1 (c)(2)(iii). Should you have additional concerns and/or questions, do not hesitate to contact me. My contact information is listed below.

Sincerely,

Kelly Francis

Mr. Kelly Francis, Cultural Specialist
Historic Preservation Department – Traditional Culture Program

Tel: 928.871.7688 Fax: 928.871.7886 E-mail:

TCP 09-073
File: Office file/chrono

PUEBLO OF SANTA CLARA

P.O. Box 580, Española, New Mexico 87532
Office - 505-753-7326 Fax - 505-753-8988

October 16, 2008

Rec'd 10-21-2008
GDE

Planning, Project and Program Management Division
Planning Branch, Environmental Resources Section
Department of the Army
Albuquerque District, Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque NM 87109-3435

Dear Julie Alcon,

This is a response letter regarding the Middle Rio Grande Ecosystem Restoration Project. The Santa Clara Pueblo supports the project of removing invasive and exotic plant species along the middle Rio Grande and eliminating fire hazards and enhancing wildlife diversity with the concurrence of surrounding Pueblos.

The Santa Clara Pueblo has and will be also conducting similar projects in the interior boundaries of the reservation and we have noticed that there was an increase in wildlife and eliminated the threat of wildfire, some planting of new cottonwood trees in an area of the reservation occurred in the late 90's and is showing good progress but have noticed more beavers in that specific area we are trying to acquire funding to put protective barriers to prevent future attacks from the beavers.

We do want to be kept updated on this project and notified if any cultural resources will be disturbed during this process. Santa Clara also respects that the Corps is working closely with the Sandia Pueblo and also would like to know of any concerns that they may have regarding the project.

Sincerely,

Ben Chavarria
Land and Cultural Resources
Santa Clara Pueblo
Rights Protection Office

OFFICE OF THE GOVERNOR

505-869-3111 / 6333
FAX: 505-869-4236

PUEBLO OF ISLETA

P.O. BOX 1270 ISLETA, NM 87022

October 22, 2008

Ms. Julie Alcon
Department of the Army
4101 Jefferson Plaza NE
Albuquerque, NM 87109

RE: Planning Project and Program management Division Planning Branch

Dear Ms. Alcon:

This letter is in response to your correspondence received on October 8, 2008 regarding the proposed project.

We are part of this project and would like to be informed and involved in any of the decisions for this project. Please send any correspondence that we may need regarding this project.

If you have any questions please contact our office at 505-869-3111.

Sincerely,

THE PUEBLO OF ISLETA

J. Robert Benavides,
Governor

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

February 12, 2009

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

086258

Ms. Katherine Slick
State Historic Preservation Officer
New Mexico Department of Cultural Affairs
Historic Preservation Division
Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe, New Mexico 87501

Rec'd 3-9-2009
GDE

Dear Ms. Slick:

Pursuant to 36 CFR Part 800, the U.S. Army Corps of Engineers (Corps), Albuquerque District, is seeking your concurrence in our determination of "No Historic Properties Effected" for the Middle Rio Grande Bosque Ecosystem Restoration Project Feasibility Study. The Corps is planning, in coordination with numerous other Federal, State, Tribal, and local entities, for the restoration project with an Area of Potential Effect (APE) that would cover approximately 668 acres within 16 parcels of the Rio Grande bosque. The project areas are in the City of Albuquerque as well as portions of Sandoval and Bernalillo Counties, New Mexico. The proposed project areas are located within the Rio Grande Floodway (the river's floodplain inside the flood control levees and riverside drains); proceeding on the north from the north side of Corrales, downstream to the south, to the north boundary of the Pueblo of Isleta. Most of the land is managed by the Middle Rio Grande Conservancy District under permit from the U.S. Bureau of Reclamation. Project land is also within the Rio Grande Valley State Park that is jointly managed by the City of Albuquerque's Open Space Division and New Mexico State Parks Division. The Corps is the Lead Federal Agency for the proposed project and the Middle Rio Grande Conservancy District (MRGCD) is the local sponsor.

The Middle Rio Grande Bosque Ecosystem Restoration Project is being conducted under the authority derived from a series of Congressional actions authorizing projects on the Rio Grande, particularly in the Middle Rio Grande Valley. These authorizations began with the basic Middle Rio Grande flood control authorization in Public Law No. 228, 77th Congress, 1st Session, H.R. 4911, dated 18 August 1941. The most recent legislation is in Section 401 of the Water Resources Development Act of 1986 (Public Law 99-662), dated 17 November 1986, that authorized the Middle Rio Grande Flood Control Project from Bernalillo to Belen, New Mexico. Additional authorization is contained in the 2002 House of Representatives Resolution 107-258.

Consulting parties in the Section 106 process for the proposed restoration project include the Corps, Bureau of Reclamation, MRGCD, the City of Albuquerque, and your office. Consistent with the Department of Defense's American Indian and Alaska Native Policy, signed by Secretary of Defense William S. Cohen on October 28, 1998, and based on the State of New Mexico Indian Affairs Department and Historic Preservation Division's 2008 Native American Consultations List, American Indian Tribes/Pueblos that have indicated they have concerns within Sandoval and Bernalillo Counties have been contacted regarding the proposed project. These tribes include the Pueblo de Cochiti, the Comanche Indian Tribe, the Hopi Tribe, the Pueblo of Isleta, the Pueblo of Jemez, the Jicarilla Apache Nation, the Pueblo of Laguna, the Navajo Nation, the Pueblo of Ohkay Owingeh, the Pueblo of San Felipe, the Pueblo of San Ildefonso, the Pueblo of Sandia, the Pueblo of Santa Ana, the Pueblo of Santa Clara, the Pueblo of Santo Domingo, the White Mountain Apache Tribe, the Pueblo of Ysleta del Sur, and the Pueblo of Zia. Scoping letters were mailed to the above tribes on October 2, 2008. To date, the Corps has received six (6) tribal responses; from the White Mountain Apache Tribe, the Hopi Tribe, the Pueblo of Laguna, the Pueblo of Santa Ana, the Navajo Nation, and the Pueblo of Isleta. None have concerns regarding the proposed project. Currently, there are no known tribal concerns and no traditional cultural properties are known to occur within or adjacent to the project areas.

6

The proposed project, very similar to the Corps' ongoing Bosque Wildfire and the recent Route 66 Restoration projects, is designed for the benefit of wildlife and habitat diversity. Specifically, the riparian restoration project will provide for the removal of exotic plant species, such as the invasive tamarisk and Russian olive, removal of dead and down vegetation debris, the thinning and removal of other vegetation, the removal of some Kellner jetty-jacks that are now deemed unnecessary for flood protection, the installation of high water flow channels, moist soil depressions, and rehabilitation of wetland areas, and re-vegetation of disturbed areas.

Please find enclosed for your review, the positive archaeological survey report entitled **A 667.6 Acre Cultural Resource Survey of the Rio Grande Floodway for the Middle Rio Grande Bosque Restoration Feasibility Project, Bernalillo and Sandoval Counties, New Mexico** (dated January 20, 2009, UNM-OCA Report No. 185-996; NMCRIS No. 111640) and associated documentation that covers the 16 project areas. The archaeological survey was conducted between September 2 and 8, 2008, by the University of New Mexico's Office of Contract Archeology (OCA) and the survey results are reported by Robin M. Cordero, Tracy Steffgen, and Patrick Hogan.

As noted for other Corps' projects and restoration activities located within the Rio Grande Floodway, segments of historic acequias and/or drainage ditches were abandoned when they were cut off by MRGCD construction of the valley's modern irrigation system and the flood control levees and riverside drains in the 1930s. Wide areas near the river were affected by years of flooding prior to the MRGCD work. There was a significant amount of rehabilitation of the MRGCD system that included the levees and riverside drains that was conducted by the Corps and the Bureau of Reclamation in the 1950s and 1960s. Several segments of historic acequia remnants and other structures have been documented during the above noted Corps projects; these all being in a weathered and dilapidated condition, having been subjected to river inundation and flooding. To date, no prehistoric archaeological sites have been discovered within the Rio Grande Floodway. The Corps is aware of two traditional cultural properties that occur within the Rio Grande Floodway. All National Register of Historic Places (NRHP) eligible historic properties recorded within the Rio Grande Floodway during recent Corps' projects have generally been linear, earthen ditch or drain remnants which are relatively easily recognizable. Due to localized areas of dense vegetation, OCA's survey did not cover 26-percent of the project area; however, given the linear nature and large size of previously recorded NRHP eligible properties, as well as the generally disturbed nature of the bosque due to the river's aggradation, degradation, and relatively frequent channel movement, the Corps finds that OCA's identification efforts that covered 74-percent of the APE are sufficient for this project.

The OCA survey documented five (5) structures as historic sites: LA160891, LA160892, LA160893, LA160894, and LA160895. These five earthen structures are reported as abandoned segments of acequias or drainage ditches. There were no artifacts or other features associated with these five sites. No other artifacts or historic properties were observed during the OCA survey. As detailed below, the Corps is of the opinion that LA160891 is a non-eligible historic ditch segment and that OCA's LA160892, LA160893, LA160894, and LA160895, all earthen structures, are not archaeological sites. As a part of this documentation package, the Corps has added sponsor comments to OCA's site forms and note that LA160892, LA160893, LA160894, and LA160895 are not archaeological sites.

The proposed project plans to conduct vegetation removal and riparian restoration activities in the vicinity of the five earthen structures recorded by OCA. OCA recommended that all five sites are not eligible for nomination to the National Register of Historic Properties (NRHP). The Corps concurs with the OCA recommendation of non-eligibility for LA160891 and finds that the other four sites are natural in origin.

The Corps has reviewed UNM/OCA's LA160891 site documentation and compared that information with recent aerial imagery, the 1922 Reclamation Service maps that were prepared from data collected during 1917/1918 field surveys, and Bureau of Reclamation's 2001 GIS data on the locations of the Rio Grande channel for the years of 2001, 1992, 1972, 1962, 1949, and 1935. The Corps agrees with OCA's recommendation that LA160891 is not eligible for nomination to the NRHP. From the available information, the Corps is of the opinion that LA160891 is a field ditch that may have been associated with the Corrales Ditch/Sandoval Lateral, and therefore, may date as early as ca. 1850 to as late as the mid-1930s MRGCD construction. The Corps, however, is of the opinion that because it is not a part of a major active acequia or primary lateral, and the salient information was recorded during survey, it is not eligible for nomination to the NRHP.

For OCA's LA160892, LA160893, LA160894, and LA160895 structures, all generally described as earthen, abandoned segments of ditches or drains, none are shown on the 1922 Reclamation Service maps. The Corps has reviewed the available mapping and river channel documentation, and the locations of these four "sites" at one time or another post-1935, were a part of the active river channel. Therefore, they are of a more recent and natural origin and are more likely remnants of naturally occurring river high flow channels/banks. In one case, for LA160895, it may also be related to fire-fighting activities that occurred a few years ago. From the available documentation, the Corps is of the opinion that these four earthen structures are the result of natural river flow or recent activity in the bosque and are therefore not historic properties and not eligible for nomination to the NRHP.

The project's proposed riparian restoration activities will occur in the vicinity of two previously recorded historic archaeological sites: LA118060, an old remnant spur line of the Atchison, Topeka and Santa Fe Railway (previously determined not eligible for nomination to the NRHP), and LA145559, documented as a northeast trending internal drain (previously determined eligible for nomination to the NRHP under criterion d of 36 CFR 60.4). Proposed work near LA118060 would not affect the railroad spur remnant. OCA (2009:29; the enclosed report) indicates that they believe Estes (2005; NMCRIS No. 89833) misidentified LA145559 as an internal drain and that it is actually a natural overflow river channel. Estes's (2005:61-63) description of the LA145559 internal drain presents an unlikely "southwest to northeast" direction and unusual dimensions for a drain ditch: "The width of the ditch varies from 17 meters at the southwestern end, and narrows to 3 meters wide near its outlet." The Corps has reviewed the 1922 Reclamation Service maps and the 2001 Bureau of Reclamation river channel documentation, and found that LA145559 is located 675-feet north of the internal drain shown on the 1922 Reclamation Service map and that LA145559 was a part of the active river channel in 1935. The Corps therefore agrees with OCA that LA145559 is in fact not an archaeological site. The documentation package includes a site update form for LA145559 with a map.

In summary, based upon the above information and available documentation, the Corps is seeking your concurrence with our determination that OCA's LA160891 field ditch is not eligible for nomination to the NRHP and that OCA's LA160892, LA160893, LA160894, and LA160895 as well as the LA145559 internal drain are in fact not archaeological sites and therefore are not eligible for nomination to the NRHP. The LA118060 railroad spur was previously determined not eligible and would not be affected by the project. Therefore, the Corps is seeking your concurrence with our determination that the proposed Middle Rio Grande Bosque Ecosystem Restoration Project would result in "No Historic Properties Effected" because there are no NRHP eligible sites within the APE.

Pursuant to 36 CFR 800.13, should previously unknown artifacts or other historic properties be encountered during construction, work would cease in the immediate vicinity of the resource. A determination of significance would be made and further consultation, on measures to avoid, minimize, and/or mitigate potential adverse effects, with your office, the Bureau of Reclamation, MRGCD, the City of Albuquerque, and with American Indian Tribes that have cultural concerns in the area will take place. If you have any questions or require additional information regarding the proposed Middle Rio Grande Bosque Ecosystem Restoration Project, please contact Gregory D. Everhart, Archaeologist at (505) 342-3352, Lance Lundquist, Archaeologist at (505) 342-3671, or myself at (505) 342-3281.

Sincerely,

John D. Schelberg

for Julie Alcon,
Chief, Environmental Resources Section

3/4/09
Date

I CONCUR

Norman Nelson

for KATHERINE SLICK
NEW MEXICO STATE HISTORIC PRESERVATION OFFICER

Enclosures

Copy furnished w/ enclosures:

Jeff Hansen, Archaeologist
U.S. Bureau of Reclamation
Albuquerque Area Office
555 Broadway Blvd., NE, Suite 100
Albuquerque, New Mexico 87102-2352

Ray Gomez
Middle Rio Grande Conservancy District
1931 Second Street, SW
Albuquerque, New Mexico 87105

Dr. Matt Schmader, Director
City of Albuquerque
Open Space Division
Post Office Box 1293
Albuquerque, New Mexico 87103

THE NAVAJO NATION

JOE SHIRLEY, JR.
PRESIDENT

BEN SHELLY
VICE-PRESIDENT

June 16, 2010

Julie Alcon, Chief, Environmental Resources section
Department of the Army
Albuquerque District, Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435

post-marked 6-21-2010
GDE

Dear Ms. Alcon:

Our apology for an oversight and missing the deadline date of our response to your request, and that the Navajo Nation Historic Preservation Department – Traditional Culture Program (NNHPD-TCP) is in receipt of the proposed project regarding the Draft Environmental Assessment for the Middle Rio Grande Bosque Restoration Project, Bernalillo and Sandoval Counties, New Mexico.

After reviewing your consultation documents, HPD-TCP has concluded the proposed undertaking/project area **will not impact** Navajo traditional cultural properties. The NNHPD-TCP, on behalf of the Navajo Nation has no concerns at this time.

However, the determination made by the HPD-TCP does not necessarily mean that the Navajo Nation has no interest or concerns with the proposed project. If the proposed project inadvertently discovers habitation sites, plant gathering areas, human remains and objects of cultural patrimony the HPD-TCP request that we be notified respectively in accordance with the Native American Graves Protection and Repatriation Act (NAGPRA).

The HPD-TCP appreciates the Department of the Army's consultation efforts, pursuant to 36 CFR Pt. 800.1 (c)(2)(iii). Should you have any additional concerns and/or questions, do not hesitate to contact me electronically at tonyjoe@navajo.org or telephone at 928-871-7750. Mr. Kelly Francis will be taking over all Section 106 Consultations soon within the near future.

Sincerely,

Tony H. Joe, Jr., Supervisory Anthropologist *(Section 106 Consultations)*
Historic Preservation Department – Traditional Culture Program

TCP 10-499
CC: Office File/Chrono

A 667.6 Acre Cultural Resource Survey of the Rio Grande Floodway for the Middle Rio Grande Bosque Restoration Feasibility Project, Bernalillo and Sandoval Counties, New Mexico

Robin M. Cordero, Tracy Steffgen, and Patrick Hogan

Office of Contract Archeology
University of New Mexico

O
C
A

NMCRIS Activity No. 111640

A 667.6 Acre Cultural Resource Survey of the Rio Grande Floodway for the Middle Rio Grande Bosque Restoration Feasibility Project, Bernalillo and Sandoval Counties, New Mexico

by
Robin M. Cordero, Tracy Steffgen and Patrick Hogan

with contributions by
J. Robert Estes and Christine S. VanPool

Prepared for
U.S. Army Corps of Engineers, Albuquerque District
Contract Number W912PP-06-D-0001, Delivery Order 0010

Graphics by
Ronald L. Stauber

Submitted by
Patrick Hogan
Principal Investigator
Office of Contract Archeology
University of New Mexico

January 20, 2009
OCA/UNM Project No. 185-996

NMCRIS INVESTIGATION ABSTRACT FORM (NIAF)

1. NMCRIS Activity No.: 111640	2a. Lead (Sponsoring) Agency: US Army Corps of Engineers, Albuquerque District	2b. Other Permitting Agency(ies):	3. Lead Agency Report No.:

4. Title of Report: A 667.6 Acre Cultural Resource Survey of the Rio Grande Floodway for the Middle Rio Grande Bosque Restoration Feasibility Project, Bernalillo and Sandoval Counties, New Mexico

Author(s) Robin M. Cordero, Tracy Steffgen and Patrick Hogan

5. Type of Report
☐ Negative ☒ Positive

6. Investigation Type
☐ Research Design ☒ Survey/Inventory ☐ Test Excavation ☐ Excavation ☐ Collections/Non-Field Study
☐ Overview/Lit Review ☐ Monitoring ☐ Ethnographic study ☐ Site specific visit ☐ Other

7. Description of Undertaking (what does the project entail?): 667.6 acre cultural resource survey of the Bosque with attempted 100% coverage.

8. Dates of Investigation: (from: 9/2/2008 to: 9/8/2008)

9. Report Date: January 20, 2009

10. Performing Agency/Consultant:
Principal Investigator: Patrick Hogan
Field Supervisor: Robin M. Cordero
Field Personnel Names: Mat Devitt, Tracy Steffgen, Adam Lujan, Gary Lawson

11. Performing Agency/Consultant Report No.: 185-996

12. Applicable Cultural Resource Permit No(s):

13. Client/Customer (project proponent):
Contact: Gregory Everhart
Address: 4101 Jefferson Plaza, N.E. / Albuquerque, New Mexico 87109
Phone: (505) 342-3352

14. Client/Customer Project No.: Contract Number W912PP-06-D-0001, Delivery Order 0010

15. Land Ownership Status *(<u>Must</u> be indicated on project map):*

Land Owner	Acres Surveyed	Acres in APE
US Bureau of Reclamation/Middle Rio Grande Conservancy District	494	667.6
TOTALS		

16 Records Search(es):

Date(s) of ARMS File Review 8/29/2008, 9/9/2008	Name of Reviewer(s) Robin M. Cordero, Tracy Steffgen	
Date(s) of NR/SR File Review 8/29/2008	Name of Reviewer(s) Robin M. Cordero	
Date(s) of Other Agency File Review	Name of Reviewer(s)	Agency

17. Survey Data:

a. Source Graphics ☒ NAD 27 ☐ NAD 83

☒ USGS 7.5' (1:24,000) topo map ☐ Other topo map, Scale:

☒ GPS Unit Accuracy ☒<1.0m ☐ 1-10m ☐ 10-100m ☐>100m

b. USGS 7.5' Topographic Map Name / USGS Quad Code

USGS 7.5' Topographic Map Name	USGS Quad Code
Isleta	34106-H6
Albuquerque West	35106 A6
Los Griegos	35106-B6
Alameda	35106-B5
Bernalillo	35106-C5

c. County(ies): Sandoval, Bernalillo

17. Survey Data (continued):

d. Nearest City or Town: Albuquerque, Coralles, Los Padillas

e. Legal Description:

Township (N/S)	Range (E/W)	Section	¼ ¼ ¼
9N	2E	13	S1/2, , .
9N	2E	24	NW, , .
9N	2E	13	, , .
9N	2E	18	NW, , .
9N	3E	7	W1/2, , .
10N	3E	31	S1/2, , .
11N	2E	35	SE, , .
11N	2E	36	SW, , .
9N	2E	36	SW, , .
8N	2E	1	E1/2, , .
9N	2E	36	NW, , .

Projected legal description? Yes [ ] , No [X] Unplatted [X]

f. Other Description (e.g. well pad footages, mile markers, plats, land grant name, etc.): Albuquerque Grant, Town of Alameda Grant, Pajarito Grant

18. Survey Field Methods:

Intensity: ☐ 100% coverage ☒ <100% coverage

Configuration: ☒ block survey units ☐ linear survey units (l x w): ☐ other survey units (specify):

Scope: ☒ non-selective (all sites recorded) ☐ selective/thematic (selected sites recorded)

Coverage Method: ☒ systematic pedestrian coverage ☐ other method (describe)

Survey Interval (m): 15 Crew Size: 4 to 5 Fieldwork Dates: 9/2/2008 to 9/8/2008

Survey Person Hours: 142 Recording Person Hours: 19 Total Hours: 161

Additional Narrative:

19. Environmental Setting (NRCS soil designation; vegetative community; elevation; etc.): Elevation of 5020 ft. to 4900 ft., Vinton and Brazito soils, Trail silty clay loam, Trail loamy sands,Torrifluvents,

20. a. Percent Ground Visibility: <25% in many parts of the survey area b. Condition of Survey Area (grazed, bladed, undisturbed, etc.): Some areas were overgrown and inaccessible. Some areas mechanically cleared of vegetation with a 5 cm thick layer of wood chips.

21. CULTURAL RESOURCE FINDINGS ☒ Yes, See Page 3	☐ No, Discuss Why:
22. Required Attachments (check all appropriate boxes): ☒ USGS 7.5 Topographic Map with sites, isolates, and survey area clearly drawn ☒ Copy of NMCRIS Mapserver Map Check ☒ LA Site Forms - new sites (*with sketch map & topographic map)* ☐ LA Site Forms (update) - previously recorded & un-relocated sites (*first 2 pages minimum)* ☐ Historic Cultural Property Inventory Forms ☐ List and Description of isolates, if applicable ☐ List and Description of Collections, if applicable	23. Other Attachments: ☒ Photographs and Log ☐ Other Attachments *(Describe)*:
24. I certify the information provided above is correct and accurate and meets all applicable agency standards. Principal Investigator/Responsible Archaeologist: Patrick Hogan Signature Patrick F Hogan Date 1-20-09 Title (if not PI):	
25. Reviewing Agency: USACE, Albuquerque District Reviewer's Name/Date Gregory D. Everhart 2-9-2009 Accepted (X) Rejected ( ) Tribal Consultation (if applicable): ☒ Yes ☐ No	26. SHPO Reviewer's Name/Date: HPD Log #: SHPO File Location: Date sent to ARMS:

CULTURAL RESOURCE FINDINGS

[fill in appropriate section(s)]

1. NMCRIS Activity No.: 111640	2. Lead (Sponsoring) Agency: U.S. Army Corps of Engineers, Albuquerque District	3. Lead Agency Report No.:

SURVEY RESULTS:

Sites discovered and registered: 5
Sites discovered and NOT registered: 0
Previously recorded sites revisited (*site update form required*): **0**
Previously recorded sites not relocated ***(site update form required):***
TOTAL SITES VISITED: 5
Total isolates recorded: 0 **Non-selective isolate recording?** ☐
Total structures recorded (*new and previously recorded, including acequias*): **5**

MANAGEMENT SUMMARY: OCA surveyed 16 parcels totaling 667 acres in the Rio Grande bosque. Five sites recorded, non eligible. Bosque restoration will not affect register-eligible properties.

IF REPORT IS NEGATIVE YOU ARE DONE AT THIS POINT.

SURVEY LA NUMBER LOG

Sites Discovered:

LA No.	Field/Agency No.	Eligible? (Y/N, applicable criteria)
160891	OCA 996-1	N
160892	OCA 996-2	N
160893	OCA 996-3	N
160894	OCA 996-4	N
160895	OCA 996-5	N

Previously recorded revisited sites:

LA No.	Field/Agency No.	Eligible? (Y/N, applicable criteria)

MONITORING LA NUMBER LOG (*site form required*)

Sites Discovered (*site form required*) **:** **Previously recorded sites** ***(Site update form required):***

LA No.	Field/Agency No.	LA No.	Field/Agency No.

Areas outside known nearby site boundaries monitored? Yes ☐, **No** ☐ **If no explain why:**

TESTING & EXCAVATION LA NUMBER LOG (*site form required*)

Tested LA number(s)	Excavated LA number(s)

ABSTRACT

Between September 2 and September 8, 2008, personnel from the Office of Contract Archeology, University of New Mexico, conducted a cultural resources inventory of 667.6 acres on the Rio Grande Floodway in Bernalillo and Sandoval Counties, New Mexico. The survey area was subdivided into 16 parcels extending from Corrales in the north to the Pueblo of Isleta in the south. This survey was performed at the request of the U.S. Army Corps of Engineers, Albuquerque District under Contract No. W912PP-06-D-0001. This project was conducted in anticipation of ongoing Middle Rio Grande Bosque Restoration projects. Bosque restoration includes mechanical and hand removal of exotic plant species, thinning and removal of other vegetation, removal of some Kellner jetty-jacks, and construction of high water flow channels and outfall wetlands. This survey resulted in the identification of five historical irrigation ditches and drains; no isolated occurrences were observed. None of the sites are recommended as eligible for nomination to the National Register of Historic Places.

ACKNOWLEDGEMENTS

This work would not have been possible without funding from and cooperation of the US Army Corps of Engineers, Albuquerque District. We also would like to extend our gratitude to the City of Corrales and Albuquerque Open Space for granting access to the survey areas. Lastly, we would like to thank the survey crew of Adam Lujan, Matthew Devitt, Tracy Steffgen, and Gary Lawson for trudging through the thickets and high brush with professionalism and a good attitude.

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CHAPTER 1

INTRODUCTION

The U.S. Army Corps of Engineers, Albuquerque District (USACE) is conducting an ecosystem restoration feasibility study of the Middle Rio Grande bosque ecosystem in coordination with the Middle Rio Grande Conservancy District (MRGCD) and other federal, state, tribal, and local stakeholders. The study area extends from the Pueblo of Sandia on the north, through Albuquerque, to the Pueblo of Isleta on the south. It corresponds roughly with the Rio Grande Valley State Park, which is jointly managed by the City of Albuquerque's Open Space Division and New Mexico State Parks Division. Other lands within the Rio Grande Floodway are managed by the MRGCD under permit from the U.S. Bureau of Reclamation. Actions proposed as part of the restoration program include the removal of exotic plant species such as tamarisk and Russian olive; the removal of dead and down vegetation debris; thinning of other vegetation; re-vegetation of selected areas; the removal of some Kellner jetty-jacks that are no longer needed for flood protection; and the installation of high water flow channels, moist soil depressions, and outfall wetlands for the benefit of habitat diversity.

As part of the feasibility study, the USACE contracted with the University of New Mexico's Office of Contract Archeology (OCA) to conduct a cultural resources inventory of previously unsurveyed portions of the study area (Contract W912PP-06-D-0001, Delivery Order No. 0010; UNM Proposal No. 185-996; NMCRIS Activity Number 111640). The purpose of the survey was to identify historic properties in the area and to evaluate their potential eligibility for inclusion on the National Register of Historic Places under criteria identified in 36 CFR 60.4.

The survey area consists of 16 parcels encompassing a total area of 667.6 ac (270.2 ha). The parcels extend from the Village of Corrales southward to the Pueblo of Isleta (Figures 1–8). In almost all cases, the eastern and western boundaries of the parcels are marked by one of the modern flood control levees and the banks of the Rio Grande. Legal description and acreages for the individual parcels are shown in Table 1.

Fieldwork for the survey was completed between 2 September and 8 September 2008, and required approximately 20 person days of labor. Patrick Hogan was Principal Investigator and Robin M. Cordero served as both Project Director and Field Supervisor. The field crew consisted of Cordero, Tracy Steffgen, Mathew Devitt, Adam Lujan, and Gary Lawson. Graphics and GIS data were compiled by Ron Stauber. The survey was conducted in part under State of New Mexico survey permit NM-08-017-S. Access to the project area was coordinated through the City of Albuquerque Open Space Division and the Village of Corrales Fire Department.

Five segments of ditches or drains were documented during the survey, none of which could be securely tied to a particular acequia or irrigation system. The properties have limited data potential beyond the basic information collected during the survey and do not appear eligible for nomination to the National Register of Historic Places.

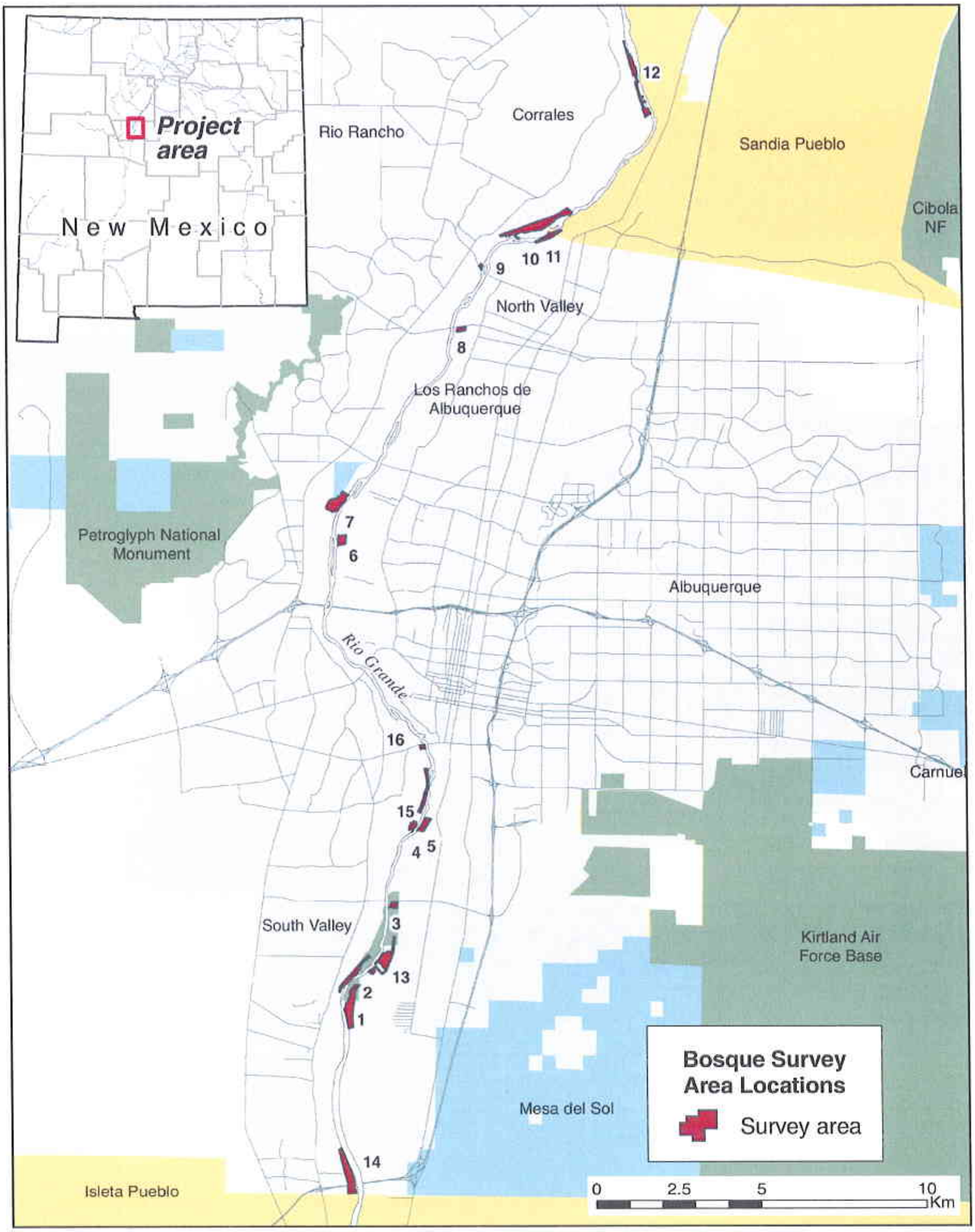

Figure 1 Project Overview.

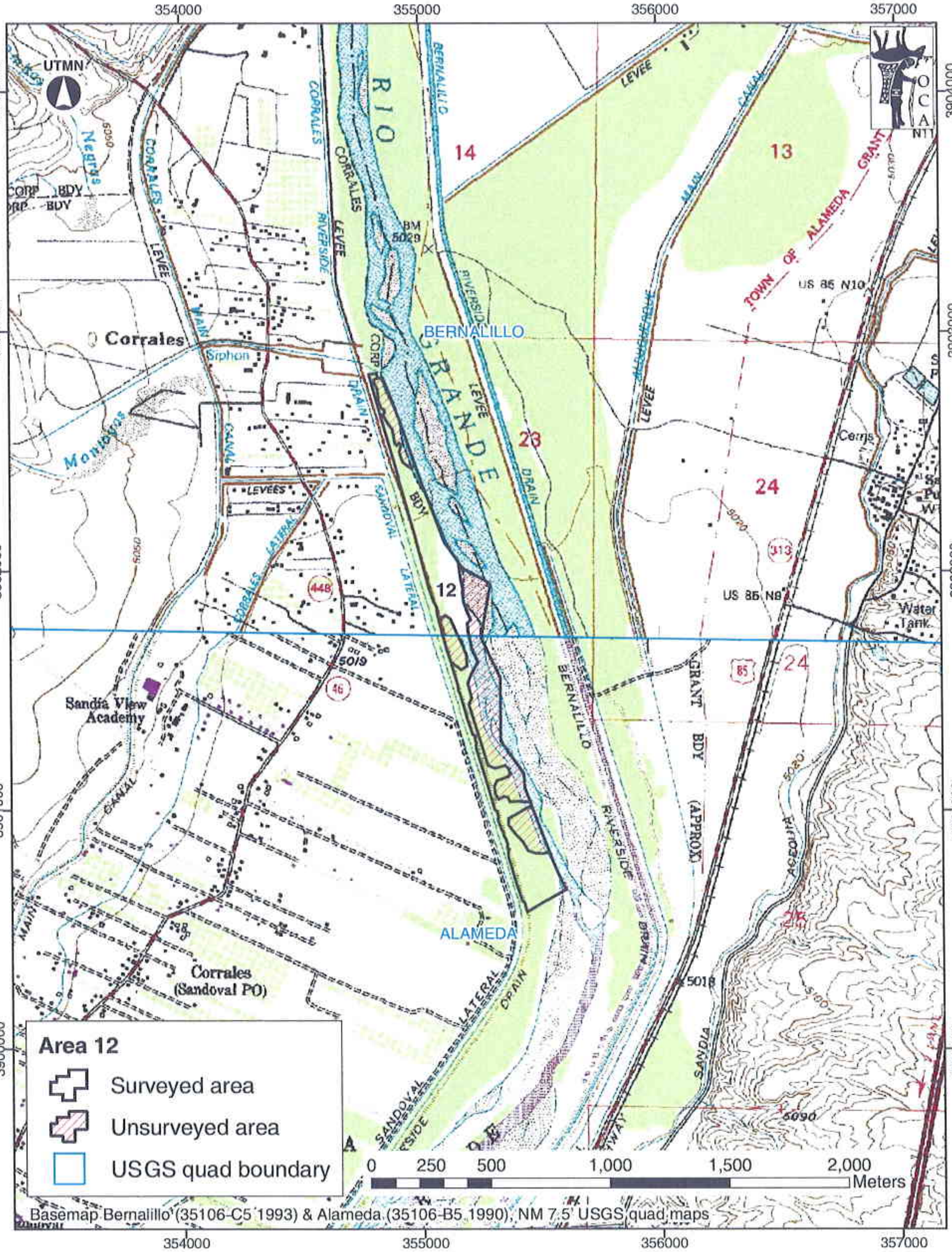

Figure 2 USGS 7.5 min. quadrangle of Survey Area 12.

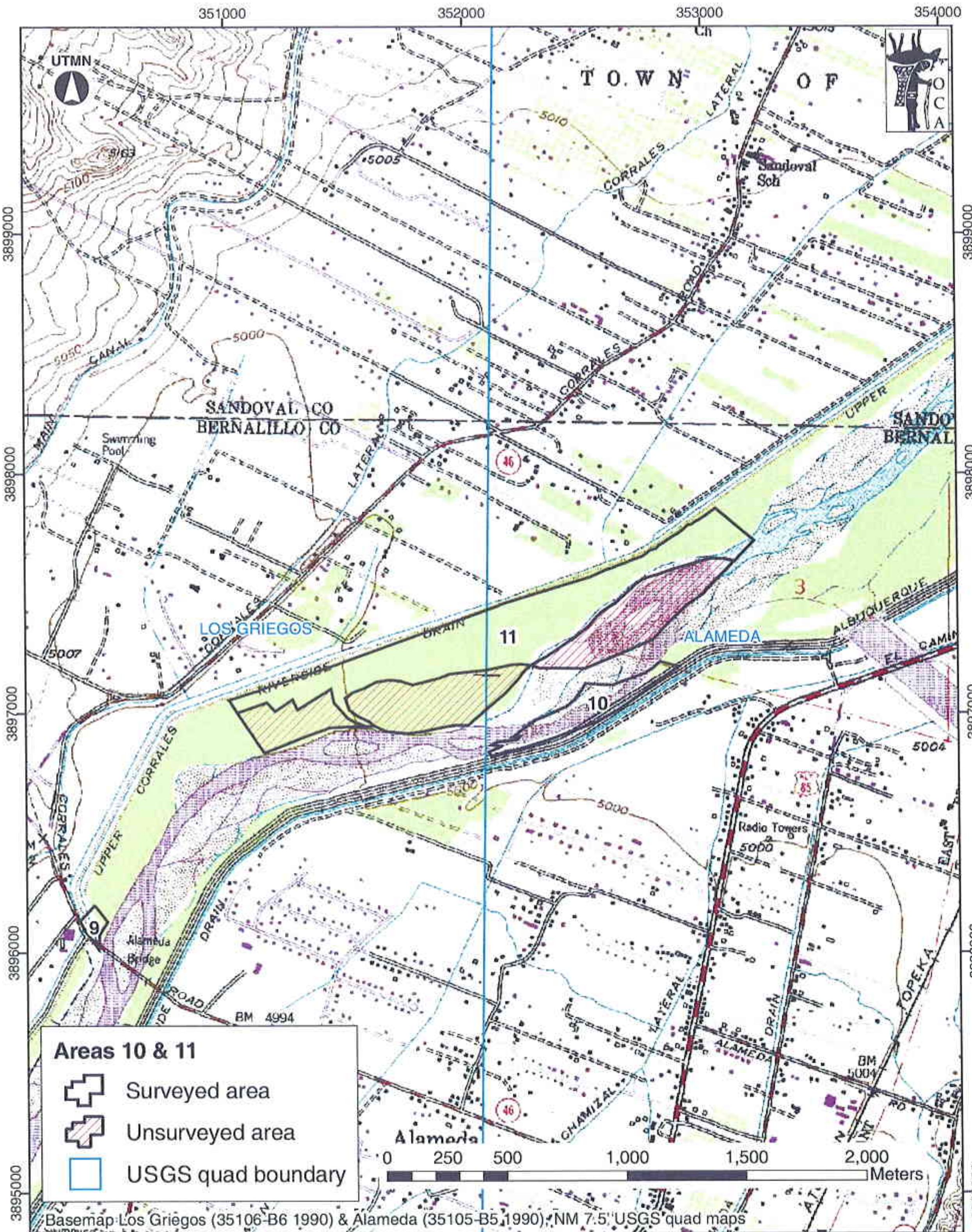

Figure 3 USGS 7.5 min. quadrangle of Survey Areas 10 and 11.

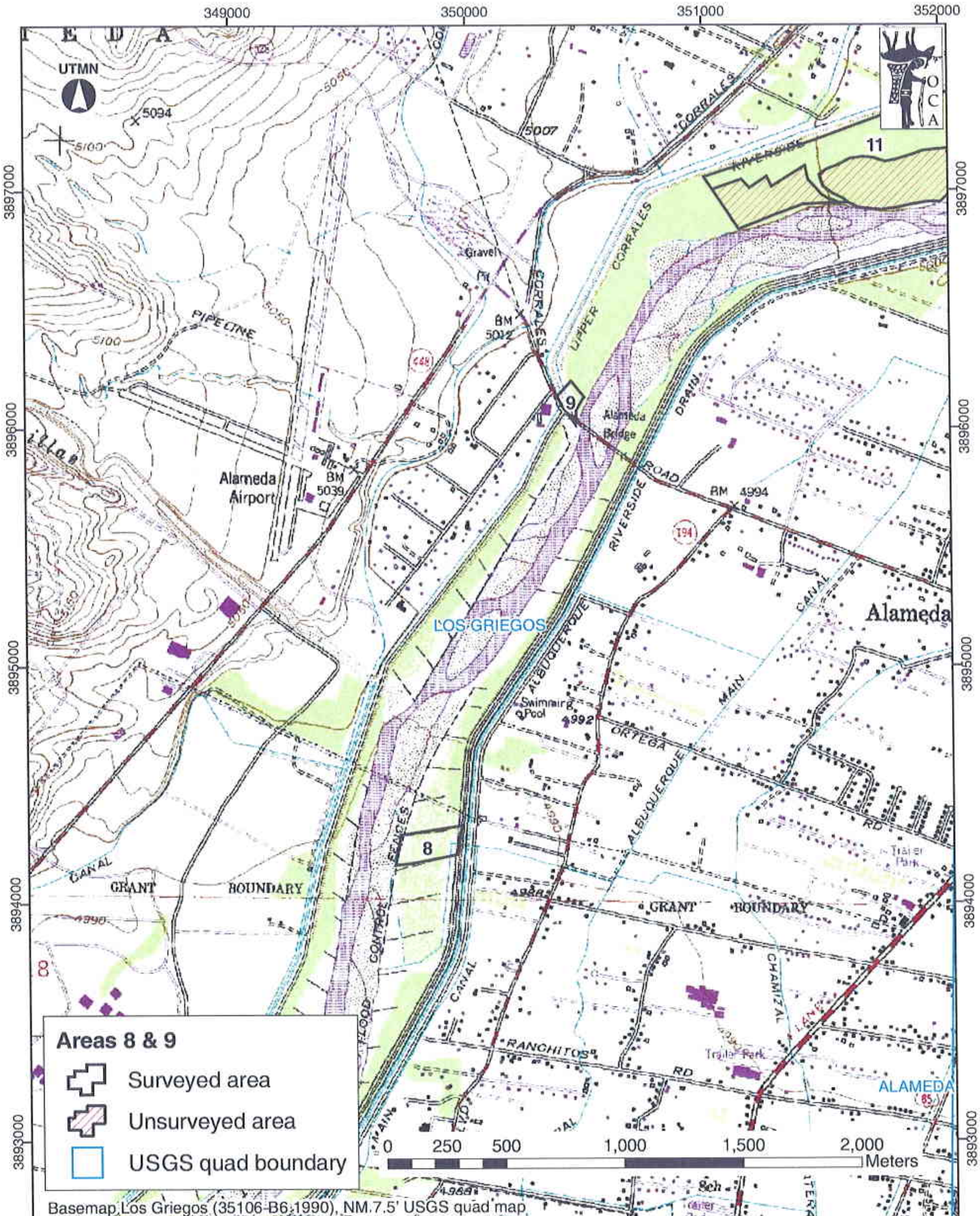

Figure 4 USGS 7.5 min. quadrangle of Survey Areas 8 and 9.

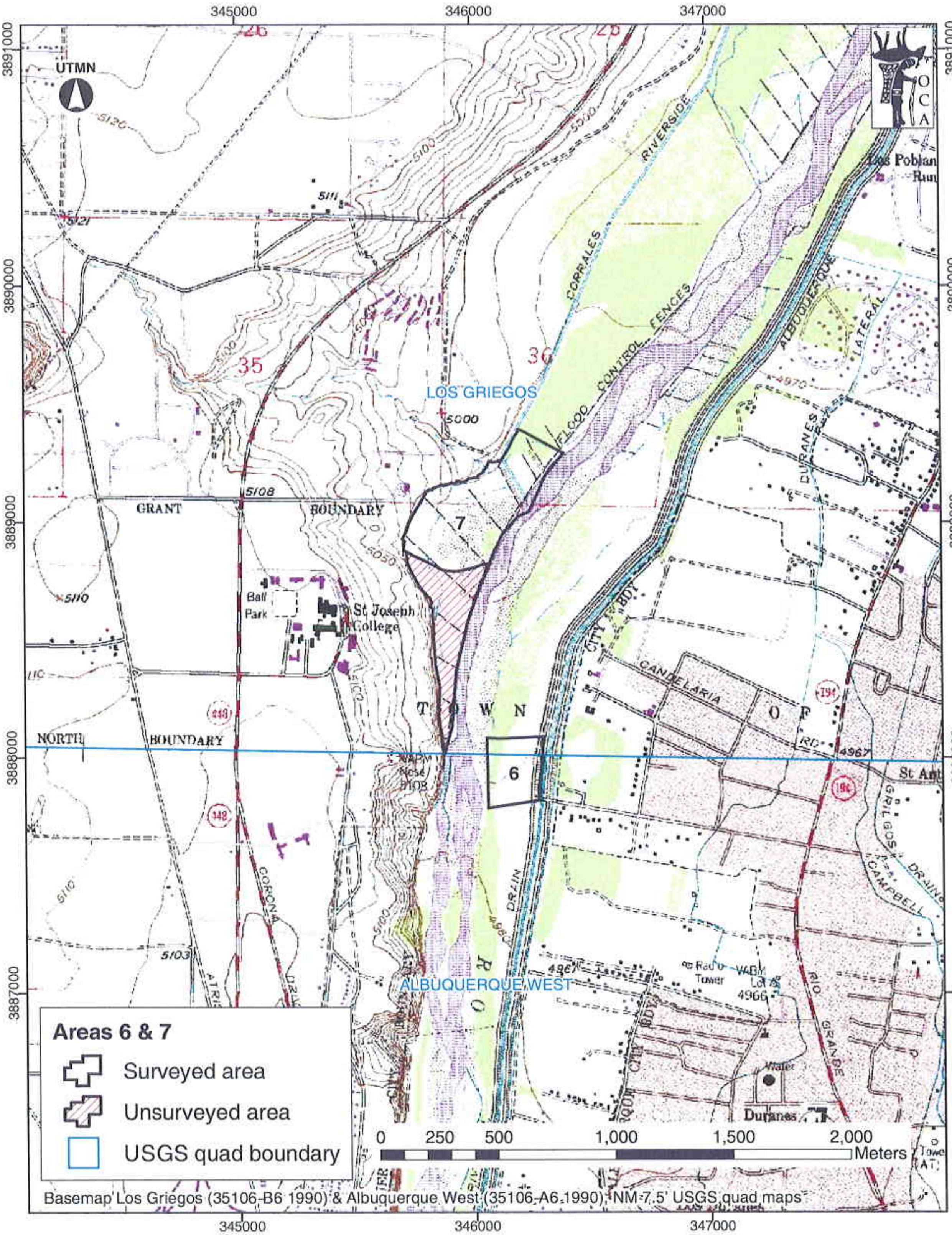

Figure 5 USGS 7.5 min. quadrangle of Survey Areas 6 and 7.

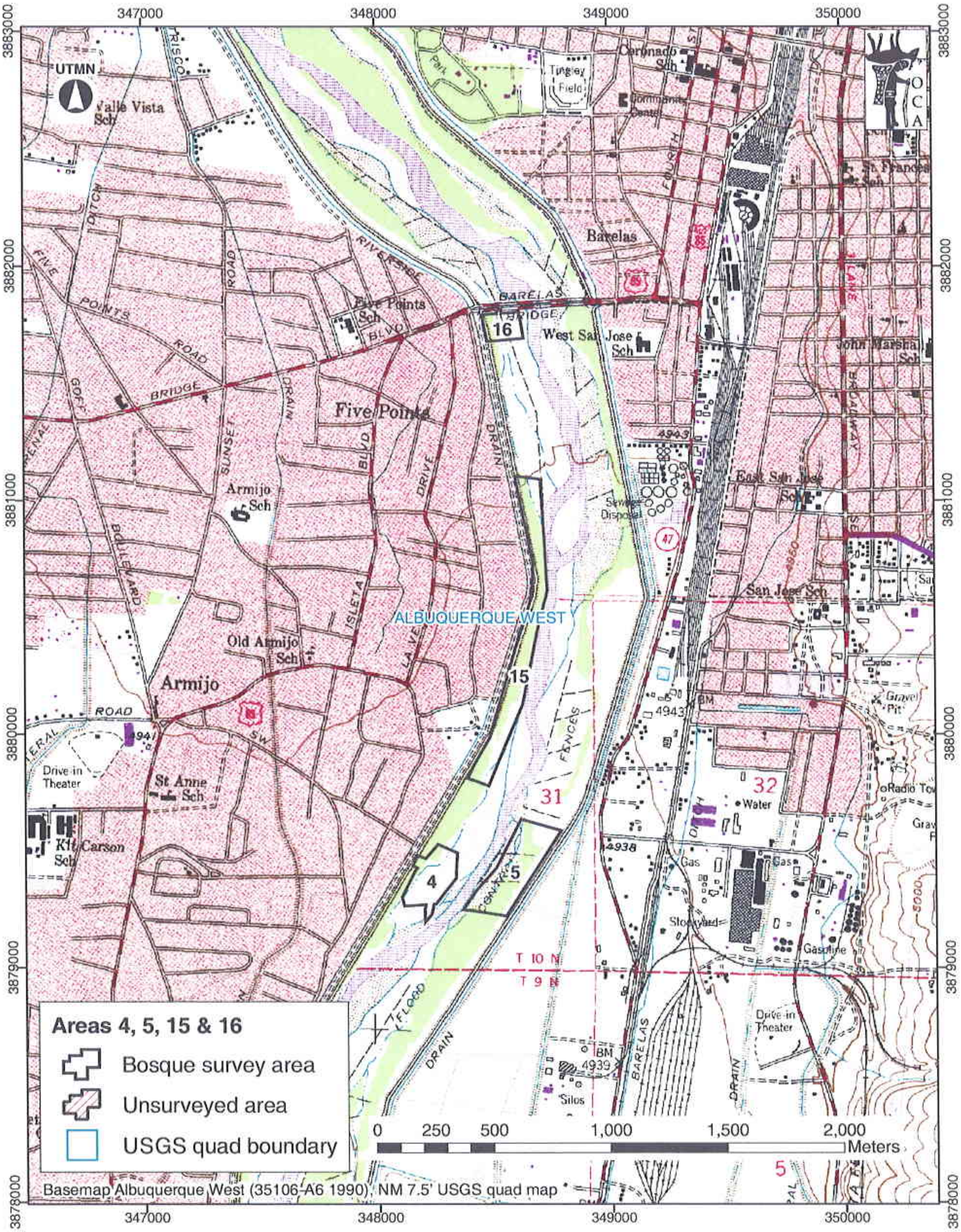

Figure 6 USGS 7.5 min. quadrangle of Survey Areas 4, 5, 15 and 16.

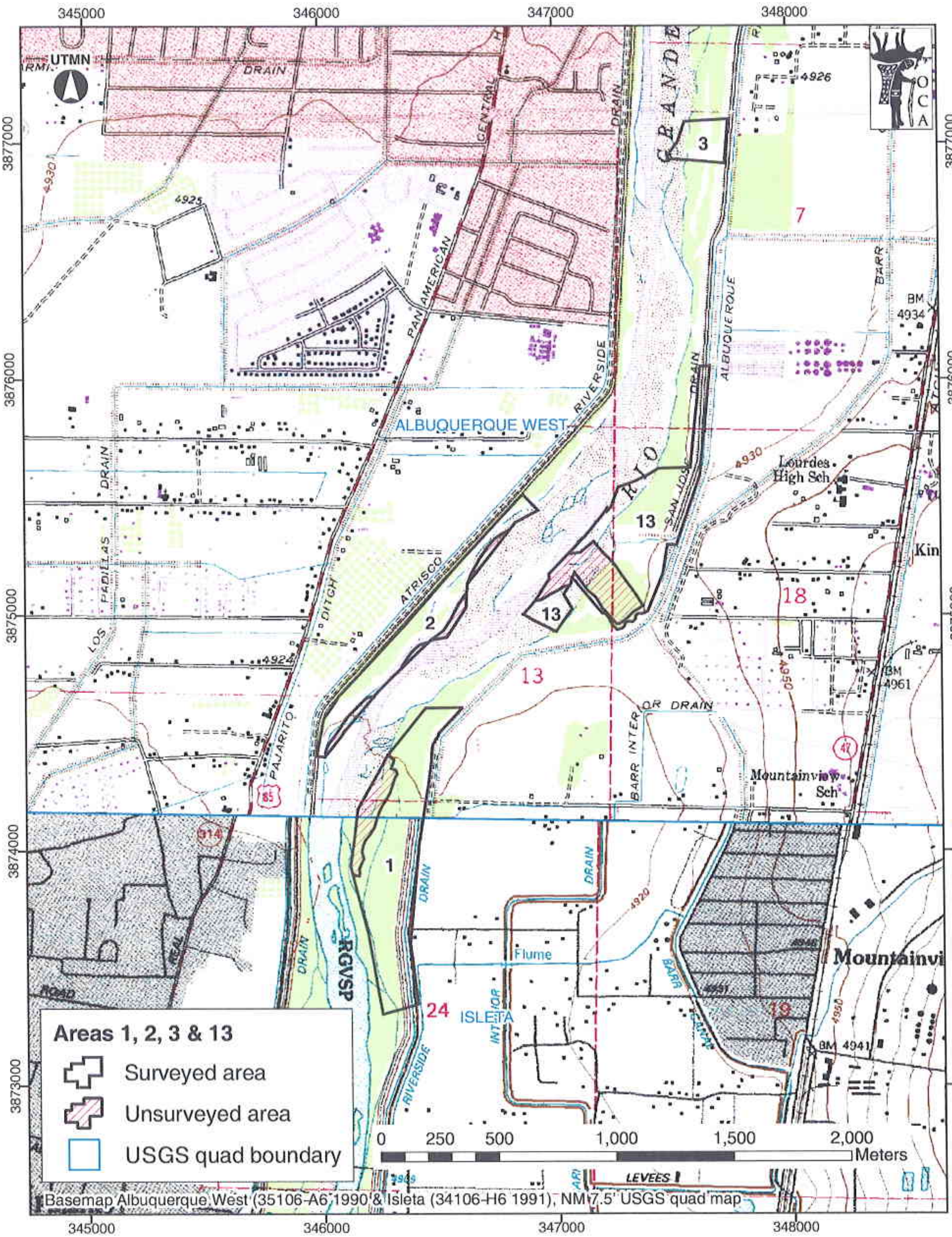

Figure 7 USGS 7.5 min. quadrangle of Survey Areas 1, 2, 3 and 13.

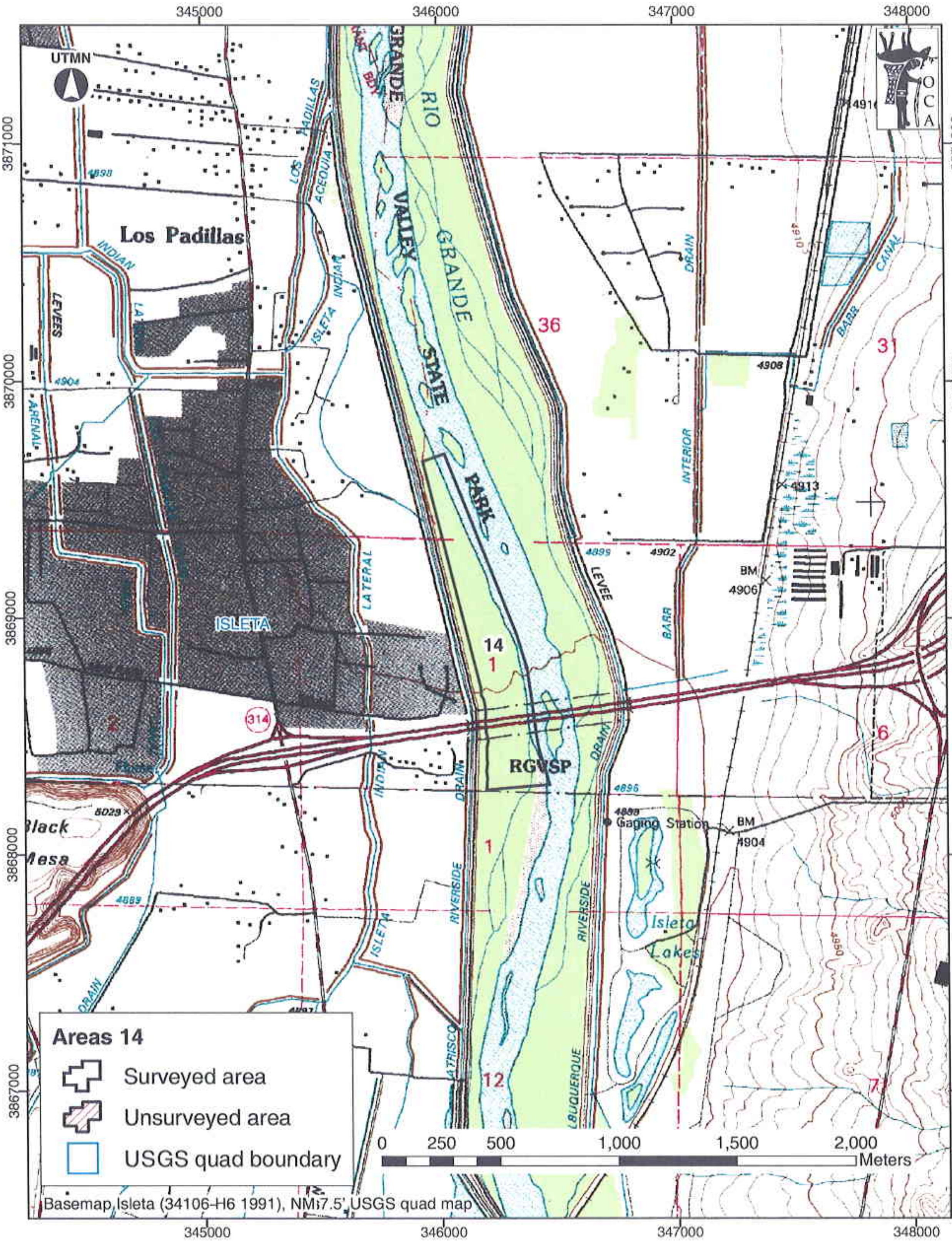

Figure 8 USGS 7.5 min. quadrangle of Survey Area 14.

Table 1 Legal Descriptions for Survey Blocks.

Parcel Id	GRANT	SECTION	RANGE	TOWNSHIP	Acres	Hectares
1		13 (S1/2)	R02E	T09N	15.89	6.43
1	Pajarito Grant	Unplatted			0.15	0.06
1		24 (NW)	R02E	T09N	43.83	17.74
2	Town of Atrisco Grant	Unplatted			9.41	3.81
2		13 (SW, N1/2)	R02E	T09N	15.03	6.08
2	Pajarito Grant	Unplatted			6.03	2.44
3		7 (NW)	R03E	T09N	9.06	3.67
4	Town of Atrisco Grant	Unplatted			9.91	4.01
4		31 (S1/2)	R03E	T10N	0.52	0.21
5		31 (SE)	R03E	T10N	17.68	7.15
6	Albuquerque Grant	Unplatted			15.90	6.43
7		35 (SE)	R02E	T11N	2.24	0.91
7		36 (SW)	R02E	T11N	19.03	7.70
7	Albuquerque Grant	Unplatted			27.40	11.09
8	Town of Alameda Grant	Unplatted			7.88	3.19
9	Town of Alameda Grant	Unplatted			2.43	0.98
10	Town of Alameda Grant	Unplatted			15.33	6.20
10	Sandia Pueblo/Town of Alameda Grant	Unplatted			2.92	1.18
11	Town of Alameda Grant	Unplatted			80.99	32.78
11	Sandia Pueblo/Town of Alameda Grant	Unplatted			10.69	4.33
12	Town of Alameda Grant	Unplatted			15.89	6.43
12	Sandia Pueblo/Town of Alameda Grant	Unplatted			26.49	10.72
13		7 (SW)	R03E	T09N	2.79	1.13
13		13 (E1/2)	R02E	T09N	15.22	6.16
13		18 (NW)	R03E	T09N	31.53	12.76
14	Pajarito Grant	Unplatted			4.43	1.79
14		36 (SW)	R02E	T09N	7.33	2.97
14		1 (E1/2, NW)	R02E	T08N	51.99	20.67
15	Town of Atrisco Grant	Unplatted			25.38	10.27
15	Albuquerque Grant	Unplatted			0.65	0.26
16	Town of Atrisco Grant	Unplatted			0.72	0.29
16	Albuquerque Grant	Unplatted			3.77	1.53

CHAPTER 2

ENVIRONMENTAL SETTING

J. Robert Estes

The study area is on the floodplain of the Rio Grande Valley within the Albuquerque Basin, a distinct part of the Mexican Highlands Section of the Basin and Range Physiographic Province (Hawley 1986; Kelley 1977). Elevations in the area range from 4880 to 4990 ft (1486–1490 m). The Albuquerque Basin is the central feature of the Rio Grande Valley rift system and is the product of block-fault tectonic movements that began in middle Tertiary times and created the region's distinctive topography (Kelley 1977). Down-dropping of one block created the offset between the Rio Grande Valley and West Mesa (Llano de Albuquerque) to the west, while uplift created the Sandia and Manzano Mountains to the east. The Rio Grande Valley is filled with Tertiary alluvium and bordered by terraces that reflect the basin's complex tectonic and geomorphic history.

The Rio Grande Valley is characterized by a semi-arid continental climate with a summer-dominant rainfall regime. Average annual precipitation is 8.7 in (22 cm), about one-third of which accumulates during July and August thunderstorms. Winters and springs are typically dry. The average maximum temperature during January, the coldest month, is 47.1° F (8.4° C) and the average minimum temperature is 23.1° F (-4.9° C). Average maximum and minimum temperature for July, the hottest month, are 91.7° F (33.2° C) and 64.5° F (18.1° C), respectively (Estes 2005:Table 3). Valley temperatures tend to be slightly more extreme (cooler lows and warmer highs) than on the adjacent mesas. The frost-free period for Albuquerque ranges from 173 to 225 days (Tuan et al. 1973:80).

Hydrology

Geomorphological research suggests that the present-day channel of the Rio Grande has been in place for at least 1000 years (Martinez et al. 1985:4.32). However, two alternative channels of the Rio Grande have been identified in the Albuquerque area. These channels diverge at a bend in the river between Corrales and Alameda, in the northern part of the study area, and follow the paths of Rio Grande Avenue and Second Street. In historic times, these channels carried floodwaters down central and eastern parts valley, threatening and damaging settlements from Alameda to about Barelas (Carter 1953:9,74; Sargeant and Davis 1986:4–5; Scurlock 1998).

Prior to 1957, when the Rio Grande was confined to its present channel by levees, the river was a meandering braided stream subject to periodic floods (Scurlock 1998). During periods of low flow the river varied in width from as little as 100 ft to as much as 1200 ft (30–366 m). When flooding occurred, however, the river could cover the entire valley floor, posing a periodic and often severe hazard to the area's occupants. The primary source of these floods was spring snowmelt in the headwaters of the Rio Grande. Historical records show that the floods scoured the valley of groves of trees, destroyed irrigation ditches and crops, washed away homes, and left communities inundated and isolated for extended periods of time (Carter 1953:20; Eisenstadt 1990:13; Scurlock 1998:44–45). At the same time, the floods carried rich alluvium that maintained the fertility of the soil, which was essential for agriculture and ultimately for permanent settlement in the valley (Sargeant 1985:2.2).

Although the primary danger of flooding in the valley came from the melting snows in the watershed of the upper Rio Grande, heavy rainfall during the summer also contributed to flooding in the valley. Rains falling on the east and west mesas flooded the valley floor, deposited large amounts of sand and silt, and damaged homes (Carter 1953:27, 30; Sargeant and Davis 1986:106–107; Tuan 1966:594).

After the floodwaters subsided some water remained in low-lying areas, creating ponds and swampy areas called *charcos* and *esteros*, respectively, by the Spanish (Scurlock 1998:45). One of these esteros extended south along the eastern side of the valley from Alameda almost to Albuquerque. A second large estero, the Estero de Mejia, was located just south of Albuquerque near present day Barelas. Although the esteros were originally natural bodies of water, poorly engineered irrigation systems exacerbated the drainage problem in the valley by creating new wetlands by the 1820s (Wozniak 1987). Moreover, poor drainage contributed to rising water tables and increasing alkalinity of the soils in the valley (Scurlock 1998:312; Wozniak 1987). These wetlands persisted in the valley until the 1930s, when the Middle Rio Grande Conservancy District projects drained them (Scurlock 1998:323).

Although floods can remove sediments, a process called scouring, the floodplain in the Middle Rio Grande has been aggrading for hundreds of years. Aggradation is a process whereby sediments accumulate in the river bed, which contributes to over-bank flooding and shifts in the river channel (Martinez et al.1985:4.15; Scurlock 1998:44). In some parts of the Middle Rio Grande Valley as much as 35 to 40 ft (10–12 m) of soil has been deposited since the mid-1600s (Titus 1963:11). Aggradation became a problem for the region's population by the 1880s. Centuries of overgrazing contributed to soil erosion, thereby increasing the sediment load carried by the river (Scurlock 1998:244, 246) at a time when the expansion of irrigation agriculture in Colorado had greatly reduced the river's flow, thereby allowing the sediment load to be deposited in the river's channel (Scurlock 1998:304). Silt clogged irrigation and drainage ditches, which contributed to waterlogging (Scurlock 1998:262–263). The river aggraded so much between 1880 and 1924 that as much as 7 ft (2 m) of silt was deposited in the riverbed in the Albuquerque Valley (Scurlock 1998:246).

Although the land use practices of Spanish colonists and Euro-American settlers affected the hydrology of the river, the greatest changes came with the construction of dams along the Rio Grande, first with Elephant Butte in 1916 and culminating with Cochiti Dam in 1973. Moreover, the establishment of the Middle Rio Grande Conservancy District in 1925 set the stage for a unified effort to create a well-managed system of diversion dams, irrigation canals, drains, and levees to conserve the agricultural resources of the Rio Grande Valley, from Cochiti to San Marcial and beyond.

Soils

Soils are an important component of the environment because their variable characteristics contribute to moisture retention and drainage, the types of vegetation that can thrive, and the potential productivity of agricultural endeavors. The soils of the floodplain are subject to dynamic processes of erosion and sedimentation, however, and have not been stable over time. Martinez et al. (1985:4.32) state that "...an unconfined river such as the Rio Grande consists of sand without any rigid structure and is therefore subject to severe scouring by flood flows." This observation echoes numerous accounts written by Spanish colonists and Euro-American explorers whose comments on the quality of soils in the valley were usually summarized by the word "sandy"(Scurlock 1998:231). However, the soils deposited by the river "serve as manure for the land," which contributed to agricultural productivity in the valley (Simmons 1982:96).

The soils in the study area consist almost entirely of a class known as torrifluvients (Hacker 1977). Torrifluvents are the soils in the active riverbed. They are sands or loamy sands, often containing gravels, and are frequently flooded. They are subject to shifting when under flowing water and to aeolian erosion when dry. Vinton and Brazito soils are less common but also occur on the floodplain. Vinton and Brazito soils are generally sandy with varying amounts of loam. They are located adjacent to the river channel in areas unprotected by levees. Although the Vinton and Brazitos soils are subject to some flooding, they are relatively stabile and are held in place by the bosque vegetation.

Another characteristic of the soils in New Mexico, especially along the river, is high salinity or alkalinity. Salinization and alkalinization are processes that take place where water stands and evaporates rather than running off or soaking into the soil. The potential causes include low soil permeability, high water tables, and poor drainage. Soil alkalinity is also exacerbated where irrigation agriculture is practiced without adequate provisions for draining excess water from fields or when excess water is dumped into low lying areas. The consequences are that soils become highly alkaline or saline and are unusable for agriculture. The problem was so widespread that only about 25% of the arable lands between Albuquerque and the mouth of the Rio Puerco was under cultivation (Scurlock 1998:246).

Vegetation

When the Spanish first came to central New Mexico they were impressed with the abundant natural vegetation in the valley and on the mesas, hills, and mountains that bordered it. They described the valley as "dotted with cottonwoods groves" (Scurlock 1998:137), planted with cotton and maize (Hammond and Rey 1966:83) and possessing abundant grassland suitable for grazing domesticated livestock (Hackett 1942:220–1).

Two kinds of vegetation probably dominated the valley. The first consisted of a thick riparian woodland or *bosque*, dominated by cottonwood trees and willow, that followed the main river channel. During the 1620s, a large expanse of cottonwoods known as the Bosque Grande de San Francisco Xavier was located along the Rio Grande near Albuquerque (Simmons 1982:40). Another extensive cottonwood bosque was located in the north valley near present day Alameda, which served as the namesake for that Spanish community and the Tiwa pueblo that preceded it (Scurlock 1998:221). The dominant species in the bosque was valley cottonwood, while coyote willow and salt grass dominated the understory. Other major plants associated with the bosque include New Mexico olive, false indigo bush, and wolfberry (Scurlock 1998:201).

A large part of the valley probably supported vegetation of the Plains and Great Basin Grassland biome (Brown and Lowe 1994). The dominant plants in this community are a mixture of grass and shrubs including alkali sacaton, vine-mesquite, blue grama, western wheatgrass, tobosa, galleta, burrograss inland saltgrass, and mat muhly. Both Spanish and Anglo-European explorers reported that the valley supported lush meadows suitable for grazing livestock (Hackett 1942:220–221; Simmons 1982:10, 40, 87, 112). Four-wing saltbush was the dominant shrub with smaller quantities of rubber rabbit brush, winterfat, and shadscale (Hacker 1977:50). Wetlands were also a prominent feature of the valley's floodplain. For example, the wetlands between present day Corrales and Isleta supported cattails, sedges, various rushes, reed grass, and carrizo (Scurlock 1998:201).

Given the valley's long history of occupation, together with centuries of cultivation and subsequent urbanization, the present-day vegetation and wildlife are a far cry from those of prehistoric times, or even those of Spanish Colonial and later pre-urban historical times. By the time of the Spanish entrada, the Pueblos of the Middle Rio Grande Valley had already planted over 20,000 acres of farmland, and the Spanish expanded this by another 27,000 acres between 1700–1800 (Scurlock 1998:144). Between 1681 and the early 1900s, chroniclers began to report a lack of trees and wood for fuel from Alameda to Socorro (Scurlock 1998:224), a shortage that may be attributed to over-exploitation by the European settlers who brought new livestock, agricultural technology to the region. However, changes in the local ecology effected by irrigation agriculture and the introduction of exotic species of plants created an environment perfect for the resurgence of the bosque along the river.

The modern bosque and its predominant plants are the result of three causes. The first is the increasing levels of salt and alkali in the previously irrigated soils of the valley. The second is the introduction of exotic plants from Asia that are salt and alkali tolerant. In the early 1900s, residents of the valley planted salt cedar (*Tamarisk spp.*), Russian olive (*Eleaganus spp.*), and the Tree of Heaven (*Ailanthus spp.*) as ornamental plants on their residential properties (Scurlock 1998:253). These species quickly spread throughout the valley until they became dominant within the bosque, and along the drains and irrigation canals. The third cause is that the MRGCD projects created a permanent channel and upstream dams that prevented the floods that had previously scoured the floodplain of vegetation. Consequently, imported species now dominate in the bosque, growing in very dense thickets that inhibit new growth of native species.

Wildlife

While the study area can be generally described as a riparian habitat for wildlife, the variety and distribution of wildlife in the Rio Grande valley is influenced by the types of land and the vegetation that grows there. Historically, the primary classes of land in the valley were primarily openland (meadows) and wetland (esteros and cienegas), with smaller areas of woodland (bosque), in addition to the river itself (aquatic) (Hacker 1977). Like other elements of the natural environment, Spanish explorers, conquistadors, and Anglo-European settlers listed the animals they encountered on their travels through the valley of the Rio Grande. Many of these species remain abundant in the valley as a whole, while others have been depleted by commercial exploitation and changes in the way land was used for agricultural activities (Scurlock 1998).

Openland in the valley include areas that are or were formerly meadows and agricultural fields. The fauna found in openland include gambel's and scaled quail, mourning and whitewing doves, cottontail rabbits, jackrabbits, and ground squirrels. Waterfowl such as ducks, geese, and cranes also feed in fields and pastures away from the river's edge.

Wetland habitat includes the poorly-drained, swampy areas along the valley floodplain, occasionally flooded areas along the river's edge and islands within the river channels. Waterfowl are common within these wetlands, which provide habitat for diving and wading birds. Birds common in wetlands include Canadian geese, great blue herons, cattle egrets, sandhill cranes, and many species of ducks. Species such as river otter, beaver, raccoon, and muskrat were once common in and along the river's channels. Many of these species were depleted in the nineteenth century by commercial trappers who took the animals' pelts for markets in the eastern United States and Europe (Scurlock 1998). Beaver and raccoon are making a comeback within the bosque, however, and evidence of these species is was widespread along the river's edge.

Woodlands currently occupy most of the land in the portion of the river floodplain that is confined within the contemporary levees. During the first few centuries of European settlement, the river provided habitat for black bears, brown bears, mule deer, and elk (Scurlock 1998:209). Other species common along the river included turkey, cottontail rabbits, coyotes, wolves, tree and rock squirrels, raccoons, and skunks (Hacker 1977). Only coyotes, cottontail rabbits, squirrels, raccoons and skunks remain common in the project area, the others being entirely extirpated. Bird species such as mourning dove, crows, turkey vultures, and a wide variety of raptors are commonly seen nesting in the woodlands.

The river provides an aquatic habitat for many species of fish and amphibians. Fish commonly found in the river at the time of Spanish colonization include blue catfish, Rio Grande cutthroat trout, yellow bullhead catfish, eel, sucker, Rio Grande chub, gar, longnose gar, and the Gila chub (Scurlock 1998:142). Many of these species were caught and used by the valley's inhabitants, in both pre-historic and historic times. However, changes in the river's flow due initially to uncontrolled irrigation agriculture and subsequently to dam construction have affected the diversity and richness of fish in the river. The results of these changes are today still unresolved.

Modern Land Use, Bosque Restoration and Wildfire Prevention

Present use of the floodplain is largely for flood control, recreation, and wildlife habitat. The river is confined by levees that are regularly interrupted by flood-control channels, irrigation canals and drains, and associated maintenance roads, which parallel the river along much of its length. Much of the area is part of the Rio Grande Valley State Park, and a network of trails has been developed to accommodate hiking, biking, horseback riding and recreational fishing. As a result of public access, several modern "dump" sites and trash are present, in addition to homeless camps. In many areas, the land is also managed as wildlife habitat.

In 2003, approximately 263 acres of the Middle Rio Grande bosque in Bernalillo and Sandoval counties were damaged during two separate wildfire outbreaks. Two more wildfires during the summer of 2004 burned an additional 81 acres and destroyed three structures. As a result, the USACE was asked to develop a plan for bosque restoration and wildfire prevention. The plan, dubbed the Bosque Wildfire Project, called for thinning areas with non-native vegetation and high fuel loads; and the removal of jetty jacks and downed vegetation, improvements to levee roads and drain crossings, and construction of turnabouts to improve access for firefighters. In addition, the thinned and burned areas are to be replanted with native species. Some recommendations of the plan, primarily thinning and the removal of non-native vegetation, have been implemented in selected parts of the study area.

CHAPTER 3

CULTURE HISTORY

Christine S. VanPool, J. Robert Estes, and Patrick Hogan

The Middle Rio Grande region, which encompasses the survey area, has been occupied by humans for at least the past 11, 000 years (Cordell 1979; Stuart and Gauthier 1981). The history of the region is commonly divided into four broad periods – Paleoindian, Archaic, Formative, and Historical – each typified by the predominance of a different cultural adaptation. Subdivisions in each period are defined on the basis of successive changes in material culture and inferred social and economic developments.

Paleoindian (10,000 to 5500 BC)

Paleoindians in the Southwest are generally portrayed as small bands of highly mobile hunters, who preyed primarily on large mammals that are now extinct (e.g., mammoth, bison, sloth, camelids, and horse). There is increasing evidence that Paleoindians in other regions also hunted smaller animals and collected wild plant resources, however, raising the possibility that some Paleoindian groups in the Middle Rio Grande region also employed a more generalized subsistence strategy.

Four Paleoindian complexes have been identified in the Middle Rio Grande region based on the occurrence of distinctive projectile point styles (Judge 1973). Clovis is the oldest securely dated Paleoindian complex in the American Southwest. The Clovis complex dates between 10,000 and 9000 BC. It is marked by the distinctive fluted Clovis spear points, occasionally found associated with gravers, bone points, foreshafts, shaft staighteners, and a variety of flaked stone scrapers (Gunnerson 1987:10). At some sites, Clovis artifacts associated with extinct megafauna such as the mammoth, camel, bison, or horse. Clovis sites are rare, and only one has been documented in the Middle Rio Grande Valley (Judge and Dawson 1972; Judge 1973).

The Folsom and Midland complexes postdate the Clovis Complex throughout much of the western United States (Frison 1978, 1991; Wendorf et al. 1955). Both complexes date from 9000 to 8000 BC, and are differentiated from one another on the basis that Folsom points are typically fluted, whereas Midland points are not (Frison 1991:242). Of all of the Paleoindian complexes present in the Middle Rio Grande Valley, the Folsom complex is the most common.

After about 8000 BC, fluted points are no longer manufactured and people instead begin to make new varieties of laterally-thinned, constricted-base, and indented-base projectile points. The appearance of these point styles marks the beginning of the Late Paleoindian period, generally called the Plano tradition, which extends to 5500 BC. The end of the Paleoindian period coincides with the final demise of the winter-dominant precipitation pattern characteristic of the early Holocene, and the onset of a climatic regime approaching present conditions. By 5500 BC, Irwin-Williams (1979) argues that climatic conditions in the Southwest were unfavorable for bison, forcing late Paleoindian groups to withdraw to the central and northern Plains in order to maintain their focal hunting economy.

Archaic (5500 BC to AD 400)

In contrast to the focal hunting economy of the Paleoindian period, the predominant cultural adaptation during the Archaic period can be described as a "diffuse" economy in which a wider variety of wild plant and animal resources were exploited (Judge 1982:49). From the limited evidence available, the lifeway of Archaic populations in the Middle Rio Grande region appears to have been similar to that of modern hunting and gathering groups inhabiting arid environments. Small residential groups, probably families or extended families, spent much of the year moving among a series of localities where water was available and select food resources were seasonally abundant. Group size and composition likely varied in response to changing economic opportunities, as smaller task groups periodically moved out from the residential camps to procure resources in more distant areas.

Archaeologists have increasingly adopted a simple three-part division of the Archaic that can be applied to the entire American Southwest – the early Archaic period, the middle Archaic period, and the late Archaic/Early Agricultural period. In addition, Irwin-Williams's (1973) defined a local Archaic sequence, called the Oshara Tradition, for the Middle Rio Grande valley during her research in the Arroyo Cuervo District, a 520 sq km area between the Rio Puerco and Jemez River. Like the Paleoindian complexes, the Oshara phases are each associated with one or more distinctive projectile point styles. For Irwin-Williams, the five phases defined for the Oshara reflect successive adaptations to fluctuating climatic conditions between 5500 BC and AD 400, which culminated in the emergence of the Anasazi Tradition.

Early Archaic

The early Archaic period encompasses the two earliest Oshara phases, Jay (5500–4800 BC) and Bajada (4800–3200 BC). Jay sites in the Arroyo Cuervo District tend to be small, shallow deposits with lithic assemblages that include Jay points (a large, stemmed and slightly shouldered projectile point), a distinctive lanceolate bifacial knife, and numerous well-made side scrapers. Sites interpreted by Irwin-Williams as base camps occur around canyon-heads near permanent water, whereas special activity sites are found near ephemeral ponds and on low mesas. Bajada sites exhibit the same pattern, but cobble-filled hearths and earth ovens appear at some sites during this phase, and the lithic assemblage includes a larger number of heavy chopping tools and crude side scrapers. Bajada points are similar to Jay points but they have increasingly well-defined shoulders and their stems are basally thinned with indented bases.

Few early Archaic sites have been excavated, and there is relatively little information about the subsistence strategies employed. Judge (1982:49) speculates that Jay and Bajada sites represent a continuation of the Paleoindian, focal-hunting economy adapted to modern faunal resources. Irwin-Williams (1973), on the other hand, argues for a mixed spectrum of subsistence activities that included hunting of both large and small game.

Middle Archaic

The Middle Archaic period in the Middle Rio Grande region roughly coincides with the San Jose phase (3200–1800 BC) of the Oshara Tradition. According to Irwin-Williams, San Jose sites are generally found in the same topographic settings as early Archaic sites, but they are more numerous and larger. Base camp debris is more extensive and concentrated than before, and cobble-filled hearths and earth ovens substantially increase in size and complexity. Shallow-basin grinding slabs and manos also appear during the San Jose phase, indicating a greater emphasis on processing wild plant seeds. This evidence suggests that resource procurement was more intensive than during the early Archaic, with local populations systematically exploiting the most productive micro-environments of the region over the course of an annual cycle (Irwin-Williams 1973:7–9).

Late Archaic

The late Archaic period or, in Huckell's (1996) terminology, the Late Archaic/Early Agricultural Period spans the interval during which cultigens were introduced into the American Southwest and agriculture emerged as a viable subsistence strategy. In the Middle Rio Grande region, the late Archaic encompasses the Armijo and En Medio phases of the Oshara Tradition.

Irwin-Williams contends that the settlement pattern during the Armijo phase (ca. 1800–800 BC) mirrored that of the middle Archaic, indicating a continuation of the broad-spectrum hunting and gathering strategy established during the San Jose phase. The canyon-head sites near the most reliable seeps evidence a new pattern, however, suggesting the seasonal aggregation of groups totaling perhaps 30–50 individuals. She further suggests that this new pattern was made possible by the introduction of maize, which provided a small but reliable seasonal surplus. Seasonal aggregation, in turn, probably stimulated social interaction and lead to the development of large-scale social and ceremonial activities (Irwin-Williams 1973:9–11).

The En Medio phase (800 BC–AD 400) encompasses the Basketmaker II occupation in the Middle Rio Grande region; that is, the earliest part of the Formative period as defined in the Pecos Classification system. Thus, in Irwin-Williams's view, the transition from Archaic to Anasazi was accomplished without any perceptible cultural break. Basecamp locations shift from the heads of canyons to rockshelters, cliff bases, and dune ridges. A new pattern of seasonal occupation of dune ridges also emerges. With this shift, new artifacts types are found such as flat and trough metates. Cultigens continue to be grown, but provide only a seasonal supplement for a diet based primarily on game and wild plant foods. Irwin-Williams argues that a primary dependence on agriculture does not emerge until the Basketmaker III-Pueblo I period.

Irwin-Williams' (1973) conclusions have been called into question as a result of recent research. Excavations at San Luis de Cabezon (LA 110946) uncovered what appears to be an agricultural village on the floodplain of the Rio Puerco, indicating that some late Archaic groups made the transition to a primary dependence on agriculture. The site yielded two San Pedro points, and the structures, features, and site layout closely resemble those of contemporary San Pedro phase agricultural villages in southeastern Arizona (Huckell 1990). The evidence from this site is therefore consistent with arguments that much of the Basketmaker II occupation in the northern Southwest can be attributed to a population intrusion by early agricultural groups from the south (Berry 1982; Huckell 1987; Matson 1991). Apart from San Luis de Cabezon, cultigens are not common at late Archaic sites in the region until after about 200 BC (Elyea 1999), however. Many late Archaic groups therefore appear to have remained hunter-gatherers though much of the period.

Formative (AD 400–1541)

Most of the known archaeological sites in the study area date to the Formative or ancestral Puebloan period. The appearance and widespread use of pottery vessels provides a convenient marker for the end of the Archaic and the onset of the Formative period. The Formative period encompasses a continuum of changes in the development of Pueblo culture from its beginnings among early agricultural populations to Spanish contact. Two chronological sequences are commonly used to subdivide this period in the Middle Rio Grande region, the Pecos Classification system (Kidder 1927) and the Rio Grande sequence (Wendorf and Reed 1955). Operationally, the subdivisions of both sequences are defined by changes in pottery styles and, to a lesser extent, architectural forms. Both were originally conceived as developmental sequences charting the major changes in Pueblo culture. In current use, however, they serve primarily as a framework for roughly ordering sites in time. The Pecos classification was used as the Formative chronological sequence for this project with the modifications and dates suggested by Cordell (1979) in her overview of the Middle Rio Grande region.

Basketmaker III–Pueblo I

The Basketmaker III (AD 400–700) and Pueblo I (AD 700–900) periods are normally distinguished under the Pecos Classification, but Cordell (1979:42) contends that it is more appropriate to combine these periods for the Middle Rio Grande sequence. In the Rio Grande sequence, this transitional period is termed early Developmental. It is during this interval that the transition to a predominantly agricultural economy appears to have been completed in the Middle Rio-Grande region (Schmader 1994:10). Many of the material culture attributes characteristic of ancestral Pueblo culture also appear during this period.

The Basketmaker III period is marked by the widespread production and use of pottery vessels. Among the early pottery types that typify this period are Lino Gray, White Mound Black-on-white, and La Plata Black-on-white. Limited quantities of Alma Plain and Alma Neck-banded are also found at Basketmaker III sites in the Middle Rio Grande. It is unclear if the presence of these Mogollon brown wares reflects the importation of trade items, movement of a Mogollon population into the region (Cordell 1979:42), or a blending of Anasazi and Mogollon groups (Stuart and Gauthier 1981:119). Painted pottery becomes more common during Pueblo I, and Kana'a Gray – a plain gray ware with clapboard neck-banding – begins to be produced.

A number of Basketmaker III-Pueblo I pithouse sites have been excavated in the Middle Rio Grande region. They are generally near water sources, occasionally on the river floodplain but more often on dune-covered ridges, gravel bluffs, and low terraces adjacent to major intermittent tributaries of the Rio Grande (Cordell 1979:42–43; Hogan and Gerow 1990:27). Residential sites typically have one to three pitstructures with associated exterior hearths, roasting pits, and storage pits. Sites with more than three pithouses are known but consistently evidence multiple occupations. Surface storage and living rooms, common at Pueblo I sites in the Four Corners region, are rare in the Middle Rio Grande and do not appear until late in the Basketmaker III–Pueblo I period.

Pueblo II

The Pueblo II or Late Developmental period is dated between AD 900 and 1200 in the Middle Rio Grande region (Cordell 1979). No major changes in settlement pattern occur during this period and, in the Middle Rio Grande region, pitstructures continue to be used as habitations well into the Pueblo II period (Bradley et al. 1999:53; Hammack et al. 1982:126).

Red Mesa Black-on-white and later Kwahe'e Black-on-white, a locally made copy, are the diagnostic ceramic types. Earlier painted wares such as San Marcial Black-on-White also continue to be produced, and Lino and Kana'a Gray remain more common at local Pueblo II sites than indented corrugated utility ware (Bradley et al. 1999:53–54; Hammack et al. 1982:84). The appearance of Red Mesa Black-on-White suggests increasing contact between populations in the Four Corners and Rio Grande areas.

Relatively few Pueblo II sites have been documented in the Middle Rio Grande valley. The paucity of sites may result in part from an identification problem. A number of excavated Basketmaker III-Pueblo I sites in the region evidence continued occupation into the Pueblo II period (Anschuetz 1995; Cordell 1979; Hogan and Gerow 1990; Schmader 1994), although Red Mesa Black-on-white sherds were either absent or present in very limited quantities. Nevertheless, there is clearly a population decline in the lowland areas of the region, reflecting a shift in settlement location to higher elevations away from the river valleys.

Pueblo III

The Pueblo III or Coalition period is dated between AD 1200 and 1300 in the Middle Rio Grande. During this hundred-year period, potters shifted from using mineral paints to organic paints. One of the earliest organic-painted types in the region, Santa Fe Black-on-White, is the diagnostic ceramic type for Pueblo III (Cordell 1979:44). Equally characteristic of Pueblo III ceramic assemblages in the northern Rio Grande region is the diversity of locally made wares. Many of these ceramic types, including Santa Fe Black-on-White, resemble wares manufactured in the San Juan region and Chaco Canyon. Others, like Galisteo Black-on-White, appear to be derivatives of Mesa Verde Black-on-White. Wiyo Black-on-White, which appears in the latter half of the thirteenth century, has less certain affinities with pottery styles from the Four Corners region (Anschuetz 1995:32). In the Albuquerque District, the presence of Chupadero Black-on-White and Socorro Black-on-White suggest a southern affinity, while the presence of small quantities of St. Johns Polychrome indicates interaction with Pueblo groups in the Upper Little Colorado drainage of east-central Arizona (Cordell 1979:44).

Pueblo III architecture echoes the regional heterogeneity of the ceramic assemblages. Pithouses continue to be used as dwellings, although the general trend is toward increasing use of surface pueblos for both living and storage.

Two major demographic changes are associated with the Pueblo III period throughout the northern Rio Grande region. The first is a sharp increase in population evidenced by the increasing number and size of habitation sites. This change is most commonly interpreted as evidence for a population influx from the Four Corners region (Frisbie 1967; Wendorf and Reed 1955), although Cordell (1979) argues that the increase is a result of internal growth. The second trend is the expansion of settlements into higher elevation areas, and the concurrent resettlement of the river valleys in some areas. In the Albuquerque District, Tijeras Canyon is first occupied during this period, and Pueblo III settlements have been documented in the Rio Grande valley north of Corrales (Cordell 1979).

Pueblo IV

The Pueblo IV period, also termed the Rio Grande Classic, is dated between AD 1300 and 1600 (Cordell 1979). The Classic period is appropriately named because it marks a period of cultural florescence, with the construction of large aggregated settlements and elaborate material culture in the Rio Grande Valley (Wendorf and Reed 1955). A distinctive change in pottery production occurs during this period as locals begin to make glaze-decorated, red- and yellow-slipped ceramics.

Marshall (1986, 1989) estimates between 50 and 75 large pueblos, some with a thousand rooms, were built along the Middle Rio Grande Valley. Large pueblos were also built in higher elevations near reliable springs or seeps (Anshuetz 1984:40; Lintz et al. 1988:141). Numerous small, specialized site are also present (Biella and Chapman 1979; Blevins and Joiner 1977; Schmader 1994; Schmader and Hays 1986). These large pueblos reflect an increase in population, which may be in part due to groups moving into the area from the San Juan Basin (Cordell 1979:103). With population aggregation into large settlements, the social system likely became somewhat unstable as a result of scalar stress, leading to warfare, resource depletion, and drought (Cordell 1979:45; Hogan and Gerow 1990:30; Wendorf and Reed 1955). Nonetheless, many of the large pueblos survived the unstable time and were occupied when the Spanish entered the region in AD 1541.

Historical (AD 1541–1952)

The first Hispanic incursion into the Middle Rio Grande valley was an expedition led by Francisco Vasquez de Coronado. When this expedition entered the valley during the winter of 1540, they found 12 large pueblos along the Rio Grande between modern Bernalillo and Isleta and two to four smaller villages further to the south, all of which were occupied by southern Tiwa groups collectively referred to as the Tiguex (Simmons 1982). The Spanish wintered in the area and their repeated demands for food and other supplies eventually elicited a hostile response from the Tiwas. The Spanish reprisals devastated the province and forced the Tiwas to temporarily abandon their remaining pueblos and seek refuge in the mountains.

In 1598, Juan de Oñate led an expedition to establish a permanent Spanish colony in New Mexico. Missions were subsequently established at Sandia and Isleta and *visitas* were constructed at Puaray and Alameda in an effort to convert the southern Tiwa to Christianity. Mission reports in 1620 indicate that an estimated 7000 Tiwas were living in 15-16 pueblos within the Tiguex province. A census report indicates that only three pueblos remained occupied in 1626 or 1641, while the 1680 census lists four pueblos – Sandia with a population of 3000; Isleta, with 2000; Alameda, with 300, and Puaray, with 200. These data indicate that many of the southern Tiwa pueblos were abandoned in the early 1600s. Isleta appears to have absorbed the population of pueblos near Albuquerque and Sandia, the population from pueblos in the Bernalillo area (Schroeder 1979:244).

The consolidation of the southern Tiwa population opened agricultural and grazing lands in the valley to Spanish settlement. Large haciendas were established near Tiwa settlements, which were taxed for labor under the *encomienda* system. By the mid-1660s, 45 such estancias were established in the valley, most of which were clustered near Bernalillo or in the area between Sandia and Isleta (Simmons 1982). Continued mistreatment of the Pueblos, illegal exactions, and active suppression of the native religion stiffened resistance to Spanish rule and precipitated the Pueblo Revolt of 1680, which forced the Spanish to retreat to El Paso. Pueblo independence was short-lived, however. In 1592, Spanish forces under the direction of Captain General Diego de Vargas re-conquered New Mexico and re-established the Spanish colony.

The colonists who returned with deVargas were soon joined by a growing number of new settlers. To accommodate this expanding population, the encomienda system was replaced by a system of land grants to individuals or groups of families. Although the Spanish government favored the plaza as the ideal settlement arrangement for defense, most early settlements in the Albuquerque area were scattered *ranchos* and *haciendas*. Spanish agriculture was based on irrigation water derived from the Rio Grande and brought to the fields by a system of ditches or *acequias*. Settlements were situated within the river valley in proximity to agricultural fields, ditches, and the entrances to major side valleys where livestock were grazed.

By the late 1700s, much of the Middle Rio Grande valley was settled and under cultivation. The Spanish census of 1790 listed six communities for the area north of the Villa of Albuquerque: San Jose de los Duranes, Candelarias, Nuestra Señora del Guadalupe de los Griegos, Señor de los Gallegos, San Antonio de los Poblanos, and San Jose de los Ranchos. South of Albuquerque, the communities included the settlements of Atrisco, Arenal, Pajarito, and Los Padillas on the west side of the river, and Estancia Varela (now Barelas) on the east side (Campbell 2001; Sargeant 1985). Although most of these early settlements have been destroyed by subsequent development, many of the acequias remain on or near their original alignments and retain the names of the communities they served (Marshall and Marshall 1990).

The colony came under Mexican rule when Mexico gained its independence from Spain in 1821. The Mexican government reversed the Spanish policy barring foreign traders in New Mexico and, with the opening of the Santa Fe Trail, American goods became increasingly available. For the United States, the trade awakened interest in the economic potential of the region. When Congress declared war on Mexico in 1846, New Mexico was occupied and annexed as a federal territory.

The annexation of New Mexico, increased traffic along the Santa Fe Trail, and the arrival of the railroad in 1881 led to considerable change in the area's population, economy, and culture, with Euro-American influence from the east gradually supplanting the connections with Mexico to the south. By the late 1800s, American military campaigns created a forced peace with Comanches, Apaches and Navajos. With the Civil War over and Native American raids no longer a threat, the influences of an increased Euro-American presence along with the technologies of the industrial revolution led to a gradual expansion of industrial aspects of the economy. At the same time, subsistence farming and herding in the valley gradually gave way to commercial agriculture, with traditional crops such as corn and beans being replaced in some fields by feed crops such as alfalfa and sorghum.

Throughout the late nineteenth and early twentieth centuries, Albuquerque proper remained limited to the 3 sq mi area of the original settlement. The local population grew steadily, however, and a "new town" arose along the railroad tracks to the east of the original settlement. This area became known as the Huning Highlands, a community that continued to expand but did not become connected with the Old Town until 1949.

Although the fertility of Rio Grande Valley soils had long been legendary, 300 years of farming, combined with flooding and a rising water table led to a marked decline in agricultural productivity and a 50% reduction in the amount of arable land by 1917. In 1925, the Middle Rio Grande Conservancy District (MRGCD) was formed to organize and improve flood control, drainage and the patchwork system of acequias that had evolved in the valley (see Marshall and Marshall [1990] for detailed listings of the present day valley ditches). The MRGCD consolidated and reengineered the ditch systems that had formerly been constructed and maintained by communities and individuals, opening thousands of acres of formerly non-irrigable lands cultivation.

Continued population growth after World War II and Albuquerque's development as a regional center for tourism, transportation and trade led to a greater demand for housing. The burgeoning east Albuquerque communities accommodated some of this need. However, as changes in government policy and improved agricultural technologies began to favor large-scale farming, more agricultural land was converted to residential use. Some of the resulting housing developments drew their names from the ranches, farms and dairies that they replaced, while many neighborhoods retained the names of the eighteenth-century plazas over which they were built.

Irrigation and Flood Control

Given its location, a culture history of the study area would be incomplete without a more detailed discussion of irrigation and flood control efforts in the valley. There are two reasons for such a discussion. First, it relates directly to the kinds of cultural properties likely to be found on the floodplain. The second reason is that the modern bosque is primarily a product of ecological changes initiated by Spanish agricultural practices and the effects of more recent actions by state and federal agencies to control flooding and provide a reliable water supply for irrigation.

At the time of Spanish contact, few Pueblo communities had well developed irrigation systems using water from the Rio Grande. Instead, they relied on dry farming techniques, diverting runoff from slopes and tributary drainages, and diverting water from overbank flooding of the river (Scurlock 1998:32). During the late fourteenth and fifteenth centuries, however, the Spanish constructed systems of acequias that diverted water directly from the Rio Grande, as well as springs and cienegas (Scurlock 1998:93), bringing about 48,000 acres into cultivation (Hedke1925:23). The Pueblos, faced with drought and increasing Spanish demands for agricultural produce, began to build or expand their own irrigation system in order to mitigate the consequent subsistence shortfalls (Simmons 1972:137; Scurlock 1998:140). After the Pueblo Revolt, settlement expanded as land grants were issued to newly arrived settlers, who built additional irrigation systems (Simmons 1982:96–97). This expansion continued until the early 1900s, when the effects of human exploitation began to be felt in the local environment.

Early on, the incessant expansion of irrigation systems caused disputes over water rights, allocation of water, rights of way for ditches, and damage caused by poorly designed and maintained systems (Scurlock 1998:140; Wozniak 1987:94). In 1851, after New Mexico was annexed by the United States, the Territorial Legislature passed a law stating that acequia alignments should remain in place, for public use, and primarily for agriculture (Wozniak 1987:85–6, 97). This law helped to maintain the community organizations that constructed and managed the acequia systems, as well as keeping ditches on, or near, their original alignments.

Poor drainage related to irrigation agriculture was a continual problem in the valley beginning in the 1820s. At that time, acequia systems were allowed to dump excess water onto low or unused pieces of land, which created man-made esteros and ciengas (Wozniak 1987:82, 94). Moreover, rainfall runoff from the heights around Albuquerque fed the natural esteros and caused widespread flooding in the valley (Carter 1953). As a result, residents began to excavate drainage ditches to relieve flooding in many areas of the valley. By 1852, new drains were in place to curtail flooding in Albuquerque and Barelas, while the Los Padillas acequia provided drainage for the southwest valley, below Pajarito (Wozniak 1987:95). The General Land Office map of Albuquerque from early 1881 suggest that many community acequias in the valley had been extended in order to discharge excess water from the system directly into the river.

As the population grew, the periodic flooding in the river valley nevertheless became an increasingly serious problem. These floods destroyed homes, irrigation ditches, crops, and isolated entire settlements for extended periods (Carter 1953). Initially, it appears that individual communities were responsible for constructing their own levees and dikes, independent of public funding (Carter 1953:86–7). In 1884, for example, Alameda built a 5000 ft long levee about 2 mi north of the village to prevent the river from overflowing its banks. Historical records suggest that the Village of Corrales may also have been protected by dikes and levees along the west side of the river (Berry and Lewis 1997:23; Eisendstadt 1990). The construction of dikes and levees continued between 1900 and 1926, and helped prevent the river's channel from shifting (Scurlock 1998:25).

The Middle Rio Grande Conservancy District was established in 1925 to consolidate water management and to alleviate flooding and poor drainage through the construction of dams, levees, drains, and the re-engineering the irrigation system (Wozniak 1987:134). The project began with the construction of drainage ditches in the valley north of Albuquerque (Sargeant and Davis 1986:103). The estros above and below Albuquerque were drained in 1930 (Scurlock 1998:323), and the State Engineer approved a plan to construct six permanent diversion structures in place of the seventy-one diversion structures managed by local communities for irrigation. Most of these MRGCD projects had been completed by 1936 (Wozniak 1987:138).

Severe flooding of the Middle Rio Grande in the spring of 1941 led to the passage of the Flood Control Act of 1941 in which Clinton P. Anderson, New Mexico's State Representative, inserted a clause requiring the Corps of Engineers and Bureau of Reclamation to develop a joint-use plan for the Rio Grande near Albuquerque. It was agreed that the Bureau of Reclamation would study irrigation and water conservation measures, while the Albuquerque District Corps of Engineers would focus on flood control and sediment storage (Welsh 1985:111). The study was delayed by World War II but the Flood Control Act of 1948, which authorized several projects in New Mexico, again called for development of a comprehensive plan for the Rio Grande (Ackerly *et al.* 1997:57; Crawford *et al.* 1993:26; Welsh 1985:115). A memorandum of agreement between the Interior secretary and the Chief of Engineers was signed on July 25, 1947 that defined the areas of responsibility for the Bureau of Reclamation and Corps of Engineers in the Rio Grande basin (Welsh 1985:115; Wozniak 1987:143).

The MRGCD levees were severely eroded by 1950 (Welsh 1985:166) and the Corps and the Bureau of Reclamation began a comprehensive Rio Grande Floodway project in 1951 that built and rehabilitated flood control levees and installed thousands of Kellner jetty-jacks to armor the river banks and maintain the Floodway (Ackerly *et al.* 1997:57–58; Crawford *et al.* 1993:26–27; Scurlock 1998:282, 328, 354; Welsh 1985:166). A major channel modification project to maintain channel capacity was also completed by the Bureau of Reclamation in 1959. Most of the planned and Corps and Bureau of Reclamation projects were completed between 1962 and 1964 (Ackerly *et al.* 1997:57–58; Crawford *et al.* 1993:43; Scurlock 1998:282, 354). With the Rio Grande confined between levees, the width of the river channel had been reduced by half by 1989 (Scurlock 1998:320).

CHAPTER 4

PRE-FIELD RECORDS CHECK AND SURVEY METHODS

Records Check

A pre-field records search of the New Mexico Cultural Resources Information System (NMCRIS) was conducted on August 29, 2008 by Robin Cordero to identify previously recorded sites in the survey parcels. The search found 40 NMCRIS activity numbers for previous archaeological surveys that were performed within the Rio Grande bosque area between Corrales and Isleta (Table 2). Most of these are linear surveys associated with road or utility improvements, irrigation or flood control projects, or recreational trails. Twenty-two previously recorded archaeological sites are located within the bosque in the vicinity of our survey areas. All of these sites date to the historical period and most are relatively recent. A search was also conducted of the National Register of Historic Places, the New Mexico State Register of Cultural Properties and the listing of National Historic Landmarks. That search established that there are no listed properties or landmarks in the immediate vicinity of the project area.

Five previous surveys focused specifically on the Middle Rio Grande Bosque Restoration Project study area. The earliest of these was conducted by Cibola Research Consultants in 2003 and involved the intensive survey of 273 acres between Interstate 40 and Bridge Boulevard (Marshall 2003). This survey resulted in the identification of seven sites: a Territorial period water/flood control structure (LA 138855), remnants of the 1930 Central Avenue bridge (LA 138856), remnants of the 1928 Bridge Boulevard bridge (LA 138857), remnants of the old Atrisco Ditch post-frame diversion structure (LA 138858), the intake area for the pre-1933 Atrisco and Ranchos de Atrisco ditches (LA 138859), a post-1933 irrigation ditch with a headgate/skimmer weir and diversion structures (LA 138860), and remnants of the Albuquerque Old Town bridge on Perea Road (LA 139208).

The second survey was completed by Cibola Research Consultants in 2004 (Walt, Marshall and Musello 2005). This survey of 490 acres along the east bank of the Rio Grande between Bernalillo and Alameda Boulevard resulted in the identification of five historical sites. Those sites are LA 146158, the concrete and post base for a gauging station cable car dating to between 1929 and 1974; LA 146160, a diversion structure for Thompson Ditch dating to between 1922 and 1933; LA 146161, a concrete foundation and a cable car anchor dating to between 1930 and 1960; LA 146162, segments of the post 1912 Rinconada slough and flood control channel; and LA 146163, the post-1912 Corrales Siphon for the Corrales Main Canal.

The third and largest survey of the Middle Rio Grande Bosque Restoration Project study area was an inventory of 1080 acres between Bernalillo and Isleta Pueblo conducted by the Office of Contract Archeology, University of New Mexico between Bernalillo and Isleta Pueblo in 2004 (Estes 2005). This survey recorded seven new sites and re-documented four previously recorded sites. The previously recorded sites were LA 100484, portions of the Los Padillas drain with associated berms and ditches; LA 132552, segments of the Acequia Madre de Corrales; LA 143458, portions of the Albuquerque Acequia Madre, Campbell Ditch, and Candelaria Ditch; LA 118119, portions of the Isleta Lateral. The newly discovered sites included a concrete-lined ditch dating sometime after 1912 (LA 145193); a segment of the Los Duranes Ditch system (LA 145194); a segments of the Griegos/Gallegos Canal (LA 145195); a system of drains and levees, and a culvert valve (LA 145200); an irrigation ditch segment with a concrete gate (LA 145559); a segment of the Los Padillas Acequia/Drain (LA 145560); and a system of internal drains, berms and levees (LA 145561).

Table 2 List of Previous Surveys of the Rio Grande Bosque from Corrales to Isleta Pueblo.

NMCRIS Activity #	Agency	Reference	Report No.
8716	NMSHTD	Koczan 1984	Not Entered
8906	NMSHTD	Koczan 1984	Not Entered
17508	NMSHTD	Taylor 1986	86-76
25509	RAAS	Gossett 1989	Not Entered
31484	UNM/OCA	Binford 1988	185-376
31908	NMSHTD	Marshall, S. 1990	NMSHTD 90-46
35329	NMSHTD	Koczan 1991	91-9
35747	NMSHTD	Marshall, S. 1991	NMSHTD 91-24
36459	UNM/OCA	Schutt 1991	185-439B
36565	NMOCA/MNM-LOA	Seaman 1976	Lab Note 127B
41394	NMSHTD	Nelson 1992	92-76
43442	CRC	Marshall, M. 1992	56
44112	ACE-ABQ	Kneebone 1993	COE-93-6
44711	NMOCA/MNM-OAS	Willmer 1993	93-36
44896	CRC	Marshall, M. 1993	81
45651	CRC	Marshall, M. 1993	76
45673	TRC	Merrill, Evaskovich, Roxlau 1994	1125
49513	CRC	Marshall, M. 1995	133
53844	CRC	Marshall, M. 1996	167
58548	QRC/A	Condie 1995	301
58681	MA	Berry 1997	Not Entered
58872	MA	Berry 1997	Not Entered
61055	PB	Fletcher 1999	131
62161	EMI	Kramer and Wells 1998	Not Entered
64863	SWCA	Not Entered	Not Entered
64946	EMI	Kramer and Wells 1999	**EMI 318**
67106	TRC	Dussinger, Goar, and Acklen 2000	27808
71175	UNM/OCA	McEnany 2002	185-682
80080	TEC	Reycraft, 2002	Not Entered
80108	CRC	Marshall, M. 2002	323
82487	MA	Brown, K. L. and Brown, M. E. 2003	4
82701	CRC	Marshall, M. 2003	345
87583	USACE-AD	Everhart 2004	COE-2004-002
89833	UNM/OCA	Estes 2005	185-839
91077	CRC	Walt, Marshall, M., and Musello 2005	378
92981	TEC	Parker, Gregory, Burrus, and Hurt 2005	600-110
93681	CRC	Marshall, M. and Marshall, C. 2005	383
103390	USACE-AD	Everhart 2007	COE-2007-002
100494	CRC	Marshall, M. and Walt 2006	415
104864	NMSP	Nelson, N. 2007	SP0704

The U.S. Army Corps of Engineers, Albuquerque District surveyed 127.3 acres between I- 40 and the Montano Bridge (Everhart 2004). This survey recorded one site, LA 143458, which is a segment of the Albuquerque Acequia Madre/Campbell Ditch/Candelaria Ditch north of the Montano Bridge that was exposed by a wildfire in the bosque.

The most recent survey was completed by Cibola Research Consultants in 2006 for the North Bosque Wildfire Project. This survey of 220 acres occurred at the northern boundary of Isleta Pueblo south of Interstate 25 (Marshall and Walt 2006). Four sites were documented during the survey: LA 153622, the remnants of a railroad bridge, dike, or causeway; LA 153623, the Atchinson Topeka and Santa Fe Railroad bridge built in 1952 and pylons of an older post-1846 bridge; LA 153624, a post-1880 to 1932 flood control dike; and LA 153625, a post-1952 footbridge across the Atrisco Riverside Drain.

Four of the previously documented sites occur in areas adjacent to the current survey parcels. LA 132552 is located north of Survey Area 12 in Corrales but is separated from it by the outlet for the Harvey Jones Flood Control Canal. LA 145200 is located immediately south of Survey Area 8. The site does not extend into Survey Area 8 but its northernmost levee is visible from the southeast corner of the parcel. LA 145561 abuts the northwest corner of Survey Area 6. This site includes a line of berms, which Estes (2005:71) suggested might extend further to the south. No berms or other features were found in Survey Area 6, however.

The last previously documented site, LA 145559, does extend into Survey Area 2. This site is a ditch segment south of Rio Bravo Boulevard. Estes identified it as an internal drain shown on the 1922 Bureau of Reclamation map (Estes 2005: Figure 34). The drain shown on the map is oriented east-west, however, while the LA 145559 is oriented northeast to southwest. Further, the portion of the ditch segment in Survey Area 2 appears natural rather than man-made. From this evidence, it appears that LA 145559 was misidentified by Estes, and is actually a natural overflow channel.

Survey Methods

For the most part, the eastern and western boundaries of the survey areas were marked by either the Rio Grande or one of the flood control levees. Nevertheless, UTM coordinates describing the boundaries of each of the 16 survey parcels were entered into hand-held Trimble GeoXT and Garmin GPSmap 76C GPS units prior to the survey to ensure that the intended areas were covered. During fieldwork, the survey areas were examined as systematically as possible by professional archaeologists. Standard procedures for surveys is to have crew members walk transects spaced at interval no greater than 15 m (50 ft) to provide even coverage. In this case, however, those procedures had to be modified because of the heavy vegetation cover.

As visibility was often limited, the crew members on each end of the line used the tracklog function of the GPS units to maintain straight transect lines and to keep the crew within the boundaries of the survey area. The crew worked to maintain the transect intervals, using machetes to cut their way through the vegetation. Transects could not be maintained in areas with impenetrable vegetation, however. In these areas, crew members either worked their way around the edge of the thickets or followed existing trails through those areas. Any small clearing encountered by the crews were examined, and transect intervals were re-established when the vegetation thinned sufficiently. High water levels also created access problems in that some parts of the survey areas were either flooded or were inaccessible islands. Most of the inaccessible areas were immediately adjacent to the river channel and they occurred primarily in the Corrales parcels (Survey Areas 11 and 12). All such areas were mapped and are shown as "unsurveyed" on Figures 2-8. The actual acreage surveyed in each survey area is shown in Table 3. Ground visibility was also a fundamental problem. In most vegetated areas, ground visibility rarely exceeded 50% and was often lower. In some areas where some restoration had been initiated, there were large piles of downed trees and other vegetation. In others, the ground was covered with a 5-10 cm thick layer of wood chips.

Table 3 Comparison of Acreage of Survey Parcels and Approximate Area Surveyed due to Inaccessibility.

Parcel #	Total Acres	Acres Surveyed
1	68.39	59.87
2	35.79	30.46
3	9.06	9.06
4	10.43	10.43
5	17.68	17.68
6	15.90	15.90
7	72.82	48.67
8	7.88	7.88
9	2.43	2.43
10	18.24	18.24
11	171.83	91.68
12	77.54	42.38
13	65.45	49.54
14	63.74	63.74
15	26.03	26.03
16	4.49	4.49

Despite these limitations, the survey methods employed represent a reasonable effort to identify cultural properties within the Middle Rio Grande Bosque Restoration Project study area. The cultural properties most likely to occur in the floodplain are remnants of irrigation or flood control structures or bridges, which are identifiable using the survey methods employed. The probability that any prehistoric or historical settlements are present appears low since, until modern flood control measures were implemented, most of the areas surveyed were periodically inundated by seasonal floods. Sites resulting from more ephemeral activities might be present but probably have been buried as the river channel aggraded over the past century. Given the localized impacts resulting from the bosque restoration, the level of subsurface testing needed to identify such sites is not warranted.

As stipulated by the USACE in the scope of work for this project, no cultural materials less than 50 years were recorded during the survey, and single undateable features and scatters of fewer than nine artifacts within a 10 m radius were recorded as isolated occurrences (IOs). When a site was found, a semi-permanent datum – a rebar stake with an aluminum cap stamped with the site's field number (OCA 996-1...996-n) – was set in place to aid in relocation. A detailed narrative description of the site was then prepared using Laboratory of Anthropology Site Records forms. To supplement the narrative description, photographs were taken of the general site using a Nikon CoolPix P2 digital camera. Given the dense undergrowth, the sites were mapped using a GPS unit with coordinates recorded in UTM NAD 27 to maintain compatibility with the USGS 7.5 min quadrangle. A schematic of the site was also drafted for use in conjunction with the GPS map. All recorded sites were ditch segments, none of which had associated artifacts or other features. The site boundaries were therefore defined as the length and width of the ditch segment.

CHAPTER 5

RESULTS OF THE SURVEY

Five sites were recorded during the survey, all of which are segments of irrigation ditches or drains. Four of the sites were recorded in the three northernmost survey parcels (Survey Areas 10, 11, and 12), all of which are in the Corrales area. The fifth site was found in the southernmost parcel (Survey Area 14) near Isleta.

LA 160891 (OCA 996-1)

LA 160891 is a segment of an abandoned irrigation ditch or drain. It does not appear on 1922 Bureau of Reclamation maps of the "Middle Rio Grande Project-New Mexico, White Rock to San Marcial" (Sheet 9). The ditch is located on the floodplain in Survey Area 12, which is heavily overgrown with vegetation (Figure 9).

The V-shaped ditch segment is 114.1 m long and runs roughly west-northwest to east-southeast (292° mag N; Figure 10). The ditch and its embankments measure 7.4 m across. The ditch about 1.2 m deep measured from the top of the embankments to the bottom of the channel. Spoils piles/berms rise approximately 20 cm above the modern ground surface on either side of the ditch. The east end of the ditch terminates abruptly at the Rio Grande cut bank while the west end is truncated at the modern levee.

Given its location and orientation, the ditch may be an abandoned branch off the Sandoval Lateral. Any connection to that lateral was truncated by the construction of the levee and Upper Corrales Riverside Drain in the 1930s (Scurlock 1998: 281, 316). The site and its boundaries are defined solely by the ditch. There are no associated artifacts or additional features.

LA 160892 (OCA 996-2)

LA 160892 consists of an irrigation ditch or drain segment in Survey Area 11 that does not appear on 1922 Bureau of Reclamation maps of the "Middle Rio Grande Project-New Mexico, White Rock to San Marcial" (Sheet 9). It is located within the Corrales bosque, which has become heavily overgrown with dense vegetation rendering large sections of this acequia inaccessible (Figure 11).

The ditch segment is 281.5 m long and runs roughly east-west. (Figure 12). It measures up to 9.6 m across and is roughly 0.6-1.0 m deep. In several areas, the ditch has been partially filled with natural debris and sediments. There is a 20 cm high berm on either side of the ditch, though in areas where infilling has occurred, this berm is entirely absent and is replaced by a shallow cut bank. This site and its boundaries are defined solely by the ditch segment. There are no associated artifacts or features.

LA 160893 (OCA 996-3)

LA 160893 is located in a heavily vegetated part of Survey Area 11. It consists solely of a short ditch segment on the west bank of the Rio Grande that empties into a large, shallow swale (Figure 13). There are no artifacts or other associated features. No acequias are shown at this location on the 1922 Bureau of Reclamation maps of the "Middle Rio Grande Project-New Mexico, White Rock to San Marcial" (Sheet 10).

Figure 9 GIS map of LA 160891 (OCA 996-1).

The ditch segment is about 32.9 m long and is oriented roughly northwest to southeast. It is 3.4 m wide and 0.4 m deep with a 20 cm high berm on either side. The bottom of the ditch is partly filled with sediments and detritus. The northeastern end of the ditch segment terminates abruptly at a line of jetty

Figure 10 LA 160891, view of abandoned ditch segment looking northwest.

jacks (Figure 14). At the southeastern end, it empties into a large, shallow swale measuring 4.7 m across and 20 cm or more deep. The swale is oriented approximately east-northeast to west-southwest. It extends about 56.8 m to the southwest of the ditch segment, toward the Rio Grande. A heavily used walking/equestrian trail enters the swale immediately north of the ditch segment and appears to follow the swale to the northeast. The swale itself can be traced for about 50 m before becoming too indistinct to be accurately defined. Given its orientation, however, the swale may be an extension of the ditch segment identified as LA 160892.

LA 160894 (OCA 996-4)

LA 160894 is an acequia segment along the east bank of the Rio Grande in Survey Area 10 (Figure 15). This segment does not appear on the 1922 Bureau of Reclamation maps of the "Middle Rio Grande Project-New Mexico, White Rock to San Marcial" (Sheet 10). There is a high water channel that roughly parallels the ditch segment approximately 5–10 m to the north. The surrounding area appears to have undergone restoration as most of the overstory is cleared and invasive species are generally absent or greatly diminished. The understory in this area was very dense, however precluding a direct line of site of this feature in most areas (Figure 16).

Figure 11 LA 160892, view of abandoned ditch segment looking east.

This ditch segment is approximately 169.4 m long and oriented roughly northeast to southwest. At its northeastern end, the ditch terminates at the high water channel, which indicates that the segment is probably the head of an irrigation ditch. The southwest end terminates at the jetty jacks indicating the lower part of the ditch was obliterated during installation of the jetty jacks as well as construction of the Albuquerque Riverside Drain and levee. The ditch segment is 4.15 m wide and up to 60cm deep. A berm is present on either side of the ditch. The southern berm is about 10 cm high with a steep slope extending into the acequia, while the northern berm is noticeably eroded and, in some sections, not visible. The base of the acequia is level indicating substantial infilling has occurred. There are no other features or associated artifacts, so the site boundaries were defined only to encompass the ditch segment itself.

LA 160895 (OCA 996-5)

LA 160985 consists of segments of two parallel ditches on the west flood bank of the Rio Grande in Survey Area 14 (Figure 17). These segments do not appear on the 1922 Bureau of Reclamation maps of the "Middle Rio Grande Project-New Mexico, White Rock to San Marcial" (Sheet 14). The bosque surrounding the site had burned recently resulting in a minimal overstory, large numbers of downed cottonwoods, and very dense understory of Russian thistle and other weeds. In most areas, this understory was over 2 m high. In addition, there is extensive ground disturbance in the immediate vicinity of the site in the form of bulldozer push piles and scrapes, large depressions, and linear excavations.

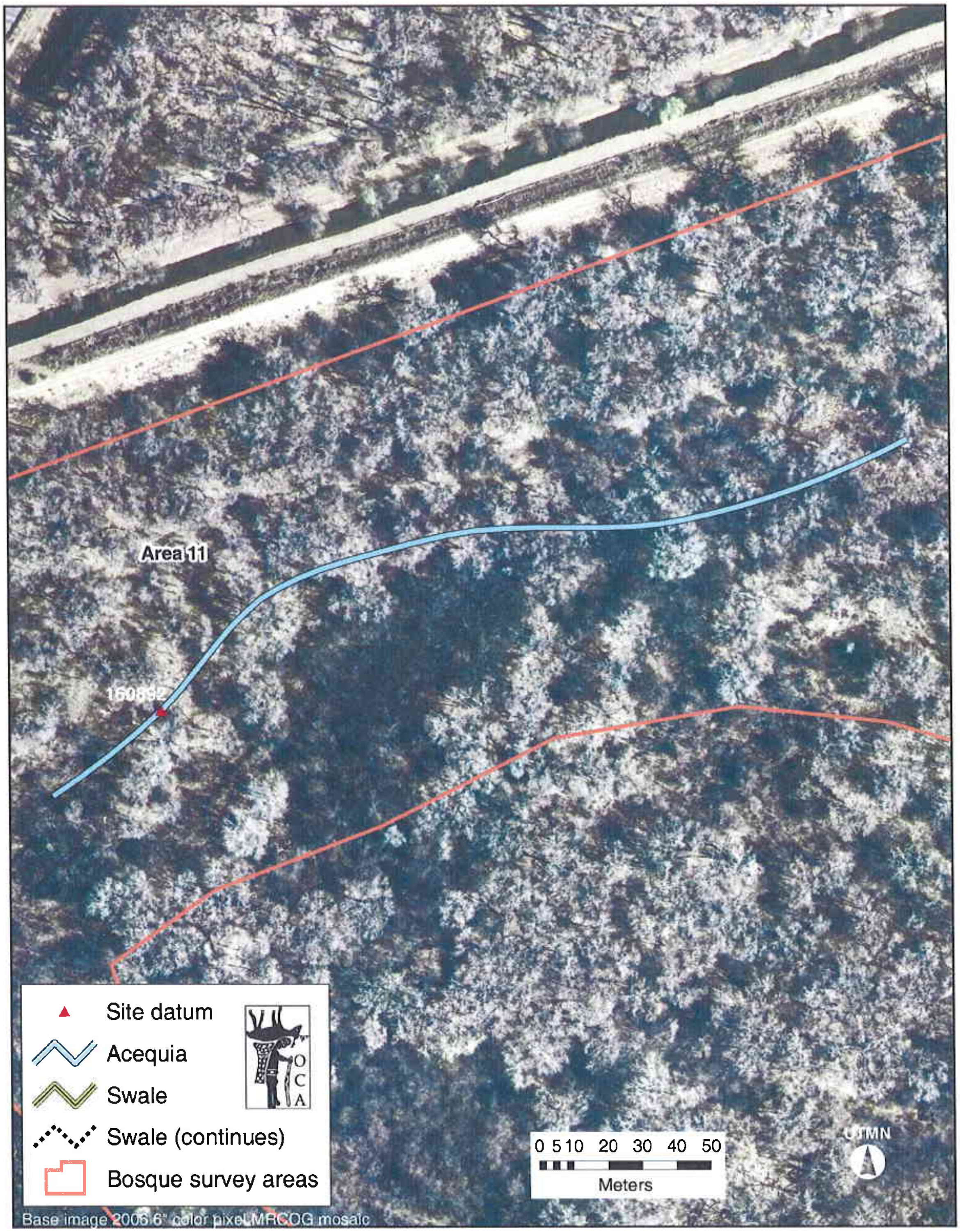

Figure 12 LA 160892 (OCA 996-2) Site Map.

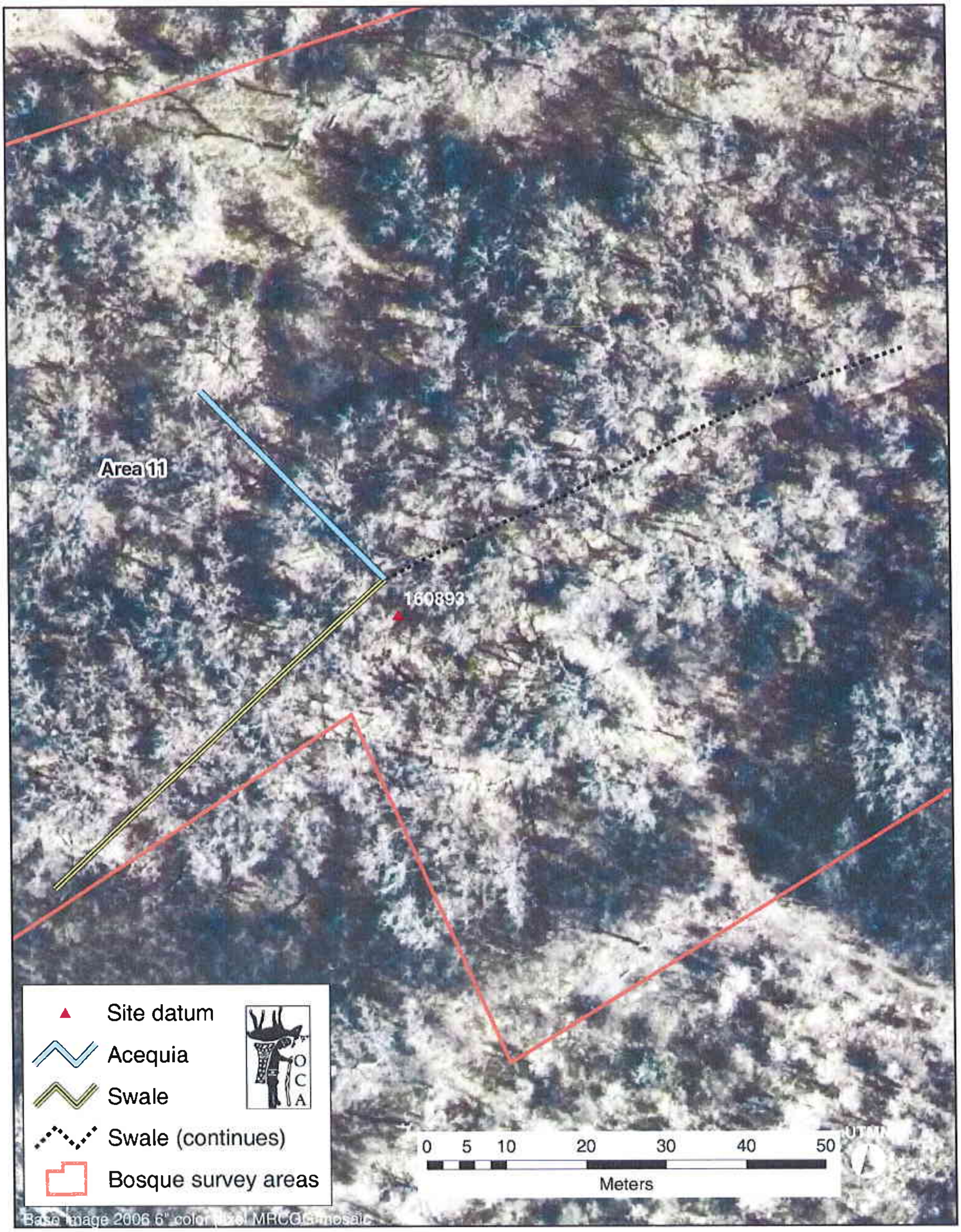

Figure 13 LA 160983 (OCA 996-3) Site Map.

Figure 14 Intact ditch segment from LA 160893 looking southeast.

This site comprises what appear to be two parallel ditch segments spaced about 7 m apart and running east to west (Figure 18). At their western end, the segments terminate at the levee. At the eastern end, they terminate in an extensive area of heavy equipment disturbance, possibly associated with the recent bosque fires. The northern ditch segment is 97.9 m long and an average of 8.5 m wide and 0.95 m deep. The southern ditch segment is 45.6 m long, and averages 7.8 m wide and 0.7 m deep. The bases of both ditches are level indicating they have been partially in-filled with sediments. Both ditches are heavily overgrown with Russian thistle rendering detailed documentation difficult. No associated artifacts or features were noted during the survey.

Given the degree of heavy equipment disturbance in this area, a recent origin for the ditch segments cannot be discounted. While it is possible that the segments are remnants of divergent acequia channels, they could also be trenches associated with firefighting activities. The extremely dense undergrowth covering the site did not allow the detailed observations needed to distinguish between these alternative interpretations.

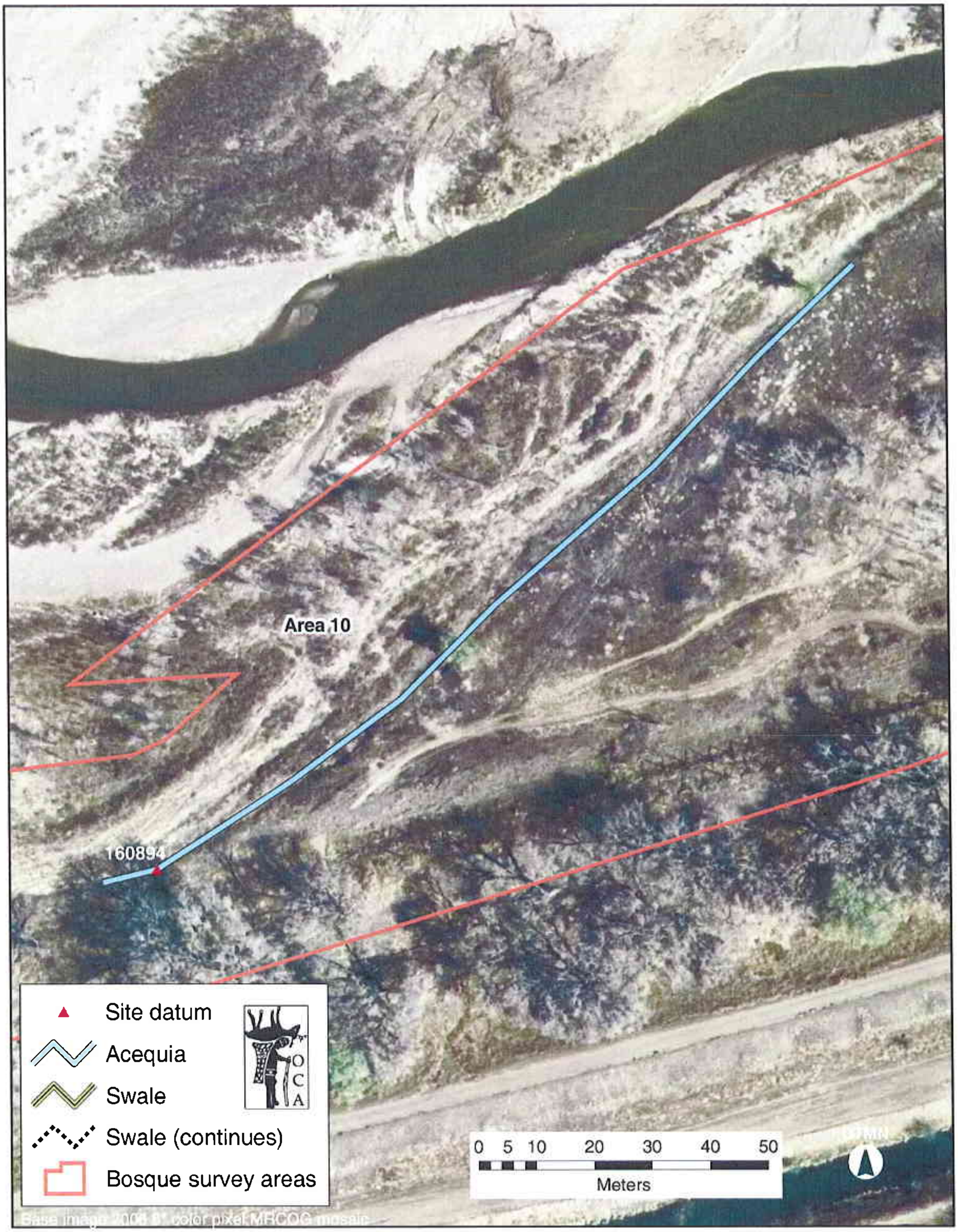

Figure 15 Intact ditch segment at LA 160894 (OCA 996-4).

Figure 16 Southwest portion of the LA 160894 ditch segment looking southwest.

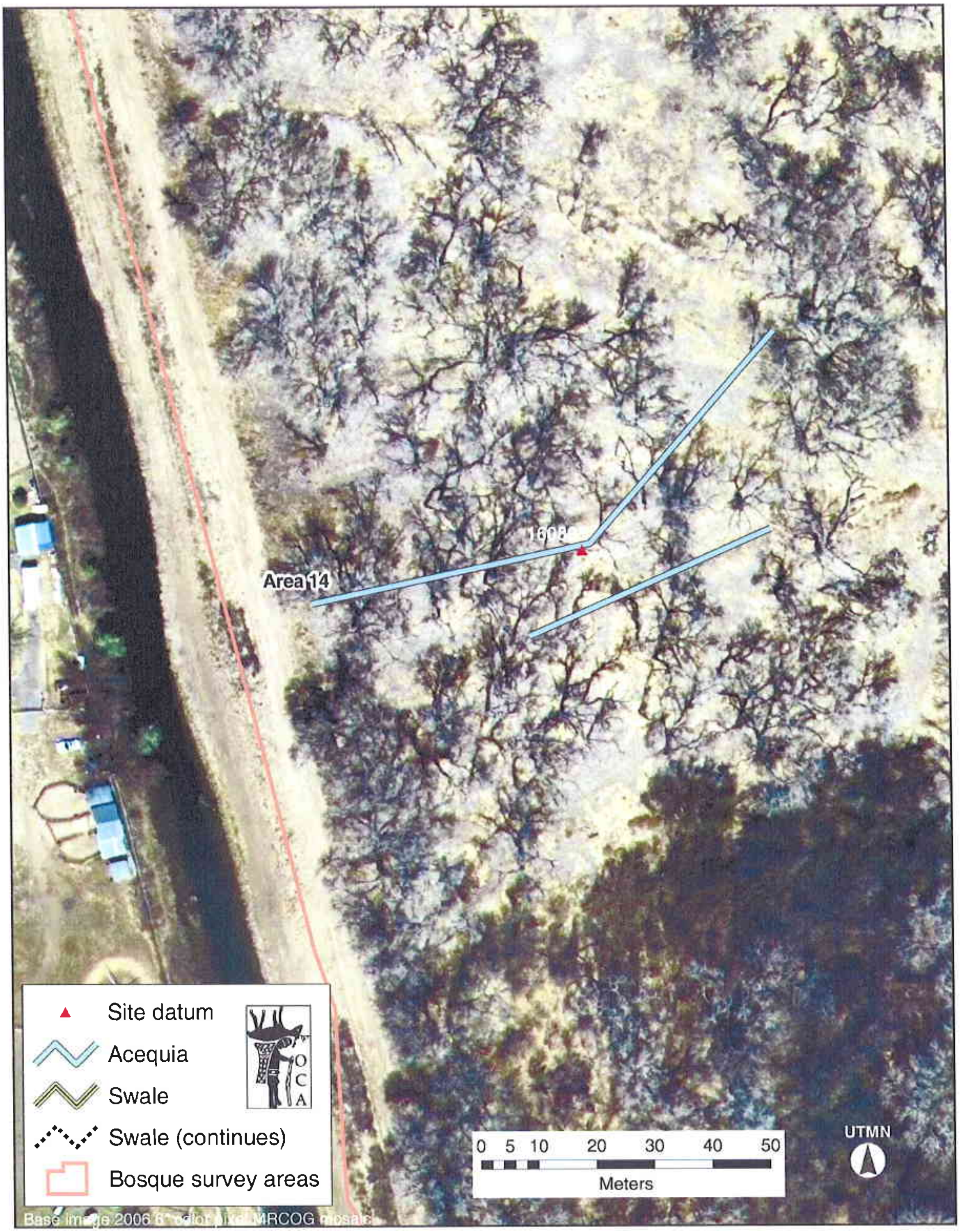

Figure 17 Site map for LA 160895 (OCA 996-5).

Figure 18 Overview of the north ditch segment at LA 160895 from berm separating the two possible acequias, looking north-northeast.

CHAPTER 6

SUMMARY AND MANAGEMENT RECOMMENDATIONS

Five sites were documented during the survey of 16 scattered parcels in the Middle Rio Grande Bosque Restoration Project study area, all of which are abandoned ditch segments. Four of the sites are located in the vicinity of Corrales: LA 160891 in Survey Area 12, LA 160892 and LA 160893 in Survey Area 11, and LA 160894 in Survey Area 10. The fifth site, LA 160895, was found in Survey Area 14 near Isleta. No isolated occurrences were observed during the survey.

Interpretation

None of the ditch segments have associated features such as gates or diversion structures, so their age and specific functions are uncertain. None of the sites correspond to acequias shown on the 1922 Bureau of Reclamation "Middle Rio Grande Project-New Mexico, White Rock to San Marcial" map series. These maps identify only the major acequias, however, and rarely present contre acequias (cross ditches) and the smaller individual field ditches. It is therefore possible that the shallow ditch segments documented as LA160891, LA160892, LA160893 and LA160894 are remnants of secondary or tertiary ditch systems extending from the acequia madre. In the case of LA160891 and LA160893, their orientations and proximity to major laterals indicates possible associations with those acequias.

Alternatively, these four sites could be segments of internal drains used for flood control within the Rio Grande floodplain. At two of the sites, LA160893 and 160894, the ditch segments appear to integrate or parallel existing channels. In describing similar sites, Estes (2005:75) noted that such drainage ditches often represent "local efforts to control flooding or improve drainage in Barelas and the Pajarito/Los Padillas communities." The ditch segments in Survey Areas 10, 11, and 12 could represent similar local efforts by communities in the Corrales area.

The fifth site, LA160895, is a possible bifurcated acequia/drain segment similar to one documented at LA145560 (Estes 2005:63–69). At LA 145560, however, the ditches parallel the Atrisco Riverside Drain while those at LA160895 runs perpendicular to the drain. It is also possible that the ditch segments at LA160895 are recent trenches, possibly related to recent firefighting or reclamation activities.

Eligibility Recommendations

As already noted, the age of the documented ditch segments is uncertain. LA 160891 and possibly LA 160895 were truncated by levees built by the MRGCD during the 1930s, which provides a minimum age for these ditch segments. The ditch segments at LA 160893 and LA 160894 are cut by lines of jetty jacks. These structures were emplaced during the 1930s and during the 1950s and 1960s, which indicates that these segments were also in use during the early twentieth century. This minimum age would also apply to LA 160892 since it appears linked to LA 160893. Most acequia systems in the valley date to the Spanish Colonial period, which is a reasonable maximum age for the sites.

If the sites are associated with one of the historical acequias, then they are potentially eligible for nomination to the National Register of Historic Places under criterion *a* of 36 CFR 60.4 in that they are associated with events that have made a significant contribution to the broad patterns of our history. The association of these ditch segments with a particular acequia system cannot be established with the information available, however. Further, the properties do not appear to have sufficient integrity to convey their significance. The ditch segments have been isolated from the rest of the acequia system and, while they retain integrity of location, the floodplain environment in the vicinity of the sites has been so extensively modified that they no longer have integrity of setting, feeling, or association.

The sites also have limited information potential. Most of the basic data obtainable from the ditch segments – location, orientation, and dimensions – were collected during the survey, and additional fieldwork is unlikely to yield significant new information. Any additional research would be more profitably directed toward a review of historical records, maps, and oral history data relating to irrigation systems in the study area. That research, in conjunction with the basic information already obtained from the sites, may allow us to determine if the ditch segments were associated with particular acequia systems. Consequently, the sites do not appear to meet the criteria for eligibility under criterion *d* of 36 CFR 60.4. It is therefore recommended that LA 160891, LA 160892, LA 160893, LA 160894, and LA 160895 be deemed *not eligible* for nomination to the National Register of Historic Places.

Potential Effects to Cultural Resources

The bosque restoration plan calls for thinning areas with non-native vegetation and high fuel loads; the removal of jetty jacks and downed vegetation; improvements to levee roads and drain crossings; and construction of turnabouts to improve access for firefighters. The thinned and burned areas will also be replanted with native species. Thinning will be done using both manual and mechanical methods. With manual thinning, chainsaws and other hand tools are used to remove non-native species and other vegetation, and to cut the debris into manageable pieces. Larger pieces are then hauled away for potential use as firewood and smaller pieces are put into a wood chipper on site. Wood chips will be tilled into the surface sediments, leaving no more than 2 in of ground cover. Excess wood chips will be hauled away. Large stumps will be treated with an herbicide or ripped out by mechanical methods, such as a tree shear or other large machinery. In most areas, a combination of manual and mechanical methods will be employed. In environmentally sensitive areas, the procedures are modified to complete the restoration tasks while remaining attentive to the special needs of the area (USACE 2004).

Re-vegetation with native grasses, shrubs, and trees will occur at various times of year depending on the plant type. In some cases, the area will be disked prior to planting if there are excessive amounts of wood chipping or other thinning debris. In some areas, soil depressions will be constructed to hold moisture and aid in the re-vegetation process. Native plants replanted in the bosque will include New Mexico olive, golden current, indigo bush, black willow, Rio Grande cottonwood, peach-leaf willow, and coyote willow (USACE 2004).

Jetty jacks presented a major obstacle to accessing areas during past wildfires. Jetty jacks along the bank lines will remain as they are fulfilling their purpose in stabilizing the riverbank and preventing erosion. Most of the remaining jetty jacks will be removed. Mechanical equipment will be used to remove and transport those structures, which will cause ground disturbance both in the immediate vicinity of the jetty jacks and along the transport routes.

Improved access to the area will also require general maintenance to the levees, nearby roads and drainage crossings. Too few bridges were in place over the riverside drains, causing major access issues for emergency vehicles during the wildfires. In addition, the few bridges that were in place were too small and required too sharp of a turn to accommodate large fire trucks and other emergency vehicles. Three emergency bridges have been built and nine more are planned. In certain areas turnabouts will also be created to accommodate larger vehicles (USACE 2004).

Given these activities, the major potential effects on cultural resources in the project area are those associated with ground disturbance activities. The most severe impacts are likely to result from the use of heavy equipment to thin vegetation and remove jetty jacks, and from the construction of bridges, turnabouts, and soil depressions. Lesser impacts are likely to result from the use of heavy equipment to transport jetty jacks or vegetation debris and from disking areas before re-vegetation. Any of these activities could potentially damage or destroy historic properties within the area of ground disturbance.

Management Recommendations

Based on the results of this survey, restoration activities in Survey Areas 3, 4, 5, 6, 8, 9, 15, and 16 will have no effect on cultural resources. All of these areas were completely surveyed and no sites were found. Survey Areas 10 and 14 were also completely surveyed and one site was found in each of those areas. As neither of the sites appears eligible for nomination to the National Register of Historic Places, restoration activities in these parcels will not affect any register-eligible historic properties.

No cultural resources were found in Survey Areas 1, 2, 7, and 13 but parts of those parcels remain unsurveyed. It is recommended that restoration activities in the unsurveyed areas be monitored or limited to manual methods to minimize the impacts to any cultural resources that might be present. Finally, Survey Areas 11 and 12 have both documented sites and areas that could not be surveyed. None of the three sites in these areas appear eligible for nomination to the National Register of Historic Places, so no protective measures are required. However, restoration activities in the unsurveyed portions of these parcels should be monitored or limited to manual methods to minimize impacts to any additional cultural resources that might be present.

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APPENDIX F
404 (B) (1) ANALYSIS

Section 404 (b) (1) Evaluation – Middle Rio Grande Bosque Restoration Project

I. Project Description

The Proposed Action would includes 916 acres of the bosque that would be restored by enhancing hydrologic function (by constructing wet features such as high-flow channels, willow swales, and wetlands) and restoring native vegetation and habitat by removing jetty jacks, exotic species/fuel reduction, and riparian gallery forest restoration.

a. Location

The Proposed Action Area includes the bosque within Albuquerque was designated as the *Rio Grande Valley State Park* through the Park Act of 1983 and is cooperatively managed by the City of Albuquerque, Open Space Division (OSD) and the MRGCD. That is, the bosque is offered protection as a State Park but without state operating funds and is administered by OSD and MRGCD through formal agreements.

The Proposed Action Area also includes the bosque within Corrales which is designated as the *Corrales Bosque Preserve* and is cooperatively managed by the Village of Corrales and the Corrales Bosque Commission through an agreement with the MRGCD. Pueblo of Sandia lands are also within the Proposed Action Area and those lands are managed by the Pueblo.

The Northern extent of the Corrales Bosque Preserve forms the north boundary of the Proposed Action Area, while the southern boundary is formed by the northern limits of the Pueblo of Isleta. The east and west boundaries of the Proposed Action Area are the easements of the *Facilities of the Middle Rio Grande Floodway Project* which include the levees, riverside drain, and an easement area between the drain and private property. The levees are between the bosque and riverside drain. The Proposed Action Area is approximately 26 miles in length along the river and roughly 5,300 acres in size.

b. General Description

See above.

c. Authority and Purpose

Authorization

The U.S. Army Corps of Engineers, Albuquerque District (Corps), in cooperation with the Middle Rio Grande Conservancy District (MRGCD) as the local sponsor and other stakeholders, is proposing an ecosystem restoration project in the Middle Rio Grande Bosque (bosque) within the Albuquerque reach, specifically from the Pueblo of Sandia on the north boundary to the Pueblo of Isleta on the south boundary. "Bosque" is a Spanish word that is used traditionally in the southwest to refer to a wooded riparian area.

The authority for this Proposed Action was derived from a series of Congressional actions authorizing projects on the Rio Grande, particularly in the Middle Rio Grande (MRG). These authorizations began with the basic flood control authorization for the Middle Rio Grande Public Law No. 228, 77th Congress, 1st Session, H.R. 4911 dated 18

August 1941. House of Representatives Resolution, dated 11 April 1974 requested a study of environmental enhancement on the Rio Grande.

The area is maintained as a part of the Middle Rio Grande Flood Control Acts of 1941 and 1950 and is within the *Facilities of the Middle Rio Grande Floodway Project* which resulted in the construction of additional levees and dams between Espanola and San Marcial, NM (USACE 2002, 2003a, 2007, 2008a,b). Section 401 of the Water Resources Development Act of 1986 (Public Law 99-662) dated 17 November 1986, authorized the Middle Rio Grande Flood Control Project from Bernalillo to Belen, New Mexico, Albuquerque Levees (PL 80-858), Cochiti Dam (PL 86-645), and Jemez Dam (PL 80-858). Additional authorization is contained in House of Representatives Resolution 107-258, 2002. This authorization provides funds to evaluate environmental restoration including recreational components.

In response to the study authorities, a Reconnaissance study was initiated in March 2002. The results and conclusions of the reconnaissance phase were presented in Middle Rio Grande Bosque Restoration Section 905(b) Analysis, U.S. Army Corps of Engineers, Albuquerque District, June 2002. The recommendation of that report was that there was a Federal interest in proceeding to feasibility phase of the General Investigation. A Feasibility Cost Sharing Agreement was signed between the MRGCD, as the non-Federal Sponsor, and the Corps, that initiated the feasibility phase of the study in the fall of 2004.

Purpose and Need

On a regional scale, estimates of riparian habitat loss in the Southwest range from 40% to 90% (Dahl 1990), and desert riparian habitats are considered to be one of this region's most endangered ecosystems (Minckley and Brown 1994, Noss et al. 1995). Decline of natural riparian structure and function of the bosque ecosystem was recognized in the 1980s as a major ecological change in the MRG (Hink and Ohmart 1984; Howe and Knopf, 1991). In ecological terms, the cumulative effects of agriculture, urban development and flood protection measures initiated over the last seven decades have resulted in a disruption of the original hydrologic (hydraulic) regime along the Albuquerque reach of the MRG and the ultimate degradation of the bosque ecosystem. This regime is key to sustaining and regenerating a variety of ecological components that make up the bosque, and the wildlife that it supports. Whereas it is not possible to return the MRG to its pre-flood protection state, there are abundant opportunities to restore function and habitat value within the constraints of current water use restrictions and without imposing flood damages.

The mosaic or patchy distribution of habitats that once made up the bosque has changed dramatically since the 17th Century (Pittenger 2003, Scurlock 1998). With changes in land use and settlement, the size and composition of various patches within the bosque have also changed (Scurlock 1998). The existence in recent decades of a continuous bosque forest between the river and the levee appears to be unprecedented. Many bosque researchers and commentators now believe that historically the bosque was a dynamic mosaic of riparian wetlands, channels, woodlands, shrub thickets and periodically wet meadows (Pittenger 2003, Crawford et al. 1998). Frequency of flooding, water table elevation and the type of sediment substrate were and continue to be important determining factors of patch type and structure. Though the manmade flood control structures that now regulate the river and bosque, for the most part, must stay in place, one of the main goals of this Proposed Action is to look for alternatives to reconnect the bosque and river floodplain.

Another problem that is now in existence is the presence (and in many cases dominance) by non-native vegetation. It is most likely not possible to totally eradicate all non-native vegetation within the 26 miles/5,300 acres of the bosque. Therefore, another purpose for this Proposed Action is to look at integrating the non-native with native species to an acceptable level.

The hydrologic cycle in the MRG (delineated as Cochiti Lake to Elephant Butte Lake) is critical to the function of the bosque cottonwood riparian communities and wetlands. It follows a pattern of high flows during spring snowmelt runoff and low flows during the fall and winter months. Additional high flows of short duration result from thunderstorms that occur in the late summer months. The high flows across the floodplain facilitated nutrient cycling, seed dispersal and seed establishment. The inundation and high water table recharged wetlands and provided for seasonal growth and nurturing of existing plant communities.

Much of this inundation has been reduced by the disconnection between the river and floodplain due to installation of flood control devices. This also created the loss of high-flow and side channels in the system. This ‘reconnection of function’ can be obtained, however, through restoration features such as the development of high flow channels, backwater channels and other features that connect the bosque and the main channel. These potential features will be further discussed below.

Based on the hydrologic and ecological problems discussed above, a number of key purpose and needs of the Proposed Action were developed and include:

1. Improve habitat quality and increase the amount of native bosque communities while creating greater stand diversity in terms of stand age, size and composition within the bosque (a mosaic).
2. Promote bosque habitat heterogeneity by recreating pockets of new cottonwood, willow and other native species throughout Proposed Action Area where root zones reach the shallow water table.
3. Implement measures to reestablish fluvial processes in the bosque, including removal of non-functional jetty jacks, bank destabilization, promote overbank flooding and high-flow/side channel creation.
4. Create new wetland habitat while extending and enhancing quality aquatic habitat in existing wetlands.
5. Reduce the fire hazard in the bosque through the reduction of fuel loads and exotic species identified as hazardous.
6. Recreate hydraulic connections between the bosque and the river consistent with operational constraints.

7. Protect, extend and enhance areas of potential habitat for listed species within the existing bosque.
8. Develop and implement a long-term operations and maintenance plan, which incorporates long-term monitoring of proposed restoration features.
9. Coordinate and integrate project implementation and monitoring with other, ongoing restoration and research efforts in the bosque.
10. Create opportunities for educational or interpretive features, while integrating recreational features that are compatible with ecosystem integrity.
11. Continue to engage the public in the restoration of the bosque ecosystem by garnering input and involvement.

d. <u>General Description of Dredged or Fill Material</u>

During construction of the proposed high flow channels, a temporary diversion structure may need to be placed at the bank of the Rio Grande, which is a water of the United States. Rehabilitation work is also proposed to take place within the San Antonio Oxbow, a 54 acre wetland within the Proposed Action Area. Work within this area is proposed to reconnect flowing water areas and recreate open water areas. Certain areas would be dredged in order to accomplish this.

(1) General Characteristics of Material (grain size, soil type)

Soils along the bank of the river are fine-grained alluvial silts, sands, and gravels. Soils derived from these deposits in the Study Area are Torrifluvents, Calciorthids and Torriorthents (Soil Conservation Service 1974). Grain size is therefore very small.

Soils within the San Antonio Oxbow are wetland soils and contain larger clayey material.

(2) Quantity of Material (cu. yds.)

The approximate quantify of material to be removed is approximately 19,025 cubic yards from each high-flow channel and the San Antonio Oxbow. This material would be removed and used within the site to build up berms along the channel or other features (such as the outfall channel habitat) but some of this dredged material would be hauled off site.

(3) Source of Material

No material would be placed during the construction of this project.

e. <u>Description of the Proposed Discharge Site(s)</u>

No material would be discharged during construction of this project.

(1) Location (map)
(2) Size (acres)
(3) Type of Site (confined, unconfined, open water)
(4) Type(s) of Habitat
(5) Timing and Duration of Discharge

f. <u>Description of Disposal Method (hydraulic, drag line, etc.)</u>

This material would be removed and used within the site to build up berms along the channel or other features (such as the outfall channel habitat) but none of this dredged material would be placed. If excess material exists, it would be hauled off site and deposited at an approved location.

II. Factual Determination

There would be short-term effects on waters of the United States during dredging of the inlet and outlet of the high flow channels and dredging within the San Antonio Oxbow. If needed, a coffer dam would be placed at the bank edge and pushed out into the water to create a 'work zone' during construction of the inlet and outlet of the high-flow channels. Sediment dredged within this area would be removed as described in Section f and would not be allowed to discharge or be placed in the river.

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope – Substrate elevation is in line with the bank of the river and a steep slope exists. This would be modified to allow a connection of the existing high flow channel to the river.

(2) Sediment Type – Sediments are those described in d.(1) as well as in river sediments consisting of organic and inorganic solid materials.

(3) Dredged/Fill Material Movement - Movement of dredged material would be limited by the methodology of removal as well as the installation of the coffer dam where needed. Material from the San Antonio Oxbow would be removed by an excavator and placed directly into a dump truck to be used on site (outside of the river) or hauled off site.

(4) Physical Effects on Benthos (burial, changes in sediment type, etc.) – Benthos would be affected during dredging of the material at the bank of the river and within the San Antonio Oxbow (Oxbow).

(5) Other Effects – Fish may also be affected by the dredging. The installation of the coffer dam will assist in minimizing effects to fish.

(6) Actions Taken to Minimize Impacts –
- If a disposal site is needed (other than on site outside of the river), a site that has been previously used for dredged material would be utilized.
- As described above, a coffer dam would be placed in the river and dewatered (if needed) in order to create a work zone.
- Work area would be monitored for fish or invertebrates present. If any are found, they would be placed back into the river or Oxbow proper.
- Construction of the diversion structures (coffer dam or other) would be performed during low-flow conditions outside of the spring runoff and summer thunderstorm seasons.

- Sediment and erosion controls would be used to prevent bank and streambed erosion if storm evens occur during the construction period and before stream banks are permanently stabilized.

b. Water Circulation, Fluctuation and Salinity Determinations

There would be minimal impact to the water within the main channel of the river since the coffer dam would be installed at the edge of the bank for the work zone. There would also be minimal impact to the water within the San Antonio Oxbow since the majority of the proposed work areas are dry.

(1) Water – There would minimal, short-term effects to water quality during the installation and removal of the coffer dam for high-flow channel construction and when working within wet areas of the Oxbow. Water quality would be monitored before, during and after installation and removal of coffer dams and during construction within the Oxbow in order to determine any major changes in the following:

(a) Salinity – No change in salinity is expected.

(b) Water Chemistry (Ph, etc.) – Ph and dissolved oxygen may change slightly due to this action.

(c) Clarity – Clarity would be affected during and after installation and removal of the coffer dam and during construction within the Oxbow.

(d) Color – Color would be affected during and after installation and removal of the coffer dam and during construction within the Oxbow.

(e) Odor – There may be an additional odor due to the excavation of river and/or wetland sediments.

(f) Taste – Taste of water may be more silty due to this action.

(g) Dissolved Gas Levels – DO levels may drop during and after installation and removal of the coffer dam and potentially during construction within the Oxbow.

(h) Nutrients – Nutrient levels may change during and after installation and removal of the coffer dam and during construction within the Oxbow.

(i) Eutrophication – Eutrophication may be affected during and after installation and removal of the coffer dam and during construction within the Oxbow.

(j) Others as Appropriate

(2) Current Patterns and Circulation - Current patterns of flow and circulation would be affected during and after installation and removal of the coffer dam and during construction within the Oxbow as follows:

(a) Current Patterns and Flow – Patterns and flow at the bank edge would be disturbed during and after installation and removal of the coffer dam. Current flow patterns of the main flow of the Oxbow may be diverted when installing a culvert under the berm to allow water to flow into dry areas.

(b) Velocity – Velocity would be slightly affected during and after installation and removal of the coffer dam. Since the coffer dam would be fairly small in size, water would be diverted around it. Velocity of the main flow of the Oxbow may also be affected when it is diverted.

(c) Stratification – Stratification may be affected as the water column is stirred up during and after installation and removal of the coffer dam and during construction within the Oxbow.
(d) Hydrologic Regime – Hydrologic regime would be fairly unaffected.
(3) Normal Water Level Fluctuations (tides, river stage, etc.) - Normal water level would not be affected.
(4) Salinity Gradients – NA.

(5) Actions That Will be taken to minimize impacts:

- Water quality would be monitored before, during and after construction in order to determine any major changes in water chemistry.
- Care would be taken to minimize effects on water quality and flow during installation of the coffer dam and during construction within the Oxbow by pushing the water column out from the edge of the bank slowly.
- Construction of the diversion structures and construction within the Oxbow (coffer dam or other) would be performed during low-flow conditions outside of the spring runoff and summer thunderstorm seasons.
- Sediment and erosion controls would be used to prevent bank and streambed erosion if storm evens occur during the construction period and before stream banks are permanently stabilized.

c. <u>Suspended Particulate/Turbidity Determinations</u>

(1) Expected changes in suspended particulates and turbidity levels in vicinity of disposal site – Suspended particulates and turbidity levels would increase during and after installation and removal of the coffer dam and during construction within the Oxbow.

(2) Effects – There would be minimal short-term effects to suspended particulates and turbidity during and after installation and removal of the coffer dam and during construction within the Oxbow.

(a) Light Penetration – Light penetration would be affected for a short period of time during and after installation and removal of the coffer dam and during construction within the Oxbow.

(b) Dissolved Oxygen – Dissolved oxygen (DO) may drop during and after installation and removal of the coffer dam and during construction within the Oxbow. DO would be monitored during and after installation and removal of the coffer dam and during construction within the Oxbow.

(c) Toxic Metals and Organics – Toxic metals and organics are not anticipated to occur due to construction.

(d) Pathogens – Pathogens are not anticipated to be found due to construction.

(e) Aesthetics – Aesthetics would be altered for a short time during construction.

(f) Others as Appropriate

(3) Effects on Biota – Macroinvertebrates, microinvertebrates, amphibious and/or fish species may be affected by these short term impacts to water quality based on suspended particulates and/or turbidity. Since this impact would be limited to a short period of time during and after installation and removal of the coffer dam, and during construction within the Oxbow, the following factors should not be affected:
(a) Primary Production, Photosynthesis
(b) Suspension/Filter Feeders
(c) Sight Feeders

(4) Actions taken to minimize impacts:

- Care would be taken to minimize effects on suspended particulates and turbidity in the water during installation of the coffer dam and during construction within the Oxbow by pushing the water column out from the edge of the bank slowly.
- This area would be monitored for amphibians, fish or invertebrates present. If any are found, they would be placed back into the river or Oxbow proper.
- Construction of the diversion structures (coffer dam or other) and during construction within the Oxbow would be performed during low-flow conditions outside of the spring runoff and summer thunderstorm seasons.
- Sediment and erosion controls would be used to prevent bank and streambed erosion if storm evens occur during the construction period and before stream banks are permanently stabilized.

d. Contaminant Determinations - Contaminants would not be increased due to construction of this project. Therefore, the required determinations pertaining to the presence and effects of contaminants can be made without testing.

e. Aquatic Ecosystem and Organism Determinations - Since there is no anticipated addition of contaminants due to construction, the following would not be affected by construction of the project due to contaminants.
(1) Effects on Plankton
(2) Effects on Benthos
(3) Effects on Nekton
(4) Effects on Aquatic Food Web
(5) Effects on Special Aquatic Sites

(a) Sanctuaries and Refuges – Not applicable.

(b) Wetlands – Wetlands would be avoided during construction of the high-flow channels. There is no wetland habitat adjacent to the channel where excavation to connect the channel to the river would take place. Dredging along the bank of the river would occur and therefore, this analysis concludes that activities would be covered under Nationwide Permit #33.

Work within the Oxbow is proposed in order to restore open water areas within the Oxbow and create connections to existing flows to dry areas. Work would also include removal of non-native vegetation and jetty jacks in some locations. This work would be covered under Nationwide Permit #27, Aquatic Habitat Restoration, Establishment and Enhancement Activities.

(c) Mud Flats – Not applicable.

(d) Vegetated Shallows - Not applicable.

(e) Coral Reefs – Not applicable.

(f) Riffle and Pool Complexes – Installation of the coffer dam to excavate the channel may have a short-term effect on riffle and pool complexes during construction only.

(6) Threatened and Endangered Species - Refer to Section 4.11 of the DEA.

(7) Other Wildlife – Refer to Section 4.11 of the DEA.

(8) Actions to Minimize Impacts – Actions to minimize impacts as described in the DEA would be implemented including the following:
- All conditions for Nationwide Permits 33 and 27 would be adhered to during construction.
- BMPS's discussed in reference to the Rio Grande silvery minnow would be implemented as follows:
- The use of silt fences adjacent to the riverbank to prevent erosion to the river .
- Work zones to the river would be blocked when constructing the High-Flow Channels.
- Fueling of vehicles would not take place inside the levees,
- Storage of equipment and vehicles would not occur in the bosque.
- The proposed work would occur during the winter, which is when Bald Eagles may be in or near the Proposed Action Area. In order to minimize the potential for disturbing Bald Eagles utilizing adjacent habitat, the following guidelines would be employed. If a Bald Eagle is present within 0.25 mile upstream or downstream of the active construction site in the morning before activity starts, or is present following breaks in project activity, the contractor would be required to suspend all activity until the bird leaves of its own volition; or an USACE biologist, in consultation with the USFWS, would determine that the potential for harassment is minimal. However, if a Bald Eagle arrives during construction activities

or if an eagle is greater than 0.25 mile away, construction need not be interrupted.

f. <u>Proposed Disposal Site Determinations</u> – Any excess excavated material would be hauled to an approved site.

(1) Mixing Zone Determination – Not applicable.

(2) Determination of compliance with applicable water quality standards – All standards listed in the Nationwide Permits 33 and 27, 401 water quality certification, and Section 402 (p) of the CWA would be adhered to during construction.

(3) Potential effects on human use characteristic – Human use would not be affected by the proposed project.

(a) Municipal and Private water supply – The proposed project is not within or adjacent to municipal or private water supplies.

(b) Recreational and commercial fisheries - Not applicable.

(c) Water related recreation – No recreational resources would be affected by the proposed project.

(d) Aesthetics – As discussed above, water quality would be affected during construction. Turbidity would be increased for a short duration.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and similar preserves – The proposed project is within the Rio Grande Valley State Park. All rules and regulations of the Park would be adhered to during construction.

g. <u>Determination of Cumulative Effects on the Aquatic Ecosystem –</u> There are numerous high-flow channels proposed within the project. They are located within the 26 miles project area. Implementation of the Proposed Action would likely take place over three to five years. Construction of water features (high-flow channels and work within the Oxbow) would be phased in order to minimize impacts to water quality. All actions to minimize impacts as described above would be implemented in order to reduce this cumulative effect as much as possible. Also, each channel would be constructed from the downstream end to the upstream end so that no sediment loosened by the construction would outflow into the river. It would all be removed before the upstream end is excavated and the coffer dam removed.

h. Determination of Secondary Effects on the Aquatic Ecosystem - There is no placement of fill proposed within this project, therefore, there no secondary effects on the aquatic ecosystem are anticipated.

III. Findings of Compliance or Non-Compliance with the restrictions on discharge

a. Adaptation of the Section 404(b) (1) Guidelines to this Evaluation – Not applicable.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge site which would have less adverse impact on the aquatic ecosystem

There is no discharge sites proposed within the project.

c. Compliance with applicable state water quality standards

The proposed action is in compliance with applicable state water quality standards. Concurrence (and a 401 water quality certificate, if required) from the New Mexico Environment Department would be obtained prior to start of construction.

d. Compliance with applicable toxic effluent standard or prohibition under Section 307 of the Clean Water Act

Not applicable.

e. Compliance with Endangered Species Act of 1973

The proposed project is in compliance with the Endangered Species Act of 1973. Effects on listed species have been determined and are discussed in Section 4.11 of the DEA. A Biological Assessment requesting concurrence would be submitted to the U.S. Fish and Wildlife Service, if required.

f. Compliance with specified protection measures for marine sanctuaries designated by the Marine Protection, Research and Sanctuaries Act of 1972

Not applicable.

g. Evaluation of Extent of Degradation of the Waters of the United States

(1) Significant adverse effects on human health and welfare – No significant adverse effects on human health or welfare would occur due to the proposed project.

(a) Municipal and private water supplies – No effect to municipal or private water supplies would occur from the proposed project.

(b) Recreation and commercial fisheries – No effect to recreation or commercial fisheries would occur from the proposed project.

(c) Plankton – Plankton would not be affected by the proposed project.

(d) Fish - Fish species may be affected by these short term impacts to water quality based on suspended particulates and/or turbidity.

(e) Shellfish – Shellfish would not be affected by the proposed project.

(f) Wildlife – Wildlife would not be affected by the proposed project.

(g) Special Aquatic sites – No applicable.

(2) Significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems – There would not be significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems.

(3) Significant adverse effects on aquatic ecosystem diversity, productivity and stability - There would not be significant adverse effects on aquatic ecosystem diversity, productivity and stability.

(4) Significant adverse effects on recreational, aesthetic, and economic values - There would not be significant adverse effects on recreational, aesthetic, and economic values.

h. Appropriate and practicable steps taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem – All of the actions to minimize potential adverse impacts of the proposed project as listed above include:

- If a disposal site is needed (other than on site outside of the river), a site that has been previously used for dredged material would be utilized.
- As described above, a coffer dam would be placed in the river and dewatered (if needed) in order to create a work zone.
- This area would be monitored for fish or invertebrates present. If any are found, they would be placed back into the river proper.
- Construction of the diversion structures (coffer dam or other) would be performed during low-flow conditions outside of the spring runoff and summer thunderstorm seasons.
- Work within the Oxbow would take place during low-flow conditions.
- Sediment and erosion controls would be used to prevent bank and streambed erosion if storm evens occur during the construction period and before stream banks are permanently stabilized.
- Water quality would be monitored during construction in order to determine any major changes in water chemistry.
- Care would be taken to minimize effects on water quality and flow during construction.

- Care would be taken to minimize effects on suspended particulates and turbidity in the water during installation of the coffer dam by pushing the water column out from the edge of the bank slowly and during construction within the Oxbow.
- This area would be monitored for amphibians, fish or invertebrates present. If any are found, they would be placed back into the river proper.
- All conditions for the Nationwide Permits 33 and 27 would be adhered to during construction.
- BMPS's discussed in reference to the Rio Grande silvery minnow would be implemented as follows:
- The use of silt fences adjacent to the riverbank to prevent erosion to the river.
- Work zones to the river would be blocked when constructing the High-Flow Channels.
- Fueling of vehicles would not take place inside the levees,
- Storage of equipment and vehicles would not occur in the bosque.
- The proposed work would occur during the winter, which is when Bald Eagles may be in or near the Study Area. In order to minimize the potential for disturbing Bald Eagles utilizing adjacent habitat, the following guidelines would be employed. If a Bald Eagle is present within 0.25 mile upstream or downstream of the active construction site in the morning before activity starts, or is present following breaks in project activity, the contractor would be required to suspend all activity until the bird leaves of its own volition; or an USACE biologist, in consultation with the USFWS, would determine that the potential for harassment is minimal. However, if a Bald Eagle arrives during construction activities or if an eagle is greater than 0.25 mile away, construction need not be interrupted.

i. <u>On the basis of the guidelines, the proposed disposal site(s) for the discharge of dredged or fill material</u>

(1) Specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects on the aquatic ecosystem.

APPENDIX G
MONITORING AND ADAPTIVE MANAGEMENT PLAN

FINAL

Middle Rio Grande Bosque Restoration Project
Monitoring and Adaptive Management Plan

Approved March 25, 2011

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1.0 Authority and Purpose

Per Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007), feasibility studies for ecosystem restoration are required to include a plan for monitoring the success of the ecosystem restoration. "Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be need to attain project benefits." Therefore, Section 2039 also directs that a Contingency Plan (Adaptive Management Plan) be developed for all ecosystem restoration projects.

2.0 Goals of the Project to be measured through monitoring

The first step in designing an evaluation program for the Middle Rio Grande Bosque Restoration Project (MRG Project) is to define the goals and objectives of the project. As stated in the U.S. Army Corps of Engineers (Corps) Feasibility Report (December 2009), they are as follows:

1. Improve habitat quality and increase the amount of native bosque communities.
2. Reestablish fluvial processes in the bosque to a more natural condition.
3. Restore hydraulic processes between the bosque and the river to a more natural condition.
4. Reduce the risk of catastrophic fires in the bosque.
5. Protect, extend and enhance areas of potential habitat for listed species within the bosque.
6. Provide educational or interpretive features.
7. Integrate recreational features that are compatible with ecosystem integrity.

Goals for a Monitoring and Adaptive Management Plan for the project should measure whether these objectives have been met or not. Some general items to keep in mind when developing specific monitoring components to measure include:

- ❑ Provide a thorough understanding of the ecosystem with and without restoration.
- ❑ Show direct cause-effect relationships between restoration measures and ecological responses.
- ❑ Include quantifiable biological responses.
- ❑ Document changes that are of social and scientific importance. (USACE, 1992).

There are also some constraints to implementation of the restoration project that should be kept in mind when developing specific monitoring components to measure. Some of these are:

1. The Rio Grande is a multi-jurisdictional, multi-boundary natural resource that is extremely human managed and manipulated due to this multi-jurisdictional setting.
2. There are legal obligations in the form of water rights in the State of New Mexico and especially on the Rio Grande.
3. With the exception of some jetty jacks (not all), river channelization and manipulation structures will remain in place.

These are some of the constraints of not only the evaluation of restoration, but of the restoration components themselves. These are the constraints, challenges, and potential benefits (when trying to approach this optimistically) that must be operated within in this large scale restoration effort.

3.0 Implementation

3.1 Implementation of the Monitoring Plan

Pre-construction, during construction and post construction monitoring shall be conducted by the Corps. After that time, monitoring would continue and be the responsibility of the local sponsor.

Monitoring will be aimed at evaluating project success and guiding adaptive management actions by determining if the project has met ‘performance standards’. Validation monitoring will involve various degrees of quantitative monitoring aimed at verifying that restoration objectives have been achieved for both biological and physical resources. Effectiveness monitoring will be implemented to confirm that project construction elements perform as designed. Monitoring will be carried out until the project has been determined to be successful (performance standards have been met), as required by Section 2039 of WRDA 2007, as noted in paragraph 3.c of the implementation guidance. Monitoring objectives have been tied to original baseline measurements that were performed during the Habitat Evaluation Assessment Tool (HEAT) modeling effort and are shown below.

Measurement	**Performance Standard**	**Adaptive Management**
Vegetation – tree density, tree canopy cover, shrub canopy cover, ground cover, species count/composition, % native/non-native; overall percent cover	Overall % cover – overall stand density mosaic per HEAT measurement goals: 50% native tree, 30% native shrub, 20% native herbaceous and/or wet habitat	Any planted material that has died shall be replaced (per one year warranty); After one year, adaptive management should focus on non-native vegetation treatment per below.
	Non-native vegetation % cover: </= 30%	On an annual basis, areas ¼ acre in size or larger that have > 30% areal cover by non-native vegetation shall be treated
	Noxious weeds: </= 30%	On an annual basis, areas ¼ acre in size or larger that have > 30% areal cover by weeds shall be treated
Hydrology – flood frequency, flood duration, depth, velocity, wetted area, groundwater depth	Increase flood frequency and duration into bosque by 10%; increase wetted area in bosque by 15%	As features potentially get filled with sediment, they will need to be cleaned out; Review designs for potential needed change
Avian monitoring -	Increase in species diversity by 10% in areas where wet	Ensure wet features are functioning (per hydrology

	habitat is constructed; Increase in species diversity by 10% of other areas within 3-5 years (noting that there will be an initial decrease); 10% increase in potential SWFL habitat	Performance Standard and Adaptive Management above); ensure native riparian vegetation is thriving (per vegetation Performance Standard and Adaptive Management above)

Vegetation: Vegetation measurements listed above were performed during baseline analysis for this project in 2005. All of these measurements (tree density, tree canopy cover, shrub canopy cover, ground cover, species count, % native/non-native) are performed along a transect at the same time and can be completed fairly quickly.

Permanent rebar were placed at the original baseline sampling locations (which are within the recommended plan proposed construction sites) and serve both as the permanent plot marker and as the center point for two, perpendicularly aligned sampling transects (Figure 1). While the sampling distance along each transect will be 50-m, each transect will actually be extended 60-m because the 5-m circumference around the center rebar is not sampled to avoid measurement overlap, and because this area gets trampled during plot set-up. Thus the rebar was located at the 30-m mark for each perpendicular sampling transect, and no data is collected between distance marks 25-m to 35-m on either tape.

The orientation of the first 50-m tape was determined randomly by standing over the rebar and making an unobserved spin of a compass dial. The second transect will be oriented at a 90º angle to the first (Figure 1).

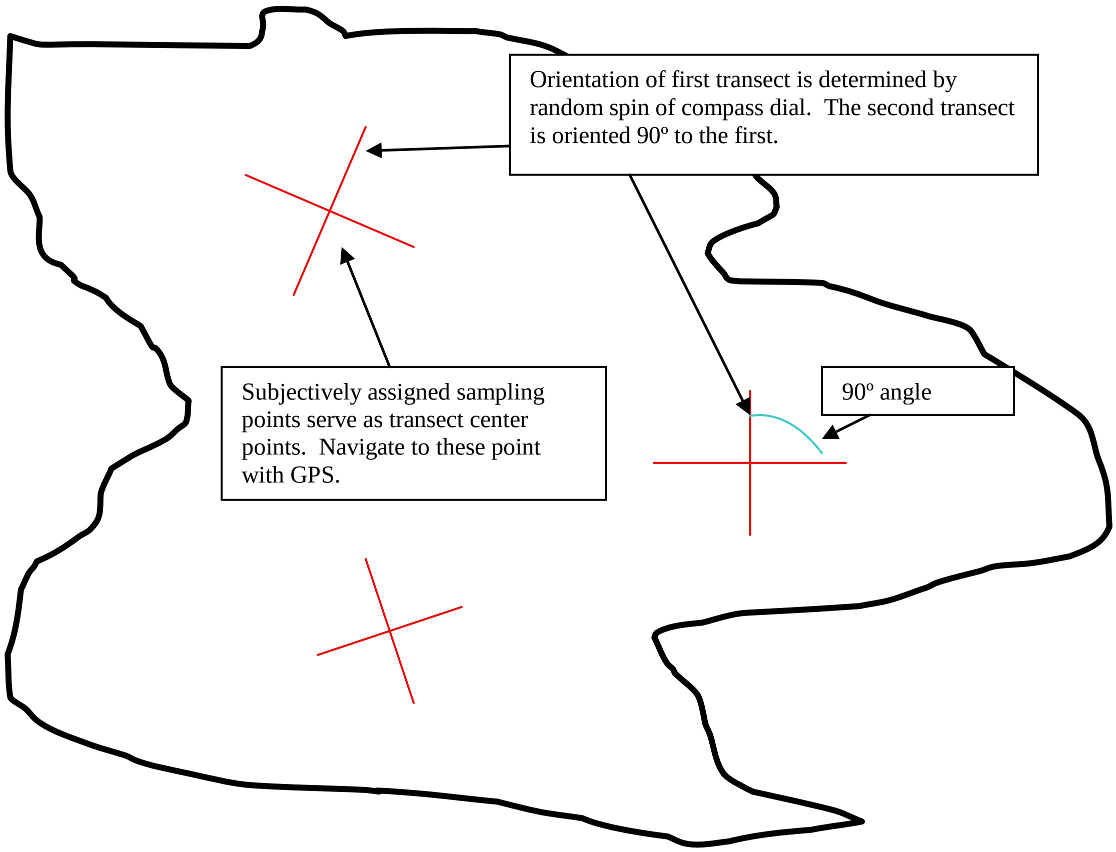

Figure 1. Sampling design. Each transect is 60-m long, although a 5-m circumference around the rebar (meter marks 25m – 35m) is not sampled, so only 50-m along each transect is sampled. Up to three 100-m plots may be established in a single vegetation polygon.

All of these measurements can then be translated into an overall percent cover. Overall percent cover should meet the performance standard for an overall mosaic per HEAT measurement goals: 50% native tree, 30% native shrub, 20% native herbaceous and/or wet habitat. Any planted material that has died shall be replaced (per one year warranty). After one year, adaptive management should focus on non-native vegetation treatment per below.

The measurements would also be used to determine the % of non-native vegetation present. Non-native vegetation % cover should be less than or equal to 30%. On an annual basis, areas ¼ acre in size or larger that have > 30% areal cover by non-native vegetation shall be treated per the Environmental Assessment and Operations and Maintenance Manual for this project. This typically includes treatment using herbicides via cut-stump or foliar application. Noxious weeds shall also be monitored with a performance standard of less than or equal to 30%. On an annual basis, areas ¼ acre in size or larger that have > 30% areal cover by non-native vegetation shall be treated per the Environmental Assessment for this project and Operations and Maintenance Manual for this project. This typically includes treatment using herbicides.

Hydrology: Flood frequency, flood duration, depth, velocity, wetted area and groundwater depth will be evaluated for constructed high-flow channels, bank terracing, willow swales and other wetland features. Results will inform need for adaptive management actions and will inform future restoration designs.

Flood frequency relates the magnitude of discharge to the probability of occurrence or exceedance. Discharge or flow rate is typically given in cubic feet per second (cfs). Flood duration defines the amount of time that a specific flood frequency will meet or exceed a given discharge or flow rate. Flood duration is typically defined in either hours or days.

Flood duration, frequency, depth and velocity would be measured using a FlowTrakker Acoustic Doppler Velocimeter (ADV). This meter samples velocity measurement over a given length of time (seconds) and averages velocity at a given point in the water column. The meter computes discharge, after transects are made, according to USGS standards.

Wetted area can be measured by measuring surface water area. This is done by using the top width of the feature (high flow channel, terrace and/or willow swale) and the duration of flow from the hydrograph. Some areas may be mapped by hand using a GPS to get the overall surface area of wetted area.

Seasonal depth to groundwater will be monitored utilizing existing instrumented shallow groundwater piezometers. Data will be used to evaluate floodplain-channel connectivity and to allow comparisons to vegetation growth parameters.

The overall Performance Standard is to increase flood frequency and duration into bosque by 10% and increase wetted area in bosque by 15%. As features potentially get filled with sediment, they will need to be cleaned out. In order to help reduce the maintenance need, an increase in interconnection between features is proposed. This will also potentially enhance wetted area habitat diversity and function in order to meet the Performance Standard. If this is occurring, adaptive management in form of the maintenance above and/or reviewing the original design would be implemented.

Avian Monitoring – Through other bosque projects, the Corps (via a contractor) has been monitoring transects and project specific locations within the recommended plan project area. This information has been used as baseline information specific to this project and monitoring of these locations prior to, during and after construction is proposed to continue.

Through this monitoring and research, much has been learned about species loss due to increase in non-native vegetation, effects of fuel reduction/exotic removal on bird species, and effects of mid-canopy removal on bird species. These studies have been conducted specifically within the project area (Hawks Aloft, 2003-2008). Therefore, information has been utilized form these studies in order to guide alternative development, project design and construction implementation. One of the main goals of this project is to improve habitat quality and increase the amount of native vegetation.

Monitoring of avian species can aid in understanding whether or not this goal has been met by evaluating the current (and recent past) use of these areas compared to their use during construction (which is hypothesized to decrease initially) and after construction (which is hypothesized to increase over time). Previous work has shown an increase in the diversity of bird species in areas where water features have been added. In areas where thinning of non-native vegetation occurs, there is an initial decrease in species diversity though population sizes remain roughly the same. Over time, species diversity increases again. Therefore, these findings have been used to develop the Performance Standards which include an increase in species diversity by 10% in areas where wet habitat is constructed; and an increase in species diversity by 10% of other areas within 3-5 years (noting that there will be an initial decrease). Through monitoring for Southwestern Willow Flycatcher (SWFL), an increase in potential habitat will be captured. Therefore, the Performance Standard is to also increase potential SWFL habitat by 10%. SWFL surveys would only be performed in areas that are expanding potential habitat (ie: willow swales). Performance Standard and Adaptive Management above); ensure native riparian vegetation is thriving (per vegetation Performance Standard and Adaptive Management above).

Methodologies used by Hawks Aloft would continue and include breeding bird point counts and monitoring of existing transects.

3.2 Additional monitoring – It should also be noted that additional endangered species monitoring for Rio Grande silvery minnow (RGSM) would be performed per the Biological Opinion for this project. While it is not listed as a specific Performance Standard above, it would still provide information regarding the use of water features by RGSM.

3.3 General periodic site assessment: In terms of assessing overall effectiveness of the restoration construction, a general annual assessment of each site would be conducted. A site assessment form is included in Appendix A.

3.4 Reporting

The Corps and/or their agents will prepare annual reports that include specific information pertaining to each of the monitoring elements. These reports will include information about all equipment and techniques used for monitoring purposes.

Annual reports will be submitted to the Middle Rio Grande Conservancy District (MRGCD), City of Albuquerque Open Space Division (OSD), U.S. Bureau of Reclamation (Reclamation, U.S. Fish and Wildlife Service (USFWS), New Mexico Department of Game and Fish (NMDGF) and other interested parties by December 31 of each monitoring year.

3.5 Photographic Documentation

Permanent locations for photographic documentation (i.e., photo points) will be established at strategic locations within each project site so that a visual record of habitat development can be provided. A sufficient number of photo points will be established in order to provide representative photographs of the site as it changes over time. The locations will be identified in the pre-construction monitoring report. Photographs taken from each of these locations will be included in subsequent monitoring reports.

4.0 Integration of project monitoring and adaptive management with other, ongoing restoration and research efforts in the bosque

One of the biggest challenges and potentially another component to this evaluation program is the coordination of monitoring and adaptive management restoration efforts. Current restoration and research efforts are underway and on the ground in the Albuquerque Reach of the Middle Rio Grande by the City of Albuquerque Open Space Division, the Middle Rio Grande Conservancy District (project sponsor), U.S. Bureau of Reclamation, Natural Heritage New Mexico, BEMP, etc. Many of the research efforts are currently being funded by the Corps in relation to other bosque projects and providing information toward pre-construction monitoring information for this project. As mentioned above, the Corps is a member of the Collaborative Program which is monitoring components of the system specifically for SWFL and RGSM. These monitoring methods have been included above (where appropriate) and close coordination of efforts on the ground would occur. The key to a successful restoration program in the Middle Rio Grande will be to collaborate with these efforts in creating a fully integrated and ecosystem-based evaluation program.

There are a large number of monitoring efforts currently being conducted in the Project Area. Many are efforts currently contracted by the Corps Albuquerque District that would continue to be contracted as part of implementing this monitoring and adaptive management plan. Other efforts are conducted by other agencies or Programs that are being coordinated with in order to reduce a duplication of effort.

The Corps has spearheaded a demonstration or 'test' of this effort during implementation of the BioPark Restoration Project and the Ecosystem Restoration @ RT66 Project. The BioPark Restoration project was completed in October 2006 and the RT66 Project is currently under construction to be completed in April 2010. The BioPark Restoration Project is currently being monitored and providing valuable input toward design of this project as well as input toward monitoring efforts. These projects are also crucial components to the analysis for adaptive management. Adaptive management will be the key to the long-term success of the MRG Project as well as the monitoring program.

5.0 Estimated Cost

Per discussion above, annual costs can fluctuate depending upon specific monitoring needs as well as available funding. Potential annual costs based on the potential combination of monitoring elements are below:

Pre-construction monitoring:

Monitoring Element	**Estimated Cost**
Vegetation	$ 25,000
Hydrology	$ 25,000
Avian Monitoring	$ 50,000
TOTAL ESTIMATED COST	$100,000

Post-construction Year 1:

Monitoring Element	**Estimated Cost**
Vegetation	$ 25,000
Hydrology	$ 25,000
Avian Monitoring	$ 55,000
TOTAL ESTIMATED COST	$105,000

Post-construction Year 2:

Monitoring Element	**Estimated Cost**
Vegetation	$ 25,000
Hydrology	$ 25,000
Avian Monitoring	$ 60,000
TOTAL ESTIMATED COST	$110,000

Post-construction Year 3:

Monitoring Element	**Estimated Cost**
Vegetation	$ 30,000
Hydrology	$ 30,000
Avian Monitoring	$ 65,000
TOTAL ESTIMATED COST	$125,000

Post-construction Year 4:

Monitoring Element	**Estimated Cost**
Vegetation	$ 32,000
Hydrology	$ 32,000
Avian Monitoring	$ 70,000
TOTAL ESTIMATED COST	$134,000

Post-construction Year 5:

Monitoring Element	**Estimated Cost**
Vegetation	$ 34,000
Hydrology	$ 34,000
Avian Monitoring	$ 75,000
TOTAL ESTIMATED COST	$143,000

References

Hawks Aloft, Inc. 2009. Bird and vegetation community relationships in the Middle Rio Grande Bosque: 2008 Interim Report. Submitted to: U.S. Army Corps of Engineers. 105 pp.

U.S. Army Corps of Engineers. 1992. Kissimmee River Restoration Study Report. Communication from the Assistant Secretary of the Army.

APPENDIX A
PERIODIC SITE ASSESSMENT FORM
Sample Format for Periodic Site Assessment Form

Middle Rio Grande Bosque Restoration Project Assessment Report

Site:
Location of site (include map:
Personnel:
Date:

Item No.	Description	Response Yes	Response No
1	Erosion observed in revegetation areas? If yes, describe location(s) and provide a map of affected area(s).		
2	Erosion control blankets, geotextile mats, and underlying soil on low berm in good condition?		
3	Fire damage to vegetation or other site features?		
4	Flood damage to vegetation or other site features?		
5	Wind damage to vegetation or other site features?		
6	Herbicide damage to desired vegetation?		
7	Wildlife damage to desired vegetation?		
8	Vandalism to desired vegetation?		
9	Vandalism to other site features (e.g., signs)?		
10	Debris or refuse present?		
11	Access roads maintained as specified?		
12	Access gates, barriers and locks in good working order?		
13	Volunteer establishment of desired species observed?		
14	Portions of revegetation areas currently flooded? If yes, describe extent of flooding and provide a map of affected area(s).		
15	Other items?		

Comments:

APPENDIX H
FISH AND WILDLIFE COORDINATION ACT REPORT

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

November 10, 2010

Lt. Col. Jason D. Williams
Attn: Ondrea Hummel
Environmental Resources
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109

Re: Fish and Wildlife Coordination Act Report for the Middle Rio Grande Feasibility Report Albuquerque, New Mexico

Dear Lt. Col. Williams:

Enclosed is the Fish and Wildlife Coordination Act Report for the Middle Grande Feasibility Report, as proposed by the U.S. Army Corps of Engineers. The proposed project would enhance and revitalize the Rio Grande bosque in the Middle Rio Grande Reach, in Albuquerque, Bernalillo County, New Mexico.

This report has been prepared by the U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e). Please provide us any comments concerning this report within 30 days.

Sincerely,

for Wally Murphy
Field Supervisor

Enclosure

cc: (w/enc)
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico

Fish and Wildlife Coordination Act Report
for the
Middle Rio Grande Feasibility Report
Albuquerque, New Mexico

Submitted to:
U.S. Army Corps of Engineers
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109-3435

Prepared by:
Santiago Gonzales
U.S. Fish and Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113

November 10, 2010

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EXECUTIVE SUMMARY

This is the Fish and Wildlife Coordination Act Report (CAR) for the Middle Rio Grande Feasibility Study (Project), Albuquerque, New Mexico, prepared by the U.S. Fish and Wildlife Service (Service). This report has been prepared by the Service under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661 et seq.). The Service has evaluated the proposed project as described in the Middle Rio Grande Bosque (Spanish word for woodland or forest) Feasibility Project Report, Albuquerque, New Mexico. This CAR report is based on coordination and information provided by and with the U.S. Army Corps of Engineers (USACE), literature research, and file reviews.

The purpose of the proposed project is to undertake environmental restoration measures to improve the Rio Grande Bosque ecosystem function in the Middle Rio Grande. Potential alternatives include removing jetty jacks and non-native vegetation, such as saltcedar (*Tamarix ramosissima*), Russian olive (*Elaeagnus angustifolia*), Tree of Heaven (*Ailanthus altissima*) and Siberian elm (*Ulmus pumila*) enhancing existing high-flow channels, outfall wetlands, and other alterations to the floodplain. Improvements of existing facilities for educational, interpretive and low-impact recreational uses have also been considered in the proposed project.

The Preferred Alternative would include 98 acres of bank destabilization; 150 acres of swales and trenches; 303 acres of water features; 1,720 acres of treat-retreat re-vegetation; and removal of 6,008 jetty jacks. Implementation of the proposed Preferred Alternative should improve habitat in the bosque and benefit fish and wildlife resources.

The overall goal of the proposed project is to restore the dynamic bosque mosaic of open areas, woodland patches, shrub patches and wet areas. The ecosystem restoration objectives for the proposed project include: 1) enhancement of the native cottonwood community; 2) enhancement of and increase of the number of water-related habitat features in the bosque; 3) implementation of limited measures to rehabilitate some hydraulic connection between the bosque and the river consistent with operational constraints; 4) protection, extension and enhancement of areas of potential habitat for listed species within the existing bosque; 5) prevention catastrophic fires in the bosque through the reduction of fuel loads identified as hazardous; 6) development and implement with the sponsor a long-term Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) plan and long-term monitoring strategy; 7) coordinate and integrate related project planning and monitoring with other ongoing restoration and research efforts in the bosque; and 8) increase access and opportunities for education and low-impact recreation that is compatible with ecosystem integrity.

Although highly altered, the Middle Rio Grande still has one of the highest value riparian ecosystems remaining in the Southwest. The variety of vegetation types support a relatively high diversity and number of animals. The vegetation communities of the bosque in the proposed project area are the result of an altered flow regime, drainage for agriculture and development, levees, channelization and straight armored bank formation from jetty jack construction; and the growth of exotic saltcedar, Russian olive, and Siberian elm. Overbank flooding and in-channel scouring rarely occurs, reducing the opportunity for cottonwood regeneration. The introduction and subsequent establishment of non-native exotic plants, which thrive in the altered hydrologic regime, has significantly degraded the riparian plant community. In addition, these conditions limit the formation and maintenance of wetlands, a habitat type that is extremely limited in the proposed project area. Changes to the river channel and floodplain that affect how base flow and flood currents move downstream and across the floodplain (dams, levees, channelization, etc.) would continue to have effects on patterns of erosion, aggradation, and maintenance or regeneration of riparian vegetation.

In the proposed project area, past actions have reduced the total habitat from historic conditions and severely altered habitat conditions for the federally listed species Rio Grande silvery minnow (minnow) (*Hybognathus amarus*) and its designated critical habitat and the Southwestern willow flycatcher (flycatcher) (*Empidonax trailii estimus*). Narrowing and deepening of the channel, lack of side channels and off-channel pools, and changes in natural flow regimes have all adversely affected the minnow and its habitat.

Without the proposed project the river, floodplain, and the associated fish and wildlife would continue to experience adverse effects from Federal, state, and private actions, including new and long-term ongoing activities. The proposed project provides opportunities to restore some Rio Grande ecosystem biological components to benefit fish and wildlife resources. The proposed project represents the extensive coordination of ideas and planning on a multi-party level. The proposed project implementation and reporting of the monitoring results will also provide valuable information for future projects in a river-based ecosystem approach to restoration throughout the Middle Rio Grande.

The proposed restoration plan incorporates many of the recommendations from the Middle Rio Grande Ecosystem: Bosque Biological Management Plan. The proposed plan would create wetlands within the Rio Grande riparian zone; and would sustain and enhance existing cottonwood communities as well as create new native cottonwood and willow communities.

Activities that restore and enhance fish and wildlife habitat within the Middle Rio Grande are timely, as riparian and wetland habitats are scare and disappearing at an astonishing rate. About 90 percent of the historic wetland and riparian habitat in the Southwest has been eliminated.

The following recommendations are provided by the Service to prevent and reduce adverse project effects on fish and wildlife resources during construction, operation, and maintenance of the proposed project:

1. Where possible, avoid construction during the migratory bird nesting season of March through August. Where that is not possible, tree stands or other adequately vegetated areas slated for grubbing or clearing should be surveyed for the presence of nesting birds prior to construction. Avoid disturbing nesting areas until nesting is complete.

2. Employ silt curtains (without lead weights), cofferdams, dikes, straw bales or other suitable erosion control measures during construction.

3. Store and dispense fuels, lubricants, hydraulic fluids, and other petrochemicals outside

the 100-year floodplain. Inspect construction equipment daily for petrochemical leaks. Contain and remove any petrochemical spills and dispose of these materials at an approved upland site. Park construction equipment outside the 100-year floodplain during periods of inactivity.

4. Ensure equipment operators carry an oil spill kit or spill blanket at all times and are knowledgeable in the use of spill containment equipment. Develop a spill contingency plan prior to initiation of construction. Immediately notify the proper Federal and state authorities in the event of a spill.

5. All work and staging areas should be limited to the minimum amount of area required. Existing roads and right-of-ways and staging areas should be used to the greatest extent practicable to transport equipment and construction materials to the project site, and described in the USACE's project description. Provide designated areas for vehicle turn around and maneuvering to protect riparian areas from unnecessary damage.

6. Backfill should be uncontaminated earth or alluvium suitable for re-vegetation with native plant species.

7. Scarify compacted soils or replace topsoil and re-vegetate all disturbed sites with suitable mixture of native grasses, forbs, and woody shrubs.

8. Protect mature cottonwood trees from damage during clearing of non-native species or other construction activities using fencing, or other appropriate materials.

9. Use local genetic stock wherever possible in the native plant species establishment throughout the riparian area.

10. Continue coordination of Rio Grande water management activities that develop and maintain riverine and terrestrial habitats by mimicking the typical natural hydrograph. An intergraded management of flows from upstream reservoirs should be pursued by USACE for the purpose of protecting and enhancing the aquatic and terrestrial habitats along the Rio Grande.

11. Pursue and conduct floodplain management activities that discourage further development in the floodplain and address physical constraints to the higher flows that would be part of a natural hydrograph.

12. Explore expansion of the active floodplain of the Rio Grande at every opportunity.

13. Develop a coordinated program to monitor biological quality with emphasis on diversity and abundance of native species and ecosystem integrity with emphasis on restoring the functional connection between the river and the riparian zone of the Middle Rio Grande ecosystem.

14. Develop partnerships with local schools, universities, or other interested groups to help address post-project monitoring and adaptive management needs (e.g., conduct periodic wildlife surveys, monitoring ecosystem response, etc.).

15. Support and participate in annual bird monitoring in the proposed project area.

16. Continue to support inventories and monitoring of southwestern willow flycatcher and their habitats.

17. The USACE and the MRGCD should analyze all projects and plans completed under this proposal for effects to listed species, including the flycatcher, and request future consultation if necessary.

18. The USACE should continue to propose conservation measures that act together to reduce or eliminate potential adverse effects from the proposed and projects.

19. Vegetation treatments will avoid the federally endangered Southwestern willow flycatcher migration and breeding seasons.

20. In conjunction with the Bureau of Reclamation and MRGCD, the USACE develop a comprehensive flood control plan for the entire stretch of the Middle Rio Grande (Cochiti Lake to Elephant Butte Reservoir). The plan should incorporate maintenance of healthy and diverse native aquatic and riparian ecosystems, while addressing public and agencies' water management needs.

21. Expand the existing active floodplain of the Middle Rio Grande by relocating levees, and implementing floodplain zoning and management to control development in the active floodplain.

22. Establish and enhance wildlife travel corridors between the river and the adjacent uplands.

23. Actively manage livestock grazing and prevent trespass grazing (i.e. construct and maintain fences).

24. Immediately prior to construction of each unit and prior to reinitiation of work following an extended period of no action, conduct surveys to assess the possible presence of Federal and State endangered or threatened species, or Tribal species of concern. If protected species are located, coordinate with Federal, State, and Tribal wildlife agencies to prevent adverse impacts to the species.

25. Construction should be accomplished during periods of least resource impact. Work should be scheduled to avoid disturbance to breeding and nesting Neotropical migrant land birds and to fish, especially native fishes, during the spawning and hatching periods. To minimize disturbance to wildlife, the duration of project construction should be as brief as possible.

26. Project activity should not take place between mid –April and mid-September in areas of suitable flycatcher habitat.

27. Implement recovery measures for the minnow. This should include long-term monitoring throughout the proposed project area.

28. Conduct bald eagle surveys to determine areas of eagle use. Avoid project activity in areas where eagles are known to perch or roost from November to March.

29. Strict control and frequent monitoring of construction activity by the USACE biologist to ensure all contract specifications and agreements are being implemented and achieved.

30. Store and dispense all fuels, lubricants, hydraulic fluids, and other petrochemicals outside the 100-year floodplain.

31. Inspect all equipment daily to ensure there are no leaks or discharges of lubricants, hydraulic fluids or fuels. Contain and remove and petrochemicals spills, including contaminated soil, and dispose of these materials in an environmentally appropriate manner at an approved upland disposal site.

32. Implement or update existing wildlife inventories of the Middle Rio Grande and the adjacent floodplain.

33. Monitor and evaluate success of project mitigation, especially water quality, re-vegetation, and habitat enhancement to determine if the mitigation actions are sufficient enough to avoid, minimize or compensate for adverse impacts.

INTRODUCTION

Identification of Purpose, Scope, and Authority

This report has been prepared by the U.S. Fish and Wildlife Service (Service) under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661 et seq.). The Service has evaluated the proposed project as described in the Middle Rio Grande Bosque (Spanish word for woodland or forest) Feasibility Project Report, Albuquerque, New Mexico. This report is based on coordination and information provided by and with the U.S. Army Corps of Engineers (USACE), literature research, and file reviews.

The Rio Grande Bosque Feasibility Project was derived from a series of Congressional actions authorizing projects on the Rio Grande, particularly in the Middle Rio Grande. These authorizations began with the basic flood control authorization for the Middle Rio Grande Public Law No. 228, 77th Congress, 1st Session, H.R. 4911 dated 18 August 1941; House of Representatives Resolution, dated 11 April 1974; and Section 401 of the Water Resources Development Act 0f 1986 (Public Law 99-662) dated 17 November 1986, authorized the Middle Rio Grande Flood Control Project from Bernalillo to Belen, New Mexico.

In response to the study authorities, a Reconnaissance Study was initiated in March 2002. The Reconnaissance Study determined that there is a federal interest in participating in cost-shared feasibility studies to investigate ecosystem restoration, education/interpretive opportunities and low-impact recreational opportunities for the Rio Grande floodway as it passes through Albuquerque, New Mexico. A Feasibility Cost Sharing Agreement (FCSA) was signed between the Middle Rio Grande Conservancy District (MRGCD), as the non-Federal Sponsor, and the U.S. Army Corps of Engineers (USACE) that initiated the feasibility phase of the study in fall 2003.

The MRGCD is the non-federal sponsor for this Project. The MRGCD manages most of the bosque and controls and maintains a system of canals, drainage ways and other facilities along the Middle Rio Grande from Cochiti Dam downstream to the northern boundary of Bosque del Apache National Wildlife Refuge. The City of Albuquerque Open Space Division (AOSD) co-manages the bosque within the proposed project area, and is a critical partner in the development and implementation of the preferred alternative. The AOSD manages 33,000 acres of Bosque in the City of Albuquerque.

The Rio Grande in New Mexico has been negatively impacted by water diversions, dams, levees, drains, channelization, jetty jacks, and urbanization. Water management has altered the river channel and floodplain, and has altered the flow regime. Willow and cottonwood recruitment has declined, noxious plants have increased in abundance, combustible organic litter has accumulated, wetlands have been lost, and the overall value of aquatic and Bosque habitat has declined. Urbanization has also impacted the Rio Grande via widespread trash and debris dumping, high-impact recreational use, and human induced bosque fires.

The purpose of the Project is to undertake environmental restoration measures to improve the Rio Grande Bosque ecosystem function in the Middle Rio Grande. Potential alternatives include removing jetty jacks and non-native vegetation, such as saltcedar (*Tamarix ramosissima*), Russian olive (*Elaeagnus angustifolia*), Tree of Heaven (*Ailanthus altissima*) and Siberian elm (*Ulmus pumila*) enhancing existing high-flow channels, outfall wetlands, and other alterations to the floodplain. Improvements of existing facilities for educational, interpretive and low-impact recreational uses have also been considered in the proposed project.

The Preferred Alternative would include removal of jetty jacks and non-native vegetation across 916 acres of bosque, non-native vegetation removal would include saltcedar, Russian olive, Tree of Heaven, and Siberian elm. The proposed action includes 98 acres of bank destabilization; 150 acres of swales and trenches; 303 acres of water features; 1,720 acres of treat-retreat re-vegetation; and removal of 6,008 jetty jacks. Implementation of the proposed Preferred Alternative should improve habitat in the bosque and benefit fish and wildlife resources.

Improvements of existing facilities for educational, interpretive and low-impact recreational uses are also included in the Preferred Alternative. Trail and facility improvements would help minimize impacts to fish and wildlife habitats by directing recreational use to designated areas. The fire breaks proposed under the Preferred Alternative should reduce the risk of catastrophic bosque fire and its impacts to fish and wildlife resources.

This CAR provides information concerning: 1) the Project Area; 2) fish and wildlife resources; 3) an evaluation of the impacts of the preferred alternative; and 4) a discussion ; and recommendations to avoid or minimize adverse effects and maximize benefits for fish and wildlife resources.

The proposed project may provide a more stable environment for population sustainability for the federally listed species Rio Grande silvery minnow (minnow) (*Hybognathus amarus*) and its designated critical habitat and the Southwestern willow flycatcher (flycatcher) (*Empidonax trailii estimus*). These would extend to the overall wildlife community (USACE 2008b).

ACKNOWLEDGMENT OF INPUT AND COORDINATION

Input from Federal, state, and local agencies was provided through project meetings as well as quarterly agency coordination meetings. These meetings were attended by MRGCD, the AOSD, BOR, USFWS, Middle Rio Grande Council of Governments, the Albuquerque Downtown Action Team, City of Albuquerque Planning Department and others.

Discussion of Prior Studies and/or Reports

Many studies have been conducted pertaining to water and related land resources within the Study Area. These studies have examined themes including development trends, environmental resources, special status species, water supply, groundwater recharge, wastewater management, flooding and erosion, geology, cultural resources, history, and recreation. The following is not intended to be a comprehensive list of previous report, but to provide a sample of the types of studies that have been completed in the Study Area.

Middle Rio Grande Flow Frequency Study, U.S. Army Corps of Engineers Hydrologic Engineering Center—June 2006
The purpose of the study was to develop a flow frequency curve for the Rio Grande at Albuquerque. Peak flows at Albuquerque are caused by snowmelt and rainfall upstream of reservoirs on the Rio Grande and major tributaries, as well as from intense rainfall on areas downstream of the reservoirs. Separate frequency curves were developed fro both runoff mechanisms, regulated flow from the reservoirs and runoff from local areas downstream of the reservoirs, and combined into one flow frequency curve at Albuquerque.

Upper Rio Grande Basin Water Operations Review (Review) *Environmental Impact Statement—June 2007*
The Review and Environmental Impact Statement is a comprehensive system-wide review of the water operations activities that are conducted under existing authorities of the Joint Lead Agencies. These operations consist primarily of the storage and release of water at reservoirs. The project considers the means available to exercise existing water operations authorities of the Bureau of Reclamation (Reclamation), USACE, and the New Mexico Interstate Commission with respect to Upper Rio Grande Water Operations to (1) meet agricultural, domestic, municipal, industrial, and environmental water needs, including water needs to conserve endangered and threatened species as required by law, consistent with the allocation of supplies and priority of water rights under state law; (2) meet downstream water delivery requirements mandated by the Rio Grande Compact and international treaty; (3) provide flood protection and sediment control; (4) assure safe dam operations; (5) support compliance with local, state, federal, and tribal water quality regulations; (6) increase system efficiency; and (7) support compliance of the Reclamation and USACE with the provisions of the National Environmental Policy Act (NEPA) for the Upper Rio Grande Basin Water Operations and activities and support compliance of all signatories with the Endangered Species Act.

Environmental Assessment for the Bosque Wildfire Project, Bernalillo and Sandoval Counties, New Mexico—September 2004
This project included selective thinning of areas with high fuel loads and/or non-native plant species populations; removal of jetty jacks and removal of debris; improvement of emergency access in the form of drain crossings, levee road improvement, and construction of turn-arounds; and re-vegetation of burned and thinned areas.

Detailed Project Report and Environmental Assessment for Albuquerque Biological Park Wetland Restoration Project, Albuquerque, New Mexico—January 2004
The ecosystem restoration project included approximately 15 acres of pond reconstruction, 9 acres of wetland restoration, and 48 acres of riparian woodland restoration.

Middle Rio Grande Bosque Restoration Supplemental Planning Document—July 2003
This report was generated as the final documentation of the Middle Rio Grande Bosque Restoration 905(b) Reconnaissance Study. The information gathered from other projects and studies involving the bosque was collected, updated, and combined with field noted, additional

graphics and maps to develop the concepts and information presented in Middle Rio Grande Bosque Feasibility Project. The synthesis of the material was used as an aid in determining which restoration measures would be further analyzed.

Middle Rio Grande Bosque Reconnaissance Study, Section 905(b) Analysis—July 2002
The purpose of the reconnaissance phase of the Middle Rio Grande Bosque Feasibility Project, was to determine if there was a federal interest in participating in cost-sharing feasibility studies to investigate ecosystem environmental restoration and low-impact recreation opportunities for the Study Area, and was initiated in March 2002. The Reconnaissance Study determined that there is a Federal interest in continuing the study into the Feasibility Phase. The purpose of the Section 905(b) Analysis was document the basis for this finding and establishes the scope of the Feasibility Study.

Environmental Assessment and Finding of No Significant Impact for Middle Rio Grande Bosque Jetty Jack Removal Evaluation Study—July 2002.
The Jetty Jack Removal Study evaluated various methods (manual, heavy equipment, etc.) for jetty jack removal with regard to position, surroundings, and degree of sedimentary entrainment while attempting to preserve the existing native vegetation to the greatest extent possible.

Environmental Assessment and Finding of No Significant Impact for Rio Grande Habitat Restoration Project, Los Lunas, New Mexico—March 2002
The project was initiated to fulfill the requirement of habitat restoration in the Belen Reach as a result of a biological opinion of the Service. The project was intended to improve habitat conditions for the Rio Grande silvery minnow and the Southwestern willow flycatcher through widening the active river channel and improving adjacent riparian habitat woodland and wetlands. Jetty jacks were removed and channel widened and excavated to create low-flow shallow water habitat. In the riparian areas, wetlands were restored through excavation and replanting of herbaceous wetland vegetation, and attendant woodlands were restored through pole planting of cottonwood and willows.

Detailed Project Report and Environmental Assessment for Riparian and Wetland Restoration, Pueblo of Santa Ana Reservation, New Mexico—February 2002 and June 2008.
The purpose of the Section 1135 Program feasibility study was to investigate and recommend cost-effective environmental quality improvements along the Rio Grande within the Pueblo of Santa Ana Reservation. Restoration of ecosystem functions and values was evaluated within riverine, riparian, and wetland communities and the recommended plan included grade restoration facilities plus a downstream bed sill.

RIO GRANDE BASIN DESCRIPTION

The Rio Grande originates in Southern Colorado runs approximately 1,865 miles to the Gulf of Mexico making it the fourth largest river in the United States in terms of length and drainage area. The river bisects New Mexico running southerly the length of the state then delineates the 1,250 mile international boundary between Texas and Mexico. The river is designated a "Wild and Scenic River" to protect its outstanding resource values. River systems and their attendant wetland and riparian woodland communities provide significant resources for both humans and wildlife in the semi-arid western United States. In New Mexico, riparian habitats make up less than 2 percent of the state's land cover yet nearly 50 percent of the vertebrate species are riparian obligates. Although these riparian ecosystems are considered to be the most productive and biologically diverse ecosystems in the region, they are now believed to be the most threatened (Johnson and Jones 1977). Substantial impacts from human activities, starting about 250 years ago, have resulted in compounding rates of change in structure and vegetation dynamics to the point that the bosque ecosystem is now on the verge of irreversible conversion (Crawford *et al*. 1993). Any open water or wet soil habitat is scarce in arid regions, by definition, and increasing demands on water further threaten this resource.

The Rio Grande's riparian system continues to provide habitat for a wide variety of wildlife species although in a much reduced and degraded state compared to its historic status. It remains a critical travel corridor for many species, especially migratory birds including Neotropical songbirds, waterfowl, raptors and cranes. Degradation of the hydrologic and geomorphic character of the river and declines in aquatic and bosque habitat value threaten these species diversity. The persistence of species however, provides the opportunity for these species to expand their occupied area or increase numbers once adjacent habitats are restored or existing habitats are improved.

Water resource management activities (diversions, dams, levees, drains, channelization, jetty jacks) by federal and other entities have significantly altered the nature of the hydrologic regime, ecological processes, water table, and sediment transport of the Rio Grande within New Mexico, which has played a part in the loss and attrition of the bosque and subsequent loss of species diversity. Abiquiu, Jemez Canyon, Galisteo and Cochiti Dams, operated for flood and sediment control by the USACE have contributed, in part, to the degradation of ecosystem functions and values (see Geomorphology).

Channelization, levee replacement and construction, jetty jack installation and maintenance, sediment retention in reservoirs, and channel widening have affected patterns of erosion, aggradation, and maintenance or regeneration of riparian vegetation. These river management structures created a fixed channel plan form and a narrower floodplain that has less frequent inundation. The result has been disruption or termination of major processes of dynamics in a naturally functioning bosque ecosystem.

Geomorphology

The previous water projects have had some dramatic effects on the geomorphology of the Middle Rio Grande. For example, since Cochiti Dam was constructed, and to a lesser extent the Jemez Canyon Dam, much of the sediment in the previously turbid Rio Grande now settles out in the reservoirs. The sediment hungry water below the dams has essentially changed the Middle Rio Grande from an aggrading regime to a degrading system and has resulted in an incised channel through much of the area. The reduction of peak flows, however, has had an opposite effect where unregulated tributaries and arroyos such as the Calabacillas Arroyo discharge into the river. Adequate flows are not available to transport the sediment. Sediment deltas are more persistent; they reduce the river gradient upstream tending to increase aggradation and increase the gradient downstream tending to reduce aggradation. These trends are usually localized near the arroyos (USACE 2008a).

Another result of the dams has been to reduce peak flows during the spring runoff period. These flood events were key to overbank flooding and river bar creation, which helped renew the cottonwood riparian forest and remaining wetlands. As a result the bosque today experiences less inundation compared to pre-dam times. This loss of inundation prevents native plant rejuvenation that once maintained a healthy riparian condition within the bosque (USACE 2008a).

As a result of the channelization projects (installation of levees and jetty jacks) the river has become constrained into a single, narrower floodway throughout much of the Middle Rio Grande, resulting in an approximate 85 percent loss of the original floodplain (Earth Reflections 2003). The current floodplain is generally confined to the levees. Historically it was bounded by lower terraces, then by 300 to 500-foot high mesas.

The flood control and drainage projects implemented were widely successful in rejuvenating the declining agricultural communities and providing opportunities for expanding settlements. This occurred, however, at the expense of wetlands and marshes, which were dramatically reduced in number and extent (Berry and Lewis 1997, Crawford *et al.* 1993, Hanson 1997). Although there are several small areas and former side channels that function as seasonal wetlands, there are no wetlands of significant size in the Project Area. These areas occasionally become wet during seasonal runoff events but may or may not be regarded as jurisdictional wetlands however they are part of the current Middle Rio Grande geomorphology.

The change in seasonal discharges has also impacted channel-forming processes. Discharge is the dominant variable that affects channel morphology, but sediment transport, channel bed & bank material and other hydraulic factors are also important influences. Historically, the wide shallow channel was described as a sand-bed stream (Nordin and Beverage 1965) with a braided pattern (Lane and Borland 1953 I*n* USACE 2008b) likely resulting from sediment overload (Woodson 1961 I*n* USACE 2008b). The river followed a pattern of scouring and filling during floods and was in an aggrading regime (accumulating sediment). Flood hazards associated with the aggrading riverbed prompted the building of levees along the floodway. However, the levee system confined the sediment and increased the rate of aggradation in the floodway.

Additionally, channel stabilization works which included jetty jacks installed during the 1950s and 1960s contributed to building up and stabilizing the over-bank areas where the bosque currently exists. The riverbed is changing from one of fine silt particles and sand to coarse sands and gravel. This is a result of the fine sediments becoming trapped by upstream dams and removed in downstream reaches by hungry water. Over time, it is expected that the transitional area will continue to move downstream, accelerating the channel degradation process.

Construction of dams at Jemez Canyon (1953), Abiquiu (1963), Galisteo Creek (1970), and Cochiti (1973) were expected to slow aggradation or reverse the trend and promote degradation in the Middle Rio Grande Valley. The flood control improvements have reduced the sediment load in the Middle Rio Grande and accomplished flood control objectives for much of the river valley. This has caused changes in the geomorphology of the Rio Grande through the Albuquerque reach and affected the conveyance capacity of the active river channel. The result of these changes has been a reduction in the frequency of over-banking flows into the Rio Grande bosque.

Within the proposed project area, the Rio Grande is predominantly a sand bed river with low, sandy banks. There are numerous sandbars, and the river channel tends to be straight due to jetty jack fields and levee placement (Crawford *et al.* 1993). In this area, the river is typified by a uniform channel width averaging approximately 600 feet. Approximately two feet of degradation has occurred in the Albuquerque reach (due to flood control measures upstream) with no significant change in bed material (Mussetter 2006). The slope of the riverbed is less than 0.01 feet per foot (Tashjian 1999). At flows less than the bankfull, the river is establishing a sinuous configuration within the cleared floodway.

Hydrology

The hydrology of the Middle Rio Grande has been well documented. There are numerous reports that provide a good summary of the data collected. Among these reports are the MRGBBMP and Bio-Park Project (USACE 2003). These two reports provide the basis for most of the text within this section.

The hydrology of the Middle Rio Grande Valley has historically followed a pattern of high flows during spring snow melt runoff and low flows during the fall and winter months and short duration high flows from summer precipitation events.

Although considered a perennial river prone to major floods, there are reaches of the Middle Rio Grande that currently experience no surface flow during some summer months in dry climatic periods. It is likely that in certain dry years, this was the case prior to man's settlement of the area as well.

Construction of reservoirs, jetty jack fields, and levees for flood control was initiated beginning in the early 1900s. The Middle Rio Grande hydrology has been altered dramatically by the flood control facilities. Average yearly hydrographs for pre- and post-Cochiti Dam periods shows that Cochiti Dam has reduced the peak flows and extended the duration of the high-flow period. In addition, average winter base flows are somewhat larger during the post-dam period.

The actual flood flow capacity of the Rio Grande is determined by the location, size, and strength of the levee system and natural features such as terraces, mesas, and rock outcrops. Within the Middle Rio Grande, the reach through Albuquerque has the highest flood flow capacity: 20,000 cubic feet per second (cfs) for sustained (spring) flows and 42,000 cfs for short duration (summer) flows. At the other extreme is the reach in the Corrales area on the east side, and between Albuquerque and Isleta on both sides of the river. In these areas the flood flow capacity is generally only 7,500 cfs (USACE 2008b). Recently completed work on the Corrales levee may have increased this capacity.

Water Quantity and Quality

It is estimated that the average annual water loss due to Evapo-transpiration (ET) in the Middle Rio Grande riparian corridor accounts for 20-50 percent of that reach's total water depletion (Dahm *et al.* 2002). Bosque ET appears to be higher in dense stands of saltcedar and in mature stands of cottonwood containing an extensive understory of saltcedar and Russian olive than it is in less dense saltcedar stands and mature cottonwood stands with few understory trees (Dahm *et al.* 2002). The proposed project area contains large areas that are predominately tall trees with a relatively dense understory of saplings and shrubs and open stands of mid-sized tress with widely scattered shrubs and sparse herbaceous growth, although most of the understory is composed of saltcedar (USACE 2008a).

There are numerous storm water outfalls to the Rio Grande in the proposed project area. Contaminants introduced to the Rio Grande from these outfalls include solid waste, oils, pesticide and herbicide residues, phosphorous, nitrogen, and fecal coliform (Tague and Drypolcher, 1979).

Vegetation Changes

A major change in vegetation dynamics in the bosque ecosystem has been loss of meander cut-off, meander migration, and flood scour processes, which were a driving force in the dynamics of the naturally functioning system. These processes removed existing vegetation and created new sites for founding of plant communities. Sediment deposition in the proposed project area is now restricted to a few, largely ephemeral, mid-channel bars and transitory lateral bars proximal to the river. Meander cut-off and lateral meander migration no longer occur. Bare soil sites are now created primarily through mechanical disturbance or fire; typically in areas no longer subject to periodic inundation and with relatively dry soil moisture regimes (Pittenger 2003).

Non-native plant species have become prominent in the bosque. Saltcedar is now a prominent colonizer of exposed, bare soil sites in the bosque (Smith *et al.* 2002). Saltcedar produces seed for several months beginning in spring whereas cottonwood (*Populus deltoides wislizenii*) produces seed only for a short time in the spring, which remains viable for only about month and a half under ideal conditions (Horton *et al.* 1960). The flowering and fruiting phenology of saltcedar allows seedlings to establish on and dominate open sites wetted by runoff, rainfall, or river flows during the summer, precluding the possibility of cottonwood establishment on potentially suitable sites the following spring.

Fire was virtually unknown in naturally functioning, low-elevation riparian ecosystems of the Southwest (Busch and Smith 1993, Steuver 1997). However, fuel accumulations coupled with mainly human-caused ignitions have introduced fire as a major disturbance mechanism in the bosque ecosystem (Steuver 1997). Russian olive was present in the bosque in 1981 (Hink and Ohmart 1984) and continues to increase in the understory of the cottonwoods in the proposed project area (Sivinski *et al.* 1990).

Several other non-native tree species, in addition to saltcedar and Russian olive, are at least locally common, if not abundant. These species are Siberian elm, tree of heaven, and mulberry (*Morus alba*). All three species are shade-tolerant and readily colonize disturbed sites (Crawford *et al.* 1993, Sivinski *et al.* 1990).

Jurisdictional wetlands were found at various locations in the proposed project area. These wetlands were characterized by shallow depth to water, saturated soils near the surface, organic-streaked sandy soils below about 10 inches, and vegetation dominated by coyote willow, cottonwood, inland saltgrass (*Distichlis spicata*), and Russian olive.

Water management, including development of impoundments, levees, and diversions have drastically altered natural hydrological processes (e.g., spring and monsoonal runoff). This altered hydrology limits natural regeneration of native cottonwoods and willows, and promotes the growth of non-native saltcedar and Russian olive, which are replacing the native cottonwood/willow vegetative complex. As a result of these changes, the quality and quantity of fish and wildlife habitat has steadily decreased (USFWS 2001).

A listing of common and scientific names of plants that may occur in the Middle Rio Grande floodplain is provided in Appendix A.

<u>Fish and Wildlife Changes</u>

Residential development, agricultural conversion and subsequent irrigation systems, and construction of bridges/roads resulted in the permanent loss of all habitats within developed areas. Development has also caused a disruption of animal movement and dispersal patterns, and has caused continual disturbance to animal communities in the adjacent, fragmented portions of the bosque (Crawford *et al.* 1993). Residential development, agricultural conversion and subsequent irrigation systems, and construction of bridges and roads resulted in permanent loss of all habitats in the developed area, disruption of animal movement and dispersal, and creation of a continual disturbance that affects animal communities in the adjacent fragmented portions of the bosque (Crawford *et al.* 1993).

The uniqueness of the Rio Grande system and its critical value as wildlife habitat make it of the utmost significance as a resource. The bosque is unique; it is a thin line of significant riparian habitat in an arid landscape of the Southwest. The habitat quality, although diminished over the past few decades, still remains one of the most significant in the region. Over 300 species of birds, mammals, amphibians and reptiles live in the bosque, which are more than double those found in any other major ecosystem in the State. In addition to the indigenous wildlife species, the bosque serves as a migration route for thousands of North American birds moving along the Central Flyway.

An estimated 407 species of vertebrates may occur in aquatic, wetland, or riparian habitat in Bernalillo County, based on a query of the Biota Information System of New Mexico (version 1/00). This estimate includes 24 species of fish, 11 amphibian taxa, 39 species of reptiles, 279 species of birds, and 54 mammalian taxa (Pittenger 2003). Birds based on number of taxa, comprise 69 percent of all vertebrate species in the estimate.

Historically, 27 native fish species occupied the Rio Grande drainage (Sublette *et al.* 1990). Many native fish are extinct or extirpated from the Rio Grande in New Mexico. There are at least 31 introduced or non-native fish species within the Rio Grande drainage (Sublette *et al.* 1990). A considerable number of non-native fishes have been introduced into the Middle Rio Grande, either accidentally or as game fish by the New Mexico Department of Game and Fish. See Appendix C for a listing of common and scientific names of fish that may occur in the Middle Rio Grande.

Wetlands and slack water areas are scarce (Crawford *et al.* 1993). The cold, clear water releases from Cochiti Dam and the entrenched channel, armored with a gravel bed, have created an aquatic system that favors cool-water fishes and invertebrates, and limits warm-water fisheries below the dam downstream to Albuquerque. Consequently, the existing aquatic resources in the proposed project area differ from those that occurred historically due to human activities (Crawford *et al.* 1993). The loss of native fish species in the Middle Rio Grande illustrates that the hydrologic and morphological changes in the channel have had a major impact on fishery resources. The Rio Grande silvery minnow (minnow) (*Hybognathus amarus*) is the only native pelagic, broadcast spawning minnow surviving in the Middle Rio Grande (Bestgen and Platania 1991).

DESCRIPTION OF THE PROJECT AREA

The Middle Rio Grande bosque is a riparian area located in the middle reach of the Rio Grande, in the vicinity of the City of Albuquerque, New Mexico. The area is maintained as a part of the Middle Rio Grande Flood Control Acts of 1941 and 1950 and is within the Facilities of the *Middle Rio Grande Floodway Project* which resulted in the construction of additional levees and dams between Espanola and San Marcial, NM (USACE 2002, 2003a, 2008a, b). The bosque area within Albuquerque was designated as the *Rio Grande Valley State Park* through the Park Act of 1983 and is cooperatively managed by the AOSD and the MRGCD (Figure 1). That is, the bosque is offered protection as a state park but without state operating funds and is administered by the City of Albuquerque and MRGCD through formal agreements.

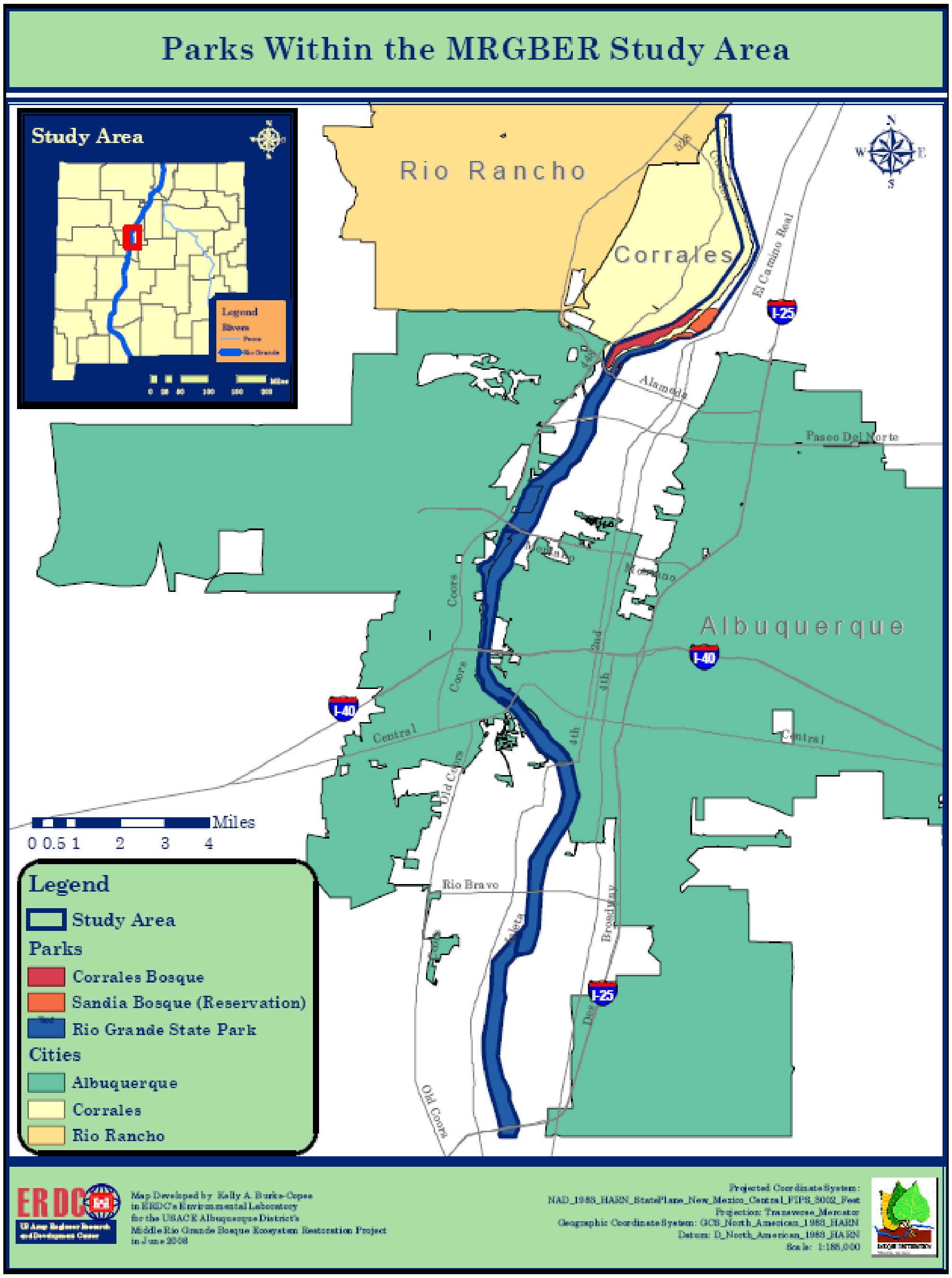

Figure 1 Project Area.

The system was so large, and the relative effects of proposed designs were localized to some degree, the project area was divided into five reaches on the basis of stakeholder interests, infrastructure (particularly bridges), hydrologic input, vegetative community makeup, and geographic location (Figure 2).

The northern extent of the Corrales Bosque Preserve forms the north boundary of the proposed project area, while the southern boundary is formed by the northern limits of the Pueblo of Isleta (Figure 2). The area is defined on the east and west by the flood control levees, although the areas adjacent to the levees within the original floodplain have also been considered in this report. The proposed project area is approximately 26 miles in length along the river and roughly 5,300 acres in size. The bosque that embraces the proposed project area was historically arguably one of the largest cottonwood riparian galleries in the southwestern United States.

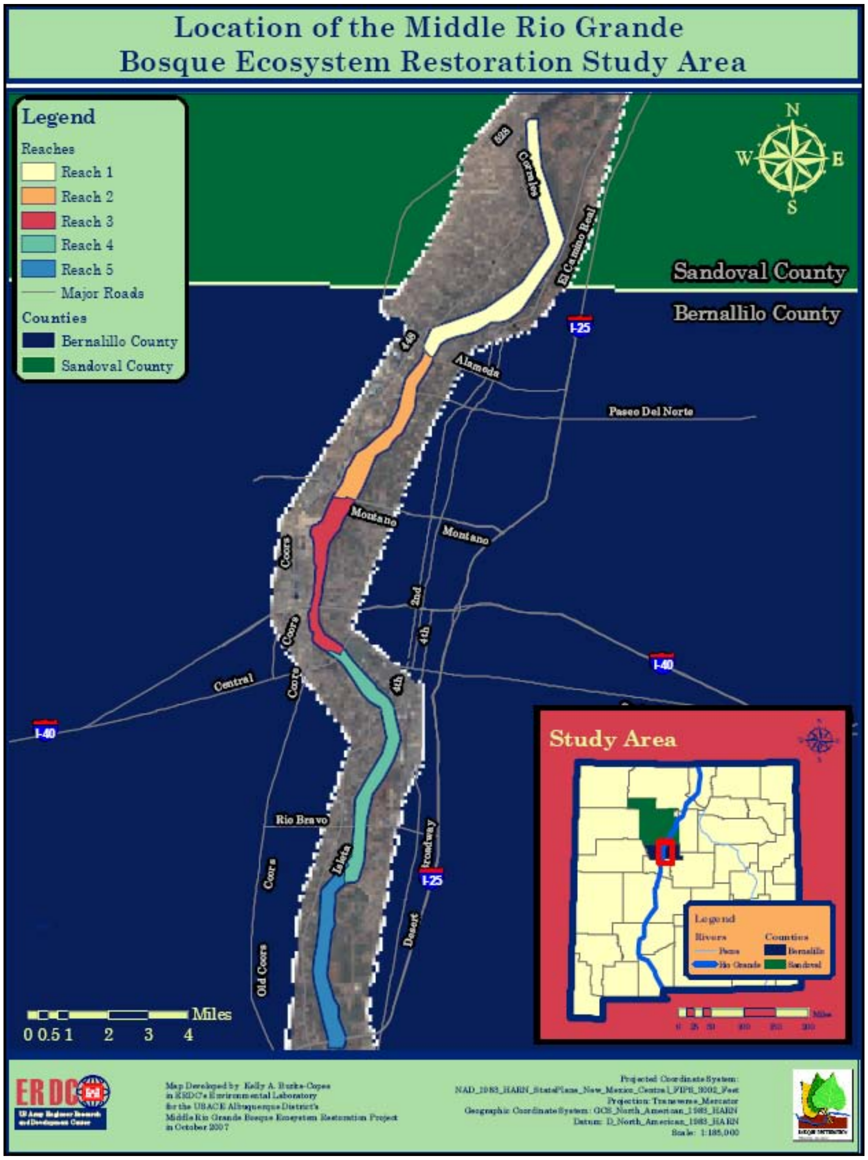

Figure 2 Reaches delineated for the Middle Rio Grande Feasibility Study

The overall goal of the project is to restore the dynamic bosque mosaic of open areas, woodland patches, shrub patches and wet areas. The ecosystem restoration objectives for the project include: 1) enhancement of the native cottonwood community; 2) enhancement and increasing the number of water-related habitat features in the bosque; 3) implement limited measures to rehabilitate some hydraulic connection between the bosque and the river consistent with operational constraints; 4) protect, extend and enhance areas of potential habitat for listed species within the existing bosque; 5) prevent catastrophic fires in the bosque through the reduction of fuel loads identified as hazardous; 6) develop and implement with the sponsor a long-term Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) plan and long-term monitoring strategy; 7) coordinate and integrate related project planning and monitoring with other ongoing restoration and research efforts in the bosque; and 8) increase access and opportunities for education and low-impact recreation that is compatible with ecosystem integrity.

EXPLANATION OF FISH AND WILDLIFE RESOURCE CONCERNS AND PLANNING OBJECTIVES

The primary goal and effect of implementation of the Preferred Alternative is to re-vegetate with native species, which would create a healthier ecosystem in the long-term for native wildlife. Without implementation of the Preferred Alternative short-term negative affects on fish and wildlife with long-term positive benefits would not occur.

The Service's concerns that are related to the proposed project objectives and are:

1) Environmental degradation of the Bosque ecosystem;
2) Loss of habitat for special status species;
3) Existence of fire hazard;
4) Persistence of non-native plant species;
5) Current water and future operations and maintenance;
6) Need for coordination of multi-agency effort and ongoing projects;
7) Impact of neighboring land uses on the bosque; and
8) Availability of water for multiple uses.

Water resources projects are planned and implemented to solve problems, meet challenges and seize opportunities. The identification of problems and opportunities gives focus to the planning effort and aids in the development of planning objectives. Problems and opportunities can also be viewed as local and regional resource conditions that could be modified in response to expressed public concerns.

On a regional scale, estimates of riparian habitat loss in the Southwest range from 40 percent to 90 percent (Dahl 1990 *In* USACE 2008b), and desert riparian habitats are considered to be one of this region's most endangered ecosystems (Minckley and Brown 1994 *In* USACE 2008b). Decline of natural riparian structure and function of the bosque ecosystem was recognized in the 1980s as a major ecological change in the MRG (Hink and Ohmart 1984; Howe and Knopf, 1991). In ecological terms, the cumulative effects of agriculture, urban development and flood protection measures initiated over the last seven decades have resulted in a disruption of the original hydrologic (hydraulic) regime along the Albuquerque reach of the Middle Rio Grande and the ultimate degradation of the bosque ecosystem. This regime is key to sustaining and regenerating a variety of ecological components that make up the bosque, and the wildlife that it supports. Whereas it is not possible to return the Middle Rio Grande to its pre-flood protection state there are abundant opportunities to restore function and habitat value within the constraints of current water use restrictions and without imposing flood damages.

EVALUATION METHODOLOGY

Since project planning began in 2002, the Service has attended meetings with the USACE, MRGCD, and the City of Albuquerque to discuss project features, design, and construction methods. The Service and USACE also conducted a joint field trip to the Project Area. Additional biological data and background information were derived through review of relevant literature and personal communications. The USACE and the City of Albuquerque have provided a majority of the technical and background information. Surveys for the southwestern willow flycatcher were conducted in the project vicinity, but no flycatchers were detected within the Preferred Alternative area. Minnow surveys were conducted in the Rio Grande along the Albuquerque reach in previous years.

DESCRIPTION OF FISH AND WILDLIFE RESOURCES: EXISTING AND FURTURE WITHOUT THE PROJECT

Aquatic Resources

Aquatic Resources Existing

In New Mexico, 27 native fish species and 33 non-native species occur in the Rio Grande (Sublette *et al*. 1990). Coldwater species are prevalent in the upper drainages (upstream of Cochiti Lake), with warmwater species dominating the fauna near Elephant Butte Reservoir. The fishery in the Middle Rio Grande contains both coldwater and warmwater species.

Fish sampling by Platania (1993) from 1986 to 1991 in the Rio Grande from Velarde to Elephant Butte Reservoir confirmed 24 species. In the Rio Grande from Albuquerque to Elephant Butte Reservoir the water is warmer, and more turbid. The most numerous fish captured in this stretch were re shiner, Rio Grande silvery minnow, western mosquitofish, and flathead chub.

A listing of common and scientific names of fish that may occur in the Middle Rio Grande floodplain is provided in Appendix C.

Terrestrial Resources

Vegetation Existing

Human populations have increased along the Rio Grande since European settlement. Irrigation, domestic water consumption, agriculture, development of urban centers, livestock grazing, and recreation have changed the Rio Grande ecosystem by altering flood cycles, channel geomorphology, watershed processes, and water quality and quantity. These alterations of abiotic factors have influenced the biological diversity and ecological functions of the Rio Grande, changing the distribution, structure, and composition of riparian plant and animal communities. The change from a mosaic of native plant communities of various structures and ages to increasingly large stands of non-native forest has affected the overall value of aquatic and terrestrial wildlife habitat provided by the bosque.

The Middle Rio Grande bosque, represents the largest cottonwood riparian forest in the southwestern United States. This reach of the Middle Rio Grande extends from Cochiti Dam downstream 160 miles to San Marcial, New Mexico. The valley traverses three major biotic communities: Plains and Great Basin Grassland, Semidesert Grassland, and the Chihuahuan Desertscrub (Brown and Lowe 1980). The Rio Grande is regulated for water supply (primarily irrigation) and flood control the regulation has contributed to the character of the riparian ecosystem in its current expression.

The loss of wetlands, braided channels and backwaters has reduced the extent and quality of aquatic habitat and the potential for aquifer recharge.

The lack of inundation, scouring and sediment deposition within the bosque has curtailed native tree species such as cottonwood and willow seedling recruitment, increased the mortality rate of cottonwoods and willows, and resulted in significant leaf litter and dead and down wood, as well as a skewed age structure in the remaining cottonwood stands.

The past water management operations and flood control measures, including levees, jetty jacks and upstream dams, have eliminated the historic broad, meandering channel and the flood regime that had resulted in periodic inundation of the bosque.

Saltcedar is now a prominent colonizer of exposed, bare soil sites in the Bosque (Smith *et al*. 2002). While individual cottonwood seedlings have a greater competitive effect relative to saltcedar seedlings under ideal soil moisture conditions (Sher *et al*. 2000 *in* USACE 2008b), the competitive effect is lost under conditions of water stress or elevated salinity (Busch and Smith 1995). Saltcedar produces seed for several months beginning in late spring (Ware and Penfound 1949, Horton *et al*. 1960) and therefore colonizes bare, moist-soil sites throughout the summer. Cottonwood, on the other hand, produces seed only for a short time in the spring and seed remains viable for only about month and a half under ideal conditions (Horton *et al*. 1960). The flowering and fruiting phenology of saltcedar allows seedlings to establish on and dominate open sites wetted by runoff, rainfall, or river flows during the summer, precluding the possibility for cottonwood establishment on potentially suitable sites the following spring. Saltcedar also becomes established in the understory of mature cottonwood stands in the proposed project area where there is sufficient light (Crawford *et al*. 1996). Russian olive is established by seed in the understory of mature cottonwood stands and also colonizes openings along the river, often forming dense stands (Hink and Ohmart 1984, Sivinski *et al.* 1990). Russian olive is also shade tolerant and can survive in areas where cottonwood canopy exists. Seeds germinate in moist to dry sites and the plant sprouts readily from the root crown after damage to or removal of above-ground portions of the plant (Sivinski *et al.* 1990). Russian olive was present in the understory in 1981 (Hink and Ohmart 1984) and continues to increase in the bosque in the proposed project area (Sivinski *et al.* 1990).

Several other nonnative tree species, in addition to saltcedar and Russian olive, are at least locally common, if not abundant, in the overstory. These species are Siberian elm, tree of heaven, and Russian mulberry. All three species are shade-tolerant and readily colonize disturbed sites (Crawford *et al.* 1996, Sivinski *et al.* 1990). Siberian elm was rare in the bosque in 1981 when it was found only at very low densities, ranging from less than 0.5 tree/acre to 3 trees/acre (Hink and Ohmart 1984). However, Siberian elm had become increasingly abundant by 1990 (Sivinski *et al*. 1990) and is now very common in the overstory. This species produces large seed crops and is ubiquitous in the proposed project area as seedlings, saplings, and mature trees. It sprouts readily from the root crown. Siberian elm seed will germinate under normal rainfall conditions and does not require moist or saturated soils (Sivinski *et al*. 1990). Tree of heaven and Russian mulberry are more localized in their distribution in the proposed project area than saltcedar, Russian olive, or Siberian elm. Both of these species typically colonize disturbed areas, such as along levees and in severely burned sites (Sivinski *et al*. 1990).

Fire was virtually unknown in naturally functioning, low-elevation riparian ecosystems of the Southwest (Busch and Smith 1993, Stuever 1997). However, fuel accumulations coupled with mainly human-caused ignitions have introduced fire as a major disturbance mechanism in the Bosque ecosystem (Stuever 1997). While Cottonwood is highly susceptible to fire-induced mortality (Stuever 1997), saltcedar re-sprouts vigorously following fire (Busch and Smith 1993, Busch 1995). Cottonwood and willow (*Salix* spp.) are poorly adapted to fire and lack an efficient post-fire re-sprouting mechanism such as that found in saltcedar (Busch and Smith 1993).

Mammals Existing

Existing mammal populations are also a result of the existing water operations and land uses in the proposed project area. Hink and Ohmart (1984) performed systematic floral and faunal surveys throughout the Middle Rio Grande. Residential development, agricultural conversion and subsequent irrigation systems, and construction of bridges/roads resulted in the permanent loss of all habitats within the developed areas. Development has also caused a disruption of animal movement and dispersal patterns, and has caused continual disturbance to animal communities in the adjacent, fragmented portions of the bosque (Crawford *et al*. 1993).

The largest mammals likely to occur in the proposed project area are black bear, mule deer, and coyotes. Other mammals such as raccoon, beaver, muskrat, long-tailed weasel, and striped skunk also occur as well. Desert cottontail rabbit, black-tailed jackrabbit, rock squirrel, pocket gopher, deer mouse, western harvest mouse, and American porcupine are also likely to occur. Terrestrial wildlife that was extirpated from the Rio Grande drainage included the gray wolf, jaguar, grizzly bear, river otter, and mink (Hink and Ohmart 1984).

Eleven species of bats are found along the Rio Grande (Findley *et al.* 1975). Two bat species are restricted to riparian areas, the Yuma myotis and little brown bat. Approximately 46 mammalian species currently occur within the Middle Rio Grande (see Appendix B for a listing of common and scientific names of mammals).

Declining species are associated with decreasing native riparian areas, and the increasing species are associated with agricultural areas (Thompson *et al.* 1994). Therefore, changes in the fish and wildlife community of the Rio Grande are largely due to the direct and indirect effects of human settlements and/or development and manipulation of the Rio Grande and associated changes in watershed and riparian zones.

Opportunities exist to increase in the amount of moist, densely-vegetated habitats and coyote willow stands would also likely increase the abundance of small mammals. The amount of habitat for mammal species associated with wetlands in the bosque would increase.

<u>Birds Existing</u>

Avian species studies in the Rio Grande corridor have documented an abundance of species. Hink and Ohmart (1984) documented 277 bird species and found that riparian areas are used heavily. Cottonwood-dominated community types are used by large numbers of bird species, and are preferred habitat for a large proportion of the species, especially during breeding season. Bird density appears to be strongly related to density of foliage, regardless of species composition of the plant community. In the Hink and Ohmart study, bird densities were higher in stands of non-native trees and shrubs. Marshes, drains, and areas of open water contribute to the bird diversity of the riparian ecosystem because of the strong attraction by water-loving birds. At various times of the year, such as during migration, riparian areas support the highest bird densities and species richness in the Middle Rio Grande region.

Migratory birds that nest in North America usually follow the major north and south waterways. River corridors may be more important to migrating birds in deserts that in other regions of North America. During spring and fall migration, riparian habitats can attract more that 10 times the number of migratory birds compared to surrounding upland sites (Stevens *et al*. 1977, Hehnke and Stone 1979, Hink and Ohmart 1984). Riparian habitats along the Rio Grande are potential stopover sites for migratory birds that use the great Plains-Rocky Mountain “flight route” (Finch *et al*. 1995). Riparian corridors may provide suitable habitat at an especially critical time for migratory birds. The availability of the food, water, cover, and north-south orientation of the Rio Grande contributes to survival and guides migration of land birds (Ligon 1961, Stevens *et al*. 1977, Wauer 1977, Finch 1991).

The river in and near the proposed project area provides habitat on a seasonal basis for a variety of waterfowl including Canada geese, mallard, gadwall, green-winged teal, American widgeon, northern pintail, northern shoveler, ruddy duck, and common merganser. Shorebirds such as the spotted sandpiper and killdeer may occur. Raptors include the bald eagle, turkey vulture, northern harrier, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, American kestrel, common barn owl, and great-horned owl. Game species include the mourning dove and scaled quail.

Opportunities exist to increase in the amount of moist, densely-vegetated habitats and coyote willow stands would also likely increase the abundance of birds. The amount of habitat for avian species associated with wetlands in the bosque would increase.

A listing of common and scientific names of birds that may occur in the Middle Rio Grande floodplain is provided in Appendix D.

Reptiles and Amphibians Existing

Fifty-seven species of reptiles and 13 amphibian species were recorded in the Middle Rio Grande Valley (Degenhardt *et al*. 1996). Hink and Ohmart (1984) documented 3 turtle species, 17 lizard species, and 18 snake species in the Middle Rio Grande Valley. Many of these are upland species that do not occur regularly in the riparian habitats. Riparian and upland habitats in the Project Study Area likely support a diverse assemblage of reptiles and amphibians. Most amphibians depend on the aquatic habitat of riparian areas for at lease a portion of their lifecycle, which are generally lacking in the Project Study Area.

Opportunities exist to increase in the amount of moist, densely-vegetated habitats and coyote willow stands would also likely increase the abundance of reptiles and amphibians. The amount of habitat for reptiles and amphibians species associated with wetlands in the bosque would increase.

A listing of common and scientific names of reptiles and amphibians that may occur in the Middle Rio Grande floodplain is provided in Appendix E.

Endangered Species Existing

As the quality and quantity of the fish and wildlife habitat within the Middle Rio Grande corridor has decreased so has its ability to sustain certain native flora and fauna. Several species endemic to the Middle Rio Grande are extinct, extirpated, or have been federally listed as threatened or endangered under the Endangered Species Act (ESA). This CAR provides information concerning the federally listed endangered Rio Grande silvery minnow with designated critical habitat and the endangered southwestern willow flycatcher that may be affected by the proposed project.

Southwestern Willow Flycatcher Existing

The flycatcher was listed as endangered, without critical habitat, on February 27, 1995 (USFWS

1995). Critical habitat was later designated on July 22, 1997 (USFWS 1997). A correction notice was published in the Federal Register on August 20, 1997 to clarify that lateral extent of the designation (USFWS 1997).

On May 11, 2001, the 10th circuit court of appeals set aside designated critical habitat in those states under the 10th circuit's jurisdiction (New Mexico). The Service decided to set aside flycatcher critical habitat in all other states (California and Arizona) until it could re-assess the economic analysis.

On October 19, 2005, the Service re-designated willow flycatcher critical habitat (USFWS 2005). A total of 737 river miles across southern California, Arizona, New Mexico, southern Nevada, and southern Utah were included in the final designation. The lateral extent of critical habitat includes areas within the 100-year floodplain. The primary constitute elements of critical habitat are based on riparian plant species, structure and quality of habitat, and insects for prey. A variety of river features such as broad floodplains, water, saturated soil, hydrologic regimes, elevated groundwater, fine sediments, etc. help develop and maintain these constituent elements (USFWS 2005).

The Southwestern Willow Flycatcher Recovery Plan was completed in 2002 (USFWS 2002). The plan describes the reasons for endangerment, current flycatcher status, addresses important recovery actions, and provides recovery goals. Recovery is based on reaching numerical and habitat related goals for each specific Management Unit established throughout the flycatcher's range and establishing long-term conservation plans (USFWS 2002).

The flycatcher is a riparian obligate and nests in riparian thickets associated with streams and other wetlands where dense growths of willow, buttonbush, boxelder, Russian olive, saltcedar or other plants are present. Nests are often associated with an overstory of scattered cottonwood. Throughout the flycatcher's range, these riparian habitats are now rare, widely separated by vast expanses of arid lands, in small and/or linear patches.

Potential flycatcher habitat exists along the Rio Grande in the Albuquerque area. This habitat is primarily composed of riparian shrubs and trees, chiefly Goodding's, peachleaf, and coyote willow, Rio Grande cottonwood, and saltcedar. The habitat within the Project Study Area may be used by migrating flycatchers.

The flycatcher is a neotropical migrant that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). Flycatcher breeding range includes southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja) (Unitt 1987, USFWS 2002).

The flycatcher breeds in dense riparian habitats from sea level in California to approximately 8,500 feet in Arizona and southwestern Colorado. Historical egg/nest collections and species' descriptions throughout its range describe the flycatcher's widespread use of willow (*Salix spp.*)

for nesting (Phillips 1948, Phillips *et al.* 1964, Hubbard 1987, Unitt 1987, San Diego Natural History Museum 1995). Currently, flycatcher primarily use Geyer willow (*Salix geyeriana*), coyote willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*), boxelder (*Acer negundo*), saltcedar, Russian olive, and live oak (*Quercus agrifolia*) for nesting. Other plant species less commonly used for nesting include: buttonbush (*Cephalanthus* sp.), black twinberry (*Lonicera involucrata*), cottonwood, white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* spp.). Four basic vegetation communities provide flycatcher habitat: monotypic willow, monotypic exotic, native broadleaf dominated, and mixed native/exotic (Sogge *et al.* 1997).

Saltcedar is an important component of the flycatcher's nesting, foraging, and migrating habitat within the bird's range. In 2006 in Arizona, 68 percent of known flycatcher nests were built in a saltcedar tree (Graber *et al*. 2007). Saltcedar had been believed to provide of lesser quality willow flycatcher habitat. However comparisons of reproductive performance (USFWS 2002), prey populations (Drost *et al*. 2001) and physiological conditions (Owen and Sogge 2002) of flycatcher breeding in native and exotic vegetation has revealed no difference (Sogge *et al*. 2005).

Flycatcher habitat is dynamic and can change rapidly: nesting habitat can grow out of suitability; saltcedar habitat can develop from seeds to suitability in five years; heavy runoff can remove/reduce habitat suitability in a single flood event; or river channels, floodplain width, location, and vegetation density may change over time. The flycatcher habitat use in different successional stages may also be dynamic. For example, over-mature or young habitat not suitable for nest placement can be occupied and used for foraging and shelter by migrating, breeding, dispersing, or non-territorial flycatcher (Cardinal and Paxton 2005, McLeod *et al.* 2005). That same habitat may subsequently grow or cycle into habitat used for nest placement. Flycatcher habitat can quickly change and vary in suitability, location, use, and occupancy over time (Finch and Stoleson 2000).

In 2007, there were 284 known flycatcher breeding sites in California, Nevada, Arizona, Utah, New Mexico, and Colorado (all sites from 1993 to 2006 where a resident flycatcher had been detected) holding an estimated 1,262 territories (Durst *et al*. 2007). A grand total of flycatcher territories can not be determined because not all sites are surveyed annually. Numbers have increased since the bird was listed and some habitat remains un-surveyed; however, after nearly a decade of intense surveys, the existing numbers are just past the upper end of Unitt's (1987) estimate of 20 years ago (500-1000 pairs).

The most significant factor affecting flycatcher within the proposed project area is habitat loss through fragmentation and vegetation modification. The lack of flood pulses, levee construction, and narrowing of shorelines due to river regulation may limit the availability of native riparian nesting habitat to develop.

Cottonwood and willow replacement by saltcedar and phragmites (*Phragmites sp.*) has changed the historical fire regime on the Middle Rio Grande. Cottonwoods are often killed by fire, but willows can re-sprout from the root crowns. Saltcedar become established in riparian communities where native species are stressed by water table declines and where flow regimes that allow for native vegetation establishment and maintenance have been changed or eliminated. As in the case with willow, saltcedar aggressively re-sprouts after burning; however, saltcedar is more efficient in water acquisition and can gain a competitive edge (Busch and Smith 1995). Saltcedar flammability increases with the build-up of dead and senescent woody material within the plant community. Dense saltcedar stands can be highly flammable where limited or non-existent flooding allows leaf litter to accumulate (UFSWS 2002).

Flycatchers begin arriving in New Mexico in late April and May to nest, and the young fledge in early summer. Flycatchers nest in thickets of trees and shrubs with a densely vegetated understory from the ground or water surface. Surface water or saturated soil is usually present beneath or next to occupied thickets (Phillips *et al.* 1964, Muiznieks *et al.* 1994). At some nest sites, surface water may be present early in the nesting season with only damp soil present by late June or early July (Muiznieks *et al.* 1994, Sferra *et al.* 1995). Habitats that not selected for nesting or singing are narrower riparian zones with greater distances between willow patches and individual willow plants. Suitable habitat adjacent to high gradient streams does not appear to be used for nesting. Areas not selected for nesting or singing may still be used during migration.

This project would create additional habitat that would potentially benefit the flycatcher. The proposed project would create management solutions that may partially fulfill requirements of the "Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of the Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, New Mexico," for the flycatcher and its potential habitat.

Rio Grande Silvery Minnow Existing

The minnow was formerly one of the most widespread and abundant species in the Rio Grande Basin occurring from Española, New Mexico, to the Gulf of Mexico (Bestgen and Platania 1991). The silvery minnow currently occupies a 170-mile reach of the Middle Rio Grande, New Mexico, from Cochiti Dam, Sandoval County, to the headwaters of Elephant Butte Reservoir, Socorro County (USFWS 1994). Currently is the only remaining endemic pelagic spawning minnow in the Middle Rio Grande.

The minnow was federally listed as endangered under the Endangered Species Act on July 20, 1994 (USFWS 1994). In addition, the proposed action area overlaps designated critical habitat for the minnow. A description of the species, it status, and designated critical habitat are provided below. The species is also listed as an endangered species by the State of New Mexico. Primary reasons for listing the minnow are:

1. Regulation of stream waters, which has led to severe flow reductions, often to the point of dewatering extended lengths of stream channel;

2. Alteration of the natural hydrograph, which impacts the species by disrupting the environmental cues the fish receives for an variety of life functions, including spawning;

3. Both the stream flow reductions and other alterations of the natural hydrograph throughout the year can severely impact habitat availability and quality, including the temporal availability of habitats;

4. Actions such as channelization, bank stabilization, levee construction, and dredging result in both direct and indirect impacts to the minnow and its habitat by severely disrupting natural fluvial processes throughout the floodplain;

5. Construction of diversion dams fragment the habitat and prevent upstream migration;

6. Introduction of non-native fishes that directly compete with, and can totally replace the minnow, as was the case in the Pecos River, where the species was completely replaced in a time frame of 10 years by its congener the plains minnow (*Hybognathus placitus*); and

7. Discharge of contaminants into stream system from industrial, municipal, and agricultural sources also impact the species (USFWS 1994).

The Service designated critical habitat for the minnow on February 19, 2003 (USFWS 2003). The critical habitat designation extends approximately 157 miles from Cochiti Dam, Sandoval County, New Mexico, downstream to the utility line crossing the Rio Grande, which is a permanent identified landmark in Socorro County, New Mexico. The critical habitat designation defines the width as those areas bounded by existing levees or, in areas without levees, 300 feet of riparian zone adjacent to each side of the bankfull stage of the Middle Rio Grande. Some developed lands within the 300-feet lateral extent are not considered critical habitat because they do not contain the primary constituent elements of critical habitat and are not essential to the conservation of the minnow. Lands located within the lateral boundaries of the critical habitat designation, but not considered critical habitat include: developed flood control facilities, existing paced roads, brides, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the Low Flow Conveyance Channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments. The Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta within the area are not included in the critical habitat designation. Except for these Pueblo lands, the remaining portion of the minnow's occupied range in the Middle Rio Grande in New Mexico is designated as critical habitat.

Within the proposed project area, past actions have eliminated and severely altered habitat conditions for the minnow. Narrowing and channel deepening, restraints to channel migration through jetty jacks, the invasion of non-native vegetation species, and changes in the flow regime have all adversely affected the minnow and its habitat. These environmental changes have degraded spawning, nursery, feeding, resting, and refugia areas required for species survival and recovery (USFWS 1993).

Future Fish and Wildlife Resources Without the Project

In order to evaluate the effectiveness of the proposed project it must be compared to the most likely future condition anticipated if no action is taken. By comparing fish and wildlife resources without the project to the most likely future with the project conditions it is possible to assess the difference or amount of improvements or enhancements the project may have over the long term. Without the project, the bosque in the proposed project area would continue to decline, decreasing both in habitat value and as a resource for the greater Albuquerque community (USACE 2008b). The size and density of non-native vegetation patches, composed of Siberian elm, Russian olive, saltcedar, tree of heaven and white mulberry, are likely to increase as they out-compete the native cottonwoods, willows and other native understory and mid-canopy plants. Native vegetation would not be planted to help increase their population. High flow channels would not be constructed, and therefore a diversity of habitat created in these high flow channels would not occur. Without the proposed project implementation, a mosaic of different vegetation types as described would not occur. Non-native vegetation would continue to overtake the existing native vegetation and create thick patches of fuel for potential fire. Despite the best efforts of the AOSD and MRGCD, devastating fires are likely to increase in number and magnitude. The future bosque is likely to have a very different character than the current bosque.

Changes to the river channel and the floodplain affect how base flow and flood currents move downstream and across the floodplain. They have effects on patterns of erosion, aggradation, and maintenance or regeneration of riparian vegetation. Some Federal activities are coordinated with the Service and often result in reducing impacts and may include additional measures that offset adverse impacts. These projects are limited in geographic extent and cannot by themselves restore the Rio Grande ecosystem.

The river dynamics that native flora and fauna depend on have been so modified that these communities are no longer able to sustain themselves, and clearly the ecosystem is stressed (Crawford *et al*. 1993). Wetland and riparian areas have been greatly reduced and fragmented, diminishing the quality and quantity of suitable wildlife habitat.

Aquatic Resources Without the Project

Aquatic habitat in the proposed project area is directly influenced by stream discharge volumes, patterns and sediment supply (USACE 2008b). Bank erosion, and thus direct sediment input from the proposed project area and local channel dynamics, is unlikely to change without implementation of the proposed project. Other agency initiatives have created potential habitat for the minnow. Without the project existing aquatic conditions would remain largely unchanged.

Wetlands consist of marches, wet meadows, and seasonal ponds that typically support hydrophytic plants such as cattails, sedges and rushes. Wet meadows were the most extensive habitat type in the Middle Rio Grande valley prior to the construction of the MRGCD drains and ditches. From 1918 to present, wetland-associated habitats have undergone a 93 percent reduction (Hink and Ohmart 1984). Wetlands are an integral component of the bosque ecosystem, not only increasing its diversity but also enhancing the value of surrounding plant communities for wildlife. Among the greatest needs of riparian ecosystem are the preservation of existing wetlands and expansion or creation of additional wetlands (Crawford *et al.* 1993). Without the project wetland restoration/construction, bank destabilization, construction of high flow channels, and construction of willow swales would not take place. Wetlands would continue to degrade and could be lost altogether from the Middle Rio Grande reach.

Under historic flood flow regimes, high flow channels were once part of the river form and function. Without the project the bosque-river connection, cleaning out debris, increase in the habitat quality would not take place. Without the project high flows would not be delivered much needed water to bosque vegetation nor increase potential water-based habitats for animals. Without the project willow swale construction and/or restoration would likely not be created. The removal of jetty jacks would not take place. Without willow swale creation riparian shrub, wetland or mesophytic plants would not be planted. Thus meadows and shrub habitats would not be created.

Confinement of the river channel and its subsequent deepening, coupled with the colonization of river banks by vegetation would continue without the project resulting in perched banks and stabilized islands. Without the project, the low sloping bank would not be created therefore wet soil terrestrial or shallow, slow moving riverine environment at the water-land interface would not exist. The opportunity to removal of non-native plants and destabilize banks and islands would not be implemented nor would opportunities to restore this habitat, facilitate overbank flows and provide sediment for the natural geomorphic system.

Confinement of the river channel by levees and jetty jacks would continue the deepened of the channel and increased velocities through the proposed project area. Although removal of the levees is not feasible, the opportunity to remove jetty jacks as well as reconnect side channels, recreate embayments and provide additional areas of low river velocity within the levees would be minimal.

Without the project loss of wetlands, braided channels and backwaters would continue to reduce the extent and quality of aquatic habitat and the potential for aquifer recharge. The opportunity to restore and create new wetland habitat and backwaters, which would improve aquatic habitat and recharge potential, as well as provide storm water filtration would likely not be carried out by USACE.

The cumulative impact of the loss of inundation, confinement of the channel, the lower water table, cottonwood mortality and urbanization has led to the replacement of the mosaic of native woodlands and wetlands in many parts of the proposed project area by dense stands of non-native plant species. The opportunity to remove non-native plants and re-vegetate with a variety of native plants of various ages, structure types, and constituent species would likely not be constructed.

<u>Terrestrial Resources Without the Project</u>

Continued isolation of riparian vegetation in the proposed project area from fluvial geomorphic processes will eventually result in complete dominance of the plant communities by non-native plant species including saltcedar, Russian olive, Siberian elm, white mulberry, and tree of heaven (USACE 2008b). Current vegetation management techniques such as understory clearing and planting of native species may temporarily reset patches of bosque to more natural structural states, but gradual replacement by non-native species could continue to occur unless the function of the bosque ecosystem and structure of the dynamic mosaic is restored. Eventual conversion of the bosque to a non-native-plant-dominated ecosystem uninfluenced by hydrologic processes, with fire as the new main disturbance mechanism, would diminish habitat suitability and quality for many native animal species (USACE 2008b). Larger scale plantings, bank destabilization or high flow channel creation may not occur due to financial limitations. Some maintenance activities would likely continue by other agencies or private organizations. Some areas have been planted with native shrubs and trees through other projects. This native vegetation will continue to grow and provide some additional habitat for wildlife.

Inundation of the bosque would remain infrequent and limited without modification to high flow channels and bank destabilization. Without the inundation the key component of a functioning bosque would remain absent limiting native plant recruitment, nutrient cycling and recharge of the shallow aquifer. Existing wetlands would continue to diminish and remain isolated from other similar habitats as they are now.

With a trend towards larger dominance of non-native plant species abundance of some species would increase at the expense of overall diversity in the bosque. Those species preferring the dense, low and mid-story habitat structure would benefit while those preferring open mature cottonwood stands with open mid- and understory would become less common. If native bosque patches became smaller and distances between them greater, some wildlife species may be lost to the area altogether. The overall trend would be for less heterogeneous habitat favoring only a portion of the existing animal species. Likewise migratory species relying on varying age stands of cottonwood bosque, wetlands, or open meadows would be forced to travel farther possible bypassing the Middle Rio Grande near Albuquerque to find favorable habitat.

Vegetation structure and species composition in the Project Area would not alter about 121 acres. Clearing of non-native understory vegetation and woody debris as part of a fire-fuel reduction program conducted under the Bosque Wildfire Project would continue. The combined effect of proposed Non-native Plant Removal, Planting of Native Species, and Excavation of Channel, Outfall Channel, and Swale areas on vegetation structure dominated by non-native species would be minimized. With respect to the entire Project Area, without implementation of the Preferred Alternative the overall increase in the diversity of vegetation communities would not occur.

The bosque would remain as is or continue to deteriorate without the project. Jetty jacks would continue to confine the Rio Grande to its existing channel, causing the river in the Project Area to further incise. As the river channel further incises, the water table would continue to lower. Periodic bosque flooding would become increasingly uncommon or nonexistent. Recruitment of native vegetation would decline as the water table lowers, bosque flooding diminishes, and non-native vegetation proliferates. Thus, non-native vegetation in the bosque would increase in abundance while native vegetation would decrease. Vegetative water demand and evapo-transpiration would likely increase as non-native vegetation proliferates. This may exacerbate the rate at which the water table declines. Bosque wetland habitat would further degrade and/or be lost as the water table lowers and non-native vegetation invades. As non-native vegetation accumulates, the risk of catastrophic bosque fire would increase. Human induced fires and high impact recreation in the Project Area would also continue to occur without the project.

Without implementation of the Preferred Alternative additional substantial enhancement of native riparian vegetation and wet habitat in the Project Area, with concurrent reduction of nonnative stands would not occur. The overall quality and quantity of fish and wildlife habitat is expected to continue to deteriorate within the Project Area.

Without maintenance of the Project Area the establishment of non-native-dominated stands would continue. The High-Flow Channels and Swales would not likely result in propagation of native vegetation. During times of low flow, the channels would not provide a moist soil area for plants, such as coyote willow, sedges, and rushes, and wildlife that prefer moister environments. Both functions are critical to improving the overall habitat in the reach (Crawford *et al.* 1993).

The High Flow channel features may not restore some semblance of over-bank flooding in localized areas. Thus establishment of early successional stands dominated by cottonwood and coyote willow would not occur. Localized lowering of the soil surface in Swales would not occur therefore some areas would not restore naturally functioning wetland plant communities in those areas. Fluvial geomorphic processes that create new sites for establishment of early succession wetland and shrub-sapling communities (Pittenger 2003) would not be influenced by the Preferred Alternative.

Individual locations within the proposed project would not have varied re-vegetation strategies. Edge effect and the creation of denser patches such as the proposed shrub thickets important for increasing wildlife diversity within the bosque would not occur. The long-term effects of replacing the non-native dominated vegetation system with native dominated species would not be as extensive.

Without the implementation of the Preferred Alternative, creation of wet habitat would not increase habitat available for wetland-dependent reptile and amphibian species. The expected increase in the amount of moist, densely-vegetated habitats and coyote willow stands would not occur therefore, an increase small mammal habitats and abundance would not be likely. The amount of habitat for mammal species associated with wetlands in the bosque would not increase.

While bird species richness may not increase in the Project Area as a result of the Preferred Alternative, bird abundance and the amount of habitat suitable for rare bird species would likely remain the same. Without restoration of wetlands, cottonwood-willow, and cottonwood-New

Mexico olive habitats, Neotropical migrant bird species that breed in the bosque would likely remain at current levels. Without restoration of early-successional willow thickets, in association with wetlands increase the amount of suitable habitat for the flycatcher and other bird species associated with wetlands and riparian shrub habitat would not occur. The proposed work would occur during the winter therefore disturbance to Bald Eagles and other wintering birds may occur. The peak nesting season in the bosque is April through August without the proposed project effects to breeding birds would be minimal.

Without the project, wetlands and native woody riparian vegetation would continue to decline in the proposed project area. This further decline would diminish habitat suitability for the flycatcher species and contribute to their decline. Other agency initiative may propose projects to benefit the flycatcher in this area though none are known at this time.
The lack of connectivity between the river and floodplain would also favor upland species that are fairly common in the region while the rarer floodplain species would remain scarce.

Endangered Species Without the Project

Given the current management practices, flycatcher habitat will continue to decline and be unsuitable in the future. Mature cottonwood trees will die naturally of senescence, and stochastic events such as drought and fire, will continue to negatively affect native bosque habitat. Without adequate cottonwood regeneration they will continue to be replaced by non-native plants.

Southwestern Willow Flycatcher Without the Project

Saltcedar is an important component of the flycatcher's nesting, foraging, and migrating habitat in the bird's range. In 2006 in Arizona, 68 percent of known flycatcher nests were built in a saltcedar tree (Graber *et al*. 2007). Saltcedar had been believed to provide of lesser quality willow flycatcher habitat. However comparisons of reproductive performance (USFWS 2002), prey populations (Drost *et al*. 2001) and physiological conditions (Owen and Sogge 2002) of flycatcher breeding in native and exotic vegetation has revealed no difference (Sogge *et al*. 2005). Without the proposed project the flycatcher would continue to use non-native saltcedar for nesting.

Flycatcher habitat is dynamic and can change rapidly: nesting habitat can grow out of suitability; saltcedar habitat can develop from seeds to suitability in five years; heavy runoff can remove/reduce habitat suitability in a single flood event; or river channels, floodplain width, location, and vegetation density may change over time. The flycatcher habitat use in different successional stages may also be dynamic. For example, over-mature or young habitat not suitable for nest placement can be occupied and used for foraging and shelter by migrating, breeding, dispersing, or non-territorial flycatcher (Cardinal and Paxton 2005, McLeod *et al.* 2005). That same habitat may subsequently grow or cycle into habitat used for nest placement. Flycatcher habitat can quickly change and vary in suitability, location, use, and occupancy over time (Finch and Stoleson 2000). Without the project native plants would be replaced by non-native plants. Over time native and non-native suitable nesting and foraging habitats would become unsuitable for flycatchers.

The most significant factor affecting flycatcher within the proposed project area is habitat loss through fragmentation and vegetation modification. The lack of flood pulses, levee construction, and narrowing of shorelines due to river regulation may limit the availability of native riparian nesting habitat to develop.

Cottonwood and willow replacement by saltcedar and phragmites has changed the historical fire regime on the Middle Rio Grande. Cottonwoods are often killed by fire, but willows can re-sprout from the root crowns. Saltcedar become established in riparian communities where native species are stressed by water table declines and where flow regimes that allow for native vegetation establishment and maintenance have been changed or eliminated. As in the case with willow, saltcedar aggressively re-sprouts after burning; however, saltcedar is more efficient in water acquisition and can gain a competitive edge (Busch and Smith 1995). Saltcedar flammability increases with the build-up of dead and senescent woody material within the plant community. Dense saltcedar stands can be highly flammable where limited or non-existent flooding allows leaf litter to accumulate (UFSWS 2002). Without the project native and non-native habitats would be lost to wild fires.

Vegetation removal activities may decrease some migratory habitat. However, unless this results in long distances between habitat patches of greater than 94 miles (150 km) (Otahal 1998) to 140 miles (225 km) (Yong and Finch 1997), this should not adversely affect the flycatcher during migration (USFWS 2002). Flycatcher insect foraging needs during migration can be met from native and introduced plant species such as saltcedar (Owen and Sogge 2002) and is expected to continue given the preponderance of saltcedar. USACE (2008b) indicated that the All Plans Combined could result in 768 acres of treat retreat re-vegetation of non-native plant treatment within the proposed project area. Non-native plant removal from the 768 acres are not likely to be a significant impact to migrating flycatcher as is it not likely to cause great distances between available foraging habitats.

Hink and Ohmart (1984) recorded 277 species of birds in the bosque ecosystem. Highest bird densities and species diversity were found in edge habitat vegetation with a cottonwood overstory and an understory of Russian olive or (Hink and Ohmart 1984). Studies done by Finch and Hawksworth (2006) indicate that bird densities of the mid-story nest guild show declining trends following treatment and removal of invasive plant species. Removal of some invasive plant species reduces the availability of nesting and foraging substrates for bird species that use the mid-story layer of habitat. Emergent marsh and other wetland habitats also had relatively high bird density and species richness. Thirty of the 46 species of breeding birds found in the bosque used Cottonwood forest habitat. No bird species showed a strong preference for Russian olive stands (Hink and Ohmart 1984). However, when Russian olive was present as a component of the understory in Cottonwood stands, it appeared to influence the quality of those stands for birds. Therefore the higher bird densities appear to relate to the structure of the habitat rather than species of plant making up that component.

The overall quality and quantity of fish and wildlife habitat is expected to continue to deteriorate within the proposed project area.

Vegetation structure and species composition in the proposed project area would not be altered. Clearing of non-native understory vegetation and woody debris as part of a fire-fuel reduction program conducted under the Bosque Wildfire Project would continue. The combined effect of proposed Non-native Plant Removal, Planting of Native Species, and Excavation of Channel, Outfall Channel, and Swale areas on vegetation structure dominated by non-native species would be minimized. With respect to the entire proposed project area, without implementation of the proposed action the overall increase in the diversity of vegetation communities would no occur.

Without the implementation of the Preferred Alternative, creation of wet habitat would not increase habitat available for wetland-dependent reptile and amphibian species. The expected increase in the amount of moist, densely-vegetated habitats and coyote willow stands would not occur therefore, an increase small mammal habitats and abundance would not be likely. The amount of habitat for mammal species associated with wetlands in the bosque would not increase.

While bird species richness may not increase in the Project Area as a result of the Preferred Alternative, bird abundance and the amount of habitat suitable for rare bird species would likely remain the same. Without restoration of wetlands, cottonwood-willow, and cottonwood-New Mexico olive habitats, Neotropical migrant bird species that breed in the bosque would likely remain at current levels. Without restoration of early-successional willow thickets, in association with wetlands increase the amount of suitable habitat for the flycatcher and other bird species associated with wetlands and riparian shrub habitat would not occur. The proposed work would occur during the winter therefore disturbance to Bald Eagles and other wintering birds may occur. The peak nesting season in the bosque is April through August without the proposed project effects to breeding birds would be minimal.

Rio Grande Silvery Minnow Without the Project

The proposed work for habitat enhancement is within designated critical habitat for the minnow. Within the proposed project area, past actions have eliminated and severely altered habitat conditions for the minnow. Narrowing and channel deepening, restraints to channel migration through jetty jacks, the invasion of non-native vegetation species, and changes in the flow regime have all adversely affected the minnow and its habitat. These environmental changes have degraded spawning, nursery, feeding, resting, and refugia areas required for species survival and recovery (USFWS 1993).

Natural habitat for the minnow includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Stream reaches dominated by straight, narrow, incised channels with rapid flows are not typically occupied by minnows (Sublette *et al.* 1990, Bestgen and Platania 1991).

SUMMARY OF PLAN SELECTION PROCESS AND IDENTIFICATION OF EVALUATED ALTERNATIVE

The Feasibility Study for the Middle Rio Grande Bosque Ecosystem Restoration Project followed the USACE six-step planning process specified in Engineering Regulation (ER) 1105-2-100. This process is used to identify and respond to problems and opportunities associated with the Federal objective and specific State and local stakeholder concerns. The process also provides a rational framework for problem solving and sound decision making.

A number of alternatives were considered and rejected, including: 1) the No Action Alternative; and 2) Alternative with significant recreational and interpretive features.

No Action Alternative Summary

Future conditions without project implementation were projected to characterize the No Action Alternative and its effects, and to form a basis for comparison of restoration benefits. Throughout the Middle Rio Grande Valley, the river, floodplain, and the associated fish and wildlife populations would be expected to continue to experience adverse effects from new and ongoing Federal, state, and private water resource development projects. Additionally, increasing urbanization and development within the historic floodplain would continue to eliminate remnant riparian areas located outside the levees, putting increased pressure on the habitat and wildlife in the riparian zone within the floodway. Local agencies would continue to perform maintenance of non-native vegetation as they are able, but the features connecting the bosque and river would not be constructed.

Preferred Alternative Summary

The Preliminary Preferred Alternative is based on Best Buy Plan #7 generated by the Incremental Cost Analysis. The Preferred Alternative represents the most cost-effective aggregation of restoration features that best meet the objectives of the restoration project.

Through implementation of the Preferred Alternative, approximately 916 acres of the Bosque would be restored by enhancing hydrologic function and restoring native vegetation. In addition, recreational use of the bosque would be improved by creating designated trails with benches, signs and other interpretive features.

DESCRIPTION OF SELECTED ALTERNATIVE AND EVALUATION

Selected Alternative

The Preliminary Preferred Alternative is based on Best Buy Plan #7 generated by the Incremental Cost Analysis. The Preferred Alternative represents the most cost-effective aggregation of restoration features that best meet the objectives of the restoration project. Through implementation of the Preferred Alternative, approximately 916 acres of the bosque would be restored by enhancing hydrologic function and restoring native vegetation. In addition, recreational use of the bosque would be improved by creating designated trails with benches, signs and other interpretive features. The preliminary preferred alternative resulted in a relatively even distribution of those restoration measures presented in Section 4 among project reaches. Due to the area covered and extent of the preferred plan, a brief summary of the project features is discussed here. A detailed description of each feature and location is located in the Middle Rio Grande Feasibility Report 23 December 2008, Model Certification Report.

Due to the scope of the project and anticipated funding availability, implementation would likely take place over five to ten years. The project would be phased to efficiently make use of available funds and accomplish tasks requiring sequential implementation. Whereas bank destabilization and side channel building at any one action area can be accomplished in a relatively short time (a few months), this activity would only take place at one or two areas simultaneously in order to minimize impacts to water quality. Removal of non-native species and re-vegetating with natives is generally a multiple year effort. Once the initial removal takes place a follow-up treatment is often required 6 months to a year later to eliminate trees that re-sprout form roots or stumps. Planting of native species may not be prudent until the follow-up treatments have been performed. In some areas removal of non-native species or Jetty-Jacks would be required to allow access to construct other features. Access to all work areas will be along the levee. Staging would occur in adjacent open areas that are available from the sponsor, MRGCD, or within the bosque if none is available. Additional access and subsidiary staging areas to facilitate construction activities would need to be coordinated with local land managers.

Construction of all features would primarily be scheduled during the typical low flow seasons on the Middle Rio Grande (fall and winter). However, any work scheduled during the nesting season (May 1- August 30) would require nesting bird surveys. Fuel reduction/exotic treatments (Treat, Retreat) would take place first, then construction of water features, and construction of recreation features last. Water features would be constructed within the bosque and then connected to the river last in order to reduce sediment inputs in to the river. If flows are adjacent to the inlet/outlet of the water feature (for example the high flow channels), the flows within the river may need to be diverted with a port-a-dam or similar device. Excess soil generated by the construction of these features would be made available to the local managing agencies

(MRGCD, Reclamation, and AOSD) for their use. Material would be hauled to local areas for use or stockpiled at their facilities for future use. Best Management Practices (BMPs) would be employed throughout the project to protect water and air quality.

<u>Treatment Methods:</u>

There are a number of methods for reducing fuel loads and treating non-native vegetation that have been and are being utilized in the Middle Rio Grande and throughout the Southwest. These methods include both manual and mechanical treatment methods, which are described below. Follow-up treatments with herbicides or root ripping are also options. Removal of non-native vegetative species, would take place between September and April of each year when possible to avoid bird nesting seasons.

1. Manual treatment - Using this method, dead material would be piled up and/or processed by cutting into small pieces using a chain saw. Large material would be hauled off, some for use as fire wood. Smaller material would be chipped using a chipper on site. Chips would either be tilled into the ground prior to re-vegetation or hauled off depending on the density. No more than 4 inches of chipped material would be left on site. The cut stumps of live non-native trees would be treated immediately with herbicide if not entirely removed. This method would be used in areas where the bosque is not very wide and equipment would not fit or areas where there are a large number of native trees and shrubs to protect.

2. Mechanical treatment - Mechanical control entails the removal of aerial portions of the tree (trunk and stems) by large machinery such as a tree shear or large mulching equipment. Both dead material and live non-native trees could be treated mechanically. Where possible, trees would be removed with root-ball intact. Otherwise, the stump would be treated immediately with herbicide. Material would be processed as stated above – large material would be hauled off and smaller material would be chipped.

3. Combination treatment - The most efficient methodology for treatment of dead material and non-native vegetation is usually a combination of manual treatment, mechanical treatment and use of herbicide. Some areas may be very thick and the use of manual methods allows them to be opened up for machinery access. Then mechanical equipment can take over while hand crews can move ahead of machinery to keep areas open enough to work in without damaging native vegetation to remain. The methodology to be implemented at each location will be evaluated on a site-by-site basis, and adaptively managed.

Once the initial removal of non-native species has occurred or in areas where AOSD crews have already removed standing non-native vegetation, re-sprouting of non-native vegetation will occur. These re-sprouts would be treated with either herbicide or by root-ripping prior to re-vegetating the area with native species. Also thinning and removal of non-native vegetation under this Preferred Alternative would include herbicide treatment in many locations. Herbicide application would be used where root ripping is not an option. Herbicide would be immediately applied to the plant using a backpack sprayer, hand application with a brush, or other equipment that allows direct application.

Jetty jack removal is also proposed at the various locations. Removal of the jetty jacks would be completed in conjunction with fuel reduction and thinning of non-native vegetation where not already complete in order to minimize disturbance. Where tieback lines are removed, new anchors would be installed to insure remaining bank lines would not migrate from their current position. Salvaged jetty jacks would be stockpiled on site during construction and removed prior to the completion of construction. It has been determined by the Corps, MRGCD and USBOR that the jetty jacks identified for removal in this Preferred Alternative can be removed with a low impact based on the proposed re-vegetation.

Wetland features would be seeded and planted with appropriate plant species such as rushes, salt grass and willows. In areas where the overstory cottonwoods remained, understory bosque plants such as New Mexico olive and *Amorpha* would be planted. Willows, seep willows, and native grasses would be planted in open areas. In conjunction with the planting, the final recreational trails would be laid out and constructed, and other recreational and interpretive features would be installed into the restored landscape.

DESCRIPTION OF IMPACTS OF SELECTED ALTERNATIVE

Implementation of the Preferred Alternative should improve habitat in the bosque and benefit fish and wildlife resources. The Preferred Alternative would include removal of jetty jacks and non-native vegetation across 916 acres of bosque, non-native vegetation removal would include saltcedar, Russian olive, Tree of Heaven, and Siberian elm. The proposed action includes 98 acres of bank destabilization; 150 acres of swales and trenches; 303 acres of water features; 1,720 acres of treat-retreat re-vegetation; and removal of 6,008 jetty jacks.

Improvements of existing facilities for educational, interpretive and low-impact recreational uses are also included in the Preferred Alternative. Trail and facility improvements would help minimize impacts to fish and wildlife habitats by directing recreational use to designated areas. The fire breaks proposed under the Preferred Alternative should reduce the risk of catastrophic bosque fire and its impacts to fish and wildlife resources.

EVALUATION OF THE SELECTED ALTERNATIVE

Aquatic Resources

Aquatic Resources with the Project

Establishment of healthy stands of cottonwoods and other native species requires water, preferably in the form of flooding for brief periods of time, until roots are mature enough to reach essential fluids and nutrients on their own. The water-related features in the proposed project attempts to mimic natural periods of inundation in specific area under certain conditions. This would create a hospitable environment for propagation of native vegetation and produce wetted areas that would increase the diversity of habitat types.

The water features considered in the proposed project are wetland restoration/construction, bank destabilization, construction of high flow channels, and construction of willow swales.

Wetland restoration would take place in various habitats. Wetland restoration/construction would take place in the form of open water wetlands, outfall wetlands or marsh wetlands.

Open wetlands would provide open water habitat for local and migrating waterfowl and other species. Outfall wetlands constructed at storm water outfalls could connect them through the bosque to the river. These would provide wetland and/or moist soil habitat from the outfall to the river. Marsh wetlands would provide additional habitats for species requiring moist soil conditions.

Bank destabilization would increase the potential for overbank flooding. This technique has been used in various locations of the Middle Rio Grande, mostly for creation of potential habitat for the minnow.

High Flow Channels would connect the bosque to the river. By creating the high flow channel, side channels would be inundated at flows between 2,500 – 3,500 cubic feet per second (cfs). Reconnecting the river to the bosque would deliver much needed water to vegetation and increase potential water-based habitats for animals.

Creating willow swales would entail optimizing the depression created by removal of non-native vegetation, dumped debris and jetty jack removal to provide microenvironments in which native plants could thrive. Willow swales could help create plant and animal diversity because these areas would be planted with riparian shrub, wetland and mesophytic plants.

Temporary, short-term impacts to fish and wildlife may occur from noise, dust, and the presence of workers and machinery during project construction. Runoff from construction work sites, access routes, staging areas, and unprotected fills could degrade water quality in the Rio Grande. Accidental spills of fuels, lubricants, hydraulic fluids and other petrochemicals, although unlikely, would be harmful to aquatic life.

Implementation of the proposed project should improve long-term bosque habitat conditions. Selected jetty jack removal should help facilitate meandering of the river and overbank flows in the Project Area. As fluvial processes in the river and bosque return to a state nearer to natural conditions, incision of the river channel should slow or cease. As a result, lowering of the water table in the Project Area should slow or cease. Overbank flows should promote native cottonwood and willow recruitment in the bosque. As native species proliferate, non-native species should, to some extent, be displaced or outcompeted. Overbank flows and flows through the high-flow side channels should help reduce accumulated fuels. This should help reduce the likelihood of catastrophic bosque fires. Human impacts to the Project Area should also decline through implementation of the interpretive elements of the project. The proposed trail improvements should encourage people to stay in designated areas and minimize use in sensitive areas. This would help facilitate bosque habitat recovery, and minimize or prevent future human induced disturbances.

With the project, short- and long-term, bosque conditions are expected to improve. Species diversity should increase and future habitat conditions should help ensure the continued persistence of federally listed species and other fish and wildlife resources. Wetlands would be created and the quality of existing wetlands should improve. Native cottonwood and willow should begin to recover as non-native vegetation is reduced in the Project Area. The overall quality and quantity of fish and wildlife habitat is expected to improve.

According to Crawford *et al.* (1993), wetlands have experienced the greatest decline of any floodplain plant community within the Middle Rio Grande. The creation of additional wetland communities would help to reduce this trend. This project supports Crawford *et al.* (1993) Recommendation No. 15 (to protect, enhance, and create wetlands throughout the Middle Rio Grande riparian zone). The bosque wetlands would create more open water habitat and edge habitat, thus increasing benefits to fish and wildlife resources. The replacement of exotic species with native species would increase the amount and types of food and cover available for resident and migratory birds and thereby increase species diversity. Long-term bosque restoration and wetland creation would enrich the local fauna by attracting wildlife that otherwise are uncommon in the arid Southwest (Crawford *et al.* 1993).

The combined effect of proposed Non-native Plant Removal, Planting of Native Species, and Excavation of Channel, Outfall Channel, and Swale areas on vegetation structure dominated by non-native species would be changed to open areas or stands dominated by native species, namely cottonwood and coyote willow. With respect to the entire Project Study Area, the Preferred Alternative would result in an overall increase in the diversity of vegetation communities.

This forecast of future conditions assumes that maintenance of the proposed project area would prevent reestablishment of non-native-dominated stands and that Outfall Channel Habitat, High-Flow Channels, and Swales would develop and maintain a hydrologic connection between the river and bosque. The High-Flow Channels and Swales would likely result in propagation of native vegetation, which would help the area. During times of low flow, the channels would provide a moist soil area for plants, such as coyote willow, sedges, and rushes, and wildlife that prefer moister environments. Both functions are critical to improving the overall habitat in the reach (Crawford *et al.* 1993). Over the long term, the cottonwood-dominated structure stands would develop into later successional structure types.

The High Flow channel features could potentially restore some over-bank flooding in localized areas. This could promote establishment of early succession stands dominated by cottonwood and coyote willow. Localized lowering of the soil surface in Swales could subject some areas to fluctuating moisture regimes, which could restore functioning wetland plant communities in those areas.

Individual locations within the proposed project would have varied re-vegetation strategies in order to achieve the target mosaic and stay within current water demands. Re-creation of the tiered bosque forest is important to sustaining a number of plants and animals in the bosque (Crawford *et al.* 1993, Hink and Ohmart 1984). These areas would become the patchy groves described in many of the early accounts of the river valley near Albuquerque (Scurlock 1998). The larger size of these patches would provide important core habitat, while maintenance of the firebreaks would provide important edge habitat (Hink and Ohmart 1984). Edge effect and the creation of denser patches such as the proposed shrub thickets would be important for increasing wildlife diversity within the bosque (Crawford *et al.* 1993, Hink and Ohmart 1984). Although, the Preferred Alternative may not be able to positively influence all the degradation processes at work in the bosque, replacement of dead material and non-native vegetation with a mosaic of native vegetation should lead to a system of less water use, decreased fire danger, and increased diversity of native species for use by wildlife. Therefore, the long-term effects of replacing the non-native dominated vegetation system with native dominated species is proposed to outweigh the short-term negative effects, which would be caused by the Preferred Alternative.

Creation of wet habitat in the proposed project area would increase habitat available for wetland-dependent reptile and amphibian species. An increase in the amount of moist, densely-vegetated habitats and coyote willow stands would also likely increase the habitat and abundance of small mammals.

Terrestrial Resources

Terrestrial Resources with the Project

With a trend towards larger dominance of non-native plant species abundance of some species would decrease and improve the overall diversity in the bosque. Those species preferring the dense, low and mid-story habitat structure would become less common while those preferring open mature cottonwood stands with open mid and understory would become more common. If native bosque patches became larger and distances between patches smaller, wildlife may increase their diversity. The overall trend would be for a more heterogeneous habitat favoring existing and less common or rare animal species. Likewise migratory species relying on varying age stands of cottonwood bosque, wetlands, or open meadow would become more abundant in the Middle Rio Grande near Albuquerque. The connectivity between the river and floodplain would also favor floodplain species that are scare in the region while the more common species would remain in the proposed project area.

Fire use and suppression effects could include disturbance from fire line construction through habitat, fire crew or vehicle presence during suppression, and loud noise from gasoline-powered equipment, fireboat and helicopter use. Fuel reduction projects in saltcedar communities may be implemented to protect structures and important wildlife habitat. These actions can temporarily affect habitat and reduce its suitability for foraging or rest during migration. However, given the preponderance of migratory habitat within the planning area, it is unlikely that these disturbances would be significant.

While bird species richness may not increase in the proposed project area as a result of the Preferred Alternative, bird abundance and the amount of habitat suitable for rare bird species would likely be increased. Restoration of wetlands, cottonwood-willow, and cottonwood-New Mexico olive habitats would provide important habitat, particularly for Neotropical migrant bird species that breed in the bosque (Thompson *et al.* 1994). Many Neotropical migrant bird species in the western U.S. are declining and many of those species breed in riparian areas, which makes those habitats particularly important (Finch 1991). Restoration willow thickets, in association with wetlands, could increase the amount of suitable habitat for the flycatcher and other bird species associated with wetlands and riparian shrub habitat. Timber-foliage foraging, timber-drilling, and timber-gleaning species that nest in the bosque would be enhanced.

The emphasis in the Preferred Alternative on creating edge habitat and a fine-grained distribution of restoration features may facilitate brood parasitism by the brown-headed cowbird. This is a threat to many nesting bird species in the bosque, including the endangered flycatcher (Finch *et al.* 1995, Schweitzer *et al.* 1998). Clustering numerous small patches to create larger, contiguous habitats and reducing the number of edges adjacent to open areas where cowbirds forage could potentially offset this effect. Also, increasing vegetation of open areas to reduce their coverage in the Project Area would reduce cowbird foraging habitat.

The proposed work would occur during the fall and winter, which is when bald eagles may be in or near the proposed project area. Also, cottonwood snags or other large trees present along the riverbanks that may serve as potential roost habitat would be left intact as part of this project. Implementation of these measures would preserve undisturbed bald eagle use of roost, foraging and perching sites in the riparian area adjacent to the project sites.

The peak nesting season from in the bosque is April through August. In order to minimize potential effects on nesting birds in the proposed project area, clearing of live vegetation would only occur between September and April. However, any work scheduled during the nesting season would require nesting bird surveys.

Since the primary goal and effect of implementation of the Preferred Alternative is to restore the bosque with native species, which would create a healthier ecosystem in the long-term for native wildlife, these short-term effects (displacement, etc.) and impacts of limited recreational access would be outweighed by the long-term benefits. Therefore, the Preferred Alternative would have short-term negative affects on fish and wildlife with long-term positive benefits.

<u>Fish and Wildlife Resources with the Project</u>

Due to the scope of the proposed project and anticipated funding availability, implementation would likely take place over five to ten years. The proposed project would be phased to effectively make use of available funds and accomplish tasks requiring sequential implementation. Whereas bank destabilization and side channel building at any one action area can be accomplished in a relatively short time (a few months), this activity would only take place at one or two areas simultaneously in order to minimize impacts to water quality. Removal of non-native species and re-vegetating with native species is generally a multiple year effort. Once the initial removal takes place a follow-up treatment is often required 6 months to a year later to eliminate resprout from roots or stumps. Planting of native species may not be prudent until the follow-up treatments have been performed. In some areas removal of non-native species or jetty jacks would be required to allow access to construct other features.

Access to all work areas would be along the levee. Staging would occur in adjacent open areas that would be available from the sponsor, MRGCD, or within the bosque if none were available. Additional access and subsidiary staging areas to facilitate construction activities would need to be coordinated with local land managers.

Construction of all features would primarily be scheduled during the typical low flow seasons on the Middle Rio Grande (fall and winter). However, any work scheduled during the nesting season (May1 – August 30) would require nesting bird surveys. Fire fuel reduction (treat, retreat) would take place first, then construction of water features, and construction of recreation features last. Water features would be constructed within the bosque and then connected to the river last in order to reduce sediment inputs in to the river. If flows are adjacent to the inlet/outlet of the water feature (for example the high flow channels), the flows within the river may need to be diverted with a port-a-dam or similar device. Excess soil generated by construction of these features would be made available to the local managing agencies (MRGCD, Reclamation, and AOSD) for their use. Best management Practices (BMPs) would be employed throughout the project to protect water and air quality.

Overall, we can expect the proposed ecosystem restoration efforts will provide significant benefits or 67-80 percent improvement in terms of bosque habitat over the No Action Plan when features are implemented in all five reaches.

Under the final array of ecologically productive, incrementally effective alternative scenarios, the bosque community can increase in both quantity and quality as a direct result of reconnecting the hydrology to the system and re-establishing a dynamic mosaic of multi-aged stands of cottonwood forests, coyote willow shrublands, wet meadows, wetlands, oxbow ponds, and open water areas with a variety of depths and flows.

<u>Vegetation Resources with the Project</u>

Indirect effects of vegetation restoration and treatments would include changes to plant community composition and species dynamics. The duration of these indirect effects depends upon the degree of saltcedar removal. Total saltcedar removal would permit cottonwood and willow establishment where suitable hydrologic conditions (protection from scouring floods and shallow water table) exist. Flycatcher would be benefited if native vegetation is restored and catastrophic wildfire risk in saltcedar-dominated habitat is reduced.

<u>Threatened and Endangered Species with the Project</u>

The effects of the proposed project on listed species will be evaluated during the formal consultation process. However, the primary reason for listing both the flycatcher and minnow has been the degradation and loss of habitat resulting from flow manipulation and destruction or alteration of native floodplain and riverine communities. With significant changes in flow management the loss of native riparian and riverine ecosystems could be restored in the Middle Rio Grande.

Southwestern Willow Flycatcher with the Project

The proposed project would provide opportunities to increase potential habitat for the flycatcher and create additional nesting habitat in this reach. If successful, these construction activities would help the flycatcher population.

Vegetation removal activities may decrease some migratory habitat. However, unless this results in long distances between habitat patches of greater than 94 miles (150 km) (Otahal 1998) to 140 miles (225 km) (Yong and Finch 1997), this should not adversely affect the flycatcher during migration (USFWS 2002). Flycatcher insect foraging needs during migration can be met from native and introduced plant species such as saltcedar (Owen and Sogge 2002) and is expected to continue given the preponderance of saltcedar. USACE (2008b) indicated that the All Plans Combined could result in 768 acres of treat retreat re-vegetation of non-native plant treatment within the proposed project area. Non-native plant removal from the 768 acres are not likely to be a significant impact to migrating flycatcher as is it not likely to cause great distances between available foraging habitats.

Studies done by Finch and Hawksworth (2006) indicate that bird densities of the mid-story nest guild show declining trends following treatment and removal of invasive plant species. Removal of some invasive plant species reduces the availability of nesting and foraging substrates for bird species that use the mid-story layer of habitat. Emergent marsh and other wetland habitats also had relatively high bird density and species richness. Thirty of the 46 species of breeding birds found in the bosque used Cottonwood forest habitat. No bird species showed a strong preference for Russian olive stands (Hink and Ohmart 1984). However, when Russian olive was present as a component of the understory in Cottonwood stands, it appeared to influence the quality of those stands for birds. Therefore the higher bird densities appear to relate to the structure of the habitat rather than species of plant making up that component.

Rio Grande Silvery Minnow with the Project

This project would provide potential habitat for the minnow and would create additional nursery habitat in this reach which would help its distribution and abundance. The bosque wetlands would create more open water habitat and edge habitat, thus increasing benefits to fish and wildlife resources.

Bank destabilization would increase the potential for overbank flooding. This technique has been used in various locations of the Middle Rio Grande, mostly for creation of potential habitat for the minnow.

The proposed work area is within designated critical habitat for the minnow. Work would not take place in the channel but it would take place along the bank and it may result in erosion or other inputs into the river. When work is to occur close to the bank of the river, best management practices (BMPs) would be enforced to prevent erosion inputs into the river. These BMPs would include, but would not be limited to: the use of silt fences without lead weights adjacent to the riverbank to prevent erosion to the river; blocking of work zones to the river when constructing the High-Flow Channels, fueling of vehicles would not take place inside the levees; and storage of equipment and vehicles should not occur in the bosque.

Additionally, this project would provide potential habitat for the minnow and would create additional nursery habitat in this reach which would help its distribution and abundance. The bosque wetlands would create more open water habitat and edge habitat, thus increasing benefits to fish and wildlife resources.

DISCUSSION

The proposed project provides opportunities to restore some Rio Grande ecosystem biological components to benefit fish and wildlife resources. The project represents extensive coordination of ideas and plans on a multi-party level. Project implementation and reporting of the monitoring results would provide valuable information for future projects in a river-based ecosystem approach to restoration throughout the Middle Rio Grande.

The proposed restoration plan incorporates many of the recommendations from the Middle Rio Grande Ecosystem: Bosque Biological Management Plan (Crawford *et al.* 1993). The proposed plan would create wetlands within the Rio Grande riparian zone; and would sustain and enhance existing cottonwood communities as well as create new native cottonwood communities.

Activities that restore and enhance fish and wildlife habitat within the Middle Rio Grande are timely, as riparian and wetland habitats are scare and disappearing at an astonishing rate. About 90 percent of the historic wetland and riparian habitat in the Southwest has been eliminated (Johnson and Jones 1977). Hink and Ohmart (1984) found a wetland and riparian area decrease of 87 percent along the Rio Grande from 1919 t0 1982.

The value of riparian habitat is well known to resource managers because of the high diversity and abundance of animal species which rely on the ecosystem for its unique plant community types, hydrologic features, soil, topography, and other environmental features that do not exist in adjacent upland habitat. Many animals species are obligates (depending entirely on the riparian zone) while most are facultative (occurring in riparian habitat as well as in other habitat types).

The ecological attributes that contribute to the high value of riparian habitat should be maintained to preserve the value to wildlife include the following:

- Heterogeneity of plant communities and structure
- Predominance of woody plant communities
- Presence of surface water, soil moisture, and high water table
- Continuous, unfragmented corridors of habitat
- Sustainability

These factors should all be seriously considered in this as well as other restoration activities within the Middle Rio Grande ecosystem.

Because of the scarcity and high wildlife value of wetlands in the Southwest, wetland restoration and creation is desirable wherever possible. Managed wetlands in areas removed and protected from human, pets, and livestock would be most valuable to fish and wildlife. The easiest method to establish a wetland is to expand an existing one or to allow natural flow regimes to re-establish former wetlands. Wetlands with a variety of water depths, water movement through the wetland, small islands, an irregular water-land interface, and protection of adjacent uplands, are habitat requirements to produce a diverse healthy wetland. To maximize benefits to fish and wildlife resources, the Service recommends further exploration of wetland creation opportunities within the Middle Rio Grande.

Construction activities that result in unavoidable adverse impacts to fish and wildlife require the development of mitigation plans. These plans consider the value of fish and wildlife habitat affected. The Service has established a mitigation policy used as guidance in determining resource categories and recommending mitigation (46 FR: 7644-7663). The riparian bosque and associated floodplain habitat within the Project Area are consistent with "Resource Category No. 2"; that is, habitats of high value that are relatively scarce or becoming scarce on a national basis or in the eco-region.

Although the Project Area contains a large amount of exotic species; overall, riparian and wetland habitats are classified in Category 2 because they are scarce. According to Johnson and Jones (1977), about 90 percent of the historic wetland and riparian habitat in the Southwest has been eliminated. Hink and Ohmart (1984) found a wetland decrease of 87 percent along the Rio Grande from 1918 to 1982. The Service mitigation policy states that the degree of mitigation should correspond to the value and scarcity of the fish and wildlife habitat at risk. Consequently, no net loss of in-kind habitat value should be the mitigation goal for this resource category. The Service believes that the proposed project not only meets, but exceeds the "no net loss of in-kind habitat" mitigation goal for this resource category. Therefore, no specific mitigation is needed for the project, as proposed.

Monitoring provides the feedback needed to establish protocols and make adjustments where and when necessary to achieve the desired results. Monitoring would be essential to the success of the proposed project, as well as other USACE studies. Baseline data would be collected so that results can be quantified and compared. Wetland and bosque monitoring would include vegetation mortality, wildlife and vegetation species, groundwater and other environmental indicators. Post-project monitoring is a crucial requisite of the adaptive management process, as performance feedback may generate new insights on ecosystem response and provides a basis for determining the necessity or feasibility of subsequent design or operational modifications. Success should be measured by comparing post-project conditions to the restoration project objectives and pre-project conditions.

Another component of restoration of the Rio Grande ecosystem is water management. The single most important adverse impact to the fish and wildlife habitat within the Rio Grande ecosystem has been the change in the flow regime through water management. Present water management, including reduced peak releases, reduced volumes due to consumption, irrigation, improper timing of water releases, water salvage attempts, and water drainage has produced an overwhelmingly negative effect on fish and wildlife and their habitat.

All waste material would be disposed of properly at pre-approved or commercial disposal areas or landfills. Fuel, oil, hydraulic fluids and other similar substances would be appropriately stored away from the Rio Grande and must have a secondary containment system to prevent spills if the primary storage container leaks. All heavy equipment operating in or near river floodplain should carry an oil spill kit or spill blanket at all times. No refueling or staging shall occur in the bosque.

Permanent structures, access roads, staging, parking, refueling, and work areas could directly impact riparian habitats through removal and/or trampling. These impacts would be mitigated because access to all work areas would be along the levee. Staging would occur in adjacent open areas that are available from the sponsor, MRGCD, or within the bosque if none is available. Additional access and subsidiary staging areas to facilitate construction activities would need to be coordinated with MRGCD, AOSD, and the Bio-Park. No fueling would take place in the bosque.

The Service anticipates some minor short-term impacts to fish and wildlife resources associated with project construction. To ensure that federally listed species are not adversely impacted by the project, ESA section 7 consultation should be completed prior to construction. To minimize adverse impacts to birds protected under the Migratory Bird Treaty Act, tree stands or other adequately vegetated areas slated for grubbing or clearing should be surveyed for the presence of nesting birds during the general migratory bird nesting season of March through August. Disturbance to nesting areas should be avoided until nesting is completed. Vegetation clearing and construction related soil disturbances can cause sediment-laden runoff to enter waterways. To minimize impacts associated with erosion, the contractor should employ silt curtains (without lead weights), coffer dams, dikes, straw bales, or other suitable erosion control measures. Construction related petrochemical spills can also negatively impact fish and wildlife resources. Therefore, measures should be implemented to minimize the likelihood of petrochemical spills. Spill procedures should be in place prior to construction to minimize impacts associated with unexpected spills. To ensure that the objectives of the project are met, post-construction monitoring of the Project Area should be conducted.

The proposed project would provide the public a quality outdoor experience and would provide fish and wildlife benefits by restoring portions of the bosque to a condition nearer to natural and productive biotic community. Therefore, the Service believes the project would improve important long-term migratory bird habitat as well as resident fish and wildlife habitat within the Rio Grande corridor in Albuquerque.

LIST OF RECOMMENDATIONS

The Service is encouraged by the restoration and conservation of valuable fish and wildlife resources represented by the proposed project. The following recommendations are provided by the Service to prevent and reduce adverse project effects on fish and wildlife resources during construction, operation, and maintenance of the proposed project:

1. Where possible, avoid construction during the migratory bird nesting season of March through August. Where that is not possible, tree stands or other adequately vegetated areas slated for grubbing or clearing should be surveyed for the presence of nesting birds prior to construction. Avoid disturbing nesting areas until nesting is complete.

2. Employ silt curtains (without lead weights), cofferdams, dikes, straw bales or other suitable erosion control measures during construction.

3. Store and dispense fuels, lubricants, hydraulic fluids, and other petrochemicals outside the 100-year floodplain. Inspect construction equipment daily for petrochemical leaks. Contain and remove any petrochemical spills and dispose of these materials at an approved upland site. Park construction equipment outside the 100-year floodplain during periods of inactivity.

4. Ensure equipment operators carry an oil spill kit or spill blanket at all times and are knowledgeable in the use of spill containment equipment. Develop a spill contingency plan prior to initiation of construction. Immediately notify the proper Federal and state authorities in the event of a spill.

5. All work and staging areas should be limited to the minimum amount of area required. Existing roads and right-of-ways and staging areas should be used to the greatest extent practicable to transport equipment and construction materials to the project site, and described in the USACE’s project description. Provide designated areas for vehicle turn around and maneuvering to protect riparian areas from unnecessary damage.

6. Backfill should be uncontaminated earth or alluvium suitable for re-vegetation with native plant species.

7. Scarify compacted soils or replace topsoil and re-vegetate all disturbed sites with suitable mixture of native grasses, forbs, and woody shrubs.

8. Protect mature cottonwood trees from damage during clearing of non-native species or

other construction activities using fencing, or other appropriate materials.

9. Use local genetic stock wherever possible in the native plant species establishment throughout the riparian area.

10. Continue coordination of Rio Grande water management activities that develop and maintain riverine and terrestrial habitats by mimicking the typical natural hydrograph. An intergraded management of flows from upstream reservoirs should be pursued by USACE for the purpose of protecting and enhancing the aquatic and terrestrial habitats along the Rio Grande.

11. Pursue and conduct floodplain management activities that discourage further development in the floodplain and address physical constraints to the higher flows that would be part of a natural hydrograph.

12. Explore expansion of the active floodplain of the Rio Grande at every opportunity.

13. Develop a coordinated program to monitor biological quality with emphasis on diversity and abundance of native species and ecosystem integrity with emphasis on restoring the functional connection between the river and the riparian zone of the Middle Rio Grande ecosystem.

14. Develop partnerships with local schools, universities, or other interested groups to help address post-project monitoring and adaptive management needs (e.g., conduct periodic wildlife surveys, monitoring ecosystem response, etc.).

15. Support and participate in annual bird monitoring in the proposed project area.

16. Continue to support inventories and monitoring of southwestern willow flycatcher and their habitats.

17. The USACE and the MRGCD should analyze all projects and plans completed under this proposal for effects to listed species, including the flycatcher, and request future consultation if necessary.

18. The USACE should continue to propose conservation measures that act together to reduce or eliminate potential adverse effects from the proposed and projects.

19. Vegetation treatments will avoid the federally endangered Southwestern willow flycatcher migration and breeding seasons.

20. In conjunction with the Bureau of Reclamation and MRGCD, the USACE develop a comprehensive flood control plan for the entire stretch of the Middle Rio Grande (Cochiti Lake to Elephant Butte Reservoir). The plan should incorporate maintenance of healthy

and diverse native aquatic and riparian ecosystems, while addressing public and agencies' water management needs.

21. Expand the existing active floodplain of the Middle Rio Grande by relocating levees, and implementing floodplain zoning and management to control development in the active floodplain.

22. Establish and enhance wildlife travel corridors between the river and the adjacent uplands.

23. Actively manage livestock grazing and prevent trespass grazing (i.e. construct and maintain fences).

24. Immediately prior to construction of each unit and prior to reinitiation of work following an extended period of no action, conduct surveys to assess the possible presence of Federal and State endangered or threatened species, or Tribal species of concern. If protected species are located, coordinate with Federal, State, and Tribal wildlife agencies to prevent adverse impacts to the species.

25. Construction should be accomplished during periods of least resource impact. Work should be scheduled to avoid disturbance to breeding and nesting neotropical migrant land birds and to fish, especially native fishes, during the spawning and hatching periods. To minimize disturbance to wildlife, the duration of project construction should be as brief as possible.

26. Project activity should not take place between mid –April and mid-September in areas of suitable flycatcher habitat.

27. Implement recovery measures for the minnow. This should include long-term monitoring throughout the proposed project area.

28. Conduct bald eagle surveys to determine areas of eagle use. Avoid project activity in areas where eagles are known to perch or roost from November to March.

29. Strict control and frequent monitoring of construction activity by the USACE biologist to ensure all contract specifications and agreements are being implemented and achieved.

30. Store and dispense all fuels, lubricants, hydraulic fluids, and other petrochemicals outside the 100-year floodplain.

31. Inspect all equipment daily to ensure there are no leaks or discharges of lubricants, hydraulic fluids or fuels. Contain and remove and petrochemicals spills, including contaminated soil, and dispose of these materials in an environmentally appropriate manner at an approved upland disposal site.

32. Implement or update existing wildlife inventories of the Middle Rio Grande and the adjacent floodplain.

33. Monitor and evaluate success of project mitigation, especially water quality, re-vegetation, and habitat enhancement to determine if the mitigation actions are sufficient enough to avoid, minimize or compensate for adverse impacts.

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APPENDICES

Appendix A. Common and Scientific Names of Plants That May Occur in the Middle Rio Grande Floodplain.

Common Name	Scientific Name
Baccharis (N)	*Baccharis spp.*
Seepwillow (N)	*Baccharis glutinosa*
Coyote willow (N)	*Salix exigua*
Peachleaf willow (N)	*Salix amygdaloides*
Goodding's willow (N)	*Salix gooddingii*
Buttonbush (N)	*Cephalanthus spp.*
False indigo bush (N)	*Amorpha fruticosa*
New Mexico olive (N)	*Forestiera neomexicana*
Black locust (N)	*Robinia pseudo-acacia*
Boxelder (N)	*Acer negundo*
Chinaberry (I)	*Melia azedarach*
Rio Grande cottonwood (N)	*Populus fremonti*
White mulberry (I)	*Morus alba*
Russian olive (I)	*Elaeagnus angustifolia*
Saltcedar (I)	*Tamarix spp.*
Siberian elm (I)	*Ulmus pumila*
Tree-of-heaven (I)	*Ailanthus altissima*
Apache plume (N)	*Fallugia paradoxa*
Wolfberry (N)	*Lycium andersonii*
Fourwing saltbush (N)	*Atriplex canescens*
Virginia creeper (I)	*Parthenocissus inserta*
Phragmites (N)	*Phragmites communis*
Sago pondweed (N)	*Potamogeton pectinatus*
Sedge (N)	*Carex spp.*
Saltgrass (N)	*Distichlis stricta*
Spikerush(N)	*Eleocharis spp.*
Horsetail (N)	*Equisetum spp.*
Rush (N)	*Juncus spp.*
Bulrush (N)	*Scirpus spp.*
Sacaton (N)	*Sporobolus spp.*
Cattail (N)	*Typha latifolia*
Smartweed (N)	*Polygonum lapathifolium*
American milfoil (N)	*Myriophyllum exalbescens*
Yerba manza (N)	*Anemopsis californica*
Primrose (N)	*Oenothera spp.*
Fendler globemallow (N)	*Sphaeralcea fendleri*
Pricklypear (N)	*Opuntia spp.*
Buffalo gourd (N)	*Cucurbita foetidissima*
Spiny aster (I)	*Aster spinosus*
Golden currant (N)	*Ribes aureum*
Watercress (N)	*Nasturtium officionale*

(N=native, I=introduced or non-native)

Appendix B. Common and Scientific Names of Mammals That May Occur in the Middle Rio Grande Floodplain.

Common Name	Scientific Name
Opossum	*Didelphis virginiana*
Desert shrew	*Notiosorex crawfordi*
Yuma myotis	*Myotis yumanensis*
Little brown bat	*Myotis lucifugus*
Long-legged myotis	*Myotis volans*
Silver-haired bat	*Lasionycteris noctivagans*
Big brown bat	*Eptesicus fuscus*
Hoary bat	*Lasiurus cinereus*
Spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Plecotis townsendii*
Pallid bat	*Antrozous pallidus*
Brazilian free-tailed bat	*Tadarida brasiliensis*
Desert cottontail	*Sylvilagus auduboni*
Black-tailed jackrabbit	*Lepus californicus*
Beaver	*Castor canadensis*
Gunnison's prairie dog	*Cynomys gunnisoni*
Colorado chipmunk	*Eutamias quadrivittatus*
Spotted ground squirrel	*Spermophilus spilosoma*
Rock squirrel	*Spermophilus variegatus*
Red squirrel	*Tamiasciurus hudsonicus*
Northern grasshopper mouse	*Onychomys leucogaster*
Deer mouse	*Peromyscus maniculatus*
White-footed mouse	*Peromyscus leucopus*
Piñon mouse	*Peromyscus truei*
Western harvest mouse	*Reithrodontomys megalotis*
Hispid cotton rat	*Sigmodon hispidus*
Norway rat	*Rattus norvegicus*
Muskrat	*Ondatra zibethicus*
New Mexican jumping mouse	*Zapus hudsonius luteus*
Ord kangaroo rat	*Dipodomys ordii*
Merriam kangaroo rat	*Dipodomys merriami*
Silky pocket mouse	*Perognathus flavus*
Plains pocket mouse	*Perognathus flavescens*
Yellow-faced pocket gopher	*Pappogeomys castanops*
Botta pocket gopher	*Thomomys bottae*
American porcupine	*Erethizon dorsatum*
Coyote	*Canis latrans*
Gray fox	*Urocyon cinereoargenteus scottii*
Raccoon	*Procyon lotor*
Striped skunk	*Mephitis mephitis*
Long-tailed weasel	*Mustela frenata*
Mink	*Mustela vison*
Badger	*Taxidea taxus*
Bobcat	*Lynx rufus*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*

Appendix C. Common and Scientific Names of Fish That May Occur in the Middle Rio Grande.

Common Name	Scientific Name
Gizzard shad (N)	*Dorosoma cepedianum*
Rainbow trout (I)	*Oncorhynchus mykiss*
Brown trout (I)	*Salmo trutta*
Northern pike (I)	*Esox lucius*
Red shiner (N)	*Cyprinella lutrensis*
Common carp (I)	*Cyprinus carpio*
Rio Grande chub (N)	*Gila pandora*
Rio Grande silvery minnow (N)	*Hybognathus amarus*
Fathead minnow (N)	*Pimephales promelas*
Flathead chub (N)	*Platygobio gracilis*
Longnose dace (N)	*Rhinichthys cataractae*
River carpsucker (N)	*Carpiodes carpio*
Flathead catfish (N)	*Pylodictis olivaris*
White sucker (I)	*Catostomus commersoni*
Rio Grande sucker (N)	*Catostomus plebeius*
Smallmouth buffalo (N)	*Ictiobus bubalus*
Black bullhead (I)	*Ictalurus melas*
Yellow bullhead (I)	*Ictalurus natalis*
Channel catfish (I)	*Ictalurus punctatus*
Western mosquitofish (N)	*Gambusia affinis*
White bass (I)	*Morone chrysops*
Green sunfish (I)	*Lepomis cyanellus*
Bluegill (N)	*Lepomis macrochirus*
Longear sunfish (I)	*Lepomis megalotis*
Largemouth bass (I)	*Micropterus salmoides*
White crappie (I)	*Pomoxis annularis*
Black crappie (I)	*Pomoxis nigromaculatus*
Yellow perch (I)	*Perca flavescens*

(N=native, I=introduced or non-native)

Appendix D. Common and Scientific Names of Birds That May Occur in the Middle Rio Grande Floodplain.

Common Name	Scientific Name
Pied-billed grebe	*Podilymbus podiceps*
Common loon	*Gavia immer*
American white pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*
Olivaceous cormorant	*Phalacrocorax olivaceus*
American bittern	*Botaurus lentiginosus*
Least Bittern	*Ixobrychus exilis*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Snowy egret	*Egretta thula*
Little blue heron	*Egretta caerulea*
Cattle egret	*Bubulcus ibis*
Green-backed heron	*Butorides striatus*
Black-crowned night heron	*Nycticorax nycticorax*
White-faced ibis	*Plegadis chihi*
Snow goose	*Chen caerulescens*
Canada goose	*Branta canadensis*
Wood duck	*Aix sponsa*
Green-winged teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Cinnamon teal	*Anas cyanoptera*
Northern shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
Hooded merganser	*Mergus cuculatus*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
Common moorhen	*Gallinula chloropus*
American coot	*Fulica americana*
Sandhill crane	*Grus canadensis*
Whooping crane	*Grus americana*
Killdeer	*Charadrius vociferus*
Black-necked stilt	*Himantopus mexicanus*
American avocet	*Recurvirostra americana*
Solitary sandpiper	*Tringa solitaria*
Spotted sandpiper	*Actitis macularia*
Long-billed curlew	*Numenius americanus*
Forster’s tern	*Sterna forsteri*
Black tern	*Chlidonias niger*
Turkey vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Black-shouldered kite	*Elanus caeruleus*
Mississippi kite	*Ictinia mississippiensis*
Bald eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Cooper's hawk	*Accipiter cooperii*
Common black-hawk	*Buteogallus anthracinus*
Swainson’s hawk	*Buteo swainsoni*

Appendix D continued. Common and Scientific Names of Birds That May Occur in the Middle Rio Grande Floodplain.

Common Name	Scientific Name
Red-tailed hawk	*Buteo jamaicensis*
American kestrel	*Falco sparverius*
American peregrine falcon	*Falco peregrinus anatum*
Ring-necked pheasant	*Phasianus colchicus*
Northern bobwhite	*Colinus virginianus*
Scaled quail	*Callipepla squamata*
Gambel's quail	*Callipepla gambelii*
Rock dove	*Columba livia*
White-winged dove	*Zenaida asiatica*
Morning dove	*Zenaida macroura*
Common ground-dove	*Columbina passerina*
Yellow-billed cuckoo	*Coccyzus erythropthalmus*
Greater roadrunner	*Geococcyx californianus*
Common barn-owl	*Tyto alba*
Great horned owl	*Bubo virginianus*
Burrowing owl	*Athene cunicularia*
Lesser nighthawk	*Chordeiles acutipennis*
Common nighthawk	*Chordeiles minor*
White-throated swift	*Aeronautes saxatalis*
Black-chinned hummingbird	*Archilochus alexandri*
Rufous hummingbird	*Selasphorus rufus*
Belted kingfisher	*Ceryle alcyon*
Northern flicker	*Colaptes auratus*
Olive-sided flycatcher	*Contopus borealis*
Western wood-pewee	*Contopus sordidulus*
Southwestern willow flycatcher	*Empidonax traillii extimus*
Black phoebe	*Sayornis nigricans*
Say's phoebe	*Sayornis saya*
Ash-throated flycatcher	*Myiarchus cinerascens*
Cassin's kingbird	*Tyrannus vociferans*
Western kingbird	*Tyrannus verticalis*
Eastern kingbird	*Tyrannus tyrannus*
Violet-green swallow	*Tachycineta thalassina*
Bank swallow	*Riparian riparia*
Cliff swallow	*Hirundo pyrrhonota*
Barn swallow	*Hirundo rustica*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Black-billed magpie	*Pica pica*
American crow	*Corvus caurinus*
Chihuahuan raven	*Corvus cryptoleucus*
Black-capped chickadee	*Parus atricapillus*
Verdin	*Auriparus flaviceps*
White-breasted nuthatch	*Sitta carolinensis*
Cactus wren	*Campylorhynchus brunneicapillus*
Black-tailed gnatcatcher	*Polioptila melanura*
Eastern bluebird	*Sialia sialis*
Western bluebird	*Sialia mexicana*
Hermit thrush	*Catharus guttatus*
American robin	*Turdus migratorius*

Appendix D continued. Common and Scientific Names of Birds That May Occur in the Middle Rio Grande Floodplain.

Common Name	Scientific Name
Gray catbird	*Dumetella carolinensis*
Cactus wren	*Campylorhynchus brunneicapillus*
Black-tailed gnatcatcher	*Polioptila melanura*
Cactus wren	*Campylorhynchus brunneicapillus*
Black-tailed gnatcatcher	*Polioptila melanura*
Eastern bluebird	*Sialia sialis*
Cactus wren	*Campylorhynchus brunneicapillus*
Black-tailed gnatcatcher	*Polioptila melanura*
Eastern bluebird	*Sialia sialis*
Western bluebird	*Sialia mexicana*
Hermit thrush	*Catharus guttatus*
American robin	*Turdus migratorius*
Gray catbird	*Dumetella carolinensis*
Northern mockingbird	*Mimus polyglottos*
Curved-billed thrasher	*Toxostoma curvirostre*
Crissal thrasher	*Toxostoma dorsale*
European starling	*Sturnus vulgaris*
Bell's vireo	*Vireo bellii*
Warbling vireo	*Vireo gilvus*
Orange-crowned warbler	*Vermivora celata*
Virginia's warbler	*Vermivora virginiae*
Lucy's warbler	*Vermivora luciae*
Yellow warbler	*Dendroica petechia*
Yellow-rumped warbler	*Dendroica coronata*
Common yellowthroat	*Geothlypis trichas*
Wilson's warbler	*Wilsonia pusilla*
Yellow-breasted chat	*Icteria virens*
Summer tanager	*Piranga rubra*
Western tanager	*Piranga ludoviciana*
Northern cardinal	*Cardinalis cardinalis*
Pyrrhuloxia	*Cardinalis sinuatus*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Black-headed grosbeak	*Pheucticus melanocephalus*
Blue grosbeak	*Guiraca caerulea*
Lazuli bunting	*Passerina amoena*
Indigo bunting	*Passerina cyanea*
Painted bunting	*Passerina ciris*
Spotted towhee	*Pipilo maculatus*
Brown towhee	*Pipilo fuscus*
Dark-eyed junco	*Junco hyemalis*
Rufous-crowned sparrow	*Aimophila ruficeps*
American tree sparrow	*Spizella arborea*
Chipping sparrow	*Spizella passerina*
Lark sparrow	*Chondestes grammacus*
Black-throated sparrow	*Amphispiza bilineata*
Lark bunting	*Calamospiza melanocorys*
Lincoln's sparrow	*Melospiza lincolnii*
White-crowned sparrow	*Zonotrichia leucophrys*
Red-wing blackbird	*Agelaius phoeniceus*

Appendix D continued. Common and Scientific Names of Birds That May Occur in the Middle Rio Grande Floodplain.

Common Name	**Scientific Name**
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Brewer’s blackbird	*Euphagus cyanocephalus*
Great-tailed grackle	*Quiscalus mexicanus*
Bronzed cowbird	*Molothrus aeneus*
Brown-headed cowbird	*Molothrus ater*
Orchard oriole	*Icterus spurius*
Northern oriole	*Icterus galbula bullockii*
House finch	*Carpodacus mexicanus*
Lesser goldfinch	*Carduelis psaltria*

Appendix E. Common and Scientific Names of Reptiles and Amphibians That May Occur in the Middle Rio Grande Floodplain.

Common Name	Scientific Name
Tiger salamander	*Ambystoma tigrinum*
Couch's spadefoot	*Scaphiopus couchii*
Plains spadefoot	*Spea bombifrons*
New Mexico spadefoot	*Spea multiplicata*
Great Plains toad	*Bufo cognatus*
Red-spotted toad	*Bufo punctatus*
Woodhouse's toad	*Bufo woodhousii*
Canyon treefrog	*Hyla arenicolor*
Western chorus frog	*Pseudacris triseriata*
Bullfrog (introduced)	*Rana catesbeiana*
Northern leopard frog	*Rana pipiens*
Yellow mud turtle	*Kinosternon flavescens*
Snapping turtle	*Chelydra serpentina*
Painted turtle	*Chrysemys picta*
Ornate box turtle	*Terrapene ornata*
Red-eared slider (introduced)	*Trachemys scripta*
Spiny softshell	*Trionyx spiniferus*
Collared lizard	*Crotaphytus collaris*
Leopard lizard	*Gambelia wislizenii*
Greater earless lizard	*Cophosaurus texanus*
Lesser earless lizard	*Holbrookia maculata*
Texas horned lizard	*Phrynosoma cornutum*
Roundtail horned lizard	*Phrynosoma modestum*
Desert spiny lizard	*Sceloporus magister*
Eastern fence lizard	*Sceloporus undulatus*
Tree lizard	*Urosaurus ornatus*
Side-blotched lizard	*Uta stansburiana*
Chihuahuan whiptail	*Cnemidophorus exsanguis*
Checkered whiptail	*Cnemidophorus grahamii*
Little striped whiptail	*Cnemidophorus inornatus*
New Mexico whiptail	*Cnemidophorus neomexicanus*
Western whiptail	*Cnemidophorus tigris*
Desert grassland whiptail	*Cnemidophorus uniparens*
Plateau striped whiptail	*Cnemidophorus velox*
Many-lined skink	*Eumeces multivirgatus*
Great Plains skink	*Eumeces obsoletus*
Texas blind snake	*Leptotypholps dulcis*
Glossy snake	*Arizona elegans*
Racer	*Coluber constrictor*
Ringneck snake	*Diadophis punctatus*
Great Plains rat snake	*Elaphe guttata*
Western hooknose snake	*Gyalopion canum*
Western hognose snake	*Heterodon nasicus*
Night snake	*Hypsiglena torquata*
Common kingsnake	*Lampropeltis getula*
Milk snake	*Lampropeltis triangulum*
Smooth green snake	*Liochlorophis vernalis*
Coachwhip	*Masticophis flagellum*
Striped whipsnake	*Masticophis taeniatus*

Appendix E continued. Common and Scientific Names of Reptiles and Amphibians That May Occur in the Middle Rio Grande Floodplain.

Common Name	**Scientific Name**
Bullsnake or gopher snake	*Pituophis melanoleucus*
Longnose snake	*Rhinocheilus lecontei*
Mountain patchnose snake	*Salvadora grahamiae*
Plains blackhead snake	*Tantilla nigriceps*
Blackneck garter snake	*Thamnophis cyrtopsis*
Wandering garter snake	*Thamnophis elegans*
Checkered garter snake	*Thamnophis marcianus*
Common garter snake	*Thamnophis sirtalis*
Western diamondback rattlesnake	*Crotalus atrox*
Blacktail rattlesnake	*Crotalus molossus*
Western rattlesnake	*Crotalus viridis*
Massasauga	*Sistrurus catenatus*

APPENDIX I
SECTION 7 CONSULTATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna NE
Albuquerque, New Mexico 87113
Phone: (505) 346-2525 Fax: (505) 346-2542

April 15, 2011

Cons. # 22420-2010-F-0077

Lt. Colonel Jason Williams
(Attn: Julie A. Hall) Environmental Resources
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Lt. Colonel Williams:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) on the effects of the action described in the 2010 Biological Assessment (BA) for the Middle Rio Grande Bosque Restoration Project, Bernalillo and Sandoval Counties, New Mexico. This BO analyzes the effects of the action on the endangered Rio Grande silvery minnow, *Hybognathus amarus*, (silvery minnow) and on the endangered southwestern willow flycatcher, *Empidonax traillii extimus*, (flycatcher). The restoration project will be located in the bosque of the Rio Grande within Sandoval and Bernalillo Counties. Request for formal consultation, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), was originally received on April 8, 2010 and was amended and resubmitted on November 23, 2010.

This BO is based on information submitted in the April 2010 BA and the November 2010 amended BA; conversations and communications between the U.S. Army Corps of Engineers (Corps) and the Service; and other sources of information available to the Service. A complete administrative record of this consultation is on file at the Service's New Mexico Ecological Services Field Office (NMESFO).

This BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. USDI Fish and Wildlife Service (CIV No. 03-35279) to complete the following analysis with respect to critical habitat. This consultation analyzes the effects of the action and its relationship to the function and conservation role of silvery minnow critical habitat to determine whether the current proposal destroys or adversely modifies critical habitat.

Southwestern Willow Flycatcher
The Corps has determined the proposed project "may affect, but is not likely to adversely affect," the flycatcher. We concur with this determination for the reasons described below.

Restoration treatments proposed may provide long term benefits to the species. As a result of implementing the proposed action, approximately 663 acres of bosque vegetation will be treated, retreated as necessary and revegetated. Approximately 65 acres of willow swales will be created and are anticipated to develop into suitable flycatcher habitat. In addition, approximately 38 acres of wetlands will be restored and some aspects may have potential to support flycatchers.

The flycatcher is a migrant through this portion of the Rio Grande and may be present from April through August. Suitable nesting habitat does not currently exist within the project area. The nearest nesting occurs approximately 1.3 miles downstream of the nearest proposed habitat restoration site. Migrating flycatchers could still be disturbed by construction activities and the clearing of woody vegetation in the action area; however, these activities will not occur during the timeframe when flycatchers could be present. No work will be conducted between April 15 and August 15 of each year. Thus, direct effects to flycatchers will be avoided.

Since implementation of the proposed action spans over multiple years during the non-breeding season, the Corps will continue to conduct flycatcher surveys. If breeding flycatchers are detected, the Corps will reinitiate consultation with the Service. Any detected territories will immediately be protected by a no-work buffer zone of 1/4 mile radius.

Although one of the long-term goals of the proposed action includes creating, restoring, and enhancing riparian habitat which would potentially benefit the flycatcher, short-term indirect effects on flycatchers are possible from the removal of any vegetation that currently represents suitable migratory-stopover habitat. Vegetation disturbance is expected to be temporary, becoming re-established after implementation of the proposed action. Vegetation will be monitored as it re-establishes in the restoration treatment areas. Water features to be constructed are expected to provide benefits to flycatchers in the long term. Creation of willow swales will over time result in willow stands of the preferred density and stature for the flycatcher. Wetland restoration, bank terracing, and creation of ephemeral and backwater channels are all expected to have the potential to result in dense native vegetation as edge habitat is established or because of lowering ground levels closer to groundwater. Restoration proposed in the San Antonio Oxbow would also improve potential habitat where migrants have been detected for the past three years. Specifically, in this area, about 1 acre of stopover habitat would be removed in order to create connections with the river in the form of backwater habitat. Nearby there is sufficient stopover habitat such that we expect any effects on migrating flycatchers to be insignificant.

Habitat may be removed for access and staging. Many of the proposed restoration sites can be access by existing levees and have existing staging areas within or near the site (i.e.: previously cleared or burned bosque areas). These areas can be utilized for daily movement of equipment while overnight staging and fueling would occur nearby along the lower levee or existing parking areas. A temporary access road off of the levee/paved trail will be constructed to access proposed construction areas where one does not exist. These temporary access roads will be removed and reseeded once construction is complete or left in place if so desired by City of Albuquerque Open Space Division (OSD). Any additional disturbance caused by equipment accessing the site will be reseeded with native vegetation and mulched once complete. Access to all work areas will occur along the levee, and staging will occur in adjacent open areas made available by the sponsor, the Middle Rio Grande Conservancy District (MRGCD).

Firebreaks associated with implementation of the Exotic Species/Fuel Load Reduction and Riparian Gallery Forest Mosaic Restoration component have the potential to affect flycatcher. No new firebreaks would be created near any potential flycatcher habitat. Also no areas will remain cleared. Where an area is already open due to new or previous fuel reduction (or a fire), the area may be reseeded with native grass seed and small shrubs to keep it more open as a fire break. Fire breaks would be maintained mainly where they already exist.

In addition, conservation measures will be implemented to minimize potential effects on vegetation in the action area. These include avoiding dense willow-dominated riparian vegetation in all project areas other than the San Antonio Oxbow, using all efforts to minimize damage to native vegetation and wetlands, using existing roads and cleared staging areas, and operating equipment in the most open area available to minimize damage to vegetation. Willow removal in the San Antonio Oxbow site is required to introduce more water into the site via backwaters resulting in long term habitat improvements and benefits to flycatchers. Stopover habitat for flycatchers is available in nearby areas. Therefore, indirect effects on flycatchers from removing vegetation are considered insignificant because vegetation in the action area does not currently support flycatcher territories, is not considered suitable breeding habitat for the flycatcher, stopover habitat for migrating flycatchers is available nearby to the San Antonio Oxbow, and disturbance to vegetation will be temporary with beneficial effects anticipated in the long-term.

Recreation features will include pedestrian bridges across ephemeral high flow channels where needed in order to maintain trail connections, enhancement of existing trails around bridges (providing access to all users by converting to crusher fine for a certain extent), addition of benches and interpretive kiosks at main public access points (again near bridges/parking lots), and improvement of canoe/boat access at locations where this activity currently takes place. The features are expected to improve safety for hikers and boaters and concentrate public use into locations already being used. The trail and boat access improvements will lessen the likelihood of the public creating new informal trails and lessen the likelihood of using existing informal trails and river access routes.

Given the conservation measures in place during the proposed restoration project including that construction will not occur during the flycatcher migratory season, anticipated effects to the flycatcher from the proposed action are insignificant and discountable. There is no designated critical habitat for the flycatcher within the action area. The remainder of this biological opinion will deal with the effects of implementation of the proposed action on the silvery minnow.

Consultation History

The Service received a BA on April 8, 2010 in which no adverse effects were anticipated to either silvery minnow or the flycatcher. The Service met with the Corps on November 4, 2010 to discuss the project. The Corps updated its BA and submitted an amended BA on November 23, 2010 and requesting incidental take for potentially adverse effects during construction of the proposed project. The Service requested additional information and clarification on the proposed action and effects analysis and received that information on January 31, 2011 and February 24, 2011. On February 26, 2011, the Service provided a draft BO to the Corps for review and met with the Corps on March 25, 2011. Additional information was received from the Corps on March 30 and April 4, 2011. On April 5, 2011, the Service provided a final draft BO to the Corps for review and also to the Pueblo of Sandia for review pursuant to our obligation in Secretarial Order 3206 (U.S. Department of the Interior 1997). Comments on the final draft were received from the Corps on April 11, 2011 and from the Pueblo of Sandia on April 14, 2011.

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

Overview

Goals of the Corps of Engineers Middle Rio Grande Bosque Restoration Project (project) are as follow:

- Improve habitat quality and increase the amount of native bosque communities.
- Reestablish fluvial processes in the bosque to a more natural condition.
- Restore hydraulic processes between the bosque and the river to a more natural condition.
- Reduce the risk of catastrophic fires in the bosque.
- Protect, extend and enhance areas of potential habitat for listed species within the bosque.
- Provide educational or interpretive features.
- Integrate recreational features that are compatible with ecosystem integrity.

The project will apply several habitat restoration techniques in 5 different reaches spanning approximately 26 miles along the Rio Grande in Bernalillo and Sandoval Counties, New Mexico. The project will restore approximately 916 acres of the bosque through (1) improving hydrologic function by constructing high-flow channels, willow swales, and wetlands, and (2) restoring native vegetation and habitat by removing jetty jacks, thinning exotic species, and re-vegetation with native species. Improvements of existing facilities for educational, interpretative and low-impact recreational uses will also be constructed. Project construction will be phased over 3-5 years and is proposed to begin in September 2011 and continue through April 2016. The proposed activities will not be conducted between April 15 and August 15, annually.

The MRGCD is the non-Federal sponsor for this project. MRGCD and OSD co-manage the bosque within the project area. Both are critical partners in the development and implementation of this project. The team responsible for the planning process (the Project Development Team) included representatives of the MRGCD, OSD and New Mexico State Parks in addition to the Corps and their consultants. Early in the process, an interagency Ecosystem Assessment Team

(E-Team) was convened. Representatives from the Corps' Albuquerque District, the Service, Reclamation, New Mexico Interstate Stream Commission (ISC), New Mexico Department of Game and Fish (NMDGF), New Mexico State Forestry Division (NMSFD), Natural Heritage New Mexico (NHNM), USFS Rocky Mountain Research Station (RMRS), MRGCD, OSD, University of New Mexico (UNM), Corrales Bosque Preserve, Village of Corrales and Parametrix consultants actively participated in the assessment process.

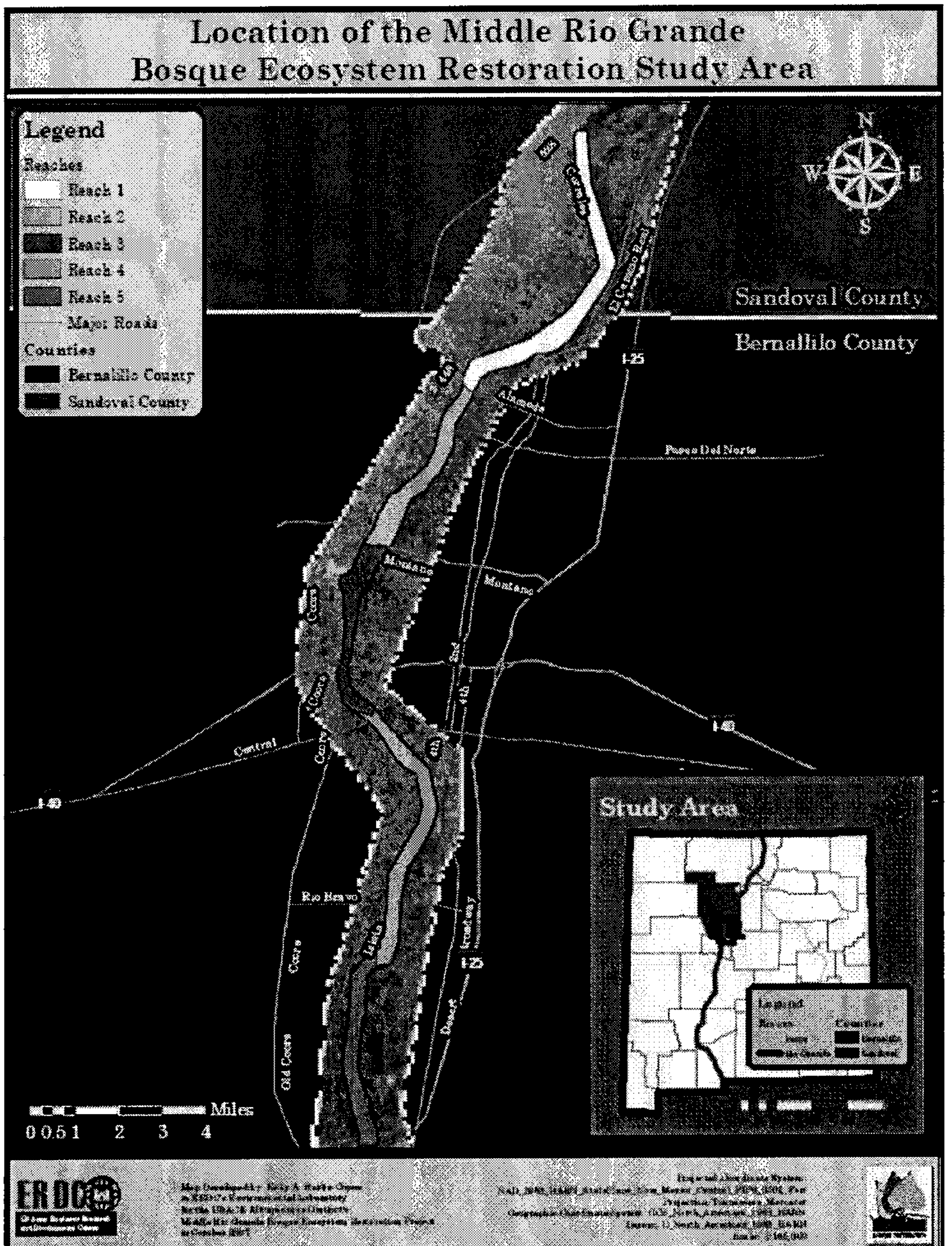

Figure 1. General project location map (from Corps November 2010 Biological Assessment)

Project Location
The proposed action will occur in the Angostura reach of the Rio Grande between the levees and the main river channel extending from north of Corrales in Sandoval County (River Mile 198.4) downstream to the northern boundary of the Pueblo of Isleta in Bernalillo County (River Mile 172) (Figure 1). The Corps has divided the proposed action area into five reaches, defined as follows:

Reach 1	North end of Corrales south to Alameda Blvd. – includes lands of Village of Corrales, Pueblo of Sandia, and Rio Grande Valley State Park (Co managed and/or owned by MRGCD, USBR and City of Albuquerque Open Space Division)	River miles ~ 198.4-192.2 (~ 6 miles in length)
Reach 2	Alameda south to Montano	River miles ~ 192.2 - 188 (~ 4 miles in length)
Reach 3	Montano south to Central	River miles ~ 188 - 183.5 (~4.5 miles in length)
Reach 4	Central south to South Diversion Channel	River miles ~ 183.5 - 177 (~6.5 miles in length)
Reach 5	South Diversion Channel south to Pueblo of Isleta boundary;	River miles ~177 - 172 (~ 5 miles in length)

The Proposed Action Area also includes the bosque within Albuquerque, which was designated as the *Rio Grande Valley State Park* through the Park Act of 1983. This area is cooperatively managed by the OSD and MRGCD. The Proposed Action Area also includes lands of the Village of Corrales, which is designated as the *Corrales Bosque Preserve* and is cooperatively managed by the Village of Corrales and the Corrales Bosque Commission through an agreement with the MRGCD. Pueblo of Sandia lands are also located within the Proposed Action Area and are managed by the Pueblo. The Pueblo of Sandia is the proponent for the two proposed project sites located within Pueblo boundaries.

Proposed Restoration Treatments
Specific restoration treatments at 18 different project sites will be implemented during the proposed action. They are designed to create aquatic habitat and to improve riparian habitat in and along approximately 26 miles of the Rio Grande. Approximately 663 acres of bosque is planned be treated, retreated and re-vegetated. Construction of the restoration treatments is expected to occur between August 15 and April 15 over a period of 3 to 5 years. Pre-construction baseline monitoring has been and will continue to be conducted. Treatments will be

monitored during construction and afterward for a period of no less than 5 years. Treatments will be evaluated to allow for adaptive management to improve the effectiveness of treatments constructed in later phases. Treatments that will be used during implementation of the proposed action include jetty jack removal, non-native plant removal, revegetation, wetland restoration, bank terracing, ephemeral high flow channels with associated backwaters and bank scallops as possible, and willow swales. Overall, plans for water features call for approximately 70 acres of bank terraces, 70 acres of high flow channels with backwaters and a 10 acres bank-line scallop, 55 acres of willow swales, and restoration of approximately 38 acres of wetlands. In addition, approximately 800 jetty jacks will be removed. In many cases, the removal of jacks allows for subsequent vegetation management and removal along a bank-line may provide for subsequent bank terracing. Construction and clearing of vegetation will not occur between April 15 and August 15.

Table 1 provides a summary of the types of restoration treatments, the area of each treatment to be constructed at the 18 different sites, and the estimated area of disturbance of wetted habitat during construction. Information in Table 1 is based on the November 2010 BA and subsequent information exchange and correspondence from the Corps.

Specific recreational features will be implemented during the proposed action. They are designed to enhance the recreation system within the action area. Recreational features that will be used include benches, picnic tables, kiosks, parking improvements, trail improvements, canoe launch improvements, a bridge, and signage. Two small canoe ramps are proposed (one at the northwest corner of Alameda and the river, and one at the northeast corner of Central and the river). Each area will disturb approximately 20 feet wide by 150 feet long of vegetation/bank edge of the river. These features conform to and build upon Open Space Division plans for the Rio Grande Valley State Park.

Table 1. MRG Bosque Restoration Proposed Restoration Treatments, Restored Area and Wetted Area Affected by Construction

Reach	Project	Treatment	Restored Area (Acres)	Construction Disturbance in Wetted Areas (Acres)[1]
1	1A	Treat-Retreat-Revegetation	34.9	-
		Bank terracing	16.35	4.51
		High flow channel	26.38	0.08
	1B	Treat-Retreat-Revegetation	82.74	-
		Bank scallop	9.46	2.64
	1C	Treat-Retreat-Revegetation	37.78	-
		Bank terracing	23.19	6.38
		High flow channel	8.36	0.08
		Willow swales	9.75	-
	1D	Treat-Retreat-Revegetation	18.74	-

		Willow swales	2.44	-
	1E	Treat-Retreat-Revegetation	66.36	-
		Bank terracing	10.38	2.86
		High flow channel	5.85	0.08
		Marsh Wetland	13.48	0
		Willow swales	11.71	-
		Jetty jack removal (30 units)		
	1F	Treat-Retreat-Revegetation	9.57	-
		Bank terracing	8.25	2.2
		High flow channel	3.6	0.08
		Jetty jack removal (100 units)		
	1G	Treat-Retreat-Revegetation	30	-
		Willow swales	3.48	-
		Canoe ramp	2.8	0.08
	1H	Treat-Retreat-Revegetation	12.21	-
		Willow swales	1.18	-
		Jetty jack removal (10 units)		
2	2A	Treat-Retreat-Revegetation	19.05	-
		High flow channel /Backwater	3.5	0.08
		Jetty jack removal (100 units)		
3	3A	Treat-Retreat-Revegetation	48.52	-
		Bank terracing	5.15	1.43
		Open Water	17.16	0
		Marsh Wetland	1.99	0
		Jetty jack removal (150 units)		
4	4A	Treat-Retreat-Revegetation	62.64	-
		Wet Meadow Wetland	5.16	-
		Canoe ramp	2.8	0.08
	4B	Treat-Retreat-Revegetation	23.86	-
		Willow swales	5.38	0.55
	4C	Treat-Retreat-Revegetation	33.45	-
		Bank terracing	7.58	2.09
		High flow channel	15.31	0.08
		Jetty jack removal (170 units)		
5	5A	Treat-Retreat-Revegetation	35.34	-
		Willow swales	4.35	-
		High flow channel/Backwater	1.0	0.08
		Jetty jack removal (100 units)		
	5B	Treat-Retreat-Revegetation	61.1	-
		Willow swales	7.29	-
		Jetty jack removal (100 units)		
	5C	Treat-Retreat-Revegetation	33.89	-

	Willow swales	4.68	-
	High flow channel	6.5	0.08
	Jetty jack removal (30 units)		
5D	Treat-Retreat-Revegetation	40.42	-
	Willow swales	6.9	-
5E	Treat-Retreat-Revegetation	12.15	-
	Willow swales	1.89	-

[1]Includes wetted area that is anticipated to be disturbed during construction and a 10% buffer zone to encompass construction disturbance zone in wetted areas.

Jetty Jack Removal

The jetty jacks within the project area are either owned or are, otherwise, under the authority of the Corps, the Reclamation or the MRGCD. Approximately 800 jetty jacks are currently proposed for removal. In a cooperative effort, the three agencies have reviewed the Albuquerque Reach to evaluate whether jetty jack removal would conflict with flood control and erosion management. Jetty jack removals have been approved in most locations, with only a few exceptions. Exceptions are typically in areas where the active river channel has migrated to an alignment very close to the levee, such that only a very narrow overbank buffer remain between the active river flow and the levee toe. Such bank line jetty jacks that are to be removed will be mitigated with some form of bio-stabilization method, such as willow swales, to prevent excessive migration of the river channel toward the levee. Typically, however, these bank line jetty jacks must remain fully intact. Any broken cable or snapped/cut wires resulting from this work or the recent activity of others will be repaired. Additionally, where tieback lines are removed, new anchors will be installed as needed to insure that the remaining lines of jetty jacks cannot migrate from their current position. If only one or two jetty jacks within a continuous line are removed, the remaining jacks will be reconnected with a buried steel cable. Tieback lines (roughly perpendicular to the river) will not be removed without also placing a buried anchor (known as a "deadman") to replace the tieback line.

The Corps Hydrology and Hydraulics Section has determined that the jetty jacks identified for removal in the proposed action can be removed with a low hydraulic risk based on implementation of the proposed restoration methods and techniques for this project.

All jetty jack materials will be safely disposed of after they are removed from the work site. Ongoing inspections as well as a final inspection will be conducted to insure that the proposed action is implemented as described above.

Vegetation Management

Restoration is basically comprised of non-native plant removal and re-vegetation. The purpose of non-native plant removal is to 1) facilitate restoration efforts by eliminating the chief competition to native trees, shrubs, forbs and grasses, 2) reduce the fire hazard, and 3) enhance aesthetic and recreational aspects of the bosque. The purpose of re-vegetation is to re-create the lost native understory in the bosque forest woodland areas and the lost native shrub thickets in open areas.

In many areas, continued maintenance and repeated treatment of invasive species for stump sprouting, and removal of juvenile volunteer non-natives, will be necessary. Both the removal of jetty jacks, where needed, and the thinning of non-native vegetation would need to occur prior to implementing the remaining activities/features described below.

Specific non-native plant treatment methods are as follows:
A number of protocols for reducing fuel loads and treating non-native vegetation have been, and are being, utilized in the MRG and throughout the Southwest. These methods include both manual and mechanical treatment methods, which are described below. Follow-up treatment with herbicides, or root ripping (raking approximately 6-12 inches into the ground in order to remove roots), are also options. Removal of non-native vegetative species, would take place between September and April 15 of each year.

1. Manual treatment - Using this method, dead material will be piled up and/or processed by cutting into small pieces using a chain saw. Large material will be hauled off, with some resources for use as fire wood. Smaller material will be chipped, using a chipper, on site. Chips would either be tilled into the ground prior to revegetation or hauled off, depending on their density. No more than 2 inches of chipped material would be left on site. The stump of any live non-native trees that is cut will be treated immediately with herbicide (see Chemical treatment below), if not entirely removed. This method will be used in areas where the bosque is not very wide and equipment will not fit, or areas where there are a large number of native trees and shrubs to protect.

2. Mechanical treatment - Mechanical control entails the removal of aerial portions of the tree (trunk and stems) by large machinery such as a tree shear or large mulching equipment. Both dead material and live non-native trees will be treated mechanically. Where possible, trees will be removed with the root-ball intact. Otherwise, the stump will be treated immediately with herbicide (see Chemical treatment below). Material will be processed as stated above: large material will be hauled off and smaller material will be chipped.

3. Combination treatment - The most efficient approach for treatment of dead material and non-native vegetation (and the most frequently used in the MRG where a fair amount of native species are mixed in with non-native) is a combination of manual treatment, mechanical treatment and use of herbicide (see Chemical treatment below). Some areas may be very dense, and the use of manual methods allows them to be opened up for machinery access. Mechanical equipment can then take over while hand crews move ahead of machinery to keep areas open enough to work in without damaging native vegetation to remain. The procedure to be implemented at each location will be evaluated on a site-by-site basis.

4. Chemical treatment - Once initial removal of non-native species has occurred, or in areas where OSD crews have already removed standing non-native vegetation as part of their routine operations and maintenance, resprouting of non-native vegetation will occur. These resprouts will be treated with either herbicide or by root-ripping prior to revegetating the area with native species. Thinning and removal of non-native vegetation under this proposed action will include herbicide treatment in many locations. Herbicide application will be used where root ripping is not an option. Herbicide will be immediately applied to the plant using a backpack sprayer, hand application with a brush, or other equipment that allows direct application.

Herbicide application would be used after manual and/or mechanical treatment of non-native vegetation. The preferred herbicides to use are Garlon®4 (for treatment of resprouts) and Garlon® 3A (for initial treatment). These are both selective herbicides which means that they can kill certain groups of plants and have little or no effect on other plants. These herbicides should not be used near surface water or saturated soils. In or adjacent to wetted areas and in areas where water would enter at some point in time after construction, only aquatic approved herbicide would be used (Renovate 3® (triclopyr) is the preferred herbicide). Renovate 3® is the only formulation of triclopyr registered by the EPA as an aquatic herbicide. Herbicides would only be used between October and April in order to protect amphibian species from potential exposure and to allow work to take place outside of the avian migratory nesting season.

Garlon® is the commercial version of triclopyr and generally contains one or more inert ingredients. The contents of two triclopyr formulations are: Garlon® 3A: triclopyr (44.4%), and inert ingredients (55.6%) including water, emulsifiers, surfactants, and ethanol (1%); and Garlon ®4: triclopyr (61.6%), and inert ingredients (38.4%) including kerosene. Triclopyr acts by disturbing plant growth. It is absorbed by green bark, leaves and roots and moves throughout the plant. Triclopyr accumulates in the meristem (growth region) of the plant. Surfactants used would include non-ionic surfactants that have been approved for use in aquatic habitats (such as Induce).

Basal bark and cut surface treatments will only be applied during the work window, from August 15 – April 15. Triclopyr should be applied only when there is little or no hazard of spray drift. It should be applied immediately to the stump of the cut tree (within two hours). Triclopyr is active in the soil, and is absorbed by plant roots. Microorganisms degrade triclopyr rapidly; the average half-life in soil is 46 days. Triclopyr degrades more rapidly under warm, moist conditions. The potential for leaching depends on the soil type, acidity and rainfall conditions. This herbicide is selective to woody plants and has little to no effect on grasses (Parker et al., 2005). It has been certified and labeled to be used near water by the Environmental Protection Agency (EPA, 1998). After use, the public must remain away from the area for 48 hours. Signage would be placed at areas after they have been treated.

Triclopyr is slightly toxic to practically non-toxic to soil microorganisms. Practically nontoxic is defined as a probable lethal oral dose for humans at less than 15 g/kg (Klaassen et al., 1986). Triclopyr is toxic to many plants if applied directly. Even very small amounts of spray may injure some plants. That is why it is to be applied directly to the stump of the tree being treated. The ester form of triclopyr, found in Garlon® 4, is more toxic, but under normal conditions, it rapidly breaks down in water to a less toxic form. Triclopyr is slightly toxic to practically non-toxic to invertebrates. Slightly toxic is defined as a probable lethal oral dose for humans at 5-15 g/kg (Klaassen et al., 1986). Triclopyr and its formulations have not been tested for chronic effects in aquatic animals. Triclopyr is slightly toxic to mammals. In mammals, most triclopyr is excreted, unchanged, in the urine. Triclopyr and its formulations have very low toxicity to birds. Triclopyr is non-toxic to bees. Triclopyr and its formulations have not been tested for chronic effects in terrestrial animals. The exposure levels a person could receive from these sources, as a result of routine operations, are below levels shown to cause harmful effects in laboratory studies. Inert ingredients found in triclopyr products may include water, petroleum solvents, kerosene, surfactants, emulsifiers, and methanol. Methanol, kerosene and petroleum solvents may be a toxic hazard if the pesticide is swallowed. Non-ionic surfactants and emulsifiers are generally low in toxicity. The formulated products are generally less toxic than triclopyr. Garlon® 3A is a skin irritant and a severe eye irritant.

It has been found by other agencies in the area currently using these herbicides (MRGCD, OSD and the Bosque del Apache National Wildlife Refuge) that both Garlon® 4 (mixed 25-75% with vegetable oil) or Garlon® 3A (mixed 50-50% with water) have been successful.

Garlon® 4 would be used for initial treatment and has been shown to be more successful in cut-stump treatments (U.S. Army Corps of Engineers 2004). Garlon® 3A would be used for treatment of resprouts once they have grown at least 3 feet in height. Garlon® 3A has been shown to be more effective on smaller stems and resprouts (U.S. Army Corps of Engineers).

Revegetation

The overall restoration strategy for the Riparian Gallery Forest Mosaic Restoration measures is to revegetate all areas within the proposed action areas utilizing native shrub and juvenile tree species. The purpose of this strategy is to re-create the lost native understory in the bosque forest woodland areas and the lost native shrub thickets in open areas. At the same time, gaps will be left in between the revegetated areas to create edge habitat, the richest type of habitat, and to create firebreaks to limit the potential for catastrophic fire.

Maintenance and adaptive management will be important to the long-term success of the revegetated areas. Ongoing removal of non-native stump sprouts and volunteers will be necessary in all planted areas. In firebreak areas, the vegetation will have to be mowed or "brush-hogged" (another mowing method that removes standing vegetation) periodically, in order to maintain the function as a firebreak and to keep out woody plants. The different planting strategies will be combined in order to create the target mosaic mixture of different ecosystem types (bosque forest, grass meadow, wet features).

Planting strategies to target a riparian gallery forest mosaic will include the following revegetation techniques:

1. Seeding with native grasses and forbs, such as Indian rice grass (*Oryzopsis hymenoides*), galleta grass (*Hilaria jamesii*), side oats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), sand dropseed (*Sporobolus cryptandrus*), and sunflower (*Helianthus annuus*) and in wetter areas, yerba mansa (*Anemopsis californicus*), emory sedge (*Carex emoryi*), and salt grass (*Distichlis stricta*). Seeding involves sowing seed via methods such as broadcasting, crimp and drill or hydro-mulching. Other than the gel in the hydro mulch, no irrigation would be applied. Timing of seeding will be critical to the establishment of the vegetative cover, and is planned for late summer (after August 15). Wood debris, such as large logs that remain after thinning, will be placed strategically to provide additional habitat once seeding is completed. Seeding will be applied wherever restoration occurs. In firebreak areas, seeding is the only revegetation strategy proposed.

2. Bare root or container planting with native shrubs, such as New Mexico olive (*Forestiera neomexicana*), four wing saltbush (*Atriplex canescens*), chamisa (*Chrysothamnus nauseosus*), false indigo (*Amorpha fruticosa*), golden currant (*Ribes aureum*), three leaf sumac (*Rhus trilobata*), wolfberry (*Lycium pallidum*), and in wetter areas, coyote willow (*Salix exigua*), black willow (*Salix nigra* var. *gooddingii*), and seep willow (*Baccharis salicifolia*) is an important strategy for establishing woody plants. Bare root planting refers to planting a plant directly in the ground without a rootball. Most of the native shrubs listed above are grown in tall pots, which provide a longer and more established root system, and have been found to support excellent seedling survival (U.S. Department of Agriculture, 2001). Container planting refers to planting small plants in small containers. A watering tube will be placed alongside the shrub plant material and will be watered through the first summer. Water is usually obtained from the riverside drain in coordination with the project sponsor, MRGCD. Coyote willows can be planted directly in wet areas as live sticks. Shrubs will be planted at various densities depending on what is currently at the location. If no native understory vegetation exists at a location, then shrub planting density will be higher (500 stems per acre or more). If there is existing native vegetation, then a lower density of native shrubs will be installed (100-500 stems per acre as needed). Shrubs will be planted in the fall and trees will be planted in the winter.

3. Plug planting will be used to plant wetland and other moist soil plants within created water features. Species that could be provided as plugs include yerba mansa (*Anemopsis californicus*), native sedge (*Carex spp.*), native rush (*Scirpus spp.*), and saltgrass (*Distichlis stricta*). Plug planting refers to insertion of small seedlings with the soil or growth medium attached. Plugs are planted directly into moist soils on the edge of water features (wetlands, high-flow channels, etc.).

4. Pole planting of native trees, such as the Rio Grande cottonwood (*Populus fremontii var. wislizenii*), black willow (*Salix nigra var. gooddingii*) and peach leaf willow (*Salix amygdaloides*). Pole planting is the technique most frequently used for restoration of riparian areas. Many of the pilot projects in the bosque have utilized pole planting, and according to OSD, they have a 90 percent success rate (U.S. Army Corps of Engineers 2004). Branches

of cottonwoods and willows, 10 feet to 15 feet in length, are slipped into holes that have been augered through the soil to the water table. Little maintenance is required beyond taking precautions to protect the young trees from beavers. Trees will be planted at a fairly low density since cottonwoods exist throughout the action area. They will be supplemented in some areas as needed but at a very low density (10-50 stem per acre). Willow trees are lacking in some areas of the action area and will be planted at a higher density in those areas (25-75 stems per acre). Planting strategies will not include planting larger plants, such as balled and burlapped or container trees, because they would not be successful in the without significant irrigation.

Water Features: bankline terracing, ephemeral high flow and backwater channels, scallops, willow swales and wetland restoration

The purpose of the water-related features is to attempt to mimic natural periods of inundation in specific areas under certain conditions. This would create a hospitable environment for propagation of native vegetation and produce wetted areas that would increase the diversity of habitat types. The proposed action includes implementation of the following water features:

BanklineTerracing

The proposed action includes a total of approximately 70 acres of bank terracing. Bank terracing or bank lowering involves the removal of vegetation and excavation of soils adjacent to the main channel to enhance the potential for overbank flooding. This technique has been utilized in various locations of the MRG, mostly for creation of potential habitat for the silvery minnow by the Middle Rio Grande Endangered Species Collaborative Program. Bank terracing provides opportunities for increasing connectivity with the river during spring runoff and monsoons. As the banks are destabilized, it creates a greater connection with the river. As the river moves through these areas, it both scours and creates moist soil for vegetation. In many cases, coyote willow will fill in these areas creating riparian shrub habitat that provides habitat for birds, small mammals and herpetofauna. Bank terracing has the potential to restore this habitat, facilitate overbank flows and provide sediment for the natural geomorphic system.

Ephemeral High Flow Channels and Backwaters

Approximately 70 acres of high flow channels and backwater channels will be constructed with implementation of the proposed action. Under historic flood flow regimes, high-flow channels were once an integral part of the river form and function. Evidence of former (or abandoned) channels is present in many locations within the action area. The objective of this feature is to re-establish the connections between the river and the bosque by creating a situation in which side channels would become inundated and flowing at flows between 2,500 – 3,500 cfs. Water at lower flows (500 – 2,000 cfs) will begin to inundate the features. Actions necessary for this feature typically include dredging the sediment out of the upstream and downstream portions of the remnant high-flow channels in order to re-establish the bosque-river connection, clearing out debris and non-native plants and revegetating with native plants to increase the habitat quality within the bosque. High-flow channels will deliver much-needed water to bosque vegetation and increase potential water-based habitats for animals. Scallops and backwater channels will be constructed as part of or within the high-flow channels when possible.

For the construction of bankline terracing, high flow channels and/or backwaters, an earthen dam (the last 1-3 feet of the bank) are left in place during construction. No material extends into the river. This last piece of bank is removed last in order to limit inputs of sediment as well as other potential impacts to silvery minnow. The area of disturbance in wetted habitat that may be occupied by silvery minnow is limited to the inlet and outlet of each high flow channel. Each of those areas is approximately 10 by 150 ft in dimension; thus, construction disturbance associated with each high flow channel is approximately 3,000 ft^2 or (0.07 acre). This is further described below under Project Implementation.

Willow Swales

Approximately 55 acres of willow swales will be created with implementation of the proposed action. The willow swale feature entails optimizing the depressions created by removal of non-native vegetation, dumped debris and jetty jacks to provide microenvironments in which native plants can thrive due to the decreased distance to the water table and moist soils. A series of depressions, approximately a half acre in size, will be created within a 5 to 10 acre area. The number of depressions within each swale would be determined by site-specific conditions. In certain areas of the bosque, the depth-to-water table is minimal and even slight excavations expose water. Willow swales also help create vegetative habitat where establishment of native plants or seed would be challenging due to soil type or depth to groundwater. Depending upon the location, there could be a series of willow swales that become progressively drier with increasing distance from the river or water table. Once established, native plants would thrive in these depressions. About 1/2 of the acreage of swales to be constructed has the potential to inundate with water from the main channel. The willow swale feature will create both wet meadow and shrub habitat.

Wetland Restoration

Wetland restoration will be implemented in various forms of habitat totaling approximately 38 acres of total wetlands. Wetland restoration will focus on development of open water wetlands, wetlands utilizing storm drain outfall areas, marsh wetlands, or wet meadows. An open water wetland planned for the San Antonio Oxbow site would be similar to that constructed at the Albuquerque Biological Park Wetland. Such wetlands provide open water habitat for migrating and local waterfowl and aquatic habitat for numerous species.

Wetland habitat utilizing and restructuring drainage outfalls will be constructed/enhanced in areas where storm water outfalls exist but currently do not create or utilize the potential to create habitat. Some simple modifications to existing outfalls will provide several benefits. The design will focus on connecting the outfall through the bosque to the river, providing wetland and/or moist soil habitat along the way. Each area will be designed differently depending on the outfall size. This will create linear wetland habitat with vegetation along the sides that could create additional habitat for various songbirds, small mammals, amphibians, reptiles, and fish species.

A marsh wetland will have fluctuating water levels (usually 1-5 feet) and various vegetative species. These areas can be created by lowering the ground level and/or creating a connection with surface water flows.

Wet meadow habitat is similar to a marsh wetland, but has much shallower standing water, and is created by allowing flow from a deeper wetland area (such as an open water wetland) flow out into an existing dry area or by lowering an area to the shallow groundwater table. This creates marshy or moist soil habitat, usually only about 6 inches deep with water.

Only the wet meadow feature will potentially have a direct connection to occupied habitat of the silvery minnow.

Proposed Recreational Features

Recreational features included in the proposed action would result in a considerable enhancement of the recreation system in the action area. Recreational features that will be used include benches, picnic tables, kiosks, parking improvements, trail improvements, canoe launch improvements, a bridge, and signage. The current trail network is poorly configured; duplicate trail segments run throughout the project area. The use of informal trails in some places has caused deterioration of vegetation and disrupted wildlife habitat. Material to be used for trail improvements is stabilized crusher fine. Additional improvements such as benches, signs and wildlife observation blinds will greatly enhance this resource. Construction activities would temporarily impede recreational activities in the Proposed Action Area. All work zones would be designated and signed with cautionary information. The paved trail would be kept clean for use by park visitors as much as possible and all machinery and vehicles would yield to park users. The only recreational features that would involve disturbance in wetted areas are the two canoe ramps. Two small canoe ramps are proposed (one at the northwest corner of Alameda and the river, and one at the northeast corner of Central and the river). Each area will disturb approximately 20 feet wide by 150 feet long (0.07 acre) of vegetation/bank edge of the river.

Access and Staging

All sites are located between the levee and the active river channel. Access from the levee through the riparian forest to the river edge is available. A temporary access road off of the levee/paved trail will be constructed to access proposed construction areas where one does not exist. These temporary access roads would be removed and reseeded once construction is complete or left in place if so desired by OSD. Any additional disturbance caused by equipment accessing the site will be reseeded with native vegetation and mulched once complete. Access to all work areas will occur along the levee, and staging would occur in adjacent open areas made available by the sponsor, MRGCD. Equipment will access proposed construction areas from the nearest river crossing. Staging will also take place within the bosque if other areas are not available. Additional access and subsidiary staging areas required to facilitate construction activities will be coordinated with local land managers.

Excess soil generated by the construction of these features will be made available to local management agencies (MRGCD, Reclamation and OSD) for their use. Material would be hauled to local areas for use, or stockpiled at their facilities for future use.

Monitoring, Adaptive Management and Maintenance

Due to the relatively recent emergence of restoration science and inherent uncertainty in some aspects of ecosystem restoration theory, planning and methods, success can vary based on a variety of technical and site-specific factors. Recognizing this uncertainty, it is prudent to allow for contingencies to address potential problems in meeting restoration goals that may arise during or after project implementation. Recent Corps' guidance (U.S. Army Corps of Engineers, 2009b) requires that a plan be developed for monitoring the success of the ecosystem restoration. This monitoring plan shall include "1) a description of the monitoring activities to be carried out, the criteria for ecosystem restoration, and the estimated costs and duration of the monitoring; and 2) specify that the monitoring shall continue until such time as the Secretary determines that the criteria for ecosystem restoration success will be met." The Corps has developed a Monitoring and Adaptive Management Plan for the proposed action (Corps of Engineers, 2011) which includes details on what parameters will be measured, sampling design, performance standards, adaptive management expectations, and estimated costs.

Post-project monitoring is a crucial requisite of the adaptive management process, as performance feedback may generate new insights on ecosystem response and provides a basis for determining the necessity or feasibility of subsequent design or operational modifications. Success should be measured by comparing post-project conditions to the restoration project purpose and needs and to pre-project conditions. Monitoring also provides the feedback needed to establish protocols and make adjustments where and when necessary to achieve the desired results. Monitoring of the Corps' Bosque Wildfire and Albuquerque Biological Park Wetlands projects has provided information that has been useful in developing goals and alternatives for this project. Monitoring from those projects will also aid in design. Monitoring of this project will be essential to the success of not only the MRG Bosque Restoration Project, but other Corps' studies as well.

Monitoring of project performance and success will be conducted for at least five consecutive years following construction. Wetland and bosque monitoring would include vegetation mortality, wildlife and vegetation species, groundwater and other environmental indicators. Monitoring of the project would include ongoing monitoring through the continuing Bosque Environmental Project Monitoring Program (BEMP) which has a number of existing sites within the project area. The BEMP program provides monthly monitoring of ground water as well as quarterly monitoring of arthropods. Avian monitoring is currently being conducted by Hawks Aloft providing input on use by raptors as well as songbirds. Comparison of use by wildlife before, during and after project implementation utilizing 'indicator species' has also occurred within the project area (Daniel B. Stephens & Associates, 2008). These monitoring activities have been conducted under the Bosque Wildfire Project, and have provided input toward planning the proposed action. These efforts will continue post-construction to show project benefits and changes in use before and after construction. Feature specific studies such as wildlife use by water features and other project features, will also be conducted.

Part of this monitoring may provide information on design that may require changes. Depending on how the project features function (i.e.: high flows move through the channel and potential for maintenance items such as scouring and/or build up of sediment could occur), adaptive management would be enlisted to make changes in the field if it is determined to be needed once the proposed action features are in use.

In addition, the Corps will conduct monitoring for potential entrapment post-construction at the high flow channels and backwaters created and any other restored features that may form isolated pools as flows recede. After two years, it may be determined in coordination with the Service that further monitoring is unnecessary. A thorough visual examination for the sites will be conducted to look for the presence of silvery minnows. This includes isolated pools of any depth where potential entrapment may have occurred. The following protocol will be used:

1. Monitoring for silvery minnow entrapment in restored features will occur following peak/secondary runoff, and after large rainfall/monsoons and any other high flow events that could introduce water into an area and then result in isolated pool(s) as water recedes.

2. Monitoring at restored features will start when discharge on the descending limb of the hydrograph approaches 0-500 cfs, or 10% of a site-specific target inundation.

3. When monitoring is started once flows are receding, monitoring at restored features will be done a minimum of twice weekly. Best judgment will be used to determine the appropriate frequency above this minimum, as well as the appropriate time of day to conduct monitoring based on conditions at the restored feature.

4. Monitoring will be conducted until such time as (a) the site is dry, (b) all silvery minnows are removed from the isolated pool, or (c) flows increase such that the isolated pool becomes reconnected to the main channel.

5. If isolated pools occur at restored features that may contain silvery minnows, a permitted fisheries biologist will lead the effort to seine (or if seining is not feasible, then other net gear may be substituted) these pools and determine (a) the presence or absence of silvery minnows, and (b) the potential number present. Fish monitoring will only be conducted in these isolated pools, and not in areas that have the potential to become isolated but are not yet disconnected from the river. Silvery minnows collected from isolated pools will then be released nearby into continuous parts of the river.

6. Species identification, standard length, reproductive condition, and health condition of fish; and pool depth, dimensions and water quality information will be recorded to the extent possible. Health information includes whether fish exhibit signs of compromised health due to disease (e.g., fungus, *Lernia*, hemorrhagic lesions), anemia (i.e., emaciation), or physical deformity. Species counts will be maintained for all collections

separately for each pool. A handheld global positioning system (GPS) unit with sub-meter accuracy will be used to record pool locations. Any dead silvery minnows will be preserved and transferred to the Museum of Southwestern Biology.

7. The findings of this monitoring program for the Corps MRG Bosque Restoration project will be reported to the Service once per year in December, including all accounts of silvery minnows found in isolated pools (whether dead or alive) and their condition.

8. If silvery minnow take is met or exceeded (based on Corps MRG Bosque Restoration Project Incidental Take Statement) in these isolated pools at the restored features, the Service will be contacted before continuing with further silvery minnow monitoring activities.

Maintenance work may be needed for ephemeral high flow channels or backwaters and would be conducted during the work window between August 15 and April 15. Any maintenance work required would be conducted in the dry when the channels are not connected to the main channel. Maintenance of vegetation treatments is anticipated to meet project objectives, monitoring and adaptive management goals.

Project Implementation Timing and Sequencing

Due to the scope of the project and anticipated availability of funding, it is estimated that implementation of the proposed action would take place over a period of three to five years. The first phase is scheduled to begin September 2011. The proposed action would be phased to make the most efficient use of available funds, and to phase tasks that require sequential implementation. Whereas bank terracing and high-flow channel building at any one site can be accomplished in a relatively short time (a few months), for example, this activity would only take place at one or two areas at a time to minimize impacts to water quality. Removal of non-native species and revegetation with natives is, generally, a multiple year effort. Once initial removal takes place, follow-up treatment is required 6 months to a year later to eliminate trees that resprout from roots or stumps. Planting of native species is not prudent until such follow-up treatments have been performed. In some areas, removal of non-native species, or jetty jacks, would also be required to allow access to construct other features.

All work will be scheduled during the typical low flow seasons on the MRG and would avoid the period between April 15 and August 15. Non-native plant removal would take place first, followed by construction of water features. Recreation features would come last. Water features would be constructed within the bosque, and only later connected to the river to reduce sediment inputs into the river and potential disturbance of silvery minnow. Water features are connected to the river during the lowest flow possible.

Sequencing the construction of high flow channels and/or bank terracing) is proposed to reduce the amount of potential sediment moving into the river and reduce impacts at the river bank edge. The high flow channels will be constructed so that the opening at the downstream end would be excavated first and the opening at the upstream end would be excavated last (similar to the Rio Grande Nature Center and Route 66 projects – U.S. Army Corps of Engineers 2006, 2008). The area of disturbance to wetted habitat is limited to approximately 1,500 ft^2 at each end of a constructed channel. Flows in the river during construction of these high flow channels are anticipated to be about 300-400 cfs. If flows are low enough, the contractor will leave the edge of the berm (the bank of the river) for each end of the ephemeral channel in place during construction until opening the channel at the very end. The berm serves as a 'dam' to avoid impacts to the river and/or silvery minnow. Therefore, a coffer dam or silt curtain is not usually needed. If one is needed, the silt curtain or coffer dam would be placed along the bank line and then pushed out into the channel to expand the bankline approximately 20 feet under the supervision of Corps' biologists, in order to minimize disturbance to the flows. The placement of cofferdams or silt fences will exclude silvery minnow, and repeated disturbance of silvery minnow at a construction site is not anticipated. If silt fences are deployed, a downstream opening will be allowed for silvery minnow escapement as sediment placement begins in the upstream portion. In all cases to date, leaving the bank edge in place for the construction of high flow channels has worked and no silt fencing or cofferdams were required.

For construction of bankline terracing, the bank edge would be removed one shelf at a time with equipment placed further back on the bank edge (ie: the fork from a track excavator would reach over and pull sediment from the bank edge). This would be done by pulling the dirt back in to the bosque in order to avoid dumping sediment into the river. The terracing would be done during very low flows in order to have limited impact to the river. Construction is expected to disturb some wetted habitat - approximately ¼ of the total treatment area.

Conservation Measures

Measures will be implemented during the proposed action to help minimize or avoid adverse effects of the restoration projects and to successfully and safely implement all habitat restoration activities. These include the following:

Construction Timing and Sequencing

- Proposed activities will not take place during April 15 – August 15 of each year.
- Sequencing the construction of high flow channels and/or bank terracing) is proposed to reduce the amount of potential sediment moving into the river and reduce impacts to the river bank edge. The high flow channels will be constructed so that the opening at the downstream end would be excavated first and the opening at the upstream end would be excavated last. The bankline terracing will be constructed by removing the bank edge one shelf at a time by pulling the material back, away from the water interface.

Equipment and Operations

- Wherever possible, equipment will operate on the riverbanks or otherwise in the dry to avoid contact with silvery minnow habitat.
- All equipment will be steam-cleaned before arriving and departing the job site.
- To avoid any potential impacts to listed species or their habitat, all fuels, hydraulic fluids, and other hazardous materials will be stored outside the normal floodplain and refueling will

take place on dry ground with a spill kit ready. Extra precautions will be taken when refueling because of the environmentally sensitive location.

- A spill kit will be maintained on every rig in the river, with spill pans, containment diapers, oil booms, absorbent pads, oil mats, plastic bags, gloves, and goggles.
- An environmental specialist trained in spill prevention and spill cleanup will be on site during all construction activities.
- Steel-mesh guards will cover all external hydraulic lines
- Silt fencing will be installed adjacent to the riverbank to prevent erosion to the river.
- Equipment operation will minimize sediment displacement by river flow.
- Prior to leaving contractor facilities, all equipment will be thoroughly inspected, and any leaky or damaged hydraulic hoses will be replaced.
- Maintenance of high flow channels or backwaters will be conducted in the dry.
- The "berm" (existing river bank), or, if necessary, cofferdams and/or silt curtains or other suitable erosion control measures will be used during construction of bank line features (high flow channel inlets and outlets, bank terracing).
- Storage and dispensing fuels, lubricants, hydraulic fluids, and other petrochemicals outside the 100-year floodplain. Inspect construction equipment daily for petrochemical leaks. Contain and remove any petrochemical spills and dispose of these materials at an approved upland site. Park construction equipment outside the 100-year floodplain during periods of inactivity.
- Ensure equipment operators carry an oil spill kit or spill blanket at all times and are knowledgeable in the use of spill containment equipment. Develop a spill contingency plan prior to initiation of construction. Immediately notify the proper Federal and state authorities in the event of a spill.
- Mature cottonwood trees will be protected from damage during clearing of non-native species or other construction activities using fencing, or other appropriate materials.
- Local genetic stock will be used wherever possible in the native plant species establishment throughout the riparian area.
- A Corps' biologist will monitor the project during construction at the bank of the river in order to detect any potential silvery minnow in the area. Findings of injured or dead silvery minnows will immediately be reported to the Service.
- All features regardless of location will be sloped toward the main river channel to minimize the potential for entrapment of silvery minnows as flows recede.
- High flow channels, backwater channels, willow swales, scallops and any other restoration features that have the potential to strand silvery minnow as flows recede will be monitored following established protocol.
- Surveys will be conducted for the presence/absence of Flycatchers during their breeding season throughout the project area immediately prior to construction. If such surveys indicate breeding season occupation, then ESA Section 7 consultation would be reinitiated and a no work buffer zone of ¼ mile would immediately be established.

Staging and Access

- All work and staging areas should be limited to the minimum amount of area required.

Existing roads and right-of-ways and staging areas should be used to the greatest extent practicable to transport equipment and construction materials to the project site, and described in the USACE's project description. Provide designated areas for vehicle turn around and maneuvering to protect riparian areas from unnecessary damage.

Permitting

- Clean Water Act (CWA) 404 and 401 permitting processes will be completed prior to commencement of the proposed action.
- Stormwater Pollution Prevention Plan (SWPPP) for construction sites will be adhered to.

Herbicide Treatments

- Herbicides will not be applied when winds exceed 15 miles per hour or when rain is forecasted for the local area within 48 hours of application. Herbicides will be applied no later than two months before the normal spring runoff and high water tables, or by March 15th. Garlon-4 will be used, but not within a 20-ft buffer zone from areas where standing or flowing water is present; Renovate 3® (triclopyr) will be applied as needed within the 20-ft buffer zone.
- All required permitting and licensure would be obtained by the contractor. Prior to application, all chemicals would be specifically approved per manufacturer's instructions.
- Herbicide label requirements will be followed. Mixing and application of these herbicides would be done so in accordance with all manufacturer instructions and proper personal protective equipment would be worn. Storage and mixing would also be performed following manufacturer's instructions. Storage would not be allowed on site within the bosque.
- Follow-up inspections and monitoring post-herbicide application would be performed at all locations. All excess herbicide would be disposed of off-site.

Water Quality Monitoring

- During in-river work, water-quality testing will be conducted prior to entering the water and periodically during the operating day to ensure that standards are being maintained. Water quality measurements will be taken before, during and after construction activity. Water-quality parameters to be tested include pH, temperature, DO, and turbidity, both upstream and downstream of the work area.

Action Area

The action area includes all areas to be affected directly or indirectly by the proposed action (see 50 CFR §402.02). The proposed action will occur in the Angostura reach of the Rio Grande between the levees extending approximately 26.4 miles from the north side of the Village of Corrales in Sandoval County downstream to the northern boundary of the Pueblo of Isleta in Bernalillo County. For this consultation, the action area is defined as the entire width of the 100-year floodplain of the Rio Grande from RM 198.4 to RM 172.

II. STATUS OF THE SPECIES

The proposed action considered in this biological opinion may affect the Rio Grande silvery minnow (*Hybognathus amarus*) which is provided protection as an endangered species under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.; ESA). A description of this species, its status, and its habitat is provided below and informs the effects analysis for this biological opinion.

RIO GRANDE SILVERY MINNOW

Description

The silvery minnow currently occupies a 170-mile (275-kilometer) reach of the Middle Rio Grande, New Mexico, from Cochiti Dam in Sandoval County, to the headwaters of Elephant Butte Reservoir in Socorro County (U.S. Fish and Wildlife Service 1994). The silvery minnow was also introduced into the Rio Grande near Big Bend, Texas, in December 2008 as an experimental, non-essential population under section 10(j) of the ESA. The silvery minnow is a stout minnow, with moderately small eyes, a small, sub-terminal mouth, and a pointed snout that projects beyond the upper lip (Sublette *et al.* 1990). The back and upper sides of the silvery minnow are silvery to olive, the broad mid-dorsal stripe is greenish, and the lower sides and abdomen are silver. Maximum length attained is about 3.5 inches (90 millimeters). The only readily apparent sexual dimorphism is the expanded body cavity of ripe females during spawning (Bestgen and Propst 1994).

In the past, the silvery minnow was included with other species in the genus *Hybognathus* due to morphological similarities. Phenetic and phylogenetic analyses corroborate the hypothesis that it is a valid taxon, distinct from other species of *Hybognathus* (Cook *et al.* 1992, Bestgen and Propst 1994). It is now recognized as one of seven species in the genus *Hybognathus* in the United States and was formerly one of the most widespread and abundant minnow species in the Rio Grande basin of New Mexico, Texas, and Mexico (Pflieger 1980, Bestgen and Platania 1991). Currently, *Hybognathus amarus* is the only remaining endemic pelagic spawning minnow in the Middle Rio Grande. The speckled chub (*Extrarius aestivalus*), Rio Grande shiner (*Notropis jemezanus*), phantom shiner (*Notropis orca*), and bluntnose shiner (*Notropis simus simus*) are either extinct or have been extirpated from the Middle Rio Grande (Bestgen and Platania 1991).

Legal Status

The silvery minnow was federally listed as endangered under the ESA on July 20, 1994 (58 FR 36988; see U.S. Fish and Wildlife Service 1994). The species is also listed as an endangered species by the State of New Mexico. Primary reasons for listing the silvery minnow are described below in the *Reasons for Listing/Threats to Survival* section. The Service designated critical habitat for the silvery minnow on February 19, 2003 (68 FR 8088). See description of designated critical habitat below.

Habitat

The silvery minnow travels in schools and tolerates a wide range of habitats (Sublette *et al.* 1990), yet generally prefers low velocity (< 0.33 $ft \cdot s^{-1}$ or 10 $cm \cdot s^{-1}$) areas over silt or sand substrate that are associated with shallow (< 15.8 in, 40 cm) braided runs, backwaters, or pools (Dudley and Platania 1997). Habitat for the silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Stream reaches dominated by straight, narrow, incised channels with rapid flows are not typically occupied by the silvery minnow (Sublette *et al.* 1990, Bestgen and Platania 1991).

Adult silvery minnows are most commonly found in backwaters, pools, and habitats associated with debris piles; whereas, young of year (YOY) fish occupy shallow, low velocity backwaters with silt substrates (Dudley and Platania 1997). A study conducted between 1994 and 1996 characterized habitat availability and use at two sites in the Middle Rio Grande – one at Rio Rancho and the other at Socorro. From this study, Dudley and Platania (1997) reported that the silvery minnow was most commonly found in habitats with depths less than 19.7 in (50 cm). Over 85 percent were collected from low-velocity habitats (<0.33 $ft \cdot s^{-1}$ or 10 $cm \cdot s^{-1}$) (Dudley and Platania 1997, Watts *et al.* 2002).

Designated Critical Habitat

The action area for this consultation occurs primarily on land designated as critical habitat for silvery minnow (16 of the 18 proposed restoration sites); however, two of the proposed restoration sites (1B and 1D) do not occur within designated critical habitat because they are located on Pueblo of Sandia lands. The Service designated critical habitat for the silvery minnow on February 19, 2003 (68 FR 8088; see U.S. Fish and Wildlife Service 2003b). The critical habitat designation extends approximately 157 mi (252 km) from Cochiti Dam in Sandoval County, New Mexico, downstream to the utility line crossing the Rio Grande, which is a permanent identified landmark in Socorro County, New Mexico. In addition to the Pueblo of Sandia, the Pueblo lands of Santo Domingo, Santa Ana, and Isleta within this area are also not included in the critical habitat designation. Except for these Pueblo lands, the remaining portion of the silvery minnow's occupied range in the Middle Rio Grande in New Mexico is designated as critical habitat.

The critical habitat designation defines the lateral extent (width) as those areas bounded by existing levees or, in areas without levees, 300 ft (91.4 m) of riparian zone adjacent to each side of the bankfull stage of the Middle Rio Grande. Some developed lands within the 300-ft lateral extent are not considered critical habitat because they do not contain the primary constituent elements of critical habitat and are not essential to the conservation of the silvery minnow. Lands located within the lateral boundaries of the critical habitat designation, but not considered critical habitat include: developed flood control facilities, existing paved roads, bridges, parking lots, dikes, levees, diversion structures, railroad tracks, railroad trestles, water diversion and irrigation canals outside of natural stream channels, the Low Flow Conveyance Channel, active gravel pits, cultivated agricultural land, and residential, commercial, and industrial developments.

The Service determined the primary constituent elements (PCEs) of silvery minnow critical habitat based on studies on silvery minnow habitat and population biology. These PCEs include:

1. A hydrologic regime that provides sufficient flowing water with low to moderate currents capable of forming and maintaining a diversity of aquatic habitats, such as, but not limited to the following: backwaters (a body of water connected to the main channel, but with no appreciable flow), shallow side channels, pools (that portion of the river that is deep with relatively little velocity compared to the rest of the channel), and runs (flowing water in the river channel without obstructions) of varying depth and velocity – all of which are necessary for each of the particular silvery minnow life history stages in appropriate seasons (e.g., the silvery minnow requires habitat with sufficient flows from early spring (March) to early summer (June) to trigger spawning, flows in the summer (June) and fall (October) that do not increase prolonged periods of low- or no flow, and relatively constant winter flow (November through February);

2. The presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat within unimpounded stretches of flowing water of sufficient length (i.e., river miles) that provide a variation of habitats with a wide range of depth and velocities;

3. Substrates of predominantly sand or silt; and

4. Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1°C (35°F) and less than 30°C (85°F) and reduce degraded conditions (e.g., decreased DO, increased pH).

These PCEs provide for the physiological, behavioral, and ecological requirements essential to the conservation of the silvery minnow.

Life History

The species is a pelagic spawner that produces 3,000 to 6,000 semi-buoyant, non-adhesive eggs during a spawning event (Platania 1995, Platania and Altenbach 1998). The majority of adults in the wild spawn in about a one-month period in late spring to early summer (May to June) in association with spring runoff. Platania and Dudley (2000, 2001) found that the highest collections of silvery minnow eggs occurred in mid- to late May. In 1997, Smith (1999) collected the highest number of eggs in mid-May, with lower frequency of eggs being collected in late May and June. These data suggest multiple silvery minnow spawning events during the spring and summer, perhaps concurrent with flow spikes. Artificial spikes have apparently induced silvery minnows to spawn (Platania and Hoagstrom 1996). In captivity, silvery minnow have been induced to spawn as many as four times in a year (C. Altenbach, City of Albuquerque, *pers. comm.* 2000); however, it is unknown if individual silvery minnow spawn more than once per year in the wild or if multiple spawning events suggested during spring and summer represent the same or different individuals.

The spawning strategy of releasing semi-buoyant eggs can result in the downstream displacement of eggs, especially in years or locations where overbank opportunities are limited. The presence of diversion dams (Angostura, Isleta, and San Acacia Diversion Dams) prevents the recolonization of upstream habitats (Platania 1995) and has affected the species' effective population size (N_e) which is at critically low levels (Alò and Turner 2005, Osborne *et al.* 2005). Adults, eggs and larvae may also be transported downstream to Elephant Butte Reservoir. It is believed that none of these fish survive because of poor habitat and predation from reservoir fishes (U.S. Fish and Wildlife Service 2010).

Platania (2000) found that development and hatching of eggs are correlated with water temperature. Eggs of the silvery minnow raised in 30°C water hatched in approximately 24 hours while eggs reared in 20-24°C water hatched within 50 hours. Eggs were 0.06 inches in size upon fertilization, but quickly swelled to 0.12 in. Recently hatched larval fish are about 0.15 inches in standard length and grow about 0.005 inches per day during the larval stages. Eggs and larvae have been estimated to remain in the drift for three to five days, and could be transported from 134 to 223 miles downstream depending on river flows and availability of nursery habitat (Platania 2000). Approximately three days after hatching the larvae move to low velocity habitats where food (mainly phytoplankton and zooplankton) is abundant and predators are scarce. YOY attain lengths of 39-41 mm (1.53-1.61 in) by late autumn (U.S. Fish and Wildlife Service 2010). Age-1 fish are 1.8 to 1.9 in by the start of the spawning season. Most growth occurs between June (post spawning) and October, but there is some growth in the winter months. In the wild, maximum longevity is about 30 months for wild fish inferred from length-frequency, but up to 36 months for hatchery-released fish (U.S. Fish and Wildlife Service 2010). Based on estimated length groups for assigning an age class, it is possible that some individuals in the wild survive to be Age-3 fish; however >95% of the population in any given year is estimated to comprise Age-0 and Age-1 fish (U.S. Fish and Wildlife Service 2010). In comparison to longevity in the wild, it is not uncommon for captive silvery minnows to live beyond two years, especially at lower water temperatures. The U.S. Geological Survey's (USGS) Columbia Environmental Research Center in Yankton, South Dakota, has several silvery minnows in captivity with a maximum age of 11 that range in size from 46 to 73 (± 8.1) mm SL (Buhl, pers. comm. *as cited in* U.S. Fish and Wildlife Service 2010).

The silvery minnow is herbivorous (feeding primarily on algae); this is indicated indirectly by the elongated and coiled gastrointestinal tract (Sublette *et al.* 1990). Additionally, detritus, including sand and silt, is filtered from the bottom (Sublette *et al.* 1990, U.S. Fish and Wildlife Service 1999). The presence of this sand and silt in the gut of wild-captured specimens suggests that epipsammic algae (algae growing on the surface of sand) is an important food (U.S. Fish and Wildlife Service 2010). Laboratory-reared Rio Grande silvery minnow have been directly observed grazing on algae in aquaria (Platania 1995 and Magana 2007 both *as cited in* U.S. Fish and Wildlife Service 2010).

Population Dynamics

Generally, a population of silvery minnows consists of only two age classes: YOY and Age 1 fish (U.S. Fish and Wildlife Service 2010). The majority of spawning silvery minnows are one year in age, with two year-old fish and older estimated to comprise less than five percent of the spawning population (U. S. Fish and Wildlife Service 2010). High silvery minnow mortality occurs during or subsequent to spawning, consequently very few adults are found in late summer. By December, in general the majority of surviving Rio Grande silvery minnow represents Age-0 fish – those that hatched the previous spring (Dudley and Platania 2007; Remshardt 2007, 2008 – all *as cited in* U.S. Fish and Wildlife Service 2010).

Platania (1995) found that a single female in captivity could broadcast 3,000 eggs in eight hours. Females produce 3 to 18 clutches of eggs in a 12-hour period. The mean number of eggs in a clutch is approximately 270 (Platania and Altenbach 1998). In captivity, silvery minnows have been induced to spawn as many as four times in a year (C. Altenbach, City of Albuquerque, *pers. comm.* 2000). It is not known if they spawn multiple times in the wild. The high reproductive potential of this fish appears to be one of the primary reasons that it has not been extirpated from the Middle Rio Grande. However, the short life span of the silvery minnow increases the population instability. When two below-average flow years occur consecutively, a short-lived species such as the silvery minnow can be impacted, if not completely eliminated from dry reaches of the river (U.S. Fish and Wildlife Service 1999, 2010).

Distribution and Abundance

Historically, the silvery minnow occurred in 2,465 mi (3,967 km) of rivers in New Mexico and Texas. The species was known to have occurred upstream to Española, New Mexico (upstream from Cochiti Lake); in the downstream portions of the Chama and Jemez Rivers; throughout the Middle and Lower Rio Grande to the Gulf of Mexico; and in the Pecos River from Sumner Reservoir downstream to the confluence with the Rio Grande (Sublette *et al.* 1990, Bestgen and Platania 1991). The current distribution of the silvery minnow is limited to the Rio Grande between Cochiti Dam and Elephant Butte Reservoir, which amounts to approximately seven percent of its historic range. In December 2008, silvery minnows were introduced into the Rio Grande near Big Bend, Texas as a nonessential, experimental population under section 10(j) of the ESA (73 FR 74357). Additional silvery minnows were stocked in this reached in 2009 and 2010. Monitoring is being conducted to determine the success of the reintroduction.

The construction of mainstem dams, such as Cochiti Dam and irrigation diversion dams have contributed to the decline of the silvery minnow. The construction of Cochiti Dam in particular affected the silvery minnow by reducing the magnitude and frequency of flooding events that help to create and maintain habitat for the species. In addition, the construction of Cochiti Dam has resulted in degradation of silvery minnow habitat within the Cochiti Reach. River outflow from Cochiti Dam is now generally clear, cool, and free of sediment. There is relatively little channel braiding, and areas with reduced velocity and sand or silt substrates are uncommon. Substrate immediately downstream of the dam is often armored cobble (rounded rock fragments generally 8 to 30 cm (3 to 12 in) in diameter). Further downstream the riverbed is gravel with some sand material. Ephemeral tributaries including Galisteo Creek and Tonque Arroyo introduce sediment to the lower sections of this reach, and some of this is transported downstream with higher flows (U.S. Fish and Wildlife Service 2001, 1999). The Rio Grande below Angostura Dam becomes a predominately sand bed river with low, sandy banks in the downstream portion of the reach. The construction of Cochiti Dam also created a barrier between silvery minnow populations (U.S. Fish and Wildlife Service 2010). As recently as 1978, the silvery minnow was collected upstream of Cochiti Lake; however surveys since 1983 suggest that the fish is now extirpated from that area (U.S. Fish and Wildlife Service 1999; Torres *et al.* 2008). Similarly, the another mainstem dam, Elephant Butte Dam, created a barrier between silvery minnow populations at a time when silvery minnow still occupied the Rio Grande to the Gulf of Mexico and contributed to its listing as endangered (U.S. Fish and Wildlife Service 1994). The last known collection of silvery minnow in the reach between Elephant Butte Dam and Presidio occurred in 1944.

Long-term monitoring for the Rio Grande silvery minnow and fish communities in the Middle Rio Grande began in 1993 and has continued annually, with the exception of 1998 and the majority of 2009. This includes monitoring at three sites, at River Mile 200 just upstream of the action area and within the action area at River Miles 183.4 and 178.3. The most recent data from these three sites indicate a density of 0.18 silvery minnows per 100 square meters within the action area in December of 2010 (Dudley and Platania 2011a). The long-term monitoring of silvery minnows has recorded substantial fluctuations (order of magnitude increases and decreases) in the population. Rio Grande silvery minnow catch rates declined two to three orders of magnitude between 1993 and 2003, but then increased three to four orders of magnitude by 2005 and continue to fluctuate (see Figure 2). Having declined again in 2010, silvery minnow catch rates are again lower than at the time of its listing as an endangered species in 1994. Population size is highly correlated with hydrologic conditions, particularly the magnitude and duration of the spring runoff (Dudley and Platania 2008b) and length of river channel that becomes intermittent (Dudley *et al*, 2009).

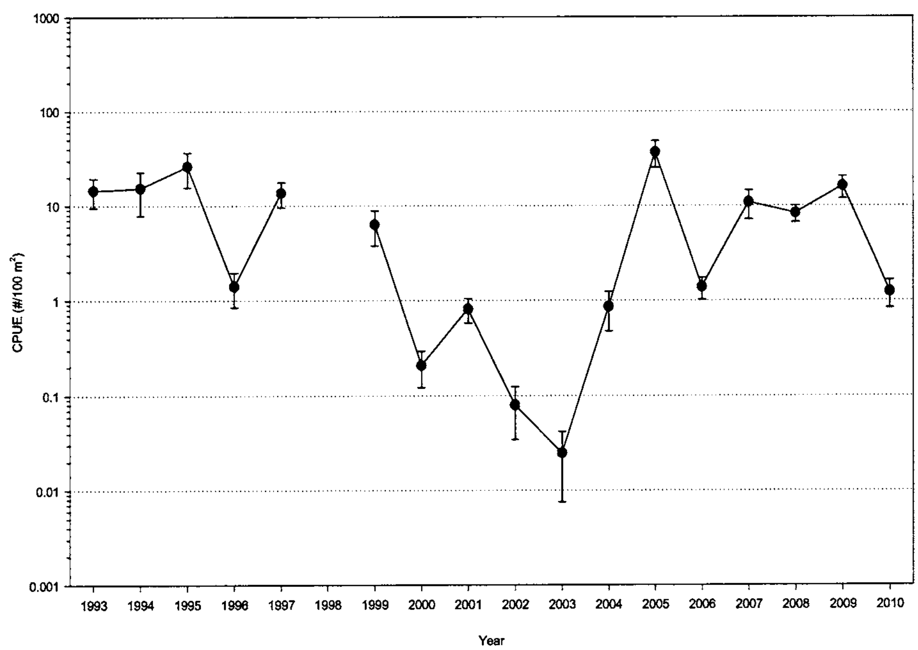

Figure 2. Rio Grande Silvery Minnow Population Trends 1993-2010 based on October CPUE data (American Southwest Ichthyological Researchers, LLC)

Augmentation has likely sustained the silvery minnow population throughout its range. Over 1.25 million silvery minnows have been released since 2002. Captively propagated and released fish supplement the native adult population, most likely prevented extinction during the extremely low water years of 2002 and 2003. Since 2001, the Angostura Reach has been the focus of augmentation efforts; however, beginning in 2008, augmentation shifted focus to the Isleta and San Acacia Reaches only (J. Remshardt, Service, *pers. comm.* 2010). To accurately determine the success of these efforts and the continued effects of these releases, a period of five years (2008-2012) without intensive stocking is being evaluated. If the overall catch rate for Angostura Reach drops to below 0.1 silvery minnows per 100 m^2 during October, then augmentation will be re-initiated for this reach the following year (Remshardt 2008).

In November 2010, the Isleta and San Acacia reaches, but not the Angostura reach, were augmented with silvery minnow. Silvery minnow surveys in December 2010 and February 2011 revealed the effect that augmentation has on maintaining the species. While catch rates in the Angostura reach declined compared to the October survey, catch rates in the Isleta and San Acacia reaches increased and many silvery minnow captured in the Isleta and San Acacia reaches were fish that had been hatchery raised and stocked – presence of the VIE tag (Dudley and Platania 2011a, 2011b).

Middle Rio Grande Distribution Patterns

During the early 1990s, the density of silvery minnows generally increased from upstream (Angostura Reach) to downstream (San Acacia Reach). During surveys in 1999, over 98 percent of the silvery minnow captured were downstream of San Acacia Diversion Dam (Dudley and Platania 2002). This distributional pattern can be attributed to downstream drift of eggs and larvae, limited availability of habitats to retain the early life stages, and the inability of adults to repopulate upstream reaches because of diversion dams.

For several years (2004, 2005, and 2007), this pattern changed. Catch rates were highest in the Angostura Reach and lower the Isleta and San Acacia Reaches. Routine augmentation of silvery minnows in the Angostura Reach (the focus of augmentation efforts starting in 2001) may partially explain this pattern. Transplanting of silvery minnows rescued from drying reaches (approximately 802,700 through 2009) has also occurred since 2003; however, it is not possible to quantify the effects of those efforts on silvery minnow distribution patterns (J. Remshardt, Service, *pers. comm.* 2010). Good recruitment conditions (i.e., high and sustained spring runoff) throughout the Middle Rio Grande during April and May followed by wide-scale drying in the Isleta and San Acacia reaches from June-September in these years, may also explain the shift. High spring runoff (>3,000 cfs for 7-10 days) and perennial flow lead to increased availability of nursery habitat and increased survivorship in the Angostura Reach. In contrast, south of Isleta and San Acacia Diversion Dams, large stretches of river (30+ miles) have been routinely dewatered and young silvery minnows in these areas were either subjected to poor recruitment conditions (i.e., lack of nursery habitats during low-flows) or were trapped in drying pools where they perished. In 2006, 2008, 2009 and 2010, densities of silvery minnows were again highest downstream of San Acacia. The Angostura reach has not been augmented with silvery minnow since 2007.

Distribution and Abundance in the Action Area

Long term monitoring for silvery minnows has been carried out at 5 sites within the Angostura reach which includes 3 sites that are within or near the action area. Until the Angostura reach was augmented with silvery minnow, the reach supported lower densities of silvery minnow than the lower reaches. After augmentation of the Angostura reach ceased in 2008, silvery minnow catch rates again declined to levels less than the catch rates in the Isleta and San Acacia reaches. In 2010, catch rates declined markedly between July and October and continued to decline in the Angostura reach. The action area extends from approximately River Mile 198.4 downstream to approx. River Mile 172. Fish monitoring occurs at sampling sites at River Miles 200, 183.4, and 178.3. The most recent CPUE data collected in December 2010 and February 2011 (Dudley and Platania 2011a, 2011b) from these three sampling locations averages 0.18 silvery minnow/100 m^2 and 0.13 silvery minnow/100 m^2, respectively. In October 2010, at the same sampling locations, the density of silvery minnow was 0.29 per 100 m^2 (Dudley and Platania 2010). Over the last 5 years (2006-2010), October catch rate data at the 3 sampling locations averaged 7.36 silvery minnows/100 m^2 (Dudley and Platania 2006, 2007, 2008a, 2009, 2010).

Reasons for Listing/Threats to Survival

The silvery minnow was federally listed as endangered for the following reasons:

1. Regulation of stream waters, which has led to severe flow reductions, often to the point of dewatering extended lengths of stream channel;

2. Alteration of the natural hydrograph, which impacts the species by disrupting the environmental cues the fish receives for a variety of life functions, including spawning;

3. Both the stream flow reductions and other alterations of the natural hydrograph throughout the year can severely impact habitat availability and quality, including the temporal availability of habitats;

4. Actions such as channelization, bank stabilization, levee construction, and dredging result in both direct and indirect impacts to the silvery minnow and its habitat by severely disrupting natural fluvial processes throughout the floodplain;

5. Construction of diversion dams fragment the habitat and prevent upstream migration;

6. Introduction of nonnative fishes that directly compete with, and can totally replace the silvery minnow, as was the case in the Pecos River, where the species was totally replaced in a time frame of 10 years by its congener the plains minnow (*Hybognathus placitus*); and

7. Discharge of contaminants into the stream system from industrial, municipal, and agricultural sources also impact the species (U.S. Fish and Wildlife Service 1993b, 1994).

These reasons for listing continue to threaten the species throughout its currently occupied range in the Middle Rio Grande.

Recovery Efforts

The final Recovery Plan for the silvery minnow was released in July 1999 (U.S. Fish and Wildlife Service 1999). The Recovery Plan was updated and revised, and a draft revised Recovery Plan (U.S. Fish and Wildlife Service 2007) was released for public comment on January 18, 2007 (72 FR 2301). Based on public comment and peer review comments on the 2007 draft Recovery Plan, the recovery criteria were revised and released for an additional period of public comment on April 9, 2009 (74 FR 16232). Incorporating public comments and peer review comments the Service received on the draft revision, the First Revision of the Rio Grande Silvery Minnow Recovery Plan was finalized and issued on February 22, 2010 (75 FR 7625). The revised Recovery Plan describes recovery goals for the Rio Grande silvery minnow and actions to complete these (U.S. Fish and Wildlife Service 2010). The three goals identified for the recovery and delisting of the Rio Grande silvery minnow are:

1. Prevent the extinction of the Rio Grande silvery minnow in the middle Rio Grande of New Mexico.

2. Recover the Rio Grande silvery minnow to an extent sufficient to change its status on the List of Endangered and Threatened Wildlife from endangered to threatened (downlisting).

3. Recover the Rio Grande silvery minnow to an extent sufficient to remove it from the List of Endangered and Threatened Wildlife (delisting).

Downlisting (Goal 2) of the Rio Grande silvery minnow may be considered when the criteria have been met resulting in three populations (including at least two that are self-sustaining) that have been established within the historical range of the species and have been maintained for at least five years.

Delisting (Goal 3) of the species may be considered when the criteria have been met resulting in three self-sustaining populations have been established within the historical range of the species and have been maintained for at least ten years (U.S. Fish and Wildlife Service 2010).

Conservation efforts targeting the Rio Grande silvery minnow are also summarized in the revised Recovery Plan. These efforts include habitat restoration activities; research and monitoring of the status of the silvery minnow, its habitat, and the associated fish community in the Middle Rio Grande; and programs to stabilize and enhance the species, such as tagging fish and egg monitoring studies, salvage operations, captive propagation, and augmentation efforts. In addition, specific water management actions in the Middle Rio Grande valley over the past several years have been used to meet river flow targets and March 2003 BO (U.S. Fish and Wildlife Service 2003a) requirements for silvery minnows.

III. ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the ESA, when considering the effects of the action on federally listed species, we are required to take into consideration the environmental baseline. Regulations implementing the ESA (50 FR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area; the anticipated impacts of all proposed Federal actions in the action area that have already undergone formal or early section 7 consultation; and the impact of State and private actions that are contemporaneous with the consultation in process. The environmental baseline defines the effects of these activities in the action area on the current status of the species and its habitat to provide a platform to assess the effects of the action now under consultation.
Several activities have contributed to the current status of the silvery minnow and its habitat in the action area, and are believed to potentially affect the survival and recovery of silvery minnows in the wild. These include the current weather patterns, changes to the natural hydrology of the Rio Grande, changes to the morphology of the channel and floodplain, water quality, storage of water and release of spike flows, captive propagation and augmentation, silvery minnow salvage and relocation, ongoing research, and past projects in the Middle Rio Grande.

Changes in Hydrology
There have been two primary changes in hydrology as a result of the construction of dams on the Rio Chama and Rio Grande that affect the silvery minnow: (1) loss of water in minnow habitat and (2) changes to the magnitude and duration of peak flows.

Loss of Water in Minnow Habitat
Prior to measurable human influence on the system, up to the fourteenth century, the Rio Grande was a perennially flowing, aggrading river with a shifting sand substrate (Biella and Chapman 1977). There is now strong evidence that the Middle Rio Grande first began drying up periodically after the development of Colorado's San Luis Valley in the mid to late 1800s (Scurlock 1998). After humans began exerting greater influence on the river, there are two documented occasions when the river became intermittent during prolonged, severe droughts in 1752 and 1861 (Scurlock 1998). The silvery minnow historically survived low-flow periods because such events were infrequent and of lesser magnitude than they are today. There were also no diversion dams to block repopulation of upstream areas, the fish had a much broader geographical distribution, and there were oxbow lakes, cienegas, and sloughs associated with the Rio Grande that supported fish until the river became connected again.

Water management and use has resulted in a large reduction of suitable habitat for the silvery minnow. Agriculture accounts for 90 percent of surface water consumption in the Middle Rio Grande (Bullard and Wells 1992). The average annual diversion of water in the Middle Rio Grande by the Middle Rio Grande Conservation District (MRGCD) was 535,280 af (65,839 hectare-meters) for the period from 1975 to 1989 (U.S. Bureau of Reclamation 1993). In 1990, total water withdrawal (groundwater and surface water) from the Rio Grande Basin in New Mexico was 1,830,628 af, significantly exceeding a sustainable rate (Schmandt 1993). Water withdrawals have not only reduced overall flow quantities, but also caused the river to become locally intermittent or dry for extended reaches. Irrigation diversions and drains significantly reduce water volumes in the river. However, the total water use (surface and groundwater) in the Middle Rio Grande by the MRGCD may range from 28 – 37 percent (S.S. Papadopulos & Associates, Inc. 2000; U.S. Geologic Survey 2002). A portion of the water diverted by the MRGCD returns to the river and may be re-diverted, sometimes more than once (Bullard and Wells 1992; Middle Rio Grande Conservancy District, *in litt.* 2003). Although the river below Isleta Diversion Dam may be drier than in the past, small inflows may contribute to maintaining flows. Since 2001, improvements to physical and operational components of the irrigation system have contributed to a reduction in the total diversion of water from the Middle Rio Grande by the MRGCD. Prior to 2001, average diversions were 630,000 afy and now average 370,000 afy. The change was possible because of the considerable efforts of MRGCD to install new gages, automated gates at diversions, and the scheduling and rotation of diversions among water users. The new operations reduce the amount of water diverted; however, this also reduces return flows that previously supported flow in the river. In February 2007, the City of Albuquerque and Albuquerque Bernalillo County Water Utility Authority with six conservation groups established a fund that will provide the opportunity to lease water from Rio Grande farmers and have that water remain in the river channel to support the silvery minnow. The Pilot Water Leasing Project supports the need for reliable sources of water to support conservation programs as identified by the Middle Rio Grande Endangered Species Collaborative Program (Middle Rio Grande Endangered Species Collaborative Program 2004).

River reaches particularly susceptible to drying occur immediately downstream of the Isleta Diversion Dam (river mile 169), a 5-mile (8-km) reach near Tome (river miles 150-155), a 5-mile (8-km) reach near the U.S. Highway 60 Bridge (river miles 127-132), and an extended 36-mile (58-km) reach from near Brown Arroyo (downstream of Socorro) to Elephant Butte Reservoir. Extensive fish kills, including tens of thousands of silvery minnows, have occurred in these lower reaches when the river has dried. It is assumed that mortalities during river intermittence are likely greater than documented levels, for example due to predation by birds in isolated pools (J. Smith, NMESFO, *pers. comm.* 2003). From 1996 to 2007, an average of 32 miles of the Rio Grande dried each year, mostly in the San Acacia Reach. The most extensive drying occurred in 2003 and 2004 when 60 and 68.7 miles, respectively, were dewatered. Most documented drying events lasted an average of two weeks before flows returned. In contrast, 2008 was considered a wet year, with above average runoff and at least an average monsoon season. As a result, there was no river intermittency and no minnow salvage that year, which is the first time there has been no river drying since at least 1996. In 2010, 28.2 miles of the river in the Isleta and San Acacia reaches experienced intermittency.

Changes to Magnitude and Duration of Peak Flow

Water management has also resulted in a loss of peak flows that historically triggered the initiation of silvery minnow spawning. The reproductive cycle of the silvery minnow is tied to the natural river hydrograph. A reduction in peak flows or altered timing of flows may inhibit reproduction. Since completion of Elephant Butte Dam in 1916, four additional dams have been constructed on the Middle Rio Grande, and two have been constructed on one of its major tributaries, the Rio Chama (Scurlock 1998). Construction and operation of these dams, which are either irrigation diversion dams (Angostura, Isleta, San Acacia) or flood control and water storage dams (Elephant Butte, Cochiti, Abiquiu, El Vado), have modified the natural flow of the river. Mainstem dams store spring runoff and summer inflow, which would normally cause flooding, and release this water back into the river channel over a prolonged period of time. These releases are often made during the winter months, when low-flows would normally occur. For example, release of carryover storage from Abiquiu Reservoir to Elephant Butte Reservoir during the winter of 1995-96 represented a substantial change in the flow regime. The Army Corps of Engineers (Corps) consulted with the Service on the release of water from November 1, 1995 to March 31, 1996, during which time 98,000 af (12,054 hectare-meters) of water was released at a rate of 325 cfs (9.8 cm). Such releases depart significantly from natural, historic winter flow rates, and can substantially alter the habitat for silvery minnows. In spring and summer, artificially low flows may limit the amount of habitat available to the species and may also limit dispersal of the species (U.S. Fish and Wildlife Service 1999).

In the spring of 2002 and 2003, an extended drought raised concerns that silvery minnows would not spawn because of a lack of spring runoff. River discharge was artificially elevated through short duration reservoir releases during May to induce silvery minnow spawning. In response to the releases, significant silvery minnow spawning occurred and was documented in all reaches except the Cochiti Reach (S. Gottlieb, UNM, *in litt.* 2002; Dudley *et al.* 2005). Fall populations in 2003 and 2004 continued to decrease despite large spawning events, indicating a lack of recruitment.

By contrast, spring runoff in 2005 was above average, leading to a peak of over 6,000 cfs at Albuquerque and sustained high flows (> 3,000 cfs) for more than two months. These flows improved conditions for both spawning and recruitment. October 2005 monitoring indicated a significant increase in silvery minnows in the Middle Rio Grande compared to 2003 and 2004. In 2006, however, October numbers declined again after an extremely low runoff period and channel drying in June and July (Dudley *et al.* 2006). October samples that year yielded no small silvery minnows, indicating poor recruitment in the spring. Runoff conditions in 2007, 2008, and 2009 were average or above average.

Mainstem dams and the altered flows they create can affect habitat by preventing overbank flooding, trapping nutrients, altering sediment transport regimes, reducing and dewatering main channel habitat, modifying or eliminating native riparian vegetation, and creating reservoirs that favor non-native fish species. These changes may affect the silvery minnow by reducing its food supply, altering its preferred habitat, preventing dispersal, and providing a continual supply of non-native fish that may compete with or prey upon silvery minnows. Altered flow regimes may also result in improved conditions for other native fish species that occupy the same habitat, causing those populations to expand at the expense of the silvery minnow (U.S. Fish and Wildlife Service 1999).

In addition to providing a cue for spawning, flood flows also maintain a channel morphology to which the silvery minnow is adapted. The changes in channel morphology that have occurred from the loss of flood flows are discussed below.

Changes in Channel and Floodplain Morphology

Historically, the Rio Grande was sinuous, braided, and freely migrated across the floodplain. Changes in natural flow regimes, narrowing and deepening of the channel, and restraints to channel migration (i.e., jetty jacks) adversely affected the silvery minnow. These effects result directly from constraints placed on channel capacity by structures built in the floodplain. These anthropogenic changes have and continue to degrade and eliminate spawning, nursery, feeding, resting, and refugia areas required for species' survival and recovery (U.S. Fish and Wildlife Service 1993).

The active river channel within occupied habitat is also being narrowed by the encroachment of vegetation, resulting from continued low flows and the lack of overbank flooding. The lack of flood flows has allowed non-native riparian vegetation such as salt cedar and Russian olive to encroach on the river channel (U.S. Bureau of Reclamation 2001). These non-native plants are very resistant to erosion, resulting in channel narrowing and a subsequent increase in water velocity. Higher velocities result in fine sediment such as silt and sand being carried away, leaving coarser bed materials such as gravel and cobble. Habitat studies during the winter of 1995 and 1996 (Dudley and Platania 1996), demonstrated that a wide, braided river channel with low velocities resulted in higher catch rates of silvery minnows, and narrower channels resulted in fewer fish captured. The availability of wide, shallow habitats that are important to the silvery minnow is decreasing. Narrow channels have few backwater habitats with low velocities that are important for silvery minnow fry and young-of-year.

Within the current range of the silvery minnow, human development and use of the floodplain have greatly restricted the width available to the active river channel. A comparison of river area between 1935 and 1989 shows a 52 percent reduction, from 26,598 acres (10,764 ha) to 13,901 acres (5,626 ha) (Crawford *et al.* 1993). These data refer to the Rio Grande from Cochiti Dam downstream to the "Narrows" in Elephant Butte Reservoir. Within the same stretch, 234.6 mi (378 km) of levees occur, including levees on both sides of the river. Analysis of aerial photography taken by Reclamation in February 1992, for the same river reach, shows that of the 180 mi (290 km) of river, only 1 mi (1.6 km), or 0.6 percent of the floodplain has remained undeveloped. Development in the floodplain, makes it difficult, if not impossible, to send large quantities of water downstream that would create low velocity side channels that the silvery minnow prefers. As a result, reduced releases have decreased available habitat for the silvery minnow and allowed encroachment of non-native species into the floodplain.

Water Quality

Many natural and anthropogenic factors affect water quality in the Middle Rio Grande, including the action area. Water quality in the Middle Rio Grande varies spatially and temporally throughout its course primarily due to inflows of groundwater, as well as surface water discharges and tributary delivery to the river. Factors that are known to cause poor fish habitat include temperature changes, sedimentation, runoff, erosion, organic loading, reduced oxygen content, pesticides, and an array of other toxic and hazardous substances. Both point source pollution (e.g., pollution discharges from a pipe) and non-point source pollution (i.e., diffuse sources) affect the Middle Rio Grande. Major point sources include waste water treatment plants (WWTPs) and feedlots. Major non-point sources include agricultural activities (e.g., fertilizer and pesticide application, livestock grazing), urban storm water run-off, and mining activities (Ellis *et al.* 1993).

Effluents from WWTPs contain contaminants that may affect the water quality of the river. It is anticipated that WWTP effluent may be the primary source of perennial flow during extended periods of intermittency in the lower portion of the Angostura Reach. For that reason, the water quality of the effluent is extremely important. Within or near the action area, the largest WWTP discharges are from Albuquerque, followed by two WWTPs in Rio Rancho, and Bernalillo (mean annual discharge flows are 80.4, 2.5, 0.9, and 0.7 cfs, respectively) (Bartolino and Cole 2002). Since 1998, total residual chlorine (chlorine) and ammonia, as nitrogen (ammonia), have been discharged unintentionally at concentrations that exceed protective levels for the silvery minnow. In addition to chlorine and ammonia, WWTP effluents may also include cyanide, chloroform, organophosphate pesticides, semi-volatile compounds, volatile compounds, heavy metals, and pharmaceuticals and their derivatives, which can pose a health risk to silvery minnows when discharged in concentrations that exceed the protective water quality criteria (J. Lusk, Service, *in litt.* 2003). Even if the concentration of a single element or compound is not harmful by itself, chemical mixtures may be more than additive in their toxicity to silvery minnows (Buhl 2002). The long-term effects and overall impacts of chemicals on the silvery minnow are not known.

Large precipitation events wash sediment and pollutants into the river from surrounding lands through storm drains and intermittent tributaries. Constituents of concern that are commonly found in stormwater include petroleum hydrocarbons (from oil spills, parking lot runoff, illicit dumping, roadways); the metals aluminum, cadmium, lead, nickel, copper, chromium, mercury, and zinc; nutrient runoff (phosphates, nitrogen compounds, potassium, trace elements); pesticide runoff (herbicides, insecticides, fungicides, termiticides); solid waste; sedimentation, erosion, and salts (which reduce oxygen content in water and alter habitat); toxics such as PCBs and controlled substances; the industrial solvents trichloroethene and tetracholoroethene (TCE); and the gasoline additive methyl tert-butyl ether (U.S. Geologic Survey 2001; J. Lusk, Service, *pers. comm.* 2010; New Mexico Environment Department 2010). Harwood (1995) studied the North Floodway Channel (Floodway) of Albuquerque, which drains an urban area of about 90 square miles and crosses Pueblo of Sandia lands. The study found that storm water contributions of dissolved lead, zinc, and aluminum were significant and posed a threat to the water quality of the Rio Grande. Because the Floodway crosses lands of the Pueblo of Sandia and enters their portion of the Rio Grande, the Pueblo requested that the Environmental Protection Agency conduct toxicity tests on water in the Rio Grande collected below the Floodway. Aquatic crustaceans exposed to this water were found to have significant reproductive impairment and mortality when compared with controls. Additionally, larval fish also experienced significant mortality and/or narcosis when exposed to water and bed sediment collected from this same area on April 22, 2002 (http://oaspub.epa.gov/enviro/pcs det_report.detail_report?npdesid=NM0022250). This study indicates that storm water runoff can impact the water quality of the Rio Grande and the aquatic organisms that live in the river.

Sediment is the sand, silt, organic matter, and clay portion of the river bed, or the same material suspended in the water column. Ong *et al.* (1991) recorded the concentrations of trace elements and organochlorine pesticides in suspended sediment and bed sediment samples collected from the Middle Rio Grande between 1978 and 1988. These data were compared to numerical sediment quality criteria (Probable Effects Criteria [PEC]) proposed by MacDonald *et al.* (2000). According to MacDonald *et al.* (2000) most of the PEC provide an accurate basis for predicting sediment toxicity to aquatic life and a reliable basis for assessing sediment quality in freshwater ecosystems. Although the PEC were developed to assess bed (bottom) sediments, they also provide some indication of the potential adverse effects to organisms consuming these same sediments when suspended in the water column.

Semi-volatile organic compounds are a large group of environmentally important organic compounds. Three groups of compounds, polycyclic aromatic hydrocarbons (PAHs), phenols, and phthalate esters, were included in the analysis of bed sediment collected by the USGS (Levings *et al.* 1998). These compounds were abundant in the environment, are toxic and often carcinogenic to organisms, and could represent a long-term source of contamination. The analysis of the PAH data by Levings *et al.* (1998) show one or more PAH compounds were detected at 14 sites along the Rio Grande with the highest concentrations found below Albuquerque and Santa Fe. Polycyclic aromatic hydrocarbons and other semi-volatile compounds affect the sediment quality of the Rio Grande and may affect silvery minnow behavior, habitat, feeding, and health.

Pesticide contamination occurs from agricultural activities, as well as from the cumulative impact of residential and commercial landscaping activities. The presence of pesticides in surface water depends on the amount applied, timing, location, and method of application. Water quality standards have not been set for many pesticides, and existing standards do not consider cumulative effects of several pesticides in the water at the same time. Roy *et al.* (1992) reported that DDE, a degradation product of DDT, was detected most frequently in whole body fish collected throughout the Rio Grande. The authors suggested that fish in the lower Rio Grande may be accumulating DDE in concentrations that may be harmful to fish and their predators.

In addition to the compounds discussed above, several other constituents are present and affect the water quality of the Rio Grande. These include nutrients such as nitrates and phosphorus, total dissolved solids (salinity), and radionuclides. Each of these also has the potential to affect the aquatic ecosystem and health of the silvery minnow. As the river dries, pollutants will be concentrated in the isolated pools. Even though these pollutants do not cause the immediate death of silvery minnows, the evidence suggests that the amount and variety of pollutants present in the Rio Grande, could compromise their health and fitness (Rand and Petrocelli 1985).

Pipelines

Based on information reported in the National Response Center (NRC) database (http://www.nrc.uscg.mil), one spill incident involving crude oil has occurred in Sandoval County near the city of Bernalillo, New Mexico just upstream from the action area for this consultation. In April 1999, a 16-inch (41-cm) transmission pipeline fitting was ruptured by a backhoe, releasing crude oil into the water and soil; reports indicate it may have entered the Rio Grande. Accordingly, this spill may have negatively affected silvery minnow in the action area. There is concern about the potential adverse effects of spills from these pipelines. Fuels such as diesel that are carried by pipelines have documented toxicity due to polycyclic aromatic hydrocarbons (PAHs), which are known to persist after spills, pass readily into tissues, are potent carcinogens, and are toxic to fish (Schein et al. 2009; Eisler 1987; and Lee and Grant 1981 *as cited in* Eisler 1987). A break in a pipeline if it were to release fuel into the river has the potential for lethal effects on minnows as well as adverse effects downstream on critical habitat (e.g., water quality; J. Lusk, Service, *pers. comm.* 2010). No available information on the spill indicates the extent of past adverse effects to silvery minnows from this incident.

Silvery Minnow Propagation and Augmentation

In 2000, the Service identified captive propagation as an appropriate strategy to assist in the recovery of the silvery minnow. Captive propagation is conducted in a manner that will, to the maximum extent possible, preserve the genetic and ecological distinctiveness of the silvery minnow and minimize risks to existing wild populations.

Silvery minnows are currently housed at two facilities in New Mexico that conduct captive propagation of the species, including the Dexter Fish Hatchery and Technology Center and the City of Albuquerque's BioPark propagation facilities. These facilities are actively propagating and rearing silvery minnow. In 2010, the Interstate Stream Commission (ISC) Refugium in Los Lunas, New Mexico reared silvery minnow and contributed to November 2010 augmentation. Silvery minnows are also held at the Service's New Mexico Fish and Wildlife Conservation Office (FWCO)[1] and at the U.S. Geological Survey Biological Resources Division Lab in Yankton, South Dakota; however, there are no active spawning programs at these facilities.

Since 2002, over 1.25 million silvery minnows have been propagated and then released into the wild (J. Remshardt, Service, *pers. comm.* 2011). Wild-caught silvery minnows are successfully spawned in captivity at the City of Albuquerque's propagation facilities. Eggs are raised and released as larval fish. Marked fish have been released into the Middle Rio Grande by the FWCO since 2002 under a formal augmentation effort funded by the Collaborative Program. Eggs left in the wild have a very low survivorship and this ensures that an adequate number of spawning adults are present to repopulate the river each year. While hatcheries continue to successfully spawn silvery minnow, wild eggs and larvae are collected to maximize genetic diversity within the remaining population (Turner and Osborne 2004).

Silvery Minnow Salvage and Relocation

[1] Formerly the New Mexico Fishery Resources Office (NMFRO)

During river intermittency, the Service's silvery minnow salvage crew captures and relocates silvery minnow. Through 2009, approximately 802,700 silvery minnows have been rescued and relocated to wet reaches. Studies are being conducted to determine survival rates for salvaged fish. Caldwell et al. (2009) reported on studies that assessed the physiological responses of wild silvery minnows subjected to collection and transport associated with salvage. The authors examined primary (plasma cortisol), secondary (plasma glucose and osmolality), and tertiary indices (parasite and incidence of disease) and concluded that the effects of stressors associated with river intermittency and salvage resulted in a cumulative stress response in wild silvery minnows. Caldwell et al. also concluded that fish in isolated pools experienced a greater risk of exposure and vulnerability to pathogens (parasites and bacteria), and that the stress response and subsequent disease effects were reduced through a modified salvage protocol that applied specific criteria to determine which wild fish are to be rescued from pools during river intermittency (Caldwell et al. 2009).

Ongoing Research

There is ongoing research by the New Mexico FWCO and University of New Mexico (UNM) to examine the movement of silvery minnows. Augmented fish are marked with a visible fluorescent elastomer tag and released in large numbers in a few locations. Crews sample upstream and downstream from the release site in an attempt to capture the marked fish. Preliminary results indicate that the majority of silvery minnows disperse a few miles downstream. One individual was captured 15.7 mi (25.3 km) upstream from its release site (Platania *et al.* 2003). Monitoring within 48 hours after the release of the 41,500 silvery minnows resulted in the capture of 937 fish. Of these, 928 were marked and 927 were collected downstream of the release point. The farthest downstream point of recapture was 9.4 mi (15.1 km). Studies are also currently underway by New Mexico FWCO using Passive Integrated Transponder (PIT) tags to examine silvery minnow movement and use of the fishway at the Albuquerque Bernalillo County Water Utility Authority's drinking water diversion site near the Alameda Bridge in Albuquerque. Preliminary results indicate use of the fishway and both upstream and downstream movement of minnows in that location.

In 2002, a hybridization study involving the plains minnow and silvery minnow was conducted to determine the genetic viability of hybrids. Plains minnow are found in the Pecos River where reintroduction of the silvery minnow is being considered. The results are preliminary because the number of trials was low and because there is some question about the fitness of the females used in the experiments. The plains minnow and silvery minnow did spawn with each other and the hybrid eggs hatched. However, none of the larvae lived longer than 96 hours. The control larvae (non-hybrids) for both the plains minnow and silvery minnow lived until the end of the study (24 days) (Caldwell 2002).

Due to the increased efforts in captive propagation, recent studies by UNM have focused on the genetic composition of the silvery minnow. Several studies since 2003 have documented a significant decline in overall mitochondrial (mt)DNA and gene diversity in the silvery minnow (e.g., Osborne *et al.* 2005; Turner *et al.* 2006), which may correspond to an increased extinction risk. Research indicates that the net effective population size (N_e) (the number of individuals that contribute to maintaining the genetic variation of a population) of the silvery minnow in the wild is a fraction of the census size (Alò & Turner 2002, *cited in* U.S. Fish and Wildlife Service 2007; Turner *et al.* 2005). In addition, estimates of the current genetic effective size for silvery minnow have consistently fallen well below the values recommended to maintain the adaptive potential of the species. For example, Alò and Turner (2005) found that genetic data from 1999 to 2001 indicated the current effective population size of the largest extant population of silvery minnows is 78. Other estimates have ranged as low as 50 (for 2004 and 2005; *cited in* U.S. Fish and Wildlife Service 2007). It has been suggested that a N_e of 500 fish is needed to retain the long-term adaptive potential of a population (Franklin 1980). Because the number of wild fish in the river appears to be low, the addition of thousands of silvery minnows raised in captivity could impact the genetic structure of the population. For example, estimates of the effective population size for stocks that were reared from wild-caught eggs were consistently lower than for wild counterparts; in addition, stocks produced by captive spawning consistently show lower levels of allelic diversity than those reared from wild-caught eggs (Osborne *et al.* 2006). This indicates that samples collected and reared in captivity do not accurately reflect the allelic frequencies or diversity seen in the wild population (U.S. Fish and Wildlife Service 2007). Results indicate that while captive propagation can be important for reducing the loss of some genetic markers (including microsatellite allelic diversity and heterozygosity) as seen in recent years, it cannot be relied upon to fully address declines in genetic diversity in the silvery minnow population.

10(j) Experimental Population

In December 2008, silvery minnows were introduced into the Rio Grande near Big Bend, Texas as a nonessential, experimental population under section 10(j) of the ESA (73 FR 74357). The Service released approximately 445,000 silvery minnows in 2008, approximately 509,000 in 2009, and approximately 488,000 in 2010. The four release sites are distributed across Federal, state, and private lands: one in Big Bend Ranch State Park; two within Big Bend National Park; and one on the Adams Ranch del Carmen, a privately-owned and managed conservation area. The silvery minnows came from the Service's Dexter National Fish Hatchery and Technology Center and the City of Albuquerque's Rio Grande Silvery Minnow Rearing and Breeding Facility.

Preliminary monitoring is currently being conducted to determine the success of the Big Bend reintroduction effort. It is expected to take years of monitoring to fully evaluate if the species is established and will remain viable in this river reach. Monitoring is expected to continue on a quarterly basis to document the success of the stocking program. Post-release monitoring of silvery minnows in proximity to the four release sites began in May 2009. Seven adult silvery minnows were found during monitoring in May, indicating at least some and likely many of the fish released in December 2008 survived over the winter. No silvery minnows were found during monitoring efforts conducted in August or October 2009. In February 2010, 84 silvery minnows were found during monitoring efforts, which includes detection at three of the four monitoring locations. During spring 2010 monitoring, the Service documented the presence of Rio Grande silvery minnow eggs at two of the monitoring sites, indicating spawning activity within the 10(j) population. February 2011 monitoring captured silvery minnow at 3 of the 6 sites. Future monitoring efforts will be expanded to document dispersal and density.

Past Projects in the Middle Rio Grande

"Take" of ESA-listed species is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (see ESA section 3(19)). Take of silvery minnows has been permitted or authorized during prior projects conducted in the Middle Rio Grande. The Service has issued permits authorizing take for scientific research and enhancement purposes under ESA section 10(a)(1)(A), and incidental take under section 7 for actions authorized, funded, or carried out by Federal agencies. Applicants for ESA section 10(a)(1)(A) permits must also acquire a permit from the State of New Mexico to "take" or collect silvery minnows. Many of the section 10 permits issued by the Service allow take for the purpose of collection and salvage of silvery minnows and eggs for captive propagation. Eggs, larvae, and adults are also collected for scientific studies to further our knowledge about the species and how best to conserve the silvery minnow. Because of the population decline in the early 2000's, the Service has reduced the amount of take permitted for voucher specimens in the wild.

The Service has conducted numerous section 7 consultations on past projects in the Middle Rio Grande. In 2001 and 2003, the Service issued jeopardy biological opinions resulting from programmatic section 7 consultation with Reclamation and the U.S. Army Corps of Engineers (Corps), which addressed water operations and management on the Middle Rio Grande and the effects on the silvery minnow and the southwestern willow flycatcher (U.S. Fish and Wildlife Service 2001, 2003a). Incidental take of listed species was authorized associated with the 2001 programmatic biological opinion (2001 BO), as well as consultations that tiered off that opinion.

The 2003 jeopardy biological opinion (2003 BO) was issued on March 17, 2003, is the current programmatic biological opinion on Middle Rio Grande water operations, and contains one RPA with multiple elements. These elements set forth a flow regime in the Middle Rio Grande and describe habitat improvements necessary to alleviate jeopardy to both the silvery minnow and southwestern willow flycatcher. In 2005, the Service revised the Incidental Take Statement (ITS) for the 2003 BO using a formula that incorporates October monitoring data, habitat conditions during the spawn (spring runoff), and augmentation. Incidental take of silvery minnows is authorized with the 2003 BO (with 2005 revised ITS), and now fluctuates on an annual basis relative to the total number of silvery minnows found in October across the 20 population monitoring locations. Incidental take is authorized through consultations tiered off this programmatic BO and on projects throughout the Middle Rio Grande.

Within the Angostura Reach of the Middle Rio Grande, the Service has conducted numerous section 7 consultations on past projects, including the following:

- In 1999, the Service consulted with Reclamation on a restoration project on the Santa Ana Pueblo in an area where the river channel was incising and eroding into the levee system. The second phase of this Rio Grande Restoration Project at Santa Ana Pueblo underwent consultation in 2008, and the Service anticipated that up to 36,688 silvery minnow would be harassed by construction, fill placement in the river, and movement of equipment; no mortality was expected.

- In 2003, the Service completed consultation with the City of Albuquerque on its Drinking Water Project, which involved the construction and operation of a new surface diversion north of the Paseo del Norte bridge, conveyance of raw water to a new treatment plant, transmission of treated water to customers throughout the Albuquerque metropolitan area, and aquifer storage and recovery. The Service anticipated that up to 20 silvery minnows would be killed or harmed during construction, up to 25,000 eggs would be entrained each year at the diversion, and up to 7,000 larval fish would be harmed, wounded, or killed during operational activities.
- The Service consulted on habitat restoration projects on the Rio Grande near Albuquerque, including the 2005 Phase I, the 2007 Phase II, and the 2009 Phase IIa projects. Biological opinions addressing this prior habitat restoration work reviewed the effects on silvery minnows. Incidental take authorized included 190 silvery minnows in 2005 due to harm or harassment, in 2007 the harassment of up to 3,365 minnows and mortality of up to 341 minnows, and in 2009 the harassment of up to 4,094 minnows and mortality of up to 187 silvery minnows.
- In 2006 and 2007, the Service consulted with Reclamation on the Bernalillo Priority Site Project and the Sandia Priority Site Project for river maintenance activities. The Bernalillo project was anticipated to kill no more than 42 silvery minnows due to channel modification, berm removal, dewatering, and sediment deposition in the river. The most recent consultation on the Sandia Priority Site River Maintenance project concluded that direct take of up to 539 silvery minnows, and harassment of 53,853 silvery minnows would occur due to construction activities.
- In 2007, the Service determined through consultation with the Corps on the Rio Grande Nature Center Habitat Restoration Project, that up to 10 silvery minnows would be harassed during construction and that up to 154 silvery minnows would be killed due to entrapment in constructed channels.
- In 2007, consultation on the Corrales Siphon River Maintenance Project concluded that the harassment of up to 244 silvery minnows would occur during construction, fill placement in the river, and movement of equipment.
- In 2008, the Service concluded an intra-Service consultation on the Pueblo of Sandia Management of Exotics for the Recovery of Endangered Species (MERES) Habitat Restoration Project. The Service anticipated that up to 2,449 silvery minnows would be harassed due to construction, and up to 770 killed due to potential entrapment in channels.
- In 2009, the Service concluded a consultation with the Bureau of Reclamation on the Pueblo of Sandia Bosque Rehabilitation Project, which concluded that up to 85 silvery minnows would be harassed during the proposed restoration activities, and up to 269 would be killed due to potential entrapment in a restored channel.
- In 2010, the Service consulted with Reclamation for a habitat restoration project located on the Pueblo of Sandia. The Service anticipated that take in the form of harassment may affect up to 36,318 silvery minnow due to proposed construction and river crossings, as

well as the harassment and mortality of up to 6 silvery minnows due to potential stranding in restored features after peak flows recede.

Summary of the Environmental Baseline

The remaining population of the silvery minnow is restricted to approximately seven percent of its historic range. With the exception of 2008, every year since 1996 has exhibited at least one drying event in the river that has negatively affected the silvery minnow population. The species is unable to expand its distribution because poor habitat quality and Cochiti Dam prevent upstream movement and Elephant Butte Reservoir blocks downstream movement (U.S. Fish and Wildlife Service 1999). Augmentation of silvery minnows with captive-reared fish has been ongoing, and monitoring and evaluation of these fish provide information regarding the survival and movement of individuals.

Water withdrawals from the river and water regulation severely limit the survival of silvery minnows. The consumption of shallow groundwater and surface water for municipal, industrial, and irrigation uses continues to reduce the amount of flow in the Rio Grande and eliminate habitat for the silvery minnow (U.S. Bureau of Reclamation 2003). However, under New Mexico State law, the municipal and industrial users are required to offset the effects of groundwater pumping on the surface water system. The City of Albuquerque for example, has been offsetting its surface water depletions with 60,000 afy returning to the river from the WWTP (U.S. Bureau of Reclamation 2003). The effect of water withdrawals means that discharges from WWTPs and irrigation return flows will have greater importance to the silvery minnow and a greater impact on water quality. Lethal levels of chlorine and ammonia have been released from the WWTPs in the last several years. In addition, a variety of organic chemicals, heavy metals, nutrients, and pesticides have been documented in storm water channels feeding into the river and contribute to the overall degradation of water quality.

Various conservation efforts have been undertaken in the past and others are currently being carried out in the Middle Rio Grande for the benefit of the silvery minnow. Population monitoring indicates that densities of this species have recently decreased to a level lower than that observed in 2006 but not as low as the extremely low levels seen in 2002–2003. However, current data show catch rates are currently lower than at the time of its listing as an endangered species in 1994. The threat of extinction for the silvery minnow continues because of increased reliance on captive propagation, the fragmented and isolated nature of currently occupied habitat, and the absence of the silvery minnow throughout most of its historic range.

IV. EFFECTS OF THE ACTION

Regulations implementing the ESA (50 FR 402.02) define the *effects of the action* as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, which will be added to the environmental baseline. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification; interdependent actions are those that have no independent utility apart from the action under consideration. The following section describes the anticipated effects on silvery minnow resulting from the proposed action. Designated critical habitat for the silvery minnow occurs throughout most of the action area.

Effects on Silvery Minnow

As described earlier, the action area for this consultation is defined as the entire width of the 100-year floodplain of the Rio Grande encompassing the disturbance zone boundaries from RM 198.4 to RM 172 which is located in the Angostura reach from just north of the Village of Corrales downstream to the northern boundary of the Pueblo of Isleta. Monitoring data are available for two sampling locations within the action area and one location just north (River Miles 200, 183.4 and 178.3), and indicate that minnows are likely to occur during habitat restoration activities and may be affected by the proposed action. Densities of silvery minnows in and near the action area in October 2010, December 2010, and February 2011, were 0.29, 0.18, and 0.13 silvery minnows/100 m^2, respectively. However, the proposed action is expected to be implemented over a period of 3-5 years beginning in Fall 2011, and silvery minnow densities are expected to vary over that period of time. Therefore, to calculate an estimated density of silvery minnow juveniles and adults during implementation of the proposed action, we averaged October catch rate data from the last 5 years available at 3 sampling locations (two within the action area and one just upstream). During the proposed action, we are estimating that silvery minnow may be present at a density of 7.36 silvery minnows/100 m^2.

The Service reviewed the proposed action, including measures implemented to reduce risk to listed species. The proposed action is expected to have beneficial effects on silvery minnows in the long-term by establishing diverse mesohabitats that support the species. Such habitat is expected to benefit silvery minnows through improved egg and larval retention, increased recruitment rates, and increased survival of both YOY and adult silvery minnows. In the long-term, the project is anticipated to contribute to improving the status of this species into the future through improved habitat availability and function.

However, we also expect the proposed action may generate adverse effects on silvery minnows as a result of two different activities: (1) construction of the proposed restoration treatments in wetted areas; and (2) indirect effects beyond the construction period due to potential stranding of silvery minnows in constructed ephemeral high flow and backwater channels and willow swales and in restored bankline features.

Short-term adverse effects on silvery minnows are expected due to in-water disturbance during construction of the high flow channels and backwaters, bank terracing, willow swales, bank scallop and canoe ramps. We expect silvery minnows will be present during these activities and will be harassed as a direct effect of the proposed action. The Service has defined take by harassment as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (see 50 CFR 17.3).

Minnows are expected to exhibit an avoidance response to construction activities. Avoidance behavior, or fleeing from the disturbance, represents a disruption in normal behaviors and an expenditure of energy that an individual silvery minnow would not have experienced in the absence of the proposed action. However, this form of harassment is expected to be short in duration, with pre-exposure behaviors to resume after fleeing the disturbance. The potential number of silvery minnows affected within the immediate vicinity of the equipment is minimized, as we expect an initial flight response at the onset of activities. In the event that cofferdams or silt fences are required, their placement will exclude silvery minnow, and repeated disturbance of silvery minnow at a construction site is not anticipated. Conservation measures used during the proposed action will help to minimize disturbance, for example by operating equipment on riverbanks whenever possible to avoid contact with silvery minnow habitats; and by using silt fencing and allowing a downstream opening for silvery minnow escapement as sediment placement begins in the upstream portion. The construction technique of using the existing bank to serve as a barrier during excavation of terraces and high flow channels avoids most disruption of silvery minnow habitat. In addition, the applicable work window (i.e., not during April 15 to August 15) will avoid adverse effects on pre-spawn and spawning adult silvery minnows, as well as YOY during early growth (i.e., until large enough for sufficient mobility and resilience). Conservation measures and best practices in place for operation of equipment also minimize risk of adverse effects due to accidental introduction of hydrocarbon contaminants such that we expect it to be discountable. As a result, given the mobility of silvery minnows, the limited area and duration where effects are expected, and the proposed work window, we do not expect the anticipated avoidance response to construction – or the timing of that response relative to the species' life history – will lead to any long-term significant effects on silvery minnow behaviors such as breeding, feeding, or sheltering.

Adverse effects on silvery minnows may also occur due to sediment disturbance by equipment and placement of materials in the channel. These activities may affect water quality, causing localized increases in turbidity and suspended sediments. Direct effects from excess suspended sediments on a variety of fish species have included alarm reactions, abandonment of cover, avoidance responses, reduction in feeding rates, increased respiration, physiological stress, poor condition, reduced growth, delayed hatching, and mortality (Newcombe and Jensen 1996). In addition, indirect effects from sediment mobilization in the channel are possible, including the potential smothering and mortality of algae and aquatic invertebrates, depressed rates of growth, reproduction, and recruitment or reduced physiological function of invertebrates. Decreases in primary production are also associated with increased sedimentation and turbidity and can produce negative cascading effects through depleted food availability for zooplankton, insects, mollusks, and fish. We expect silvery minnows will exhibit an avoidance response to construction activities as described earlier. Water quality monitoring previously conducted by the Corps before, during and after construction of similar habitat restoration features did not produce any results exceeding the range of values normal for the Rio Grande. Conservation measures will help minimize the risk due to dispersal of suspended sediments (e.g., construction technique, silt fences or cofferdams as needed; water quality monitoring) and restrict the effects of suspended sediments to within the action area. Therefore, beyond the initial avoidance response to activities, we do not expect suspended sediments will result in significant direct effects on silvery minnows. Those same conservation measures are also expected to reduce the risk of indirect effects on silvery minnows from these activities.

Indirect effects on silvery minnows may also result from the proposed restoration treatments. Beyond the construction period, harassment and mortality of silvery minnows may occur due to potential stranding of fish in restored features. For example, high flows may deposit sediment in or near restored features resulting in isolated pools containing silvery minnows, particularly in ephemeral channels. Also, some of the willow swales proposed for construction will have the potential to become inundated and strand silvery minnow in isolated pools. We expect silvery minnows may become stranded in these isolated pools and die. Entrapment has also been noted to occur in other types of restored features on an infrequent basis (e.g., bankline scallop features similar to the proposed bankline terracing). Therefore, we cannot discount the probability that some entrapment mortality may occur as an indirect effect of the proposed action. The Corps designs these features such that they drain back into the river as flow recedes during the descending limb of the spring hydrograph. Monitoring of similar features at other habitat restoration sites during normal river recession has shown little to no entrapment of silvery minnow (New Mexico Interstate Stream Commission 2010; U.S. Army Corps of Engineers 2009a).

Given our assessment of anticipated effects on silvery minnows, and the available information on disturbance zones for each activity (see Table 1), we expect silvery minnows will be harassed by construction activities related to habitat restoration treatments in wetted areas over a total area of 23.46 acres (94,939 m^2). The best available information on silvery minnow density in the action area for 5 past October surveys was used to estimate silvery minnow density at the time of construction between Fall 2011 and 2016 – a density of 7.36 silvery minnows per 100 m^2. Therefore, we expect that 6,988 silvery minnows (juveniles and adults) would be harassed during construction. Given the timeframe for construction, we do not expect any eggs or larval silvery minnows will be harassed or otherwise taken during construction. Potential entrapment and stranding of silvery minnows in restored features is expected to result in take of this species due to harassment and mortality. Although entrapment has been noted to occur in other features on an infrequent basis (e.g., bankline scallops), we expect the majority of risk for entrapment of silvery minnows as flows recede will occur in ephemeral channels and willow swales. Thus, we assume the calculation of incidental take for entrapment in ephemeral channels and willow swales (the swales with a connection to the river) will encompass all entrapment-related take in both ephemeral channels and other features during the proposed action. Of the total post-construction area of these features, we expect a smaller portion (1/3) of the area has the potential to become disconnected when flows recede and result in entrapment of silvery minnow in isolated pools. In addition to the potential entrapment of juveniles and adults, during and immediately following the silvery minnow spawning period, there is potential for silvery minnow eggs and larvae to be entrained and stranded. Given a total impact area for ephemeral channels of 70.5 acres (285,303 m^2) and 24.3 acres (98,339 m^2) for willow swales connected to the river, and an adjustment to one-third of the total impact area, we expect take of 8,471 silvery minnows (juveniles and adults) in the form of harassment and mortality due to indirect effects from stranding. In addition, we expect an unquantifiable amount of silvery minnow eggs and larvae will be taken in the form of harassment and mortality due to indirect effects from stranding.

The Service notes that this represents a best estimate of the amount and extent of take that is likely during the proposed action. Thus, estimated incidental take may be modified from the above should research or early life stage monitoring indicated substantial deviations from the estimated extent of incidental take, or if it allows for a calculation of the amount of take of young life stages. In this case further consultation may be necessary.

Effects on Silvery Minnow Critical Habitat
The action area occurs within designated silvery minnow critical habitat. Direct and indirect effects of the proposed action are likely to result in a beneficial impact on several primary constituent elements (PCEs) of silvery minnow critical habitat. PCEs for critical habitat include backwaters, shallow side channels, pools, and runs of varying depth and velocity; substrates of predominantly sand or silt; and the presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat within unimpounded stretches of flowing water of sufficient length that provide a variation of habitats with a wide range of depth and velocities. The proposed action is expected to contribute to these PCEs, which provide for the physiological, behavioral, and ecological requirements essential to the conservation of the silvery minnow.

However, construction activities during the proposed action may have short-term adverse effects on PCEs of silvery minnow critical habitat. Specifically, there is risk of adverse effects on water quality due to equipment fueling and leakage or accidental spills. We expect the conservation measures and best management practices (e.g., cleaning of equipment, inspection, storage and refueling requirements, spill kit readiness, and guards on external hydraulic lines) will reduce this risk such that it is extremely unlikely to occur and is therefore discountable. The proposed action will also disturb sediment due to equipment operation and placement of materials in the channel, which is expected to adversely affect water quality in designated critical habitat within the applicable disturbance zone. However, conservation measures in place during the proposed action are expected to restrict this disturbance and minimize the risk to the water quality PCE of critical habitat. These include the use of silt fences during placement and/or disturbance of sediments; water quality monitoring to ensure standards are maintained during the proposed action; and compliance with the SWPPP. In addition, the temporary disturbance to critical habitat would result in adverse effects to water quality over a very small area relative to the overall critical habitat designation, which extends approximately 157 miles (252 km) from Cochiti Dam in Sandoval County, New Mexico, downstream to the utility line crossing the Rio Grande in Socorro County, New Mexico.

In summary, we find that the effects of the proposed action on the function and conservation role of silvery minnow critical habitat relative to the entire designation are not significant because the effects will be temporary, are minimized by conservation measures employed during the proposed action, and will occur over a very small area relative to the overall critical habitat designation. In addition, the proposed action is intended to have beneficial effects over the long-term and contribute to the PCEs that form critical habitat. Therefore, we conclude that the primary constituent elements of silvery minnow critical habitat will continue to serve the intended conservation role for silvery minnows with implementation of the proposed action.

V. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur within the action area considered in this biological opinion (50 FR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.
The Service expects the natural phenomena in the action area will continue to influence silvery minnows as described in the *Environmental Baseline.* The Service also expects the continuation of habitat restoration projects in the Middle Rio Grande and research that will benefit silvery minnows in the action area, for example projects funded and carried out by the State of New Mexico, City of Albuquerque, the Pueblos, and other groups. In addition, we expect cumulative effects to include the following:

- Increases in development and urbanization in the historic floodplain that result in reduced peak flows because of the flooding threat. Development in the floodplain makes it more difficult, if not impossible, to transport large quantities of water that would overbank and create low velocity habitats that silvery minnows prefer.

- Increased urban use of water, including municipal and private uses. Further use of surface water or further groundwater withdrawals that reduce surface water from the Rio Grande will reduce river flow and decrease available habitat for the silvery minnow.

- Contamination of water (i.e., sewage treatment plants; runoff from urban areas, small feed lots, and dairies; and residential, industrial, and commercial development). A decrease in water quality and gradual changes in floodplain vegetation from native riparian species to non-native species (e.g., saltcedar), as well as riparian clearing and chemical use for vegetation control and crops could adversely affect the silvery minnow and its habitat.

- Human activities that may adversely impact the silvery minnow by decreasing the amount and suitability of habitat include dewatering the river for irrigation; increased water pollution from point and non-point sources; habitat disturbance from recreational use, and suburban development.

The Service anticipates the continued and expanded degradation of silvery minnow habitat as a result of these types of activities. Effects from these activities will continue to threaten the survival and recovery of the species by reducing the quality and quantity of minnow habitat.

VI. CONCLUSION

After reviewing the current status of the silvery minnow, the environmental baseline for the action area, the anticipated effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Corps MRG Bosque Restoration Project, as proposed in the November 2010 amended BA and subsequent correspondence with the Service during this consultation, is not likely to jeopardize the continued existence of the silvery minnow. We expect the level and type of take associated with this project is unlikely to appreciably diminish the population in the Angostura Reach, or the species as a whole. We expect harassment of minnows may occur, but the duration and intensity of this effect will be short-term, with no long-term significant effects on silvery minnow behaviors such as breeding, feeding, or sheltering. Any risk of more serious effects or repeated harassment is minimized due to measures employed during the proposed action. Mortalities may occur due to stranding in restored sites as peak flows recede; however, we anticipate that the increased availability of nursery habitat will improve overall survival of early life stages, and we do not expect these incidental mortalities to result in any significant long-term effects on the population in the Angostura Reach or for the species as a whole.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require adherence to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement (50 CFR §402.14(i)(3)).

Amount or Extent of Take Anticipated

The Service has developed the following incidental take statement based on the premise that the Middle Rio Grande Bosque Restoration Project will be implemented as proposed. Take of silvery minnows is expected in the form of harassment and mortality due to the proposed habitat restoration activities, and is restricted to the action as proposed. If actual incidental take meets or exceeds the predicted level, the Corps must reinitiate consultation.

The Service anticipates that take in the form of harassment may affect up to 6,988 silvery minnows due to proposed construction, as well as the harassment and mortality of up to 8,471 silvery minnows (juveniles and adults) due to potential stranding in restored features after peak flows recede. We base these figures on the best available information on minnow density in the area to be disturbed by the proposed activities during the next 3-5 years of project implementation. We also expect mortality of silvery minnow eggs and larvae that may become stranded in restored features after flows recede; however, it is not possible to estimate the number of eggs and larvae that would be taken. We expect the extent of this take would encompass the project area over the same footprint that applies to stranding of juveniles and adults. We expect any take of eggs and larval silvery minnows would be small in relation to natural mortality of these life stages.

Effect of Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the silvery minnow. The restoration project is likely to have adverse effects on individual silvery minnows but those effects are not anticipated to result in any long-term consequences on the population. Incidental take will result from harassment of minnows during construction activities and mortality of any individuals that may become stranded in restoration features (e.g., ephemeral channels/backwaters/willow swales) after peak flows recede.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the silvery minnow resulting from the proposed action:

1. Minimize take of silvery minnows due to habitat restoration activities.

2. Manage for the protection of water quality from activities associated with the restoration project.

3. Work collaboratively with the Service on the Middle Rio Grande Endangered Species Collaborative Program.

Terms and Conditions
Compliance with the following terms and conditions must be achieved in order to be exempt from the prohibitions of section 9 of the ESA. These terms and conditions implement the Reasonable and Prudent Measures described above. These terms and conditions are non-discretionary. The Corps must report to the Service's New Mexico Ecological Services Field Office (NMESFO) on the implementation of these terms and conditions.

To implement RPM 1, the Corps shall:

1. Ensure that all restoration treatment work is conducted during low flow periods, avoiding the silvery minnow spawning period and effects to potentially large numbers of offspring, by working within the timeframes described in this biological opinion (not between April 15 and August 15 of each year).
2. Ensure that conservation measures described in this biological opinion are implemented, including those pertaining to equipment and operations, staging and access, water quality, and others.
3. Ensure that the presence/absence of silvery minnows is visually monitored at construction sites by a permitted biologist, and use adaptive management to modify activities to minimize adverse effects.
4. Implement the project-specific monitoring, including entrapment monitoring, and adaptive management as proposed and report results annually to the Service.
5. As appropriate, report to the Service the results and effectiveness of restoration treatments.
6. Report to the Service findings of injured or dead silvery minnows.
7. Monitor the implementation of RPM 1 and its associated Terms and Conditions.

To implement RPM 2, the Corps shall:

1. Ensure that conservation measures described in this biological opinion are implemented, including those pertaining to construction timing and sequencing, water quality monitoring, equipment and operations, and staging and access.
2. Ensure that all restoration treatment work is conducted during low flow periods, minimizing water quality impacts, by working within the timeframes described in this biological opinion (not between April 15 and August 15 of each year)
3. Report to the Service any significant spills of fuels, hydraulic fluids, and other hazardous materials.
4. Monitor the implementation of RPM 2 and its associated Terms and Conditions.

To implement RPM 3, the Corps shall:

1. Encourage adaptive management of flows and conservation of water to benefit listed species.
2. Utilize existing authorities and discretion to maximize water management benefits to silvery minnow.

3. Work to further conduct habitat/ecosystem restoration projects in the Middle Rio Grande to benefit the silvery minnow.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following conservation activities:

1. Evaluate the effectiveness of habitat restoration techniques implemented in the Middle Rio Grande for ESA-listed species, including an evaluation of site longevity and benefits provided to species.
2. Seek additional authorities and flexibilities in the operation and management of Corps reservoirs/facilities that may benefit southwestern willow flycatcher and silvery minnow.
3. Implement recovery actions identified in the southwestern willow flycatcher and silvery minnow recovery plans.

RE-INITIATION NOTICE

This concludes formal consultation on the action described in the November 2010 amended Biological Assessment. As provided in 50 CFR § 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this BO; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this BO; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending re-initiation.

In future correspondence on this project, please refer to consultation number 22420-2010-F-0077. If you have any questions or would like to discuss any part of this biological opinion, please contact Lori Robertson of my staff at (505) 761-4710.

for Wally Murphy

cc:
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APPENDIX J
PUBLIC COMMENTS

Note: How comments were addressed/changes to the EA are noted after each comment. If the response is '*noted*' then no change to the document was made.

Commenter	**Comment Summary**	**Corps Response**
Bernalillo County Public Works (BCPWD)	"References to the Project Action Alternative are discussed in several sections of the No Action Alternative Section of the report. These references are often confusing when trying to understand the current functional characteristics of the ecosystem. The No Action Alternative section needs to provide a clear description of the existing conditions and the progression of those conditions without change. Numerous evaluations in this section focus on descriptions of the Proposed Action Alternative instead of describing the existing conditions and the results of continued No Action."	Concur. The No Action, Without Project and With Project Sections updated for clarification.
BCPWD	"In the section of the report providing an assessment of the Action Alternative, the focus of ecological risk assessment seems to be focused on the project area as an isolated feature, and only assesses changes to the environment during the construction phase. Many of the evaluations do not include information about the spatial scale of impacts that would be distributed throughout the environment outside the project area or an evaluation of how changes to the ecosystem and the duration of loss within the Bosque will impact the viability of cited endangered species in the long term."	The Proposed Action Alternative is evaluated for a 50 year time span.
BCPWD	"Evaluation of the quantity of habitat currently used by native species within the project area and the result of added population pressures on other habitats in the ecosystem that may result from migration of inhabiting species due to construction and removal of suitable habitat. An evaluation to determine the impact of added populations in other suitable areas to determine if their potential presence will cause a significant impact on existing populations in those areas would be beneficial in assessing mitigation needs and assist in relocating upland species to areas outside of the Bosque. Population density increases in limited habitat areas may decimate food resources or cause mortality in some species if migration over-stresses the impacted areas."	The planning objective for the proposed project is ecosystem restoration, not just specifically habitat creation. In order to meet this objective, elements are proposed that would potentially benefit the ecosystem as a whole.
BCPWD	"An evaluation of providing habitat to attract endangered and	Again, the planning objectives focus on ecosystem

	listed species should include the potential of invasive, predatory, or parasitic species, such as the Brown Headed Cow Bird, mentioned in the EA as a species present in the area, becoming more prevalent due to modification of the existing habitat. Modification plans for the Bosque describe the end result as a mosaic of trees and open brush/grassland, which is described as the preferred habitat of Cowbirds as cited below in information available from the Audubon Society. Creation of more edge habitat may increase the potential of parasitism by this species. Although they are not considered a significant threat to established populations of birds, they may be a significant influence in determining the susceptibility of small populations with limited nesting pairs trying to become established in the area, especially in regard to listed and endangered species."	restoration with components that may benefit endangered species. There is not any 'one species' focus so that habitat components may benefit all levels of wildlife from an ecosystem perspective. By its very nature, the bosque is an edge habitat rather than an expansive forest stand and Brown Headed Cow Birds have been present in the area historically, were present during the Middle Rio Grande Biological Survey (Hink and Ohmart 1983) and are still common in the bosque today. What small populations of nesting pairs are being referred to? Southwest Willow Flycatcher? While this project seeks to increase potential stopover habitat, breeding habitat between Santa Ana Pueblo and Isleta Pueblo is virtually non-existent.
BCPWD	"Considerations for preserving or replanting existing native plants from disturbed project locations may be beneficial in achieving the desired endpoint. Although plants may be of the same species, plants that are currently present in these areas may have specific genetic adaptations or characteristics that may provide them with an advantage for survival in these specific locations. Assessment of the value of this contingency would be beneficial."	When vegetation material is procured it is requested that they come from local genetic stock as much as possible. This was clarified in this section.
BCPWD	"A description of the purpose and duration of use for port-a-dams is not provided (pg 32). It may be helpful to clarify this by modifying the statement such as: active flows may need to be diverted temporarily with a port-a-dam or similar device during construction of water features."	This has been clarified.
BCPWD	"The report cites an increase of water volume by 160%. However it does not provide information as to how an increased flow to inundate the project area may impact water levels in constricted areas of the river system upstream and downstream of the project area. Additional flow that may be required in the project area may affect water stores in the Cochiti Dam reservoir during drought periods. The impact on end users and structures that may be designed for the existing flow volumes and the potential need to modify them could financially impact end users or modify flow	The report does not cite an increase of water volume by 160%. The report cites an increase in the area of inundation by 160%. While there are water losses due to evaporation, most of the water will not be lost to the system. Further, additional flow will not be required to inundate these restoration features since the features will be lowered to allow overbanking during average spring flow.

	patterns. More information on these potential changes would be helpful in understanding and mitigating impacts or verifying the limitation of stressors created by these changes.”	
BCPWD	“The added presence of native species of plants and animals and the density of wildlife could be included in the aesthetic evaluation of the project area. Viewing wildlife and plants is one of the features listed as an endpoint of the project.”	This information has been added to the aesthetics section.
BCPWD	“The assessment of Noise disturbance from wildlife such as birds and frogs that may be persistent during the evening hours may need to be included in the Action Alternative. Noise levels may not exceed the decibel levels; however, they may be a nuisance at night for residential areas close to habitat areas.”	This wildlife currently exists in the bosque. Though the project proposed to increase habitat for these wildlife groups, it would not be to the point where this noise would increase greatly. Also, prior to the 2003 fires, a larger number of these species were present (before trees were lost to fires and removed for fire reduction). This project proposes to replace some of that habitat (and therefore wildlife) lost.
BCPWD	“Propagation of non-native species by birds that eat and spread the seeds may be a consideration in controlling the spread of non-native plants in rehabilitated areas. Provision of other suitable food sources from native species to aid in the establishment of native plants should be included in planning. Removal of non-native species and establishment of native species that provide a suitable food source in forage areas may be beneficial in controlling invasive species.”	The native vegetation proposed to be used in the project (New Mexico olive, wolfberry, etc.) does provide an alternate food source to Russian olive, etc. There would still be some level of introduction of non-native seeds into the project area via avian species and transport from adjacent non-project areas. There will also be some percentage (though a lower proportion is proposed) of non-native vegetation in the bosque.
BCPWD	“Information provided in regard to establishing fire breaks could include information on native species that may be used in those areas. Evaluation of native species or less invasive more desirable species that may not be susceptible to fire-induced mortality, if any, may assist in establishing desired flora and limiting the presence on non-native and invasive species.”	Fire breaks still include vegetation (such as open meadow grasses).
BCPWD	“Evaluation of bird species in the Bosque should include an assessment of native to nonnative species and the change in these population densities anticipated by the Action Alternative. Establishment of suitable habitat outside of the Bosque area for upland species that currently utilize the Bosque area and may have been forced out of their natural habitat due to development and loss of those areas may allow for increased habitation of the	From an ecosystem restoration perspective, project components are proposed to provide a ‘mosaic’ of habitats for all types of wildlife. Riparian dependent species currently inhabit the bosque and the proposed action would provide more native habitat for their use. Some upland species use the bosque as well and may ‘migrate’ between the bosque and adjacent upland

	Bosque habitat by desired species, including propagation of desired flora."	habitat. The proposed action does not propose to change that balance, but provide additional native vegetation for riparian dependent species.
BCPWD	"Evaluation of recreational use under the Proposed Action does not provide information regarding impacts to current uses, in particular Equestrian use. Narrowing paths, paving paths, and restricting use in areas may potentially eliminate or significantly reduce the availability for Equestrian use in the project area. The presence of horses on paved trails would likely cause damage creating maintenance costs and potential hazards for walking and biking and other low impact uses. The presence of manure on trails utilized by Equestrians may also be an issue for walking, biking, and wildlife impacts from runoff in these areas."	The recreation components proposed are meant to enhance the existing trail system and provide access for all users. It is known that equestrians frequent the area and that the natural surface trail inside the bosque is most used by them. Crusher fine trails are only proposed near bridge access points to allow full access to some portion of the bosque. The paved trails along the levee are not being proposed to be changed in anyway. Those would remain as is for those users (bicyclists, roller bladers, etc.). Visitors can walk on any of the three surfaces. Therefore, the recreation plan provides access for all users who currently use the area. The proposed recreation plan would not increase any potential hazards. The local sponsor (MRGCD) is aware of the existing and potential future maintenance, though it is proposed that it would not increase much under the proposed action.
BCPWD	"Section 3.17 should include hazardous waste reaching the river from discharges into arroyos from industries and development upstream. Contaminants, such as PCB at elevated levels in the river ecosystem, are known and documented. A recent report presented by NMED, Environment Department Finds Elevated Levels of PCBs in the Rio Grande near Albuquerque during Storm Flows, released April 19, 2010" "The risk for impacts of these contaminants on the potential of establishing habitat with water quality suitable for the Silvery Minnow should be assessed. Cited Human toxicity levels may not be a good indicator of toxicity on sensitive species. References of toxicity should be applicable to the species being discussed. Mitigation of this risk may have potential financial impacts to remove the source if contaminants are determined to be harmful to desired species."	This documentation has been reviewed as well as information regarding storm flows in these areas by the Corps' Environmental Engineering Section. It has been determined that these storm flows do not typically reach the river. Enhancement by the proposed project will not increase storm flows into the river but may provide a water source for vegetative restoration components.

BCPWD	"In Section 4.20, on the use of Garlon herbicides: The first paragraph states, "These herbicides should not be used near surface water or saturated soils." Then this is contradicted in paragraph 3: "It has been certified and labeled to be used near water by the Environmental Protection Agency." Clarification is needed of these statements to resolve the apparent contradiction."	This section has been updated for clarification.
BCPWD	"A comprehensive map of existing, current, completed project areas that also includes the proposed project area would be helpful in showing features described on Pages 94- 96 and illustrating the total scale of areas being improved throughout the region and the association of projects to one another, i.e. big picture of improvements and added features, etc."	A map has been added.
BCPWD	"The Draft states that establishment and maturation of replanted areas will take a minimum of 10 years (pg 97). An assessment of the impacts resulting from loss of mature habitat for that period of time on native species of fauna should be provided. Staging of removal and revegetation efforts to maximize available habitat or ensure adequate resources for existing populations or migratory species may be beneficial in achieving the desired endpoint and help to mitigate any impacts that may result from removal of large areas of vegetation. Waiting until this is studied after the fact may not be acceptable as a remediation plan if loss of species would result. This may also have an impact on population pressures and may need to be evaluated. Loss of a significant amount of potential forage areas, nesting sites, and cover for some species for a period exceeding 10 years may cause loss of habitation in the area or mortality. This should be assessed for potential risk and evaluation of mitigation that may be needed to minimize potential impacts."	Mature native habitat is not being removed as part of the proposed action. Much of the non-native understory has initially been removed under other projects/agency actions. The proposed action is to further treat these areas for non-native vegetation and plant native vegetation in order to replace the understory. The initial loss of mature understory occurred a number of years ago (since the 2003 fires) though the mature cottonwood canopy remains. Numerous studies have taken place since this time and are referenced in the document (Hawks Aloft, etc.). The implementation would also be phased so that no one habitat type receives a significant loss at a time.
Ysleta del Sur Pueblo	"We would like to request consultation should any human remains or artifacts unearthed during this project be determined to fall under Native American Graves Protection and Repatriation Act (NAGPRA) guidelines. This area pertains more to our northern relatives, the Isleta and Sandia Pueblo Tiwas, as we have been living down here in the El Paso area since the year 1680, but anyways keep us up-dated on any inadvertent discoveries."	Pueblos would be notified if any remains or artifacts are unearthed. If there are any further questions/comments, please contact Gregory Everhart at 342-3352 or Ron Kneebon, Tribal Liason, 342-3355.

Clifford Crawford	"Plant species names on page 20. Populus fremonti var. wislizenii should be Populus deltoides spp. wislizenii, which is called Rio Grande Cottonwood in the Field Guide. Salix nigra var. gooddingii should be Salix gooddingii, which is called Goodding's Willow in the Field Guide. Forestiera neomexicana should be Forestiera pubescens. Chrysothamnus nauseosus should be Ericameria nauseosus. Lycium pallidum is called Pale Wolfberry in the Field Guide, which distinguishes it from L. torreyi, Torrey's Wolfberry which has smaller flowers. Both are common in the bosque. Anemopsis californicus should be Anemopsis californica Baccharis salicifolia is called Willow Baccharis in the Field Guide, while the closely related B. salicina is the called Great Plains Seep-Willow in the Field guide. The former has willow-like leaves. Both are common in the bosque. Hilaria jamesii should be called Pleuraphis jamesii. Oryzopsis hymenoides is called Achnatherum hymenoides in the Field Guide, although the former name is considered in synonymy with the latter."	Species names have been updated.
Anita Walsh	"Please lend assistance here, in The Corrales Bosque Preserve, in a way that is in keeping with the management structure which is currently in place, and perhaps, as Cliff Crawford mentions in his summary, leave this place , as one of the places by which you may compare results of methodology. We have an exceptionally successful preserve, not that it couldn't use any improvement; one	We will continue to work with the Village and the Corrales Bosque Preserve Commission to perform restoration in a way that is the least invasive but still meets the stated planning objectives. These planning objectives match up with the Corrales Bosque Preserve Habitat Management Plan objectives.

	that I would like to see would be mild manipulation to assist in beaver-created wetlands and fencing around culverts in the clear ditch, as you know... so do Councilors Gerhart and Clauser.. Janet Ruth, of the CBAC, has also seen increased erosion where vegetation has been removed on water banks. Mark Kaib feels that there are too many maintenance vehicles, on a consistent basis, racing on the levy. I have heard them say these things. These are two professionals on the commission. We have always taken a less invasive approach, and the success of that.. the proof of that, is in the pudding. I ask that you exclude the Corrales Bosque Preserve from the general plan, but assist us in reaching some of the same goals of the plan in a more natural way.; Natural as in employing Narure's assistance, and 'Natural' in the sense of the history and pattern of the management this preserve has practiced for so long, and to such good effect."	
Lynn and John Altman	"We ask that at this time the Corps refrain from disturbing the Corrales Bosque Preserve. It is our belief that much more experience is required in order to determine the full effects of the proposal; digging channels, excavating swales, razing river banks, creating artificial ponds and clearing woodlands in our beloved Bosque. Please wait until there is greater certainty that the proposed good will outweigh potential short and long-term damage. This is a relatively new science and much more study is needed. While we appreciate the good intentions for "restoration," it seems completely inappropriate to us to mess around in an area that is succeeding in order to make it "better." Better for whom?"	We will continue to work with the Village and the Corrales Bosque Commission to perform restoration in a way that is the least invasive but still meets the stated planning objectives. These planning objectives match up with the Corrales Bosque Preserve Habitat Management Plan objectives.
New Mexico Interstate Stream Commission (NMISC)	"The effectiveness of passive restoration techniques like bankline destabilization in the MRG is debatable (appears to work under specific channel conditions). High flow/ephemeral side channels as they are currently constructed in the MRG do not facilitate/promote overbank flooding (they can but need specific design criteria)." (pg. 3, line 7-9)	Noted. It is proposed that the high flow channels would be designed similar to RT66 where there are no berms and overbanking from the high flow channels into the bosque has occurred (at roughly 4000 cfs and even lower) with great success. Bank destabilization is proposed in conjunction with high flow features to further increase the potential for water to move into them and then into the bosque. The Corps will continue

		to coordinate and collaborate with ISC throughout project development and implementation (including operation and maintenance).
NMISC	"Wetland/swale habitats that do not periodically connect to the river are of less overall benefit then those that do periodically connect to the river." (pg. 3, line 10-11)	Through previous projects (both the Corps' and other agencies), it has been noted that wetland and swale habitats do provide benefit. The Corps is also currently conducting a study of willow swale habitats and their benefits to wildlife. If the NMISC has information to support the comment, the Corps would appreciate a copy.
NMISC	"It will be important to verify the presence of other projects (both HR and other) in the areas highlighted for restoration under this EA. The proposed project areas in some locations overlap with past published NMISC HR projects sites and some recent CABQ Open Space work areas." (Page 12-16)	Other projects are listed in Section 4.21 and shown on a map that has been added to this section.
NMISC	"See wetland comment two comments up." (Pg. 23, line 10-13)	Same response as above.
NMISC	"There is a distinct difference between trying to destabilize a feature and lowering a feature to create habitat. Knowing the difference and indicating for each project area the intent will be important." (Pg. 26 1-13)	This would be determined during design.
NMISC	"Allowing a connection between the proposed willow swales and the river during high flow may allow for natural regeneration of native plant species and reduce the cost/effort of manual re-vegetation, especially where the distance between the two is short" (Pg. 30, line 1-10)	During the design phase, most swales were connected to the main channel, allowing high flows to spill out of the channel and into the swales.
NMISC	"BEMP stands for – Bosque Ecosystem Monitoring" (Program Pg. 34, line 7)	This is no longer in the document.
NMISC	"More recent water quality reviews/publications may counter this claim." (Pg 59, line 12)	Please provide references. Thank you.
NMISC	"Don't see where WIFL was defined?" (Pg. 62, line 10)	SWFL is used throughout the document and defined on p. 58.
NMISC	Good job on the depletions language both here and on page 47. It may be worth mentioning here that depletion offsets are bases on open water evaporation rates (NADA, 1983) and the period of inundation for each particular year. (Pg. 74, line 1-4)	Section updated.

NMISC	"What are the sedimentation rates in the floodplain areas? Need to be aware of the potential that mobile bed load material may get deposited on low elevation floodplain restoration sites." (Pg 74, line12-17)	This was considered and analyzed in detail. Further discussion can be found in the H&H Technical Appendix. While this is not the full discussion, selected text from that Appendix is as follows: An analysis of the overbank sediment-transport characteristics was conducted to evaluate the long term sustainability of restoration features. Overbank flows will cause sediment deposition on the floodplain and sediment deposition will also occur in the proposed channel restoration features, particularly after the vegetation has established. An estimate of the amount and rate of sediment deposition within the features was made for Restoration Alternative 1 (Maximum Effort alternative) under the Hydrology Scenario 4 (100-year post-Cochiti flood-flow snowmelt hydrograph) in order to evaluate the long-term sustainability of the proposed features. Assuming that 12 percent of the suspended bed-material load of the main-channel is transported onto the overbank, the predicted average depth of sedimentation on the overbanks is 0.19, 0.25, 0.29, 0.14 and 0.12 feet for Subreaches 1 through 5, respectively. Since the restoration features are designed to be lower than the surrounding overbank elevation, they would likely receive more sediment deposition than the higher surrounding overbanks due to the higher roughness values created by the vegetation and the associated decreased velocities. Assuming that 35-percent of the suspended bed-load would be conveyed into the features, the estimated amount of sedimentation in the channel restoration features is 0.6, 0.7, 0.9, 0.4, and 0.4 feet for Subreaches 1 through 5 respectively. Given that the 100-year hydrograph has a duration of approximately 102 days (3.4 months) above 7,000 cfs, the predicted amount of

		overbank deposition appears reasonable and relatively low during the 100-year event. Furthermore, given that the predicted depth of overbank is an upper limit and the depth of deposition is significantly less than the depth of the features, the overbank features should not be unreasonably affected by sediment deposition over the 50-year life of the project.
NMISC	Water savings through vegetation management/manipulation is not definitive and depends significantly on local physical variables.(Pg 78, line 14 & 25-26)	Section updated.
NMISC	See Comment above (Pg 79, line 15)	Section updated.
NMISC	Not sure how non-native veg. removal allows the floodplain to expand? (Pg 79, line 30-31)	This removal may allow more overbanking to occur. This has occurred in the RT66 project area.
NMISC	Are you really not going to fuel equipment between the levees? NMED criteria requires a buffer of 100ft to water. (Page 81, line 13-14)	Yes. Fueling would only take place in the staging area (outside of the bosque).
NMISC	Is there a buffer to water that must be maintained during application of the herbicide? (Pg 92,line 1-10)	Yes, at least 50 feet. This section has been updated.
NMISC	The specific uses (initial and resprouts) for Garlon 4/Garlon 3A are not consistent between this sentence and line 3-4 on page 92. (Pg 93, line 17-21)	Section updated.
NMISC	You list the USBR here, but then don't have a specific project for them on the specifics on the next page (95), and opposite is true for City of ABQ Open Space. (Pg 94, line 19)	Since USBR is the Project Manager for the Program, they are listed. City of Albuquerque has been added.
NMISC	Cannot figure out what impacts from previous projects this project is trying to rectify? (Pg 96, line 28-29)	Project list added to sentence.

Bureau of Reclamation (BOR)	Page 7 - Under scoping, does the Corps expect to do another scoping mtg since the last occurred on Feb 2003? The public may want an update on the proposed project.	The public was notified of the release of the DEA for public review and a public meeting was also held on April 27, 2010 .
BOR	Page 9 – Other agencies are doing similar work in the Albuquerque reach and that could be mentioned in the EA. The proposed work would be the largest project similar to ongoing work.	Other projects in the area being conducted by other agencies are discussed on pages 98-101.
BOR	Page 17 – Since construction is not expected to begin until 2012, the proposed work needs to be coordinated with agencies that are doing similar work in the reach. Ongoing projects need to complement each other as stated in the cumulative effects section.	Construction is expected to begin in 2011 and the Corps will continue to coordinate with all other agencies working in the area.
BOR	Page 36 to 45 – This hydrology and geomorphology section is confusing. The Albuquerque reach has some very specific river flow restrictions due to houses and other infra-structure adjacent to the river. The restoration activities can only be done within those specific parameters.	The hydrology and geomorphology section is a summary of the Feasibility Report where a more detailed discussion is provided. Flow restrictions between the levees were considered and modeled as part of the analysis. Restoration sites are all located between the levees. The sites are located in areas of widened bosque where a buffer exists between the active river channel and the levees. While the restoration features are designed for average spring flow conditions, care was taken to avoid creating flow patterns that could adversely affect levees or other infrastructure during high flood flows. These higher flows were modeled and will be carefully considered during the design phase. Further discussion can be found in the Feasibility Report and the H&H Technical Appendix.
BOR	Page 69 – The proposed work has a recreational component. In the corresponding Chapter 4 section it states that a benefit to the natural conditions of the reach is a result of providing well defined trails and recreational locations. Thus, for that to be true is means that the ongoing recreational conditions are not the best for the ecology of the reach. Existing recreation is not confined or restricted and there is a tendency for a myriad of access points to the river from the levee, which has an impact on the riparian vegetation. Tell the reader what is the assessment of the existing	In general, disturbance by humans can disrupt wildlife. Therefore, recreational components are proposed to balance with providing wildlife habitat. Monitoring of both types of features, and their interaction, would occur as part of this project.

	recreation in the reach and what impacts the Bosque.	
BOR	Page 81 to 82 – In the minnow section, the BA and the EA need to state the same determinations of effects.	Sections updated.
BOR	Page 93 to 95 – The cumulative effects section needs to be updated, mainly the second paragraph and the list of ongoing/finished projects within the reach.	Please provide additional information on USBR projects within the proposed project area.
U.S. Fish and Wildlife Service (USFWS)	Apply ecosystem management to preserve, maintain, or restore native biodiversity and ecological integrity of natural biotic communities in large areas to avoid fragmentation.	The planning objectives have been slightly revised to include these concerns to the extent that are consistent with the USACE mission.
USFWS	Assure that ongoing monitoring programs, such as the Bosque Ecosystem Monitoring Program (BEMP) are located within the proposed restoration project areas, adding new sites as necessary.	These elements have been included in the Monitoring & Adaptive Management Plan.
USFWS	Develop a long-term water-quality monitoring plan for areas to be modified connecting the outfall through the bosque to the river) to function as wetlands where storm water/drainage outfalls previously existed.	These elements have been included in the Monitoring & Adaptive Management Plan.
USFWS	Develop a long-term maintenance plan in cooperation with all cooperating/participating parties.	An Operation and Maintenance Plan will be developed for the local sponsor, MRGCD, to implement.
USFWS	Protect migratory bird resources in accordance with MBTA.	No work would occur during nesting season (per MBTA in the DEA, Section 4.10).
USFWS	Conserve all species in the action area listed by the state of New Mexico as threatened or endangered in accordance with state law and Corps regulations and guidance.	State listed species are discussed in Section 3.11.
USFWS	Continue managing developed and natural water sources for wildlife to support viable wildlife populations and to minimize conflict with Corps-related activities.	Concur. All projects would be planned/designed in accordance with current and potential future water regimes. The Corps must create restoration features in a way so as not to negatively impact the flood mitigation mission of the levees. This is discussed in Sections 3.2 and 4.2 of the EA.

USFWS	Adhere to all recommendations in the U.S. Fish and Wildlife Coordination Act Report for the Middle Rio Grande Draft Feasibility Report, Albuquerque NM (service written communications to the Corps dated April 19, 2010).	The Corps would adhere to recommendations as they match up with the planning objectives of the proposed action. This is discussed in Section 4.10 of the EA.
Corrales Bosque Advisory Commission (CBAC)	"There appear to be few grounds for concern with regard to the proposed implementation details, such as responsibilities for adherence to the Migratory Bird Treaty Act, special provisions for avoidance of Bald Eagles during winter months, use of herbicides, and removal and disposal of dredged spoil material, assuming these are carried out as described. Local regulations, including all permitting requirements, must be adhered to (page 24).	All federal regulations (MBTA, etc.) would be adhered to and are discussed in the DEA. Any local regulations would also be taken into consideration (but federal regulations must be followed if there is a conflict).
CBAC	However, how much physical disturbance of habitat do we anticipate from this work; what else in addition to torn up soil and vegetation? On p. 32 it says that "Staging would occur in adjacent open areas made available by the sponsor, MRGCD. Staging could also take place in the bosque if other areas are not available."	Physical disturbance would be mainly removal of non-native vegetation, removal of jetty jacks, and excavation of soil where needed to construct wetlands, swales, etc. Staging areas in Corrales would be coordinated with both the Village and the Corrales Bosque Preserve Commission.
CBAC	Details of these requirements [site disturbance] will need to be more specific in relation to actual site disturbance. In particular we need assurance that soil disturbance will be rigorously minimized by both design and mode of operation, and large scale staging of removed materials will not occur in the Corrales Preserve.	The Corps will continue to collaborate with the Village and the Corrales Bosque Preserve Commission throughout the design process.
CBAC	"The proposed plan includes several parking lot improvements and one new parking area, park benches, tables, and improved surfaces for nature trails to both guide users through the natural environment and provide extra facilities for recreation visitors." (page 189). The Federal requirements served by *the overall project* (all 5 Reaches of the Rio Grande) evidently has to include	Noted. Only the recreation features proposed for Reach 1 (such as signage) would be installed. No other recreation features are proposed in Corrales.

	some funding to be spent on recreational facilities, but “the guidance costs for recreation features cannot exceed 10% of the Federal restoration project cost” (page 200). The recreation funding at this level may thus benefit the Rio Grande State Park in the Albuquerque Reach, or others. Other reaches of the bosque evidently are not obliged to have recreational improvements – “…that are compatible with ecosystem integrity” (item 7 above). These would mostly be incompatible with a wildlife preserve. Further, it is acknowledged in an earlier section (page 68) that “In the Corrales Bosque Preserve, a natural surface trail allows limited access (for those capable of navigating a natural surface trail to enjoy jogging, walking, horseback riding, and bicycling). No motorized vehicles are allowed, except for maintenance and emergency vehicles, per Village ordinance”. Nevertheless, we may be able to take advantage of this element to provide additional interpretive signs at the main entrances to the Preserve (Alameda, Cabezon, Romero, and North End).”	
CBAC	We will need further assurance that park-like recreational features will not be forced on the Corrales Bosque Preserve.	Only the recreation features proposed for Reach 1(such as signage) would be installed. No other recreation features are proposed in Corrales.
CBAC	The Corrales Bosque Preserve should be mentioned wherever the discussion focuses on who manages the land within the project areas. There needs to be explicit recognition that the needs and mission of the Preserve can be very different than in the RGVSP. A further point arises here concerning specific needs of the Corrales Bosque Preserve. The Corrales Bosque Preserve is recognized at various places in the report, but in other places (e.g. under Land Use on p. 68) only the Rio Grande Valley State Park is mentioned. Another place is under Ecological Resources on p. 97 where it states that the “Proposed Action Area is within a State park and is located in the middle of a major metropolitan area, recreational use and demand is high and widespread.” Again, no mention of the Corrales Bosque Preserve and thus little or no recognition that its needs and mission are different in many	Sections updated.

	respects compared to the RGVSP.	
CBAC	Although not apparent from the report, the northern area contains, among cottonwood forest and native shrubs: 1. 1 area of 3.6 acres of cryptobiotic soils 2. 2 small patches of Yerba Mansa totaling 0.2 acres at the extreme south end of the project area. Although not apparent from the report, the southern area contains, among cottonwood forest and native shrubs: 1. 8 patches of Yerba Mansa totaling 1.5 acres 2. 5.1 acres of successfully replanted cottonwoods 3. 8.5 acres of invasive Ravenna grass 4. 7 small areas of successfully replanted shrubs 5. 3 jetty jack lines that are not along the river banks 6. 25 acres of recently thinned of excessive dead and downed wood and salt cedar/Russian olive near Via Oreada 7. About 20 acres that may yet need to be thinned 8. About 9 acres of closely spaced, young, but rapidly re-sprouting salt cedar and Russian olive following thinning some years ago in the Cabezon area. There are other extensive areas of cryptobiotic soils in the Preserve. These soils have very little shrub or tree cover and appear to form in less than 2 or 3 years in areas that were periodically flooded in decades past. Because this soil cover forms rapidly in this area, they probably are not of special value. This is significant as some of these soils will almost certainly be destroyed by the northern part of the project. However, it is not totally essential to preserve all native vegetation as, for example, Yerba Mansa is quite common in the Preserve – 21 such patches have been mapped so far. Further, some damage to existing native plants and shrubs may be tolerable if specifically considered and delineated during detailed project planning. What we cannot tolerate is lax planning that leads to unconsidered or	Native vegetation would be disturbed as little as possible. All native patches and other features mentioned would be flagged to be avoided during construction

	negligent destruction of native species and habitat through ad hoc decisions during project implementation, or by contractors who lack adequate supervision.	
CBAC	Baseline assessment of native vegetation should be developed to map spatial extent and to enable the maintenance and conservation of these species and habitats within the project areas. I. All yerba manza, salt grass, native grass and forbs, silver-leaf buffaloberry, New Mexico privet, and coyote willow stands should be maintained where possible. II. All Goodings willow and other tree willows should be maintained where possible. III. The successfully replanted cottonwoods should be preserved.	Per the Monitoring & Adaptive Management Plan, each proposed project area would be monitored before any construction occurs (including vegetation).
CBAC	However, the jetty jack lines, extensive areas of invasive Ravenna grass, certain areas of re-sprouting Salt Cedar and Russian Olive, and areas that were thinned in recent years and which now require re-vegetation or additional re-vegetation and re-sprout treatment, would benefit from intervention of the type proposed. Jetty Jacks should be removed throughout the entire Corrales Bosque Preserve including along the river banks, using manual and small mechanical equipment to minimized footprint and native vegetation and soil disturbance.	All non-native vegetation would be treated using the most feasible method for that specific area. Jetty jack removal would be evaluated by our Hydrology & Hydraulics Section.
CBAC	In the treatment-retreatment re-vegetation areas, soil disturbance should be very limited. Exotic tree species should be treated with cut stump methods *with no root plowing or other root extraction methods*. Soil disturbance in these areas will exacerbate exotic species invasions, increase cost and limit the effectiveness of the invasive species control objectives. Heavy machinery and soil disturbance should be limited only to the swale and water feature treatment polygons. Any areas where	Development of specifications for treatment would occur during the design phase. The Corps will continue to collaborate with the Village and the Corrales Bosque Preserve Commission to meet planning objectives.

	soil is disturbed should be re-vegetated with native plant materials and treated for exotic invasive for the following 2-5 years. Exotic invasive species control outside of treatment polygons should be applied surgically using manual cut-stump techniques that minimize soil disturbance and that maximize the sustainability of native plant habitats and species. Some of these more open areas may also need native re-vegetation treatments as an exotic invasive species control treatment. The feasibility report acknowledges that a condition like a "savannah" is not a goal for the health of bosque. We need to be assured that fuel reduction activities don't become overzealous to the extent that the restoration itself leads to a savannah-like condition with reduced canopy cover, increased sunlight to the floor of the bosque, and reduced soil moisture and sandy conditions in between remaining trees.	
CBAC	Given the context of the work that's been done over past several years throughout the middle Rio Grande, including in our Preserve, we think that appropriate replanting with native plants should now be a significantly higher priority than additional fuel reduction. Replanting will be vital in disturbed areas, but it will also be important to improve cottonwood understory structure in otherwise undisturbed areas within the project boundary. Fuel reduction, if any, should occur only in designated and planned areas with full concurrence of the Corrales Bosque Advisory Commission. Wood chips and other mulch resulting from treatment should be spread thinly on the ground in accordance with the treatment prescription in the Habitat Management Plan, or removed from the site. Hydrological studies predict a further lowering of river by 6 feet in next 50 years (Fig 3.3, page 77). If no action is taken, "Continued isolation of riparian vegetation in the Study Area from fluvial geomorphic processes will eventually result in complete dominance of the plant communities by non-native plant species including salt cedar, Russian olive, Siberian elm, white mulberry,	You have referenced sections from the EA that elaborate on our planning objectives. Revegetation planning would be conducted at a site specific level and in coordination with Corrales.

	and tree of heaven……. with fire as the new main disturbance mechanism, would diminish habitat suitability and quality for many native animal species" (pages 79-80). Since our Preserve holds the largest part of the forested acres in Reach 1 (page 99) and is "the (ecologically) highest functioning reach …….(as)….. expected – the last vestiges of undisturbed Bosque are found in this area", we have the most to lose in the mid Rio Grande region by neglecting to make improvements when they are possible, perhaps resulting in "conversion from forest to savannah" (page 104). This possibility is somewhat more likely in the project area in the Corrales Bosque Preserve because those project areas already contain significant stretches with little or no forest cover. "Reach 1 would decline to an HSI of 0.35 from 0.50….. By 2066 (TY51) 20 percent of the bosque community's functionality is lost (Table 3.7). Reaches 1 and 5 are likely to incur the highest losses (29% each)." (pages 105-106). Implementation of the project would halt this decline and is projected to result in an improvement to an HSI of 0.55 from 0.50. "The Preliminary Preferred Plan would include restoration of 916 acres of the Middle Rio Grande bosque by enhancing hydrologic function (by constructing wet features such as high-flow channels, willow swales, and wetlands) and restoring native vegetation and habitat by removing jetty jacks, exotic species/fuel reduction, and riparian gallery forest restoration" (page 200). "All sites would be tested for depth to groundwater, soil salinity, and soil texture" (page 211). Apart from construction of wetlands, the project would be little different than the kinds of thinning and re-vegetation that have occurred in the past, but with considerably more emphasis on effective re-vegetation and the prevention of re-sprouting. Wetlands would consist of re-establishing river flow in old side channels at high flow rates, and smaller wet spots and meadows. Pre-project and post-project monitoring of the project areas is a	

	crucial component of the overall project plan as stated on pages 33-34. A number of ongoing monitoring programs are mentioned (Bosque Environmental Monitoring Program (BEMP), Hawks Aloft raptor and songbird monitoring, and some comparison of before, during and after using "indicator species".	
CBAC	It will be important that monitoring occur at the locations of specific features at the proposed project sites rather than relying on existing monitoring that is nearby or in the general area. Otherwise it will not be possible to know whether changes, or lack of changes, are related to the projects or not.	That is what is proposed in the Monitoring & Adaptive Management Plan.
CBAC	The putative arrest of the projected habitat decline due to the project depends on modeling and projections from past trends. There are uncertainties, but there is also significant experience with wetland development in the Rio Grande valley, as well as elsewhere. Re-established side channels can silt up again and become non-functional, although the hydrological studies have considered this possibility: "the functioning of a high flow channel is relatively certain at a predicted water surface elevation due the accuracy of hydrology models, ..(but)..the frequency at which that water surface elevation will be reached is dependent on weather and therefore difficult to predict….. the risk of water features in restoration alternatives being filled with sediment over the period of analysis: Flow modeling shows to be satisfactory." (page 180).	A sediment transport analysis was performed during the feasibility study and it was concluded that the Rio Grande in this reach is in a state of relative equilibrium. Also, while sediment would be flushed though the high flow channel features, they would remain relatively sustainable over time. This has been confirmed through observation of the several high flow channels constructed over the past several years. However, this will be monitored as part of the adaptive management plan and localized areas of sediment accumulation may need to be addressed. Second, the flow frequency issue was addressed with the development of an average annual hydrograph that considered the flow record of the Rio Grande at Albuquerque after Cochiti was constructed to target regulated spring flows. The average annual hydrograph has shown that a peak flow of approximately 3500 cfs occurs approximately every other year. This flow and duration can be expected to occur, on average, every year or two. The high flow channels were set to flow when the Rio Grande flow rate reached 2000 cfs to 3000 cfs. On this basis, looking at the USGS flow record at the Albuquerque gage on the Rio Grande, a high flow channel constructed in this manner would have

		experienced spring flow in 28 out of 36 years from 1975 to 2010.
CBAC	The HSI 'scores' and their significance would be easier to understand if they were to be related to what an observer would notice when walking in the project areas in the Preserve 50 years in the future, i.e. related explicitly to what is there now. The subject matter experts obviously cannot be expected to provide a precise picture, but their combined final HSI of 0.35 with no intervention, compared with a score of 0.50 at present suggests they might be able to provide a more complete picture than is currently in the feasibility report.	More detail is available in the Technical Appendices. An example of the scores could possibly be a reference to the Hink and Ohmart Types 1-6 photos. A reference/photo will be added if possible.
CBAC	If no restorative action is taken for 50 years *at the actual sites*, we need to know what would have disappeared altogether, which features that are now common would become scarce, and what, if anything would have replaced these features. We recommend we undertake visits as soon as possible to previous projects, with USACE and MRGCD project personnel, to get a first hand understanding of analogous situations. These visits should be followed by walking through the actual sites in the Corrales Preserve with project personnel to improve our understanding of the likely positive and negative changes.	The Future Without Project is described (ie: dying off of cottonwoods in Section 3.8, etc.) in Section 3.0. The Corps will continue to coordinate with Corrales to take them to sites of existing restoration projects.
CBAC	Current and projected future HSI scores of 0.50 and 0.35 (no intervention) and 0.55 (with proposed intervention) are point values obtained from averaging the individual values representing the opinions of the subject matter experts. This feasibility study is not complete without more consideration of the uncertainties involved. The first step would be to look at the spread among the expert opinions. For example, if the 'no intervention' point values ranged from 0.17 to 0.46 but averaged to 0.35 we would not feel confident about the expertness of their opinions or the stability of the process. On the other hand, if the spread in values was only 0.33 to 0.37 we should probably be suspicious of 'group think' and other such 'common cause' influences. One of the dominant concerns of many in Corrales is the fear of unintended consequences. Each expert may have been asked to	The HSI scores were developed as part of the Habitat Evaluation Assessment Tool (HEAT) analysis using an interdisciplinary team (the E-Team) of subject matter experts. The E-Team was made up of members from UNM, US Fish and Wildlife Service, USGS, US Bureau of Reclamation, MRGCD, Open Space, New Mexico Interstate Stream Commission, and New Mexico Department of Game and Fish. HSI scores were developed and agreed upon by this team. The HEAT modeling information is provided in the Technical Appendix of the Feasibility Report.

	express a range of opinion on each of the various factors that lead to their final HSI score. If that has, in fact, been done the final score from each expert could also be expressed as a range, as there are standard ways of combining the ranges on the contributing factors. As it is, the ecological benefit added by the proposed project is entirely expressed by the two HSI point values 0.35 (without project) and 0.55 (with project). For example, some of the experts' might have a low end for their range of HSI close to 0.35 even with the project, indicating a reasonable chance that no benefit at all would be derived from the project. Without some evidence of the stability of these numerical judgments across the group of experts, and the range of values attributable to each expert, the HSI values provide little useful information.	
CBAC	We would benefit from seeing the range of uncertainty on each expert's HSI value if these have been obtained, as well as the spread of values on the final HSI score among the experts who contributed. In addition, the experts should be consulted directly on the potential for unintended consequences. What might these consequences be? Are we correct in assuming that they could be limited by gradual implementation, monitoring, and adaptive management?	The E-Team agreed on each HSI score developed. There was no range of scores though if there was disagreement by a member and/or discussion, it was noted.
CBAC	A further negative impact of the project is the noise and disturbance in those areas of the Preserve during the period of channel dredging (Fall and Winter). Heavy machinery would be required; access would be via the levee road. Dredged material would be removed, although some temporary storage on or adjacent to the site must be assumed.	Noise during construction is discussed in Section 4.6 of the EA. Work would take place during normal working hours. Material would either be hauled off or used on site per design.
CBAC	However, the total area of wetland development envisaged is small – only about 4% in the overall project (page 211). Detailed maps of the high flow channels in Reach 1 of the project have not yet been made available, so the extent of channel restoration in the Preserve is currently unclear.	This level of detail would be provided during the design process. We will, as indicated, continue to collaborate with Corrales during the design phase.
CBAC	To better gauge the degree of disturbance, we need much more detailed maps showing the dimensions of swales, wet meadows,	This level of detail would be provided during the design process. We will, as indicated, continue to collaborate

	and flow channels, and their placement in relation to existing features such a replanted cottonwoods. We will need similar information on the placement, extent, and content of thinning and re-vegetation plans. This information will need to be developed in conjunction with walkdowns of the sites by project personnel and persons identified by the Corrales Bosque Advisory Commission.	with Corrales during the design phase.
CBAC	Finally, our Habitat Management Plan calls for these kinds of developments to be done in a cautious, gradual, and adaptive manner. Further information will be needed before it can be ascertained if the proposals are to be implemented cautiously. Current signs from the feasibility study are reasonably encouraging as there is much evidence of adopting appropriate standards for studying the areas before project start, and the use of careful procedures. However, gradual and adaptive introduction of wetlands implies several small scale developments spread out in time so there is opportunity to learn from mistakes, which if they occur, will then have a better chance of being limited in both scope and degree. The conceptual maps currently in the feasibility report give the impression of a large scale project that might all be implemented in one determined drive to completion. Further, the report proposes to start with the northernmost region, i.e. our Preserve. In addition to detailed maps as discussed above, we will need schedule information to become confident of a gradual and adaptive mode of operation.	These details would be worked out in the design and specifications package. We will, as indicated, continue to collaborate with Corrales during the design phase.
CBAC	Every opportunity should be taken to develop the project schedule to accommodate multiple staged developments in the Corrales Preserve, introduced over as long a period of time as possible, ideally over the whole period of the project (i.e. in all regions), backed up by intensive monitoring of groundwater, surface water, flora, and fauna. In general, we strongly favor a gradual, adaptive mode of implementation to the degree possible, rather than a rapidly implemented project across the whole of the proposed area in the Corrales Preserve. This recognizes that, 1) the proposed areas are in a functioning nature preserve where disturbance must be minimized, and 2) a slower rate of development with intensive monitoring provides lower risks of significant unintended	Phasing of construction is proposed and discussed in Section 2.0. The exact sequencing of locations (and timing) is still to be determined during the design phase. We will, as indicated, continue to collaborate with Corrales during the design phase.

	consequences.	
	To ensure the proposed project can deliver an appropriate level of restoration in an appropriate manner will require further work by USACE, MRGCD, and their contractors, *in partnership with the Corrales Bosque Advisory Commission* during the detailed planning of the project in Reach 1. To begin this process we request that USACE and MRGCD present relevant features of their proposal at a public meeting in Corrales after they and members of the Corrales Bosque Advisory Commission have visited some local sites, including Sandia Pueblo. The main purpose of the presentation should be to address these comments to the degree possible at this stage and to listen to the concerns of Corrales citizens.	Per ongoing discussions, the Corps would be happy to attend a public meeting in Corrales when more detailed information is ready to share.
New Mexico Environmental Department (NMED) Air Quality Bureau	Dust control measures should be considered to minimize the release of particulates due to vehicular traffic and ground disturbances. If activities result in significant ground disturbance, the project area should be reclaimed to avoid long-term problems with erosion and fugitive dust.	BMPs for dust and erosion control are in Section 4.6. Revegetation is discussed in Section 4.8.
NMED Ground Water Quality Bureau	"Execution of the project is not expected to have any adverse impacts on ground water quality in the area of the project. However, heavy equipment is likely to be used on the project, thereby leading to a possibility of contaminant releases (e.g., fuel, hydraulic fluid, etc.) associated with equipment malfunctions. The GRWQB advises all parties involved in the project to be aware of notification requirements for accidental discharges contained in 20.6.2.1203 NMAC."	The Corps' contractor is required to complete an Environmental Protection Plan and a SWPPP which must include a Spill Control Plan and adhere to these requirements. This reference has been added to Section 4.5.
NMED Surface Water Quality Bureau	No comments	
NMED (overall)	"Potential impacts on environmental resources are anticipated to be minimal under the proposed guidelines"	Thank you for your comment.
Middle Rio Grande Conservancy	Section 1.2 Project Location, second Paragraph: This area is owned and cooperatively managed by the City of Albuquerque Open Space Division and the Middle Rio Grande Conservancy	This information has been updated in Section 1.2.

District (MRGCD)	District.	
MRGCD	Section 1.2 Third paragraph: The Proposed Action Area also includes the bosque within the Village of Corrales, which is owned by the MRGCD and co-managed by agreement with the Village of Corrales.	This section has been updated.
MRGCD	Table 1., Water Features/High Flow Channels: Should the word “were” be “where”?	Yes. Thank you.
MRGCD	Table 1., Water Features/Swales: A sentence description of how swales can be used to connect the river to the bosque is needed here or elsewhere in the document. Perhaps you can include a photo of a new swale at Rt. 66 project to demonstrate this.	This information has been added.
MRGCD	Table 1., Vegetative/Exotic Species Removal: Bank and bars tend to be dominated by or monocultural stands of exotics but these areas are ideal hydrologically to plant native riparian plants. Exotic trees and shrubs such as Salt cedar and Russian olive are larger in stature than many native shrubs, contain volatile oils and form ladder fuels that increase fire danger.	Noted.
MRGCD	Table 1., Vegetative/Fuel Load Reduction: Jetty jacks often prevent recreational, management or emergency access.	This information has been added.
MRGCD	Table 2. It would be easier to assess the effects of the overall project if the acreage slated for removal of mature understory (as opposed to treatment of re-sprouts) was broken out of the total “ESFLRRGFMR” acreage.	This varies by area and has been determined during the design phase of the project.
MRGCD	General comment on project maps: One cannot assess the potential impact (positive and negative) of trails without knowing their location, length and surfacing.	The Recreation Plan is presented in detail in the Feasibility Study. The Recreation Plan maps have been added to the EA.
MRGCD	Page 18: Jetty Jack Removal, 1st paragraph, last line: Will willow swales or other biostabilization occur in all locations of bank line jack removal?	Most of the locations where jacks would be removed along the bank would be in order to construct a channel opening and/or promote overbank flooding. The banks of these areas would be planted with native vegetation but any opening (ie: a high flow channel opening) would not be vegetated in order to allow water to move into the feature.
MRGCD	Page 26; Bank destabilization: This technique and bank lowering expand the active floodplain over a range of higher flows. There	This description has been added and is also discussed in Sections 3.10 and 4.10.

	needs to be a better description of the potential benefits to aquatic and terrestrial species.	
MRGCD	Page 32, Project Implementation, third paragraph: Please include another option(s) if agencies cannot use the fill dirt from restoration projects due to tree roots, etc.	While the majority of dirt will be used on site, any remaining fill would be hauled off site.
MRGCD	Page 34, Monitoring, Adaptive Management and Maintenance: Is project money allocated for 5 years of monitoring promised in the EA? Monitoring data and adaptive management techniques from other projects should be utilized, where applicable.	Monitoring is to be performed for up to 10 years by the Corps. Monitoring and adaptive management techniques from other projects (such as the Collaborative Program) have been incorporated. This information is available in the Monitoring and Adaptive Management Plan.
MRGCD	Page 48, Water Depletions: This section should be rewritten slightly to clarify that the BOR, ISC and COE don't need water rights permits from the New Mexico State Engineer for the project but do have to offset any depletions resulting from habitat restoration outside the 600 foot floodway, as required by the State Engineer. It is somewhat unclear as currently written.	This section was written/reviewed by ISC.
MRGCD	Table 7.: The EA also needs a table that shows the Habitat Units and HSIs estimated with project. We could not locate this information.	This information is available in the Feasibility Report.
MRGCD	Section 3.8 could use a comparative breakdown (past and present) of general vegetation communities in the Project Area (% or acreages) from the Bosque Biological Management Plan and/or other sources as background information. A summary comparison of changes in plant community types from the 1984 and more recent Hink and Ohmart surveys would also be helpful to describe changes in the spread of exotics, etc.	This information is available in the Feasibility Report.
MRGCD	Section 3.15, 1st paragraph: Refer to the Paseo del Bosque (paved) trail with mileage and location. Include the paved loop and mileage at the Rio Grande Nature Center. People use the levee access road, ditch access roads and primitive, informal and formal trails inside the bosque throughout the project area for recreational purposes.	This information has been added.
MRGCD	Secion 3.19: Include a statement that restoration sites will be monitored for noxious or other invasive weeds.	This section has been updated.
MRGCD	Section 4.8: Citations are needed for statements on birds'	This reference has been added.

	preferences to nest in native vegetation.	
MRGCD	Section 4.9, 2nd paragraph: The sentence "The removal of native vegetation may allow the floodplain to expand…" should be rewritten to clarify that this is the active floodplain or floodway within the levee system and the processes that would make this happen. There needs to be a brief description on how projects would be analyzed and built to avoid negative impacts to flood control levees. What are current vegetation management standards, BMPs etc. (i.e. levee buffer zones for plantings, tree/root removal, etc.	This information has been added.
MRGCD	Section 4.13: Examples from the Route 66 project could be used and scaled up to better describe benefits. More data/description on the economic benefits of recreation improvements is needed. The addition of recreation facilities like improved access, trails, picnic areas and aesthetics benefit socially disadvantaged neighborhoods adjacent to the bosque with currently limited opportunities.	The Feasibility Report contains a detailed analysis of the Recreation Plan.
MRGCD	Section 4.15: Recommend deleting "for the stakeholder as well" from the third sentence. Boat ramps are not listed in the "Interpretive and Recreational Enhancements" but are on the project maps. We think the boat ramps should be included as funding allows.	This section has been updated.
MRGCD	Section 4.18: Last sentence, "The Proposed Action benefits all income brackets by increasing ecosystem restoration, access and recreational amenities…"	Change made.
MRGCD	Section 4.19: New patches of weeds should be mapped and provided to landowners/managers and the State Weed database for monitoring and follow-up.	This information was added to this section.
MRGCD	Section 4.20: Need citations for statements on Forest Service pesticide evaluations. What is the reason(s) the Corps has chosen to use Garlon 3 and 4 versus the Arsenal mix used by the City of Albuquerque?	Citations have been added. Garlon 3 and 4 are preferred over Arsenal as Arsenal has been shown to be most effective during the month of September only (per discussion with construction contractors).
MRGCD	Page 97, Ecological Resources, 2nd paragraph: Change first sentence to read: "Because the majority of the Proposed Action area is within a State park…" You might want to mention (in the appropriate section) that there are no recreational features proposed for Reach 1.	This change has been made. A boat ramp is proposed for Reach 1.

MRGCD	Page 97, Ecological Resources, 3rd paragraph, last sentence: What are the existing conditions referred to here? Untreated areas with mature understory?	This paragraph has been updated.
MRGCD	Table 5.1: The "No Effect" assessment seems to be in conflict with the last paragraph of Section 4.3, which says the Proposed Action will have a positive affect on H&H&G and increase the connectivity and area of inundation. This needs clarification. The socioeconomic considerations should include long-term positive impacts with improved aesthetics, access and additional recreation features.	Section 5.1, Table 10 has been updated.
COA Open Space	The Draft EA document and all associated planning need to be "live," that is, continually updated according to presently completed and/or near-term contemplated activities of local agencies and the Middle Rio Grande Endangered Species Act Collaborative Program. Updates to planned project areas, including deletion of proposed work, should be incorporated throughout the life of the project to avoid any duplications of planning, compliance, construction, maintenance, or monitoring.	The DEA and associated documents have been continually updated as information becomes available but once all documentation is signed it will become the final version. During the design phase, the Corps will continue to coordinate with all stakeholders and other programs/agencies performing work in the area in order to avoid duplication of effort.
COA Open Space	Table 2 (page 17) shows 551 acres of habitat features and 1,729 acres of other actions—in any case, these do not equate to the 916 acres described on page ii of the Draft FONSI?	This Table has been updated to the correct version.
COA Open Space	The Draft EA needs to refer to and incorporate the City of Albuquerque's Environmental Enhancement Plan (2005), especially at pages 20-23 and 78. This Plan was provided during the feasibility study phase and has been the basis for vegetation and habitat types used by Open Space Division to establish a habitat mosaic in the bosque. The Plan was reviewed by the U.S. Fish and Wildlife Service and used as a basis for excluding Rio Grande Valley State Park from critical habitat designation for the southwestern willow flycatcher in 2005. The City is obliged to implement this Plan, while we are not aware that any such equivalent review or status has been conferred to Crawford and Grogan (2004), for example. Please add this Plan to the appropriate places in the text and to the list of references.	References to this plan have been made in the appropriate locations.
COA Open Space	How was the estimated project cost or cost detail on page 33 determined? Costs per acre of treatment types? Should not the	Project cost estimates were developed using the Corps' MCASES (Micro Computer Aided Cost Estimating

	Draft EA contain all of the modeling and different project cost estimates used to determine preferred actions?	System) software program. Detailed information on modeling and cost analysis are provided in the Feasibility Report.
COA Open Space	Recreation improvements need first of all to comply with the Bosque Action Plan (1993); see pages 87-88. Please add this Plan to the appropriate places in the text and to the list of references.	This reference has been added.
COA Open Space	General comment: please involve local agencies by allowing them to have a greater role in pre-project planning and construction oversight, or contract directly with them for implementation of certain projects or activities.	During the design and construction phases, the Corps will continue to coordinate with all stakeholders and other programs/agencies performing work in the area. Similar to the Ecosystem Restoration @ RT66, the Corps will coordinate with Open Space and other stakeholders to develop plans and specifications that meet the project goals on the ground.
COA Open Space	General comment: the bosque in the Albuquerque area seems to be suffering from too much restoration activity. It is our opinion that fewer projects and less work may be desirable in the near future, in lieu of continual activity and multiple projects which all need to be coordinated by several agencies. In the Albuquerque area, it may be that "less is more" and that more work could be focused on Sandia Pueblo or Corrales for burn rehabilitation.	The proposed action includes projects in the Village of Corrales, on the Pueblo of Sandia and in the City of Albuquerque/Rio Grande Valley State Park (RGVSP). The majority of projects are actually in Reach 1 which is on mostly Village of Corrales and Pueblo of Sandia lands. The areas designated in the RGVSP have varying levels of effort which can be further defined with Open Space during the design phase.
Lynn and John Altman	We ask that at this time the Corps refrain from disturbing the Corrales Bosque Preserve. It is our belief that much more experience is required in order to determine the full effects of the proposal; digging channels, excavating swales, razing river banks, creating artificial ponds and clearing woodlands in our beloved Bosque. Please wait until there is greater certainty that the proposed good will outweigh potential short and long-term damage. This is a relatively new science and much more study is needed. While we appreciate the good intentions for "restoration," it seems completely inappropriate to us to mess around in an area that is succeeding in order to make it "better." Better for whom?	Thank you for your comments. The Corps has coordinated closely with the Village of Corrales and the Corrales Bosque Advisory Commission in order to scale back restoration features and implement them in a way that was agreed upon. Monitoring within the area will occur both before and after the project.
Anita Walsh	Please lend assistance here, in The Corrales Bosque Preserve, in a way that is in keeping with the management structure which is currently in place, and perhaps, as Cliff Crawford mentions in his summary, leave this place , as one of the places by which you may	Thank you for your comments. The Corps has coordinated closely with the Village of Corrales and the Corrales Bosque Advisory Commission (including yourself) in order to scale back restoration features and

	compare results of methodology. We have an exceptionally successful preserve, not that it couldn't use any improvement; one that I would like to see would be mild manipulation to assist in beaver-created wetlands and fencing around culverts in the clear ditch, as you know... so do Councilors Gerhart and Clauser..	implement them in a way that was agreed upon. Monitoring within the area will occur both before and after the project.
	I ask that you exclude the Corrales Bosque Preserve from the general plan, but assist us in reaching some of the same goals of the plan in a more natural way.; Natural as in employing Nature's assistance, and 'Natural' in the sense of the history and pattern of the management this preserve has practiced for so long, and to such good effect.	Thank you for your comments. The Corps has coordinated closely with the Village of Corrales and the Corrales Bosque Advisory Commission (including yourself) in order to scale back restoration features and implement them in a way that was agreed upon. Monitoring within the area will occur both before and after the project.
The following comments were received on December 29, 2010, after closing of the public comment period. This was allowed in order to gain input from the recreation community in regard to potential recreational features, especially those related to boating/canoeing. While some of the comments are addressed in the EA, the majority will be considered during design of recreational features related to these comments.		
New Mexico State Parks Division (NMSPD)	"Having reviewed the DEA, NMSPD finds that launch access points are not spaced adequately along the 25 miles of the MRGBRP (Middle Rio Grande Bosque Restoration Project). Optimal concern for safety and emergency river access, as well as for enhancing recreational access, would space access points about every four miles."	The planning objectives for this project focus on ecosystem restoration. The amount that can be spent on recreation components is limited by the funding authority and this is the reason that there is limited focus on launch access points.
NMSPD	"Costs and safety concerns regarding the proposed access point at Central Ave (northeast side) as well as the inability of this location to access the river channel when it is used at flows under 500 cfs are strong reasons to recommend that this launch access and it's designs be abandoned."	This information will be considered during the design phase of the project.
NMSPD	"Constructing and installing such bridges (as those used in the Ecosystem Restoration @ RT66) should be limited and only when the bridges provide adequate clearance (for kayaks and canoes)." "There is a question of cost relative to recreational need, since most of the year the channels would be dry and no foot bridge would be necessary."	Concur. Bridges proposed for this project would have a higher clearance. Though the high flow channels are not intended specifically for boat use, we realize that this does occur and want to make it safe.
NMSPD	"It would be desired to remove those hazards to navigation (jetty jacks) found within the riverbed, to remove them at locations close to launch access such as at NW Alameda…."	Jetty jacks would be removed where ramps are proposed, if they are nearby, and if the ramp is constructed.

Kelly Gossett, New Mexico Kayak Instruction	"…having access to a pond, such as those at Tingley Beach of the 'water feature' described in Reach 1 (1E) and Reach 3 (3A), would be an ideal venue to teach boating safety, an intermediate step for kids between learning in the pool, and paddling on the river."	This is not a goal of this project. Any newly created water features would be constructed primarily for wildlife habitat.
Kelly Gossett, New Mexico Kayak Instruction	"This (revamping existing ponds for recreation use such as the project undertaken at Sandia Lakes) is far less expensive than building a new pool, and given that the ponds are already included in the budget, it should come at little or no cost to designate one (or portions of one) for recreational use."	This is not a goal of this project. Any newly created water features would be constructed primarily for wildlife habitat.
Michael Hayes, Quiet Waters Paddling Adventures	Regarding proposed launch at site 4A, NE side of Central Ave: "1.) Proposed launch is located very close to the Central Avenue bridge" which would pose a hazard at higher flows "2) Numerous sand bars and mudflats on the east side of the river" make putting in and taking out more difficult, deeper water flows on west side of river "3) Proposed location of launch requires long-distance carry from parking area while crossing heavily-trafficked multi-use trails" "4) Limited parking and no close vehicle access" discourages use by disabled and outfitters	This information will be considered during the design phase of the project.
Michael Hayes, Quiet Waters Paddling Adventures	Proposes alternative launch site on NW side of Central Ave (via existing stormwater outfall and RT 66 channel) "The alternative access recommended above would be functional immediately by simply opening a single RGVSP gate from dawn to dusk. Minimal improvements involving a natural launch site approach might involve grading or terracing in anticipation of varying water levels, and stabilizing with native vegetation, or perhaps adding some synthetic materials…"	This location was considered but rejected due to the fact that the high flow channels constructed at this site were constructed for wildlife habitat. Also, the stormwater outfall at this location (managed by the City of Albuquerque) and it's intermittent flash flows, would not allow safe use of this area by boaters.

United States Department of the Interior

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May 14, 2010

Julie Alcon, Chief
Attn: Ondrea Hummel
Environmental Resources Section
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Ms. Alcon:

Thank you for your April 5, 2010, letter requesting our review and comment on the Draft Environmental Assessment (DEA) for the Middle Rio Grande Bosque Restoration Project, Bernalillo and Sandoval Counties, New Mexico. The Proposed Action is to restore 916 acres of the Middle Rio Grande bosque through (1) improving hydrologic function by constructing high-flow channels, willow swales, and wetlands, and (2) restoring native vegetation and habitat by removing jetty jacks, thinning exotic species, and revegetation with native species. Improvements of existing facilities for educational, interpretive and low-impact recreational uses are also proposed.

The U.S. Fish and Wildlife Service (Service) supports the U.S. Army Corps of Engineers (Corps) proposed Middle Rio Grande Bosque Restoration Project. We offer the following comments on the DEA and recommendations to reduce potential effects to wildlife from project implementation:

General DEA Comments

- Pages vi and 81 refer to Appendix H Draft Biological Assessment; there is no Draft Biological Assessment with the DEA.
- Page 2: There is no reference for Crawford et al. 1998.
- Page 4: Text is missing from this page.
- Page 6: Figure 24 does not show levees, bosque or riverside drain as referenced in the text; Figure 20 does.

General Recommendations

- Apply ecosystem management to preserve, maintain, or restore native biodiversity and ecological integrity of natural biotic communities in large areas to avoid fragmentation.
- Assure that ongoing monitoring programs, such as the Bosque Ecosystem Monitoring Program (BEMP), are located within the proposed restoration project areas, adding new sites as necessary.

- Develop a long-term water-quality monitoring plan for areas to be modified (connecting the outfall through the bosque to the river) to function as wetlands where storm water/drainage outfalls previously existed.
- Develop a long-term maintenance plan in cooperation with all cooperating/participating parties.
- Protect migratory bird resources in accordance with the Migratory Bird Treaty Act.
- Conserve all species in the action area listed by the State of New Mexico as threatened or endangered in accordance with state law and Corps regulations and guidance.
- Continue managing developed and natural water sources for wildlife to support viable wildlife populations and to minimize conflict with Corps-related activities.
- Adhere to all recommendations in the Draft U.S. Fish and Wildlife Coordination Act Report for the Middle Rio Grande Draft Feasibility Report, Albuquerque, NM (Service written communication to the Corps, April 14, 2009).

General recommendations for Threatened and Endangered Species

- Consult or conference with the Service on any Federal actions (funded, permitted, or authorized) that may affect federally listed species or species proposed for listing or their designated or proposed critical habitat. The DEA identified foreseeable effects as "May affect but not likely to adversely effect" the federally listed endangered Southwestern willow flycatcher and Rio Grande silvery minnow with designated critical habitat, and the yellow-billed cuckoo (candidate species).
- Complete any Endangered Species Act section 7 consultations for any listed and candidate species or critical habitat affected by the proposed action in the action area.
- Document the distribution of federally listed and candidate species in the action area and monitor their status and population trends to determine whether restoration is being properly implemented and whether the actions are effective at achieving or moving toward desired conditions (see DEA for more details).
- Conserve all federally listed and candidate species and their habitats in the action area in accordance with Federal law and Corps regulations and guidance.

We appreciate the opportunity to comment on the proposed project and appreciate your support of fish and wildlife habitat restoration. If you have any further questions or comments, please contact Cyndie Abeyta at (505) 761-4738.

Sincerely,

Wally Murphy
Field Office Supervisor

cc:
Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico
Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, New Mexico

Interim Comments on:

US Army Corps of Engineers MRG Bosque Improvement Feasibility Report

issued for public review in April 2010.

Corrales Bosque Advisory Commission

Scope

These comments are specific to work proposed in the subject report in Reach 1 of Project #7 (1-J), which includes the 662 acre Corrales Bosque Preserve (of 1090 acres in Reach 1).

The feasibility report has been thoroughly and professionally prepared, with reference to the process that was followed, the applicable legal authority, and extensive technical references. For example, a series of ten expert workshops were held over the course of three years (2005-2008) to provide input to ecological and hydrological models. Funding of approximately $25M has been secured from Federal Government sources with additional participation in the amount of $1.3M from the MRGCD as a non-Federal cost share partner. There appear to be few grounds for concern with regard to the proposed implementation details, such as responsibilities for adherence to the Migratory Bird Treaty Act, special provisions for avoidance of Bald Eagles during winter months, use of herbicides, and removal and disposal of dredged spoil material, assuming these are carried out as described. Local regulations, including all permitting requirements, must be adhered to (page 24).

However, how much physical disturbance of habitat do we anticipate from this work; what else in addition to torn up soil and vegetation? On p. 32 it says that "Staging would occur in adjacent open areas made available by the sponsor, MRGCD. Staging could also take place in the bosque if other areas are not available."

1. Details of these requirements will need to be more specific in relation to actual site disturbance. In particular we need assurance that soil disturbance will be rigorously minimized by both design and mode of operation, and large scale staging of removed materials will not occur in the Corrales Preserve.

Planning for this project has been proceeding for many years. The Corrales Bosque Advisory Commission has been aware of the general objectives during that period, so this project proposal is not new and it is not a complete surprise – except to the degree that it has actually emerged from the planning process at this particular time.

Alignment with the Corrales Bosque Habitat Management Plan

The proposed project covers two areas in the Corrales Preserve. One of these stretches 1.43 miles from the southern boundary of the Harvey Jones Flood Control Channel south to a position approximately at Manierre Road. The other stretches about 2 miles from an extension of Spirock Lane, south to the Alameda Bridge. The total length of bosque that is involved on the west side of Reach 1 is thus about 50% of the Preserve. The goals are to "focus on restoration of degraded significant ecosystem structure, function and dynamic processes to a less degraded, more natural condition" (pg 22). The seven specific objectives of the proposed project are well aligned with the Corrales Bosque Habitat Management Plan. They are:

1. Improve habitat quality and increase the amount of native Bosque communities (expressed in Average Annual Habitat Units) to a sustainable level.
2. Reestablish fluvial processes in the Bosque to a more natural condition. Area of scour or amounts of sediment mobilization through the Bosque would indicate improvements.
3. Restore hydraulic Processes between the Bosque and the river characterized by a more natural overbank inundation pattern and higher riparian groundwater levels.
4. Reduce the risk of catastrophic fires expressed in either number of fires or area affected.
5. Protect, extend, and improve areas of potential habitat for listed species within the Bosque.
6. Provide interpretive features in recreational use areas within the study area.
7. Integrate recreational features throughout the study area that are compatible with ecosystem integrity.

Of these, the last two demand some caution: "The proposed plan includes several parking lot improvements and one new parking area, park benches, tables, and improved surfaces for nature trails to both guide users through the natural environment and provide extra facilities for recreation visitors." (page 189). The Federal requirements served by *the overall project* (all 5 Reaches of the Rio Grande) evidently has to include some funding to be spent on recreational facilities, but "the guidance costs for recreation features cannot exceed 10% of the Federal restoration project cost" (page 200). The recreation funding at this level may thus benefit the Rio Grande State Park in the Albuquerque Reach, or others. Other reaches of the bosque evidently are not obliged to have recreational improvements – "…that are compatible with ecosystem integrity" (item 7 above). These would mostly be incompatible with a wildlife preserve. Further, it is acknowledged in an earlier section (page 68) that "In the Corrales Bosque Preserve, a natural surface trail allows limited access (for those capable of navigating a natural surface trail to enjoy jogging, walking, horseback riding, and bicycling). No motorized vehicles are allowed, except for maintenance and emergency vehicles, per Village ordinance".

Nevertheless, we may be able to take advantage of this element to provide additional interpretive signs at the main entrances to the Preserve (Alameda, Cabezon, Romero, and North End).

2. We will need further assurance that park-like recreational features will not be forced on the Corrales Bosque Preserve.

A further point arises here concerning specific needs of the Corrales Bosque Preserve. The Corrales Bosque Preserve is recognized at various places in the report, but in other places (e.g. under Land Use on p. 68) only the Rio Grande Valley State Park is mentioned. Another place is under Ecological Resources on p. 97 where it states that the "Proposed Action Area is within a State park and is located in the middle of a major metropolitan area, recreational use and demand is high and widespread." Again, no mention of the Corrales Bosque Preserve and thus little or no recognition that its needs and mission are different in many respects compared to the RGVSP.

3. The Corrales Bosque Preserve should be mentioned wherever the discussion focuses on who manages the land within the project areas. There needs to be explicit recognition that the needs and mission of the Preserve can be very different than in the RGVSP.

Relation to Features of the Preserve in the Project Area

Although not apparent from the report, the northern area contains, among cottonwood forest and native shrubs:

1. 1 area of 3.6 acres of cryptobiotic soils
2. 2 small patches of Yerba Mansa totaling 0.2 acres at the extreme south end of the project area.

Although not apparent from the report, the southern area contains, among cottonwood forest and native shrubs:

1. 8 patches of Yerba Mansa totaling 1.5 acres
2. 5.1 acres of successfully replanted cottonwoods
3. 8.5 acres of invasive Ravenna grass
4. 7 small areas of successfully replanted shrubs
5. 3 jetty jack lines that are not along the river banks
6. 25 acres of recently thinned of excessive dead and downed wood and salt cedar/Russian olive near Via Oreada
7. About 20 acres that may yet need to be thinned
8. About 9 acres of closely spaced, young, but rapidly re-sprouting salt cedar and Russian olive following thinning some years ago in the Cabezon area.

There are other extensive areas of cryptobiotic soils in the Preserve. These soils have very little shrub or tree cover and appear to form in less than 2 or 3 years in areas that were periodically flooded in decades past. Because this soil cover forms rapidly in this area, they probably are not of special value. This is significant as some of these soils will almost certainly be destroyed by the northern part of the project.

However, it is not totally essential to preserve all native vegetation as, for example, Yerba Mansa is quite common in the Preserve – 21 such patches have been mapped so far. Further, some damage to existing native plants and shrubs may be tolerable if specifically considered and delineated during detailed project planning.   What we cannot tolerate is lax planning that leads to unconsidered or negligent destruction of native species and habitat through ad hoc decisions during project implementation, or by contractors who lack adequate supervision.

4. Baseline assessment of native vegetation should be developed to map spatial extent and to enable the maintenance and conservation of these species and habitats within the project areas.

I. **All yerba manza, salt grass, native grass and forbs, silver-leaf buffaloberry, New Mexico privet, and coyote willow stands should be maintained where possible.**
II. **All Goodings willow and other tree willows should be maintained where possible.**
III. **The successfully replanted cottonwoods should be preserved.**

However, the jetty jack lines, extensive areas of invasive Ravenna grass, certain areas of re-sprouting Salt Cedar and Russian Olive, and areas that were thinned in recent years and which now require re-vegetation or additional re-vegetation and re-sprout treatment, would benefit from intervention of the type proposed. Jetty Jacks should be removed throughout the entire Corrales Bosque Preserve including along the river banks, using manual and small mechanical equipment to minimized footprint and native vegetation and soil disturbance.

5. In the treatment-retreatment re-vegetation areas, soil disturbance should be very limited. Exotic tree species should be treated with cut stump methods *with no root plowing or other root extraction methods*. Soil disturbance in these areas will exacerbate exotic species invasions, increase cost and limit the effectiveness of the invasive species control objectives.
Heavy machinery and soil disturbance should be limited only to the swale and water feature treatment polygons. Any areas where soil is disturbed should be re-vegetated with native plant materials and treated for exotic invasive for the following 2-5 years.

Exotic invasive species control outside of treatment polygons should be applied surgically using manual cut-stump techniques that minimize soil disturbance and that maximize the sustainability of native plant habitats and species. Some of these more open areas may also need native re-vegetation treatments as an exotic invasive species control treatment.

The feasibility report acknowledges that a condition like a "savannah" is not a goal for the health of bosque. We need to be assured that fuel reduction activities don't become overzealous to the extent that the restoration itself leads to a savannah-like condition with reduced canopy cover, increased sunlight to the floor of the bosque, and reduced soil moisture and sandy conditions in between remaining trees.

6. Given the context of the work that's been done over past several years throughout the middle Rio Grande, including in our Preserve, we think that appropriate replanting with native plants should now be a significantly higher priority than additional fuel reduction. Replanting will be vital in disturbed areas, but it will also be important to improve cottonwood understory structure in otherwise undisturbed areas within the project boundary. Fuel reduction, if any, should occur only in designated and planned areas with full concurrence of the Corrales Bosque Advisory Commission. Wood chips and other mulch resulting from treatment should be spread thinly on the ground in accordance with the treatment prescription in the Habitat Management Plan, or removed from the site.

Hydrological studies predict a further lowering of river by 6 feet in next 50 years (Fig 3.3, page 77). If no action is taken, "Continued isolation of riparian vegetation in the Study Area from fluvial geomorphic processes will eventually result in complete dominance of the plant communities by non-native plant species including salt cedar, Russian olive, Siberian elm, white mulberry, and tree of heaven……. with fire as the new main disturbance mechanism, would diminish habitat suitability and quality for many native animal species" (pages 79-80). Since our Preserve holds the largest part of the forested acres in Reach 1 (page 99) and is "the (ecologically) highest functioning reach …….(as)….. expected – the last vestiges of undisturbed Bosque are found in this area", we have the most to lose in the mid Rio Grande region by neglecting to make improvements when they are possible, perhaps resulting in "conversion from forest to savannah" (page 104). This possibility is somewhat more likely in the project area in the Corrales Bosque Preserve because those project areas already contain significant stretches with little or no forest cover. "Reach 1 would decline to an HSI of 0.35 from 0.50….. By 2066 (TY51) 20 percent of the bosque community's functionality is lost (Table 3.7). Reaches 1 and 5 are likely to incur the highest losses (29% each)." (pages 105-106). Implementation of the project would halt this decline and is projected to result in an improvement to an HSI of 0.55 from 0.50.

"The Preliminary Preferred Plan would include restoration of 916 acres of the Middle Rio Grande bosque by enhancing hydrologic function (by constructing wet features such as high-flow channels, willow swales, and wetlands) and restoring native vegetation and habitat by removing jetty jacks, exotic species/fuel reduction, and riparian gallery forest restoration" (page 200). "All sites would be tested for depth to groundwater, soil salinity, and soil texture" (page 211). Apart from construction of wetlands, the project would be little different than the kinds of thinning and re-vegetation that have occurred in the past, but with considerably more emphasis on effective re-vegetation and the prevention of re-sprouting.

Wetlands would consist of re-establishing river flow in old side channels at high flow rates, and smaller wet spots and meadows.

Pre-project and post-project monitoring of the project areas is a crucial component of the overall project plan as stated on pages 33-34. A number of ongoing monitoring programs are mentioned

(Bosque Environmental Monitoring Program (BEMP), Hawks Aloft raptor and songbird monitoring, and some comparison of before, during and after using "indicator species".

7. It will be important that monitoring occur at the locations of specific features at the proposed project sites rather than relying on existing monitoring that is nearby or in the general area. Otherwise it will not be possible to know whether changes, or lack of changes, are related to the projects or not.

Other Aspects of the Proposed Project

The putative arrest of the projected habitat decline due to the project depends on modeling and projections from past trends. There are uncertainties, but there is also significant experience with wetland development in the Rio Grande valley, as well as elsewhere. Re-established side channels can silt up again and become non-functional, although the hydrological studies have considered this possibility: "the functioning of a high flow channel is relatively certain at a predicted water surface elevation due the accuracy of hydrology models, ..(but)..the frequency at which that water surface elevation will be reached is dependent on weather and therefore difficult to predict….. the risk of water features in restoration alternatives being filled with sediment over the period of analysis: Flow modeling shows to be satisfactory." (page 180).

The HSI 'scores' and their significance would be easier to understand if they were to be related to what an observer would notice when walking in the project areas in the Preserve 50 years in the future, i.e. related explicitly to what is there now. The subject matter experts obviously cannot be expected to provide a precise picture, but their combined final HSI of 0.35 with no intervention, compared with a score of 0.50 at present suggests they might be able to provide a more complete picture than is currently in the feasibility report.

8. If no restorative action is taken for 50 years *at the actual sites*, we need to know what would have disappeared altogether, which features that are now common would become scarce, and what, if anything would have replaced these features. We recommend we undertake visits as soon as possible to previous projects, with USACE and MRGCD project personnel, to get a first hand understanding of analogous situations. These visits should be followed by walking through the actual sites in the Corrales Preserve with project personnel to improve our understanding of the likely positive and negative changes.

Current and projected future HSI scores of 0.50 and 0.35 (no intervention) and 0.55 (with proposed intervention) are point values obtained from averaging the individual values representing the opinions of the subject matter experts. This feasibility study is not complete without more consideration of the uncertainties involved. The first step would be to look at the spread among the expert opinions. For example, if the 'no intervention' point values ranged from 0.17 to 0.46 but averaged to 0.35 we would not feel confident about the expertness of their opinions or the stability of the process. On the other hand, if the spread in values was only 0.33 to 0.37 we should probably be suspicious of 'group think' and other such 'common cause' influences.

One of the dominant concerns of many in Corrales is the fear of unintended consequences. Each expert may have been asked to express a range of opinion on each of the various factors that lead to their final HSI score. If that has, in fact, been done the final score from each expert could also be expressed as a range, as there are standard ways of combining the ranges on the contributing factors. As it is, the ecological benefit added by the proposed project is entirely expressed by the two HSI point values 0.35 (without project) and 0.55 (with project). For example, some of the experts' might have a low end for their range of HSI close to 0.35 even with the project, indicating a reasonable chance that no benefit at all would be derived from the project.

Without some evidence of the stability of these numerical judgments across the group of experts, and the range of values attributable to each expert, the HSI values provide little useful information.

9. We would benefit from seeing the range of uncertainty on each expert's HSI value if these have been obtained, as well as the spread of values on the final HSI score among the experts who contributed. In addition, the experts should be consulted directly on the potential for unintended consequences. What might these consequences be? Are we correct in assuming that they could be limited by gradual implementation, monitoring, and adaptive management?

A further negative impact of the project is the noise and disturbance in those areas of the Preserve during the period of channel dredging (Fall and Winter). Heavy machinery would be required; access would be via the levee road. Dredged material would be removed, although some temporary storage on or adjacent to the site must be assumed. However, the total area of wetland development envisaged is small – only about 4% in the overall project (page 211). Detailed maps of the high flow channels in Reach 1 of the project have not yet been made available, so the extent of channel restoration in the Preserve is currently unclear.

10. To better gauge the degree of disturbance, we need much more detailed maps showing the dimensions of swales, wet meadows, and flow channels, and their placement in relation to existing features such a replanted cottonwoods. We will need similar information on the placement, extent, and content of thinning and re-vegetation plans. This information will need to be developed in conjunction with walkdowns of the sites by project personnel and persons identified by the Corrales Bosque Advisory Commission.

Finally, our Habitat Management Plan calls for these kinds of developments to be done in a cautious, gradual, and adaptive manner. Further information will be needed before it can be ascertained if the proposals are to be implemented cautiously. Current signs from the feasibility study are reasonably encouraging as there is much evidence of adopting appropriate standards for studying the areas before project start, and the use of careful procedures. However, gradual and adaptive introduction of wetlands implies several small scale developments spread out in time so there is opportunity to learn from mistakes, which if they occur, will then have a better chance of being limited in both scope and degree. The conceptual maps currently in the feasibility report give the impression of a large scale project that might all be implemented in one determined drive to completion. Further, the report proposes to start with the northernmost region, i.e. our Preserve. In addition to detailed maps as discussed above, we will need schedule information to become confident of a gradual and adaptive mode of operation.

11. Every opportunity should be taken to develop the project schedule to accommodate multiple staged developments in the Corrales Preserve, introduced over as long a period of time as possible, ideally over the whole period of the project (i.e. in all regions), backed up by intensive monitoring of groundwater, surface water, flora, and fauna. In general, we strongly favor a gradual, adaptive mode of implementation to the degree possible, rather than a rapidly implemented project across the whole of the proposed area in the Corrales Preserve. This recognizes that, 1) the proposed areas are in a functioning nature preserve where disturbance must be minimized, and 2) a slower rate of development with intensive monitoring provides lower risks of significant unintended consequences.

We feel that this project, in conjunction with the Corrales Bosque Preserve Habitat Management Plan, provides a shared vision to enhance the Bosque Preserve wildlife habitat and ecological function. The short-term effects (1-5 years) to the natural resources should far outweigh the much longer-term benefits of this project to the preserve native wildlife and habitats.

The establishment of wetland areas, swales, and restoration of native habitat islands will in the long run reinvigorate the entire food chain and bosque habitat along the Corrales Bosque Preserve. The development of these moist soil, swales, and wetland areas will provide crucial habitat for micro- and macro- invertebrates which supply the foundation of the greater food chain in these riparian ecosystems. The native vegetation that will be restored in these areas, and beyond will provide productive resource islands and seed sources from which these native species will spread to adjacent areas. Currently most of the trees in the preserve are of one or two age classes that will be likely experience widespread die-back over the next few decades. Thus, these re-vegetated areas will also provide a diversity of tree and shrub age classes to sustain this riparian ecosystem well into future. The increased connectivity to the Rio Grande hydrologic cycle will help mimic the historical hydrological and ecological function of this riparian ecosystem. Overall this riparian restoration plan, if successful, will provide increased wildlife habitat productivity, increased wildlife abundance and diversity, and enhance the sustainability, resilience and resistance of the Bosque preserve to future perturbations like wildfire, flood, and climate change.

One's attitude to this project will be determined largely by one's attitude to the introduction of wetlands and short term disturbance in the Corrales Bosque. The project has been planned with a large amount of professional ecological input from people who have long experience studying not just plant and animal communities like those in question, but from actual projects locally along the Mid Rio Grande Valley. For example, Sandia Pueblo has undertaken this kind of restorative work in their bosque over the past 21 years, with apparently good results to date. It appears to be potentially beneficial in comparison with the downside risks of poor or ineffective outcomes and the inconvenience of short term noise and disturbance. What is certain is the large scale deterioration of the Corrales Bosque Preserve over the next 50 years if no action is taken to get more water into at least some parts of it.

12. To ensure the proposed project can deliver an appropriate level of restoration in an appropriate manner will require further work by USACE, MRGCD, and their contractors, *in partnership with the Corrales Bosque Advisory Commission* during the detailed planning of the project in Reach 1.

To begin this process we request that USACE and MRGCD present relevant features of their proposal at a public meeting in Corrales after they and members of the Corrales Bosque Advisory Commission have visited some local sites, including Sandia Pueblo. The main purpose of the presentation should be to address these comments to the degree possible at this stage and to listen to the concerns of Corrales citizens.

Meeting the needs of the Corrales Bosque Preserve as described in these comments, should not be viewed as a delaying tactic. If confidence can be gained that the various parts of the project can be carried out in the manner described, Corrales should provide full support to the project because, 1) there is little doubt that the alternative of no restoration of this kind has a high chance of being a bad outcome (or at least one that does not resemble the current Preserve), 2) similar projects in the region have produced an improved ecosystem, which is our main objective for the Preserve, and 3) the post-project monitoring that is planned, combined with adaptive development and management, has a good chance of mitigating unintended consequences in localized areas over the mid to long term, should any occur.

Middle Rio Grande Conservancy District (MRGCD) Comments on Draft Environmental Assessment for the Middle Rio Grande Bosque Restoration Project, Bernalillo and Sandoval Counties, Issued April 2010.

Section 1.2 Project Location, second Paragraph: This area is owned and cooperatively managed by the City of Albuquerque Open Space Division and the Middle Rio Grande Conservancy District.

Section 1.2 Third paragraph: The Proposed Action Area also includes the bosque within the Village of Corrales, which is owned by the MRGCD and co-managed by agreement with the Village of Corrales.

Table 1., Water Features/High Flow Channels: Should the word "were" be "where"?

Table 1., Water Features/Swales: A sentence description of how swales can be used to connect the river to the bosque is needed here or elsewhere in the document. Perhaps you can include a photo of a new swale at Rt. 66 project to demonstrate this.

Table 1., Vegetative/Exotic Species Removal: Bank and bars tend to be dominated by or monocultural stands of exotics but these areas are ideal hydrologically to plant native riparian plants. Exotic trees and shrubs such as Salt cedar and Russian olive are larger in stature than many native shrubs, contain volatile oils and form ladder fuels that increase fire danger.

Table 1., Vegetative/Fuel Load Reduction: Jetty jacks often prevent recreational, management or emergency access.

Table 2. It would be easier to assess the effects of the overall project if the acreage slated for removal of mature understory (as opposed to treatment of re-sprouts) was broken out of the total "ESFLRRGFMR" acreage.

General comment on project maps: One cannot assess the potential impact (positive and negative) of trails without knowing their location, length and surfacing.

Page 18: Jetty Jack Removal, 1st paragraph, last line: Will willow swales or other biostabilization occur in all locations of bank line jack removal?

Page 26; Bank destabilization: This technique and bank lowering expand the active floodplain over a range of higher flows. There needs to be a better description of the potential benefits to aquatic and terrestrial species.

Page 32, Project Implementation, third paragraph: Please include another option(s) if agencies cannot use the fill dirt from restoration projects due to tree roots, etc.

Page 34, Monitoring, Adaptive Management and Maintenance: Is project money allocated for 5 years of monitoring promised in the EA? Monitoring data and adaptive management techniques from other projects should be utilized, where applicable.
Page 48, Water Depletions: This section should be rewritten slightly to clarify that the BOR, ISC and COE don't need water rights permits from the New Mexico State Engineer for the project but do have to offset any depletions resulting from habitat restoration outside the 600 foot floodway, as required by the State Engineer. It is somewhat unclear as currently written.

Table 7.: The EA also needs a table that shows the Habitat Units and HSIs estimated with project. We could not locate this information.

Section 3.8 could use a comparative breakdown (past and present) of general vegetation communities in the Project Area (% or acreages) from the Bosque Biological Management Plan and/or other sources as background information. A summary comparison of changes in plant community types from the 1984 and more recent Hink and Ohmart surveys would also be helpful to describe changes in the spread of exotics, etc.

Section 3.15, 1st paragraph: Refer to the Paseo del Bosque (paved) trail with mileage and location. Include the paved loop and mileage at the Rio Grande Nature Center. People use the levee access road, ditch access roads and primitive, informal and formal trails inside the bosque throughout the project area for recreational purposes.

Secion 3.19: Include a statement that restoration sites will be monitored for noxious or other invasive weeds.

Section 4.8: Citations are needed for statements on birds' preferences to nest in native vegetation.

Section 4.9, 2nd paragraph: The sentence "The removal of native vegetation may allow the floodplain to expand…" should be rewritten to clarify that this is the active floodplain or floodway within the levee system and the processes that would make this happen. There needs to be a brief description on how projects would be analyzed and built to avoid negative impacts to flood control levees. What are current vegetation management standards, BMPs etc. (i.e. levee buffer zones for plantings, tree/root removal, etc.

Section 4.13: Examples from the Route 66 project could be used and scaled up to better describe benefits. More data/description on the economic benefits of recreation improvements is needed. The addition of recreation facilities like improved access, trails, picnic areas and aesthetics benefit socially disadvantaged neighborhoods adjacent to the bosque with currently limited opportunities.

Section 4.15: Recommend deleting “for the stakeholder as well” from the third sentence. Boat ramps are not listed in the “Interpretive and Recreational Enhancements” but are on the project maps. We think the boat ramps should be included as funding allows.

Section 4.18: Last sentence, “The Proposed Action benefits all income brackets by increasing ecosystem restoration, access and recreational amenities…”

Section 4.19: New patches of weeds should be mapped and provided to landowners/managers and the State Weed database for monitoring and follow-up.

Section 4.20: Need citations for statements on Forest Service pesticide evaluations. What is the reason(s) the Corps has chosen to use Garlon 3 and 4 versus the Arsenal mix used by the City of Albuquerque?

Page 97, Ecological Resources, 2nd paragraph: Change first sentence to read: “Because the majority of the Proposed Action area is within a State park…” You might want to mention (in the appropriate section) that there are no recreational features proposed for Reach 1.

Page 97, Ecological Resources, 3rd paragraph, last sentence: What are the existing conditions referred to here? Untreated areas with mature understory?

Table 5.1: The “No Effect” assessment seems to be in conflict with the last paragraph of Section 4.3, which says the Proposed Action will have a positive affect on H&H&G and increase the connectivity and area of inundation. This needs clarification. The socioeconomic considerations should include long-term positive impacts with improved aesthetics, access and additional recreation features.

Bernalillo County Public Works
Comments provided by Allison Hensel

RE: The Daft Environmental Assessment of the Middle Rio Grande Bosque Restoration Project Bernalillo and Sandoval Counties, New Mexico

I appreciate the opportunity to provide my comments on the project to restore vital habitat areas to the Bosque in Albuquerque. I believe this project will improve the area for everyone who has an opportunity to use it. The benefits to native wildlife and the riverine environment will also be a valuable asset to present and future residents. I have provided suggestions that I believe will improve the content of the Assessment and make it more informative for residents and help ensure that the objectives of the project are a success.

Comments:

References to the Project Action Alternative are discussed in several sections of the No Action Alternative Section of the report. These references are often confusing when trying to understand the current functional characteristics of the ecosystem. The No Action Alternative section needs to provide a clear description of the existing conditions and the progression of those conditions without change. Numerous evaluations in this section focus on descriptions of the Proposed Action Alternative instead of describing the existing conditions and the results of continued No Action.

In the section of the report providing an assessment of the Action Alternative, the focus of ecological risk assessment seems to be focused on the project area as an isolated feature, and only assesses changes to the environment during the construction phase. Many of the evaluations do not include information about the spatial scale of impacts that would be distributed throughout the environment outside the project area or an evaluation of how changes to the ecosystem and the duration of loss within the Bosque will impact the viability of cited endangered species in the long term.

Detailed description for the assessments of the Source, Stressors, and Exposure Risks for the comments posted below can be found in the **Guidelines for Ecological Risk Assessment** (Published on May 14, 1998, Federal Register 63(93):26846-26924)
available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=35860

Additional Information or Evaluations would be helpful for the following items:

1) Evaluation of the quantity of habitat currently used by native species within the project area and the result of added population pressures on other habitats in the ecosystem that may result from migration of inhabiting species due to construction and removal of suitable habitat. An evaluation to determine the impact of added populations in other suitable areas to determine if their potential presence will cause a significant impact on existing populations in those areas would be beneficial in assessing mitigation needs

and assist in relocating upland species to areas outside of the Bosque. Population density increases in limited habitat areas may decimate food resources or cause mortality in some species if migration over-stresses the impacted areas.

2) An evaluation of providing habitat to attract endangered and listed species should include the potential of invasive, predatory, or parasitic species, such as the Brown Headed Cow Bird, mentioned in the EA as a species present in the area, becoming more prevalent due to modification of the existing habitat. Modification plans for the Bosque describe the end result as a mosaic of trees and open brush/grassland, which is described as the preferred habitat of Cowbirds as cited below in information available from the Audubon Society. Creation of more edge habitat may increase the potential of parasitism by this species. Although they are not considered a significant threat to established populations of birds, they may be a significant influence in determining the susceptibility of small populations with limited nesting pairs trying to become established in the area, especially in regard to listed and endangered species.

" Cowbirds occur most often in agricultural/residential landscapes near open woodlands. Cowbirds frequent woodland edges created when deforestation leads to a mosaic of trees and open brush/grassland. In the west, cowbirds strongly prefer riparian deciduous woodlands near agricultural/residential landscapes.

Large, contiguous forests sustain lower rates of parasitism than fragmented forests. This is because cowbirds (1) scan for hosts at forest edges, rarely in forest interiors; and (2) fragmented forests have proportionally more edge than contiguous forests, creating small woodlots that are easy for cowbirds to penetrate." Audubon Society Website, Author: Vincent Muehter

3) Considerations for preserving or replanting existing native plants from disturbed project locations may be beneficial in achieving the desired endpoint. Although plants may be of the same species, plants that are currently present in these areas may have specific genetic adaptations or characteristics that may provide them with an advantage for survival in these specific locations. Assessment of the value of this contingency would be beneficial.

4) A description of the purpose and duration of use for port-a-dams is not provided (pg 32). It may be helpful to clarify this by modifying the statement such as: active flows may need to be diverted temporarily with a port-a-dam or similar device during construction of water features.

5) The report cites an increase of water volume by 160%. However it does not provide information as to how an increased flow to inundate the project area may impact water levels in constricted areas of the river system upstream and downstream of the project area. Additional flow that may be required in the project area may affect water stores in the Cochiti Dam reservoir during drought periods. The impact on end users and structures that may be designed for the existing flow volumes and the potential need to

modify them could financially impact end users or modify flow patterns. More information on these potential changes would be helpful in understanding and mitigating impacts or verifying the limitation of stressors created by these changes.

6) The added presence of native species of plants and animals and the density of wildlife could be included in the aesthetic evaluation of the project area. Viewing wildlife and plants is one of the features listed as an endpoint of the project.

7) The assessment of Noise disturbance from wildlife such as birds and frogs that may be persistent during the evening hours may need to be included in the Action Alternative. Noise levels may not exceed the decibel levels; however, they may be a nuisance at night for residential areas close to habitat areas.

8) Propagation of non-native species by birds that eat and spread the seeds may be a consideration in controlling the spread of non-native plants in rehabilitated areas. Provision of other suitable food sources from native species to aid in the establishment of native plants should be included in planning. Removal of non-native species and establishment of native species that provide a suitable food source in forage areas may be beneficial in controlling invasive species.

9) Information provided in regard to establishing fire breaks could include information on native species that may be used in those areas. Evaluation of native species or less invasive/more desirable species that may not be susceptible to fire-induced mortality, if any, may assist in establishing desired flora and limiting the presence on non-native and invasive species.

10) Evaluation of bird species in the Bosque should include an assessment of native to non-native species and the change in these population densities anticipated by the Action Alternative. Establishment of suitable habitat outside of the Bosque area for upland species that currently utilize the Bosque area and may have been forced out of their natural habitat due to development and loss of those areas may allow for increased habitation of the Bosque habitat by desired species, including propagation of desired flora.

11) Evaluation of recreational use under the Proposed Action does not provide information regarding impacts to current uses, in particular Equestrian use. Narrowing paths, paving paths, and restricting use in areas may potentially eliminate or significantly reduce the availability for Equestrian use in the project area. The presence of horses on paved trails would likely cause damage creating maintenance costs and potential hazards for walking and biking and other low impact uses. The presence of manure on trails utilized by Equestrians may also be an issue for walking, biking, and wildlife impacts from runoff in these areas.

12) Section 3.17 should include hazardous waste reaching the river from discharges into arroyos from industries and development upstream. Contaminants, such as PCB at elevated levels in the river ecosystem, are known and documented.

A recent report presented by NMED, **Environment Department Finds Elevated Levels of PCBs in the Rio Grande near Albuquerque during Storm Flows, released April 19, 2010,** cites: "The PCBs measured in water collected from the Rio Grande during high flow storm water events were below the maximum contaminant level (MCL) established in U.S. Environmental Protection Agency (USEPA) standards for drinking water but were above the state human health and wildlife habitat criteria for surface waters in New Mexico."

The risk for impacts of these contaminants on the potential of establishing habitat with water quality suitable for the Silvery Minnow should be assessed. Cited Human toxicity levels may not be a good indicator of toxicity on sensitive species. References of toxicity should be applicable to the species being discussed. Mitigation of this risk may have potential financial impacts to remove the source if contaminants are determined to be harmful to desired species.

13) In Section 4.20, on the use of Garlon herbicides: The first paragraph states, "These herbicides should not be used near surface water or saturated soils." Then this is contradicted in paragraph 3: "It has been certified and labeled to be used near water by the Environmental Protection Agency." Clarification is needed of these statements to resolve the apparent contradiction.

14) A comprehensive map of existing, current, completed project areas that also includes the proposed project area would be helpful in showing features described on Pages 94-96 and illustrating the total scale of areas being improved throughout the region and the association of projects to one another, i.e. big picture of improvements and added features, etc.

15) The Draft states that establishment and maturation of replanted areas will take a minimum of 10 years (pg 97). An assessment of the impacts resulting from loss of mature habitat for that period of time on native species of fauna should be provided. Staging of removal and revegetation efforts to maximize available habitat or ensure adequate resources for existing populations or migratory species may be beneficial in achieving the desired endpoint and help to mitigate any impacts that may result from removal of large areas of vegetation. Waiting until this is studied after the fact may not be acceptable as a remediation plan if loss of species would result. This may also have an impact on population pressures and may need to be evaluated. Loss of a significant amount of potential forage areas, nesting sites, and cover for some species for a period exceeding 10 years may cause loss of habitation in the area or mortality. This should be assessed for potential risk and evaluation of mitigation that may be needed to minimize potential impacts.

Grammatical, Formatting, Etc.:

1) Pg 26, Line 7: "…scours and creates most soil for vegetation." Omit the word "most", or if typo correct spelling – moist?

2) Pg 48, Section 3.7, end of first paragraph: "Aesthetics analysis considers the existing and future appearance, or perception of views, of the project site and areas surround the site, as well as viewer sensitivity." Change to "surrounding" or "around".

3) Pg 56, second paragraph, line 3: "…overstory and an understory of Russian olive or (Hink and Ohmart 1984)." Omit the word "or".

4) Pg 66, last paragraph, line 4 and line 9: "The without project alternative…. " Change to "No Action".

5) Pg 67, Section 3.13: Omit second and third paragraphs. Information is redundant – presented in previous and following paragraphs.

6) Pg 68, Section 3.13: Insert break between paragraphs at end of line 5.

7) Pg 69: incorporate lone sentence after paragraph 2 into paragraph 1.

8) Pg 70, paragraph 2, line 1: " … frequented by hikers, equestrians along informal…." Omit comma and insert the word "and".

9) Pg 73, Section 4.1, end of first paragraph:" Vegetation may come in on its own as well." Poor grammar. Change to read "Revegetation may also occur through natural processes."

10) Pg 76: Insert break between paragraphs 2 and 3 in Section 4.6.

11) Pg 77 and Pg 79: Orphan at bottom of page. Check formatting for orphaned headers and single lines at bottom of pages after editing.

12) Pg 80, line 6: " … or an Corps biologist, in consultation…". Delete "n" (or a Corp biologist) or use full acronym USACE (or an USACE biologist).

13) Pg 80, line 7: "would determine that the potential for harassment is minimal." Change to "if" or "whether or not"

14) Pg 81, paragraph 1, line 5: "…recommendations would incorporated as construction BMPs…." Insert the word "be" (would be incorporated), or omit the "d" and the word "as" (would incorporate construction BMPs).

15) Pg 81, Section 4.11, paragraph 2, line 3: "…embayments which would help…" Change "which" to "that".

16) Pg 86, Map Legend: Add zero – 2000 Census.

17) Pg 87 (last paragraph)- Pg 88 first paragraph: "The current trail network is poorly configured; duplicate trail segments run throughout the Proposed Action Area. The use of informal trails in some places has caused deterioration of vegetation and disrupted wildlife habitat. Additional improvements such as benches, signs and wildlife observation blinds would greatly enhance this resource."
Omit last sentence, redundant; stated in previous paragraph. Insert first two sentences of this paragraph from page 88 into the last paragraph of Pg 87 at the end of the third sentence on line 5.

18) Pg 93, paragraph 5, line 4: "…application of these herbicides would be done so in accordance with…." Omit the word "so".

19) Pg 94, header at top of page: Correct Font

20) Page 97, first line: "…existing chronic effects the potentially lead…." Change to "that".

21) Page 97, paragraph 5, last line: "…for planted shrubs to be achieve stature…." Omit the word "be".

Sincerely,

Allison Hensel, BS
BCPWD Water Resources

COOMENTS: DRAFT ENVIRONMENTAL ASSESSMENT, MIDDLE RIO GRANDE BOSQUE RESTORATION PROJECT (U.S.A.C.E. April 2010)

1. The Draft EA document and all associated planning need to be "live," that is, continually updated according to presently completed and/or near-term contemplated activities of local agencies and the Middle Rio Grande Endangered Species Act Collaborative Program. Updates to planned project areas, including deletion of proposed work, should be incorporated throughout the life of the project to avoid any duplications of planning, compliance, construction, maintenance, or monitoring.
2. Table 2 (page 17) shows 551 acres of habitat features and 1,729 acres of other actions—in any case, these do not equate to the 916 acres described on page ii of the Draft FONSI?
3. The Draft EA needs to refer to and incorporate the City of Albuquerque's Environmental Enhancement Plan (2005), especially at pages 20-23 and 78. This Plan was provided during the feasibility study phase and has been the basis for vegetation and habitat types used by Open Space Division to establish a habitat mosaic in the bosque. The Plan was reviewed by the U.S. Fish and Wildlife Service and used as a basis for excluding Rio Grande Valley State Park from critical habitat designation for the southwestern willow flycatcher in 2005. The City is obliged to implement this Plan, while we are not aware that any such equivalent review or status has been conferred to Crawford and Grogan (2004), for example. Please add this Plan to the appropriate places in the text and to the list of references.
4. How was the estimated project cost or cost detail on page 33 determined? Costs per acre of treatment types? Should not the Draft EA contain all of the modeling and different project cost estimates used to determine preferred actions?
5. Recreation improvements need first of all to comply with the Bosque Action Plan (1993); see pages 87-88. Please add this Plan to the appropriate places in the text and to the list of references.
6. General comment: please involve local agencies by allowing them to have a greater role in pre-project planning and construction oversight, or contract directly with them for implementation of certain projects or activities.
7. General comment: the bosque in the Albuquerque area seems to be suffering from too much restoration activity. It is our opinion that fewer projects and less work may be desirable in the near future, in lieu of continual activity and multiple projects which all need to be coordinated by several agencies. In the Albuquerque area, it may be that "less is more" and that more work could be focused on Sandia Pueblo or Corrales for burn rehabilitation.

Comments on USACE Middle Rio Grande Bosque Restoration Project EA
Comment Due Date: May 5th, 2010

Agency Name: _NMISC____________________________

Commenting Participants: Anders Lundahl, Kevin Flanagan ______________________________

Chapter / Section	Page #	Line #	Comment
	3	7-9	The effectiveness of passive restoration techniques like bankline destabilization in the MRG is debatable (appears to work under specific channel conditions). High flow/ephemeral side channels as they are currently constructed in the MRG do not facilitate/promote overbank flooding (they can but need specific design criteria).
	3	10-11	Wetland/swale habitats that do not periodically connect to the river are of less overall benefit then those that do periodically connect to the river.
	12-16	General	It will be important to verify the presence of other projects (both HR and other) in the areas highlighted for restoration under this EA. The proposed project areas in some locations overlap with past published NMISC HR projects sites and some recent CABQ Open Space work areas.
	23	10-13	See wetland comment two comments up.
	26	1-13	There is a distinct difference between trying to destabilize a feature and lowering a feature to create habitat. Knowing the difference and indicating for each project area the intent will be important.
	30	1-10	Allowing a connection between the proposed willow swales and the river during high flow may allow for natural regeneration of native plant species and reduce the cost/effort of manual re-vegetation, especially where the distance between the two is short.
	34	7	BEMP stands for – Bosque Ecosystem Monitoring Program
	59	12	More recent water quality reviews/publications may counter this claim.
	62	10	Don't see where WIFL was defined?
	74	1-4	Good job on the depletions language both here and on page 47. It may be worth mentioning here that depletion offsets are bases on open water evaporation rates (NADA, 1983) and the period of inundation for each particular year.

	74	12-17	-What are the sedimentation rates in the floodplain areas? -Need to be aware of the potential that mobile bed load material may get deposited on low elevation floodplain restoration sites.
	75	18	Past NMISC work has indicated positive results/benefits to an overall project through placing sediment spoils in the wetted river (within permit guidelines).
	78	14 & 25-26	Water savings through vegetation management/manipulation is not definitive and depends significantly on local physical variables.
	79	15	See comment above
	79	30-31	Not sure how non-native veg. removal allows the floodplain to expand?
	81	13-14	Are you really not going to fuel equipment between the levees? NMED criteria requires a buffer of 100ft to water.
	92	1-10	Is there a buffer to water that must be maintained during application of the herbicide?
	93	17-21	The specific uses (initial and resprouts) for Garlon 4/Garlon 3A are not consistent between this sentence and line 3-4 on page 92.
	94	19	You list the USBR here, but then don't have a specific project for them on the specifics on the next page (95), and opposite is true for City of ABQ Open Space.
	96	28-29	Cannot figure out what impacts from previous projects this project is trying to rectify?

NEW MEXICO
ENVIRONMENT DEPARTMENT

Office of the Secretary

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RON CURRY
Secretary
Sarah Cottrell
Deputy Secretary

May 13, 2010

Julie Alcon, Chief
Environmental Resources Section
Department of the Army
Albuquerque District, Corps of Engineers
4101 Jefferson Plaza, NE
Albuquerque, NM 87109-3435

RE: Proposed Middle Rio Grande Bosque Restoration Project
Bernalillo and Sandoval Counties

Dear Ms. Alcon:

Your letter regarding the above named project was received in the New Mexico Environment Department (NMED) and was sent to various Bureaus for review and comment. Comments were provided by the Air Quality, Ground Water Quality and Surface Water Quality Bureaus and are as follows.

Air Quality Bureau
The proposed Middle Rio Grande Bosque Restoration Project is located in Bernalillo and Sandoval Counties. The New Mexico Environment Department-Air Quality Bureau does not have jurisdictional authority over air quality issues in Bernalillo County. Air quality concerns arising in Bernalillo County are evaluated by the City of Albuquerque-Air Quality Division and can be found at the following website: http://www.cabq.gov/airquality/. However, Sandoval County is currently considered to be in attainment with all New Mexico and National Ambient Air Quality Standards.

Air quality impacts due to restoration activities identified in this proposal are difficult to ascertain from the project description. Earth-moving and construction equipment will create increases in emissions due to combustion and soil disturbances. It is important that all concrete, quarrying, and crushing facilities contracted in conjunction with the proposed project have current and proper air quality permits. For more information on air quality permitting and modeling requirements, please refer to 20.2.72 NMAC.

Dust associated with vehicular use and earth-moving activities may also impact local air quality. However the increases should not result in non-attainment of air quality standards. Dust control measures should be considered to minimize the release of particulates due to vehicular traffic and ground disturbances. If activities result in significant ground disturbance, the project area should be reclaimed to avoid long-term problems with erosion and fugitive dust.

Activities identified in this proposal will increase emissions and may temporarily impact air quality in the area. Negative impacts associated with construction activities identified in this proposal will be minimized if regulations and guidelines identified in this document are followed.

Ground Water Quality Bureau
The Ground Water Quality Bureau (GWQB) staff reviewed the above-referenced letter as requested, focusing specifically on the potential effect to ground water resources in the area of the proposed project.

The DEA notes that the proposed action would restore 916 acres of the Middle Rio Grande Bosque by constructing high flow channels, willow swales, and wetlands to improve hydrologic function; other associated activities would include removal of jetty jacks, reduction of exotic species, and restoration of the riparian forest. Execution of the project is not expected to have any adverse impacts on ground water quality in the area of the project. However, heavy equipment is likely to be used on the project, thereby leading to a possibility of contaminant releases (e.g., fuel, hydraulic fluid, etc.) associated with equipment malfunctions. The GWQB advises all parties involved in the project to be aware of notification requirements for accidental discharges contained in 20.6.2.1203 NMAC. Compliance with the notification and response requirements will further ensure the protection of ground water quality in the vicinity of the project.

Surface Water Quality Bureau
The proposed action would treat 916 acres of Middle Rio Grande Bosque by improving hydrologic function using constructed high flow channels, swales and wetlands, removing jetty jacks, thinning exotic species, and revegetation with native species. Improving existing facilities for educational, interpretive and recreational uses are also proposed.

Overall, potential impacts on environmental resources are anticipated to be minimal under the proposed guidelines.

I hope this information is helpful to you.

Sincerely,

Georgia Cleverley

Georgia Cleverley
Environmental Impact Review Coordinator
NMED File #3201

Hummel, Ondrea C SPA

From: Garcia, Hector F [HGarcia@usbr.gov]
Sent: Tuesday, May 11, 2010 6:43 PM
To: Hummel, Ondrea C SPA
Subject: Review of Draft EA for the MRG Bosque restoration Project

In general, the document has a very good description of the proposed work. Some of the information seems a little outdated. The proposed work will help existing ecological conditions in the Albuquerque Reach of the MRG. Comments were requested by May 14, please consider these to be Reclamation's comments unless I get additional before the due date. Any questions Ondrea, please do not hesitate to call, thanks.

Specific comments:

Page 5, figure 1 – The small scale map has colored dots that are not applicable to the use of this map in the EA.

Page 4 to 6 – There is a gap in the text and the two sentences that begin with "The east and west boundaries …" do not make sense and have the wrong figure #.

Page 6, figure 2 – The title of the figure needs to reflect the main title page.

Page 7 - Under scoping, does the Corps expect to do another scoping mtg since the last occurred on Feb 2003? The public may want an update on the proposed project.

Page 9 - Other agencies are doing similar work in the Albuquerque reach and that could be mentioned in the EA. The proposed work would be the largest project similar to ongoing work.

Page 17 – Since construction is not expected to begin until 2012, the proposed work needs to be coordinated with agencies that are doing similar work in the reach. Ongoing projects need to complement each other as stated in the cumulative effects section.

Page 33 – There should be a large ongoing monitoring program in the reach by the time the Corps implements this project. Will the Corps work with other ongoing monitoring programs or will this proposed project have its own monitoring? Does the Corps have funding for the monitoring and O&M of the project for the future, is five years enough monitoring?

Page 36 to 45 – This hydrology and geomorphology section is confusing. The Albuquerque reach has some very specific river flow restrictions due to houses and other infra-structure adjacent to the river. The restoration activities can only be done within those specific parameters.

Page 39 - The table has data through 2001 which seems to miss the last 8 yrs, an update could help.

Page 69 - The proposed work has a recreational component. In the corresponding Chapter 4 section it states that a benefit to the natural conditions of the reach is a result of providing well defined trails and recreational locations. Thus, for that to be true is means that the ongoing recreational conditions are not the best for the ecology of the reach. Existing recreation is not confined or restricted and there is a tendency for a myriad of access points to the river from the levee, which has an impact on the riparian vegetation. Tell the reader what is the assessment of the existing recreation in the reach and what impacts the Bosque.

Page 81 to 82 - In the minnow section, the BA and the EA need to state the same determinations of effects.

Page 93 to 95 - The cumulative effects section needs to be updated, mainly the second paragraph and the list of ongoing/finished projects within the reach.

Hummel, Ondrea C SPA

From: Anita Walsh [awalshcgm@yahoo.com]
Sent: Tuesday, April 27, 2010 6:50 PM
To: Hummel, Ondrea C SPA
Cc: fishdad@q.com; Sayre Gerhart; Pat Clauser; jradford19@comcast.net
Subject: Sorry I missed it

Ondrea,

I am sorry I missed the presentation and comment today. I do have a comment to make.

When The Corrales Bosque Preserve was started, it started out with members of the original Bosque Advisory Commission hauling out cars and trash, and setting some basic guidelines. it has been with some exceptions, a minimal impact plan, formal or otherwise. Over the years the Commission has changed and finally now we are back to a Commission which touts a couple of scientists with relevant expertise.

The Commission also has a much expanded, never finished, Bosque Management Plan.

This year the Nature Conservancy gave back the Bosque acreage to The Village of Corrales. It has until now, been managed by the Village, MRGCD, and The Conservancy. It will continue to be managed by The Village and MRGCD.

The Bosque Advisory Commission is appointed by the Mayor, and its mission is to advise the Village Government as to recommendations concerning the Corrales Bosque Preserve. Over the years, depending on the Commission, the Preserve has fared pretty well, despite some major setbacks along the way. Though the Council has usually gone along with the Commission, it does not have to, because that would reverse the order of responsibility. With each element of the Bosque Management Plan, Council decisions still may override the document.

The Council and MRGCD have had meetings on the details, but as things come up, I believe, a low impact method of improvement, which has been the policy thus far will and should, prevail.

We have exceptional bird counts as you know, and some rare native plant colonies, and many other good things as the result of this method of management.

My comment is:

Please lend assistance here, in The Corrales Bosque Preserve, in a way that is in keeping with the management structure which is currently in place, and perhaps, as Cliff Crawford mentions in his summary, leave this place , as one of the places by which you may compare results of methodology. We have an exceptionally successful preserve, not that it couldn't use any improvement; one that I would like to see would be mild manipulation to assist in beaver-created wetlands and fencing around culverts in the clear ditch, as you know... so do Councilors Gerhart and Clauser..

Janet Ruth, of the CBAC, has also seen increased erosion where vegetation has been removed on water banks. Mark Kaib feels that there are too many maintenance vehicles, on a consistent basis, racing on the levy.I have heard them say these things. These are two professionals on the commission.

We have always taken a less invasive approach, and the success of that.. the proof of that, is in the pudding.

I ask that you exclude the Corrales Bosque Preserve from the general plan, but assist us in reaching some of the same goals of the plan in a more natural way.; Natural as in employing Narure's assistance, and 'Natural' in the sense of the history and pattern of the management this preserve has practiced for so long, and to such good effect.

Thanks for listening,
Anita Walsh

Hummel, Ondrea C SPA

From: Lynn Altman [jlaltman@comcast.net]
Sent: Wednesday, May 05, 2010 4:50 PM
To: Hummel, Ondrea C SPA
Attachments: image001.jpg

May 5, 2010

Ondrea Hummel

Corps of Engineers

4101 Jefferson Plaza, NE

Albuq., NM 87109

Dear Ms. Hummel,

We are responding to the Army Corps of Engineers request for local residents' thoughts about the proposed Middle Rio Grande Bosque Restoration Project for the Corrales Bosque Preserve. My husband and I are long-time residents of Corrales, going on 37 years. The Corps has praised Corrales' accomplishments with the Corrales Bosque as an example of good community stewardship. We are proud of our community, too. The Bosque is a haven for wildlife and for our human need for wilderness in our lives.

We ask that at this time the Corps refrain from disturbing the Corrales Bosque Preserve. It is our belief that much more experience is required in order to determine the full effects of the proposal; digging channels, excavating swales, razing river banks, creating artificial ponds and clearing woodlands in our beloved Bosque. Please wait until there is greater certainty that the proposed good will outweigh potential short and long-term damage. This is a relatively new science and much more study is needed. While we appreciate the good intentions for "restoration," it seems completely inappropriate to us to mess around in an area that is succeeding in order to make it "better." Better for whom?

Thank you very much for requesting and considering our input. We are grateful and hopeful that the Corps will respond favorably to our request.

Sincerely,

Lynn and John Altman

272 Paisano Road

Corrales, NM 87048

505-331-9521

New Mexico Energy, Minerals and Natural Resources Department

Bill Richardson
Governor

Jim Noel
Cabinet Secretary

Karen Garcia
Deputy Cabinet Secretary

David J. Simon
Division Director
State Parks

NEW MEXICO STATE PARKS

December 29, 2010

U.S. Army Corps of Engineers,
Albuquerque District Environmental Resources Section
Attn: CESPA-PM-LE (Ondrea Hummel)
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Ms. Hummel:

The New Mexico State Parks Division (NMSPD) would like to thank the U.S. Army Corps of Engineers (ACE) for the opportunity to comment on the Draft Environmental Assessment for the Middle Rio Grande Bosque Restoration Project (DEA-MRGBRP).

The Middle Rio Grande Bosque Restoration Project is an important initiative that NMSPD supports. The project will improve the ecological health of the bosque as well as support recreational and educational benefits. Significant portions of the project area would affect the Rio Grande Valley State Park, and the entire initiative ties into NMSPD's major programs and objectives in the middle Rio Grande to promote the protection and restoration of the river and bosque ecosystem and to expand river-based recreation and outdoor education.

The Rio Grande is a priceless natural, cultural, and recreational resource. NMSPD has statutory duty to develop, maintain, manage and supervise all state parks and state-owned or state-leased recreation areas, and the responsibility for preparing the federally-required State Comprehensive Outdoor Recreation Plan (SCORP). NMSPD also administers the New Mexico Boat Act [Section 66, Article 12 NMSA 1978] on waters of the State (including the Rio Grande), promotes motorized and non-motorized boating, and promotes boating safety.

NMSPD's comments in this letter are focused on non-motorized river-based recreation and boating safety, which have received less attention relative to other issues. Throughout its course, the Rio Grande still has considerable potential to support additional recreation use, which can expand quality-of-life and economic benefits. This is particularly true for the middle Rio Grande, which has the largest population center in the state.

NMSPD's comments and concerns are based on the professional expertise of our boating officers, and are also informed by two listening sessions that NMSPD hosted in November and December 2010. The listening sessions were originally conceived to get a sense of the recreation needs and safety concerns of the paddle craft user community statewide, but the sessions also focused especially recreational paddle craft use in the stretch of the Rio Grande from north

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Corrales to the Isleta Reservation (just south of the I-25 bridge). The listening sessions were followed by field visits to various locations within this stretch.

NMSPD's comment and recommendations reflect both agency and public input from this process and they are consistent with the policies for the Rio Grande Valley State Park and those supporting NMSPD's boating safety objectives for safe paddle craft boating within the reach of the Draft Environmental Assessment. Those policies include the permitting and ensuring accommodation for compatible uses with the waterways and floodplain management such as canoeing. (RGVSP Management Policies C1, C3, C9, C10). The public input also stressed the need for safe supporting facilities consistent with recreational use of the Rio Grande. NMSPD and representatives of paddle craft users are mindful that facilities should be located and designed to minimize environmental/habitat impacts and in ways that are sustainable from an operations stand-point.

NMSP comments cover the following aspects of the DEA impacting paddle craft:

- Launch Access and Construction
- High Flow Channel Bridges
- High Flow Channel Construction
- Jetty Jack Removal
- Riverside Drain Bosque Bridge(s)
- Trails Integrated with Paddle craft Emergency Bail Out Points
- Augmenting existing and potentially new recreation opportunities safely.

Launch Access and Construction: Having reviewed the DEA, NMSPD finds that launch access points are not spaced adequately along the 25 miles of the MRGBRP. Optimal concern for safety and emergency river access, as well as for enhancing recreational access, would space access points about every four miles. This spacing system is the standard recommended by national river management expert authorities, such as the National Park Service. Obviously, in a privative or wilderness river setting, fewer access points are needed and desired. The stretch of the Rio Grande within the MRGBRP area, however, is within a major urban area. Recreation users obviously benefit from more access options, but emergency first responders really need direct access. The disposition of access points should include a put-in at the northern boundary of the Project and a take-out at the southern boundary.

Our recommendations for the best launch access locations are as follows, based on site visits and public input from the recreation paddle-craft community:

1P. NW side of Rio Grande just above the Corrales Diversion Canal;
2P. NW sides of Alameda at the Corrales Diversion Canal outfall drain on both sides of the drain outfall;
3P. NW side of Montano at Bridge Drain or about 100' south of the SW side of Montano or both providing water level launch options;
4P. NW side of Central Ave at the Orillia Drain;
5P. NW side of Bridge @ 150' north at the high water flow channel outfall;
6Pa. NW side of Rio Bravo Blvd by existing parking area; and/or
6Pb. NE side of Rio Bravo @300' west of existing parking area;
7P. Prices Dairy and potential Bosque Campsite;

8P. NE or SE side of I-25 north of the Isleta Reservation boundary.

In most cases, less obtrusive and safer launch facilities can be constructed than some of those proposed in the DEA. Design manuals and guidance for similar river situations are available from several good sources, including from the Iowa Department of Natural Resources (www.iowadnr.gov/riverprograms/rivertrails.html) and from the National Park Service, Rivers and Trails Conservation Assistance Program (http://www.nps.gov/ncrc/programs/rtca/helpfultools/launchguide.pdf.

Costs and safety concerns regarding the proposed access point at Central Ave (northeast side), as well as the inability of this location to access the river channel when it is used at flows under 500 cfs are strong reasons to recommend that this launch access and it's design be abandoned. In all cases, however, preliminary and final access point and launch point designs should be vetted with the paddle craft community as each individual launch access point is advanced. Some members of the paddle craft community even expressed interest in assisting with the construction of such facilities as community volunteer projects to reduce costs, increase the number of formal launch access points, and foster partnerships and community involvement.

NMSPD recognizes that there are legitimate concerns about the operation and maintenance of river access points (e.g. agency staffing and funding limitations). These concerns, however, should not limit the vision at this time for a fully-accessible river corridor. Operating protocols designed to limit administrative burdens (e.g. by time-year, time-of-day, loading/unloading only restrictions), take advantage of collaboration among agencies, draw on the private recreation/paddling sector for some responsibilities, and utilizing volunteer assistance are strategies that can be combined to manage a robust system of access points.

High Flow Channel Bridges: NMSPD supports the objective of increasing recreation access to portions of the project area and understands that existing and future high flow channels are both beneficial for bosque/river/endangered species management and are interesting features to the public. These proposed recreation amenities for trail crossings of seasonal water features are a safety concern, however, since the channels themselves can be attractive for paddle craft. If steps are not taken to block physical access to the channels themselves, they will get used. Trying to block all access to the high flow channels, however, will require extensive effort and may prove difficult.

A site visit to the high flow channel bridge installed north of Bridge Street on the west side of the Rio Grande determined that this particular bridge was constructed with inadequate clearance for kayaks and canoes. Constructing and installing such bridges should be limited and only when the bridges provide adequate clearance. ACE should further consider the long-term impacts of installing bridges along the flood channels. There is a question of cost relative to recreational need, since most of the year the channels would be dry and no foot bridge would be necessary. The bridges also could become long term safety hazards (like jetty jacks) and might require future removal.

High Flow Channel/Drains Water Features Construction: Water features can provide opportunities for safe launch access sites. Access points can be constructed at the tail end of the high flow channels where they flow back into the main body of the Rio. Such features can also serve as emergency bail-out locations with eddy out zones integrated by design during bank destabilization. They should serve both safe recreational boating and environmental purposes where ever possible. Those locations identified that can serve depend on whether they are existing (N. of Bridge High Flow Channel) or proposed (Reach 1 – Feature 1C. Dixon Road Bail out, 1G. Alameda West Side at Corrales Drain Launch Access, Reach 4 – Feature 4C. South Diversion Trail Picnic Ground Bail out).

Jetty Jack Removal: This is a commendable goal and will improve water safety if done during the process for targeted areas. It would be desired to remove those hazards to navigation found within the riverbed, to remove them at locations close to launch access such as at NW Alameda, and to remove them along the portage zone necessary for the San Juan Drinking Water Diversion for both the safe take out and the safe put in on the east side of the Rio. NMSPD also believes, however, that there is a environmental education benefit to leaving a few jetty jacks in place—particularly close to locations that already serve as environmental education nodes—as they are a part of telling the story of the river, its historic management, and its restoration.

Riverside Drains Bosque Access Bridges: The provision of these over the Drains/Canals should be located not only to provide fire service access to the bosque but also sited where launch access or bail-out points are identified. Two locations identified here are: ¼ mile west of Lagunitas Road SW by Prices Dairy (for over both the Irrigation Canal and Riverside Drain) and over the Riverside Drain at the MRGCD access road just north of I-25. The MRGBRP should also recognize that there is existing popular recreational boating use of some of the Clear Ditches/Drains. Given this existing compatible use in certain sections, and possible future area recreation section considerations for wildlife observation, whenever bridges are built there should be canoe/kayak clearances provided for high normal water flows for safety and clear spans to eliminate debris piles that may cause a hazard.

Trails Integrated with Recreational Boating Bail Out Points: Trail construction, reconstruction, relocation and/or elimination should not be done without integration of riverside access bail-out points for boating emergencies and for other emergency services access (fire/water rescue). Points to consider for boating safety include:

- Reach 1 – Romero Road Corrales, Dixon Road Corrales
- Reach 2 – Shining River Paseo Del Norte Los Ranchos, Montano Aldo Leopold Clear Ditch Rapid to Dietz Farm Rd.
- Reach 3 – Campbell Road COA, I-40 Galbodon Road
- Reach 4 – S. Diversion Channel Bern Co.
- Reach 5 – Isleta Blvd SW CR 4798, Prices Dairy, West Side I-25 and Rio Grande.

These can be simply marked with trail sign posts or posts with color inserted reflective paint and were identified as good volunteer project opportunities.

Augmenting Existing and Potentially New Recreation Opportunities Safely: Good signage is extremely important. NMSPD has committed to providing Launch Access Signage specifically to enhance navigational safety of paddle craft. Other way-finding signage will also be needed.

Recreational Use of Limited Surface Waters: NMSPD has observed that recreational use of both the main body of the river and in some locations, the associated Clear/ Riverside Drain, does occur. So far there have been no boating-related fatalities. NMSPD realizes that this use can be at odds with the MRGCD and Safe Kids Programs promotion of Ditch Safety. In the long run, however, replacing fear of water with skills and knowledge and directing uses it to where they are appropriate and desired is the best approach.

Managing agencies in the project area should work to promote safe boating by creation of new appropriate water features and by re-examining the existing limited surface water features for suitable use. Just as fishing use of drains outside of unsafe outfall areas or siphon locations is supported with recreation features such as fishing docks, canoe and kayak use should also with enhanced launch access, for example. In addition, if money for mitigation measures for projects within the bosque is available in the future, the paddle craft community has asked that some of it be directed to Tingley Beach for a new deeper water pond that can be used to teach safe kayaking and canoeing in a sheltered and safe outdoor setting.

Paddle craft recreation use has been steadily surging nationally. National Marine Manufacturing Association 2009 sales of canoes and kayaks increased to 343,600. The Albuquerque metro area and New Mexico in general, has enormous potential associated with the Rio Grande that can take advantage of our unique outdoor recreation resources to capitalize on this public interest and to grow economic activity based on river recreation.

In light of the growth of recreational paddle craft recreation, the MRGBRP Plan should consider and discuss the full recreational, economic benefits, and outdoor/environmental education benefits that would arise from significantly enhancing river access in order to support and expand recreational use of the Rio Grande in the project area.

Thank you for considering our comments. NMSPD looks forward to working with ACE and other federal, state and local agencies to realize an expanded vision for protecting and utilizing this stretch of the Rio Grande.

Sincerely,

David J. Simon

David J. Simon
Director, New Mexico State Parks

Enclosures: Listening Session PowerPoint Presentation
List of Launch Access Points

cc: Julie Luna, Mid-Region Council of Governments
Wally Murphy, U.S. Fish and Wildlife Service
Yasmeen Najmi, Middle Rio Grande Conservancy District
Matt Schmader, Ph.D., City of Albuquerque Open Space Division

US Army Corps of Engineers
Albuquerque District Environmental Section
Attn: CESPA-PM-LE (Ondrea Hummel)
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435

December 29, 2010

Re: Draft Environmental Assessment for the Middle Rio Grande Bosque Restoration Project

Hello Ms. Hummel,

My name is Kelly Gossett, owner of New Mexico Kayak Instruction, Inc. I am writing on behalf of the various outdoor communities and youth groups I work with, and would like to comment on their behalf regarding the MRG Bosque Draft Environmental Assessment (DEA). Thank you for considering our comments.

Throughout the DEA, the author recognizes a number of Bosque users, such as hikers, joggers, cyclist, roller bladders, equestrians and birders, but does not recognize the paddling community or users of the river (not necessarily the Bosque). Several large projects have taken place in the recent past, such as the $400mm San Juan/Chama River Diversion Project, the $187mm Buckman Direct Diversion Project, where significant alterations were made to the river, some of which are considered unsafe to canoes, kayaks and rafts, but could have been designed to safely accommodate a growing community here in Albuquerque, boost the city's tourism and economic development, and – if done properly – host Olympic games. It is my hope that we can work together on these projects to safely meet each stakeholder's needs, while adding to the quality of life with the funds allocated to these massive projects.

Upon extensive review of the DEA, and collaboration with other paddlers and outdoor communities (including many kids programs), and active participation in the New Mexico State Parks listening sessions (Nov. 18 & Dec. 16, 2010; facilitated by Boating Safety Officer Stephen Verchinski), there are three areas of direct interest to these communities:

1. Improved canoe/kayak access to the Rio Grande at selected locations between Bernalillo and the Isleta Pueblo.
2. Additional ponds, such as those at Tingley Beach (which could be used for paddling, particularly with kids, seniors and those with disabilities – but are currently not intended for paddling).
3. Reconstruction of parts of the "Clear Ditch" - particularly the "outflows" where there is most gradient (which could include small whitewater features or a series of artificial rapids).

To understand the nature of these comments, it is necessary to understand the size and scope of the growing paddling community, and others we serve.

- Each year since 2008, I teach more than 400 adults how to kayak. I've noticed many people relocate to New Mexico, for one reason or another, and they're looking for any type of water-activity they can find. Kayaking is an affordable means of social and physical recreation for any average adult, child, senior, family or disabled person.

- Each year, I teach more than 300 Girl Scouts how to kayak, almost exclusively in City of Albuquerque indoor pools. Without exception, these girls want to apply their newly acquired skills and confidence in an outdoor environment.

- I continue to receive request, as a guest speaker, to teach Adaptive Kayaking PE classes for special needs kids at Albuquerque Public Schools, and after-school programs for Rio Rancho Public Schools, area charter and private schools, home school kids, and programs for kids with disabilities (UNM Center for Development & Disability, Special Olympics and Para Olympics, among others). As I teach these kids in City of Albuquerque indoor pools, the desire to kayak outdoors is a natural progression.

- In 2008, I started the Albuquerque Kayak Meetup Group and Santa Fe Kayak Meetup Group as a place for my former students to meet others, learn from one another, and explore New Mexico's scenic landscape from the seat of a kayak. Combined, the groups have more than 300 active members. We paddle through the Rio Grande often and have an annual Balloon Fiesta Float, assist in Open Space River Cleanups, and volunteer to support open-water triathlons throughout New Mexico.

- From 2005 – 2008, I was on the Board of Directors for the Adobe Whitewater Club. At that time, there were more than 400 active members.

- The "Great Raft Race" grew in size and popularity in 2008 & 2009. In 2009, the original race had more than 1,800 registered paddlers, prior to its cancelation following the Corbin Hayes accident.

- Albuquerque native Eric Southwick is a 2-time World Champion free-style kayaker, and 6-time US National (Olympic) Team Member. Eric acquired his skills from humble beginnings kayaking and 'playboating' in the Clear Ditch right here in Albuquerque, defeating competitors from around the world with far greater access to whitewater and opportunity to practice. In the "Land of Entrapment" – Eric is a prime example of how the youth of Albuquerque can acquire a skills and motivation to pursue any dream.

While this list does not include Boy Scouts, the New Mexico Adventure Racing Club, SCUBA divers, kayak anglers or other outdoor groups I work with, an active paddling community does exist, and is significantly larger than my reach, which is primarily with beginner kayakers.

I believe the reason kayaking has gained so much momentum and popularity locally, particularly among youth, families and people with disabilities, is because I go to great lengths to deemphasize the adventure and adrenalin most people associate with whitewater kayaking. Instead, I teach kayaking as a social activity, where everyone is invited. I teach kids a kayak can take them places where roads and trails don't go, where they can access remote campsites, fishing holes and photograph wildlife. When possible, I incorporate Science, Technology, Engineering & Math to broaden their interest. I teach whitewater as a strategic game that anyone can play once they know the rules. These are messages that transcend the sport of kayaking and appeal to a broad range of every-day people, not just the extreme risk-takers.

With regard to access points, it is my understanding the Corps of Engineers has identified a few access points already. Suggestions from the community, facilitated through the New Mexico State Parks listening sessions outline improvements regarding safety, location of the points (upstream vs. downstream of bridges and other hazards) as well as logistics for improved use (minimizing distances from parking areas to river access). I have no comments to offer here, only to say – if these access points were added, our communities would appreciate them, and use them frequently. It is recommended, due to the number of disabled people I work with, that the access points be built in accordance with the Americans with Disabilities Act, and allow for adequate transportation to an area approximately near the river.

With regard to additional ponds – having access to a pond, such as those at Tingley Beach, or the 'water feature' described in Reach 1 (1E) and Reach 3 (3A), would be an ideal venue to teach boating safety, an intermediate step for kids between learning in the pool, and paddling on the river. The Rio Grande, while mostly mellow, is still an uncontrolled environment where hazards exist, and would be a challenge for many younger kids learning to kayak. A pond allows youth to continue learning one gradual step at a time, building confidence and courage at each step along the way.

Another consideration is the City of Albuquerque pools are already at critical mass. An outdoor pond would serve many people and free up already limited pool time. In 2008-09, Sandia Lakes was completely revamped for approximately $4mm. This included three amazing lakes, conference and classrooms, a banquet room with kitchen, toilets and picnic tables for around $1.3mm per lake. This is far less expensive than building a new pool, and given that the ponds are already included in the budget, it should come at little or no cost to designate one (or portions of one) for recreational use.

With regard to the outflows and reconstruction of the 'Clear Ditch,' it is our understanding one or more of these outflows may be reconstructed to minimize hazards and facilitate the wetland restoration. In ~2005, Mayor Martin Chavez and the City Council entertained the idea of building a whitewater park as a means of economic development, similar to those in other states. The City of Albuquerque's internal study concluded that (1) there is not enough gradient in the Rio Grande and (2) the sediment load is so high, that any 'feature' would backfill with sediment in a short period of time. There are, however, other prime venues, including the Clear Ditch, where an Olympic venue can be built with as little as 80cfs (cubic feet/second flow-rate), and 1% gradient. The outflow at Tingley Beach, for example, has flow-rates varying from 50 – 200cfs, and 5ft of gradient. Reconstruction of an unsafe outflow could easily be rebuilt into a world-class training facility, providing locals, especially youth, with a controlled environment to learn water safety, and excel in a unique, adventurous life-long activity. Many whitewater parks sell ½-day, full-day, and season passes to offset the cost. A whitewater park along the flowing Clear Ditch could 9 – 12 months a year, adding significantly to the eco-tourism here in Albuquerque.

An example is the enclosed 'EPD Package Whitewater Course,' built for approximately the same price as one of the City of Albuquerque's skate parks.

A need exist for more controlled environments where these kids can practice, build confidence and learn life-lessons, such as better judgment, accountability for actions, respect for the environment, social awareness and social skills. The river can teach all this and more, while providing multi-purpose, multi-generational uses.

It is our hope that these comments will be considered as supplemental improvements to the projects already budgeted. While we realize these projects have associated cost, it has been proven time and time again, when the Corps of Engineers first recognizes the local paddling communities, then engages them, their projects can be designed for safe paddling, economic development and improving the character of today's urban youth.

Thank you,

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December 29. 2010

U.S. Army Corps of Engineers, Albuquerque District
Environmental Resources Section
Attn: CESPA-PM-LE (Ondrea Hummel)
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Re: Improving non-motorized watercraft access to the Middle Rio Grande

Dear Ms. Hummel,

Good Morning. Stephen Verchinski of NM State Parks has asked that I share my thoughts and recommendations regarding potential canoe and kayak access points along the Albuquerque reach of the middle Rio Grande. Thank you for the opportunity to do so, which are enclosed, but first it might be helpful if you had a little background.

This is a rather lengthy introduction, but I'd like to ask that you wade through it. I arrived in the Albuquerque area in the late summer of 2007. As an avid canoeist since the mid-nineties, I immediately discovered the Rio Grande, and began paddling the river between Algodones and the Alameda bridge regularly. I found it quite puzzling that I rarely encountered other canoeists or kayakers on the river, and even more puzzling that the people I would occasionally come across along the bosque trails apparently had no idea that the Rio Grande was navigable by canoe or kayak.

I quickly fell in love with the peace and serenity of the middle Rio Grande, and was quite impressed by the remote feel of the river, as well as the spectacular scenery and wildlife of the bosque, especially given its proximity to a major city. As I'd arrived here with two canoes (a tandem and a solo), I soon found myself introducing people to the river. The response I heard, from both locals and tourists, was overwhelmingly positive, and I was puzzled again to find myself introducing long-term New Mexico natives to the Rio Grande as a recreational resource.

I'd arrived in New Mexico with the idea of purchasing or starting a business of some sort, and had been researching numerous options along those lines without much success. In the spring of 2009, in large part as a consequence of the continual positive feedback I'd been hearing from the people I was regularly introducing to the river, it occurred to me that it was quite odd that no one was offering outfitting services on the middle Rio Grande. Although there were (and are) numerous outfitters running the whitewater in the north, there was no one offering mellow float trips along the Rio near Albuquerque, and my research led me to believe that there was a much larger market for gentle float trips than there was for wild whitewater. The idea grew from there, and I incorporated and established Quiet Waters Paddling Adventures in the summer of 2009. It was the spring of this year before I'd actually found and moved into our location in Bernalillo.

Our first customer arrived in March, and they proved to be quite typical of what we've seen throughout the year: An older couple who have lived in Albuquerque for 35 years, had some prior experience in canoeing, but had never floated the river here. Their experience was one to which I've now become accustomed – extremely positive feedback regarding the beauty, peace and serenity that's found along the middle Rio Grande. That feedback has continued throughout the year with no exceptions that I can think of – I've never been involved in a business that receives so many positive remarks from its clientele. Customers are arriving excited, (although some are a little apprehensive), and leaving enthused. So enthused that they're actively marketing for us, distributing our rack cards, emailing their friends and generally creating a positive buzz. To give you an idea, here's a few of the comments we've received:

> "I cannot express how much I enjoyed today's trip down the Rio Grande. It's amazing that such a peaceful and beautiful experience can happen right in our own backyard . . . Without a doubt, I will share my experience with not just corporate clientele, but my friends and family . . . Once again, I loved it and agree that this is something new that our area needs . . . "
>
> *Lisa Biby, General Manager, SouthWest HospiTotally @ The Hyatt Tamaya*
>
> "Paddling down the Rio Grande River with Quiet Waters still remains my #1 adventure in the Albuquerque area! The staff was courteous, pleasant, and well informed about the flora, fauna, and history of the river . . . Who would have thought that right in the middle of the hustle and bustle of the Albuquerque metro area lies the most peaceful, scenic and mind restoring place around . . . Lots of smiles, laughs and tranquility to be found here . . ."
>
> *Patty Anderson, Bernalillo*
>
> "It is truly the best thing I've enjoyed with my kids in New Mexico . . . "
>
> *Ramak Boswell, Rio Rancho*
>
> "We enjoyed our trip today so much! Thank you for taking such good care of us and showing us (natives) the river in a way we have never seen it. I will be back soon!"
>
> *Heather Armstrong, University of New Mexico*
>
> "Thank you for a wonderful trip yesterday. We loved the whole experience, from the professional instruction and service, to the fall colors along the bosque, to the wildlife (i.e., blue heron, Canadian geese, Sandhill cranes... and a curious coyote), to the open skies above. Truly, you made our day!"

Stacy and Dorothy Sacco, Rio Rancho

When I conceived the company, I knew that I wanted to offer a canoe/kayak livery service that would exceed expectations on every possible level. As a Michigan native, I'd seen plenty of liveries that used cheap, low-quality boats and equipment, old, beat up vans and buses, provided virtually no safety or instructional information, and saw nothing wrong with sending customers careening down a river in canoes loaded with coolers full of beer. I decided to do things on a completely different level. To my knowledge, we're the only New Mexico outfitter that maintains membership in the Professional Paddlesports Association, and I'm personally a long-time member of the American Canoe Association. Our canoes and kayaks are all high-end boats – The canoes are all Royalex construction from Bell, Wenonah and Old Town (all retail in the neighborhood of $1500), while the kayaks are all manufactured in Tennessee by Jackson Kayak – the kayaks are recreational boats that are very stable and beginner-friendly, as are our canoes. Our fifteen passenger van is an air-conditioned 2003 Ford E-350 in excellent mechanical condition.

We're also extremely safety conscious. Our PPA membership provides us with some great safety information, including an excellent 12-minute video that we require all of our customers to view before they leave our shop, and our local trips also include a live, pre-launch safety and instructional session as well. Finally, we have a strict prohibition against alcohol use of any kind.

What we've seen as a consequence of these decisions is a highly desirable customer base. The majority of our clientele falls into one of two main groups: either the family market or the "active boomer" market. Many of our customers especially appreciate our guided trips, as we provide instruction and guidance for what are often people who've never spent any time in a canoe or kayak before. We've found that offering guided tours of the river encourages beginners to come out and float with us, and we've also found that not only do people leave with an enhanced appreciation of the river and bosque, but also with a measure of confidence in their ability to learn a new sport, which they're thoroughly enjoying. They also leave with a solid understanding of the safety issues involved in paddling on moving water.

Our longer term goals include interpretive tours of the bosque, revolving around the ecological concerns facing what is one of the few remaining riparian ecosystems in the southwest. We had a group of middle school through high-school age kids from Rio Rancho's Living Word Christian Academy out in early November, and recently booked a group of high school students from East Mountain High for next May. The kids from LWCA left like many of our customers – caring more about the river and bosque than they had before.

At the present time, we're focusing on a fifteen mile stretch of the Rio, from Algodones to the Alameda bridge, which allows us to offer trips of varying length, from just over an hour to a five or six hour float. This past August, we participated in the annual Paddle Fest at Heron Lake State Park, where I had the opportunity to meet and speak with Dave Simon, director of NM Sate Parks. I was pleasantly surprised to hear his enthusiasm regarding our little business, and he indicated that he really wanted to encourage more paddlesports throughout the State Park system, including the reach through the Rio Grande Valley State Park through Albuquerque. I shared with him that we had had several requests from customers to float the section of the river through RGVSP, but that the difficult access south of the Alameda bridge made it impossible to offer those trips as a commercial outfitter – the long distances and difficult access involved would make launching and loading several boats a multi-hour affair, which would not only require us to increase costs, but the wait times would almost certainly alienate customers. The lack of easy access also creates concerns about injuries to our personnel, as the long carry distances would necessarily create additional stresses and strains.

It's to this end that the following recommendations are offered. I'm obviously someone who wants to encourage the recreational use of the Rio Grande here in the Albuquerque area. The river here is an outstanding resource, although sadly, it's often regarded by locals as a blight. Yet, what we've found is that once we get people out on the river, their perception of the Rio changes - often dramatically. We've had several customers come out to help on the river clean-up events (We coordinate with ABQ and Rio Rancho Open Space twice a year, donate the use of our boats and equipment and provide shuttles for any volunteers who are willing to come out and help), and we've had many more leave telling us that they never realized how beautiful the Rio Grande here actually is. The tourists are also highly impressed, and are leaving with an elevated perception of the Albuquerque area as a whole.

Thank you again for the opportunity to provide my thoughts regarding improving canoe and kayak access throughout the Albuquerque reach of the middle Rio Grande. I truly hope to see improved access to the river here come to fruition. Please feel free to call or email anytime if there are any questions, or if QWPA can contribute anything to help further.

Best Regards,

Michael Hayes
President
Quiet Waters Paddling Adventures