USIBWC Rio Grande Canalization Project

River Management Plan

International Boundary and Water Commission, U.S. Section

Last Updated December 8, 2016

River Management Plan

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ABBREVIATIONS

BA - Biological Assessment
BMP - Best Management Practice
BRO - USIBWC Boundary and Realty Office
cfs - cubic feet per second
CMA – channel maintenance alternative
CSWCD – Caballo Soil and Water Conservation District
CWA - Clean Water Act
CY - cubic yards
EBID - Elephant Butte Irrigation District
EIS - Environmental Impact Statement
EMD - USIBWC Environmental Management Division
EPCWID#1 – El Paso County Water Improvement District #1
ESA - Endangered Species Act
ESD - USIBWC Engineering Services Division
EWTP - Environmental Water Transaction Program
Flycatcher - Southwestern Willow Flycatcher
IBWC - International Boundary and Water Commission, both U.S. and Mexican Sections
MOU - Memorandum of Understanding (or Memorandum of Agreement)
NDVI - Normalized Differential Vegetation Index
NEPA - National Environmental Policy Act
NMDOT - New Mexico Department of Transportation
NMOSE - New Mexico Office of the State Engineer
NRCS - Natural Resources Conservation Service
NWP - Nationwide Permit
OHWM - Ordinary High Water Mark
O&M - USIBWC Operations and Maintenance Division
Opinion - Biological and Conference Opinion
POD - Point of Diversion
PPE - Personal Protective Equipment
RGCP - Rio Grande Canalization Project
ROD - Record of Decision
ROW - Right of Way
RPM - Reasonable and Prudent Measure
SANWR - San Andres National Wildlife Refuge
SCS - Soil Conservation Service (now NRCS)
SHPO - State Historic Preservation Officer
USACE - U.S. Army Corps of Engineers
USBR - U.S. Bureau of Reclamation
USFWS - U.S. Fish and Wildlife Service
USGS - U.S. Geological Survey
USIBWC - International Boundary and Water Commission, U.S. Section
WRN - Water Right Number

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cover photo: View from Rincon Railroad Bridge looking north towards the Rincon Siphon restoration site, May 2012. E. Verdecchia

USIBWC Canalization River Management Plan -

PART 1 - INTRODUCTION AND OVERVIEW

1.1 Rio Grande Canalization Project (RGCP)

The Rio Grande Canalization Project (RGCP), located in Doña Ana and Sierra Counties in New Mexico and El Paso County, Texas, extends for 105.6 miles along the Rio Grande from Percha Diversion Dam in New Mexico, to approximately 200 feet downstream from American Diversion Dam where the Rio Grande begins to form the international boundary at El Paso, Texas and Ciudad Juarez, Chihuahua (see Figure 1-1). The RGCP is designed to provide flood protection against a 100-year flood and assures releases of waters to Mexico from the upstream Elephant Butte and Caballo Reservoirs in accordance with the 1906 Convention between the United States and Mexico. The U.S. Section of the International Boundary and Water Commission (USIBWC) was granted authority to construct, operate, and maintain the project through the Act of June 4, 1936, 49 Stat. 1463, Public Law No.648.

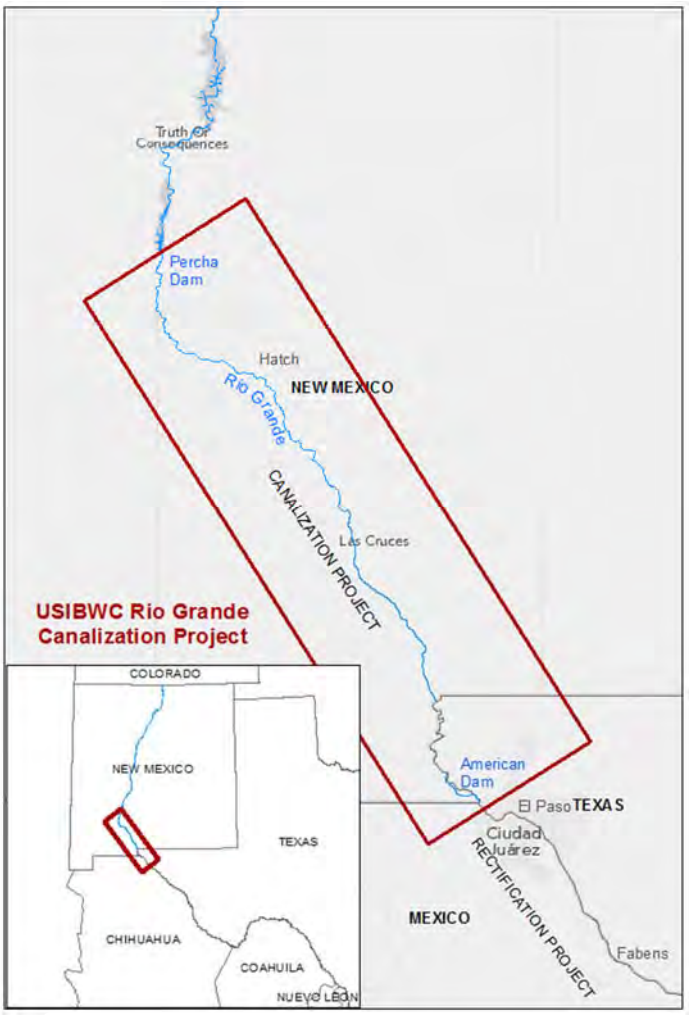

Figure 1-1. Rio Grande Canalization Project location

1.1.1 Statutory Authority

The USIBWC operates and maintains the RGCP under the requirements of the 1906 Convention, the Act of June 4, 1936 (Public Law 648; 49 Stat. 1463), and 22 U.S.C 277 (implementing regulations for the USIBWC). The USIBWC also must follow federal laws enacted after the 1936 RGCP authorization, such as the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and the Clean Water Act (CWA). These laws require compliance as part of USIBWC's statutorily-required duties.

1.1.2 RGCP Record of Decision

This River Management Plan is being updated in accordance with USIBWC's 2009 *Record of Decision on the River Management Alternatives for the RGCP*. In compliance with NEPA, in 1999, the USIBWC began a public scoping and consultation process to develop alternatives for an Environmental Impact

Statement (EIS) on river management of the RGCP. In 2001, an Alternatives Formulation Report was issued, and in 2003, the Reformulation of River Management Alternatives Report was issued, leading to the release of the Draft EIS in December 2003 for public comment. The Final EIS was issued in July 2004 (Parsons 2004a), with a Record of Decision (ROD) expected in August 2004. On August 3, 2004, New Mexico Governor Bill Richardson, U.S. Senators Jeff Bingaman and Pete Domenici, and other stakeholders from New Mexico requested a delay in signing the ROD in order to address concerns of stakeholders. From 2004 to 2009, the RGCP Collaborative, a group of stakeholders working with USIBWC on the RGCP, revisited aspects of the EIS, biological assessments, hydraulic modeling, and technical assessments to address stakeholder concerns.

The RGCP EIS evaluated four long-term River Management Alternatives: a) No Action, b) Flood Control Improvement, c) Integrated Land Management, and d) Targeted River Restoration. The goals were to accomplish flood control, water delivery, and operation and maintenance activities in a manner that would enhance or restore the river ecosystem. Following an 8-year consultation process with stakeholders, the USIBWC selected the Integrated Land Management Alternative and the RGCP ROD was finally signed by USIBWC Commissioner Ruth on June 9, 2009 (USIBWC 2009). The ROD committed USIBWC to a 10-year implementation of the Integrated Land Management Alternative as well as 30 conceptual river restoration sites developed by the U.S. Army Corps of Engineers (USACE) documented in the Conceptual Restoration Plan of March 2009 (USACE 2009). The total cost was estimated initially at just over $5 million and included restoration projects throughout the 105-mile project area (USACE 2009). USIBWC later estimated the total cost to be closer to $11.1 million.

The Integrated Land Management Alternative addressed the following issues:

- Continued RGCP Mission – USIBWC will continue mission operations of water delivery and flood control, as well as levee improvements to meet flood capacity;
- Water Use and Environmental Water Transactions – The Conceptual Plan estimated water used by restoration sites and USIBWC would acquire or lease water to offset depletions as result of restoration sites
- Maintaining Farmland in production – Nearly all measures will be implemented on USIBWC property, and the remaining measure would only take place through voluntary cooperative agreements with private landowners
- Environmental Improvements – USIBWC will balance mission while improving the environmental quality of the river as well enhancing multiple-use of RGCP (hike and bike trails, horse trails, boating)
- ESA Liability – USIBWC will comply with Endangered Species Act (ESA), complete a Biological Assessment and ESA Section 7 consultations to provide regulatory assurances to stakeholders for the federally and state endangered Southwestern Willow Flycatcher;
- Channel Maintenance – USIBWC will:
    - update the river management plan to incorporate new strategies for channel maintenance;
    - establish a data collection and evaluation program for channel maintenance;

  - update and evaluate river cross section data and hydraulic model (in 4-5 year cycles);
  - conduct in-channel enhancements at 3 arroyos (Yeso, Placitas, Angostura) and one inset floodplain (Yeso West)
- Floodway Vegetation Management – USIBWC will:
  - restore 553 acres on 30 conceptual restoration sites within the floodplain, including 4 sites with in-channel enhancements;
  - minimize or reduce mowing at these sites
  - make permanent three (3) "no-mow" zones ;
  - reduce grazing by phasing out grazing leases;
  - implement up to 1,983 acres of managed grasslands;
  - actively remove and control salt cedar and Russian thistle.

The ROD set a 10-year implementation period where the first Phase (2009 to 2014) included studies, pilot projects of restoration sites, and the creation of an environmental water rights transaction framework, and the second Phase (2014 to 2019) includes completing the implementation of the remaining restoration sites. Adaptive Management will guide the implementation of environmental measures (USIBWC 2009).

1.1.3 RGCP Endangered Species Consultation

In 2010 and 2011, the USIBWC contracted a number of technical studies to begin implementation of the ROD, including groundwater and soil surveys, cultural resource surveys, endangered species surveys, and a biological assessment (BA). The latter two, in conjunction with the ROD and Conceptual Restoration Plan, became the basis for reinitiating consultation with the U.S. Fish and Wildlife Service (USFWS) to address the potential impacts of the ROD activities on the endangered Southwestern Willow Flycatcher (flycatcher), in accordance with the ESA. The Section 7 consultation process resulted in USFWS issuing a Biological and Conference Opinion (Opinion) in August 2012 (USFWS 2012b), which committed the USIBWC to several Reasonable and Prudent Measures (RPM) to ensure the creation and protection of habitat for the flycatcher. Floodplain management decisions affecting the flycatcher are incorporated into the Part 2 - Floodplain Management Plan, as well as Part 3 - Endangered Species Management Plan.

1.2 River Management Plan Objectives

This River Management Plan (RMP) was developed to provide a guide for preserving and enhancing the resources of the RGCP in a manner consistent with USIBWC mission requirements and recent USIBWC resource management commitments. The objectives of this RMP are to outline management procedures of the RGCP in order to provide USIBWC staff with a guide to:

- Fulfill statutory duties to operate and maintain the RGCP,
- Complete mission requirements of flood control and water delivery while preserving and restoring natural resources,
- Implement the requirements outlined in the ROD,
- Ensure compliance with the Opinion and related ESA consultation, and

- Ensure compliance with other federal and state regulations.

This RMP updates and replaces the 2004 River Management Plan for the RGCP prepared by Parsons for the USIBWC (Parsons 2004a). This RMP document is divided into multiple parts:

Part 1 - Introduction and Overview

Includes the River Management Objectives and Background of the RGCP

Part 2 - Floodplain Management Plan

Describes levee, floodplain, and vegetation management procedures along the floodplain within the USIBWC Right of Way (ROW) in the RGCP, including ROD implementation actions

Part 3 - Endangered Species Management Plan

Describes conservation management procedures, many of which are included in Part 2, to protect endangered, threatened, and candidate species of the Endangered Species Act, and includes the Flycatcher Management Plan

Part 4 - Channel Maintenance Plan

Includes dredging and channel maintenance protocols, hydrologic and hydraulic modeling, and permit information

Part 5 - Field Guide to Common Native & Non-Native Flora & Fauna in the RGCP Riparian Zone

Includes photographs of common animals and plants in the RGCP, for the purposes of quick identification to assist the field staff in determining areas that should not be disturbed

Part 6 - No-Mow Zones Maps

Includes a map book outlining the green zones, no-mow zones, and other maintenance zones on an aerial background

Part 7 - References

1.3 Updating the RMP

Parts 2 through 6 each have their own approval signatures and will be updated and dated according to agency needs. Part 4 recommends timeframes for updating the Channel Maintenance Plan. Whenever any Part of this RMP is updated, the date in the footer of the appropriate Part should reflect the new date. In addition, the cover page should have a revised "Last Updated" date, and the Table of Contents and References should also be updated.

USIBWC Canalization River Management Plan -

PART 2 - FLOODPLAIN MANAGEMENT PLAN

Approval Signatures

José A. Nuñez, P.E.
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11/20/14
Date

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Principal Engineer, Operations Division
Nov 17, 2014
Date

Gilbert Anaya
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11/20/14
Date

2.1 Introduction

This section of the River Management Plan outlines USIBWC management policy for the floodplain, vegetation, river banks, and levees of the Rio Grande within the USIBWC Right of Way (ROW) from Percha Dam in Doña Ana County, New Mexico downstream to American Dam in El Paso County, Texas.

2.2 Levees

The RGCP flood control system was completed in 1943 to provide protection from the 100-year flood. Flood control in the RGCP relies on flow regulation by upstream reservoirs that include Elephant Butte Dam, completed in 1916, and Caballo Dam, completed in 1938. During non-irrigation season, the reservoirs are used for storage and regulation of winter flows. In addition to the flow regulation, flood control in the RGCP relies on the use of levees to contain flooding in areas with insufficient natural terrain elevation. The levee system extends for 57 miles along the west side of the RGCP, and 74 miles on the east side for a combined total of 131 miles of levees. The levees, ranging in height from about 3

feet to about 10 feet, are designed and maintained to provide 3 feet of freeboard during the 100-year design flood in most reaches. The levees have a gravel maintenance road along the top (Parsons 2004a).

2.2.1 Levee Maintenance

Levee maintenance along the entire RGCP is conducted on a routine basis per the RGCP Operations & Maintenance Manual. Levees are inspected regularly at the beginning of each flood season and immediately after each flood event. Levee maintenance equipment consists of water trucks, graders and rollers for levee surface, and slope grading and blading activities. Maintenance includes encouraging grass growth on the levee slopes for erosion control, cutting brush and tall weeds from the slopes, and repairing levee slopes following flooding. Levee slopes are mowed to prevent growth of brush and trees that could obstruct flows, or cause damage to the levee as a result of penetration by roots of plants.

Levee roadways are generally unpaved gravel roads designed for passage of operations and maintenance personnel and equipment. Levee maintenance includes road grading and resurfacing with gravel as needed. The entire levee road system for RGCP is resurfaced within a 20-year cycle. No dozers are used as part of levee maintenance activities (SWCA 2011).

USIBWC has an informal agreement with the U.S. Bureau of Reclamation (USBR) to remove small amounts of water (less than 20 acre feet per year) from the river for levee maintenance purposes. A formal Memorandum of Understanding is in the works for this activity.

2.2.2 Levee Rehabilitation and Construction

The *Final Environmental Assessment for Flood Control Improvements to the Rio Grande Canalization Project* completed in December 2007, outlines USIBWC actions for raising the elevation of a number of levee segments for improved flood protection, as well as additional levee construction improvements (USIBWC 2007). USIBWC continues to implement construction and rehabilitation projects. Many of the levee improvement projects were conducted from 2009 to 2013. Certain segments of the river levees are currently still in design phase, including Canutillo and Sunland Park areas. USIBWC Engineering Services Division (ESD) continually evaluates the flood containment capacity of the floodplain and certifies that the levees meet standards set by the Federal Emergency Management Agency (FEMA).

Additional levee work remains for the Vado Reach, Courchesne Reach, Nemexas Reach, and the Canutillo Reach. The *Final Supplemental Environmental Assessment - Flood Control Improvements to the Rio Grande Canalization Project in Vado, New Mexico* from July 2014 documents levee work and associated river re-alignment for the Vado Reach.

2.2.3 Mitigation for Construction Activities

Whenever USIBWC has construction activities underway in the floodplain, USIBWC and its contractors should follow these mitigation requirements (SWCA 2011).

Water Resources Protection

- During construction near the river, best management practices (BMPs) and spill control procedures will be used to prevent contamination and increased erosion to the river. Servicing of heavy equipment will be done outside of the riparian zone.

- Sediment for restoration bankwork (USACE 2009) on New Mexico restoration sites may be moved to nearby floodway locations and stabilized by revegetation during shavedowns and bank preparation. Shavedowns will be designed to promote backflow inundation and reduce the possibility of sediment entering the river.
- Proper permits or authorization is required for any river water use related to construction activities, such as water spraying for dust abatement.

Soil Protection

- Temporary materials and equipment-staging areas for construction areas will be reclaimed and revegetated with suitable native woody trees, shrubs, and native grasses and forbs. The USIBWC will monitor performance of these environmental measures.
- Signage will indicate that riparian use and access will be limited during construction activities to limit erosion, minimize damage to vegetation, and provide refuge areas where wildlife can remain undisturbed.
- Levees will be reinforced if construction activity threatens levee protection.

Wildlife Protection

- Construction should occur outside of the migratory bird breeding season from September 1 through February 28; If construction is necessary during the migratory bird breeding season, surveys will be conducted per Section 2.3.1 and treatment will be selected to minimize the effect.
- A 0.25-mile buffer zone will be established around flycatcher territories. Buffer zones may also be established for the yellow-billed cuckoo under the guidance of the USFWS.
- No construction activities will be conducted in known habitats of listed or sensitive species. If construction activities must occur during the flycatcher breeding season and within the buffer zones, USIBWC will utilize Best Management Practices listed in Section 3.1.16, Table 3-7.

Aquatic Habitat Protection

- If fish are stranded when equipment is operating in the river or arroyo tributaries, they will be salvaged and put into the main river channel.
- Work in the channel should be conducted during low-flow or dry river conditions.

2.3 Vegetation Management

The USIBWC has jurisdiction on about 9,000 acres of land within the RGCP Right of Way (ROW). The floodplain within the ROW is maintained to reduce erosion potential, remove potential obstructions that could reduce flood containment capacity, help stabilize stream banks, control weed and brush including saltcedar, and provide wildlife habitat at suitable locations. Vegetation is managed by mowing, mechanical or chemical treatment, through provisions in leases, or through cooperative agreements for recreation areas. This section discusses vegetation management and new alternatives that USIBWC will implement to meet ROD requirements, such as the implementation of managed grasslands.

2.3.1 Bird Breeding Season

To comply with the Migratory Bird Treaty Act, USIBWC will not mow or conduct management activities within the floodplain or on the levee slopes during the active migratory bird breeding season without a bird nesting survey. For RGCP, the breeding season has been designated by USFWS as March 1 through August 30.

2.3.2 Bird Nesting Surveys

In order to comply with the Migratory Bird Treaty Act, USIBWC may perform management activities (mowing, herbicide treatment, levee grading, etc.) on an as-needed basis during the active bird breeding season (March 1 to August 30) only if bird nesting surveys are conducted and impacts and disturbance to any active or potentially active nests are minimized. Maintenance activities will not occur within a35-foot buffer from active nests (HDR 2012).

Survey protocol (HDR 2012) is as follows:

1. Use the field sheet provided to the field office by Environmental Management Division (EMD) (Figure 2-1).
2. Using a GPS, record a start coordinate each day for this activity.
3. Walk along a planned route parallel to the flood control area.
4. Adjust distance between surveyors depending on vegetation height and density. Distance should be no more than 30 feet.
5. Look for nests in trees, along banks, on the ground and undercover (Figure 2-2).
6. If a nest or evidence of nesting is found:
    a. Obtain a GPS coordinate.
    b. Write down GPS coordinates and fill out other cells on field sheet (ex: names of surveyors)
    c. Note if the nest is active or inactive.
    d. Identify the species of bird and plant that the nest is in or near, if possible, in the comments section. A basic bird identification guide is available from the EMD staff.
    e. Take a photograph and write the photo number on the field sheet.
    f. Flag a buffer of at least 35 feet from the nest.
    g. Write the “nest number” on the buffer flagging and on the field sheet.
    h. Keep your distance if nest is active!
7. Record a stop coordinate each day.
8. Conduct Post-Action Monitoring within 7 days of management action.
    a. Record a start and stop coordinate each day for this activity.
    b. Verify that buffers were not compromised.
    c. If buffers were not compromised:
        i. Remove the flagging.
        ii. Record not disturbed (ND) on field sheet, date, and sign.
    d. If buffers were compromised:
        i. Take a picture and identify the “nest number”.
        ii. Record the picture number for the appropriate compromised nest number.

iii. Notify EMD.

9. Field staff should give the field notebook to the administrative staff after each survey event.
10. Administrative staff enters field data into the spreadsheet stored in the Upper Rio Grande Project network drive, under Operations/Bird Surveys.
11. Administrative staff will download photos (from 6.e. and 8.d.) and rename accordingly and/or ensure the current names match the field sheet.

Upper Rio Grande Bird Nesting Survey Field Sheet

Field Office American Dam / EMD

Date	Name of Surveyor(s)	General Location	Nest #	GPS - latitude	GPS - longitude	Photo #	Nest Active/ Inactive (A/I)	Comments	Post-action Monitoring (disturbed/ not disturbed D/ND)	Post-action Photo # (disturbed nests)
6/12/12	R. LittleOwl E. Verdecchia W. Belzer	Americ Dam	start	31°47'02.8" N	106° 31' 39.4"W	—	—	start of survey- Am. Canal Head Gates		
6/12/12	"	"	1	31 46'52.9	106 31'36.7	061212_ nest 1	A	egg - (duck?)	ND 6/19/12 EV	
6/12	"	"	2	31 46'52.9	106 31'36.6	061212_ nest 2	A	quail activity under palo ~~verde~~ verde	ND 6/19/12 EV	
6/12	"	"	3	31 46'52.4	106 31'39.7	061212_ nest 3	A	2 hatched eggs, Dug Nest, salt cedar	ND 6/19/12 EV	
6/12	"	"	end	31° 46' 51.7	106°31'38.6	—	—	above Int Dam end of survey		

Figure 2-1. Sample Field sheet for bird nesting surveys

Figure 2-2. A) Nest in a tree in the floodplain B) Ground nest in the floodplain.

2.3.3 Bird Nesting Survey Training and materials

The USIBWC EMD conducted bird nesting survey protocol training for the USIBWC Upper Rio Grande Project staff of Las Cruces, El Paso, and Fort Hancock on July 17, 2012. EMD will conduct refresher

training every spring for all three field offices in the Upper Rio Grande Project (Las Cruces, El Paso, and Fort Hancock). Refresher training was conducted in March 2013 and 2014. Refresher training can include classroom portion and/or field work. Field office staff should contact EMD staff with questions concerning bird surveys.

EMD provided the following equipment to the all the USIBWC Upper Rio Grande Project field offices for the bird nest surveys: Survey Protocol Reference Guide, point-and-shoot camera, Garmin GPS unit, permanent marker, field books, flagging tape, and carrying case. As needed, EMD can replace bird survey supplies such as flagging tape and field books.

2.3.4 ROD and Biological Opinion Requirements

The ROD outlined changes to vegetation management, as follows:

- Convert 1,983 acres to managed native grasslands;
- Enhance 553 acres with native riparian vegetation.

In addition, the Biological Opinion outlined additional vegetation management:

- Establish of a minimum of 53 acres targeted for flycatcher habitat (dense riparian shrub habitat) by 2017 and up to 119 acres by 2019.

2.3.5 Mow Zones

Other than in No-Mow Zones outlined in subsequent sections, vegetation treatments will continue to be implemented by both USIBWC Operations and Maintenance Division (O&M) and EMD. Vegetation treatments will include annual mowing of approximately 2,500 acres within the 105-mile flood control project corridor.

Mowing of the floodway outside the main channel but between the flood control levees is completed annually to remove obstructions to flood flows and to maintain flood capacity. Mowing of the floodway controls weed, brush, and tree growth, and is conducted at least once each year. Farm tractors with 20-foot rotary mowers are generally used to mow the floodways. Slope mowers are used for vegetation maintenance on the channel banks and levee slopes. Some areas with dense vegetation may require a second mowing. No bulldozers are used for vegetation treatments. Cut-stump treatment and other saltcedar removal occurs at select restoration sites. Mowing during bird nesting season will follow bird nest surveying protocol in Section 2.3.2.

Mowing and maintenance also occurs on the 5 sediment control dams built by Natural Resources Conservation Service (NRCS), as described in Section 4.5.3. In addition, USIBWC may mow irrigation ditches as described in Section 4.11.

Mow areas are also described in Section 2.3.7.

Historically, the USIBWC has conducted mowing within the levee reaches of the RGCP. USIBWC has not been conducting any mowing where there are no levees within the ROW, including the reach from the Percha Diversion Dam downstream to the beginning of the east levee near the Sierra and Doña Ana county line, and from Percha Diversion Dam down to the Hatch Siphon on the west levee. In addition, no

levees exist in Seldon Canyon, where USIBWC has limited ROW, and thus USIBWC has not conducted vegetation maintenance. These reaches, unofficially called the Pre-ROD No-Mow Zones, have become unofficial permanent no-mow zones and offer future habitat restoration opportunities within the river corridor.

2.3.6 USIBWC No-Mow Zones

USIBWC will implement No-Mow zones to include the following:

- 553 acres of habitat restoration sites, as stipulated by the ROD
- 1,983 acres of managed grasslands, as stipulated by the ROD. USIBWC has determined these acres will include:
    - 15-foot wide band of riparian vegetation along the bank of the river, the "fringe" (Figure 2-3A)
    - 100-foot buffers around restoration sites
    - 1/4-mile buffers around flycatcher territories
    - Connectivity no-mow zones to connect flycatcher buffers or restoration site buffers
- Areas within the USIBWC ROW but outside of levees, or where no levees exist, also referred to as the Pre-ROD No-Mow Zones (about 2,856 acres)
- Three (3) no-mow zones called "Green Zones" from the 1999 MOU with Southwest Environmental Center, which were made permanent in the ROD. These include:
    - Percha Dam to Doña Ana County Line (5 river miles on each side of the channel for a total of 10 corridor miles), fringe width 10 to 35 feet adjacent to the river channel (depending on the right of way and geography of the river). This Green Zone is included in the Pre-Rod No Mow Zones.
    - Seldon Canyon (8 river miles on each side for a total of 16 river miles), no vegetation maintenance. This Green Zone is included in the Pre-Rod No Mow Zones.
    - Shalem Bridge to Picacho Bridge (5 river miles on each side for a total of 10 river miles), fringe of 35 feet along the edge of the channel.

Cessation of mowing at restoration sites, riparian fringe, and managed grasslands, along with selective treatment of exotic vegetation, will allow native vegetation to establish itself for the improvement and restoration of riparian habitats. USIBWC will promote the growth of target species including: Goodding's willow (*Salix gooddingii*), Cottonwood (*Populus deltoides ssp*), Coyote willow (*Salix exiqua*), Alkali sacaton (*Sporobolus airoides*), pale wolfberry (*Lycium pallidum*), four-wing saltbush (*Altriplex canescens*), screwbean mesquite (*Prosopis pubescens*), arrow weed (*Pluchea sericea*), three-leaf sumac (*Rhus trilobata*), false indigo (*Amorpha fruticosa*), apache plume (*Fallugia paradoxa*), desert willow (*Chilopsis linearis),* and inland saltgrass (*Distichlis spicata*).

As of June 2013, USIBWC has designated 2,079 acres out of the 2,536 acres allowed in the ROD. However, restoration sites which fall under the Pre-ROD No-Mow Zones (Trujillo) or Seldon Canyon (Broad Canyon Arroyo, Seldon Point Bar) are not included in these No-Mow Zones because no maintenance has been done in the past in these areas. These 3 restoration sites total approximately 52 acres. The Green Zones also have overlap from the 15-foot riparian fringe in the new No-Mow Zones.

Therefore, there are about 350 remaining acres allowed in the ROD to be designated as No-Mow Zones, and these will be designated in future years to accommodate new conditions, such as increased flycatcher buffer areas or new restoration sites.

In addition, some No-Mow Zones include restoration sites that are covered in areas maintained by other entities under recreation leases (Sunland Park)). These are currently marked as No-Mow Zones and included in the 2,134 acres discussed above; initial coordination has been conducted with the City of Sunland Park on the recreation lease changes in management.

2.3.7 Exceptions to No-Mow Zones

USIBWC has established exceptions to the No-Mow Zones in order to comply with USIBWC mission, facilitate maintenance activities, facilitate recreational use as agreed upon with stakeholders, minimize flood impacts, minimize impacts to flood control infrastructure, and reduce flooding bottlenecks. The following are Exceptions to the No-Mow Zones, where USIBWC will continue to mow vegetation:

- Levee slopes,
- 20 feet from levee toe for a maintenance road,
- 300 feet around USIBWC, EBID, and USGS gages,
- 300 feet upstream and downstream of bridges, including the fringe along the river bank beside the bridge (Figure 2-3B) (unless this overlaps a restoration site, in which case the 300 feet may be reduced), and
- Observation points or "windows" through the riparian fringe vegetation of no more than 100 feet, at intervals no more frequent than every 800 feet.

Figure 2-3. A) Left - Riparian fringe No-Mow Zone upstream of Vinton Bridge, and B) Right - mowing within 300 feet of Vinton Bridge (right)

2.3.8 Saltcedar Management in No-Mow Zones

USIBWC and its partners will manage and remove saltcedar growth in the No-Mow Zones. USFWS San Andres National Wildlife Refuge (SANWR) staff and USIBWC EMD staff conducted the first saltcedar removal training for USIBWC Las Cruces and American Dam field office staff on October 2, 2012. Methods are discussed in Section 2.4.

2.3.9 Marking of No Mow Zones

No Mow Zones will be marked in one of three ways:

1. Temporary USIBWC Environmental Zone Flags (Figure 2-4).

Figure 2-4. Temporary USIBWC Environmental Zone Flags marking a No-Mow Zone

2. Semi-permanent Environmental Restoration Orange Markers made of high-impact flexible plastic (also called Delineator Posts) (Figure 2-5A) and larger steel white Restoration Signs (Figure 2-5B)

Figure 2-5. A) Left - Orange Delineator Posts, and B) Right - steel Restoration Signs

3. Using landmarks such as culverts, arroyos, and bridges as the end of each No-Mow Zone. These are delineated on No-Mow Zone Map Book in Part 6 of this RMP.

2.3.10 No-Mow Zone Calculations Methodology

The USIBWC EMD staff delineated the No-Mow Zones and calculated acreages using the following methodology.

- Created a 100-foot buffer around Restoration sites. Original 2009 restoration sites polygon from USACE was modified to include optional areas and revised restoration sites in 2012.

- Created a 0.25 mile buffer around southwestern willow flycatcher detections in 2010, 2011, and 2012.
- Overlapping buffers were unioned then dissolved to make one polygon.
- Buffers were clipped to USIBWC ROW polygon. (Note: this removes property outside ROW such as restoration sites to include Bailey Point Bar.)
- Subtracted river polygon from buffers. River polygon was manually digitized at 1:5000 scale using Bing 2012 imagery.
- Clipped restoration buffer and flycatcher buffer to levee buffer. Levee centerline buffered 50 feet to represent: levee top width of 16 feet with base of at least 20 feet, and 20-foot area from levee toe for maintenance, plus 10 feet just to make sure levee footprint is included. Levees may be up to 80 feet wide but 40 feet is used as the minimum. Subtracted levee buffer from no mow zones polygons.
- Added flycatcher buffer and restoration buffer. Used intersect to find overlapping areas with the two buffers.
- Green zones digitized. River polygon buffer of 35 feet to get riparian vegetation next to river.
- Areas inaccessible in between two no-mow zones were digitized as miscellaneous no-mow zone, for connectivity between no-mow polygons.
- All no-mow zones merged to remove sensitivity to flycatcher territories.

2.3.11 Hydraulic Analysis of No-Mow Zones

USIBWC ESD staff will analyze all No-Mow Zones for hydrologic and hydraulic impacts prior to their finalization. The establishment of No-Mow Zones will increase vegetation density, thereby increasing the roughness coefficients. The resulting increase in water surface elevations compared to the existing condition can potentially decrease levee freeboard and/or cause adverse impacts to life and property at certain locations. The location and magnitude of such hydraulic impacts resulting from both the No-Mow Zones and the pre-ROD restoration areas will be evaluated using FLO-2D software. The No-Mow Zones and restoration areas will be overlayed on the FLO-2D grid, and the roughness coefficients increased for grid elements with changes. The FLO-2D model will also be updated for any new structures and levee segments that have been built since the date of the previous model that was used to establish minimum top of levee elevations. Rating curves for new structures will be developed using HEC-RAS models. The FLO-2D model will be run and the resulting water surface elevations will be compared to those in the existing condition model for each grid element. This will yield the magnitude and location of the hydraulic impacts. Engineering analysis will evaluate a worst-case scenario by assuming reasonable maximum roughness coefficients for managed grasslands, riparian fringe, and restoration sites.

2.4 Invasive Species Management

USIBWC will help ensure the long-term persistence of riparian habitats and associated species by removing and controlling invasive species, primarily saltcedar, in the No-Mow Zones. USIBWC will employ validated chemical and mechanical methods, listed below. USIBWC may also address woody debris left from impacts caused by the saltcedar beetle, which is moving into the RGCP.

In No-Mow Zones, the USIBWC will remove invasive species, such as saltcedar, using one of 5 methods. Three methods are chemical: 1) manual/herbicide, 2) mechanical/herbicide, and 3) herbicide only. The last two methods are mechanical: 4) excavation, and 5) mastication. Saltcedar is the main target species and the information below is geared to saltcedar removal, but methods can be employed for other non-native species.

2.4.1 Chemical Methods

1. Manual/ Cut-Stump treatment method

Manual treatment, also called Manual Cut-Stump treatment, methods are prescribed for small monotypic stands of invasive trees/shrubs (e.g., saltcedar) and some stands with mixed native shrubs, or isolated large shrubs. Manual treatment involves manual cutting with a chainsaw (Figure 2-6A) and must be immediately followed by cut-stump herbicidal treatment to kill the root system (USIBWC 2009). Cut-stump herbicidal treatment is performed by applying the herbicide directly on the stump (Figure 2-6B) within 15 minutes of the cutting operation. The herbicide is absorbed by the plant and is translocated to the entire root system, which it kills.

Safety precautions include wearing kevlar chaps, helmet, safety goggles, and ear protection. A strong chainsaw with at least a 22" blade is recommended.

Figure 2-6. A) Left - Manual treatment method involving cutting with chainsaw, and (B) Right - immediate herbicide application on cut stumps.

2. Mechanical and Herbicide/ Mechanical Cut-Stump Treatment

Mechanical and Herbicide treatment, also called Mechanical Cut-Stump Treatment, methods are also prescribed for small monotypic stands and some stands with mixed native shrubs. This method involves cutting or mulching the saltcedar with small equipment such as a skid steer loader with a forestry

attachment, and a second team member immediately applying herbicide (Figure 2-7). Box 2-1 discusses USIBWC herbicide requirements.

Figure 2-7. Mechanical and Herbicide Treatment method. A) Top left - example attachment on skid steer loader. B) Top right - equipment mulching large saltcedar. C) Bottom left - herbicide application on cut saltcedar stems. D) Bottom right - after herbicide.

3. Herbicide Only (Basal Bark Method)

Herbicide Only, also referred to as Basal Bark, treatment methods are prescribed for isolated small shrubs of saltcedar. Basal Bark herbicidal treatment involves application of the herbicide together with an oil penetrant to the lower 30 to 45 cm (12–18 inches) of the trunk or stem (Figure 2-8). Basal Bark and cut-stump techniques can be done at any time of year except for the green-up period (spring) (SWCA 2011).

Figure 2-8. Herbicide Only/Basal Bark method involving herbicide application to the stem of a small plant

2.4.2 Herbicide Treatment

Box 2-1 discusses herbicide requirements. Herbicide treatments should occur for at least two subsequent years and will continue on as needed, based on monitoring outcomes.

The following best management practices will be followed when using herbicide applications of any kind.

Water Resources Protection

- Herbicide will be applied directly to targeted plants in a manner to minimize runoff to surface water. All herbicides will be licensed herbicides and will be used in conformance with labeled instructions. Herbicides will not be aerially applied over open water; instead, formulations labeled for use in or near aquatic habitats will be used.

Vegetation Protection

- Herbicides will be sprayed by hand application to targeted species, whenever feasible. Herbicides will not be aerially applied on areas where sensitive riparian vegetation such as cottonwoods, willows, and screwbean mesquite are extensively intermingled with saltcedar.
- Vegetation will be monitored (species, composition, abundance and distribution) before and after vegetation treatments. Saturated and ponded areas will be avoided during mechanical and chemical treatments.

Box 2-1. HERBICIDE USE REQUIREMENTS

- Herbicide application should be under the direct supervision of an experienced herbicide applicator
- Herbicides to be used consist primarily of Garlon 4 and Habitat.
- Garlon 4 can be used as needed throughout most of the project sites, except within a 9-m (30-foot) buffer of the river channel or a seasonal pond
- All herbicide products will be stored, mixed, applied, and disposed of in compliance with material safety data sheets and label instructions.
- Herbicides will not be applied during windy conditions exceeding 15 miles per hour or when rain is forecast within three days.
- Spray equipment will be properly maintained and calibrated to ensure accurate application according to manufacturer's and label instructions.
- For all application methods, no treatment with a non-aquatic label herbicide will be made within 30 feet of water to avoid the possibility of spray drift.

Wildlife Protection

- Vegetation treatments with herbicide will occur outside the nesting season (i.e., September 1 through March 1). If treatments must occur during the migratory bird-nesting season, surveys will be conducted and active nests will be marked and avoided.

Air Quality Protection

- The amount of vapors will be minimized by dispensing herbicide in a vegetable oil solution limiting airborne particulates. Application of this treatment will not occur during high-wind conditions.

Herbicides to be used consist of Garlon 4 and Habitat. Other herbicides can be used as long as they meet the requirements stated above and in Box 2-1. Best management practices ensure that both Garlon 4 and Habitat will be applied in a targeted fashion (spot spraying) using low-pressure application methods and only when there is little or no hazard of spray drift to ensure that the minimum to no amount of herbicide contacts non-target vegetation, soil, or water. Garlon 4, to the extent that it comes into contact with soil, adheres tightly to soil particles; the potential to leach from soil into groundwater is minimal.

Herbicide treatment requirements are listed Box 2-1 (SWCA 2011).

A. **Garlon 4/Triclopyr**

Garlon 4 is a formulation of triclopyr. Garlon 4 will be used as needed throughout most of the project sites, except within a 9-m (30-foot) buffer of the river channel and seasonal ponds. Triclopyr is the preferred herbicide for control of saltcedar, as it is effective year-round outside the green-up period (time period when saltcedar emerges from winter dormancy until after first flower), affects only woody broad-leaved plants (not grasses), and has limited mobility in soil (SWCA 2011).

Garlon 4 should be diluted at a ratio of 1 to 3 with vegetable oil (25% Garlon 4, 75% vegetable oil or biofuel). Six to 8 ounces of blue dye can be added to ensure that applicators know where herbicide has been applied.

B. **Habitat/Imazapyr**

Habitat is an isopropylamine salt of Imazapyr. Habitat is approved for aquatic use and can be applied within this buffer area where needed.

Imazapyr is a non-selective herbicide used for the control of a broad range of weeds, including terrestrial annual and perennial grasses and broadleaved herbs, woody species, and riparian and emergent aquatic species.

Habitat should be mixed with water at a ratio of 1 to 10 (10% habitat, 90% water). As with Garlon-4, 6-8 ounces of blue dye can be added.

2.4.3 Herbicide Treatment Safety and Training

At least one person on each crew of herbicide applicators should have at least 3 years of experience with chemical application. The Upper Rio Grande Project Facility Supervisors should be trained and, if possible, licensed or State-certified in herbicide application. Reference materials on pesticide application should be available for the staff if questions arise. Part 5 includes a field guide so that the field crew can identify common native and exotic plant species.

Herbicide applicators should follow Safety Data Sheets (SDS) (previously Material Safety Data Sheets (MSDS)) and have Personal Protective Equipment (PPE), including gloves, goggles, and breathing mask, if necessary. USIBWC staff should refer to safety guidelines established by USIBWC Safety and Security Office through the hazard communication program, specifically Appendix N to the USIBWC Safety Manual.

2.4.4 Mechanical Treatment

Mechanical invasive species treatment may consist of extraction or mastication. Typically, mechanical extraction methods will only be utilized within the first year, with foliar, basil, or cut stump herbicide follow-up treatments, as described above, in subsequent years.

Mechanical treatment should follow the best management practices listed below.

Water Resources Protection

- Manual, rather than mechanical, removal of saltcedar will be used during maintenance on the river margin. Woody debris as a result of saltcedar reduction will be mulched, burned, or removed from the floodway.

Soil Protection

- Heavy equipment used for brush reduction will minimize impacts to native brush. Crews will evaluate the least invasive equipment available to be used for each activity. Heavy equipment can be tracked, not wheeled, for less brush impact. Heavy equipment that is wheeled and not tracked may leave ruts when turning, but may also compact the soil less.
- Mechanical treatment will be conducted in weather conditions that provide for dryer soil conditions to avoid creating ruts and compacting soil.

4. Mechanical Excavation Treatment Method

Mechanical Excavation treatment methods are prescribed for large monotypic stands; for example, a plot of 20 acres with only saltcedar is a prime candidate to employ this method (Figure 2-9A). This method involves using an excavator to completely remove the entire shrub along with its root ball.

Extraction is performed with a clasping thumb attachment fitted on an excavator, front-end loader, or backhoe (Figure 2-9B). The thumb attachment grasps the plant at or below the root crown and extracts the plant and its roots from the soil (SWCA 2011). Care will be taken by an experienced operator to remove as much of the root crown and lateral roots as possible to reduce damage to existing native plants (USFWS 2012a).

A tracked skid steer loader, such as a Bobcat, with a brush rake attachment can be used to rake and pile slash as well as smooth divots or ruts back to the original grade.

The extracted debris (Figure 2-9C and 2-9D) can be placed immediately in piles or trucks to be hauled away (USIBWC 2009), or else it may be windrowed and masticated on-site. If the debris is left in piles, it is left to dry several months, and can be subsequently burned when appropriate. See Section 2.5 Prescribed Burns for additional information.

The extraction method is useful in areas where desirable native shrub and herbaceous vegetation would not be disturbed. It is especially useful in controlling saltcedar, whose taproot structure minimizes disturbance and resprouting.

Figure 2-9. Mechanical Excavation Treatment method at the Broad Canyon Arroyo restoration site. A) Top left - example of monotypic stand of saltcedar. B) Top right - equipment excavating saltcedar. C) Bottom left - landscape after excavation. D) Bottom right - debris piles.

5. Mechanical Mastication Treatment Method

The mastication technique is based on the use of a mastication head—essentially a wood chipper or grinder—mounted on a tracked vehicle. Typically the mastication head has carbide teeth that break up the vegetation by grinding it. Mastication can be conducted with an excavator equipped with a flail mower attachment (SWCA 2011).

Masticated mulch may be hauled away or redistributed on the floodplain to provide organic material and a base for seed germination.

2.5 Prescribed Burns

For restoration work where debris collected with mechanical methods that is not hauled off in trucks, USIBWC, or USIBWC partners, will conduct prescribed burns. USIBWC will ensure debris has enough time to dry out (typically 6-9 months, but can depend on wood type, size, and weather conditions).

USIBWC will have a burn plan, appropriate burn permits, and appropriate environmental documentation. USIBWC will coordinate with appropriate entities including local municipalities, emergency services districts, Forest Service crews, and the USFWS New Mexico Fire District to prepare all plans and regulatory compliance documentation as well as mobilize resources to implement burning under prescription. The cities of Las Cruces and El Paso as well as Doña Ana County require permits to burn. Sierra County currently has an "Open and Controlled Burn Restriction Ordinance" (Ordinance No. 11-006 signed in 2011.

Burns will be conducted in appropriate weather conditions and with certified fire staff. The 2004 EIS briefly covered prescription burning for the selected alternative (Parsons 2004a). The Broad Canyon Arroyo restoration site has its own environmental analysis, which included prescription burning, conducted by the USFWS on behalf of the USIBWC (USFWS 2012a).

In addition to the restoration sites, USIBWC may conduct a burn rotation once every 10 years of the managed grasslands to regenerate plants and seeds, as recommended by USFWS (USFWS 2012a). USIBWC will complete necessary environmental documentation prior to conducting burn rotations.

The USIBWC will use the following best management practices when conducting or planning prescribed burns.

Water Protection

- Prescribed burns will incorporate best management practices (e.g., careful selection of fire lines and weather conditions, avoid intense burns) to limit runoff into the river.

Vegetation Protection

- Prescribed burns will be conducted in accordance with techniques identified in a plan to be developed by the USIBWC with guidance from federal and state resource management agencies. Degraded or burned areas will be inter-seeded with native grasses and forbs to further enhance the establishment of desirable browse and forage species.

Air Quality Protection

- Smoke management techniques will be used to determine smoke dispersion prior to prescribed burns.

Cultural Resources Protection

- USIBWC Cultural Resources Specialist will conduct pre- and post-burn site inspections for cultural resources.

2.6 Restoration Sites

2.6.1 Restoration Sites

USIBWC will follow the *Conceptual Restoration Plan and Cumulative Effects Analysis for the Rio Grande - Caballo Dam to American Dam, New Mexico and Texas* (Conceptual Plan) (USACE 2009) and the updated *Site Implementation Plans - Rio Grande Canalization Project River Restoration Implementation Plan* (TRC 2011). Changes to the Conceptual Plan and Site Implementation Plans will be documented and maintained by EMD. The Conceptual Plan originally contemplated 30 sites; some sites have been removed or added. Table 2-1 lists the 27 restoration sites as of December 2012. (Note: For USACE permit discussion, see Section 4.13).

Table 2-1 Updated USIBWC Restoration Sites for RGCP

Site #	Site Name	River Mile and Bank	Acres	Target Habitat Type(s)	ET difference	GW well	Comments
1	Trujillo	103 W	14	Dense riparian shrubs, woodland	0	Y	Active restoration site
2	Jaralosa	94.9 E	4.5	Open riparian woodland	5.0	Y	
3	Yeso Arroyo	94 W	10.6	Aquatic Habitat	-26.5	N	Needs USACE permit; needs review of potential levee impacts
4	Yeso East	93.7 E	9.7	Open riparian woodland	10.7	Y	
5	Yeso West	93.5 W	2.5	Aquatic Habitat	-6.3	N	Inset floodplain
6	Crow Canyon A	92 E	90	Riparian savanna & shrubland	81.4	Y	Active restoration site
7	Crow Canyon B	90.5 E	25.6	Dense riparian shrubs, meadow	17	Y	Active restoration site
8	Placitas Arroyo	85 W	21.8	Aquatic Habitat	-14	N	Needs USACE permit; needs review of potential levee impacts
9	Rincon Siphon A through D	82.5 E	16.3 (expanded to 28)	Dense riparian shrubs	31	Y	Active restoration site
10	Angostura Arroyo	80 W	15.4	Aquatic Habitat	-16.9	N	Needs USACE permit; needs review of potential levee impacts
11b	Broad Canyon Arroyo	68 E	30	Dense riparian shrubs, saltgrass meadow	0	Y	Active restoration site
14	Broad Canyon Ranch South	66.8 W	20.6	Saltgrass meadow	0	N	Private property (NMSU); some of the site is currently being restored by NMSU
15	Seldon Point Bar	66 E	7.7	Dense riparian shrubs	1	Y	Land acquired in 2011; Active restoration site
16	Bailey Point Bar	64E	16.6	Dense riparian shrubs	0	N	Private land; site dependent on USIBWC purchase of land

17	Shalem Colony	50.5 E	14.2	Screwbean mesquite & riparian grassland	5	N	Minimal work - mesquites already established. Needs saltcedar removal only
18	Leasburg Extension Lateral WW 8	47.8 E	4.1 (expanded to 30)	Dense riparian shrubs	10.3	Y	Active restoration site; Site expanded
19	Clark Lateral	43.5 E	6	Dense riparian shrubs	14.9	Y	Requires supplemental irrigation
20	Mesilla Valley Bosque State Park	41.5 W	31.8	Riparian forest, shrubland, meadow and grassland	14.4	N	Active restoration site. See IBM14A0021 for State Parks collaboration. Site covers USIBWC land, but State of NMhas long-term lease
21	Mesilla East	41 E	15.8 (expanded to 70 in 2012)	Dense riparian shrubs	39.5	Y	Active restoration site; Site expanded
22	Berino West	25.5 W	10.3	Dense riparian shrubs and forest	25.8	Y	Active restoration site
23	Berino East	24.5 E	9.5	Dense riparian shrubs	23.3	Y	Active restoration site
24	Vinton A	17 W	14.7	Riparian forest	25.7	Y	
25	Vinton B	16 W	20	Riparian woodland	22	Y	
26	Valley Creek	9W	22	Riparian woodland	22.9	Y	Through City of El Paso river park trail system
27	NeMexas Siphon	7 W	16.7	Dense riparian shrubs	0	Y	Ownership in question
28	Country Club East	6.8 E	29	Riparian forest & woodland	51.4	Y	
29	Sunland Park	4E	28.8	Riparian woodland	31.7	Y	Under lease to City of Sunland Park through 2017; Through river park trail system
30	Anapra Bridge	3 E	11	Open riparian woodland	5.5	Y	Under lease to City of Sunland Park through 2017; Through river park trail system

Restoration sites that have been eliminated from the original Conceptual Plan include Lack Property and Bailey Point Bar because USIBWC was unsuccessful in obtaining the property, as well as Pasture 18 because the Conceptual Plan did not recommend it. However, Bailey Point Bar was opened up back on the real estate market in 2013 and is still a possible site but depends on USIBWC successful acquisition. The NeMexas Siphon site ownership is disputed and restoration work depends on a resolution of the property dispute. In addition, Broad Canyon Middle was removed because it is currently being restored by the Interstate Stream Commission and Bureau of Land Management. The Biological Opinion references "Site #31," which refers to the Horner Property near Radium Springs; however, this site has been eliminated because USIBWC was unsuccessful in obtaining the property.

Broad Canyon Arroyo was added as a restoration site after the original Conceptual Plan. USIBWC is considering a wetlands project at Montoya Drain as an alternate site to one of the aquatic habitat types listed in Table 2-1.

Restoration sites may be changed, added, or dropped as appropriate. USIBWC may expand current restoration sites in lieu of implementing all restoration sites. Sites that are being expanded under current implementation include Leasburg Extension Lateral and Mesilla East. Sites being considered for expansion include Crow Canyon and Rincon Siphon. Alternate sites should still fall within the acreages outlined in the ROD. Because islands and sandbars are transient features within the channel, USIBWC will not depend on or expand on habitat located within the channel for restoration purposes.

USIBWC field staff may assist in site preparation, planting, and maintenance. Restoration work is subject to available federal funding.

USIBWC has had multiple re-vegetation efforts over the years, including a tree planting program in from 1972 to 1977 which involved planting combinations of species in small groves of 8-15 trees. Another re-vegetation effort in 1996-1997, the USIBWC planted over 600 cottonwoods and willows in areas near Country Club, Mesquite Bridge, Santo Tomas Bridge, Shalem Bridge, and upstream of Mesilla Dam. The 2009 restoration sites will compliment any previous planting actions. By 1998, 2,13 trees had been planted in the floodway for recreational purposes (USIBWC 2000).

2.6.2 Groundwater Monitoring Wells

In 2013 and 2014, USIBWC contractors installed 55 shallow groundwater monitoring wells at 19 restoration sites and one no-mow area. These selected areas are: Anapra Bridge, Berino East, Berino West, Broad Canyon Arroyo, Clark Lateral, Country Club East, Crow Canyon A, Crow Canyon B, Jaralosa, Leasburg Extension Lateral, Mesilla East, Below Mesilla Dam, Rincon Siphon, Seldon Point Bar, Sunland Park, Trujillo, Valley Creek, Vinton A, Vinton B, and Yeso East. Wells were not installed on restoration sites that are not USIBWC property or on restoration sites targeted for aquatic habitat.

There are 22 automated loggers collecting daily data, one at each of the selected restoration sites, with two at Rincon Siphon and 2 at Below Mesilla Dam. The rest of the wells will have manual monitoring, at a frequency depending on resources and season. At a minimum, all wells will be monitored biannually before and during irrigation releases.. Wells were drilled to depths ranging from 12 to 16 feet deep, and the Below Mesilla Dams wells were 20 feet deep. Each well is numbered and capped with a steel, yellow case.

2.7 Monitoring of Restoration Sites

In 2013, USIBWC established a monitoring protocol for restoration sites. The goals of the monitoring are to determine whether the habitat type is being achieved and measure the success of the restoration site. The monitoring protocol includes (Lodwick 2012):

- Field checklist to document native and nonnative plants at site and site conditions
- Groundwater levels monitoring sheet
- Monitoring methods, data collection and visual monitoring

- Establishment of photo points, maintain GPS coordinates and upload progress photos onto website quarterly, if possible
- Maintain lists of species growing at each site
- Estimate vigor and density of plantings
- Estimate percent survival rate of pole plantings.

Monitoring work may be accomplished by USIBWC staff, contracting staff, or USFWS staff. Monitoring reports will be produced at least once during each growing season. Results will be displayed visually as appropriate, such as photo time lapses, graphs of water levels or planting survival rates. The monitoring protocol will be approved and maintained by EMD. Groundwater level monitoring is discussed in Section 2.6.2.

In addition to restoration site monitoring, USIBWC will monitor flycatcher populations according to Section 3.12. The monitoring results for flycatcher sites will be sent to USFWS by the USFWS-permitted entity conducting the surveys, and a summary included in the USFWS submittals (Section 3.16).

2.8 Water Rights for Restoration Sites

All restoration sites with a net depletion of water will be required to have water rights to offset allocated system water. Net depletions will be calculated as the difference in evapotranspiration (ET) losses as estimated in the Conceptual Restoration Plan, but across the entire site. For example, if a 10-acre area which has historically been mowed (with less than 2.4 feet/year ET rate) is replaced by riparian forest (with 4.8 feet/year ET), then this site must have water rights of 10 acres to account for losses to the system. If a site is cleared of dense saltcedar (4.9 feet/year) and is targeted for dense riparian shrub habitat (4.9 feet/year), then net ET is zero and that site does not need to have a water right. Sites requiring water rights to offset net depletions, as calculated by the Conceptual Plan, are listed in Table 2-2. To maintain consistency with EBID procedures, no credit will be taken for sites with net depletions that are negative. In addition to purchasing or lease water rights for net depletions, USIBWC may also purchase water rights for supplemental irrigation of restoration sites.

The ROD also committed the USIBWC to evaluate the possibility of a peak restoration flow of 3,500 cfs every 3 to 10 years. The ROD stated that the estimated average amount of environmental water needed to augment irrigation releases to achieve a 3,500 cfs release is 9,500 acre-feet per augmentation event. USIBWC would purchase water rights for the additional environmental water. In drought years, the agency could purchase or lease water rights and apply them to the sites which would benefit from this peak to simulate peak release conditions (overbank conditions) in lieu of the peak release.

Restoration sites with recommended water rights for supplemental irrigation or in lieu of a peak release are also listed in Table 2-2.

USIBWC and its cooperators have established rules and procedures for environmental water transactions in 2013, and will be documented in the USIBWC Environmental Water Transaction Framework (EWTF). From 2014 to 2019, USIBWC and its cooperators will pursue purchases or leases of water rights to meet ROD requirements. USIBWC and its cooperators have estimated that USIBWC needs a minimum of 475 acres of water rights.

The purchase and lease of water rights must follow all state, federal, and local regulations governing real property, water transfers and water rights ownership. USIBWC Legal will be responsible for preliminary title opinions associated with water rights purchases, as well as communication with Department of Justice.

USIBWC may choose to defer responsibilities to a cooperating entity to fulfil its ROD requirements.

Additional information on the Environmental Transaction Program is in Section 3.1.5.

Table 2-2. Restoration Sites Requiring Water Rights for Offset of Net Depletions or Recommended Supplemental Irrigation

Site #	Site Name	Acres	ET difference	Offset Water Right Required?	Supplemental Irrigation Recommended?
1	Trujillo	14	0	NO	Recommended
2	Jaralosa	4.5	5.0	YES	Recommended
3	Yeso Arroyo	10.6	-26.5	NO	NO
4	Yeso East	9.7	10.7	YES	Recommended In Lieu of Peak Release
5	Yeso West	2.5	-6.3	NO	Recommended In Lieu of Peak Release
6	Crow Canyon A	90	81.4	YES	Recommended
7	Crow Canyon B	25.6	17	YES	Recommended In Lieu of Peak Release
8	Placitas Arroyo	21.8	-14	NO	NO
9	Rincon Siphon A through D	16.3 (28)	31	YES	Recommended In Lieu of Peak Release
10	Angostura Arroyo	15.4	-16.9	NO	NO
11b	Broad Canyon Arroyo	30	0	NO	NO
14	Broad Canyon Ranch South	20.6	0	NO	Recommended In Lieu of Peak Release
15	Seldon Point Bar	7.7	1	NO	Recommended In Lieu of Peak Release
17	Shalem Colony	14.2	5	YES	NO
18	Leasburg Extension Lateral WW 8	4.1 (30)	10.3	YES	Recommended
19	Clark Lateral	6	14.9	YES	Required
20	Mesilla Valley Bosque State Park	31.8	14.4	YES	NO
21	Mesilla East	15.8 (70)	39.5	YES	Recommended In Lieu of Peak Release
22	Berino West	10.3	25.8	YES	Recommended In Lieu of Peak Release
23	Berino East	9.5	23.3	YES	Recommended In Lieu of Peak Release
24	Vinton A	14.7	25.7	YES	NO
25	Vinton B	20	22	YES	NO
26	Valley Creek	22	22.9	YES	NO
27	NeMexas Siphon	16.7	0	NO	Recommended In Lieu of Peak Release
28	Country Club East	29	51.4	YES	Recommended In Lieu of Peak Release
29	Sunland Park	28.8	31.7	YES	Recommended In Lieu of Peak Release
30	Anapra Bridge	11	5.5	YES	Recommended In Lieu of Peak Release

2.9. Recreational Activities

2.9.1 Allowed Activities

The USIBWC allows the public's non-intrusive use of USIBWC-controlled lands, including the floodplain, channel, and levees, for recreational activities such as walking, jogging, fishing, horseback riding, and other activities having a minimal impact on the levees and floodplain. The Rio Grande is a navigable river, and hence the channel up to the high water mark is open to compatible public use; however, USIBWC does not have designated public recreational access points to the river such as boat ramps.

2.9.2 Prohibited Activities and Enforcement

The USIBWC strictly prohibits the use of motor vehicles, including full-size and all-terrain vehicles, in the floodway, in the channel, and on the levee. The USIBWC also prohibits camping and littering on USIBWC-controlled lands.

In addition, felony violations and crimes of significant interest such as, but not limited to, threats to persons or property, vandalism, and the use or presence of firearms on USIBWC property are all prohibited. The exception to firearms is in selected areas that are open to hunting (See Section 9.3).

Signs are posted at bridges and access points to trails listing prohibited activities.

The USIBWC has granted authority to the Doña Ana County, New Mexico, and the El Paso County, Texas local sheriff to enforce state law and local ordinances on U.S. Government property. An MOU with the Doña Ana County Sheriff is being implemented. Local sheriffs' offices should be notified of any such prohibited activities.

2.9.3 Hunting

Hunting has been strictly prohibited on USIBWC-controlled lands in Doña Ana County; however, in 2014 USIBWC opened up selected areas to avian hunting in the RGCP. In 2014, these areas were:

- From Highway 187 bridge near Derry to the Highway 187 bridge north of Hatch,
- From Highway 154 south of Hatch to the end of the levees north of Seldon Canyon (State Road 393 on the east river bank), and
- From Highway 28 south of Mesilla to Highway 189 in Vado.

Specific information is available in the *Final Environmental Assessment: Allowing Avian Hunting in Designated Areas along the Rio Grande Canalization Project, Sierra and Doña Ana Counties, New Mexico* http://www.ibwc.gov/Files/FINAL_EA_Hunting_in_Canal_072514.pdf. USIBWC is working with New Mexico entities, particularly New Mexico Department of Game and Fish, on enforcement of hunting regulations on USIBWC property.. Hunting information will be posted on the USIBWC website: http://www.ibwc.gov/home.html.

2.10 Leased Areas/ Areas Maintained by Non-USIBWC Entities

The USIBWC administers a land lease program in the RGCP, therefore some areas of the floodplain are not maintained by USIBWC. Leases for grazing are no longer being renewed. However, USIBWC

continues to lease 66 acres for crop leases. In addition, over 250 acres are leased through collaborative agreements for recreational use.

Lease management is regulated according to the USIBWC Directive Volume III, Chapter 501 "National Environmental Policy Act (NEPA) Procedures for USIBWC Real Property Actions and Management of Environmental Impact" issued on March 13, 2002. The directive assigns to the Principal Engineer, Engineering Department the authority to issue revocable licenses and leases on USIBWC real property. Administration of the USIBWC real property program and preparation or oversight of the preparation of contractual agreements for USIBWC real property activities or works is assigned to the Boundary and Realty Office (BRO).

All USIBWC licenses, leases, permits, and easements are initiated and coordinated through the BRO. The Boundary and Realty Officer will coordinate and work with other USIBWC support divisions and field offices to assist in the monitoring of contractual agreements made with regard to USIBWC real property. With input from appropriate staff elements, the Boundary and Realty Officer has the authority to request corrective action of a lessee if a violation of an agreement is found, and/or to issue a notice of termination of the agreements.

No permanent structures may be constructed in leased areas without the written permission of USIBWC.

2.10.1 Grazing Lease Program

The grazing lease program is currently being phased out, as required by the ROD, and as recommended by the U.S. Environmental Protection Agency. One lease remains, approximately one mile downstream of Mesilla Dam on the east side of the river and extends to the Santo Tomas Highway Bridge.

2.10.2 Leases for Recreational Use Areas

Table 2-3 lists the USIBWC leases through which various entities have to maintain river parks along the floodplain.

Table 2-3 Recreational Use Areas Within the RGCP ROW

Recreational Area	Operating Organization	Acreage within ROW	Description
Sunland Park	City of Sunland Park, NM	57 acres, east floodway	Beginning at Frontera Road down to below Anapra Bridge, day use. Includes swings and picnic tables.
Rio Grande River Park	City of El Paso, Sunland Park and other cooperating entities	Unknown - up to 100 acres, east and west floodways	Only in planning phases; no leases have been issued. Will connect bike trails from Country Club to Sunland Park.
El Paso County River Park	City of El Paso , TX and El Paso County, Texas	150 acres, west and/or east floodway	Country Club Bridge to NM state line
Anthony Country Club	Anthony Country Club, Anthony NM	33 acres, east floodway	62-acre privately operated golf club

Mesilla Valley Bosque State Park	New Mexico State Parks	100 acres, west floodway	Habitat restoration and recreational purposes. Includes roadway and levee maintenance throughout the state park
La Llorona Park	City of Las Cruces, NM	5 acres, east floodway	Possible expansion up to 475 acres. 11 linear miles originally planned for multi-purpose use from Shalem Colony bridge to Mesilla Dam (both floodways)
Percha Dam State Park	New Mexico State Parks	13 acres, west floodway	LSF/G-1744. Beginning at the southern tip of Percha Dam State Park extending about half mile downstream Contemplated but not executed

2.11 Access to Levee Roads and Gates

Most levees are closed to public vehicle access by locked vehicle gates. Field offices maintain control of key access. Community groups needing access to the levee roads for the Adopt-a-River Program cleanups can obtain keys prior to their cleanup and will be required to return the keys after use.

Road barriers may also be installed on the floodplain to block dirt roads, particularly on restoration sites. These are installed and maintained on an as-needed basis.

See Section 2.9 for public access for recreational activities.

2.12 Adopt-a-River Program

The USIBWC Adopt-a-River Program began in 2000 to involve the community members in the care of the river, to assist the USIBWC field offices to pick up trash for easier vegetation maintenance in the floodway, and to promote a litter-free Rio Grande floodplain. Community groups adopt a section of river, approximately 2 miles long, and conduct two or three cleanups each year. The group will notify USIBWC Adopt-a-River Coordinator about dates of cleanups, who will in turn notify the appropriate USIBWC field office which will pick up and dispose of the trash bags the next business days after the cleanup. The USIBWC will purchase and post signs acknowledging the volunteer group and the adopted section. Currently the program extends from Las Cruces in Doña Ana County, NM to the El Paso/Hudspeth County line in Texas. Coordinators are Rebecca Little Owl and Elizabeth Verdecchia in EMD.

Program information and brochures are located at http://www.ibwc.gov/CRP/adoptariver.htm.

2.13 Other activities within the floodplain

2.13.1 Tree Debris

USIBWC will leave standing trees in the floodplain unless they pose a threat for flood debris. See Section 4.10 for more information.

2.13.2 Sediment Excavation and Disposal within the ROW

USIBWC may excavate sediment from areas within the ROW for levee repair. In addition, USIBWC may designate upland spoil areas for sediment disposal. See Section 4.12 for more information.

2.14 Coordinating with EMD

Any action not described above, especially any action involving ground disturbance, should be run through EMD to ensure that the action complies with all environmental regulations.

2.15 Stakeholder Involvement and ROD Implementation Group

USIBWC continues to inform stakeholders and gain their input during the process of ROD implementation. ROD Implementation Group meetings are held regularly (every 2 months, on average, although they can be as far apart as bi-annually), alternating between Las Cruces and El Paso for meeting locations. USIBWC ESD, EMD, and O&M participate in the meetings with stakeholders. Stakeholders involved in the ROD Implementation Group include:

- Irrigation Districts (EBID and El Paso County Water Improvement District #1)
- Environmental Groups (Audubon New Mexico, Southwest Environmental Center, Paso del Norte Watershed Council)
- Other federal agencies (USBR, USFWS)
- Representatives of elected officials in New Mexico and Texas

2.16 Adaptive Management

The ROD states that "an adaptive management strategy will be used in implementing river management alternatives" (USIBWC 2009). Adaptive management is a science-based decision process which allows for the outcomes of the management actions to be monitored and the results could lead to adjusted management decisions. It is an experimental approach to making decisions which facilitates continuous learning from the results. It allows for scientific information and experimentation to guide management decisions. Adaptive management requires ongoing effort, funds, and staffing to support monitoring and related science programs, evaluation of strategies, and management adjustment (Daily 2006).

USIBWC will use adaptive management strategies to review policies set forth in this RMP. USIBWC will consider input from the ROD Implementation Group to modify any necessary policy to adapt to new information or science, to address a new issue or concern, to address an inefficient policy, or to increase efficiency or productivity in work load. Changes to current policies resulting from adaptive management strategies should not increase the financial burden of the agency.

USIBWC will review the RMP at least every 2 years and update as necessary to include advancing science and lessons learned in management.

2.17 Long Term River Management of Restoration Sites

USIBWC will investigate the option of working with cooperators, such as the USFWS, on long-term management of the restoration sites. One option is to hand over management or land to the USFWS for an unofficial or official National Wildlife Refuge within the RGCP.

SUBPART 3.1 FLYCATCHER MANAGEMENT PLAN

3.1.1 Introduction

3.1.1.1 Biological Opinion

In 2011 and 2012, the USIBWC consulted with the U.S. Fish and Wildlife Service (USFWS), in accordance with Section 7 of the Endangered Species Act, on possible effects of the proposed Integrated Land Management Alternative for Long-Term Management (Land Management Alternative) of the Rio Grande Canalization Project (RGCP) in Sierra County and Doña Ana County, New Mexico, and El Paso County, Texas. of the on the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (flycatcher) and on the flycatcher's proposed critical habitat. The Integrated Land Management Alternative was selected in the USIBWC 2009 Record of Decision (ROD) (see Section 1.1.1).

The 2012 Biological and Conference Opinion (Opinion) dated August 30, 2012 [Consultation NO. 02ENNM00-2012-F-0016 and Previous Consultation No. 2-22-00-I-025] (USFWS 2012b) provides Reasonable and Prudent Measures (RPM) that the USIBWC will undertake to ensure the protection of the flycatcher. RPM 2 stipulates that the USIBWC will "implement a flycatcher management plan by October 1, 2015, to minimize flycatcher disturbance and quantify and manage flycatchers and their habitat."

The RPMs are outlined in Box 3-1. The terms and conditions of RPM 1 and 2 are listed in Box 3-2 and 3-3, "Requirements of the USIBWC to maintain Flycatcher Habitat" and "Requirements of this Flycatcher Management Plan," respectively.

3.1.1.2 USIBWC Goals to Protect Flycatchers

USIBWC management goals are to conduct necessary operations and maintenance activities while avoiding adverse impacts to flycatcher populations and habitat. USIBWC aims to establish a minimum of 53.5 acres (21.7 ha) of flycatcher breeding habitat by 2017, and as many as 119 acres (48 ha) by 2019, as stipulated in RPM 1. USIBWC envisions a potential of 40 future flycatcher territories in the USIBWC restoration sites (from Table 1 in the Opinion).

USIBWC Canalization River Management Plan -

PART 3 - ENDANGERED SPECIES MANAGEMENT PLAN

Approval Signatures

José A. Nuñez, P.E. — Date: 11/20/14
Principal Engineer, Engineering Division

Carlos Peña, Jr., P.E. — Date: Nov 17, 2014
Principal Engineer, Operations Division

Gilbert Anaya — Date: 11/20/14
Division Chief, Environmental Management Division

This section of the RMP outlines conservation measures that the USIBWC is required to implement in order to avoid adverse effects on federally listed species (endangered, threatened and candidate species) and their habitats. The majority of this section (Section 3.1.1 through 3.1.18) is focused on measures to protect the endangered Southwestern Willow Flycatcher (flycatcher). Although this plan is specifically geared to address the flycatcher, many of the management recommendations outlined are also applicable to other listed species, such as the yellow-billed cuckoo, a candidate species of the Endangered Species Act. Conservation measures for federally listed species other than the flycatcher are described in Sections 3.2.1 and 3.2.2.

BOX 3-1. Reasonable and Prudent Measures in the USIBWC Biological Opinion

The following Reasonable and Prudent Measures (RPMs) were established by the USFWS to minimize impacts of incidental take due to ROD implementation:

RPM 1. Operations, maintenance, and the Land Management Alternative of the RGCP must maintain at least 53.5 ac (21.7 ha) of dense riparian shrub habitat suitable as flycatcher breeding habitat, during the months of May through August for the duration of the project by 2017 and as many as 119 ac (48 ha) by 2019.

RPM 2. Implement a flycatcher management plan by October 1, 2015, to minimize flycatcher disturbance and quantify and manage flycatchers and their habitat. (USFWS 2012b)

BOX 3-2. Requirements of the IBWC to maintain Flycatcher Habitat

"To implement **RPM 1**, USIBWC shall:

RPM 1.1 Restore and establish 53.5 ac (21.7 ha) of dense riparian shrub habitat suitable flycatcher breeding habitat at the Restoration Sites identified in the BA (or equivalent alternatives) for the duration of the proposed action.

RPM 1.2 At least half (26.8 ac or 10.8 ha) of the dense riparian shrub habitat suitable as flycatcher breeding habitat at Restoration Sites or at equivalent areas must occur within proposed critical habitat (above Leasburg Dam).

RPM 1.3 All flycatcher breeding habitat destroyed or degraded due to future project activities shall be restored at Restoration Sites or equivalent areas within the RGCP to an acreage not less than 53.5 ac (21.7 ha) by IBWC for the duration of the project in accordance with a flycatcher management plan. Suitable breeding habitat may be maintained over time through natural processes and/or active human manipulation.

RPM 1.4 Where there is USIBWC discretion regarding the scheduling of activities, Restoration Sites identified as Priority Category 1 and then Priority Category 2 in Table 1 of this Opinion should be prioritized for all actions, including reducing any project water shortages at the expense of other lower Priority Category sites identified in Table 1.

RPM 1.5 If USIBWC is unable to implement the Water Transfer Framework by 2015, USIBWC will identify and pursue any additional opportunities to improve the quality of flycatcher breeding habitat including, but not limited to, purchase of private property, purchase of additional water rights, obtaining any alternative sources of supplemental water necessary that will offset expected future water table declines, reduced restoration flows, or flycatcher breeding habitat loss.

RPM 1.6 Habitat restoration shall begin as soon as feasible, and occur outside buffer zones that may affect flycatchers as determined by appropriate flycatcher surveys and a flycatcher management plan. Habitat restoration activities may continually occur over time, but 53.5 ac (21.7 ha) of dense riparian shrub suitable as flycatcher breeding habitat at the Restoration Sites must be achieved by October 1, 2017. Additional dense riparian shrub at additional restoration sites totaling 119 ac (48 ha) should be achieved by the end of 2019.

RPM 1.7 IBWC will annually quantify the amount of dense, riparian shrub habitat suitable as flycatcher breeding habitat during the flycatcher breeding season, using methods of quantification described in the flycatcher management plan, and provide that information to the Service.

-- Biological and Conference Opinion, pp. 65-66 (USFWS 2012b)

BOX 3-3. Requirements of this Flycatcher Management Plan

"To implement **RPM 2**, USIBWC shall:

RPM 2.1 Prepare a draft flycatcher management plan for Service and other peer reviewers by December 31, 2013. After peer review of the draft flycatcher management plan by flycatcher experts or wildlife management agencies, including the Service, and any adjustments to reflect peer review and IBWC management needs, prepare and implement the final flycatcher management plan into IBWC rules and environmental operations.

RPM 2.2 Adopt policies and implement procedures that identify and restricts all activities funded, authorized, or permitted by IBWC within predetermined buffer areas or with seasonal timing restrictions necessary to prevent or minimize any adverse effects to flycatcher, its habitat, or its breeding habitat in a flycatcher management plan in the project area.

RPM 2.3 Eliminate mowing and grazing of native riparian vegetation, and forbs within a predetermined buffer area of around flycatchers and flycatcher breeding habitat unless it is demonstrated to be required for conveyance of all flood flows, in a flycatcher management plan.

RPM 2.4 Implement a flycatcher management plan that identifies the number, location, timing, and protocols of appropriate flycatcher surveys.

RPM 2.5 Monitor flycatchers at all Restoration Sites or other areas within the RGCP as described in a flycatcher management plan.

RPM 2.6 Implement a flycatcher management plan that identifies the quantity and quality of flycatcher habitat and dense riparian shrub suitable as flycatcher breeding habitat. Report annually on the amount of flycatcher habitat.

RPM 2.7 Monitor and quantify dense riparian shrub habitat suitable for flycatcher breeding habitat by developing and using a Geographic Information System based model using appropriate satellite imagery during cloud free periods inside the months of May, June, July or August and calculating the Normalized Difference Vegetation Index, or any equivalent measures, based on flycatcher breeding habitat use patterns in the RGCP through an adaptive management process. Quantify dense riparian shrub habitat and flycatcher breeding habitat on maps, determined using statistical or graphical methods of quantifying relationships, and assess areas at each Restoration Site or other areas to determine where breeding habitat is being lost or gained and adopt adaptive management strategies to maintain at least 53.5 ac (21.7 ha) of dense riparian shrub suitable as flycatcher breeding habitat as measured during the breeding, annually.

RPM 2.8 Restoration Sites containing some willow vegetation and insect prey must occur at locations at no greater than at 40 mi intervals to protect and conserve flycatcher migratory stopover habitat and flycatcher migration.

RPM 2.9 IBWC will review the Southwestern Willow Flycatcher Recovery Plan and update the environmental commitments related to flycatcher as appropriate.

RPM 2.10 Include the best available science, partner with stakeholders, agencies, and the public to learn and share information about riparian habitat restoration, flycatcher habitat use and flycatcher habitat optimization and monitoring in the Lower Rio Grande for the duration of the project.

For all RPMs, USIBWC will monitor the implementation of the RPMs and their associated terms and conditions, and report their status to the Service annually. Ensure that the Service receives electronic copies of all annual or other reports quantifying the spatial extent of dense riparian shrub habitat suitable as flycatcher breeding habitat no later than March 31, 2015, for the preceding calendar year ending December 31, 2014, and annually thereafter."
-- Biological and Conference Opinion, pp. 66-67 (USFWS 2012b)

3.1.2 Species Information

3.1.2.1 Species Description and Listing History

The southwestern willow flycatcher (*Empidonax trillii extimus*) (flycatcher) is a small Neotropical migratory songbird (Figure 3-1) that breeds in Arizona, New Mexico, and southern California, plus portions of southern Nevada and Utah, southwest Colorado, and possibly western Texas. It winters in the rain forests of Mexico, Central America and northern South America (USFWS 2002).

Figure 3-1. Southwestern Willow Flycatcher (photo credit Suzanne Langridge, USGS).

The flycatcher was listed as a category 2 candidate species of the Endangered Species Act in 1989. It was elevated to candidate category 1 in 1991 and was finally listed as an endangered species in March 1995 (USFWS 2002). Critical habitat was designated in 1997, revised in 2005, and again in 2013. In the final Critical Habitat Rule from January 3, 2013, the USFWS designated approximately 1,227 stream miles as critical habitat but excluded the RGCP because of USIBWC's existing riparian habitat restoration efforts (USFWS 2013).

Below is a summary of nesting habitat, breeding characteristics, and threats pertinent to USIBWC RGCP; more detailed species information can be found in the 2012 Biological Opinion (USFWS 2012b) and the USFWS 2002 Recovery Plan (USFWS 2002).

3.1.2.2 Nesting Habitat Description

Flycatcher nesting habitat is restricted to relatively dense growths of trees and shrubs in riparian ecosystems in the arid southwestern United States and possibly extreme Northwestern Mexico (USFWS 2002). Flycatchers usually breed in patchy to dense riparian habitats along streams or other wetlands, near or adjacent to surface water or underlain by saturated soil. Common tree and shrub species comprising nesting habitat include: willows (*Salix* spp), seepwillow (*Baccharis* spp), boxelder (*Acer negundo*), stinging nettle (*Urtica* spp.), blackberry (*Rubus* spp.), cottonwood (*Populus* spp.), arrowweed (*Tessaria sericea*), tamarisk/saltcedar (*Tamarix ramosissima*), and Russian olive (*Eleagnus angustifolia*) (USFWS 2002).

Regardless of the plant species composition or height, occupied sites usually consist of dense vegetation in the patch interior, or an aggregate of dense patches interspersed with openings. In most cases this dense vegetation occurs within the first 10 to 20 feet above ground (USFWS 2002; Moore 2007). These dense patches are often interspersed with small openings, open water, or shorter/sparser vegetation,

creating a mosaic that is not uniformly dense. In almost all cases, slow-moving or still surface water and/or saturated soil is present at or near breading sites during wet or non-drought years (USFWS 2002).

Thickets of trees and shrubs used for nesting range in height from 6 to 98 feet. Nest sites typically have dense foliage from the ground level up to approximately 13 feet above ground, although dense foliage may exist only at the shrub level, or as a low dense canopy (USFWS 2002).

Patch size can vary. Flycatchers have been recorded nesting in riparian habitat patches as small as 0.1 ha (0.25 ac) along the Rio Grande, and as large as 70 ha (175 ac) in the upper Gila River, New Mexico (USFWS 2002). The mean reported size of flycatcher breeding patches was 8.6 ha (21.2 ac), with the majority of sites toward the smaller end, as evidenced by a median patch size of 1.8 ha (4.4 ac) (USFWS 2002). Mean patch size of breeding sites supporting 10 or more flycatcher territories was 25 ha (62 ac). In addition, flycatchers are generally not found nesting in narrow strips of riparian vegetation less than 10 m (33 feet) wide (USFWS 2012b; USFWS 2002).

Nearly all flycatcher nesting sites are associated with lentic water (quiet, slow-moving, swampy, or still) or saturated soil. Along streams, those areas tend to be of relatively low slope or gradient. In the southwest, hydrological conditions at a site can vary. At some locations, water or saturated soil may be present only during the breeding season (May and June); at other sites, vegetation may be immersed in standing water during a wet year but be hundreds of meters from surface water in dry years (USFWS 2002). Physical presence of surface water may be a determining factor of territory establishment for breeding flycatchers (Ahlers and Moore 2009). Territories are typically located within 100 m from water (Hatten, Paxton, and Scogge 2010; Moore 2007) with a mean of 33 m along riparian areas (Moore 2007).

Historically, the flycatcher nested in native vegetation such as willows, buttonbush, boxelder, and Baccharis. Following modern changes in riparian plant communities, the flycatcher still nests in native vegetation where available, but also nests in thickets dominated by non-native saltcedar and Russian olive, as well as in habitats of mixed habitats (USFWS 2002). However, more recent surveys of delta flycatcher populations from the Elephant Butte Reservoir indicate that flycatchers are increasingly using exotic and mixed exotic-dominant stands with greater frequency, possibly due to limited patches of native thickets (Ryan 2012; Ahlers and Moore 2009). Table 3-1 shows the percentage of known flycatcher territories located within major vegetation/habitat types, across all USFWS recovery units, as well as in the Middle Rio Grande.

Table 3-1. Percentage of Flycatcher Territories By Vegetation Type

Vegetation Type	**Percentage of territories**		
	Across all recovery units, 2002 (USFWS 2002)	**Middle Rio Grande, 2010** (Ryan 2012)	**Middle Rio Grande, 2012** (Ryan 2012)
Native (>90%)	49%	61.5%	48.3%
Mixed native/exotic (>50% native)	24%	32.7%	29.3%
Mixed exotic/native (>50% exotic)	17%	5.8%	22.4%
Exotic (>90%)	9%	Combined with exotic dominated	Combined with exotic dominated

Regarding the specific tree which flycatchers use to place their nests, flycatchers use willows the majority of the time; however, flycatchers do use saltcedar to a significant extent, a trend which has been increasing in recent years (Ahlers and Moore 2009). Table 3-2 lists the species used as nest substrate. Flycatchers likely selectively use saltcedar as a nest substrate due to its twig structure. In 2002, 29.2% of nests within Elephant Butte Reservoir were found in saltcedar, which increased to 42.5% in 2008; nest success rates for nests in saltcedar also increased during that time frame (Ahlers and Moore 2009).

Table 3-2. Nest Substrate Species

Vegetation Type	**Percentage of territories**		
	Across all recovery units, 1993-2000 (USFWS 2002)	**Elephant Butte Reservoir, 2002-2008** (Ahlers and Moore 2009)	**Middle Rio Grande, 1999-2012** (Moore and Ahlers 2012)
Willows (*Salix*)	38%	65%	56%
saltcedar	28%	35%	42%
Other (Russian olive, *Baccharis*, cottonwood, boxelder, coast live oak)	34%	<1%	<3%

Flycatcher habitat also has abundant flying insects, such as wasps, bees, flies, dragonflies, flying ants, etc. Flycatcher food availability may be largely influenced by the density and species of vegetation, proximity to and presence of water, saturated soil levels, and microclimate features such as temperature and humidity (USFWS 2012b; USFWS 2002).

3.1.2.3 Migratory Habitat

Migratory habitat is usually comprised of willows and does not require some of the components important for breeding birds such as density, presence of standing water or moist soils, and suitable riparian patch size and structure (USFWS 2012b).

3.1.2.3 Breeding Biology

The flycatcher's primary song, "*fitz-bew*," the primary territorial song of the male, distinguishes it from all other flycatchers and bird species (USFWS 2002). This vocalization, along with the common "*whitt*" call given by both sexes, are used to verify presence of flycatchers during surveying. Flycatchers typically arrive on breeding grounds between early May and early June and have a short breeding season lasting through mid-June to mid-July. Flycatchers build a small open cup nest constructed of leaves, grass, and fibers (Figure 3-2), and typical clutch size is 3 eggs, but ranges from 2 to 7 (USFWS 2002).

Figure 3-2. Flycatcher nest at a USIBWC restoration site, 2012. A mirror attached to a stick is used to check on clutch size and fledgling success.

Flycatchers have a strong sense of site fidelity and typically return to former breeding areas, with as much as 78% return rates; about a quarter of flycatchers move from previous nest areas average distances of 1.2 to 19 mi (USFWS 2002). For this reason, USIBWC is interested in expanding habitat areas near existing territories.

3.1.2.3 Threats

The flycatcher is threatened by many natural and anthropogenic factors, impacting both the habitat quantity and quality as well as the abundance and vulnerability of populations. The primary cause of the flycatcher's decline is loss and modification of habitat (USFWS 2002; Moore 2007). Threats are detailed in the 2002 Recovery Plan and the 2012 Biological Opinion. Table 3-3 below summarizes some of the threats to the flycatcher applicable to the RGCP (USFWS 2002; SWCA 2011; USBR 2012b).

Table 3-3. Threats to the Flycatcher

Category	Threat	Description of Impacts
Habitat Quantity/ Quality	Dams and Reservoirs, and Diversions	Operation of dams modifies, reduces, destroys or increases riparian habitats both upstream and downstream of the dam site. Alters natural hydrological cycle, including min and max flow events. Leads to changes in sediment deposition, floodplain hydration and flushing, and timing of seed dispersal.
	Groundwater Pumping and Water Table	Reduces water in riparian ecosystems and associated subsurface water tables. Recharge to the groundwater aquifer is impacted. Still and slow-moving waters and high water tables associated with alluvial aquifers, which are important for flycatchers, are impacted.
	Drought and Climate Change	Limits water in the system and limits water available for release by dams and reservoirs; deteriorates habitat quality. Increases evaporation. May be accompanied by increasing temperatures, silting from erosion, and non-native plant invasions.
	Changes to Floodplain	Channel narrowing is accompanied by deepening of the channel, thereby the adjoining floodplain is inundated less frequently, and vegetation growth occurs on or near the banks, but reduces the width of the active channel and increases non-native plant species
	Channelization, Channel Narrowing, and Bank Stabilization	Affects riparian systems by separating a stream from its floodplain and preventing overbank flooding; reduces water tables adjacent to streams, increases stream velocity, increases intensity of extreme floods, and reduces volume and width of wooded riparian habitats; Changes to flow and channel result in a current channel pattern that is more narrow and supports less native riparian vegetation

	Livestock Grazing	Can alter plant community structure, species composition, relative abundance of species, and alter stream channel morphology. May also increase cowbird populations.
	Recreation	Can reduce vegetation through trampling, clearing, woodcutting and prevention of seedling germination due to soil compaction; bank erosion; increased incidence of fire; promoting invasion by exotic plant species, promoting increases in predators and scavengers due to food scraps and garbage; noise disturbance
	Fire	Causes immediate and drastic changes in riparian plant density and species composition; flycatcher habitats are neither fire-adapted nor fire-regenerated.
	Agriculture Development	Re-engineering of floodplains, diverting water for irrigation, groundwater pumping, applications of herbicides/pesticides. Increases likelihood or severity of cowbird parasitism. May also affect chemistry, especially salinity, of water and soils.
	Urbanization	Direct and indirect effects, including increased demand for domestic and industrial water use, urban development that can affect natural river processes, decreased infiltration, removal of conservation land, removal of vegetation, increased trash, production of pollutants, and increase of non-vegetated riparian areas.
	Insufficient Migratory Habitat	Migrating individuals must find suitable stopover habitat to replenish energy reserves for the next step in migration.
Changes in Abundance of Other Species	Exotic species	Exotic species (saltcedar) can outcompete native plants and alter food sources.
	Brood Parasitism	Reduces reproductive performance by reducing flycatcher fledglings per female per year. Ex: brown-headed cowbirds lays its eggs in nests of other species and the host species incubate the cowbird eggs and raise the young, which outcompete the host's young.
	Saltcedar Leaf Beetles	Beetles have the potential to spread widely and defoliate large expanses of saltcedar-dominated flycatcher breeding habitat, particularly during the most vulnerable part of nesting season. Changes food abundance, vegetation structure, nest temperature and site humidity.
Vulnerability of Small Populations	Demographic Effects	Small, isolated breeding groups are vulnerable to local extirpation by floods, fire, severe weather, disease, shifts in birth/death rates and sex ratios.
	Genetic Effects	Potential for low genetic variation within populations due to small populations.

3.1.3 Establishment of Habitat

Per RPM 1.1, USIBWC will establish a minimum of 53.5 acres of dense riparian habitat suitable for flycatcher breeding by October 1, 2017, and up to 119 acres by 2019. USIBWC will make the establishment of dense riparian shrub habitat a priority for ROD implementation, as well as for the selection of restoration sites. Target density of flycatcher habitat will vary from approximately 1,000 to 1,200 stems per acre upon maturity (Moore 2007). Target habitat should be comprised mostly of willows. Saltcedar removal will be implemented at restoration sites.

Per RPM 2.8, restoration sites will be located at intervals closer than 40 miles. In addition, USIBWC established No-Mow Zones for at least 15 feet of riparian fringe along the riverbank throughout almost the entire maintained portion of the levee project, assisting in providing migratory habitat along the length of the RGCP.

USIBWC will use the Conceptual Plan (USACE 2009) and Site Implementation Plans (TRC 2011) as guides for restoration site implementation. In addition, USIBWC will stagger plantings of willow poles across the years to increase structural age and integrity at the flycatcher restoration sites. USIBWC will also aim to expand habitat areas near existing territories due to nesting site fidelity.

3.1.4 Restoration Sites for Flycatcher Habitat

Twelve of the originally contemplated restoration sites in the Conceptual Restoration Plan (USACE 2009) have flycatcher breeding habitat as the target habitat. However, two of these twelve have since been removed from the list because they are not feasible (Bailey Point Bar[1], Lack property). The Broad Canyon Arroyo site has also since been added. The remaining 11 flycatcher restoration sites are listed in Table 3-4. USIBWC will follow the recommendations in the Conceptual Restoration Plan as well as the 2011 Site Implementation Plans (TRC 2011) for habitat restoration techniques.

Table 3-4. Restoration Sites with Target Flycatcher Breeding Habitat

Site Name	River Mile and Bank	Miles to next downstream flycatcher site	USFWS Priority in the Opinion	Flycatcher Acreage	Total Acreage at site	Comments
Trujillo	103 W	12.5	1	10	14	Active Restoration site
Crow Canyon B	90.5 E	8	1	10.6	25.6	Active Restoration site
Rincon Siphon (4 parcels A, B, C, and D)	82.5 E	12	1	18	28	Active Restoration site
Broad Canyon Arroyo	68 E	2	1	4.0	30	Active restoration site
Seldon Point Bar	66 E	2	1	6.9	7.7	Land acquired in 2011; Active Restoration site
Bailey Point Bar	64 E	16.2	3[1]	16.6	36	Depends on successful property acquisition
Leasburg Extension Lateral WW 8	47.8 E	4.3	2	3.1, possibly more	4.1 (expanded to 30)	Active restoration site; Site expanded
Clark Lateral	43.5 E	2.5	2	4.5	6	Requires supplemental irrigation
Mesilla East	41 E	15.5	2	15.8	15.8 expanded to 70)	Active restoration site; Site expanded
Berino West	25.5 W	1	2	10.3	10.3	Active Restoration site

[1] USIBWC attempted unsuccessfully to acquire the Bailey Point Bar in 2011. USIBWC has expressed continued interest to purchase the parcel and will re-evaluate the feasibility of acquiring the Bailey Point Bar if and when the property is back on the market. USFWS included a lower Priority on this site because it is not USIBWC property.

Berino East	24.5 E	17.5	2	5.0	9.5	Active Restoration site
Nemexas Siphon	7 W	4	2	16.7	16.7	Ownership in question

In addition, due to observations of migrant flycatchers in both 2010 and 2011, the riparian portion of the following site has potential to also establish additional flycatcher habitat (even though the original target habitat was designated as riparian woodland), as shown in Table 3-5.

Table 3-5. Restoration Sites with Possibility for Flycatcher Breeding Habitat

Site Name	River Mile and Bank	Miles to next downstream flycatcher site	USFWS Priority in the Opinion	Flycatcher Acreage	Total Acreage at site	Comments
Sunland Park	3 E	--	3	About 5	28.8	Under lease to City of Sunland Park

In addition, pursuant to RPM 2.8, restoration sites containing some willow vegetation and insect prey should occur at locations no greater than 40 mi intervals to protect and conserve flycatcher migratory stopover habitat and flycatcher migration.

See Section 2.6 and 2.7 for additional information on restoration site implementation and monitoring.

3.1.5 Environmental Water Transaction Program

USIBWC is developing an Environmental Water Transaction Program (EWTP) to allow the USIBWC to deliver water to restoration sites and to offset depletions to the allocated water system caused by increased vegetation and evapotranspiration. USIBWC is collaborating with local irrigation districts (i.e. Elephant Butte Irrigation District (EBID)) and other stakeholders to establish rules, procedures, and MOUs to implement the EWTP. EBID passed a policy in June 2013 allowing restoration sites to receive irrigation water. Supplemental water will allow USIBWC to establish flycatcher habitat and maintain it during drought conditions.

USIBWC is also considering the option of purchasing primary groundwater rights that will allow for irrigation of flycatcher habitat during drought years. These primary groundwater rights would not depend on the rules of surface water. The USIBWC currently owns 23.75 acres of primary groundwater rights (New Mexico Office of the State Engineer Water Rights File Numbers LRG 12710-2 and LRG 12725-2) which are currently being unused; USIBWC plans to redirect these water rights as needed for flycatcher habitat.

If core acres or flycatcher restoration sites are deteriorating in habitat quality, USIBWC will consider either supplemental surface or groundwater rights, whichever is appropriate, for the site in question.

In May 2014, the EBID Board approved the transfer of the first water rights to USIBWC property. The Leasburg Extension Lateral Wasteway #8 restoration site was the first site to receive irrigation water in June and July 2014.

The EWTP will be outlined under a separate framework document. See Section 2.8 for additional information on water rights program. See Section 3.1.19 for a drought contingency plan.

3.1.6 Adaptive Management Strategies for Habitat Establishment

Per RPM 2.10, USIBWC will implement adaptive management strategies that will assist the agency in complying with the goals of the ROD and the requirements of the Opinion. USIBWC will include the best available science in monitoring, mapping, and restoration work. In addition, USIBWC will partner with stakeholders, agencies and the public to learn and share information about riparian habitat restoration, flycatcher habitat use, and flycatcher habitat optimization and monitoring in the RGCP.

Specifically, USIBWC is using adaptive management to select the best restoration sites. USIBWC is considering purchasing plots of land that could be used for flycatcher habitat establishment along the river. USIBWC will evaluate the progress of restoration activities as well as established habitat outside of restoration sites on a yearly basis. USIBWC may move, add, or expand restoration sites based on environmental conditions to meet the RPM 1.1 requirement and to benefit the flycatcher.

USIBWC is also implementing adaptive management to the river management in general, as described in Section 2.13.

3.1.7 Vegetation Management

No-Mow Zones are established per Section 2.3.6 and in the Maintenance Zone Maps in Part 6. In addition, grazing leases have been phased out of the RGCP (Section 2.10.1). The following describes No-Mow Zones protecting flycatchers.

3.1.7.1 Buffers

Per RPM 2.3, if any flycatcher territories are present, a 0.25-mile buffer will be established around each territory. Project activity will be excluded from within the buffer zone. These flycatcher buffers are included in the No-Mow Zones outlined in Section 2.3.6. Although they are included in the No-Mow Zones in Maintenance Zone Maps in Part 6, they are not identified specifically as flycatcher buffers in order to protect the sensitivity of the territory locations.

USIBWC will review the flycatcher buffers every 3 years. If flycatcher territories increase in numbers and move toward the edges of the buffers, USIBWC will consider revising or increasing the buffers. USIBWC will consider the acreage outlined in the ROD for areas that are not mowed in order to adjust any buffers as necessary. In addition, significant changes in No-Mow Zones should be re-evaluated for hydraulic/hydrologic impacts on the flood capacity of the RGCP, per Section 2.3.11.

The exception to the 0.25 mi buffer is within USIBWC restoration sites. USIBWC will continue to conduct restoration activities, such as saltcedar excavation and tree planting, at restoration sites falling within the buffer of flycatcher territories. Such activities will follow the best management practices listed in Table 3-7.

3.1.7.2 Exotic species removal

Exotic species, namely saltcedar, will be removed according to methods described in Section 2.4.

Mechanical and chemical vegetation management will be conducted outside the flycatcher breeding season, which typically extends from May 15 through August 15 of each year, to avoid potential effects from human disturbance such as noise and pesticides. Work should be conducted after September 1, if possible, to avoid impacts to straggling flycatchers.

No chemicals will be sprayed within 10 feet of a previously occupied flycatcher nest/territory. Saltcedar will not be removed within 10 feet of a previously occupied flycatcher territory. In cases of extreme drought where native willow stands are weakened or dying due to drought conditions, USIBWC may leave saltcedar along the banks for at some distance around a documented territory until native willows have recovered or native plantings have grown to sufficient heights to replace saltcedar as a nest substrate. The distance of saltcedar left standing around a territory will be determined on a case-by-case basis, depending on the condition of the willows and other vegetation at the site as well as proximity to saltcedar beetle observances.

3.1.8 Vegetation Mapping

As required by RPM 2.7, USIBWC will quantify on a yearly basis the spatial extent in acres of dense riparian habitat suitable for flycatcher breeding within the RGCP. RPM 2.7 recommends using a Geographic Information System based model using appropriate satellite imagery and calculating the Normalized Difference Vegetation Index (NDVI), or any equivalent measures. Table 3-6 lists the acres of dense vegetation outlined by the procedures in the following section.

Table 3-6. NDVI Calculations

Satellite	Imagery Date	From Percha Dam downstream to Leasburg Dam	From Leasburg Dam downstream to American Dam
Landsat 5	August 20, 2011	316 acres	178 acres
Landsat 7	Main data collected from August 30, 2012 with some gaps filled in using July 29 and August 5, 2012 imagery	66 acres	38 acres
Landsat 8	August 9, 2013	334 acres	127 acres
Landsat 8	August 28, 2014	486 acres	453 acres

The NDVI values calculated for 2011-2014 vary significantly. There are several factors that can impact these values. First, local rainfall and monsoon rain events may affect the amount of "greeness" detected during a particular image. For example, in 2011, there were rain events in the upper part of the project area for over a week immediately before the Landsat 5 image was taken. In 2013, there was considerable rainfall in late July before the Landsat 8 image was taken, and in 2014, there were several small rain events in the first three weeks of August before the Landsat 8 image was taken.

Image date can also be a factor; for this reason, image date priority was 1) late August 2) early August 3) late July 4) early July. Satellite equipment may also impact the values, as Landsat 5 was no longer available in 2012 and the available Landsat 7 data had data gaps. Furthermore, the duration of irrigation season can also be a factor. In 2011, irrigation releases from Caballo Dam continued into September, while in 2012 they began decreasing in August. In 2013, releases ended in mid-July, while in 2014 releases decreased in August and ended in the third week of August.

In addition, not all NDVI pixels are flycatcher habitat, since NDVI picks up all dense vegetation, including monotypic saltcedar, cottonwoods, and mesquite within the floodplain. The NDVI is also measuring weed growth. However, USIBWC can evaluate the low-lying areas and areas along the banks which are picking up higher NDVI values in larger acreages to determine feasibility for additional or alternate restoration areas. The NDVI values in Table 3-6 are picking up management changes that include the beginning of not mowing around restoration sites (2011) and the implementation of No-Mow Zones, including the riparian fringe (winter of 2012-2013).

3.1.8.1 NDVI Overview

NDVI is a common method of calculating density of vegetation using visible and near-infrared wavelengths that are reflected from plants as measured from satellite imagery. The calculation is near-infrared radiation minus visible radiation divided by near-infrared radiation plus visible radiation. Calculations of NDVI for a given pixel always result in a number that ranges from minus one (-1) to plus one (+1). No green leaves gives a value close to zero. A zero means no vegetation, and close to +1 (0.8 - 0.9) indicates the highest possible density of green leaves (NASA 2012).

Riparian habitat areas exhibit NDVI values of >0.126, and flycatcher breeding habitat has NDVI values of >0.33 (Hatten, Paxton, and Scogge 2010; Hatten and Scogge 2007). Based on that, USIBWC used NDVI ranges 0.3 to 0.6 for dense riparian habitat suitable for flycatcher breeding.

USIBWC will use Landsat 5, 7, or 8 images provided free by the USGS, with little to no cloud cover, from May, June, July or August. Images are Path 33 Row 38 (southern Canalization Stretch, around Pasture 18 to end of project) and Path 33 Row 37 (northern stretch, Elephant Butte to Seldon Point Bar). NDVI calculations will use bands 3 and 4. Pixel size is 30 by 30 meters. Landsat 8 images began to be collected in 2013 with the same pixel size and similar instrumentation.

3.1.8.2 USIBWC NDVI Calculation Methodology

Because the Biological Opinion calls for at least half of the established habitat to be above Leasburg dam (RPM1.2), the project was divided into two sections: the northern section extended from Percha Dam, south of Caballo Reservoir, to Leasburg Dam, and the southern from Leasburg Dam to American Dam.

NDVI was used for habitat analysis for 2011 and 2012 base conditions. The procedure used and recommended for future calculations is as follows:

1. Start by downloading two Landsat scenes, from the Earth Explorer website:
    a. Go to http://earthexplorer.usgs.gov/, and login.
    b. Download a scene for Path 33, Row 37 (covering the northern section).
    c. Download a second scene for Path 33, Row 38 (covering the southern section).

d. The two scenes should be cloud free, at least over the areas of interest.
e. The scenes must have been acquired during the summer (May - August).
f. Ideally, both scenes will have been acquired on the same day, in succession.

2. Unzip the scenes. The NDVI is computed using only the red and near-infrared bands. For Landsat 8 these are bands 4 and 5, respectively, while for Landsat 5 and Landsat 7 they are bands 3 and 4. While there are several ways to compute the NDVI using various software applications, the easiest method is to use the Raster Calculator in ArcGIS. This will produce the true range of values, from -1.0 to +1.0.
   a. Open an ArcMap .mxd document, and add the two bands.
   b. Open ArcToolbox > Spatial Analyst Tools > Map Algebra > Raster Calculator.
   c. The general formula for the NDVI is (NIR - Red) / (NIR + Red). While this can be calculated in one step in the Raster Calculator, it may be clearer if the process is divided into three steps, in which the numerator and denominator are computed separately, and then used to arrive at the final ratio.
   d. In Raster Calculator, create an expression to compute the numerator, such as:

      num_raster = Float("xxxxxx.tif") - Float("yyyyyy.tif")

      where:

      - "num_raster" is the name you supply for the output raster which will be the numerator. Note that raster names must be less than 14 characters long.
      - "Float" is a function call that will convert the input rasters, which are in integer format, into floating point equivalents. It is critical that these calls be selected from the scrollable list in the dialog, and NOT simply typed in.
      - "xxxxxx.tif" is the name for the NIR band, selected from the list of datasets in the dialog.
      - "yyyyyy.tif" is the name for the Red band, similarly selected.
      - Note that the way to insert the names of the bands into the Float() function calls is to position the cursor between the two parens, then click on the appropriate name from the list in the dialog.

   a. Browse to the desired output location, and enter the same output raster name that was specified in the above expression.
   b. Click OK.
   c. Repeat Steps (d) through (f) to compute the denominator (i.e., the sum of the two bands).
   d. Repeat Steps (d) through (f) to compute the final NDVI (i.e., the ratio of numerator to denominator), using an expression such as:

      ndvi = Float("num_raster") / Float("den_raster")

3. Now that the NDVI layer has been created, it needs to be "clipped" so that only the portion within the USIBWC ROW remains.
   a. The entire USIBWC ROW is located in SDE on the Nossob server, under Z:\SDE.fd_LandManagement\SDE.fc_US_ROW.

b. Make a copy of this feature class on your PC, then edit it to describe the area that you are interested in. Or simply use the polygon "Project_ROW_Boundary" that has been included with the datasets already created. Alternatively, use the ROW boundary feature class maintained by EMD which includes 2013 edits such as the inclusion of the Seldon Point Bar and exclusion of Seldon Canyon lands.
c. Open ArcToolbox > Spatial Analyst Tools > Extraction > Extract by Mask.
d. Fill in the dialog, using the right of way polygon as the mask, and the raster will be clipped to the correct outline.

4. Next, we need to symbolize the clipped NDVI rasters:
   a. Right click the raster layer name, then Properties > Symbology Tab.
   b. On the dialog, select "Classified", under Show:
   c. Specify 3 Classes.
   d. Click the "Classify ..." button.
   e. Enter 3 break values: 0.2, 0.3, and 1.
   f. Click OK. The raster is now classified, and ready to be colored according to taste.
5. The analysis will be done using polygons, so the rasters will have to be converted into a more usable format, then merged into two feature classes.
   a. Note that at this point there are two floating point NDVI rasters, one covering path 33, row 37, and the other path 33, row 38, and that these rasters overlap each other.
   b. Let us assume that one of these rasters is named "ndvi_clipped", and follow it through the necessary computations in Raster Calculator.
   c. Create a new raster, by multiplying each cell by 100:

      ndvi_100 = 100.0 * ("ndvi_clipped")

   d. Convert the new floating point raster to an integer raster:

      int_ndvi_01 = Int("ndvi_100")

   e. Create another new raster by selecting integer values greater than 20. These will correspond to NDVI values of 0.2 to 1.0:

      int_ndvi_02 = Con("int_ndvi_01" >= 20, 2)

   f. Create yet another raster by selecting integer values greater than 30, which correspond to NDVI values of 0.3 to 1.0:

      int_ndvi_03 = Con("int_ndvi_01" >= 20, 3)

   g. Now repeat steps (a) through (f) for the other clipped raster.
6. Next, generate four sets of polygons from these rasters:
   a. ArcToolbox > Conversion Tools > From Raster> Raster to Polygon
   b. While using this tool, be sure to uncheck the box "Simplify Polygons".
7. The output from the previous step are shapefiles, so convert them into feature classes using the Load utility.

8. Next, combine the polygons into two feature classes:
    a. Edit the feature class representing 0.2 to 1.0, for path 33 row 37, and delete all of the polygons that overlap those in path 33 row 38.
    b. Repeat the previous step for the feature class representing 0.3 to 1.0.
    c. Append the result of Step (a) with the corresponding path 33 row 38 polygons, to create the final combined feature class, representing NDVI values of 0.2 to 1.0.
    d. Similarly, append the result of Step (b) with the corresponding path 33 row 38 polygons to create the final feature class, representing NDVI values of 0.3 to 1.0.
    e. At this point, the two feature classes can be further edited to eliminate the effects of agriculture adjacent to the right of way, for example.
9. Remove all areas located at a distance greater than 328 feet from the river (except for restoration sites outside of that buffer) by clipping to the GIS file (maintained by EMD) "RioGrandebanks100mbuffer_NDVI," which is a file with a 100 m buffer from each bank plus any restoration site that fell outside of the 100 m (See 3.1.8.3).
10. Remove any NDVI polygons that are not within USIBWC property (ex: Seldon Canyon), using the Doña Ana County parcel GIS data, unless they fall within a designated restoration site.
11. Remove all NDVI polygons that could be impacted by agriculture on the edge of the ROW, verifying manually using aerial imagery.
12. Remove all polygons made of single pixels of NDVI greater than 0.3, unless the single pixels are within restoration sites (See 3.1.8.3).
13. Remove polygons within mow areas.
14. The acreages can be determined by adding an "Acres" field to each of the feature classes, and computing the totals. Compute the totals for above and below Leasburg Dam by selecting the appropriate polygons.

Dense flycatcher habitat must also meet the requirements outlined for core acreage in Section 3.1.8.3.

3.1.8.3 Core Acreage in Opinion

Areas calculated by the NDVI procedure outlined in Section 3.1.8.2 will be overlayed with restoration sites. Areas of dense habitat *outside* of the restoration sites will be considered the USIBWC "core" acreage required by RPM 1. These are areas that are naturally maintaining dense habitat without supplemental irrigation and with minimal or no maintenance. Flycatcher habitat established within the restoration sites will be subject to water rights through the EWTP and will supplement the existing core acreage.

Core acreage, and all dense habitat to meet RPM 1, should be suitable flycatcher breeding habitat meeting the following requirements:

1. NDVI of 0.3 or greater (Hatten, Paxton, and Scogge 2010)
2. Minimum patch size of 2 pixels (0.44 ac) (USFWS 2002)
3. Distance to water of 328 feet, using a buffer of 100 m from riverbank (Hatten, Paxton, and Scogge 2010). The exception to this is if the site is clustered near other observed territories.

3.1.8.4 Other metric options

USIBWC may explore the use landscape metric software (such as FRAGSTAT, LFT, or Patch Analyst) to get acreages.

In addition, USIBWC may explore the possibility of using leaf area index (LAI) to determine density. Although the cost is higher and requires flying of equipment, the accuracy will be improved.

3.1.9 Conservation Recommendations

In the Opinion, USFWS included conservation recommendations that "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" (USFWS 2012b, p. 68). Listed below are the Conservation Recommendations and the USIBWC action plan for each.

a. Encourage adaptive management of flows and conservation of water to benefit flycatcher and yellow-billed cuckoo habitat in the Lower Rio Grande.

The ROD recommended periodic restoration peak flows once every 3 to 10 years of a target release of 3,500 cfs from Caballo Dam (requiring 9,500 acre-feet of water per event). USIBWC will continue to work with agencies and irrigation districts to determine the feasibility of various flow regimes for the benefit of the flycatcher. USIBWC is considering the option of leasing additional water rights to simulate peak flows at restoration sites.

b. Work to secure long-term water sources to support habitat restoration activities in the Lower Rio Grande.

USIBWC is working to implement the EWTP for water delivery to habitat. USIBWC and its cooperators will purchase or lease water rights to offset depletions to the allocated system caused by increased vegetation growth at restoration sites, as well as for supplemental irrigation. The EWTP encompasses both surface water acquired and delivered through irrigation districts, as well as primary and supplemental groundwater rights. In addition, inundation maps at releases of 2,000 or 2,500 cfs can show areas that overbank with smaller releases. Water rights purchased by the USIBWC are real property and will remain appurtenant to USIBWC land in perpetuity, as long as USIBWC pays assessment fees to the irrigation district, subject to the availability of funds. See Section 3.1.5 for more information.

c. Monitor, maintain, and expand riparian habitat restoration areas.

Changes to the Conceptual Plan include expansions of current pilot projects under restoration, including expanding Leasburg Extension Lateral WW 8 from 4.1 to 30 acres, and Mesilla East from 15.8 acres to 70 acres. USIBWC agrees that larger restored areas may be more sustainable than many isolated smaller patches of restored areas. USIBWC is also connecting restoration sites with No-Mow zones in between sites in close clusters. In addition, USIBWC is implementing a No-Mow policy of at least 15 feet of riparian fringe throughout the project. This will allow for additional flycatcher migratory habitat between all restoration sites. USIBWC will also be implementing a monitoring protocol, as discussed in Section 2.7 of the RMP.

d. Expand the Yeso West Restoration Site further west into the floodplain. Allow river meanders from Yeso Arroyo Restoration Site to push water onto floodplain near the Yeso West Site.

USIBWC will consider this recommendation when planning/implementing these restoration sites (See Section 4.8).

e. Widen the arroyo mouths of Yeso, Placitas, and Angostora Arroyos, within the floodplain and within USIBWC lands, to encourage riparian vegetation on swales at high and medium flows within the arroyos.

USIBWC will consider this recommendation when planning/implementing these restoration sites (See Section 4.8).

f. Develop and regularly convene a Flycatcher Lower Rio Grande Recovery Management Unit Implementation Subgroup.

USIBWC will implement this recommendation. Initial participants include Bureau of Reclamation, USFWS, other federal and state agencies, irrigation districts, members of groups such as the Paso del Norte Watershed Council, and local NGOs. Face-to-face meetings may be planned around the annual USFWS flycatcher survey training. Meetings may also be conference calls.

g. Coordinate the reporting of flycatcher survey data and its management, collection, entry, and reporting with the Service and other agencies.

USIBWC coordinated with USBR on flycatcher surveys and survey results from 2012 through 2014 and will continue coordination for future surveys. In an effort to reduce duplication of effort, USIBWC and USBR have signed an Interagency Agreement to assist each other with conducting surveys every other year and coordinating the data exchange. (See Section 3.1.12.2)

h. Inform partners and the public about tamarisk beetle issues. Continue to improve an understanding about tamarisk using the latest science.

USIBWC participates in the annual TX/NM/Mexico Saltcedar Biological Control Consortium. USIBWC staff provide presentations and learn the latest science at this workshop. In addition, USIBWC uses this forum to inform stakeholders. USIBWC also maintains in communication with partners monitoring the beetle, including Texas AgriLife, Texas universities, and the Tamarisk Coalition. USIBWC distributes beetle observation location information to stakeholders and Tamarisk Coalition via email when available.

i. Purchase private lands within the floodplain near Bailey Point Bar, Selden Canyon, and Nemexas along with necessary buffer areas to conserve those habitats and restoration options in perpetuity.

USIBWC has purchased a 7.7 acre tract on Seldon Point Bar in Seldon Canyon, which is now a priority for flycatcher restoration work, and the site is being implemented. USIBWC has been in unsuccessful negotiations for two additional properties in Seldon Canyon. USIBWC is working on ownership issues related to the Nemexas property. USIBWC is pursuing the purchase of the Bailey Point Bar . USIBWC

is proactive about acquiring lands that can be used for restoration, particularly if they were outlined in our Conceptual Plan, can provide flycatcher habitat, or have water rights. Additionally, acquiring lands with primary groundwater rights is a transactional approach in the EWTP.

j. Trap Brown-headed Cowbirds and control feral hogs, as needed.

USIBWC does not have staff, resources, or the mission statement to implement this conservation recommendation.

In addition, studies have documented that efforts spent trapping brown-headed cowbirds has little impact on flycatcher nest success rates (Moore 2006; Moore and Ahlers 2003).

k. Monitor ground water levels near Restoration Sites, as needed.

USIBWC has installed 55 shallow groundwater monitoring wells at 19 restoration sites and two non-restoration site areas. 22 wells include automatic reading equipment which collect continuous data, and is currently collecting hourly at most sites. The remaining wells will be for manual data collection. USIBWC will implement a long-term monthly monitoring program. USIBWC may use this data to establish a minimum depth of groundwater to plant trees (for example no trees are planted if groundwater is greater than 15 feet) if no supplemental water is available. In addition, planting depths may be increased if deeper augers are available. USIBWC may also use the data to determine priority sites for supplemental irrigation or to adjust the target habitat type. Monitoring of restoration sites and groundwater wells are discussed in Sections 2.7 and 2.6.2, respectively.

l. Provide for and maintain riparian vegetation along drainage ditches.

USIBWC has designated draft No-Mow Zones throughout the RGCP in accordance with the ROD. Some natural and constructed channels and ditches are included in or adjacent to these No-Mow Zones areas; however, USIBWC has the responsibility to limit vegetation growth in these ditches. Drain ditches in the floodway must be kept clear to assure proper drainage of the irrigation, return flows and storm-water systems. Allowing these ditches to overgrow may impact the function of the valves and obstruct the flow of these systems. USIBWC will evaluate on a case-by-case basis whether targeted drains can be designated as No-Mow, thereby allowing for riparian vegetation to establish in these areas.

3.1.10 Refuge System

USIBWC will work with USFWS to evaluate options and possibilities to establish an official, or unofficial, refuge system for long-term commitment of the restoration. USIBWC could transfer management of the restoration sites to the USFWS or transfer land fee-title while retaining a flood easement. The creation of a National Wildlife Refuge in the RGCP, or expansion of existing refuges, will be explored with USFWS.

3.1.11 Saltcedar Leaf Beetle

Many agencies and organizations, such as Texas AgriLife Extension, Texas A&M, National Park Service, Texas Parks and Wildlife, and USDA, have promoted biological control of saltcedar through a natural predator, the saltcedar leaf beetle (*Diorhabda* spp.) from Asia and Europe. Beetles have been released

throughout Texas since 2004. In 2007, beetles were released along the Rio Grande near Candelaria, Texas. Beetle populations have continued to increase, defoliating miles of saltcedar along the Rio Grande. In summer of 2012, the saltcedar leaf beetle had reached the El Paso/ Hudspeth County line. In the summer of 2013, beetles had entered into the RGCP in the Sunland Park and El Paso area, and were documented as far north as Vado, NM. In summer of 2014, beetles were again documented in Sunland Park and Anthony, New Mexico and El Paso area.

Although the beetle has been successful in controlling saltcedar growth and seeding, it does represent a threat to the flycatcher because beetle defoliation corresponds to vulnerable early breeding season. Flycatchers may be nesting in or near saltcedar which is providing canopy cover to the nest, and beetles will very quickly defoliate a saltcedar during the nesting period. The reduced canopy cover may lead to increased predation and scorching of the nests by the sun.

USIBWC supports the removal of saltcedar during the winter months in flycatcher breeding areas. USIBWC promotes the planting of native vegetation in lieu of saltcedar on restoration sites. In addition, USIBWC restoration sites will provide future breeding habitats to replace many habitat areas affected by future beetle expansion.

Depending on the extent of beetle dispersion, and the impact of defoliation on survivability of saltcedar, there may be significant saltcedar debris throughout the RGCP. USIBWC will remove saltcedar debris from No Mow Zones as resources allow.

3.1.12 Surveys

3.1.12.1 Territory Surveys

Per RPM 2.6, USIBWC will conduct **annual** flycatcher surveys at all Restoration Sites and areas where flycatchers have been observed in previous years. Methods for surveying include contracting the work, conducting the surveys with available and trained USIBWC staff, or collaborating with additional federal organizations with similar objectives, such as the USFWS or USBR.

Surveys will follow USFWS-approved survey protocols and will be performed by USFWS-permitted staff. Required survey protocol is the USGS Protocol "A Natural History Summary and Survey

BOX 3-4. Flycatcher Survey Protocol Requirements

- Staff conducting surveys will have completed a formal survey protocol course offered by USFWS or affiliated entity approved by USFWS. Staff should also have a minimum of 40 flycatcher survey observation hours with a certified surveyor.
- Staff conducting surveys should have a permit issued by USFWS for surveying (Form 3-200-55 Federal Fish and Wildlife Permit Application Form)
- Surveys should be conducted a minimum of 3 surveys per site, at least once in each of 3 survey periods: 1) May 15-31, 2) June 1-24, and 3) June 25-July 17.
- If the site will have ground disturbance or other type of project, a minimum of 5 surveys per site are required, with one during the first and second survey period and 3 surveys during the third survey period.
- Each complete survey must be at least 5 days apart. The entire site must be surveyed during each survey period even if it takes multiple days to complete.
- Surveys should be conducted between the hours of 5:00 am to 11:00am.

Protocol for the Southwestern Willow Flycatcher," last revised 2010 (Scogge, Ahlers, and Sferra 2010). A summary of protocol requirements are listed in Box 3-4 (Scogge, Ahlers, and Sferra 2010).

Surveys commissioned by USIBWC in 2010 and 2011 included surveys at USIBWC restoration sites only. USBR surveys use a wider approach and survey suitable habitat along the entire river section divided up into sub-segments and surveyed by boat or by foot. USIBWC will adopt the USBR method of surveying in order to accurately assess territories outside of USIBWC restoration sites. The entire stretch of river above Leasburg to Percha Dam will be surveyed. Surveys should focus on areas of more suitable habitat. USBR quantified suitable habitat via a 2012 classification of habitat (Darrel Ahlers, USBR, personal communication 2012).

3.1.12.2 Collaboration with USBR

USBR has a similar need to conduct flycatcher surveys for both the Elephant Butte Reservoir and the RGCP. USBR's 2012 Flycatcher Management Plan recommended that USBR coordinate surveys with USIBWC to avoid duplication of survey effort. USBR recommended that USIBWC survey sites on even years and USBR would survey on odd years (USBR 2012b).

In May 2013, USIBWC and USBR signed an Interagency Agreement (IBM13A0017) to collaborate on biological survey services and to share data. Under this agreement, USIBWC issued a work order to USBR to conduct flycatcher and yellow-billed cuckoo surveys in the RGCP in the 2013 nesting season. USBR conducted surveys in 2014.

3.1.12.3 Nesting Success Surveys

Although not required, USIBWC recommends conducting nesting success surveys at least twice from 2013 to 2019. Nesting success surveys require more follow up visits to territories with hatchlings in order to document the percentage of successful hatchlings. As these types of surveys are more invasive, they will be required to be conducted by certified and qualified personnel with appropriate USFWS permits and will likely be contracted out or conducted in conjunction with USBR. Nesting success surveys were conducted in 2013 and 2014.

3.1.13 Environmental Commitments of the Recovery Plan

Per RPM 2.9, USIBWC will review the USFWS Southwestern Willow Flycatcher Recovery Plan about every 3 years and update the environmental commitments related to the flycatcher, as appropriate. This will include nesting and surveying data.

3.1.14 USIBWC Licenses/Leases/Permits

Per RPM 2.2, EMD will review all USIBWC licenses, leases, and permits for the RGCP and consider potential impacts to flycatchers. USIBWC will not authorize any license, lease, or permit that will potentially harm the flycatcher nesting habitat or observed territory locations within the 1/4 mile buffers. USIBWC will reference compliance with the Migratory Bird Treaty Act and the Endangered Species Act for actions or projects authorized on USIBWC property. See Section 2.10 for additional Lease information.

3.1.15 Dredging/Channel Maintenance

Channel maintenance activities that may potentially adversely impact the flycatcher or its habitat, such as removal of islands that have established flycatcher territories in the river, will require concurrence from USFWS. Dredging and excavation procedures are outlined in Part 4 – Channel Maintenance Plan.

3.1.16 Summary of Best Management Practices for Flycatcher Protection

Table 3-7 below lists a summary of Best Management Practices (BMPs) for overall flycatcher management in the RGCP.

Table 3-7. Summary of BMPs for Flycatcher Management

Action	Management Practice	Applicable Timeframe
General Management Practice	• Establish a 1/4 mile buffer around observed territories where USIBWC will not mow	All year
Any work within 1/4 mile of flycatcher territories	• No work should be conducted during the flycatcher nesting season (May 15 - Sept 1). • If work must be conducted during the breeding season, then to minimize impacts the following is required: o No work conducted prior to 9:00 am o Work should be reduced to shortest time frame possible to minimize impacts o Noise should be kept to a minimum	May 15 - Sept 1
General Management Practice	• Review USIBWC licenses, permits, and leases for potential impacts to flycatchers	All year
Restoration Sites	• Stagger plantings to increase structural and age diversity • No mowing • Remove saltcedar, unless near a territory with drought-affected willows. Distance of saltcedar left standing will be determined on case-by-case basis, depending on the conditions of the willows and other vegetation at the site. • Consider supplemental water to support flycatcher habitat	All year, as appropriate
Any Action not covered under RMP	• Consult via email with USFWS ESD in Albuquerque to ensure minimal impacts	May 15-Sept 1

3.1.17 Flycatcher Lower Rio Grande Recovery Management Unit Implementation Subgroup

As discussed in Conservation Recommendation f. in Section 3.1.9, USIBWC will lead and facilitate coordination of a Lower Rio Grande Recovery Management Unit Implementation Subgroup to facilitate collaboration with agencies and organizations with input or those working on similar restoration efforts.

3.1.18 Contingency Plan for drought

Considering the Rio Grande in New Mexico has been in extended drought conditions for the past several years, the USIBWC has developed a contingency plan to sustain flycatcher habitat, specifically the 53.5 acres in RPM 1.1, in the event of prolonged and severe drought conditions. The Contingency Plan will focus on two conditions: 1) natural conditions and 2) fortifying restoration sites with supplemental water, and groundwater in particular.

3.1.18.1. Natural Conditions

USIBWC will focus restoration efforts (such as planting) at sites within Selden Canyon where the main channel naturally retains more water than other more open areas of the river corridor. Natural conditions in Selden Canyon allow pools of water to stay in the channel during non-irrigation season for longer periods than the rest of the RGCP. Restoration sites in Selden Canyon are listed in Table 3-8. If water is pooled on the opposite bank, USIBWC may consider routing the ponded water to the bank with the restoration site, pending appropriate USACE permits (See Section 4.13) and if conditions allow.

Table 3-8. Sites within Selden Canyon that may have natural conditions to be supported without supplemental irrigation

Site	Maximum Acres to be Sustained Without Irrigation	Opinion Priority	Comments	ROD Offset Required water rights?
Broad Canyon Arroyo, lower terraces	4 to 6	1	Due to geometry and terrain, site would be difficult to irrigate	NO
Selden Point Bar	7	1	Site will be double protected with groundwater	NO
Total Acres	**13**			

Note: Bailey Point Bar will be added to Table 3-8 if USIBWC successfully acquires the property. The maximum acres to be sustained without irrigation are 16, offset water rights are not required, and the Opinion Priority was 3.

3.1.18.2. Supplemental Irrigation

Supplemental irrigation can be done either with surface water or with groundwater. Some sites are candidates for both surface and ground water irrigation; in these cases, the most feasible will be implemented depending on the circumstances. Priority sites for each kind of irrigation were chosen based on site conditions and based on the priority listing assigned by USFWS in Table 1 of the Opinion.

3.1.18.2.a. Supplemental Irrigation - Surface Water

Surface Water irrigation will occur within the framework of the EWTP, as described in Sections 2.8 and 3.1.5. Sites with priority for surface water irrigation are listed in Table 3-9. The EBID as a participant of the EWTP is covered under the Incidental Take Statement of the Opinion for these sites as long as the USIBWC maintains the 53.5 acres of flycatcher habitat.

Table 3-9. Priority Sites for Surface Water Irrigation				
Site	**Acres to be Irrigated**	**Opinion Priority**	**Can be irrigated with surface Water Via**	**ROD Offset Required water rights?**
Crow Canyon B	26	1	Hatch Canal; Also a priority for groundwater	YES
Trujillo	14	1	Trujillo lateral	NO
Leasburg Extension Lateral WW8	6 (and up to 30)	2	Leasburg Extension Lateral Wasteway 8 (Irrigation in 2014)	YES
Mesilla East	16 (and up to 70)	2	California Lateral WW13 or Alamo Drain	YES
Total Acres	**62**			

3.1.18.2.b. Supplemental Irrigation - Groundwater

Groundwater is an important element for critical drought periods. Groundwater will allow irrigation of poles in critical early spring timeframe when trees are beginning to bud, and will ameliorate tree stress and vulnerability caused by heat in the summer prior to irrigation flows being released into the river. Groundwater rights can pump their full allotment of water, based on the groundwater priority, and are not held to shortages during drought conditions as surface water rights are.

Sites irrigated with groundwater need a legal Point of Diversion (POD) approved by the New Mexico Office of the State Engineer (NMOSE). They also need a designated and approved Place of Use. Groundwater rights are subject to the rules and regulations imposed by the State of New Mexico in Title 19, Chapter 27 Part 1 of the New Mexico Administrative Code (19.27.1 NMAC).

USIBWC owns 23.83 acres of groundwater rights (Water Right File Numbers (WRN) LRG-12725-2 and LRG 12710-2. As of fall of 2014, USIBWC is working with the NMOSE to transfer these rights (change the place of use) to 2 restoration sites (Rincon Siphon and Selden Point Bar). USIBWC will also apply for a permit for a new POD to construct a new groundwater supply well at the sites. Possible issues that may arise during the NMOSE review of the application include a determination that USIBWC has forfeited or abandoned the rights for non-use as well as a requirement to have surface water offsets for wells close to the river.

USIBWC may also pursue the acquisition of additional groundwater rights. Sites with a priority for groundwater rights are listed in Table 3-10.

Table 3-10. Priority Sites for Groundwater Irrigation				
Site	**Acres to be Irrigated**	**Opinion Priority**	**Comments**	**ROD Offset Required water rights?**
Crow Canyon B	26	1	Also a priority for surface water	YES
Rincon Siphon A-B	16	1	LRG 04770-S is a nearby well. No EBID infrastructure for surface water irrigation	YES

Selden Point Bar	7	1	Outside of EBID boundaries; No EBID infrastructure for surface water irrigation	NO
Total Acres	65			

Note: Bailey Point Bar will be added to Table 3-10 if USIBWC successfully acquires the property. The maximum acres to be sustained without irrigation are 16, offset water rights are not required, and the Opinion Priority was 3. This tract is outside of EBID boundaries and there is no EBID infrastructure for surface water irrigation at this site.

3.1.18.3. Groundwater Monitoring and Non-drought Year Prioritization

In 2013 and 2014, USIBWC installed a network of 55 shallow groundwater monitoring wells (Section 2.6.2 and 3.1.9.k). USIBWC will use the data to determine planting depths and irrigation needs, as well as to further refine this Contingency Plan for drought.

Because the RGCP has been in drought conditions for the past several years, USIBWC will be focusing initial restoration implementation efforts on sites listed in Tables 3-8 to 3-10. USIBWC is placing priority on all sites with a target of dense riparian habitat (Section 3.1.4), and all except 4 sites appear in Tables 3-8 to 3-10. Berino East and Berino West are additional sites being implemented in fiscal years 2014 and 2015. Depending on data from groundwater monitoring, Tables 3-8 to 3-10 may be modified for more suitable site conditions during extended drought.

3.1.19 Schedule of Future Tasks

In order to implement the RPMs and meet the goals of the Opinion and the ROD, the USIBWC has identified the following future tasks and timelines.

Table 3-11. Schedule of Future Tasks

Area	Task	Target Date	RPM
Restoration	Continue restoration work under the USFWS Interagency Agreement, including planting an estimated 20,000 trees at 9 sites (Trujillo, Crow Canyon, Broad Canyon Arroyo, Seldon Point Bar, Rincon Siphon, Leasburg Extension Lateral WW8, Mesilla East, and Mesilla Bosque).	Through March 2016	1.1, 1.2, 1.4, 1.6, 2.8
	Implementation of Berino East and Berino West restoration sites	Winter 2014-2015	1.1, 1.4, 1.6
	Complete purchase of Bailey Point Bar	Decemmber 2014	1.1, 1.2
	Purchase NeMexas Siphon property	2015 or 2016	1.1, 1.6
Channel Maintenance	Survey 160 cross sections	Winter 2014-2015	
	Conduct investigations to evaluate alternatives to channel maintenance	By 2015	2.2, 2.10
	Continue discussions with stakeholders on channel maintenance	Through 2015	2.2, 2.10

	Finalize Channel Maintenance Plan with USFWS and stakeholder input	2015	
Environmental Water Transaction Program	Complete 2 trial transactions of water rights	June 2014	1.1, 1.5
	Irrigate first restoration site, Leasburg Extension Lateral WW8	Summer 2014	1.1
	Finalize Environmental Transfer Framework Document	December 2014	
	Purchase and/or lease additional supplemental water rights for supplemental irrigation and offsets of water depletions	2014-2017	1.1, 1.2, 1.4
River Management Plan	Finalize the River Management Plan, the Flycatcher Management Plan	2014	2.1

3.1.20 Reporting to USFWS

Annually, USIBWC will submit the following documents to USFWS:

- Annual Survey Data, including territory locations, GPS coordinates, field sheets, etc. (except when submitted by USBR)
- Progress Report of restoration activities and status
- NDVI calculation of current dense acreage throughout the RGCP, and maps showing those acres

Electronic copies will be submitted by March 31 of the following year to nmesfo@fws.gov and if necessary by mail to the New Mexico Ecological Services Field Office, 2105 Osuna Road NE, Albuquerque, NM 87113.

SUBPART 3.2 - OTHER ENDANGERED SPECIES

3.2.1 Federally listed species

There are 4 federally listed species that are known or likely to occur within the RGCP (SWCA 2011), besides the flycatcher. Table 3-7 lists these species and their affects determination from the 2011 Biological Assessment and from USFWS in the 2012 Biological Opinion.

Table 3-7. Federally listed species in the RGCP other than flycatcher

Common Name (Species Name)	Status	County where Species Occurs and/or listing Applies	Range or Habitat Requirements	Potential for Occurrence in RGCP	BA Effects Determination	USFWS BO Effects Determination
Aplomado falcon (*Falco femoralis septentrionalis*)	E	Sierra and Doña Ana counties, El Paso County	Documented at Mesilla Valley Bosque State Park in 2010	Known to occur	May affect, but is not likely to adversely affect	May affect, but is not likely to adversely affect
Least tern (*Sterna antillarum*)	E	Sierra and Doña Ana counties	Migratory species occurring in North America during the breeding season, when it is associated with water (e.g. lakes, reservoirs, rivers) Documented in the RGCP including at Mesilla	Known to occur	May affect, but is not likely to adversely affect	May affect, but is not likely to adversely affect
Yellow-billed Cuckoo (*Coccyzus americanus)*	C*	Sierra and Doña Ana counties, El Paso County	Western subspecies nests preferentially in large patches of moist cottonwood-willow woodland, where it prefers high canopy closure for nesting. Documented on some proposed RGCP restoration sites	Known to occur	Not likely to jeopardize	No determination
Sprague's pipit (*Anthus spragueii*)	C	Sierra County	Within NM migrates in the northeast and winters in the southwest and occasionally in the southwest. Uses grasslands of intermediate height and sparse to intermediate vegetation density; prefers native prairies.	May occur	May affect, but is not likely to adversely affect	No determination

** Proposed to be listed as Threatened in 2014.*

3.2.2 Actions to protect

For these species, USIBWC will allow these species to leave on their own volition when encountered prior to or during restoration activities.

3.2.2.1 Yellow-Billed Cuckoo

In 2012, the yellow-billed cuckoo is a Category 3 Candidate Species. In October 2013, the USFWS issued a proposed rule to change the status of the yellow-billed cuckoo to Threatened. The decision was extended December 2013 and again in April 2014. If approved, the cuckoo would be listed in late 2014. USIBWC will initiate consultation with USFWS if the cuckoo is upgraded from a candidate species. In August 2014 the USFWS proposed Critical Habitat for the yellow-billed cuckoo; however, the RGCP was not part of the proposed critical habitat designation.

USIBWC restoration sites with a target habitat type of riparian woodland or forest, particularly sites with plantings of cottonwoods and willows in association with overbank lowering, bank cuts, natural levee breeches, secondary channels, bank destabilization, and construction of inset floodplains, have the potential to benefit the yellow-billed cuckoo (SWCA 2011).

Yellow-billed cuckoos have been recorded at or near several of the proposed restoration sites (Trujillo, Crow Canyon, Broad Canyon Arroyo, Berino East, and Berino West). Excavation work at Broad Canyon excluded a portion of saltcedar to be excavated in order to protect the cuckoo existing habitat. When additional habitat is established, USIBWC will return to remove saltcedar on the remaining parcel at Broad Canyon Arroyo.

The Yellow-billed cuckoo is benefited from the planting of cottonwoods. From 2011 to 2013, the USIBWC and USFWS planted about 300 cottonwood trees and over 3,300 total native trees (willows and cottonwoods). From 2013 to 2016, the USIBWC plans to plant another 20,000 trees, including over 1,000 cottonwoods. These efforts will assist the USIBWC to provide cuckoo habitat.

Yellow-billed cuckoos have a large nesting range and need at least 37 acres of deciduous, riparian forest and at least 7 acres of closed canopy, with a canopy height of 16-98 feet and a vegetation understory averaging 3-20 feet (SWCA 2011). The foraging habitat is even larger, averaging 48.4 acres (SWCA 2011). Because of the large nesting and foraging habitats, buffers around observed birds during nesting season are more difficult to implement. USIBWC will work with USFWS to determine reasonable buffers around observed yellow-billed cuckoo sites. Larger and expanded restoration sites are also preferred.

3.2.2.2 Other species

Restoration sites with saltgrass meadow will beneficially impact the Sprague's pipit (SWCA 2011).

The least tern habitat is generally lacking in the RGCP, including sandbars, alkali flats, and non-vegetated shorelines (SWCA 2011); restoration sites with aquatic habitat or inset floodplains could benefit the least tern.

USIBWC Canalization River Management Plan -

PART 4 - CHANNEL MAINTENANCE PLAN

Approval Signatures

Jose A. Nuñez, P.E. — Date: 12/08/16
Principal Engineer, Engineering Department

Carlos Peña, Jr., P.E. — Date: 12/8/16
Principal Engineer, Operations Department

4.1. Introduction and Authority

This Part of the River Management Plan outlines management procedures for operations and maintenance of the Rio Grande channel, stream banks, irrigation water deliveries and drain water returns, siphons, diversion dams, and sediment control dams from Percha Dam in Doña Ana County, New Mexico downstream to American Dam in El Paso County, Texas.

Under the terms of the 1906 Convention, the U.S. Government, through the activities of the USIBWC, has the obligation to deliver 74 million cubic meters (60 thousand acre-feet) of Rio Grande water annually to Mexico. The RGCP was constructed between 1938 and 1943 as authorized by the Act of Congress approved June 4, 1936 (Public law 648; 49 Stat 1463) "to facilitate compliance with the convention between the United States and Mexico concluded May 21, 1906, providing for the equitable division of the waters of the Rio Grande, and to properly regulate and control, to the fullest extent possible, the water supply for use in the two countries as provided by treaty."

The Act authorized construction, operation, and maintenance of the RGCP in accordance with the plan in the Engineering Report of December 14, 1935, which covers the engineering works to implement the 1906 Convention: 1) constructing American Dam and Canal, 2) acquiring a strip of land on each bank of the river, and 3) "a channel designed to carry the ordinary flows of the river, and a flood channel, to be defined by adequate and proper levees, designed to carry the estimated maximum flood flows." The

project included the acquisition of the right of way for the river channel and adjoining floodways and improvement of the alignment and efficiency of the river channel conveyance of deliveries to Mexico, pursuant to the 1906 Convention, as well as conveyance of deliveries to the United States Bureau of Reclamation (USBR) Rio Grande Project in the Mesilla and Rincon valleys of New Mexico and the El Paso valley of Texas, and protection against a flow equal to the largest flood of record in this reach (USIBWC 1994; IBC 1935). The 1935 Report also stated that "in order to prevent meandering of the controlled flow, it is proposed to perform the excavation by suction dredges, discharges the excavated material in such areas" (IBC 1935).

22 U.S.C 277 provides the USIBWC with additional authorization to operate and maintain any projects or works provided for in a treaty entered into with Mexico. USIBWC must maintain the RGCP channel as stipulated in 22 U.S.C 277b, which states that the USIBWC may make improvements to the RGCP, and that "such improvements may include all such works as may be needed to stabilize the Rio Grande" between Percha and American Dam.

In addition, the 2009 Record of Decision (ROD) (USIBWC 2009) required the USIBWC to improve river management by:

- Updating the river management plan,
- Establishing a data collection and evaluation program for channel maintenance,
- Updating and evaluating river cross section data every four to five years and updating hydraulic models,
- Conducting studies and investigations to evaluate channel maintenance activities and levee protection,
- Conducting in-channel enhancements at 3 arroyos (Yeso, Placitas, Angostura) and one inset floodplain (Yeso), and
- Using adaptive management strategies.

4.2 Objectives of USIBWC and Stakeholders regarding channel maintenance

The ROD states that "USIBWC, in consultation with stakeholders, including EBID and EPCWID, will update the May 2004 USIBWC Rio Grande Canalization Project, River Management Plan," including channel management policy. The objectives of USIBWC and stakeholders are discussed in this section. USIBWC has integrated stakeholder objectives into the channel maintenance policy in this Plan, as determined feasible.

4.2.1 USIBWC objectives

USIBWC must ensure that the requirements of the 1906 convention are met. The USIBWC objectives can be summarized by: Flood Conveyance and Flood Protection, Channel Conveyance Reliability, Delivery Efficiency, Compliance with U.S. Regulations, and Minimizing Costs.

Flood Conveyance and Flood Protection. The RGCP was designed to handle, according to the 1935 Engineering Report, a flood flow of 12,000 cubic feet per second (cfs). The 100-year 24-hour peak flows at various locations along the RGCP as estimated from the FLO-2D modeling in 2007 are listed in Table 4-

1 (USACE, Mussetter Engineering, Inc., and Riada Engineering, Inc. 2007). The purpose of a channel maintenance program is to ensure that the river channel geometry remains capable of handling its portion of Design Flood flows safely and protect surrounding urban and agricultural lands from Rio Grande floods.

Table 4-1. 100-year 24-hour routed peak discharges between Caballo and American Dams

Location	Flood-routed (FLO-2D) Rio Grande Peak Discharge (cfs)
Caballo Dam Release	2,350
Trujillo Canyon	4,880
Montoya Arroyo	8,470
Green Canyon	11,600
Tierra Blanca Arroyo	10,430
Sibley Arroyo	12,970
Berrenda Arroyo	14,900
Arroyo Cuervo	15,150
Placitas Arroyo	14,690
Angostura Arroyo	14,300
Rincon Arroyo	14,070
Reed Arroyo	14,110
Broad Canyon	11,690
Faulkner Canyon	10,990
Leasburg Diversion Dam	12,060
Shalem Bridge	13,120
Dona Ana Dam	12,580
Picacho Dam	12,700
Mesilla Diversion Dam	12,870
Vinton, Texas	12,110
Nuway, Texas	13,130
Canutillo, Texas	13,090
Borderland, Texas	11,170
Courchesne Bridge	9,790
American Diversion Dam	10,990

Channel Conveyance Reliability. The RGCP channel was designed to ensure irrigation water deliveries to Mexico and United States water users. The normal flow channel conveys irrigation releases from Elephant Butte and Caballo Dams to the headworks of irrigation projects in New Mexico and Texas developed by the USBR and USIBWC and also conveys waters released for delivery to Mexico under the 1906 Convention. The normal flow channel with baseline river channel dimensions has a depth of 4 to 5 feet, a width ranging from 150 to 500 feet, and a capacity ranging from 2,500 cfs above Leasburg Dam to 1,200 cfs at El Paso (see Figure 4-1). The conveyance system must be reliable to deliver Mexico's 60,000 acre-feet of water annually to the headworks of the Acequia Madre in Ciudad Juarez, Mexico. The 1935

Engineering Report states that the project will ensure "the uninterrupted delivery to Mexico of her treaty allotment of water." Article II of the Convention states that the U.S. will distribute the water via the U.S. irrigation system. Therefore, the normal flow channel must be maintained in accordance to its baseline dimensions to efficiently convey irrigation releases to the United States and Mexico. In addition, all tributaries and irrigation structures draining into the river contribute to the system and must be maintained to efficiently convey drainage flow to the main stem of the Rio Grande.

Delivery Efficiency. Article III of the Convention states that the U.S. assumes the whole cost of storing, measuring, conveying, and delivering water to Mexico. Therefore, it is the obligation of the U.S. to ensure that water charged to U.S. will be conveyed efficiently along the RGCP. Additionally, the 1935 Engineering Report states that the project will protect U.S. lands in New Mexico and Texas "from a threatened shortage of water." Therefore, efficient conveyance becomes especially important during low flow and drought periods.

Compliance with U.S. regulations. The USIBWC must also ensure that U.S. laws and regulations enacted after the Convention and the construction of the RGCP are followed. These include the Clean Water Act, the Endangered Species Act, the National Environmental Policy Act, and the Federal Emergency Management Agency (FEMA) National Flood Insurance Program, among others. The USIBWC is committed to meeting the requirements of the 1906 Convention and the goals of the RGCP while maintaining compliance with these regulations.

Minimize Costs. The USIBWC's primary goals are the above listed; however, if alternatives are available that assist the agency in minimizing costs while still achieving the primary goals, then USIBWC is interested in implementing those lower-cost alternatives.

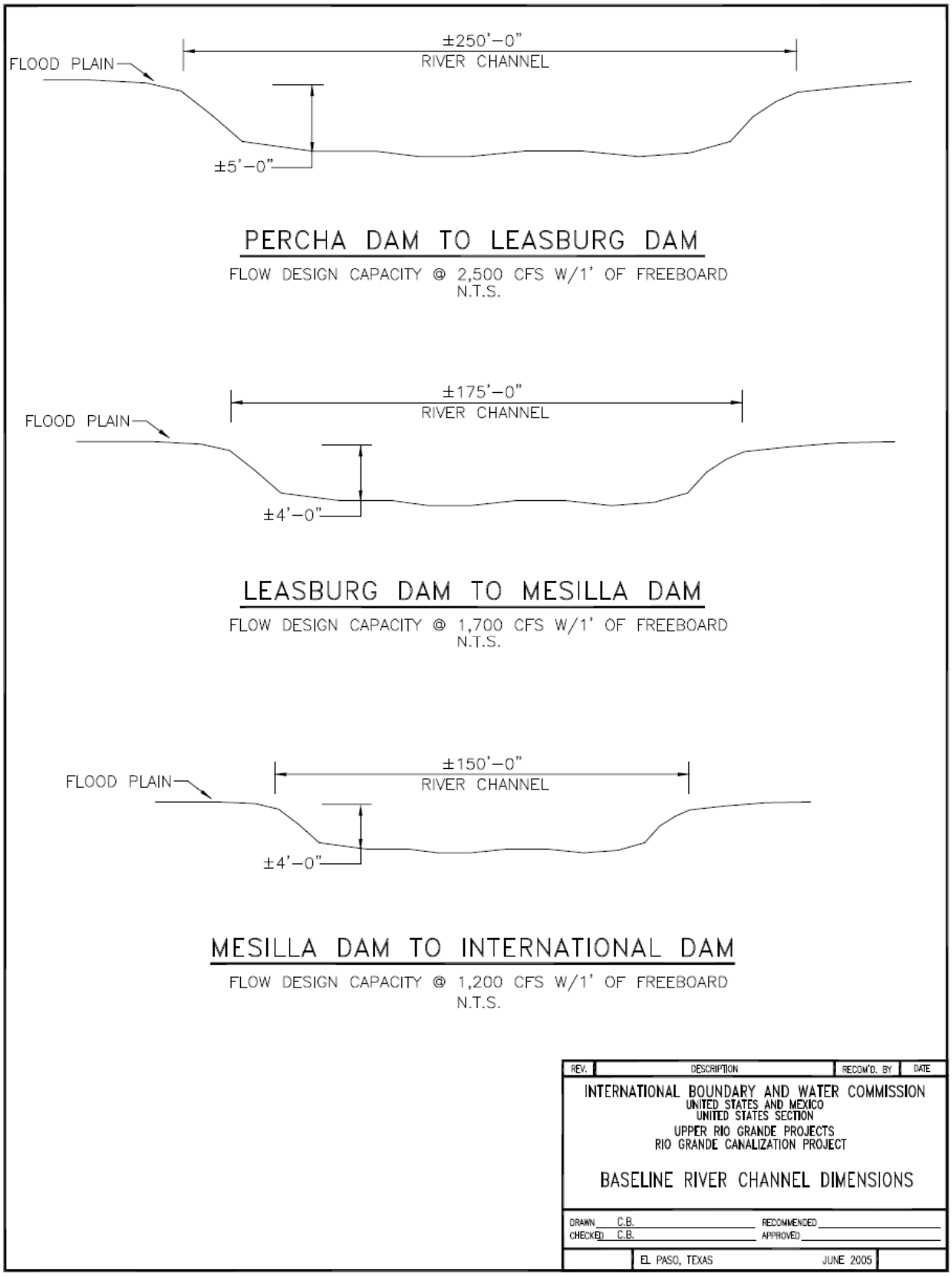

Figure 4-1.Baseline River Channel Dimensions

4.2.2 Stakeholder Objectives

4.2.2.1 Irrigation Districts' Objectives

The Elephant Butte Irrigation District (EBID) and the El Paso County Water Improvement District #1 (EPCWID) must work with USBR and rely upon USIBWC to deliver Rio Grande Project water to their users. The irrigation districts and USBR work with USIBWC to deliver water to Mexico. In addition, USIBWC and EBID work together to operate gated structures during floods (Memorandum of Understanding IBM16P0081).

Irrigation districts objectives can be summarized by Infrastructure Function and Channel Sediment Control, Delivery Efficiency/Timing, Flood Conveyance, and Establishment of Habitat Outside of the River Channel. USIBWC has integrated stakeholder objectives into the channel maintenance policy in this Plan, as determined feasible.

Infrastructure Function and Channel Sediment Control. The canals, laterals, drains, storage reservoirs, and diversion dams and other diversion structures were all designed to function under specific conditions. For example, drains were designed to convey flow into the river at a specific gradient. The irrigation districts need USIBWC cooperation by maintenance of the main channel to ensure proper function of their infrastructure. Issues such as sediment accumulation at the dam headworks or drain outlets and sediment plugs at drain or arroyo confluences cause problems that include slow moving drains, fluctuating water tables (waterlogged farm fields and resulting increases in salinity), inability to open and close gates, and increased costs for the irrigation districts maintenance program to remove sediment. In addition, the sediment limits the flood waters that can pass through the infrastructure. If the infrastructure and channel are properly maintained, then subsequent issues such as raised water tables are also mitigated. Improving sediment flow past diversion structures will also minimize sediment intake into the canal system and delivery to farms. The irrigation districts also want to make sure that sediment accumulation at arroyo confluences with the RGCP and other areas within the channel will not impact their operations (Audubon and EBID 2012).

Delivery Efficiency/Timing. Irrigation districts are interested in maximizing delivery efficiency of the Rio Grande Project water to both U.S. users and Mexico. This includes ensuring that the diversions and timing of releases are minimally affected by such aspects as seepage in the river and island effects which may slow down release schedules. Irrigation districts are accountable to the accounting criteria in their operating agreement (USBR 2016; Audubon and EBID 2012). Recent hydraulic modeling studies have shown increased seepage in the ongoing drought years as compared to previous normal flow years (Tetra Tech, 2013). All costs of delivery to Mexico are assumed by the U.S.

Flood Conveyance. Irrigation districts want to ensure that flood conveyance capacity is maintained in the main stem of the river, and that flood waters are able to pass through their irrigation system into the river. Irrigation districts are interested in having the USIBWC maintain flood water evacuation functions of tributaries, meaning that tributaries will be able to carry their flood flows into the river (Audubon and EBID 2012).

Establishment of Reliable Habitat for Endangered Species Outside of River Channel. Irrigation districts are interested in supporting development of habitat outside of the river channel.

4.2.2.2 Environmental Groups' Objectives

Environmental stakeholder groups that are collaborating with the USIBWC through the ROD Implementation Group include Audubon New Mexico, the Southwest Environmental Center, and the Paso del Norte Watershed Council. Their objectives can be summarized by Natural Channel Processes, Instream and Riparian Habitat, and Water Quality. See Section 4.2.3 for more information on environmental effects. USIBWC has integrated stakeholder objectives into the channel maintenance policy in this Plan, as determined feasible.

Natural Channel Processes. Environmental groups support incorporating natural channel processes to encourage a trend towards dynamic equilibrium that maintains effective water delivery and sediment transport without human intervention. They want adequate sediment available to support shallow water habitats and other riverine processes. Drought conditions may reduce the effectiveness of natural processes.

Instream and Riparian Habitat. Environmental groups support habitat improvements and sustainability for threatened and endangered species and declining native species. Environmental groups want to minimize channel narrowing and lowering of the groundwater table resulting from dredging activities. They want to promote channel management practices that facilitate overbanking processes to support native vegetation and reduce the success of non-native vegetation. They support restoration efforts and management measures that increase in-channel and floodplain habitat complexity and diversity, including aquatic, riparian, and wetland habitats.

Water Quality. Environmental groups are also interested in promoting management actions that will benefit point source and non-point source pollution management to ensure that water quality is not deteriorated in the channel (PdNWC 2014).

4.2.3 Environmental Effects of River Channelization

The environmental effects of river channelization are well documented and it is not the intent or scope of this plan to detail those impacts. To summarize, however, the hydraulic characteristics of a river channel, its depth, velocity, and ability to transport sediment, are all changed with the channelization of rivers. Channel modification can alter instream water temperature and sediment characteristics and the rates and paths of sediment erosion, transport, and deposition. Channel changes alter the nature of river and floodplain interactions resulting in reduced floodplain dynamics such as accretion and erosion. Dredging sediment causes channel narrowing and subsequently lowers floodplain water levels. Dredging activities also loosen sediment and can lead to an increased turbidity and nonpoint source pollutants entering the river and accelerated rate of delivery of pollutants to downstream sites. Alterations that increase the velocity of surface water or that increase flushing of the streambed can lead to more pollutants being transported to downstream areas at possibly faster rates (USIBWC 1994).

Other effects include delayed or interrupted migrations related to fish movement both upstream and downstream by the introduction of barriers and isolation of the main river channel from its alluvial plain,

eliminating access to backwaters, floodplain lakes, and marshes. Generally, these effects have had a major effect on both the ecological diversity of highly productive alluvial corridors and riverine fish populations in rivers. The impacts of channelizing a river include changes to the substrate characteristics and altered space and shelter availability, all impacting benthic organisms and fish within the natural stream. These activities can also lead to loss of wildlife migration pathways and loss of conditions suitable for reproduction and growth (USIBWC 1994).

There are also effects to the riparian habitat along the banks and on the floodplain. As a river channel narrows, it deepens and the adjoining floodplain is inundated less frequently, which fosters conditions favoring vegetation growth on or near the banks, and thereby reducing the width of the active channel. The invasion of riparian vegetation, predominantly by non-native tamarisk, has been extensive in the RGCP and may be attributed to floodplain aggradation and channel narrowing (USFWS 2012b).

USIBWC is implementing habitat restoration as outlined in the ROD. USIBWC is committed to working with environmental groups and evaluating alternatives to mechanical river maintenance to ameliorate some of these environmental effects.

4.3 Channel Maintenance Before and After the ROD

Since the RGCP was completed in the 1940s, the USIBWC has conducted channel maintenance activities as part of its statutory requirements to ensure efficient deliveries and to contain and convey flood flows.

4.3.1 Channel Maintenance before the ROD

The USIBWC's routine channel maintenance activities conducted in the RGCP prior to the ROD included dredging or excavating along the RGCP to control sediment below dam structures; stabilizing banks; removing obstructions such as debris, sediment plugs, or gravel deposits; and maintaining arroyos that act as flood conveyance.

The volumes of sediment removed from the channel and tributaries each year has varied widely. Prior to 1990, between 40,000 and 450,000 cubic yards (CY) of sediment were removed from the main channel each year to maintain normal and flood flow capacities (USIBWC 2000). Quantities after 1990 also varied highly, but ranged from 20,000 to 235,000 CY. When the ROD was signed in 2009, the USIBWC committed to evaluating those practices.

Table 4-2 lists reported sediment excavation volumes for several years from available historical operations and maintenance reports and the 1977 RGCP Environmental Assessment (USIBWC 1977).

Table 4-2. Historic Annual Excavated Quantities in CY			
Fiscal Year	**Channel Excavation**	**Arroyo Earthwork**	**Total**
1954			43,200
1955			91,585
1956			133,796
1972	212,280	78,100	290,380
1973	144,650	143,486	288,136
1974	79,080	34,650	113,730
1975	180,100	67,300	247,400
1976	392,800	56,200	449,000
1995			21,000
1996			25,000
2006	220,000	15,000	235,000
2007	20,000	46,750	66,750
2008	0	0	0

Table 4-3 lists the "5-year maintenance plan" maintenance activities for 2006 to 2008 authorized under the U.S. Army Corps of Engineers (USACE) permits 2005-00569 and SPA-2007-587-ELP (See Section 4.13). Channel maintenance work effectively ceased during the preparation of the ROD, and after its signing, pending the development of this Channel Maintenance Plan.

Table 4-3. Channel Maintenance Activities FY 2006 to 08[1]					
Site Name	**Description of Work**	**Est. Vol. (CY)[1]**	**Actual FY06 (CY)**	**Actual FY07 (CY)**	**Actual FY08 (CY)**
Mesilla Dam to Picacho Bridge	Sediment removal within channel including immediately upstream of dam. Place excavated material along eroded river banks. Dispose material at selected sites	166,667	175,000		
American Dam to Canutillo Bridge		55,556	45,000	20,000	
Trujillo Arroyo	Remove sediment fan and use it as in-fill material to re-establish east bank where erosion has threatened adjacent maintenance road. Re-align arroyo to merge with river at an angle in lieu of perpendicular. Relocate material along arroyo banks	20,000	10,000	10,000	
Placitas Arroyo	Remove sediment fan and re-align arroyo to merge with river at an angle in lieu of perpendicular. Relocate material along arroyo banks	20,000	5,000	10,000 (860 CY rip rap)	

Tipton Arroyo	Remove sediment fan from channel and use it as an in-fill material to re-establish east bank where erosion has threatened adjacent maintenance road	15,000		2,000	
Rincon Arroyo	Re-align arroyo to merge with river at an angle in lieu of perpendicular. Relocate material along arroyo & river banks	33,333			
Sibley Arroyo	Remove sediment fan from channel and re-align arroyo to merge with river at an angle in lieu of perpendicular. Relocate material along arroyo banks and east river bank.	11,111		10,000	
Salem Bridge Area	Monitor large vegetated islands that have formed upstream & downstream of Salem bridge. Removal may be required if islands begin to obstruct flows.	47,777			
Hatch Bridge Area		16,667			
Thurman Arroyo	Relocate sediment material from the arroyo mouth to the opposite river bank to prevent further erosion. Place rip-rap along riverbank.	NA		7,250 (10,500 CY rip rap)	
Hersey Arroyo	Relocate sediment material from the arroyo mouth to the opposite river bank to prevent further erosion	NA		7,500	
	Total	386,111	235,000	66,750	0

[1]-From the 2006 to 2010 5-year Maintenance Plan under USACE Action No. SPA-2007-587-ELP

4.3.2 ROD Requirements for Channel Maintenance

Excerpts from the ROD regarding channel maintenance are listed in Box 4-1 (emphasis added). Additional excerpts regarding data collection and monitoring are in Section 4.7 and Box 4-3.

BOX 4-1. Excerpts from ROD regarding Channel Maintenance

- To ensure efficient water delivery, the **selected alternative allows for maintenance of the river, removal of obstructions from the river, and dredging under an adaptive management program.**
- Trends in aggradation and degradation in the Rio Grande Canalization Project were evaluated. There is a slight aggradational trend (≤0.04 ft/yr) in three of the thirteen reaches including Rincon Siphon to Bignell Arroyo, Picacho Bridge to Mesilla Dam and Mesilla Dam to Vado Bridge. From the head of Selden Canyon to American Dam, the transport capacity is approximately in balance with the supply.
- The effect of channel maintenance activities including channel dredging, and removal of sediment plugs at and immediately below arroyo mouths, vegetated islands and sand bars on water deliveries (timing and water volume) and flood control was evaluated. Preliminary results indicate that historical channel maintenance practices generally have minimal impact on the water delivery efficiency in terms of volume and arrival of irrigation releases. The over-excavation currently practiced when removing sediment plugs is likely unnecessary and short-lived. **The question of the overall necessity of channel dredging will be investigated through additional monitoring and modeling**.
- An alternative management approach to maintaining or increasing the flood conveyance capacity of the channel is to **enable the channel to expand or migrate where constrictions occur**. Under this approach, rip-rap would be removed at the toe of the bank and channel stabilization activities would be curtailed, though levees in such reaches would have to be reinforced to ensure that the channel migration does not compromise the levee integrity. Supplementary erosion protection at the foot of the levee is advisable with this approach.
- **Additional evaluation of future channel maintenance activities using an adaptive management program is warranted** to justify annual maintenance expenditures.
- **Approaches to channel restoration include bank cutting, bank destabilization and cessation of dredging.**
- Channel management and maintenance activities could **include dredging, island removal, arroyo realignment, arroyo mouth management, inset floodplains, bank destabilization and removal of rip-rap at the toe of the bank**. Additional studies and investigations will also be necessary to ensure that the levees are capable of providing flood protection in such reaches as flood levels may increase and river channel migration may present a scour threat to the levees.
- USIBWC, in consultation with stakeholders, including EBID and EPCWID, will update the May 2004 USIBWC Rio Grande Canalization Project, River Management Plan (RMP). The purpose of the RMP will be to **identify specific goals and objectives for channel management, establish a data collection and monitoring program in support of these objectives and goals, and provide recommendations or guidelines for channel management policy**.

4.3.3 Channel Maintenance Approach – Fiscal Years 2009-2016

From 2009 to 2013, after the signing of the ROD, USIBWC stopped almost all channel maintenance with the exception of sediment excavation at the gates of American Dam, as shown in Table 4-4. Lack of channel maintenance and low flows caused by drought conditions led to numerous sediment plugs and issues that required the USIBWC's attention. In December of 2013, USIBWC drafted a preliminary working draft of this Channel Maintenance Plan and distributed to ROD stakeholders for review. The draft proposed that during 2014-2015, USIBWC continue with some of the activities conducted before the signing of the ROD while the USIBWC evaluated alternatives and conducted further discussions with stakeholders. During 2014-2015, USIBWC implemented the preliminary working draft of the channel maintenance plan. This included resuming channel excavation activities from the 5-year Plan. From September 2014 to October 2015, USIBWC contractors conducted a *Channel Maintenance Alternatives* (CMAs) *and Sediment Transport Study for the RGCP* (henceforth referred to as the "2015 CMA Study". The final report and recommendations are discussed in Sections 4.16.1, 4.17.2 and 4.17.3. This Channel Maintenance Plan was revised in summer 2016 to incorporate recommendations from that study as well as comments received on the December 2013 preliminary working draft of the Channel Maintenance Plan.

During 2014-2016, USIBWC:

- Continued some pre-ROD maintenance activities, shown in Table 4-4, as defined in the updated 5-year plan (Section 4.6.1)
- Conducted new procedures for documenting channel work, including pre-and post-monitoring and justification, as documented in Section 4.6.2 and 4.6.3
- Contracted the 2015 CMA Study, which:
    - updated the HEC-RAS hydraulic model and sediment transport models, as described in Section 4.4.3, and developed localized sediment transport models
    - evaluated the need for sediment removal within the channel at nine representative problem locations listed in Table 4-5
    - evaluated alternatives for nine problem locations for sediment work at nine problem locations listed in Table 4-5
    - evaluated what other agencies are doing for channel maintenance (such as the Bureau of Reclamation in the Middle Rio Grande)
    - evaluated alternative projects and infrastructure for longer-term solutions (examples are listed in Section 4.16 and 4.17)
    - evaluated the lifespan of dredging/excavation activities
    - evaluated impacts of islands and tributary sediment on flood conveyance and channel conveyance efficiency
    - presented progress and results to stakeholders and incorporated stakeholder comments.
- Began monitoring, as described in Section 4.7
- Began identifying long-term infrastructure and other long-term solutions (examples are listed in Section 4.16 and 4.17)

- Contracted design work for two channel maintenance alternatives (sediment traps on Thurman I and II arroyos) identified in the 2015 CMA Study
- Conducted initial legwork for implementation of infrastructure projects, described in Section 4.16 and 4.17
- Conducted channel maintenance listed in Table 4-4
- Initiated a Rio Grande Sediment Control Initiative with regional stakeholders (Section 4.17.5)
- Updated this Channel Maintenance Plan with results of studies and stakeholder discussions.

Table 4-4. Channel Maintenance Activities (Sediment Removal) FY 2009 to 2016, After ROD

Site Name	FY09 (CY)	FY10 (CY)	FY11 (CY)	FY12 (CY)	FY13 (CY)	FY14 (CY)	FY15 (CY)	FY16 (CY)
Tipton Arroyo							1,900	
Trujillo Arroyo	4,000						8,850	
Montoya Arroyo						636	4,750	
Holguin Arroyo							4,000	
Tierra Blanca/Green Arroyos						4,740	5,700	
Hatch Siphon						3,590		
Placitas Arroyo	Cleared vegetation					7,544		
Rincon Siphon					400	5,000		
Rincon Arroyo						21,189		
Hershey Arroyo								20,000
Tonuco Drain								47,046
Mesilla Dam to Picacho Bridge								32,500
American Dam to Canutillo Bridge			14,055 (America n Dam)			15,320 (Montoya Drain)	58,250 (Montoya Drain) 14,200 (American Dam)	
Total	4,000	0	14,055	0	400	58,019	97,650	99,546

4.3.4 Channel Maintenance Approach for 2016-2019

For the period from the last half of 2016 to June 2019 (the end of the ROD timeframe), USIBWC proposes to:

- Begin implementing alternatives to channel maintenance and phase out pre-ROD maintenance activities, as appropriate
- Work out long-term solutions
- Evaluate potential impact to levees for allowing the river to meander within the levee infrastructure at points below tributaries
- Implement channel maintenance activities as documented in this final Channel Maintenance Plan.

4.3.5 Long-term Channel Maintenance Approach for 2019 and beyond

USIBWC commits to updating the Channel Maintenance Plan every five years or as needed, including any changed circumstances or new decision documents in place. In addition, USIBWC commits to evaluating and implementing feasible long-term solutions for channel maintenance. Such options are listed in Section 4.16 and 4.17.

4.4 Hydrologic, Hydraulic, and Sediment Transport Modeling

Hydraulic analysis has improved understanding of the flow characteristics along the RGCP during both high flood flow and lower irrigation flow conditions. Pre-ROD, hydraulic modeling results have indicated that while individual sediment plugs do not raise water surface elevations beyond 0.5 foot, the cumulative effect of sediment deposition will cause significant changes to flow conditions, such as increased water surface elevations, increased velocities, and scouring of the river banks. For this reason, it is important that sandbars and arroyo mouth sediments in the river channel be removed as quickly as possible. Detailed simulations performed in several studies have also identified optimal restoration sites and methods. Post-ROD, USIBWC will update the hydraulic, hydrologic and sediment models to evaluate the best management procedures. Model maintenance will continue including new structures, evaluating current flood risks, and quantifying channel seepage, sediment transport and other components.

4.4.1 Models

There have been several detailed modeling studies along the RGCP. These are briefly described below:

- In 1996, the USACE conducted a detailed hydrologic, hydraulic and sediment analysis of the RGCP. This study included HEC-1 modeling for the approximately 900-square mile drainage area. A HEC-2 hydraulic model computed water surface profiles. Using the Modified Universal Soil Loss Equation (MUSLE) to estimate the wash load and the HEC-6 sediment transport model for the bed load, the total sediment load was obtained for 20 arroyo basins along the RGCP for the 2-, 5-, 10-, 25-, 50- and 100-year storm events and the average annual storm (USACE and Resource Technology, Inc 1996; URS 2013; Unnikrishna 2012).
- In 2003, Parsons created a HEC-RAS model for the Environmental Impact Statement process (Parsons 2004b).

- In 2005, a FLO-2D model of the RGCP was developed by Tetra Tech for the Upper Rio Grande Water Operations Study (Tetra Tech 2005). This model evaluated and updated the 1996 HEC-1 model as well as the 2003 Parsons HEC-RAS model. The 100-year floodplains were mapped based on FLO-2D simulations. This 2005 study also evaluated the 1996 sediment studies and recommended adjustment factors.
- In 2007, the USACE updated the 2005 FLO-2D model in the Baseline Report (USACE, Mussetter Engineering, Inc., and Riada Engineering, Inc. 2007). This baseline conditions investigation assessed overbank flow potential and geomorphologic processes within the RGCP reach (Unnikrishna 2012). It also evaluated 20 previously selected restoration sites and identified additional feasible sites along the RGCP corridor.
- In 2009, the USACE analyzed the restoration potential at 30 restorations sites using the 2007 model (USACE 2009). The study included a sediment continuity analysis to evaluate the potential for aggradation and degradation for reservoir operations. A cumulative effects analysis was performed to evaluate the effects of all proposed restoration activities on water surface elevations, flood wave attenuation and timing, channel stability and other factors (Unnikrishna 2012).
- In 2013, URS developed a smaller 50-foot grid FLO-2D model for eleven (11) arroyos contributing from the east in the Vinton Bridge to Borderland Bridge reach. Arroyo flows were calculated using a HEC-HMS model. The results were used to design approximately six (6) miles of levee improvement projects in the Canutillo, Texas area (URS 2013).
- In 2013, Tetra Tech completed a Preliminary Water Budget Study that determined the extent to which the amount of Rio Grande Project water would be available for diversion to US irrigators and for delivery to Mexico under different release scenarios compared to the actual 2012 release. Hypothetical normal release (end March to mid September) and delayed release (end May to mid September) scenarios were explored (Tetra Tech 2013). Part of this work was to update the 2007 FLO-2D and HEC-RAS models to estimate the 2012 seepage.
- In 2015, Tetra Tech completed the Channel Maintenance Alternatives and Sediment Transport Study for RGCP which included updating the HEC-RAS model with locally surveyed cross sections at the nine problem locations and creating sediment-transport models in HEC-RAS Version 4.1.

4.4.2 Studies

The Riada Engineering (2009) study determined that channel maintenance activities to remove individual sediment plugs and islands have minimal impact on the flood maximum water surface elevations and irrigation in terms of volume and arrival of the irrigation releases. In addition, the study found that the lifespan of such expensive maintenance activities is relatively short (ranging from months to 1.7 years). However, the same study also stated that the cumulative effect of the formation of islands and sediment plugs in the channel can be more pronounced than the impact of individual islands and plugs. In response to a general 100-year storm over the entire basin where all of the arroyos create sediment plugs simultaneously in the channel, the maximum flood water surface can increase up to two feet in specific locations. The same study also showed that flood water surface elevations could increase up to two feet in specific locations as a result of sediment buildup (Riada Engineering, Inc. 2009).

Similarly, the 2007 USACE study stated that "the profile and sediment continuity data suggest that there may be more hydraulic capacity in the RGCP than was initially designed, and extensive removal of sediment from the river may, therefore, not be necessary to maintain conveyance capacity, at least in portions of the reach" (USACE 2007, p 6.18).

It must be noted that previous studies have assumed a dynamic equilibrium of sediment inflow and outflow along the RGCP. However, individual storm events can bring in more sediment from the tributary arroyos that, in the absence of efficient transport downstream and removal, will accumulate within the RGCP. Under flooding conditions, the resulting water surface elevation increase will compromise levee freeboard and increase the risk of flooding to adjoining communities. USIBWC verified this in 2013 using HEC-RAS modeling at the Montoya Drain outfall location.

The USACE 2007 report also indicated that sediment delivery events "have significant local impacts on the mainstem Rio Grande, primarily in the portions of the RGCP upstream from Selden Canyon" where channel blockage occurs by coarse-grains tributary fans, causing upstream backwater, overbank flows, and flow conveyance losses. In addition, the sediment may damage existing bank protection or lead to lateral migration of the river, both causing "potential threats to the integrity of the levee system or other channel margin infrastructure such as bridges and siphons" (USACE 2007, p 6.9).

Under irrigation flow conditions, hydraulic modeling studies have indicated increased seepage in the ongoing drought years as compared to the previous normal flow years (Tetra Tech 2013). Seepage will increase further with the accumulation of sediment in the main channel, reducing the efficiency of irrigation water deliveries during a time of water shortage.

Therefore, accumulation of sediment has an adverse localized impact during both high flow and low flow conditions. The ROD contemplated addressing some channel maintenance issues with new approaches and adaptive management. Although the ROD listed the cessation of dredging as a channel restoration approach, it did not rule out dredging and pre-ROD maintenance activities altogether. The ROD listed channel management and maintenance activities, including dredging, island removal, arroyo realignment and arroyo mouth management, along with other more non-traditional activities such as bank destabilization.

The 2015 CMA Study also analyzed sediment transport and aggradation/degradation of the river, and the study concurred with the previous studies regarding predicted and observed aggradation and degradation patterns. The study did indicate that localized sediment buildup was an issue and that addressing the sedimentation would result in lower predicted water surface elevations (Tetra Tech 2015). Figure 4-2 compares the Pre-Canalization, 1943 design and 2004 thalweg profiles of the RGCP, as well as the changes in elevation between the Pre-Canalization and 1943 profiles (green line) and between the 1943 profile and the 2004 profile (red line). The study documented the following aggradation and degradation in the RGCP since 1943:

- From Percha Dam to the Hatch Siphon - historically degraded between 4 and 6 feet
- From the Hatch Siphon to the head of Selden Canyon - Immediately downstream of the Hatch Siphon, the channel has historically degraded about 10 feet. For the remainder of the upper part

of the subreach, the degradation reduces from about 6 feet in the upstream end to about 1 foot upstream of the Rincon Siphon. Downstream of the Rincon Siphon, there has been about 9 feet of degradation, but the degradation diminishes in the downstream direction to about 2 feet. Upstream of Bignell Arroyo there has been about 2 feet of aggradation

- From the head of Selden Canyon to Leasburg Diversion Dam - There are no comparative thalweg data for this subreach, but under low-flow conditions the bed of the channel is braided and appears to be mildly aggradational.
- From Picacho Bridge to the Mesilla Diversion Dam - 2 to 3 feet of historical degradation
- from the Mesilla Diversion Dam to the Vinton Bridge - up to 8 feet of historical degradation downstream of the Mesilla Diversion Dam, but the amount of degradation diminishes in the downstream direction to about 1 foot
- from the Vinton Bridge to the American Diversion Dam - up to 2 feet of aggradation

The 2015 CMA Study is discussed in more detail in the following section.

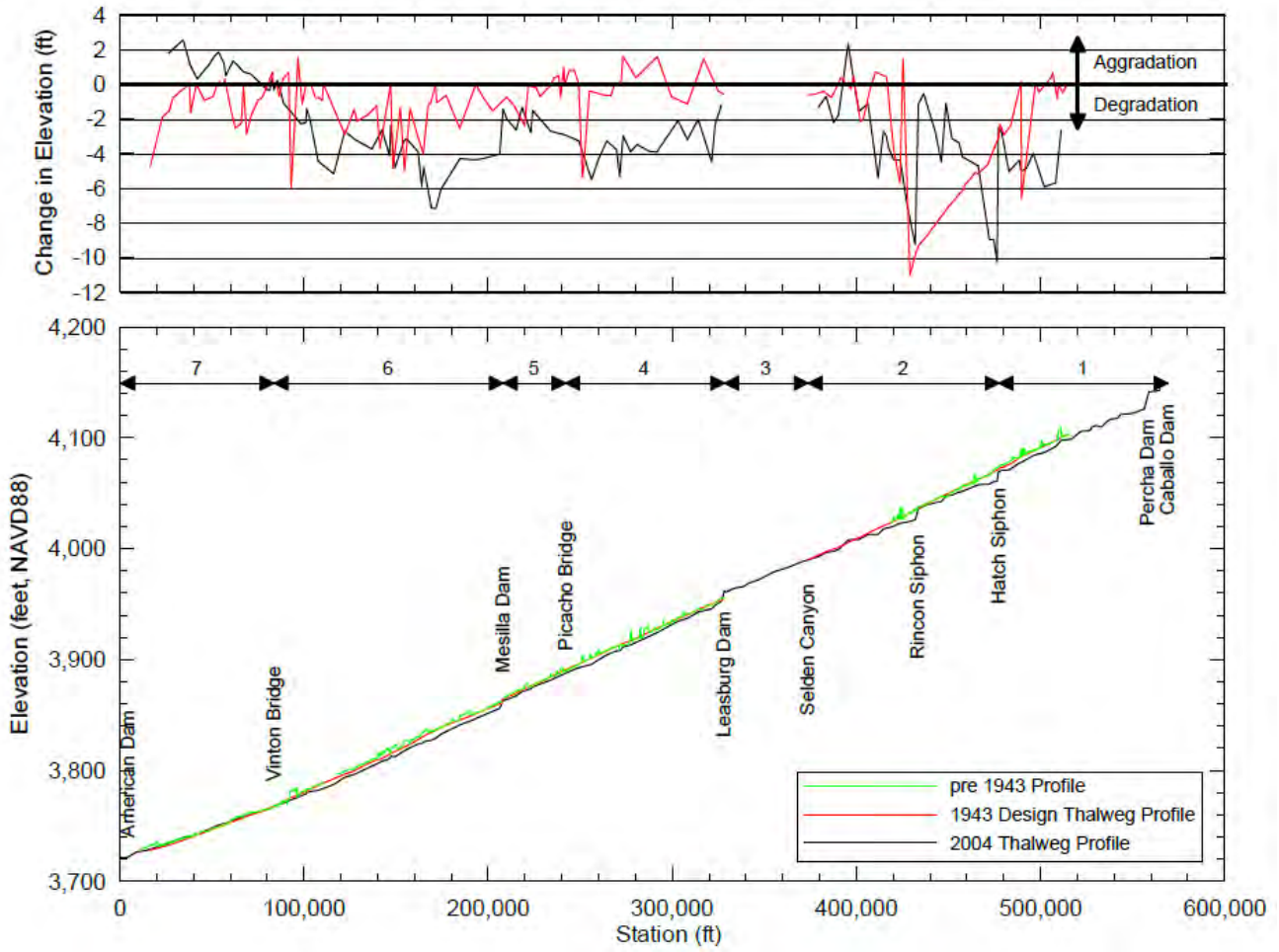

Figure 4-2. Pre-Canalization, 1943 design and 2004 thalweg profiles of the RGCP. (From 2015 CMA Study Fig 2)

4.4.3 2015 Channel Maintenance Alternatives and Sediment Transport Study

In September 2014, the USIBWC contracted Tetra Tech to undertake the Channel Maintenance Alternatives and Sediment Transport Study to evaluate sedimentation issues along the RGCP at nine representative problem locations, listed in Table 4-5. Objectives of the study included:

- Update the base HEC-RAS model with additional components such as the latest levee; information and changed site conditions, updated cross section survey data, and 2011 LIDAR data;
- Conduct additional hydraulic modeling to provide quantitative measures to support the stated goals of the ROD;
- Conduct sediment transport analyses to study sediment aggradation/degradation along the RGCP under normal operations and in response to storm events to obtain and understanding of required operations and maintenance consistent with the ROD;
- Analyze impacts of sediment plugs on water surface elevations at particular locations;
- Analyze impacts of channel maintenance, such as island removal and sediment excavation, and other representative site-specific characteristics such as an existing vortex weir, dams, islands, arroyos, and drains;
- Propose and analyze alternatives to sediment removal;
- Evaluate sediment removal and non-sediment removal channel maintenance options using a set of evaluation criteria; and
- Recommend the top scoring channel maintenance alternatives for implementation at each of the nine representative problem locations.

Results from the study are documented in the October 2015 final report (Tetra Tech 2015) and provide a suite of alternatives to reduce or minimize sediment issues. The report identified the most efficient, sustainable, and environmentally beneficial alternatives, both sediment removal and non-removal. The study evaluated five channel maintenance alternatives (CMAs) at each of the nine problem locations, including three classified as sediment removal alternatives (short, long, and localized excavation scenarios) and two that were classified as non-sediment removal alternatives and varied by problem location. The study included field reconnaissance, cross section surveying, steady-state hydraulic modeling of the existing conditions and with CMAs, sediment transport modeling of the problem locations, and evaluation of CMAs.

Non-sediment removal CMAs considered under the study included:

- Vortex weir
- Arroyo sediment traps
- Island destabilization/ vegetation removal
- Siphon modifications
- Low-elevation spur dikes
- Dam gate automation
- Sluiceway and check structures
- Rip rap

Alternatives were evaluated using the following criteria:

- reduction in water-surface elevation along the modeled reach,
- reduced levee freeboard encroachments,
- groundwater benefits, which include the benefit of increased groundwater levels in the vicinity of restoration sites as well as reduced groundwater levels elsewhere, particularly at drains,
- reduction in aggradation and downstream sediment loading,
- improved irrigation drain return flows,
- durability of the alternative,
- restoration benefits, in addition to benefits associated with increased groundwater levels, and
- additional site-specific benefits.

The costs and consequences considered in assessing the alternatives included:

- annualized total cost of the alternative based on the up-front construction cost and projected O&M costs,
- increases to water-surface elevation along the modeled reach,
- levee freeboard encroachments,
- groundwater consequences, which include the consequence of decreased groundwater levels in the vicinity of restoration sites as well as increased groundwater levels elsewhere,
- increases to aggradation and downstream sediment loading,
- increased bank erosion potential,
- restoration consequences, in addition to those consequences associated with increased groundwater levels, and
- additional site-specific consequences.

Recommendations for CMAs to implement are discussed in Sections 4.16.1 and 4.17 and Tables 4-12 to 4-14.

Table 4-5 Problem Areas evaluated in the 2015 CMA study

Problem Location		Representation	River Mile Range (miles upstream of American Dam)	Length (miles)
1.	Tierra Blanca Creek to Sibley Arroyo	Vortex Weir	97.8 - 100.1	2.3
2.	Salem Bridge to Placitas Arroyo	Arroyos and Islands	84.4 - 88.2	3.8
3.	Rincon Siphon A Restoration Site to Rincon Siphon	Restoration Sites and Siphon	82 - 82.8	0.8
4.	Rincon Arroyo to Bignell Arroyo	Arroyos and Islands	75.5 - 79	3.5
5.	Rock Canyon to 1.4 mi below Rincon/Tonuco Drain Confluence	Drain and Mouth of Selden Canyon	68.9 - 71.8	2.9
6.	Picacho Drain to below Mesilla Dam	Drain, Canals, and Dam	38.8 - 41.2	2.4
7.	East Drain to below Vinton Bridge	Drain and Arroyo	14.8 - 16.6	1.8
8.	Upstream of Country Club Bridge to NeMexas Siphon	No Inputs, Bridge, Populated Area, Levee Encroachments	7.1 - 8.6	1.5
9.	Montoya Drain to American Dam	Drain, Dam	0 - 2.7	2.7

4.4.4 Updating Cross Sections

In July 2004, 145 cross sections were surveyed by Tetra Tech. These included 66 cross sections between Caballo and Leasburg Dams, 25 cross sections between Leasburg and Mesilla Dams, and 54 cross sections between Mesilla and American Diversion Dams (Tetra Tech 2004). The ROD committed the USIBWC to updating cross sections in the RGCP. The updated cross sections are used to update hydraulic models and to evaluate the need and effectiveness of channel maintenance measures. The following are tasks related to the collection of updated cross sections:

- In 2011, an additional 15 cross sections were proposed by the ROD Implementation Group for surveys, for a total of 160.
- In 2011, USIBWC collected Lidar data along the RGCP during low flow season.
- In 2013 and 2014, selected cross sections were resurveyed by USIBWC staff in areas where sediment work was planned, including Placitas and Rincon arroyos.
- In 2014, additional areas were resurveyed by Tetra Tech/Del Sur and in 2015 by USIBWC as part of the 2015 CMA Study. Surveys included some of the original 160 cross sections.
- In 2015 and 2016, USIBWC surveyed upstream of Mesilla Dam as part of the monitoring program.
- In 2016, USIBWC contracted a resurvey of the full 160 cross sections.

USIBWC may consider acquiring additional LIDAR data in subsequent years. See Section 4.7 for additional data collection and monitoring.

4.5 Dam Maintenance

The RGCP is comprised of a series of diversion and sediment control dams maintained by USIBWC and other entities.

4.5.1 American Diversion Dam

The American Diversion Dam, defining the southern boundary of the RGCP, is owned, operated and maintained by the USIBWC. The USIBWC Upper Rio Grande Area Operations Manager cooperates and coordinates dam operations with the USBR to ensure that water delivery objectives are met. Normal maintenance of the American Diversion Dam is performed during the non-irrigation season (typically October to March).

Gates at American Diversion Dam were replaced in FY2014. Dredging at American Diversion Dam is covered under Section 4.6.1.2.

4.5.2 Other Diversion Dams

Three diversion dams associated with the RGCP (Percha, Leasburg, and Mesilla Dams) are operated and maintained by the EBID and owned by the USBR. (See Section 4.6.1.2 for channel maintenance at Mesilla Dam).

4.5.3 Maintenance of NRCS Dams by USIBWC

There are five (5) sediment control dams built by the Natural Resources Conservation Service (NRCS) (originally the Soil Conservation Service (SCS)) of the U.S. Department of Agriculture. In the 1960s, the

SCS conducted reconnaissance studies of means of controlling the sediment inflow from tributary streams into the RGCP in the Rincon valley and into the Selden Canyon in order to reduce project maintenance costs to economic levels. The SCS found that flood and sediment retention dams could be considered under its Public Law 566 program for 11 arroyos tributary to the Rio Grande between Caballo and Leasburg Division Dams. Between 1969 and 1975, five sediment control dams were completed on four arroyos. They are designed, with one exception, to provide sufficient storage capacity to contain an estimated 100 years of sediment inflow and to control the estimated 100-year flood. The exception (Broad Canyon) is designed to contain 100 years of sediments and control an estimated 50-year flood. These dams control flood runoff to the RGCP from 39 percent of the watershed upstream from Leasburg Dam (USIBWC 2000).

USIBWC performs maintenance of these dams, as authorized by Congress on September 18, 1964, under Public Law 88-600 (78 Stat. 956), which authorized the USIBWC to enter into contracts with local organizations for maintenance of these dams, in recognition of the savings in maintenance costs of removing sediments from the RGCP. Additional authorization is in 22 U.S.C. 277d-29 as well as under an agreement with EBID and Caballo Soil and Water Conservation District (CSWCD) (IBM 65-356 dated December 10, 1965, and Supplement No. 1, dated February 15, 1974). Maintenance work includes the dam itself (intake, outlet, and outlet channel structures) and accompanying access roads constructed by NRCS. A joint annual inspection that may include the CSWCD, EBID, the NM State Engineer, and the USIBWC will be performed on the structures to assess maintenance needs. Inspections usually take place after the irrigation season in late fall or early winter. For example, in November 2015, inspections provided action items for rodent traps, woody vegetation removal from outlet channel, and gate or staff gage repair.

The five dams that are maintained by USIBWC as part of the RGCP include Broad Canyon, Crow Canyon, Green Arroyo, and Jaralosa Arroyo (two dams). The USIBWC mows the discharge channel slopes; cleans and maintains trash racks, intake structures, and outlet structures; repairs fences; and grades access roads. The USIBWC monitors the level of sediment in the dams in order to ensure that the outlet gates on the discharge structure are set to the proper level. This maintenance allows the dams to perform effectively in reducing sediment load to the river and reducing flooding potential. Public Law 93-126; 87 Stat. 451, approved October 18, 1973, limits the USIBWC maintenance activities to $50,000 per year (Parsons 2004a).

Table 4-6 lists the 1975 conditions of the 5 constructed dams (USIBWC 2000).

Table 4-6 Soil Conservation Service, Public Law 566 Projects, 1975 Conditions

Arroyo/Dam	Completed	Drainage Area Regulated (Sq. Mi)	Capacity in Acre-Feet			Height (Feet)
			Sediment	Flood	Total	
Broad Canyon, No. 1	1969	64	2,625	3,405	6,030	70.5
Crow Canyon, No. 2A	1971	120	3,945	7,384	11,329	65.5
Green Arroyo, No. 1A	1972	31	1,320	1,612	2,932	90.2
Jaralosa Arroyo No 4	1975	86	3,427	2,891	6,318	91.5
Jarralosa Arroyo No. 5	1975	6	389	327	716	27.5
Total		307	11,706	15,619	27,325	

4.6 Channel Maintenance Planned Activities

4.6.1 Routine River Channel Maintenance Work and 5-Year Plan

As discussed in Section 4.3.3, the USIBWC's channel maintenance approach will follow the 5-year plan for 2014 through 2019, while working to implement long-term alternatives.

Areas with chronic sediment problems require sediment removal on a near-annual basis to restore the river channel to its baseline dimensions (Figure 4-1). USIBWC will continue sediment removal in these areas as necessary. During this timeframe, USIBWC will be considering and implementing some alternatives outlined in Sections 4.16 and 4.17.

4.6.1.1 Five-year Maintenance Plan for 2014-2019

During the five-year period of 2014 to 2019, USIBWC anticipates removing river sediment material from the river channel and arroyo mouths, as determined necessary. The areas of routine channel maintenance and estimated sediment removal volumes are summarized in Table 4-7 and described in detail in the 5-year plan below.

USIBWC proposes to conduct sediment removal activities in the 5-year Plan on a rotating basis, as needed, based on frequency ranking of each site. The frequency listing is as follows:

- **High** - annual maintenance is likely
- **Medium** - monitor annually to ensure that obstruction to flow is not occurring; may not require work more than once every three to four years
- **Low** - monitor annually to ensure that obstruction to flow is not occurring; may not require work more than once every five years

The 2015 CMA study estimated the maintenance period for various volumes and lengths of excavation (Localized, Short, and Long). These terms vary per location but are referenced when appropriate. In addition, the estimated maintenance period is included for each area where analyzed. Frequency listing did not change in this plan as a result of the 2015 CMA Study results, but need for action will be verified in the field and maintenance conducted as needed.

The estimated volumes of sediment in Table 4-7 are estimated from sediment transport studies, from visual inspection and calculations, and from modeling efforts. Actual quantities will depend on rainfall conditions. Volumes for areas studied in the 2015 CMA Study were incorporated into Table 4-7. Other areas, such as arroyos not studied, were taken from previous 5-year plan estimates and historical trends for sediment deposition in the area.

Table 4-7. 5-year Plan for Proposed Channel Maintenance Activities FY 2014-2019			
Site Name	**Frequency**	**Estimated Volume of Sediment Excavation (Cubic Yards)**	**Estimated Bank Stabilization (Linear Feet)**
Tipton Arroyo	MED	5,556	NA
Trujillo Arroyo	MED	6,667	300 (east bank)
Montoya Arroyo	LOW	4,750	NA
Holguin Arroyo	LOW	4,000	NA
Tierra Blanca/Green Arroyos	LOW[1]	21,780	NA
Sibley Arroyo	LOW[1]	13,300	NA
Hatch Siphon	HIGH	3,704	NA
Salem Bridge	LOW	35,556	NA
Thurman I and II Arroyo	LOW[1]	8,340	NA
Placitas Arroyo	HIGH[1]	13,000	NA
Hatch Bridge	LOW	33,333	NA
Rincon Siphon	HIGH[1]	15,000	NA
Garcia I Arroyo	LOW[1]	11,330	NA
Rincon Arroyo to Bignell Arroyo (includes Reed)	HIGH[2]	85,051	400 (west bank at Rincon)
Hersey Arroyo	LOW	6,944	NA
Rock Canyon to 1.4 mi below Rincon/Tonuco Drain Confluence	MED[2]	71,240	NA
0.17 miles upstream of Mesilla Dam to Mesilla Bridge	MED[1]	58,170	NA
East Drain to Vinton Bridge	LOW	38,050	NA
Country Club Bridge	HIGH	43,000	790 (west bank)
Sunland Park Bridge to American Dam	HIGH	176,250	NA
Total		**655,021**	**1,490**

1 – CMAs were identified in the 2015 CMA study in lieu of excavation

2 – According to 2015 CMA Study, frequency will be reduced if Long Excavation is completed. Volumes noted are Long Excavation volumes from the study for Tierra Blanca, Rincon/Reed, Mesilla Dam, and Anapra Bridge to American Dam.

Table 4-8 compares the calculated sediment excavation volumes from the 2015 CMA Study to the previous 5-year plan estimated excavation volumes, along with maintenance period calculated by the 2015 CMA Study. The volumes in this section are chosen based on a maintenance period of at least 5 years. Although the 2015 CMA Study recommended that Long Excavation be done whenever sediment removal is conducted, the shaded cells are the selected volumes based on at least a 5-year durability as assessed by Tetra Tech in that study.

Table 4-8. Comparison of Excavated Volume Calculations						
Site Name	**Annual Sediment Yield (CY)** [1]	**Previous 5-year Plan Estimated Volume of Sediment Excavation (CY)** [2]	**2015 CMA Study Estimated Volume of Sediment Excavation (CY)** [3]			**Average Maintenance Period (years) and Recommended Excavation Scenario**[4]
			Localized	**Short**	**Long**	
Tierra Blanca	30,573	8,888	1,570	7,250	21,780	Long – 2.8
Sibley	12,891	11,111	4,180	13,300	26,740	Short - 4.9
Thurman I and II	3,194	7,767	8,340	71,580	126,890	Localized - 6.8
Placitas	15,924	10,000	7,680	13,000		Short - 4.8
Garcia	5,647	10,000	11,330	17,220	36,370	Localized - 8.8
Rincon	58,403	25,000	13,200	24,690	66,940	Long - 9.7
Reed	4,679	11,333	6,730	16,050		
Bignell	613	11,667	18,111	24,550	154,650	Localized - 10
Rincon/Tonuco Drain	--	33,333	71,240	100,920	221,880	Localized - 10.4[2]
Mesilla Dam	--	58,333	--	35,540	58,170	Long - 6.7
East Drain to Vinton Bridge	--	--	4,330	38,050	48,160	Short - 7.6
Country Club Bridge	--	Bank stabilization only	8,770	21,520	43,000	Long - 4.7
Sunland Park Bridge to American Dam	--	55,556	15,650	38,130	176,250	Long - 10.4

Shaded boxes are what is included in the 5-Year Plan (Table 4-7).

[1] – From USACE 2007

[2] – From the 2006 to 2010 5-year Maintenance Plan under USACE Action No. SPA-2007-587-ELP

[3] – From 2015 CMA Study (Tables 28 and 29 of 2015 CMA Study)

[4] – 2015 CMA Study recommended Long excavation at Rincon/Tonuco Drain and East Drain to Vinton Bridge; however, the study indicated that maintenance period of localized and short excavation, respectively, would have a durability of over 5 years

The following is a description of the 5-year Maintenance Plan areas. They are listed from north to south. River Miles commence at American Dam, in El Paso, Texas and increase upstream.

TIPTON ARROYO

Located at River Mile RM 104 (See Section 4.19 Map 1 of 33). Sediment fan has built up immediately downstream from the arroyo mouth. Propose to remove arroyo sediment from river channel. Estimated sediment removal: 5,556 CY. Frequency: MEDIUM

TRUJILLO ARROYO

Located at RM 103 (See Section 4.19 Map 1 of 33). This arroyo drains about 53 square miles; does not have a sediment control dam. Propose to remove point bar forming along west channel bank. East channel bank across from and downstream of the arroyo mouth is eroding toward the maintenance roadway. Erosion has cut into the opposite bank about 20 or 30 feet threatening the maintenance roadway along channel bank. Therefore, work will also include river bank stabilization to protect the channel bank using a combination of riprap with gravel bedding material and sandbar willow (*Salix spp.)* pole planting for a distance of approximately 300 LF. Estimated quantity of material: gravel bedding material - 135 CY, rock rip-rap- 375 CY. In addition, work will include re-aligning the arroyo to merge with river at an angle in lieu of perpendicular. Estimated sediment removal: 6,667 CY. Frequency: MEDIUM

MONTOYA ARROYO

Located at RM 101.5 (See Section 4.19 Map 1 of 33). Does not have a sediment control dam. Small arroyo entering from west bank. Excavate sediment at mouth; re-align arroyo to merge with river at an angle in lieu of perpendicular. Estimated sediment removal 4,750 CY. Frequency: LOW

HOLGUIN ARROYO

Located at RM 101 (See Section 4.19 Map 2 of 33). Does not have a sediment control dam. Small arroyo entering from east bank. Excavate sediment at mouth; re-align arroyo to merge with river at an angle in lieu of perpendicular. Estimated sediment removal 4,000 CY. Frequency: LOW

TIERRA BLANCA / GREEN ARROYOS

Located at River Mile 99.8 (See Section 4.19 Map 2 of 33). Tierra Blanca enters on the west bank and Green on the east bank. Sediment has built up from the mouth to 0.4 miles downstream to the vortex weir installed in the 1990s. Long excavation for 3,420 linear feet is proposed. Sediment trap CMAs were proposed for these arroyos. Estimated sediment removal: 21,780 CY. Frequency: LOW

SIBLEY ARROYO

Located at RM 99 (See Section 4.19 Map 2 of 33). A point bar forms on the west side downstream from the mouth of the arroyo. Re-align arroyo to merge with river at an angle in lieu of perpendicular. Short excavation for 1,400 feet is proposed. A sediment trap CMA was recommended for this arroyo. Estimated sediment removal: 13,300 CY. Frequency: LOW

HATCH SIPHON

Located at approximate River Mile (RM) 90.1, 2.1 miles upstream of the Salem Bridge (See Section 4.19 Map 5 of 33). As a result of reduced velocity as flows encounter the sheet pile wall, sediment load is deposited over this area creating two islands (Figure 4-5B). One of these islands was removed in 2014 (Fig. 4-3). Propose regular sediment removal (islands) from the channel. Also, remove branches and vegetation along sheet pile wall and rock riprap. Estimated sediment removal: 3,704 CY. Frequency: HIGH

Figure 4-3. Hatch Siphon. Debris on Hatch Siphon sheet piling and island buildup upstream of Hatch Siphon,looking upstream, September 2013.

SALEM BRIDGE

Located near RM 87 (See Section 4.19 Map 6 of 33). Large vegetated sandbar has formed upstream and downstream from the bridge. It will be monitored and if it begins to obstruct delivery flows it will be considered for removal. Estimated sediment removal: up to 35,556 CY. Frequency: LOW

THURMAN I AND II ARROYOS

Thurman I is located at River Mile RM 85.8 and Thurman II at RM 86 (See Section 4.19 Map 6 of 33). A sediment fan has built up immediately downstream from the arroyo mouth. Propose to remove arroyo mouth sediment from river channel. Re-align arroyo to merge with river at an angle in lieu of perpendicular and widen arroyo mouth. Localized excavation for a distance of 880 feet is proposed. Sediment trap CMAs were recommended for these arroyos. Estimated sediment removal: 8,340 CY. Frequency: LOW

PLACITAS ARROYO

Located at RM 85 (See Section 4.19 Map 7 of 33). Drains about 35 square miles; does not have a sediment control dam; average annual sediment load approximately 15 acre-feet. This arroyo is cleared of sediment annually by Doña Ana County and the New Mexico Department of Transportation (NMDOT) along most of its length as it enters the Rincon Valley; however, the County and NMDOT do not work within the USIBWC right of way. There is a potential for heavy sediment inflows to the river at this location, and it is necessary to keep the arroyo mouth clear of sediment annually to ensure proper drainage to the river. Also, the arroyo will be re-aligned to merge with river at an angle in lieu of perpendicular. Note: this arroyo caused major flooding to the town of Hatch, NM, during the 2006 storms. The east arroyo bank eroded immediately upstream of the Canal Bridge, flooding the town of Hatch. Maintaining the mouth of the arroyo clear will prevent backwater and possible failure of arroyo banks. A sediment trap CMA was recommended for this arroyo. Estimated sediment removal: 13,000 CY. Frequency: HIGH

HATCH BRIDGE

Located near RM 84.4 (See Section 4.19 Map 7 of 33). Large vegetated sandbars have formed upstream and downstream from the bridge. Propose to monitor for flow obstruction potential and remove islands if they become too large and obstruct water deliveries. Estimated sediment removal: 33,333 CY. Frequency: LOW

RINCON SIPHON AND GARCIA ARROYO

RINCON SIPHON: Located at approximate River Mile (RM) 81.9, 215 feet downstream of the Rincon-Hatch Bridge (See Section 4.19 Map 7 of 33). As a result of reduced velocity as flows encounter the sheet pile wall, sediment load is deposited over this area. The excess sediment upstream of the Rincon Siphon was removed in 2014 (Figure 4-4) because the normal flows were overbanking into the floodway and around the siphon, eroding small flows have eroded the west floodway and created another small channel. The levees in this area may be compromised during heavy flood flows if this erosion continues. Propose regular sediment removal (islands) from the channel beginning from sheet pile wall upstream to the Santa Fe Railway Bridge. Also, remove branches and vegetation along sheet pile wall and rock riprap. Estimated sediment removal: 15,000 CY. Frequency: HIGH

GARCIA ARROYO: Located at RM 82.9 (See Section 4.19 Map 7 of 33). Does not have a sediment control dam. This arroyo changed its course during a heavy rain storm in the summer of 2009 and cut into an adjacent alfalfa field. Sediment removal will take place within arroyo mouth and river channel and the arroyo will be re-aligned to merge with river at an angle in lieu of perpendicular. A sediment trap CMA was recommended for this arroyo. Localized excavation is proposed for a distance of 410 feet. Estimated sediment removal: 11,330 CY. Frequency: LOW

Figure 4-4. Looking upstream from Rincon Siphon, east bank. Left – Sediment accumulation and island formation upstream of Rincon Siphon, September 2013. Right – After excavation, March 2014.

RINCON ARROYO DOWNSTREAM TO BIGNELL ARROYO, INCLUDES REED ARROYO

Rincon Arroyo: Located at RM 78.6 (See Section 4.19 Map 9 of 33). Drains about 125 square miles; does not have a sediment control dam; average annual sediment load about 34 acre-feet. Monitor sandbar forming at the mouth and upstream to Rincon Bridge, a distance of about 1500 feet. Since this arroyo does not have a sediment control dam there is potential for heavy sediment inflows to the river at this location. Work includes re-aligning the arroyo mouth to merge with river at an angle in lieu of perpendicular. Work also includes river bank stabilization along the opposite riverbank using a combination of riprap with gravel bedding material and sandbar willow (*Salix spp.*) pole planting for a distance of approximately 400 LF. Note that the opposite river bank has eroded forty feet into the floodway and erosion is fifty feet away from the levee toe (Figure 4-5). If riverbank erosion continues, the structural integrity of the levee may be compromised during a heavy storm. Estimated quantity of bank stabilization material: gravel bedding material - 180 CY, rock rip-rap- 400 CY.

Reed Arroyo: Located at RM 78 (See Section 4.19 Map 9 of 33). A point bar forms on the west side downstream from the mouth of the arroyo and needs to be removed. Re-align arroyo to merge with river at an angle in lieu of perpendicular.

Long excavation of 6,210 feet is proposed for Rincon and Reed arroyos. Estimated sediment removal: 66,940 CY. Frequency: HIGH (Long excavation should lower this to LOW)

Bignell Arroyo: Located at River Mile RM 76 (See Section 4.19 Maps 9 and 10 of 33). A sediment fan builds up immediately downstream from the mouth. Propose to remove arroyo sediment from river channel. Re-align arroyo to merge with river at an angle in lieu of perpendicular. Proposed localized excavation for 280 feet. Estimated sediment removal: 18,111 CY. Frequency: LOW

Figure 4-5. Eroded banks encroaching on the levee opposite Rincon Arroyo, looking slightly downstream, March 2013.

HERSEY ARROYO

Located at River Mile RM 74.4 (See Section 4.19 Map 10 of 33). A sediment fan builds up immediately downstream from the mouth. Propose to remove arroyo sediment from river channel. Estimated sediment removal: 6,944 CY. Frequency: LOW

ROCK CANYON TO 1.4 MILES BELOW RINCON/TONUCO DRAIN OUTLET

Located at approximate River Mile (RM) 70.3 (See Section 4.19 Map 11 of 33). Sediment deposition occurs in this area preventing proper drainage of irrigation return flow into the river channel (Figure 4-6). Propose localized sediment removal from the river channel beginning upstream of the drain to 1,500 feet downstream. The benefits include drainage of irrigation water into the river and prevention of water logged conditions in the upstream fields which may have also contributed to increases in salinity. Also, the discharge to the downstream Selden canyon reach should increase, promoting aquatic habitat. Estimated sediment removal: 71,240 CY. Frequency: MEDIUM

Figure 4-6. Sediment acculumation in the Rio Grande below the Rincon/Tonuco Drain, looking upstream, March 2013.

0.17-MILE UPSTREAM OF MESILLA DAM UPSTREAM TO MESILLA BRIDGE (CALLE DEL NORTE)

Located from about RM 39 to RM 42.4 (See Section 4.19 Map 20 of 33). As a result of decreased flow velocities upstream of the diversion dam, sediment load is deposited over this river reach. This reach needs annual monitoring because of this dynamic. USIBWC proposes regular sediment removal from the channel from 0.17 mi upstream of Mesilla Dam (Figure 4-7) to Mesilla Bridge. Excavation work immediately upstream of Mesilla Dam for 0.17 mile will be worked out with USBR. Sediment was excavated in January 2016 in cooperation with USBR upstream of the dam. Estimated sediment removal: 58,170 CY. Frequency: MEDIUM

Figure 4-7 Left – Sediment accumulation at Mesilla Dam, March 2013. Right – After excavation, January 2016.

EAST DRAIN TO BELOW VINTON BRIDGE

Located at approximate RM 16.5 (See Section 4.19 Map 28 of 33). The 2015 CMA Study recommended long excavation in this stretch over 8,920 feet. Estimated sediment removal: 38,050 CY. Frequency: LOW

COUNTRY CLUB BRIDGE

Located at approximate RM 7.84, 0.2 miles downstream of the Country Club Bridge along west riverbank (See Section 4.19 Map 31 of 33). Recent levee raising efforts resulted in the new levee toe being located adjacent to the riverbank. The levee may be compromised during high river flows. Therefore, work will include river bank stabilization using a combination of riprap with gravel bedding material and sandbar willow (*Salix spp.*) pole planting for a distance of approximately 790 LF. Estimated quantity of material: gravel bedding material - 356 CY, rock rip-rap- 988 CY and up to 43,000 CY. Frequency: HIGH

SUNLAND PARK BRIDGE TO AMERICAN Diversion DAM

Located from RM 0 to approx. RM 2.68 (See Section 4.19 Maps 32 and 33 of 33). As a result of decreased flow velocities upstream of the dam, sediment load is deposited over this river reach. Annual attention is necessary because of this dynamic. Propose regular sediment removal from the channel including immediately upstream of American Diversion Dam and placement of excavated material at designated disposal areas located on the landside of the west levee.

Propose to monitor for flow obstruction potential and remove islands if they become too large and obstruct deliveries and/or water measuring devices (gaging stations) located at the Courchesne Bridge. The proposed work will also enable efficient flow of water from the Montoya Drain into the river (Figure 4-8). This flow is currently being impeded by sediment accumulation at the outfall and under the gate. The average channel design dimensions are 130' wide x 4' deep. Long excavation over 11,530 feet is proposed. Estimated sediment removal: 176,250 Cubic Yards (CY). Frequency: HIGH

Figure 4.8 Montoya Drain confluence with Rio Grande, looking from the east levee, October 2014.

4.6.1.2 Sediment Excavation at American Diversion Dam and Mesilla Dam

USIBWC is responsible for channel maintenance at American Diversion Dam, and sediment removal is considered routine, conducted every one to three years, to ensure proper operation. USIBWC excavated sediment upstream of American Diversion Dam in May 2015. USIBWC excavated sediment in December 2010 for a safety of dams inspection (SWCA 2011), and in December 2012 for maintenance of the radial gates on the dam, as authorized by USACE permit SPA-2012-00494-LCO.

USIBWC plans to continue sediment excavation at American Diversion Dam to ensure that gates operate as designed and that deliveries are made to Mexico without issues.

The USBR owns the Mesilla Dam and has a right of way in the river 900 feet upstream and 660 feet downstream of the dam (2016 correspondence with USBR's Bert Cortez). The USIBWC and USBR will work together to determine the work requirements for channel maintenance at Mesilla Dam. Table 4-7 and USIBWC's 5-year plan begins 0.17 miles upstream of Mesilla Dam.

Sediment removal just upstream of Mesilla Dam is conducted on an as-needed basis. USIBWC excavated over 32,000 CY upstream of Mesilla Dam in March of 2016; sediment was deposited on Bureau of Reclamation land adjacent to the floodplain upstream of Mesilla Dam. Previous to that, USIBWC excavated sediment upstream of Mesilla Dam in December 2005 (SWCA 2011). Sediment removal of 60,000 CY was reported to have been conducted by contractors mobilized near the site in December 2011.

The 2015 CMA Study evaluated possible alternatives to control sediment upstream of Mesilla Dam in lieu of mechanical excavation.

4.6.1.3 Channel Maintenance at Gage Stations

USIBWC conducts, on an as-needed basis, dredging/excavation at the IBWC gage stations to maintain long term flow records at those sites, including Leasburg, Canutillo, and the Courchesne bridge gage stations. USIBWC may work with other entities to maintain the area around other gaging equipment of the USGS or Elephant Butte Irrigation District, including Mesilla, Haynor, and Anthony.

In order to maintain this vital data-gathering equipment that facilitates model calibrations and treaty deliveries, USIBWC will continue to maintain the channel at gage stations on an as-needed basis.

4.6.1.4 Arroyo Mouth Maintenance

USIBWC has historically removed major depositions or channel closures caused by sediment loads from arroyo flows. The 1996 sediment study for the 100-year model determined that maximum deposition depths are found at cross sections located below major tributaries (such as Rincon, Trujillo, Tierra Blanca, Placitas, and Faulkner) due to the addition of sediment loads (USACE and Resource Technology, Inc 1996). The 2007 sediment continuity analysis estimated that the sediment yield of arroyos entering into the river is close to 400,000 cubic yards per year (USACE, Mussetter Engineering, Inc., and Riada Engineering, Inc. 2007; Tetra Tech 2005; Riada Engineering, Inc. 2009).

Sediment and gravel that washes into the river channel from arroyos are highly variable in response to individual rain events and may create a plug that can reduce the flow capacity of the channel or lead to a change in channel location, which may cause a scour threat that will compromise levee infrastructure. Sediment removal from the arroyo mouths maintains the RGCP flow capacity and reduces flooding in nearby communities. The purpose of removing material, which is washed into the river from arroyos and that builds into sandbars as a result of the river's sediment load, is to reduce the possibility of a plug being created in the river channel that would reduce the normal and Design Flood flow capacity of the channel (USIBWC 1994).

Table 4-9 lists the total sediment yield estimates (USACE 2007, Tetra Tech 2015), which includes both the fine sediment (wash) load and the bed material load (sand and coarser sediment). Bed material component of the annual total sediment yield from the tributaries to the RGCP was assumed to be 35% (USACE 2007).

Table 4-9. Mean Annual Tributary Total Sediment Yield and Mean Annual Tributary Bed-Load Yield upstream of Leasburg Dam		
Arroyo Name	**Mean Annual Sediment Yield**	
	acre-feet	**CY**
Trujillo Arroyo	14.7	23,716
Montoya Arroyo	6.93	11,180
Holguin Arroyo	1.29	2,081
Tierra Blanca	18.95	30,573
Green Arroyo[1]	10.13	16,440
Sibley Arroyo	7.99	12,891
Berenda Creek[1]	24.54	39,591
Jaralosa Arroyo[1]	2.76	4,453
Yeso Arroyo	3.49	5,630
Arroyo Cuervo (Crow Canyon) [1]	36.69	59,193
Thurman I	1.98	3,194
Thurman II	1.12	1,807
Placitas Arroyo	9.87	15,924
Angostura Arroyo	3.33	5,373
Garcia I Arroyo	1.22	1,968
Rincon Arroyo	36.2	58,403
Reed Arroyo	3.52	5,679
Bignell Arroyo	0.38	613
Rock Canyon	1.03	1,662
Horse Canyon	1.04	1,678
Lytten Canyon	0.74	1,194
Buckle Bar Canyon	1.26	2,033
Foster Canyon	3.89	6,276
Faulkner Canyon	7.43	11,987

[1] –arroyos with sediment retention dams; it is unclear if the sediment retention dam was considered with this sediment volume

Sediment excavation should take place during dry or low flow conditions. River water is diverted around the sediment excavation area during the maintenance period. Excavated sediment is deposited in the designated sediment disposal, according to USACE permit requirements (Parsons 2004a). (See Section 4.13.)

In the 5-year plan (Section 4.6.1.1), USIBWC has identified the arroyos that will be monitored for sediment deposition, possible levee threats and work that may be performed through 2019. Arroyo mouths are usually excavated up the arroyo as far as the extent of USIBWC property or ROW. Arroyos with chronic sediment plugs include the Tierra Blanca, Rincon, Placitas, and Trujillo Arroyos. USIBWC will evaluate arroyo sediment bars on a case-by-case basis.

One possibility is to segment larger sediment bars rather than completely removing them during river channel maintenance. This way, some sediment and shallow backwaters will still be present, while

minimizing the potential to impact the levees on the opposite bank. For example, in a 100-foot channel, an 80-foot sandbar restricts the channel to 20 feet and will threaten floodplain and levee infrastructure in the event of a large storm; 50% removal of the sandbar would still leave about 40 feet of sandbar. Alternately, USIBWC could excavate sediment across the sandbar, promoting cross flow and reducing erosive impacts on banks.

Additional channel maintenance alternatives for arroyos are outlined in Sections 4.16 and 4.17.

4.6.1.5 Drain Confluence Maintenance

The RGCP was engineered in the 1930s and 1940s so that the river, irrigation structures, and drains would function at a particular gradient. Cessation of channel maintenance leads to sediment buildup that will plug the confluence of irrigation drains, thereby restricting return flows to the river.

The 5-year Plan (Section 4.6.1.1) lists two drain mouths that cause chronic sediment plugs and may be excavated or dredged if return flows are not being drained properly. These drains are Rincon/Tonuco Drain and Montoya Drain (American Dam to Anapra Bridge), and both were analyzed in the 2015 CMA Study. The USIBWC will consider alternatives to channel maintenance at the drains outlined in the 2015 CMA Study, including island destabilization/vegetation removal and arroyo sediment traps. However, the 2015 CMA Study did indicate the Long Excavation ranks in the top two options at these drains.

In addition, USIBWC will consider mitigation measures that may enhance aquatic habitat at or near the drain mouths or other outlet works. One such preliminary suggestion is to create aquatic habitat near the drain confluences, such as at the Montoya Drain. USIBWC will continue to work with stakeholders such as El Paso Water to evaluate this and other similar projects. Habitat at the drains must not interfere with drain operation, and the appropriate irrigation district(s) must be on board with any plans.

4.6.1.6 Island Removal

Islands in the river have some benefits, including that they vertically accrete sediments and prevent the migration of sediments downstream where they subsequently deposit at diversion dams and inhibit the operation of these dams. Islands also provide instream habitat diversity and allow side channel and backwater habitats to develop (USIBWC 1994; Riada Engineering, Inc. 2009).

However, islands may also decrease the carrying capacity of the channel, decrease efficiency in deliveries, and decrease flood

BOX 4-2 Channel Maintenance and Flycatchers

Suitable flycatcher habitat is found on many islands in the northern part of RGCP, particularly between Rincon and Hatch. Flycatchers have been documented to occupy many of these areas. Large islands (greater than 0.1 ha or about 0.25 acre) with suitable habitat should not be excavated or destabilized unless habitat is available along the nearby riverbanks or unless flood modeling predicts impacts to human health and safety from flooding created by the islands. Islands will be monitored. Any island with documented territories should have USFWS approval prior to any excavation activity.

In addition, all channel work must be in compliance with Part 3, the Endangered Species Management Plan, as well as the 2012 Opinion, unless area is shown to pose a public safety hazard.

capacity. In addition, these studies indicate that individual islands may not impact the water surface elevations substantially, but that the cumulative effect of many islands will have a greater impact on the RGCP.

Islands and sediment bars with vegetation will require individual analysis. They may remain in place as long as the project design flood flow, flood carrying capacities, and efficiencies are not significantly affected or restricted. USIBWC will monitor islands, annually if possible, with field inspections, aerial imagery, and/or elevation data. ESD will determine whether large islands are causing issues to the normal flow and flood capacity through hydraulic modeling and analysis. Typically islands within a wider river channel with wider floodplain and less urbanized landscape are of less concern than islands in areas with levee gaps, concentrated urbanization, narrow floodplain, and narrow river channel. The latter will be modeled for impacts to the flood capacity and conveyance.

USIBWC will follow the procedures in Box 4-2 when large islands with documented flycatchers have been identified as flood capacity or flood control threats.

4.6.2 Documentation Required for all Routine Channel Maintenance

All routine maintenance listed in Section 4.6.1 will require the following, followed by the responsible lead division:

- Photo documentation, both before and after work - EMD/O&M
- Description of justification of the work (Recommend including as many elements as possible that are listed in Section 4.6.3 required for non-routine work documentation) - EMD/O&M
- Calculations of amounts of sediment removed or rip rap installed in CY and linear feet - O&M
- Verification of regulatory requirements (example: USACE permit (Section 4.13) and USFWS coordination (Section 3) if necessary) - EMD
- Data collection and monitoring, as described in Section 4.7 – BRO, ESD and EMD
- For actions such as island removal, evaluation of possible impacts to biological, cultural, and natural resources – EMD

O&M, BRO, ESD and EMD should work collaboratively to ensure these requirements are met and documented.

4.6.3 Non-Routine Channel Maintenance and Documentation

Any channel maintenance activity not listed in the 5-year Plan (Section 4.6.1.1) will be considered Non-Routine. Non-routine work may be performed by USIBWC on a site-by-site basis. USIBWC will briefly provide the following information for non-routine activities:

1. Provide a description of the maintenance project including location, purpose and benefits (including the irrigation delivery or river functions being addressed), objectives, estimated quantities, type of equipment and materials, construction timing and duration, potential impacts.
2. Conduct cross section and longitudinal surveys (thalweg) adequate to cover the project area, or evaluate LIDAR data, if work is not an emergency.

3. If appropriate, document the detrimental impact on infrastructure operation through cross sections or other appropriate measure.
4. Identify any potential ecological responses associated with the maintenance project (benefit/impacts).
5. Identify any alternative approaches to addressing the impact on infrastructure operation.
6. Verification of regulatory requirements, including concurrence from USFWS, if not covered under the 2012 Opinion.
7. If there is insufficient time to provide this information, demonstrate that there is an immediate risk to health, life, or property.

Post project monitoring and evaluation:

8. Monitor the response to channel maintenance by surveying established cross sections, as appropriate. Groundwater level monitoring will be considered for specific projects as appropriate.
9. Prepare a brief summary to document the post-project findings and analyze them for the effectiveness of the results of the non-routine channel maintenance after an appropriate period of time. Use lessons learned to adapt future responses.

4.6.4 Best Management Practices and Mitigation Measures for all Channel Work

The following is a list of best management practices and mitigation measures to limit environmental impacts during all channel work, both routine and non-routine, whether maintenance is performed on the pilot channel, dredging at dams or gages, or at arroyo or drain confluences to the Rio Grande (Boisselier and Solo 2010; Parsons 2004a).

- Work should be during non-irrigation and non-flood periods when water levels are lowest, approximately from September 15 to March 1, and preferably during dry conditions. This also corresponds to the non-nesting season (September 1 - March 1) to avoid impacts to sensitive wildlife during breeding seasons.
- Channel excavation is performed with bulldozers, excavators, front end loaders and scrapers either from the channel bank or from within the channel.
- No wetlands or other waters shall be filled in during the maintenance activities.
- Spoil from channel sediment excavation will be deposited in upland locations to ensure spoil will not be re-deposited into the river. Upland deposit locations will be pre-approved by USIBWC management (See Section 4.12). Sediment will be stabilized by vegetation, where needed.
- Crews will take care to have minimal incidental fallback of excavated material into the riverbed. Water quality could decrease in terms of total suspended solids during sediment excavation, but should improve upon completion of maintenance work.
- During maintenance work within the river, best management practices and spill control procedures will be used to prevent contamination and increased erosion to the river. Servicing of heavy equipment will be done out of the riparian zone.

- When equipment is operating in the river or arroyo tributaries, if fish are stranded, they will be salvaged and put into the main river channel.
- No maintenance activities will be conducted in known habitats of listed or sensitive species. Where maintenance will be necessary in proximity to known listed or sensitive species' habitats, USIBWC will follow recommendations laid out in Part 3, and treatment will be selected to minimize any effect.
- No potential bald eagle winter roosting trees will be disturbed during maintenance activities. Presence/absence of bald eagles will be monitored during maintenance work in the fall and winter.
- Existing roads through the floodplain will be used to avoid impacts to vegetated areas.
- Before ground-disturbing maintenance work, a conference will be held with maintenance crews to inform them of the potential for disturbing subsurface cultural resources, and the procedures involved in the event that this occurs. Precautions will be taken to ensure that archaeological assistance is promptly available in case of a discovery.
- Dust control measures, such as sprinkling/irrigation, mulch, vegetative cover, and wind breaks, will be used in construction sites where there is the potential for air and water pollution from dust transport by high winds.
- Staging areas are located in areas that will avoid impacts to vegetated areas.

4.6.5 Emergency Channel Maintenance Work

Emergency situations may arise where water deliveries or infrastructure are threatened. Examples could be if a sediment plug causes irrigation releases during an extreme drought to overflow into the floodplain, or if large floods create sediment bars that are threatening immediate levee breach or erosion that may cause further flooding. In these cases, USIBWC will still attempt, to the extent possible, to meet the requirements outlined for routine maintenance (Section 4.6.2) under the emergency situation.

4.7 Data Collection and Monitoring

Per the ROD, the USIBWC will establish a data collection and monitoring program to identify specific goals and objectives for channel management, and provide recommendations or guidelines for channel management policy. Excerpts from the ROD regarding data collection and monitoring requirements are listed in Box 4-3.

In accordance with the requirements in Box 4-3, the USIBWC data collection and monitoring program will include the following:

- Data collection
    - Cross section surveying
        - Survey the 145 surveyed cross sections as recommended by the ROD as well as the additional 15 cross sections recommended by the ROD group. In FY16, USIBWC has contracted to survey of all 160 cross sections

        - Localized cross sections as determined necessary
    - Cross section extraction from existing LIDAR data, and future LIDAR data collection as feasible
- Hydraulic Models
    - Monitor the cross sections during high irrigation flows to determine the potential impacts on flood stage
    - Update the calibration of the existing FLO-2D and HEC-RAS models
    - Use the FLO-2D model to evaluate the cumulative impacts on loss of flood conveyance capacity and efficiency of water deliveries
    - Monitor impacts of islands
- Field inspection
    - Inspect arroyo confluences where sediment plugs occur and channel banks where islands develop for evidence of bank erosion
    - Monitor channel changes after flooding
    - Inspect islands for possible issues, as deemed necessary
- Monitoring outlined in Section 4.7.1
- Additional Monitoring Opportunities
    - USIBWC may collaborate with stakeholders on other monitoring options that have a direct impact on the USIBWC mission.

Findings from the data collection and monitoring program will be synthesized and summarized in writing on an annual basis and used to routinely update the RMP.

4.7.1 Recommended Data Collection and Monitoring for Routine and Non-Routine Channel Maintenance Work

The USIBWC will implement the following data collection and monitoring actions for activities conducted under the 5-year Plan (Section 4.6.1), as well as any non-routine maintenance activity:

1. Collect cross section data before and after work. "Before" cross sections should be collected within the time-frame of after the last irrigation release and before the next irrigation release. LIDAR data or similar elevation data may be used in lieu of surveyed cross sections. "After" cross sections should be collected during the timeframe from immediately after the action (preferred if possible) up until the next irrigation release. These should be conducted by BRO staff at the request of EMD or ESD.
2. A review of the most recent LIDAR data and/or aerial imagery to document the need for action.
3. A review of any other available data as determined necessary for the action, such as available groundwater wells in the vicinity (from USIBWC, EBID, USGS, or other entity), or a visual inspection of the site conditions.
4. A review of listed species in the vicinity.
5. A review of possible impacts to native vegetation.
6. Photo documentation before and after work.
7. Documentation as required in Section 4.6.2 or 4.6.3.

8. Site post-action monitoring to include evaluation of biological effects (ex: changes to vegetation) and hydrological effects (ex: changes to drain flows, overbanking patterns, and geomorphology), as appropriate and as resources are available.
9. Evaluation of costs.

This monitoring program is subject to available funding and resources and any immediate need for emergency work.

BOX 4-3 ROD Requirements for Data Collection and Monitoring

- The purpose of the USIBWC data collection and monitoring program will be to identify assumptions and gaps in current understanding, establish baseline conditions of the river, implement site-specific projects to test hypotheses, collect and analyze data, monitor site specific projects and sensitive reaches, evaluate site-specific and cumulative impacts, and recommend any annual channel maintenance, channel stabilization or destabilization activities and in an iterative cycle, evaluate the effect of those activities in meeting the RMP goals and objectives.
- USIBWC will utilize the 145 cross-sections in the RGCP, resurveying the cross-sections on the average of once every four to five years and more frequently in local reaches following large flood events. USIBWC will monitor the cross sections during high irrigation flows to determine the potential impacts on flood stage and to update the calibration of the existing FLO-2D and HEC-RAS models. The FLO- 2D model will be utilized to evaluate the cumulative impacts on loss of flood conveyance capacity and efficiency of water deliveries.
- Arroyo confluences where sediment plugs occur and channel banks where islands develop will also be inspected for evidence of bank erosion and channel changes will be monitored after flooding.
- Findings from the data collection and monitoring program will be synthesized and summarized in writing on an annual basis and used to routinely update the RMP.

4.8 Restoration Site In-channel Enhancements and Bank Work

There are several restoration sites which call for in-channel enhancements and bank work.

The 2009 Conceptual Restoration Plan (USACE 2009) recommended one site, Yeso West, for the creation of an inset floodplain. In addition, USIBWC has evaluated another inset floodplain, Crow Canyon C, as a possible restoration site. Yeso West is authorized under U.S. Army Corps of Engineers (USACE) Action No. SPA-2012-00529-LCO. Inset floodplain sites are listed in Table 4-10.

Table 4-10. Restoration Sites with Inset Floodplains				
Site Name	**River Mile and Bank**	**Acres**	**Target Habitat Type**	**Type of Channel Enhancement**
Yeso West	93.5 W	2.5	Aquatic Habitat or Dense Riparian Shrub	Create Inset floodplain
Crow Canyon C	90 E	3.4	Dense Riparian Shrub	Enhance inset floodplain

The three restoration sites which contemplate re-opening river meanders (Yeso Arroyo, Placitas Arroyo, and Angostura Arroyo) may require USACE CWA permit, such as NWP 27, discussed in the Section 4.13. The arroyo sites contemplate removing rip-rap below the arroyos in order to destabilize the bank and encourage slight river meandering. Erosion protection may be required along levees for these sites; further investigation on the potential impacts to the levees may be warranted prior to implementation.

The 2009 Conceptual Restoration Plan (USACE 2009) recommended several restoration sites that would target aquatic habitat, listed in Table 4-11. In the 2012 Opinion, USFWS recommended expanding the arroyo sites. USIBWC will consider these expansions prior to implementation of these restoration sites and USACE permit applications (See Section 4.13).

Table 4-11. Restoration Sites Impacting Arroyos				
Site Name	**River Mile and Bank**	**Acres**	**Target Habitat Type**	**Type of Channel Enhancement**
Yeso Arroyo	94 W	10.6	Aquatic Habitat	Arroyo mouth management/ meander encouragement
Placitas Arroyo	85 W	21.8	Aquatic Habitat	Arroyo mouth management/ meander encouragement
Angostura Arroyo	80 W	15.4	Aquatic Habitat	Arroyo mouth management/ meander encouragement

Additionally, there are three other restoration sites that call for between 1,400 and 1,800 feet of bank destabilization and bank shaving to enhance floodplain connectivity with abandoned river meanders. bank destabilization will promote lateral river migration and involves removing any present rip rap and shaving the bank with a 4:1 slope over 25 feet, or a drop of about 6 feet over 25 feet. Bank shaving will be conducted with use of a bulldozer or excavator. Where bank destabilization is prescribed, bank vegetation may be removed manually but in some cases may require mechanical treatment. Sites requiring bank destabilization are listed in Table 4-12. As discussed in Section 4.13.3, the USACE determined in January 2013 that restoration site bank work that involves excavation work only, including excavation below the Ordinary High Water Mark (OHWM) does not require a USACE permit. These are also authorized under USACE Action No. SPA-2012-00529-LCO.

Table 4-12. Restoration Sites with Bank Destabilization					
Site Name	**River Mile and Bank**	**Acres**	**Target Habitat Type**	**Recommended Bank Destabilization**	**Comments**
Trujillo	103 W	18	Dense riparian shrubs	1,400 feet on west bank	Trujillo does not appear to have rip rap on the west bank, only the east bank. Further site verification needed
Jaralosa	94.9 E	4.5	Open riparian woodland	1,400 feet on east bank	Old river meander
Yeso East	93.7 E	9.7	Open riparian woodland	1,800 feet on east bank	Old river meander

The sites listed in Tables 4-11 and 4-12 need further study to determine if the bank work and river meanders will negatively impact the levees.

4.9 Bank Work

USIBWC must maintain stream banks in the RGCP to assist in flood protection and water supply deliveries.

4.9.1 Bank Maintenance and Stabilization

Stream banks erode in a number of locations along the RGCP, but the degree of threat to adjacent levees varies considerably. Erosion is episodic, so identifying and prioritizing sites for treatment requires annual site inspection and review. Once the decision is made to provide bank protection, considerable cost is involved, and could result in loss of habitat and recreation values (Parsons 2004a).

If required, annual maintenance of banks may include placement of additional riprap. In most cases and where feasible, rip rap will be combined with willow pole planting (*Salix spp.*) to protect meandering and erosion of the channel and stream banks. The new policy of not mowing the banks (Section 2.3.6) will reduce erosion due to the root systems and will therefore require less bank protection.

Bank work below the OHWM will require USACE permitting, generally by NWP 13 (Section 4.13).

USIBWC will consider and evaluate possible alternatives to bank stabilization work.

USIBWC will repair immediately any scouring or gouging of the banks due to flooding. USIBWC may determine to add rip rap or other bank stabilization of critical areas that impact levee stability, as per Sections 4.9.2 and 4.9.3 below.

4.9.2 Emergency Bank Protection

USIBWC strives to minimize the need for emergency bank protection through routine and preventative maintenance measures. Emergency actions that may be taken during flood events could involve major losses of floodway vegetation and dumping of coarse rock fill. If emergency bank protection is required, risks are high for levee failure and catastrophic flooding of protected areas.

If emergency action is required, impacts will be mitigated as follows (Parsons 2004a):

- Where emergency action is undertaken, USIBWC will evaluate and implement post-action mitigation for habitat impacts, where possible. Onsite mitigation may prove difficult for those emergency repairs. Each site would be individually evaluated to determine effective mitigation actions such as vegetation plantings. In some instances, it may be necessary to provide enhancement of other areas in an attempt to provide compensating values.

4.9.3 Critical Eroding Sites

Non-emergency bank protection at critical eroding sites also tends to cause losses of habitat. Full-bank revetment entails a considerable area of impact, and providing full onsite mitigation could be costly. USIBWC will employ bank protection designs through adaptive management that optimize onsite protection and replacement of habitat values.

Potential measures may include (Parsons 2004a):

- Provide hard bank protection only to the degree needed to prevent further erosion.
- Combine hard protection with bioengineered mitigation features to provide in stream woody material; visually and hydraulically irregular surfaces; and extensive wetland and riparian vegetation on created low floodplain surfaces (benches or low berms for planting).
- Establish vegetation, to the extent possible considering water usage, in revetment near the normal edge of water. This is partially being done by not mowing the banks along the river corridor. The vegetation will assist in bank stability and erosion prevention (Section 2.3.6).
- For sites at which onsite replacement of habitat values is not feasible, plan projects in groups for which full onsite mitigation occurs on a combined basis; recognizing that full replacement cover values may not be achieved at some bank protection sites.
- Seek to employ lower cost mitigation designs and vegetation establishment methods using bioengineered materials so that mitigation costs could be reduced over time. This would be applied as an adaptive management strategy, identifying potentially more cost-effective designs based on actual performance.
- Implementation of Restoration Sites in Section 2.6.

Additionally, demonstration projects within the floodway to assess the feasibility of using various bioengineered materials to achieve needed mitigation are encouraged. Mitigation elements contributing to shaded riverine aquatic cover value would be analyzed in some detail to help identify the most cost-effective approaches. Innovative bank-protection designs that minimize habitat impacts would be employed where conditions are appropriate.

4.10 Trees and Snag Removal

Selected dead trees that are close to the channel and threatening to fall into the channel are removed to prevent them from obstructing or deflecting river flows. The main channel is maintained by removing debris including dead trees and weeds and brush that grow along the bed. Snag removal improves water delivery for irrigation by preventing damage to irrigation delivery structures. Removal of obstructions from the river channel maximizes the carrying capacity of the river for both water deliveries and for

flood flows. Snags and dead or dying trees located on the floodway are not removed unless they are about to fall into the channel or pose a flood debris hazard (Parsons 2004a).

4.11 Maintenance of Irrigation Facilities

Maintenance of drainage structures within the USIBWC levee ROW, such as spillways and drains from the canal system, culverts, and non-irrigation structures, is performed by USIBWC, irrigation districts, local governments, and private owners. Spillways and drains allow for both surface water return flows and shallow ground water to be drained from the irrigated land into the river. These channels (laterals, wasteways, and drains) inside the levees within the USIBWC right of way are cleared periodically to ensure that water drains freely. As discussed in Section 3.1.9 (l), USIBWC will evaluate on a case-by-case basis if the vegetation is allowed to grow within the ditches on the floodplain.

Gates installed on many drains are kept in working order to allow them to be closed during floods on short notice. Maintenance of the gated structures includes painting, oiling, and cleaning. USIBWC and EBID have written agreements that identify structures for which each entity is responsible.

Some drainage and irrigation structures in the RGCP are licensed to other entities by the USIBWC. The USIBWC BRO issues the licenses; USIBWC O&M confirms that the licensee adequately maintains the structures, and that all inlet and outlet channels to the structures are kept open and free of sediment and debris, and O&M notifies BRO if there are any instances of license noncompliance.

The Hatch and Rincon Siphons, operated and maintained by the EBID, are subject to erosive forces that, if not controlled, would impact the integrity of the structures. The USIBWC completed the construction of erosion protection measures for the Hatch Siphon during the winter of 2003 and the Rincon Siphon in 2005. The engineering design for the Picacho Flume pier rehabilitation was completed in 2004 (Parsons 2004a).

See Section 4.13.5 for USACE permit requirements for irrigation ditches.

4.12 Spoil Areas/ Sediment Deposition Areas

The USIBWC will designate upland spoil areas within USIBWC ROW, on nearby federal land, or, in some cases, on private land, for deposit and removal of material (sediment, sand, gravel or rock). Material may be removed from these sites for levee maintenance. In addition, dredged or excavated sediment from the river channel may be deposited in these areas. Upland spoil areas will not be in an area where spoil material can be washed back into the river. No spoil areas will be in or near wetlands.

One spoil area, for example, is the upland side of the west bank immediately upstream of the Hatch Siphon and downstream of Arroyo Cuervo. Another area is a rock spoil pile on the east bank about 1.5 miles downstream of the Berino Bridge. The complete list of spoil areas will be maintained by EMD.

EMD will coordinate with the New Mexico or Texas State Historic Preservation Office (SHPO) when new spoil areas are designated within their respective states. NMSHPO has requested that any property outside of USIBWC jurisdiction where sediment will be deposited be cleared by SHPO.

Any deposit site outside of USIBWC property must have a landowner written agreement. USIBWC Legal maintains the agreement template.

Material removed from the channel is naturally damp and does not require sprinkling to reduce blowing particles. Where sediment is hauled from excavation sites, haul roads should be sprinkled with water to diminish blowing dust. If possible, and if the extent of the deposit site merits it, the USIBWC may seed those areas with native species, with a seed mix recommended by NRCS made of native species and beneficial for wildlife.

Individual disposal sites may not be used each year, and there may be intervals of several years between disposal operations at any given site. In this case, crews will inspect spoil deposit areas prior to placing spoils to ensure sensitive resources (cultural or biological) are not impacted. Crews will take note of any native vegetation and avoid disturbance to native vegetation. Spoil deposited during migratory bird season will require bird nesting surveys. In addition, at all spoil sites, crews will be on the lookout for possible cultural resources, they will stop work immediately if any cultural resource is found and will notify EMD promptly.

4.13 Permit Requirements

USIBWC will obtain the appropriate permits or appropriate concurrence for channel maintenance work in this Channel Maintenance Plan.

4.13.1 CWA Section 404 Permit Requirements

The USIBWC is required to obtain a Clean Water Act (CWA) Section 404 permit from the USACE for work and construction activities that are within navigable waters or will result in fill, dredged material, or sediment (erosion) entering the river and for all work below the OHWM. The OHWM for the RGCP was defined in 2004 by the USACE El Paso Field Office as the bank vegetation line created by the annual irrigation flow (Parsons 2004a). (Note: the USACE El Paso field office is now the Las Cruces field office.)

The USACE has 32 Nationwide Permits (NWP) that are used to permit typical construction activities. These NWPs also contain applicable Rivers and Harbor Act Section 10 and CWA Section 401 State Water Quality Certification permit conditions.

The USACE has indicated permit NWP 27 may be appropriate for the RGCP environmental measures (Parsons 2004a; TRC 2011). NWP 27 authorizes modifications of the stream bed and/or banks to restore or establish stream meanders; activities needed to reestablish vegetation; mechanized land clearing to remove non-native invasive, exotic, or nuisance vegetation; and planting native plant species (TRC 2011).

The USACE Permit NWP-31 can be used as an all-encompassing RGCP maintenance permit as opposed to seeking individual dredging project-by-project USACE CWA permits. This NWP requires obtaining the details of the original flood and/or irrigation flow conveying design and any original river cross-sections. The design parameters and cross-section form the maintenance baseline. The purpose of the maintenance baseline is to maintain the original flow carrying capacity of the man-made canal (Parsons 2004a).

The USACE Permit NWP-13 is used for bank stabilization activities, such as the installation of rip rap, no more than 500 feet in length along the bank, unless the district engineer waived this criterion in writing. Invasive plant species may not be used for vegetative bank stabilization.

The USACE Permit NWP-3 is used for the repair, rehabilitation, or replacement of any previously authorized, currently serviceable structure or fill.

Permits require coordination with USFWS and state water quality agencies (NMED and/or TCEQ). In addition, in 2008, EPA passed the compensatory mitigation rule. USIBWC will comply with all mitigation requirements of permits.

4.13.2 USEPA Construction Storm Water General Permit

The USEPA requires the USIBWC to obtain a Construction Storm Water General Permit (CGP) for construction jobs (non-maintenance) that will disturb 1-acre or more of land with some exceptions for small construction jobs (Parsons 2004a). USIBWC typically requires contractors to obtain this permit.

4.13.3 Excavation Only

Per 33 CFR 323.2, some activities which involve only the excavation of sediment may not be regulated by the USACE and may not require a permit. Specifically, 33 CFR 323.2 (2) (iii), "the term discharge of dredged material does not include...incidental fallback." Additionally, 33 CFR 323.2 (3) (i) states that Section 404 authorization is not required for incidental addition that does not destroy or degrade waters of the U.S., and that the undertaking agency "bears the burden of demonstrating that such an activity would not destroy or degrade any area of waters of the U.S."

Some excavation work within the Rio Grande channel may fall under Excavation-only and not require a USACE permit. In such cases, USIBWC should obtain a letter of concurrence from the USACE that the action is not regulated and will not result in degradation of the waters of the U.S.

The Conceptual Restoration Plan recommended bank work for some restoration sites, as discussed in Section 4.7. In January 2013, the USACE determined that no permit was necessary for excavation-only work at the following restoration sites: Trujillo, Jaralosa, Yeso East, Yeso West, Rincon Siphon B, Seldon Point Bar, Nemexas Siphon, and Country Club East (SPA-2012-00529-LCO).

4.13.4 Emergency Repair

In January 2013, the USACE Albuquerque District issued Regional General Permit No. NM-12-01 (USACE File No. SPA-2012-00347-ABQ) which authorizes discharges of dredged or fill material for necessary repair and protection measures associated with an emergency situation in New Mexico. An "emergency situation" is present where there is a clear, sudden, unexpected, and imminent threat to life or property demanding immediate action to prevent or mitigate loss of, or damage to, life, health, property, or essential public services. Examples include levee construction, rebuilding or maintenance; removal of accumulated sediment, debris or vegetation to prevent or mitigate the emergency situation; bank stabilization to prevent or minimize erosion or the loss of structures such as bridges; debris containment structures; or construction of diversion channels and flow deflection structures (USACE 2013). The Las Cruces USACE office advises that they be notified of emergency situations and intent to apply using this permit within a short time (1-2 weeks) after the storm event.

4.13.5 Irrigation Ditches

33 CFR 323.4 (a)(3) states that maintenance of irrigation ditches (including siphons, pumps, headgates, wingwalls, weirs, diversion structures, and such other facilities) is not subject to a USACE 404 permit for dredged or fill material.

4.13.6 Construction and Maintenance of In-channel Infrastructure

All design construction and construction work for culverts, floodwalls, and other in-channel infrastructure, including for levee segment improvements, will require the appropriate permit from USACE. For example, maintenance of existing drains can typically be done under USACE NWP 3.

4.13.7 Letter of Permission for New Mexico work

In May 2016, the USACE Albuquerque District issued a public notice for SPA-2016-00034-ABQ - Letter of Permission (LOP) NM-2, providing the procedure for authorizing work within the state of New Mexico that includes:

1. Returning Engineered Projects to Original Design
2. Removing or Reducing Flood Hazards in Disturbed Watersheds (wildfire or floods)
3. Providing for Protection of Existing Infrastructure, including removal of debris and sediment
4. Other Sediment and Debris Removal in ephemeral or intermittent streams for alleviating flood hazards
5. Sand, Gravel and Aggregate Mining

USIBWC may utilize this LOP when appropriate for channel maintenance activities in NM.

4.14 Mitigation

4.14.1 Past mitigation

In accordance with USACE Permit NM/TX 91-50427, in 1997 and 1998, the USIBWC implemented mitigation actions as follows:

- Vortex weirs consisting of rock boulders placed across the river bed in a "V" shape with the tip pointing upstream and the center construction lower than the sides. These were determined not to create a barrier to aquatic life movement up and down the river. The work was done from December 1, 1997 to February 3, 1998. The sites were near the town of Garfield, NM and were installed downstream of the Montoya Arroyo and downstream of the Tierra Blanca and Green Arroyos (Figure 4-11).
- Groins consisting of approximately six rock boulders placed on the river, beginning from the bank and extending outward into the river channel. Eight groins were installed either upstream or downstream of the confluence of the Trujillo, Holguin, Sibley, Yeso, Placitas, Garcia, Angostura, and Rincon arroyos with the Rio Grande.
- Embayments consisting of a 40-foot by 40-foot excavated area that allows water to pond adjacent to the river bank with rock rip-rap placed on the sides of the entrance to this area for stabilization. The work was completed from February 4 to February 13, 1998. The embayments

were constructed 1,000 feet downstream of the confluence of Trujillo, Jaralosa, and Rincon Arroyos with the Rio Grande.

- A monitoring program in 1999 to sample the above sites for 3 irrigation/non-irrigation cycles, where water quality, biodiversity, natural recruitment, and stability parameters were monitored. Through a collaborative agreement, the New Mexico Fishery Resources Office collected data at the 14 mitigation sites. Transects were used to determine habitat availability. Water quality parameters were collected using field instrumentation. Fish were monitored by either a mesh seine or electro-fisher; several individuals were preserved and the remainder were released.

4.14.2 Future Mitigation

USIBWC will implement all mitigation requirements in any approved USACE permits as they are issued. In addition, the USIBWC will implement restoration measures in the Conceptual Restoration Plan and outlined in Section 2.6 of this Plan. USIBWC will implement requirements and recommendations from the USFWS 2012 Biological Opinion (Section 3). All channel work shall follow the Best Management Practices discussed in Section 4.6.4.

USIBWC will also consider implementing additional mitigation as it is presented, if feasible and not cost-prohibitive. Such mitigation could include some of the alternatives listed in Section 4.16.2 (for example, weirs, embayments, inset floodplains, or bank destabilization) as well as implementation of arroyo restoration sites discussed in Section 4.7. In addition, the possibility of wetlands projects is discussed in Section 4.6.1.5.

4.15 Cost Analysis

USIBWC will evaluate annual costs of river channel maintenance. USIBWC is interested in implementing measures that require less annual river maintenance over the long run.

USIBWC O&M Division also must ensure there are appropriate funds in the annual budget to conduct the necessary maintenance work in the river channel, in the floodplain and at the 5 NRCS sediment control dams.

4.16 Channel Maintenance Alternatives

In lieu of annual or near-annual river dredging or sediment excavation from areas which repeatedly plug with sediment, as documented in the 5-year Plan (Section 4.6.1), the USIBWC will consider implementing the channel maintenance alternatives outlined in this section.

4.16.1 Channel Maintenance Alternatives from the 2015 CMA Study

USIBWC will consider implementing the CMAs recommended in the 2015 CMA Study discussed in Sections 4.4.3, 4.17.2 and 4.17.3 and listed in Table 4-13. Recommended CMAs include arroyo sediment traps, long excavation, spur dikes, modifications to existing in channel infrastructure, and island destabilization.

Logistics for implementation of these CMAs is documented in Capital Project Plan: Channel Maintenance Alternatives and Sediment-transport Studies for the Rio Grande Canalization Project - Master Project, dated November 2015 or subsequent revision.

Details of arroyo sediment traps are discussed in Section 4.17.2. Details of other infrastructure projects are discussed in Section 4.17.3.

Island and bar destabilization was designed to evaluate the potential for erosion of these features after mechanical removal of the vegetation. This alternative involves clearing, grubbing, and disposal of herbaceous and woody vegetation from the islands and sediment bars. The grubbing process would reduce the elevation of the selected features by 6 inches. [See CMA Study Section 4.6.4 and Appendix J for more information.]

Table 4-13 Recommended CMAs in the 2015 CMA study

Problem Location		Recommended CMAs	Maintenance Period (years)	Total Annualized Cost[1]	Total First Costs[2]
1.	Tierra Blanca Creek to Sibley Arroyo	Arroyo Sediment Traps	2.9	$285,000	$1,094,920
		Vortex Weir	10	$4,100	$31,092
2.	Salem Bridge to Placitas Arroyo	Arroyo Sediment Traps	6.2	$90,600	$721,108
		Island Destabilization/Vegetation Removal	4	$77,000	$525,357
3.	Rincon Siphon A Restoration Site to Rincon Siphon	Arroyo Sediment Traps	4	$14,100	$154,634
		Rincon Siphon Modifications	2	$100,400	$1,989,426
4.	Rincon Arroyo to Bignell Arroyo	Long Excavation	9.7	$653,500	$548,800
		Island Destabilization/Vegetation Removal	4	$97,500	$664,644
5.	Rock Canyon to 1.4 mi below Rincon/Tonuco Drain Confluence	Arroyo Sediment Traps	12.1	$175,900	$3,830,434
		Long Excavation	27.7	$269,500	$3,830,434
6.	Picacho Drain to below Mesilla Dam	Gate Automation	1	$164,200	$3,565,000
		Sluiceway and Check Structures	1	$154,800	$3,298,338
7.	East Drain to below Vinton Bridge	Arroyo Sediment Traps	4.3	$77,500	$600,031
		Long Excavation	8.7	$164,800	$701,998
8.	Upstream of Country Club Bridge to NeMexas Siphon	Riprap	10	$28,300	$415,412
		Spur Dikes	3	$34,200	$305,367
9.	Montoya Drain to American Dam	Island Destabilization/Vegetation Removal	4	$32,300	$219,529
		Long Excavation	10.4	$534,700	$225,419

1 includes life cycle O&M costs and O&M contingency plus annualized O&M costs

2 includes planning, engineering, and design; construction management; construction contingency; and annualized first costs

4.16.2 Other Channel Maintenance Alternatives to Consider

In addition to the recommended CMAs from the 2015 study, USIBWC may choose to evaluate and implement additional CMAs. Some of these are being implemented by the Bureau of Reclamation in the Middle Rio Grande (USBR 2012a). Others were recommended by the ROD (USIBWC 2009).

- **Vortex and rock weirs** - placing rocks for bed control, raising the river bed/water surface elevation, direct stream flow or control stream grade; help alleviate bank erosion by deflecting flows away from eroding banklines, and break up the secondary circulation cells which add to the stress in the near bank region; help create grade stabilization.
- **Embayments** - formation of a low-lying basin or bay filled with sediments that creates backwater habitat
- **Inset floodplains, terraces and overbank lowering** - modifying the floodplain typically by removing sediment; re-establishes floodplain connectivity to the river, reduces velocities, and may increase flood storage capacity.
- **Bank destabilization and channel widening** - allows natural process to take over and allows the river to meander and/or the channel to widen within the levees, slowing velocities and providing habitat. Bank destabilization can occur by rip rap and jetty removal, clearing vegetation via root plowing, and bankline lowering.
- **Revetments** - a facing placed on a river bank to resist and prevent further erosion; many types of materials but most require period maintenance. Rip rap is most common.
- **Oxbow re-establishment** - reestablishing a flow source to an oxbow/resaca to increase flow area and reduce the average velocity. (Note: Crow Canyon A and Jaralosa are restoration sites with similar intentions.)
- **River bar/island maintenance** - maintenance of river sediment bars or islands for the purpose of increasing flow area within the river channel and providing a more efficient channel for the delivery of water and sediment.
- **Channel realignment/pilot channels** - relocation of the river channel away from a river facility including levees that is threatened by erosion and/or to bring the channel to an equilibrium slope. Pilot channels are excavated to establish a new river course and may need stabilization. They encourage the river to move the sediment and reform the channel and allow for minimal disturbance as opposed to channel dredging.
- **Native material bank stabilization** - these structures are intended to provide bank stabilization through various alternatives of root wad and boulder placement, J-Hook and rootwad vanes, cross vanes, log revetments, and vegetation planting.
- **Groins/Bendway Weirs** - embankments or dikes projecting from the bank into the channel to regulate river flow alignments; may be perpendicular to the bank or angled either up or downstream in an L or T shape. Can be used in combination with bar reconstruction to move the channel away from a trouble spot along a safer alignment. Generally require a wide channel.
- **Toe revetment plantings** - utilize a combination of rock or riprap material and willow planting to protect an eroding bank. The rock or riprap material is placed at the toe of the bank to prevent erosion at the toe and the undercutting of a bank; the plantings are placed along the top of the bank or on terraces along the bank to prevent overland erosion to the bankline.

- **Training dikes** - constructed parallel to the channel to guide flow; usually built in conjunction with revetment works or channel re-alignment/pilot channel projects; good for where the river banks are low.
- **Arroyo plug grading and removal** - remove deposited sediment at the mouth of tributary arroyos by excavation to prevent diminished channel capacity or deflection of flows into banklines or towards levees.
- **Removal of lateral confinements** - in areas where the river channel is constricted, the removal and/or relocation of confining terraces, levees, and jetties could be performed for floodplain expansion. Would likely require acquisition of additional property.

4.17 Long-Term Management Solutions

The following is a brief description of tasks that USIBWC should consider to properly address the long-term needs of the RGCP, depending on funding as well as regulatory and environmental requirements. The resultant would assure deliveries of water to U.S. and Mexican irrigators and provide adequate flood protection (USIBWC 2000).

4.17.1 Grade control structures

Construction of grade control structures would prevent scouring of channel infrastructure, such as the Hatch and Rincon Siphons (USIBWC 2000). Grade control structures also would create additional backwater habitat and possibly increase localized groundwater to facilitate bank restoration. There are no slated grade control projects during the FY16 to 19 timeframe, but they should be evaluated in future studies for long-term projects.

4.17.2 Sediment control dams/traps

The construction of additional sediment control structures at tributary arroyos would reduce flood peaks and sediment inflows into the Rio Grande, thereby increasing the flow capacity and eliminating or reducing the excavation of sediment from the river. Easements or the purchase of private land will be required to construct many of the sediment control structures (USIBWC 2000).

As discussed in Section 4.5.3, the NRCS/SCS originally considered 11 tributaries to construct sediment retention dams, but only 5 were constructed between 1969 and 1977. The other 6 dams recommended for construction of sediment dams were:

- Trujillo
- Montoya
- Tierra Blanca
- Sibley
- Placitas
- Rincon
- Candler (McCall)

Other entities have constructed sediment dams on smaller arroyos outside of USIBWC ROW, are such as Nordstrom, McLeod, and Ralph arroyos; Box, Apache and Spring Canyons; and Reed-Thurman Dam Drain. These sediment dams are not owned or maintained by USIBWC.

In 1996, the USACE evaluated sedimentation rates from tributary basins to the RGCP and found that the most significant sediment loads (greater than 5 acre-feet per year) are generated in the Rincon Valley, associated with tributary basins without control dams (Parsons 2004b, USACE 1996):

- Trujillo
- Montoya
- Tierra Blanca
- Sibley
- Placitas
- Angostura
- Rincon
- Reed
- Foster
- Faulkner Canyon

Some of the problem areas from the 2015 CMA study listed in Table 4-13 recommend more than one sediment trap. The study recommended 13 arroyo sediment traps [see 2015 CMA Study Section 4.6.2, Table 10 and Appendix H], which are summarized in Table 4-14. Some of the recommended traps are within USIBWC ROW and are more feasible for implementation. Others would require easements or acquisition of property. Some were conceptually designed to redirect the arroyo mouth upstream of downstream to be built within the existing ROW; however, the 2015 CMA Study recommended re-evaluating these outside of the USIBWC ROW.

USIBWC is moving forward with a pilot project to implement sediment traps on the small arroyos of Thurman I and II. In FY 16, USIBWC is contracting the design and construction specifications and completing NEPA compliance for these CMAs, with a target construction of FY17. This will be a pilot project to evaluate cost-benefit and efficiency for future sediment trap implementation.

All of the sediment traps from the 2015 CMA Study would include a series of trapping features (rock check structures, piles or fence screens) designed to trap the coarse material and allow a portion of the finer (sand, silt and clay) fractions to pass to reduce maintenance and manage the most problematic coarse material. All of the sediment traps would also include an embayment at the downstream end connecting to the Rio Grande. A debris rack would be necessary at the upstream entrance to the trap to capture floating debris that could affect the performance of the trapping features. The traps were designed to have a trapping volume that exceeds the average annual bed-load yield from the tributaries. Where possible, the footprint of the trap was laid out within the USIBWC ROW to avoid the need to purchase private property. Surface areas of the traps ranged from 0.3 acres to 4.4 acres, and the average depth of the trap ranged from 3 feet to 4 feet. The 2015 CMA Study conceptually designed the trapping features to be constructed with rebar and wire screens with progressively finer mesh openings in the downstream direction. All would have an access road and most would have a berm.

Table 4-14 Summary of Arroyo Sediment Traps recommended in 2015 CMA Study					
Problem Location	Arroyo Name	Surface Area (Acres)	Trap Volume (acre-feet)	%t of Annual Total Yield Trapped	Comments on Implementation
1	Tierra Blanca Creek	4.4	17.7	94%	2015 study rerouted the arroyo mouth upstream to stay within USIBWC ROW
	Green Canyon	2.7	11.0	108	Already an NRCS sediment dam on the Green; 2015 study rerouted the arroyo mouth downstream to stay within USIBWC ROW
	Sibley Arroyo	2.7	8.2	102%	2015 study rerouted the arroyo mouth upstream to stay within USIBWC ROW
2	Thurman II Arroyo	1	2.9	148%	Under design in FY16 for pilot project implementation
	Thurman I Arroyo	1.4	4.1	364%	Under design in FY16 for pilot project implementation
	Placitas Arroyo	3.5	14	142%	Could overlap other regional efforts
3	Garcia Arroyo	0.6	1.7	140%	Near active flycatcher territories
4	Rock Canyon	1.7	5.2	501%	Outside of USIBWC ROW
	Horse Canyon	1.2	3.6	347%	Outside of USIBWC ROW
7	Subarea 101	0.3	1.0	67%	All on the east bank where USIBWC is proposing to construct the Canutillo floodwall
	Subarea 102 (U/S)	0.5	2.0	118%	
	Subarea 102 (D/S)	1.4	4.1	398%	
	Subarea 103 (U/S)	0.6	1.8	129%	

In addition to the sediment traps from the 2015 CMA Study, future studies could evaluate other sediment dams recommended by previous studies for feasibility and effectiveness, including Trujillo, Montoya, Angostura, Rincon, Reed, Foster, and Faulkner arroyos.

4.17.3 Other sediment control infrastructure

In addition to the sediment dams or traps discussed in the previous section, additional infrastructure should be considered for sediment control to assist in sediment capture. The infrastructure alternatives recommended in the 2015 CMA Study are listed in Table 4-15.

Table 4-15 Summary of Infrastructure Alternatives recommended in 2015 CMA Study					
Problem Location	Problem Location Name	CMA	Description	CMA Study Reference Location	Comments on Implementation
1	Tierra Blanca Creek to Sibley Arroyo	Tierra Blanca Vortex Weir Modification	middle portion of the existing weir would be removed over a distance of 30 feet. Includes excavation of a pilot channel downstream of weir	4.6.5, p. 4.32 Figures 28 & 29	
3	Rincon Siphon A Restoration Site to Rincon Siphon	Rincon Siphon Modification	removal of the sheet pile and rock grade control structure at the siphon and replacing the siphon with a flume crossing over the Rio Grande	4.6.5, p. 4.32 Figure 30	Needs coordination with EBID
6	Picacho Drain to below Mesilla Dam	Mesilla Dam Gate Automation	installation of automated gate operators at Mesilla Dam Gates 5 and 9	4.6.5, p. 4.32 Appendix K	Mesilla Dam is owned by USBR; needs coordination with USBR
		Sluiceway and Check Structures	installation of check structures with sluiceways in the Eastside and Westside canals	4.6.5, p. 4.32 Appendix K	Mesilla East and West Canals are owned by EBID; needs coordination with EBID
8	Upstream of Country Club Bridge to NeMexas Siphon	Rip Rap Revetment	Rip rap revetment along the right bank downstream from the bridge, extending along the inside of the bend through the straight reach to just above the NeMexas Siphon over a distance of 2,300 feet. Designed for 1.5H:1V sideslope	4.6.5, p. 4.38 Figure 33	
		Spur Dikes	The spurs are very similar in concept to bendway weirs in that they have low elevations relative to the channel banks and are oriented about 30 degrees in the upstream direction	4.6.3, p. 4.27 Appendix I	

Regarding projects proposed for Mesilla Dam, USIBWC has limited ability to work on infrastructure belonging to another entity. USIBWC is authorized (22 U.S.C 277c and 277d-29) to enter into agreements with political subdivisions in connection with the maintenance of works that facilitate compliance with treaties between the United States and Mexico. However, USIBWC must ensure the proper funding authority and legal accountability for these projects. USIBWC will work with appropriate entities (USBR, EBID) on a possible path forward for these projects.

4.17.4 Acquisition of Land

Acquire land within and outside of the Rio Grande floodplain. Areas within the floodplain are needed to assure the prevention of flow obstructions. There are currently areas which are privately owned that would be inundated. Areas outside of floodplain are necessary to provide future sediment disposal sites (USIBWC 2000).

4.17.5 Sediment Control Initiative

USIBWC is reaching out to stakeholders to work towards a collaborative sediment control initiative which would address sediment inflows to the RGCP prior to entering the river. Such efforts would address sediment control outside of USIBWC jurisdiction and require a collaborative approach. Key stakeholders include the Rio Grande Compact Commission, counties, federal agencies (including water and land management agencies), state agencies, irrigation districts, water utilities, environmental groups, regional organizations such as the Stormwater Coalition, and others. USIBWC is spearheading the effort to convene stakeholders to discuss collaborative projects.

4.18 Updating this Plan

This Channel Maintenance Plan will be reviewed at least every 3 years, and will be updated at least every 5 years, or sooner if there are substantial changes.

4.19 Channel Maintenance Maps

The following pages are maps of locations referenced in Section 4.6.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Percha Dam

Alignment Map No. 32

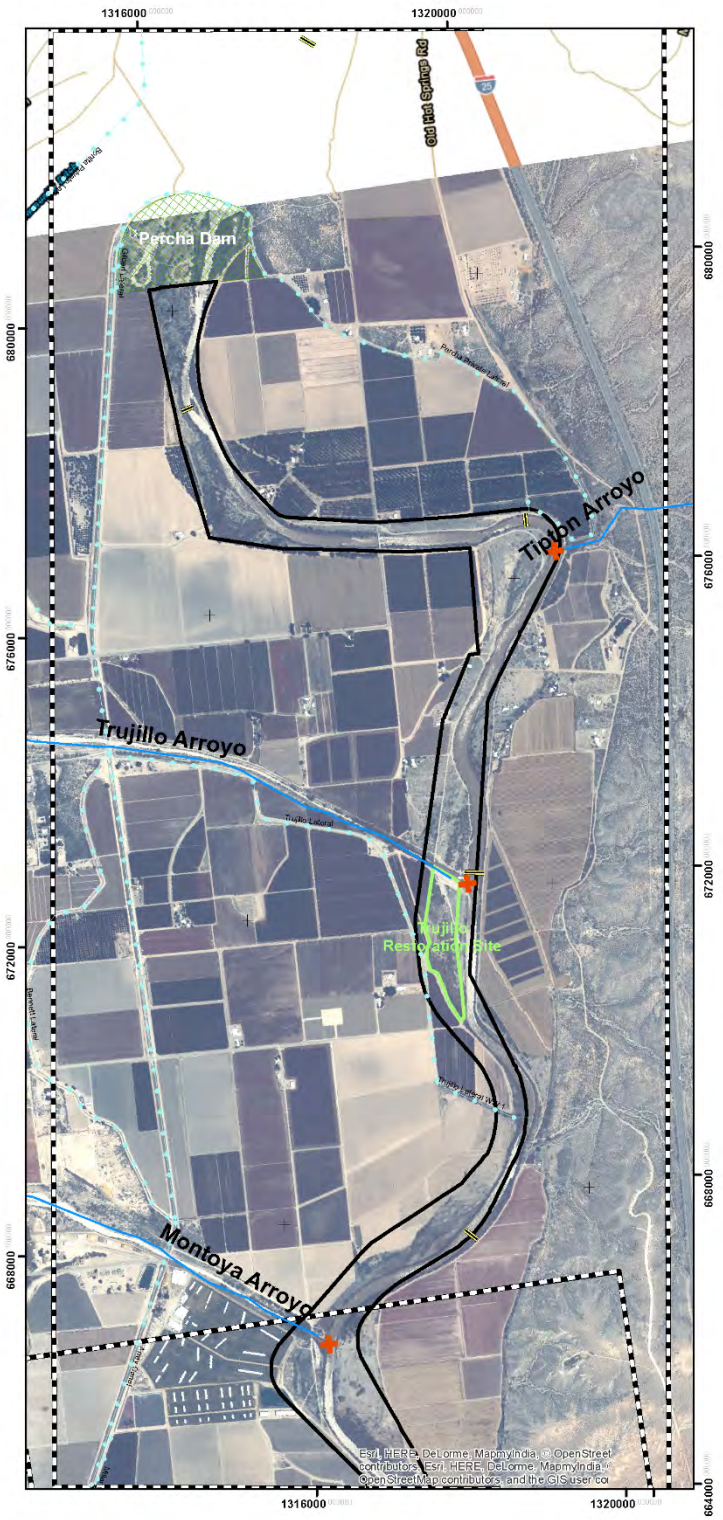
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 120 240 480 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

Page 2 of 33

Tierra Blanca Sibley

Alignment Map No. 31

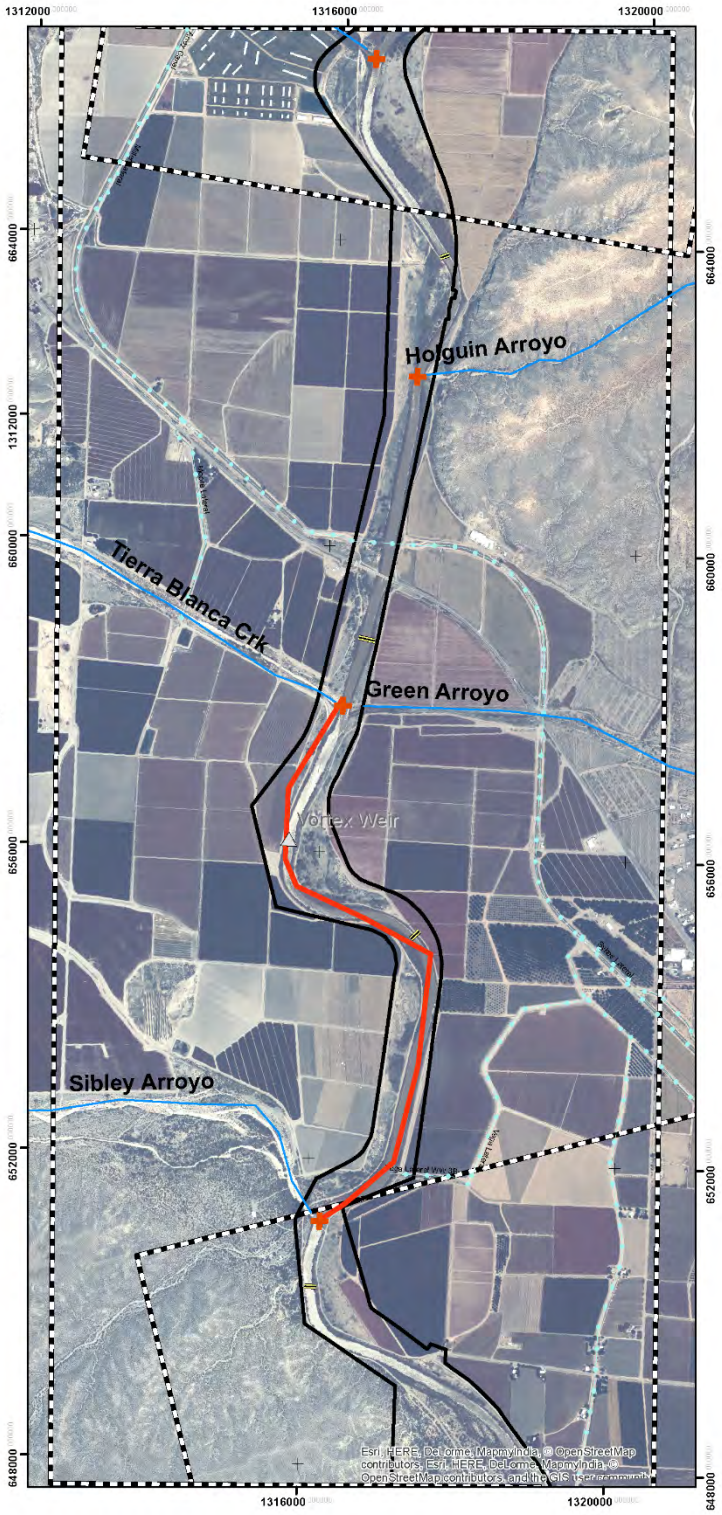
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

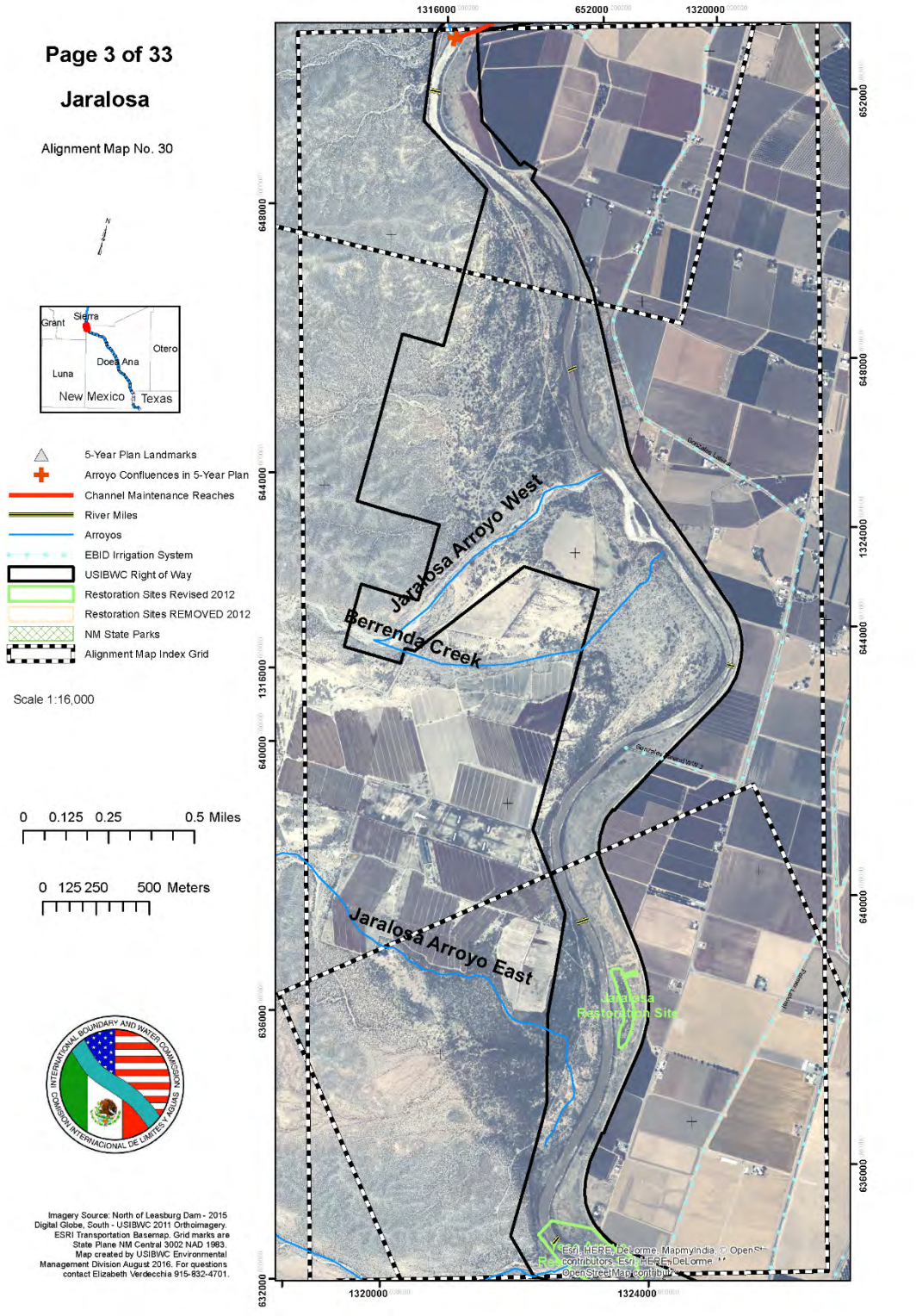
0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

Page 4 of 33

Crow Canyon

Alignment Map No. 29

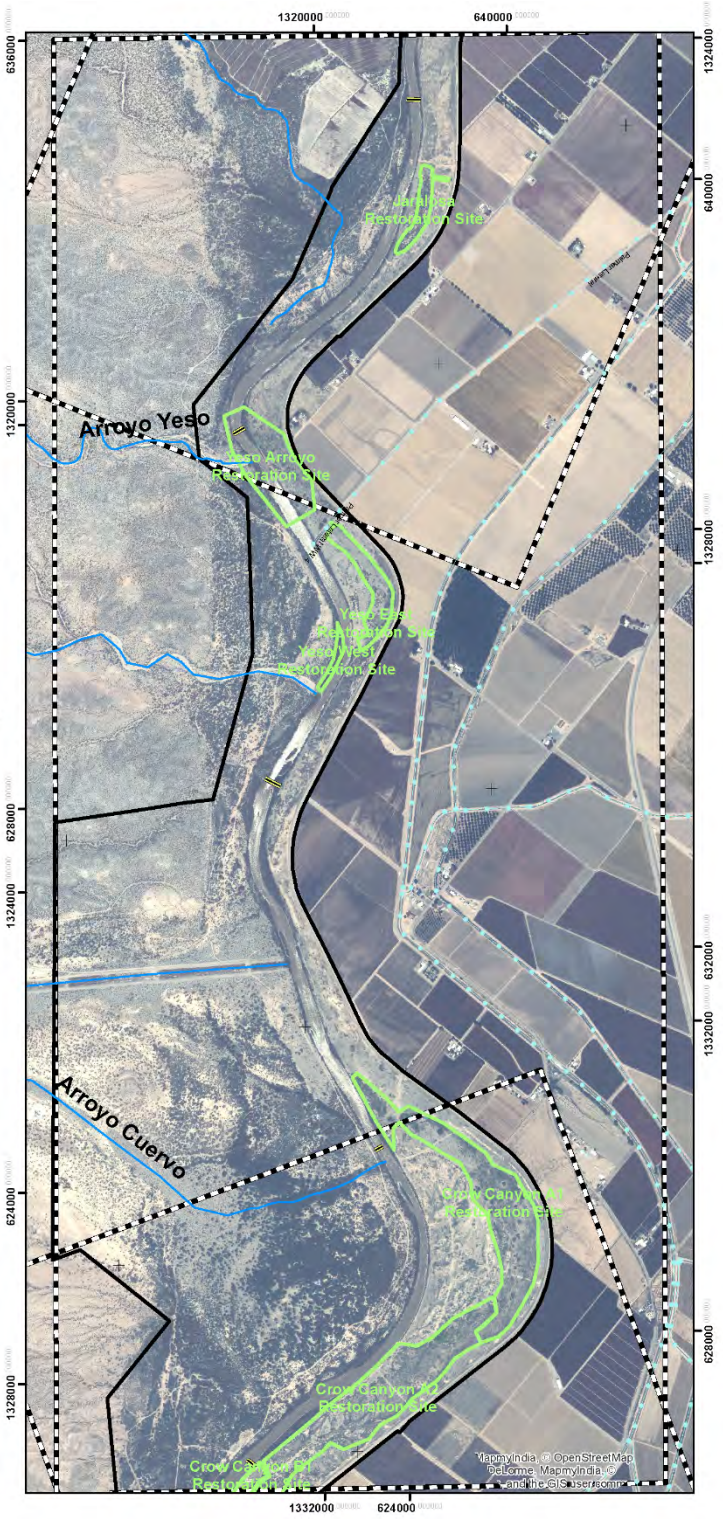
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

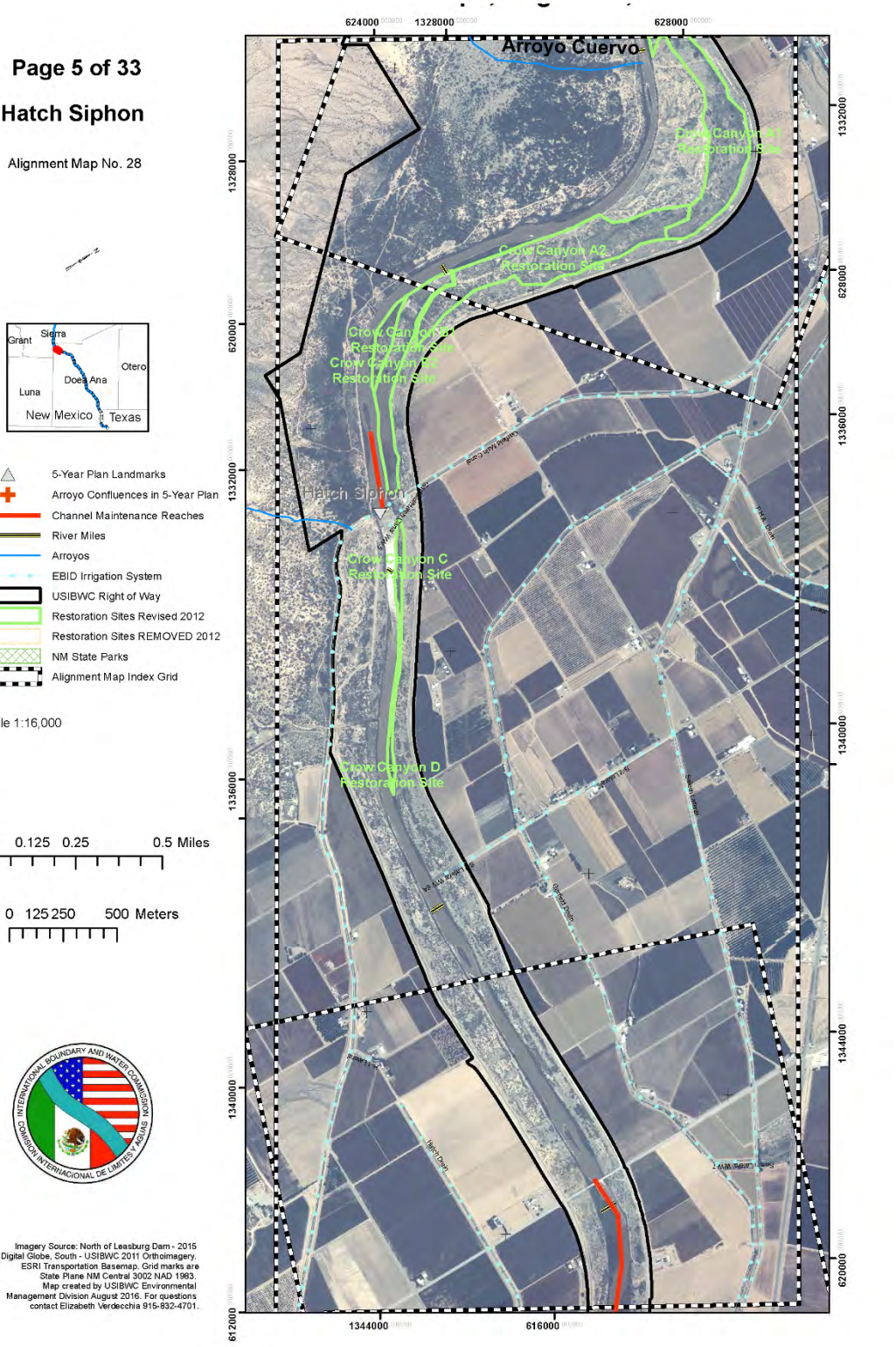


USIBWC Rio Grande Canalization Project Channel Maintenance Maps

Page 5 of 33

Hatch Siphon

Alignment Map No. 28



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

Page 6 of 33

Salem Bridge

Alignment Map No. 27

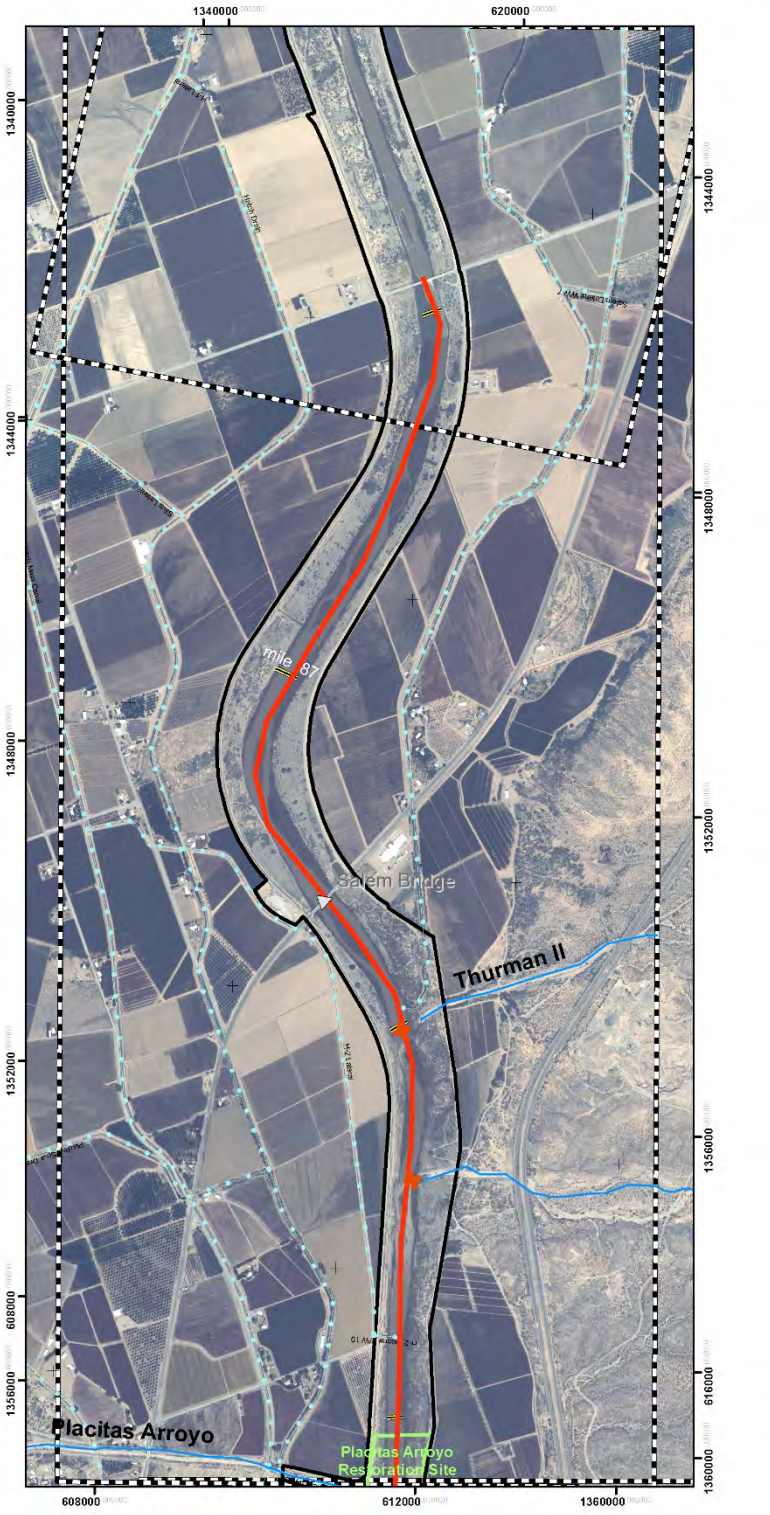
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Hatch

Alignment Map No. 26

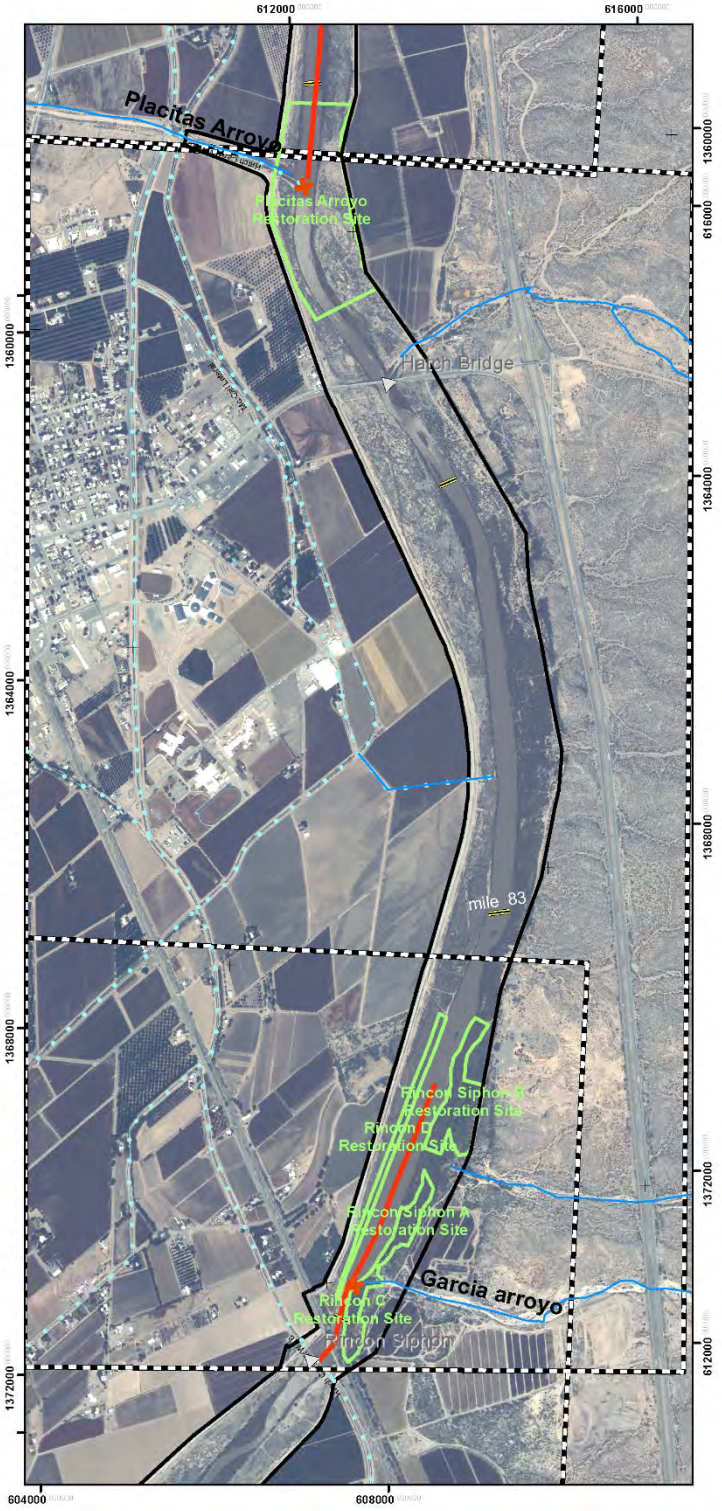
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.1 0.2 0.4 Miles

0 115 230 460 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Rincon Siphon

Alignment Map No. 25

5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Rincon and Reed Arroyos

Alignment Map No. 24

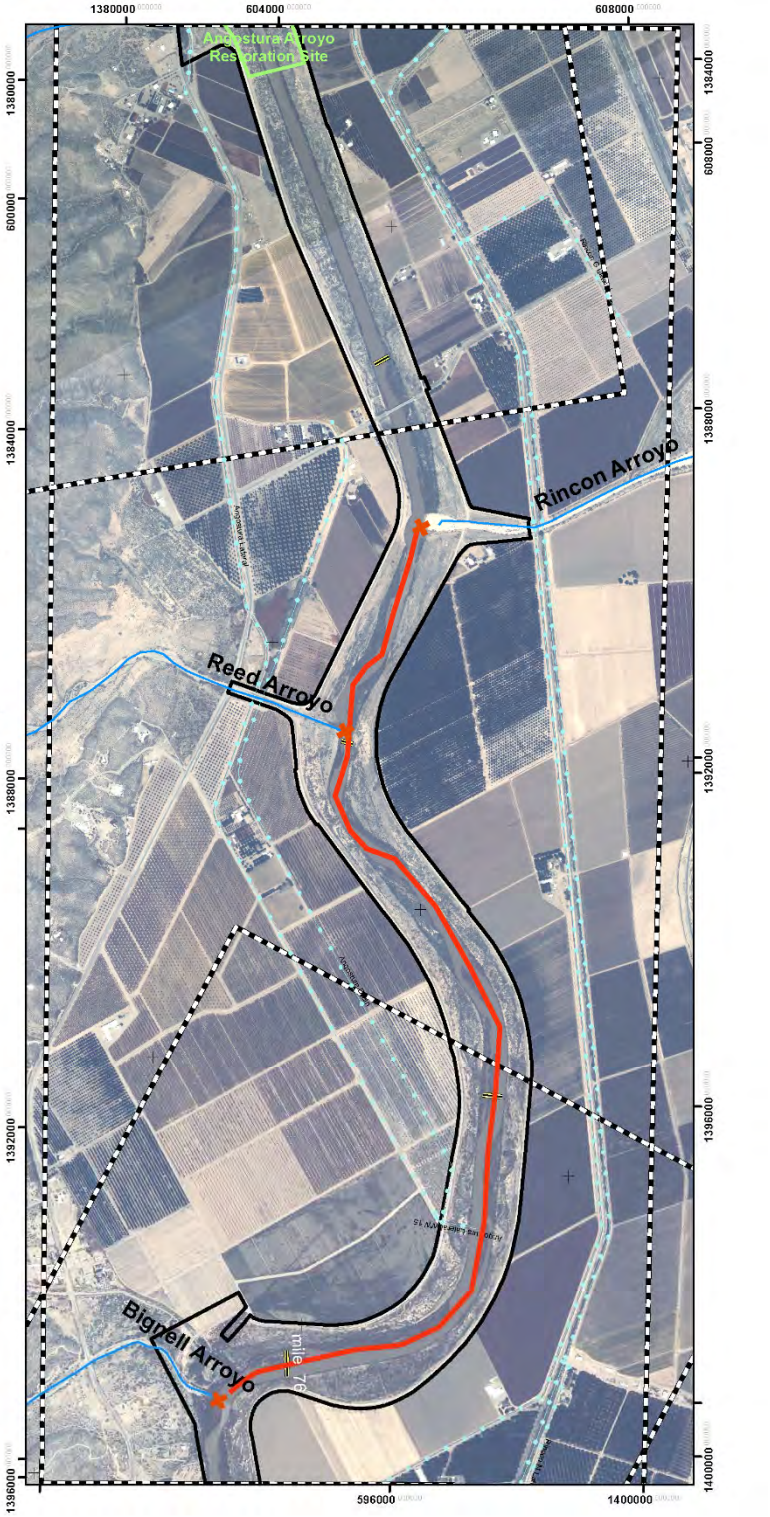
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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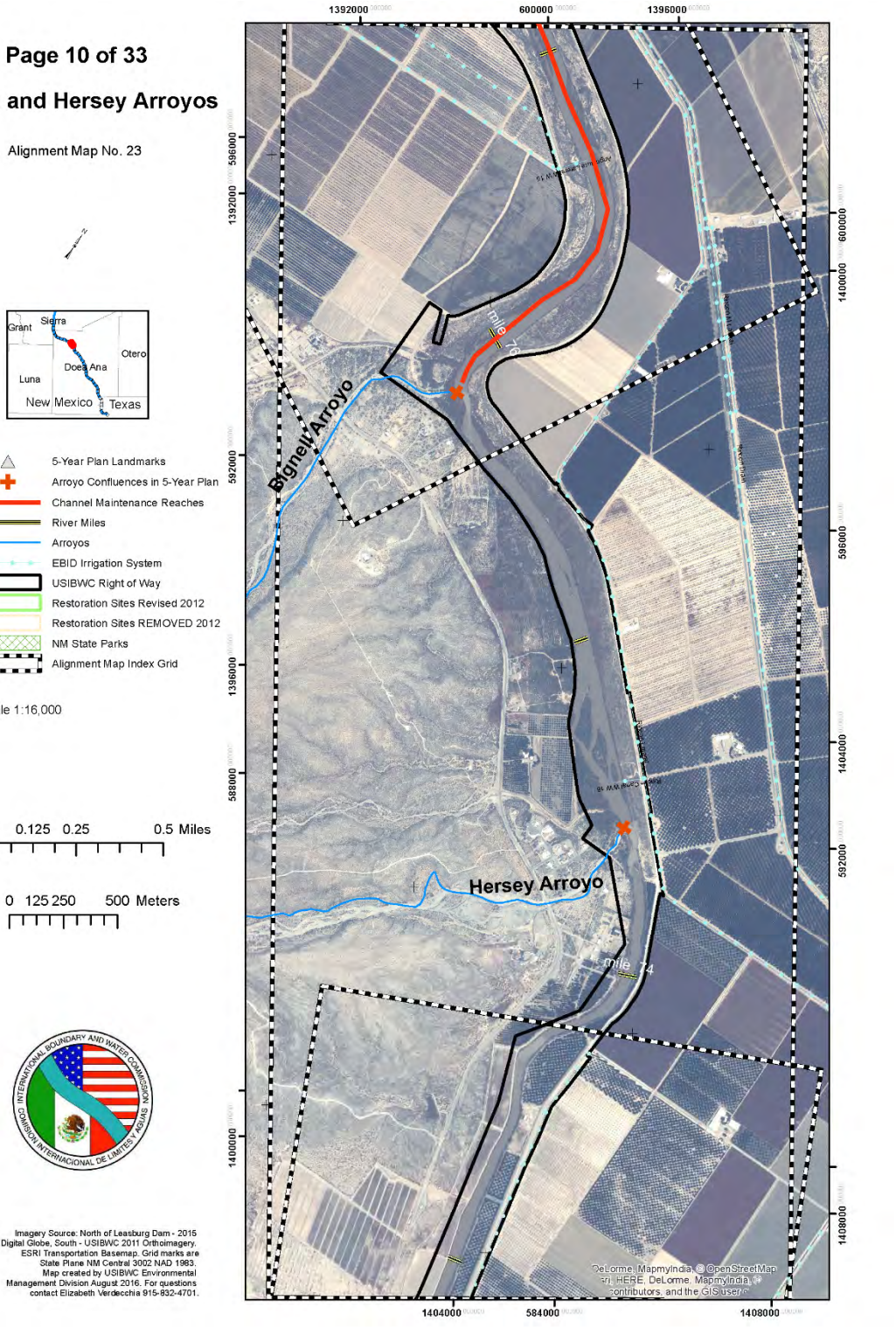
Bignell and Hersey Arroyos

Alignment Map No. 23



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Tonuco Drain

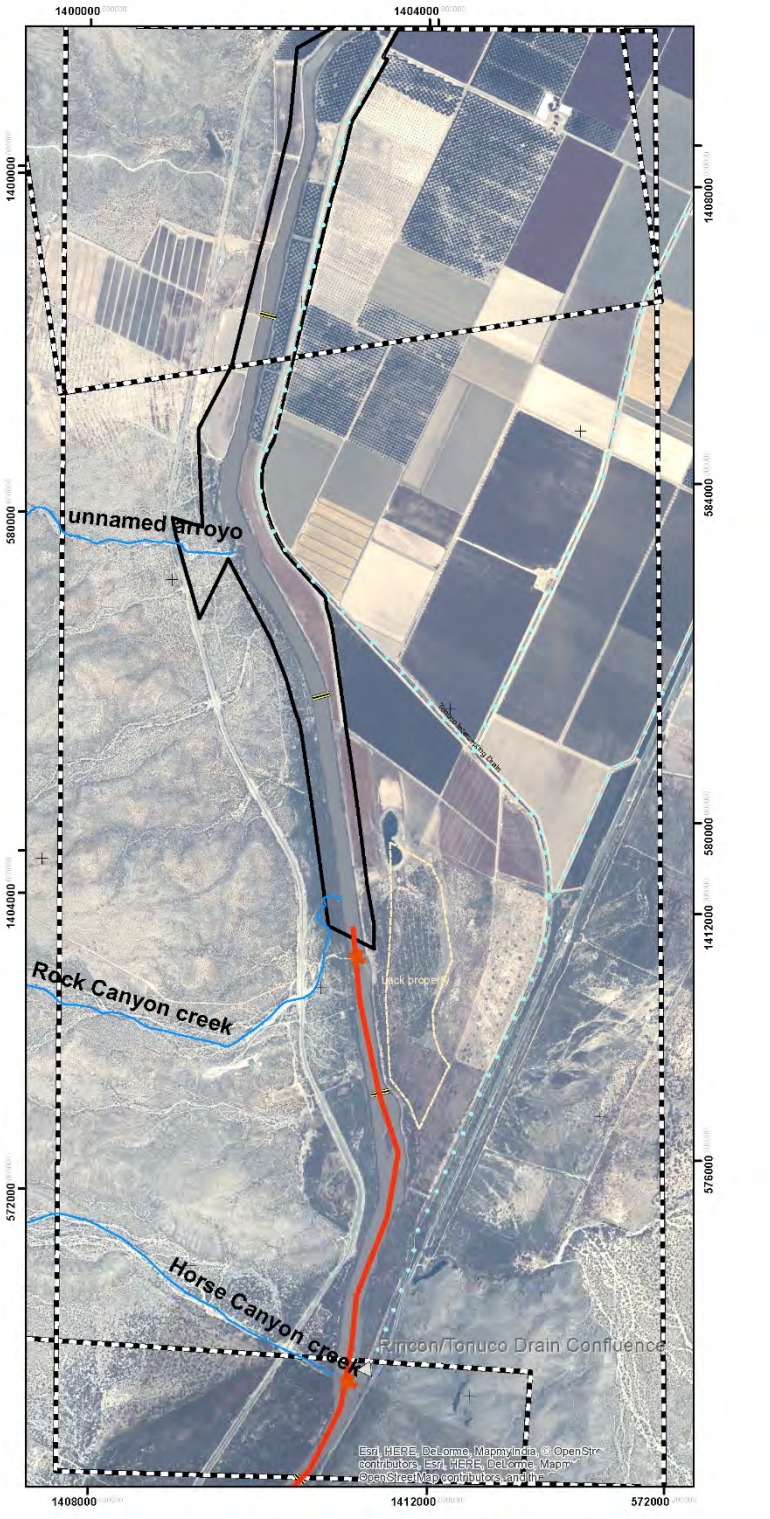
Alignment Map No. 22

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

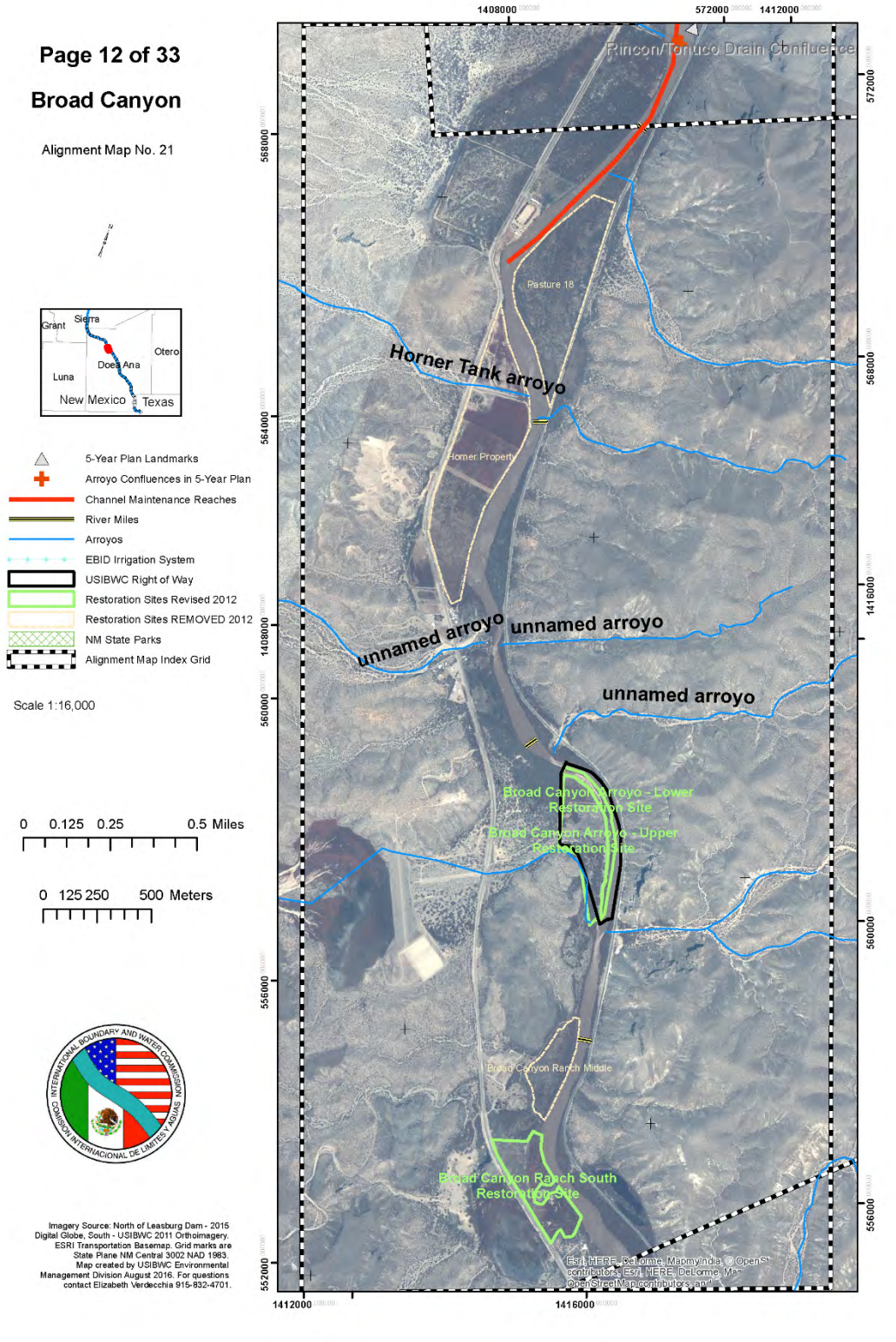
0 0.125 0.25 0.5 Miles

0 120240 480 Meters



Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Above Leasburg Dam

Alignment Map No. 20

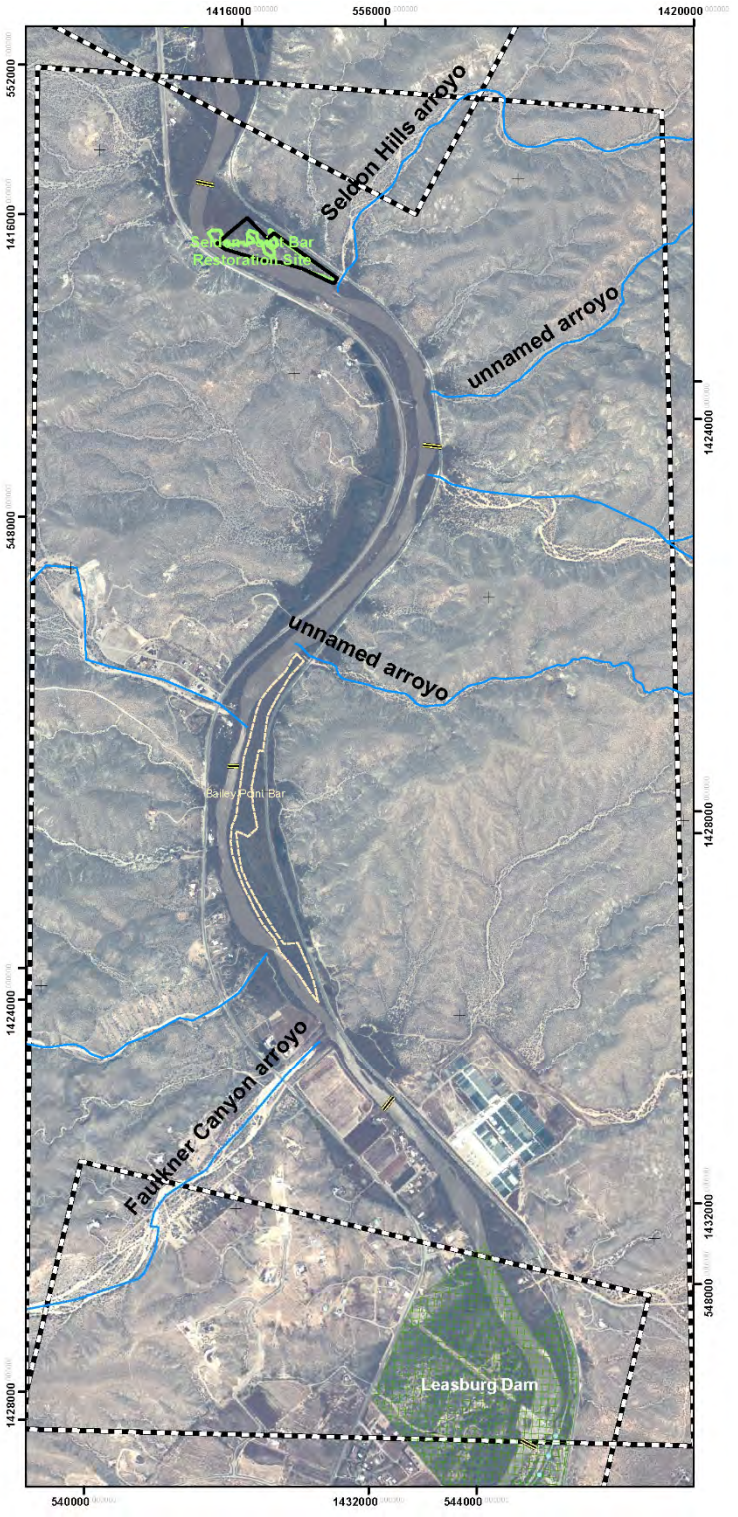
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Leasburg Dam

Alignment Map No. 19

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Between Leasburg and Shalem

Alignment Map No. 18

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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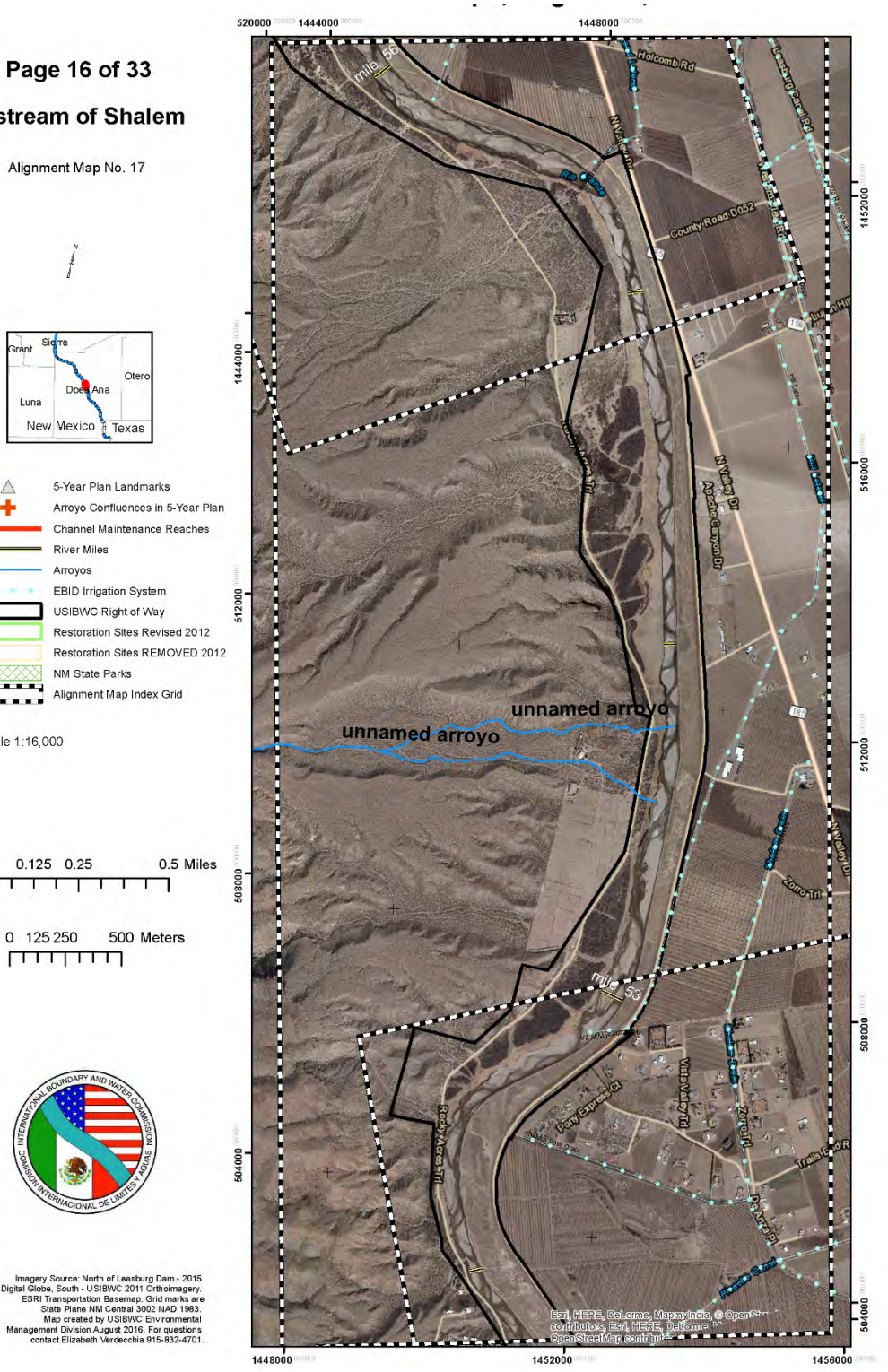
Upstream of Shalem

Alignment Map No. 17



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Shalem

Alignment Map No. 16

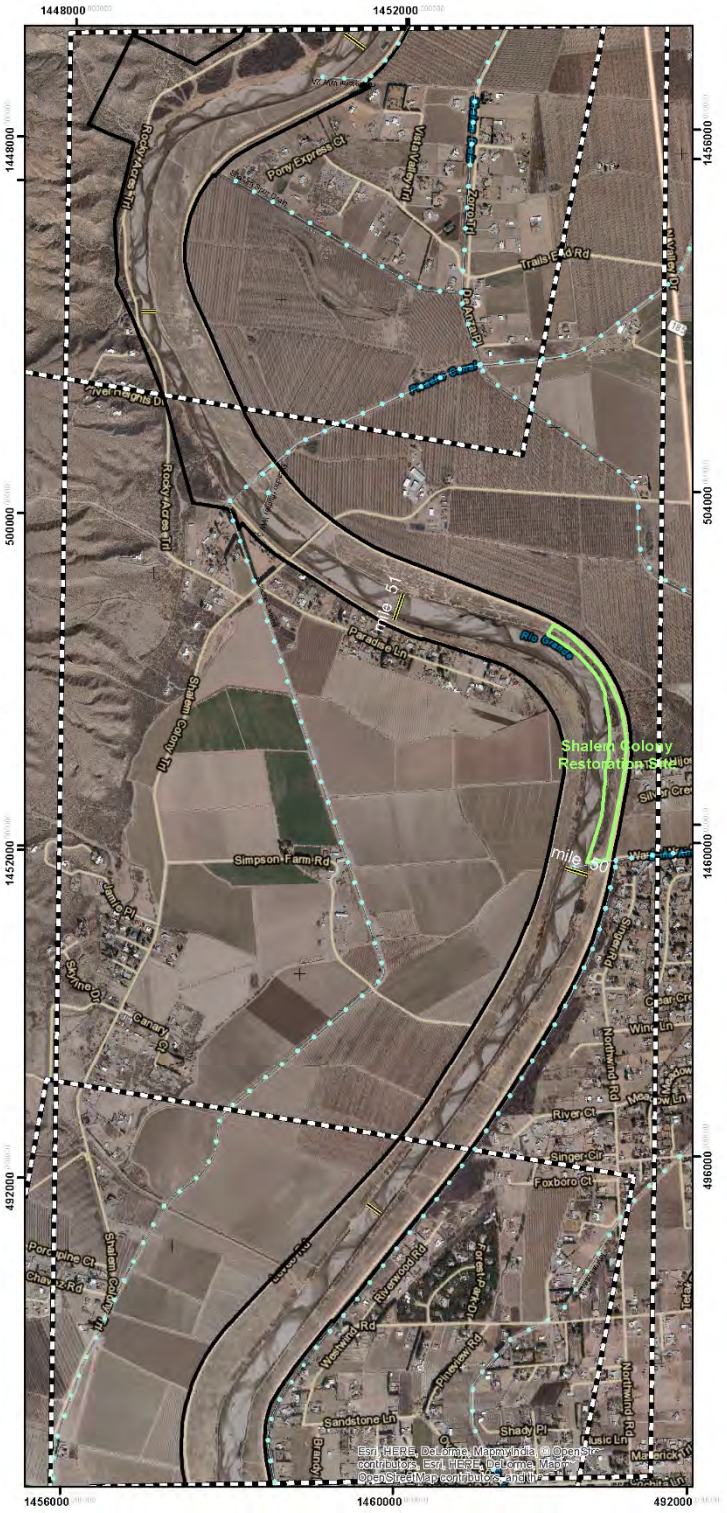
5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Picacho Bridge

Alignment Map No. 15

5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Las Cruces I-10 Bridge

Alignment Map No. 14

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Mesilla Valley Bosque

Alignment Map No. 13

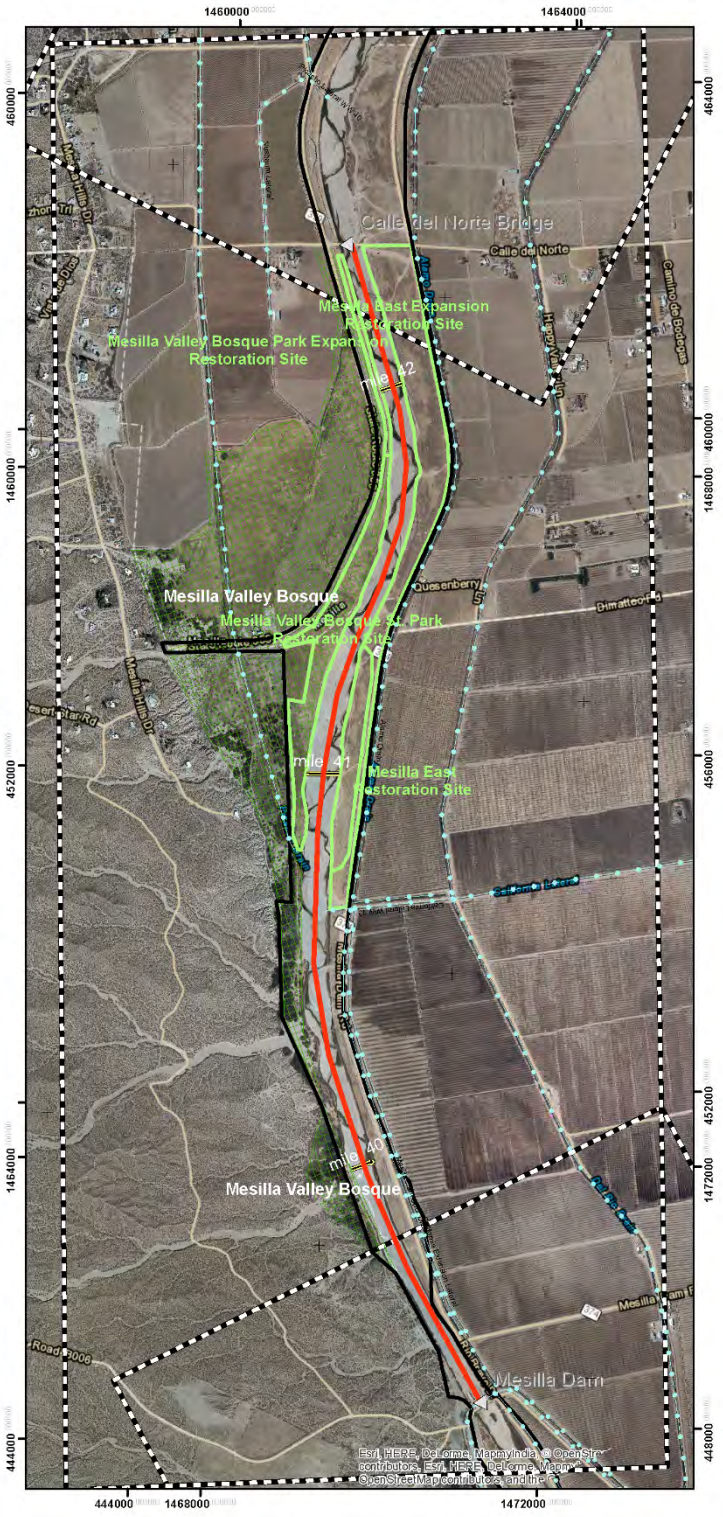
5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Mesilla Dam

Alignment Map No. 12

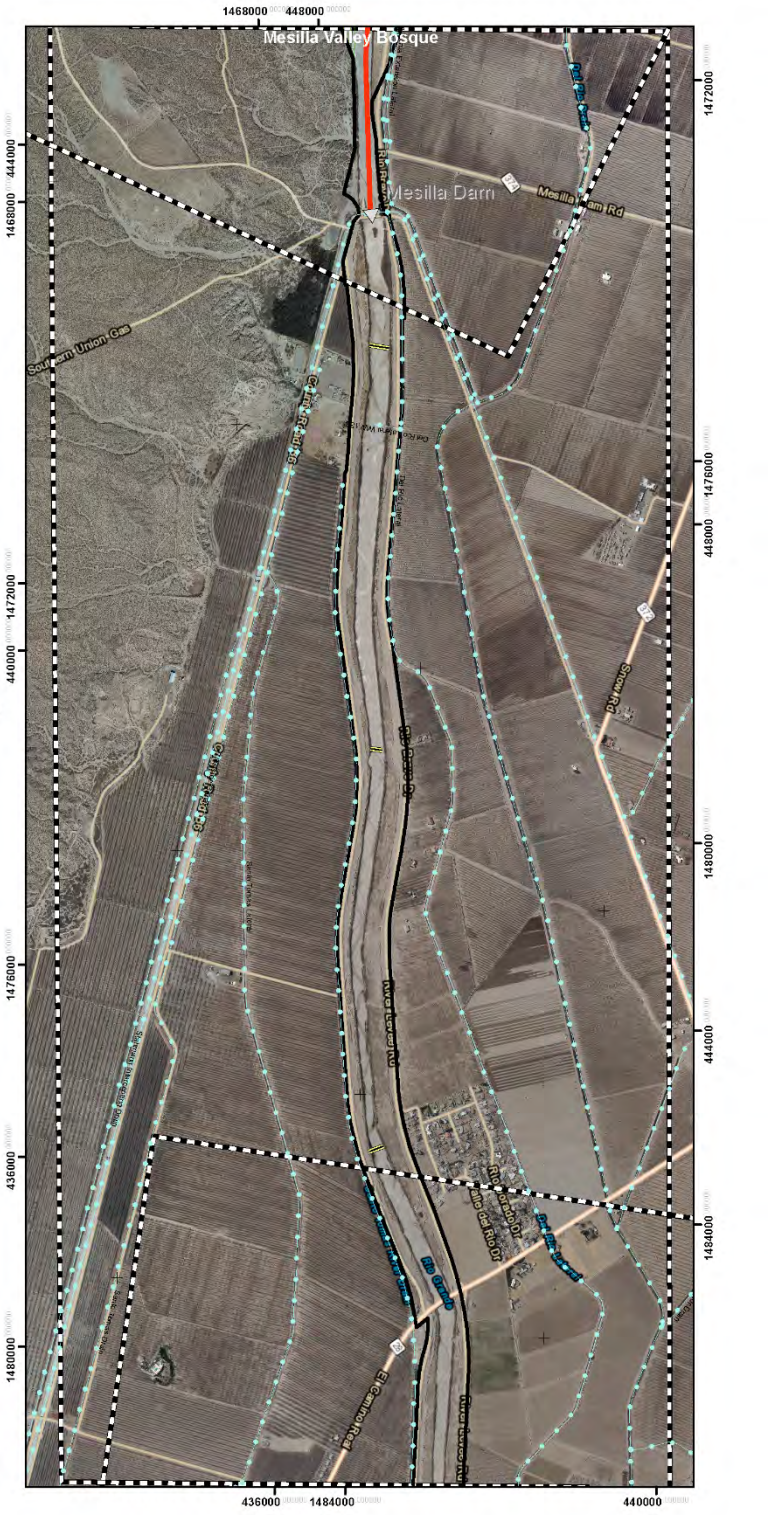
5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Santo Tomas

Alignment Map No. 11

5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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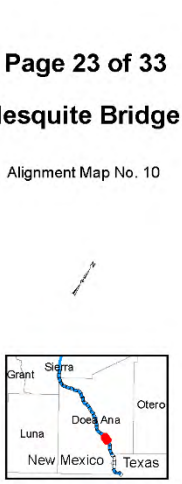
Mesquite Bridge

Alignment Map No. 10



5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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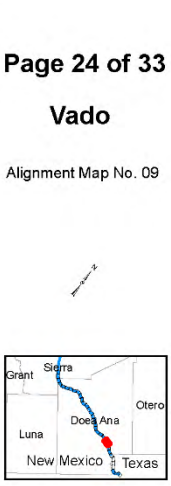
Vado

Alignment Map No. 09



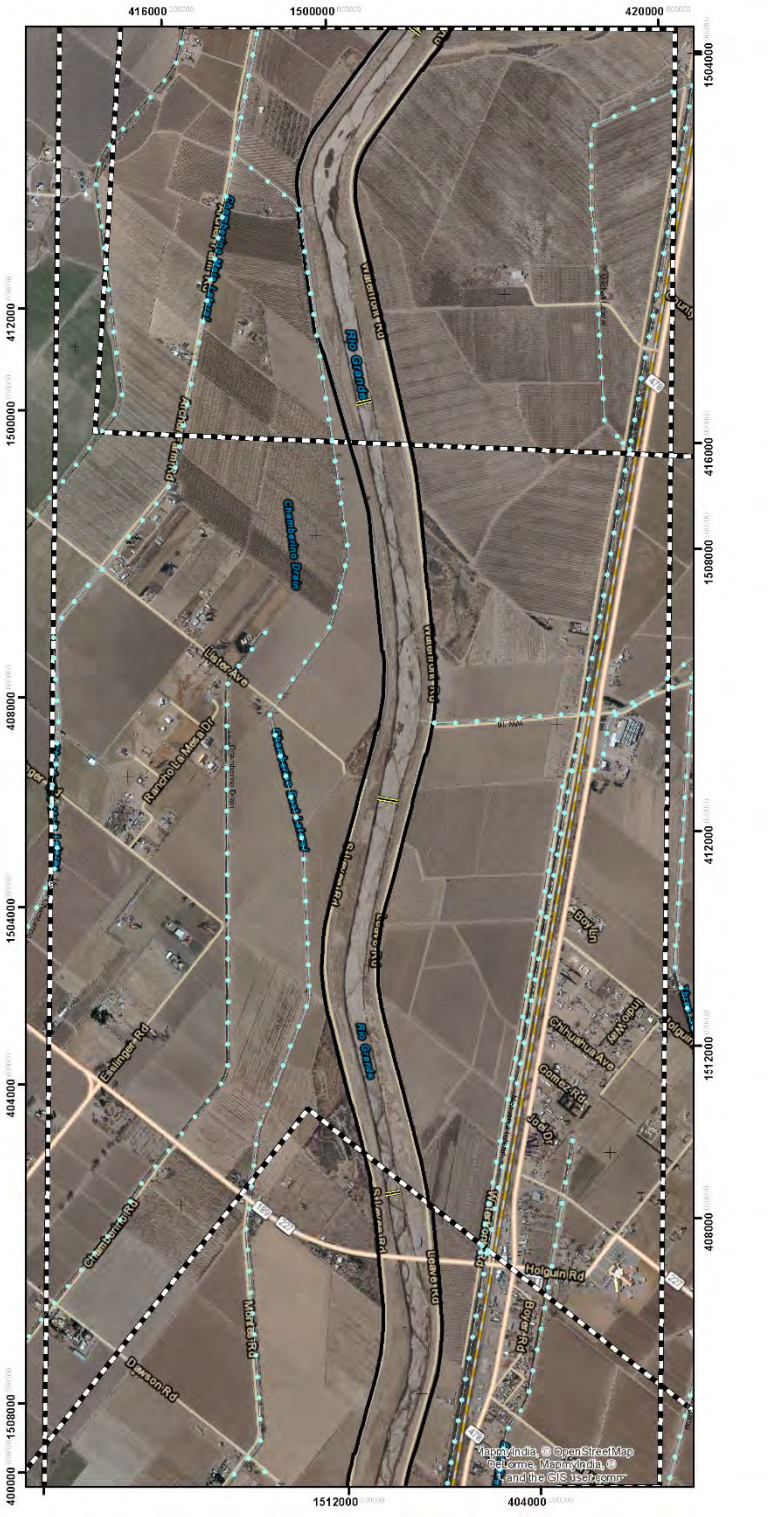
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery, ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Berino

Alignment Map No. 08

5-Year Plan Landmarks
Arroyo Confluences in 5-Year Plan
Channel Maintenance Reaches
River Miles
Arroyos
EBID Irrigation System
USIBWC Right of Way
Restoration Sites Revised 2012
Restoration Sites REMOVED 2012
NM State Parks
Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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La Union

Alignment Map No. 07

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Anthony

Alignment Map No. 06

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Vinton

Alignment Map No. 05

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Canutillo

Alignment Map No. 04

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Borderland

Alignment Map No. 03

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

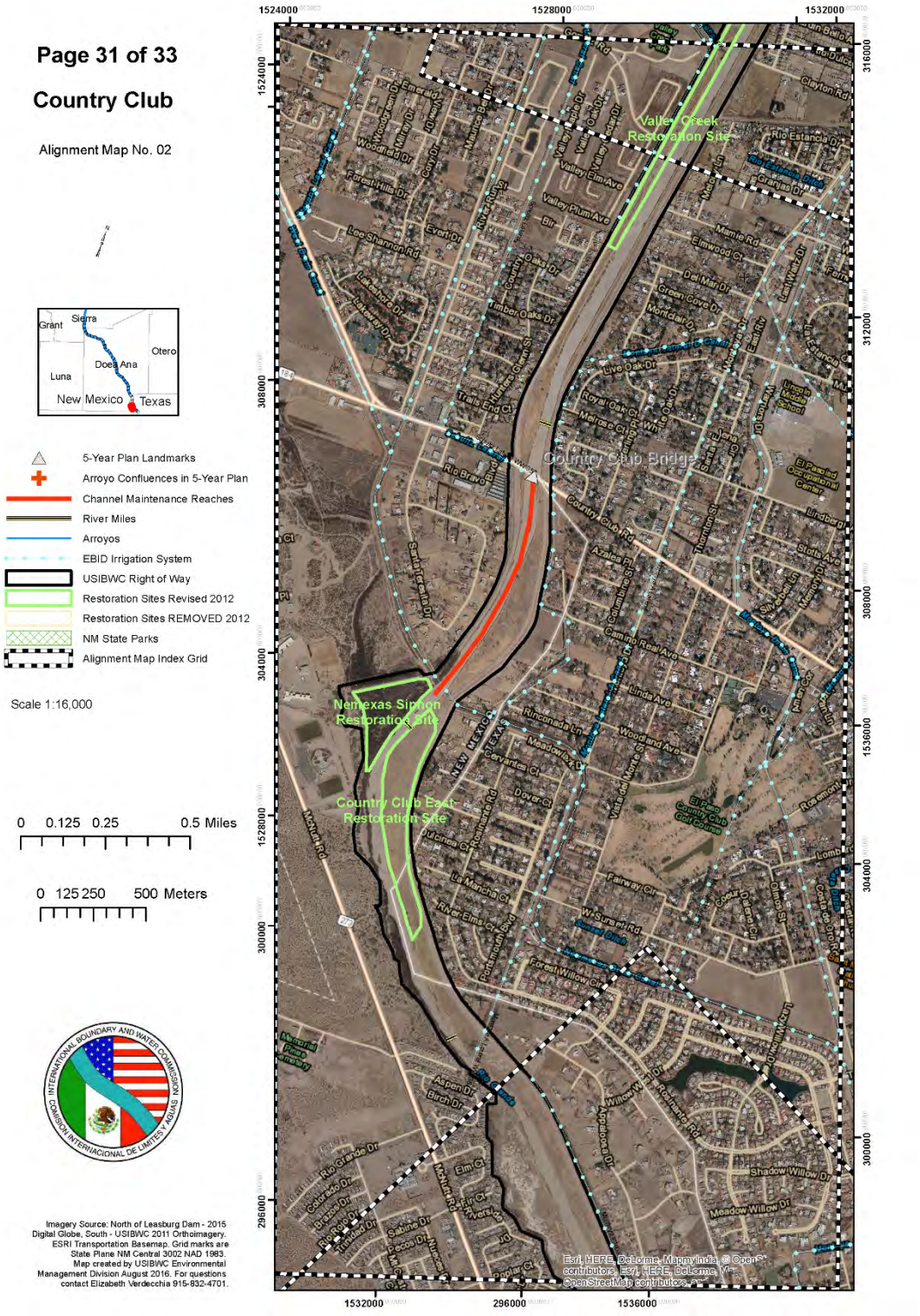
Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Rio Grande Canalization Project Channel Maintenance Maps



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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Sunland Park

Alignment Map No. 01

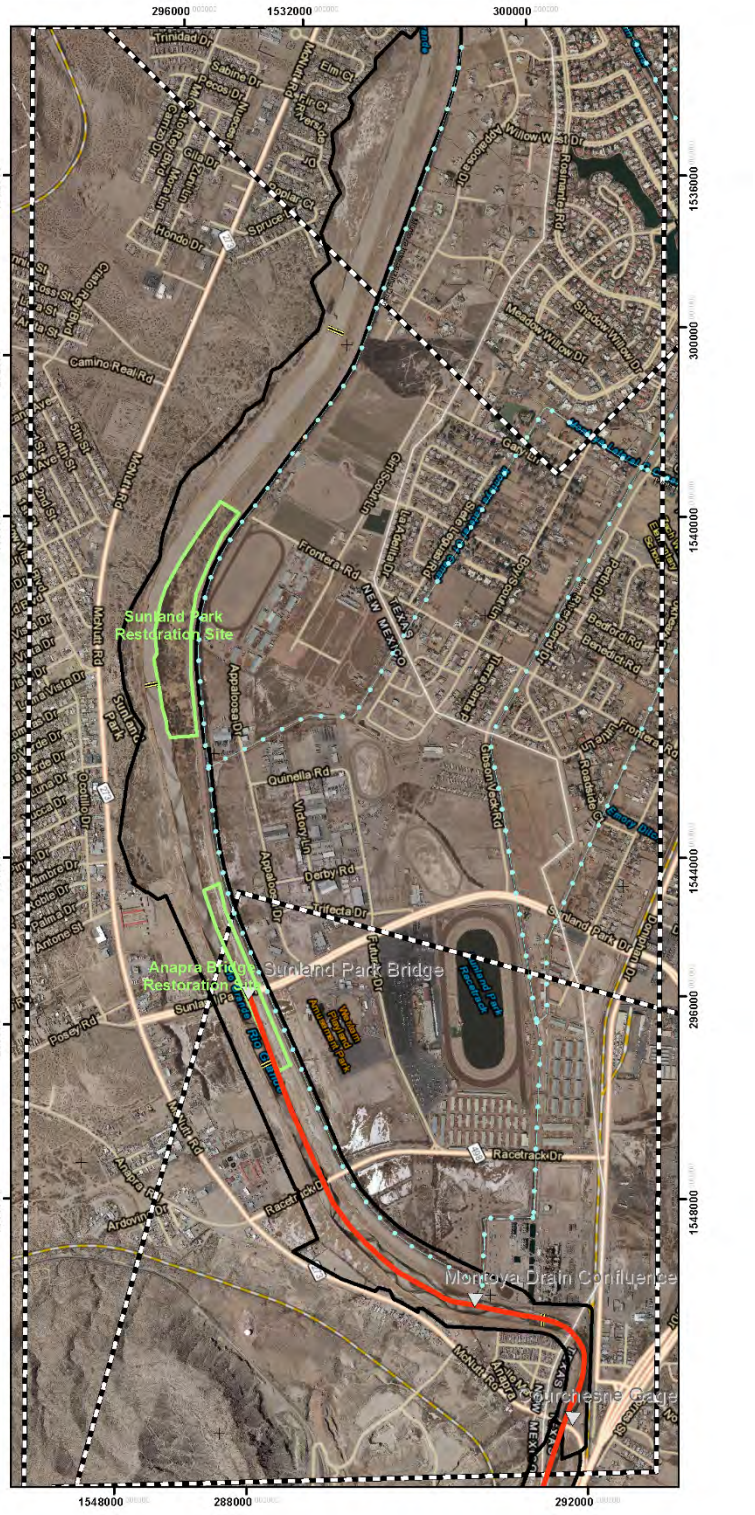
- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.



USIBWC Rio Grande Canalization Project Channel Maintenance Maps

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American Dam

Protective Works Above American Dam

- 5-Year Plan Landmarks
- Arroyo Confluences in 5-Year Plan
- Channel Maintenance Reaches
- River Miles
- Arroyos
- EBID Irrigation System
- USIBWC Right of Way
- Restoration Sites Revised 2012
- Restoration Sites REMOVED 2012
- NM State Parks
- Alignment Map Index Grid

Scale 1:16,000

0 0.125 0.25 0.5 Miles

0 125 250 500 Meters

Imagery Source: North of Leasburg Dam - 2015 Digital Globe, South - USIBWC 2011 Orthoimagery. ESRI Transportation Basemap. Grid marks are State Plane NM Central 3002 NAD 1983. Map created by USIBWC Environmental Management Division August 2016. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Canalization River Management Plan -

PART 5 - FIELD GUIDE TO COMMON NATIVE & NON-NATIVE FLORA & FAUNA IN THE RGCP RIPARIAN ZONE

Approval Signatures

Gilbert Anaya 11/20/14

Gilbert Anaya Date

Division Chief, Environmental Management Division

5.1 Introduction

This Field Guide is intended to provide information on common plants and animals found within the USIBWC lands in the RGCP, in order to assist field staff and environmental staff in management decisions. Native species should generally be left to thrive in areas designated as No-Mow Zones and restoration sites, whereas non-native species can be disturbed or removed in these and other areas. This guide is by no means an exhaustive reference, and staff are encouraged to seek additional biological references if positive identification of a species is not accomplished with this guide. In addition, if field staff encounter a threatened or endangered species, they should call EMD immediately.

5.2 Native Plants of the Rio Grande Riparian Zone

Black Willow / Goodding's Willow

Coyote Willow

Cottonwood



Three-leaf Sumac


New Mexico Olive



Screw-bean Mesquite


Honey Mesquite

Saltgrass (Right: exotic bermuda grass in gloved hand, native saltgrass in right hand)

Yerba Mansa

False Indigo

Wolfberry

Sacaton grass

Chusa grass

Bulrush

Sacred Datura

Four-winged saltbush

Cocklebur

Rabbitbrush

Baccharus/ seep willow

Velvet ash tree

5.3 Native Special Status Species of Wildlife of the Rio Grande Canalization Riparian Zone

Southwestern Willow Flycatcher (Endangered)

Yellow-Billed Cuckoo (ESA Candidate Species)

Aplomado Falcon (Endangered)

Interior Least Tern (Endangered)

Peregrine Falcon (Texas Threatened)

Chihuahuan Desert Lyre Snake (Texas Threatened)

5.4 Non-native Flora and Fauna

Salt cedar / Tamarisk

Giant Cane / Arundo Donax



Russian Thistle/ "Tumbleweed"


Kochia

Exotic Elm (Siberian or Chinese)

5.5 Additional Resources and Photo Sources

5.5.1 Additional Resources

- The Vegetation Types of Texas, including Cropland
  www.tpwd.state.tx.us/publications/pwdpubs/pwd_bn_w7000_0120/
- Field Guide for the Identification and Use of Common Riparian Woody Plants of the Intermountain West and Pacific Northwest Regions
  http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpu7428.pdf
- The Grasses and Grass-like Plants of New Mexico
  https://archive.org/details/grassesgrasslike00woot
- Invasive Riparian Plant Identification Guides
  http://www.epa.gov/naaujydh/pages/publications/authored/EPA620R-06003EMAPSWFieldOperationsManualAppendixD.pdf

5.5.2 Photo Sources:

All photos E. Verdecchia, USIBWC except for the following:

Southwestern Willow Flycatcher – USFS Colorado Plateau Research Station
http://sbsc.wr.usgs.gov/cprs/research/projects/swwf/wifllook.asp

Yellow Billed Cuckoo – The Cornell Lab of Ornithology http://www.allaboutbirds.org/guide/Yellow-billed_Cuckoo/lifehistory

Aplomado Falcon – US Department of Defense & US Fish and Wildlife Service Northern Aplomado Falcon factsheet
http://www.fws.gov/endangered/esa-library/pdf/aplomado_falcon_fact_sheet.pdf

Interior Least Tern – Oklahoma Department of Wildlife Conservation
http://wildlifedepartment.com/wildlifemgmt/endangered/least_tern.htm

American Peregrine Falcon – Texas Parks and Wildlife Department
http://www.tpwd.state.tx.us/huntwild/wild/species/amperegrine/

Chihuahuan Desert Lyre Snake – UTEP Biodiversity Collections, Centennial Museum-
http://www.utep.edu/leb/PleistNM/taxa/Trimorphodon.htm

USIBWC Canalization River Management Plan -

PART 6 - NO-MOW ZONE MAPS

Approval Signatures

11/20/14

José A. Nuñez, P.E
Principal Engineer, Engineering Division

Date

NOV. 17, 2014

Carlos Peña, Jr., P.E
Principal Engineer, Operations Division

Date

WORKING DRAFT

6.1 Introduction

The Maintenance Zone maps show areas where USIBWC will refrain from vegetation management throughout the RGCP. The methodology and justification for maintenance zones is documented in Part 1, Floodplain Management Plan.

6.2 Maps

No-Mow Zone MAPS are in working draft format. The latest version is June 2013. Finalization is depending on further hydrologic and hydraulic analysis.

The current draft version of the map book is a series of 33 maps at 1:20,000 scale at 11x17 inches. Each page covers a width of 5 miles. Grid rectangles for each map sheet are shown and are 5,000 m (3.1 miles) wide. Sheets are rotated so that the maximum length appears on the sheet; the North arrow direction is also shown.

Imagery Source: ESRI Bing Hybrid Basemap or 2011 USIBWC orthoimagery. Right of Way is unofficial; it is digitized in 2011 by URS from USIBWC Canalization Alignment Maps and modified by EMD in 2013. No-mow zones include USIBWC restoration sites, Green Zones, flycatcher buffers, and connectivity zones for managed grasslands.

Map created by USIBWC Environmental Management Division June 2013. For questions contact Elizabeth Verdecchia 915-832-4701.

USIBWC Canalization River Management Plan -

PART 7 - REFERENCES

Ahlers, Darrell, and Dave Moore. 2009. "A Review of Vegetation and Hydrologic Parameters Associated with the Southwestern Willow Flycatcher 2001-2008: Elephant Butte Reservoir Delta, NM". U.S. Department of the Interior Bureau of Reclamation, Technical Service Center, Fisheries and Wildlife Resources Group. http://www.usbr.gov/pmts/fish/Reports/EBR%20SWFL%20veg%20and%20hydro%20review.pdf.

Audubon, and EBID. 2012. "Rio Grande Canalization Project Adaptive Channal Management Program, Draft."

Boisselier, Cesar, and Antonio Solo. 2010. "Rio Grande Canalization Project: Two-Year Channel Maintenance Plan FY2010 and FY2011". non-published internal correspondence.

Daily, Marc. 2006. "White Paper -Adaptive Management: Exploration of the Framework and Its Potential Use in Hydraulic Project Approval Habitat Conservation Planning". Washington Department of Fish and Wildlife, Habitat Program. http://wdfw.wa.gov/publications/00724/wdfw00724.pdf.

Hatten, James, Ebin Paxton, and Mark Scogge. 2010. "Modeling the Dynamic Habitat and Breeding Population of Southwestern Willow Flycatcher." Ecological Modeling 221 (13-14) (July 10): 1674–1686. doi:10.1016.

Hatten, James, and Mark Scogge. 2007. "Using a Remote Sensing/GIS Model to Predict Southwestern Willow Flycatcher Breeding Habitat along the Rio Grande, New Mexico". Open-File Report 2007-1207. USGS. http://pubs.usgs.gov/of/2007/1207/.

HDR. 2012. "Lower Rio Grande Bird Survey Protocol Training."

IBC. 1935. Final Report: Control of the Rio Grande, Caballo Dam, New Mexico to El Paso Texas. American Commissioner to the Secretary of State. Public Resolution No. 4 - 74th Congress, Approved February 13, 1935. El Paso, Texas. December 14, 1935. International Boundary and Water Commission.

Lodwick, Larry. 2012. "Habitat Site Restoration - BIO406". Northwest Environmental Training Center.

Moore, Dave. 2006. "Riparian Obligate Nesting Success as Related to Cowbird Abundance and Vegetation Characteristics Along the Middle Rio Grande, NM". Denver, CO: Bureau of Reclamation. http://www.usbr.gov/pmts/fish/Reports/Rip%20Ob%20Nesting%20Success%20report%20Feb%2006.pdf.

———. 2007. "Vegetation Quantification of Southwestern Willow Flycatcher Nest Sites: Rio Grande from La Joya to Elephant Butte Reservoir Delta, New Mexico - 2004-2006." http://www.usbr.gov/pmts/fish/Reports/SWFL%20nest%20veg%20quant%2004-06.pdf.

Moore, Dave, and Darrell Ahlers. 2003. "An Assessment of the Brown-Headed Cowbird Control Program in the Middle Rio Grande, New Mexico". US Department of the Interior, Bureau of Reclamation, Technical Service Center, Ecological Planning and Assessment, Denver Colorado.

———. 2012. "2012 Southwestern Willow Flycatcher Study Results: Selected Sites along the Rio Grande from Bandelier National Monument to Elephant Butte Reservoir, New Mexico". Bureau of Reclamation, Albuquerque Area Office.

NASA, Earth Observatory. 2012. "Measuring Vegetation (NDVI & EVI) : Feature Articles." http://www.earthobservatory.nasa.gov/Features/MeasuringVegetation/measuring_vegetation_2.php.

Parsons. 2004a. "2004 River Management Plan, Rio Grande Canalization Project". Prepared for USIBWC. http://www.ibwc.gov/Files/Final_RMP_May2004.pdf.

———. 2004b. “Final Environmental Impact Statement: River Management Alternatives for the Rio Grande Canalization Project”. United States Section, International Boundary and Water Commission (USIBWC) with cooperation from U.S. Department of Interior Bureau of Reclamation. http://www.ibwc.gov/EMD/USIBWC_RGCP_FEIS.html.

PdNWC. 2014. Paso del Norte Watershed Council. The Paso del Norte Watershed Based Plan: Mitigation Measures to Reduce Bacterial Pollution in the Rio Grande. May 2014.

Riada Engineering, Inc. 2009. “Rio Grande Canalization Project Channel Maintenance Analysis: An Evaluation of Channel Maintenance on Flood Water Surface and Irrigation Efficiency”. World Wildlife Fund.

Ryan, Vicky. 2012. “Flycatcher Distribution Focused on Middle Rio Grande Project In New Mexico” (Tech, October 2015)presented at the TX/NM/Mexico Saltcedar Biological Control Consortium Meeting, October 30, El Paso, TX.

Scogge, Mark, Darrell Ahlers, and Susan Sferra. 2010. “A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher”. USGS Techniques and Methods 2A10. USGS. http://pubs.usgs.gov/tm/tm2a10/.

SWCA. 2011. “FINAL BIOLOGICAL ASSESSMENT INTEGRATED LAND MANAGEMENT FOR LONG-TERM RIVER MANAGEMENT OF THE RIO GRANDE CANALIZATION PROJECT”. SWCA Environmental Consultants, In Association with MWF Americas. http://www.ibwc.gov/EMD/documents/Final_IBWC_RGCP_BA2011.pdf.

Tetra Tech. 2004. “Upper Rio Grande Water Operations Hydrographic Data Collection, Caballo Dam NM to American Dam, El Paso TX: Field Data Collection Report - Cross Section Surveys and Plots”. USACE.

———. 2005. “FLO-2D Model Development Below Caballo Dam - URGWOM: Final Report on FLO-2D Model Development”. USACE.

———. 2013. “Preliminary Analysis of Channel Seepage and Water Budget Components Along the Rio Grande Canalization Project: 90% Draft Report”. October 20, 2015. USIBWC, IBM14T0016.

———. 2015. Channel Maintenance Alternatives and Sediment-transport Studies for the Rio Grande Canalization Project: Final Report. USIBWC.

TRC. 2011. “Site Implementation Plans - Rio Grande Canalization Project River Restoration Implementation Plan”. USIBWC, TRC Environmental Corporation.

Unnikrishna, Padinare. 2012. “Draft Rio Grande Canalization Project Modeling Approach for Channel Maintenance to Implement the Record of Decision (ROD)”. USIBWC.

URS. 2013. “Rehabilitation Improvements for the Rio Grande Canalization Protective Levee System, Canutillo Phase II: Hydrologic and Hydraulic Analysis Report”. USIBWC.

USACE. 2009. “Conceptual Restoration Plan and Cumulative Effects Analysis, Rio Grande - Caballo Dam to America Dam, New Mexico and Texas”. US Army Corps of Engineers, Albuquerque District, with Mussetter Engineering Inc and Riada Engineering, Inc.

———. 2013. “Department of the Army Regional General Permit Number NM-12-01 for Repair and Protection Activities in Emergency Situations.”

USACE, Mussetter Engineering, Inc., and Riada Engineering, Inc. 2007. “Baseline Report: Rio Grande-Caballo Dam to American Dam FLO-2D Modeling, New Mexico and Texas”. USIBWC. http://www.ibwc.gov/EMD/CanalizationWebpage/BaselineReport.pdf.

USACE, and Resource Technology, Inc. 1996. “Rio Grande Canalization Improvement Project: Percha Diversion Dam, New Mexico, to American Diversion Dam, Texas - Executive Summary Volume I”. USIBWC.

USBR. 2012a. “Middle Rio Grande River Maintenance Program Comprehensive Plan and Guide: Appendix D: Strategy Assessment”. Bureau of Reclamation, Middle Rio Grande Project New

Mexico, Upper Colorado Region. http://www.usbr.gov/uc/albuq/envdocs/reports/mrgRivMaint/index.html.

———. 2012b. “Southwestern Willow Flycatcher Management Plan for the Rio Grande Project”. Bureau of Reclamation, Albuquerque Area Office.

———. 2016. Continued Implementation of the 2008 Operating Agreement for the Rio Grande Project, New Mexico and Texas: Final Environmental Impact Statement. Upper Colorado Region, Albuquerque Area Office. September 20, 2016.

USFWS. 2002. “Final Recovery Plan - Southwestern Willow Flycatcher (Empidonax Traillii Extimus)”. USFWS Region 2 Southwestern Willow Flycatcher Recovery Team Technical Subgroup. http://www.fws.gov/southwest/es/Documents/R2ES/Southwestern_Willow_Flycatcher_FINAL_Recovery_Plan_Aug_2002.pdf.

———. 2012a. “Environmental Assessment for Non-Native Plant Control and Reestablishment of Riparian Habitats Along the Rio Grande River on US International Boundary and Water Commission and Bureau of Land Management Lands”. USIBWC, USFWS San Andres NWR. http://www.ibwc.gov/Files/BLM_Final_wAppendices2.pdf.

———. 2012b. “Biological and Conference Opinion on the Effects of USIBWC Integrated Land Management Alternative for Long-Term Management for RGCP”. USFWS New Mexico Ecological Services Field Office.

———. 2013. “Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Southwestern Willow Flycatcher; Final Rule, 50 CFR Part 17, [Docket No. FWS–R2–ES–2011–0053; 4500030114]”. Federal Register / Vol. 78, No. 2, January 3, 2013 / Rules and Regulations.

USIBWC. 1994. “Rio Grande Management Plan.”

———. 2000. “USIBWC Project Technical Summaries.”

———. 2007. “Final Environmental Assessment - Flood Control Improvements to the Rio Grande Canalization Project.” ftp://63.96.218.8/Final_EA_RGC_Levee_Raising.pdf.

———. 2009. “Record of Decision - River Management Alternatives for the Rio Grande Canalization Project.” http://www.ibwc.gov/EMD/CanalizationWebpage/ROD_EIS%20June2009.pdf.