BUREAU OF RECLAMATION

River Mile 82 to 79 Pilot River Realignment Project at Bosque Del Apache National Wildlife Refuge, Environmental Assessment

Interior Region 7: Upper Colorado Basin

U.S. Department of the Interior

March 2020

Mission Statements

Department of the Interior

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Prepared by: U.S. Department of the Interior, Bureau of Reclamation

Cover Photograph. Rio Grande through the Bosque del Apache National Wildlife Refuge near RM 81 (2012 river mile demarcation) by Aubrey Harris on May 16, 2016

The Bureau of Reclamation (Reclamation) prepared this River Mile (RM) 82 to 79 Pilot River Realignment Project at Bosque del Apache National Wildlife Refuge (BDA), Environmental Assessment (EA) to assess the potential consequences of a proposed realignment of approximately three miles of the Rio Grande within BDA south of Socorro, New Mexico. (Note the river miles increase or ascend as you move upstream.) This EA includes a description of the proposed alternative that will be implemented under the US Fish and Wildlife Service's 2016 Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico (2016 BO). It proposes moving a segment of the river from a perched reach, beginning near RM 82, to the east in an area of the Bosque (floodplain forest) that is lower in elevation than the old, perched river channel creates several concerns such as difficulty maintaining continuous low flows during drought, loss of native riparian woody plant species resulting in declining habitat, sediment transport imbalance leading to sediment plug formation, overbanking flows into the floodplain that are disconnected from the main channel during flood events, stranding of aquatic species during high flows, and threats to existing infrastructure from an uncontrolled channel avulsion (uncontrolled meander). The new channel will consist of a diversion at the upstream end (RM 82), a cleared 300-foot-wide corridor through the Bosque, and a return diversion (RM 79) back to the river. In addition to the cleared stands of vegetation that will be removed within the corridor, exotic vegetation adjacent to the cleared channel will also be removed to facilitate channel complexity, to increase water delivery conveyance through the floodplain, and to allow for the reestablishment of native riparian vegetation. This EA presents the proposed Federal action, and presents an evaluation of the potential environmental, economic, and social consequences that could result from implementing this alternative. This alternative addresses a segment of river identified as being problematic for the effective movement of water and sediment, as demonstrated by the sediment plugs that occurred in 2008, 2017, and 2019.

The proposed alternative will impact riparian habitat, both native and exotic, that support two federally listed bird species, the endangered Southwestern Willow Flycatcher (flycatcher) and the threatened Western Yellow-billed Cuckoo (cuckoo) and riverine habitat for the endangered Rio Grande Silvery Minnow (minnow). These habitats are designated as Critical Habitat for the flycatcher and minnow and proposed Critical Habitat for the cuckoo. Seasonal monitoring, in coordination with the United States Fish and Wildlife Service (Service), will occur to avoid any direct impacts to the listed bird species that enter the project area. The new channel will be monitored to assess the recovery of native riparian species after completion of the project. It is assumed that native riparian species will respond to the disturbance and the increased presence of river flows and groundwater should create early successional conditions that will progress toward improved suitable habitat in this area. If monitoring reveals that suitable habitat is not improving over time, then further activities will be implemented to improve habitat conditions. This vegetative monitoring will be a critical component for the first five years. The Minnow will also benefit from the inundation of a shallower and wider channel with an improved connection between the main channel and floodplain. As new early successional riparian vegetation establishes this will also increase the benefits to the minnow and its critical habitat. This EA has been prepared in compliance with the National Environmental Policy Act and Reclamation

procedures and is intended to serve environmental review and consultation requirements pursuant to Executive Order 11988 (Floodplain Management), Executive Order 11990 (Wetlands Protection), Executive Order 12898 (Environmental Justice), the National Historic Preservation Act (section 106), Endangered Species Act (section 7(c)), and Departmental and Reclamation Indian Trust Asset policies.

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U.S. Department of the Interior

Bureau of Reclamation

Albuquerque Area Office

Albuquerque, New Mexico

FINDING OF NO SIGNIFICANT IMPACT

River Mile 82 to 79 Pilot River Realignment Project at Bosque Del Apache National Wildlife Refuge, Environmental Assessment

Manager, Environment and Lands Division

3/18/2020
Date

Area Manager, Albuquerque, New Mexico

3/26/2020
Date

FONSI Number: AAO-20-006

Summary of the Proposed Action

The U.S. Department of the Interior, Bureau of Reclamation, is proposing a three-mile-long channel relocation of the Rio Grande between River Miles (RM) 82 and 79 (2012 channel demarcations) within the Bosque del Apache National Wildlife Refuge (BDA) (Reclamation 2017). During the 2017 spring runoff and continuing through the summer of 2017, during planning for this current project, a sediment plug formed in this reach and was classified as a Class 2 river maintenance site (Maestas et al., 2014). A pilot channel was dug through the plug and was analyzed in the "Sediment Plug Removal at Bosque del Apache National Wildlife Refuge 2017 Middle Rio Grande Project, New Mexico EA" (Reclamation, 2017c). In 2019, the third plug in eleven years developed within BDA at the pilot river realignment project area. In order to act as quickly as possible, it was decided to use the 404 permit that Reclamation had just received to perform the inlet and outlet excavation part of the project and circumvent flows around the plug through the Realignment Project Area. This action allowed water to be delivered downstream past the plug thus helping ISC and Reclamation maintain compliance with Compact requirements to deliver water to Elephant Butte Reservoir. This action was analyzed in the 2019 Phase 1 Sediment Plug Circumvention: River Mile 82 to 79 Pilot River Realignment Project at Bosque Del Apache National Wildlife Refuge, Environmental Assessment. The current project was designed to address the perched river channel within this reach that create several concerns including difficulty maintaining continuous low flows, declining riparian habitat, reduces sediment transport leading to sediment plug formation, overbanking flows into the disconnected floodplain such that these flows may not return to the river via surface flows and subsequent stranding of aquatic species during high flows, and threats to existing infrastructure from an uncontrolled channel avulsion. The project area is located within Socorro County, NM approximately 16 miles south of the town of Socorro.

Major components of this project include:

- Mowing and vegetation removal of a 300-foot-wide realignment corridor in the floodplain east of the river. This is approximately 100 acres.
- Mowing and exotic species (mostly saltcedar) removal of patches contiguous with the realignment corridor. This is approximately 170 acres (200 max.)
- Excavation of an inlet and outlet to the new realignment channel at the upper and lower ends of the realignment.
- Filling of approximately 1.6 miles of the current main river channel (includes the area of the 2017 and 2019 sediment plug).
- Maintaining access roads, routes, and staging areas.
- Monitoring of federally listed bird species and species protected by the Migratory Bird Treaty Act during the migratory bird breeding season.

- Monitoring of project components following construction.

The work if approved work would commence in 2020 and would include removal of vegetation and clearing of the 300-foot wide realignment corridor, construction of the inlet and outlet channels, connection of the inlet and outlets, and subsequent monitoring of the realignment related to water delivery, sediment deposition and transport, native and exotic vegetation, groundwater, and listed species.

The Proposed Action would not have significant impacts to any of the following: land use, water resources and water quality, air quality and noise, vegetation, wetlands, fish and wildlife resources, threatened and endangered species, Indian Trust Assets, Environmental Justice, cultural resources, irreversible and irretrievable commitment of resources and cumulative impacts.

A Clean Water Act (CWA) Section 404 permit, Rio Grande Realignment Pilot Project, SPA-2009-00520-ABQ, was obtained from the U.S. Army Corps of Engineers (Corps), Albuquerque District, along with a Section 401 water quality certification from the New Mexico Environment Department (NMED) to maintain compliance with the CWA, which prohibits the discharge of dredged or fill material into waters of the United States (see Appendix J). With the implementation of environmental commitments, effects are largely beneficial and only minor and/or temporary negative impacts have been identified.

Environmental Impacts:

The following resources and socioeconomic factors were evaluated in detail in this EA to determine the impacts that would result from the proposed work: land use and recreation, water resources and water quality, groundwater, air quality and noise, geomorphology, vegetation, wetlands, noxious weeds, fish and wildlife resources, Threatened and Endangered Species and their Critical Habitat, socioeconomics, Indian Trust Assets, Environmental Justice, and cultural resources. The following resources are discussed further:
Land Use:

Under the Proposed Action, land use would not change and there would be no permanent impacts. Public use may be affected by construction activities but would be temporary in nature and the impact would be reduced by placement of warning signs and road maintenance in active construction zones.

Water Resources/Water Quality:

The effects of the Proposed Action on erosion and water quality are considered minor and temporary in nature. Best Management Practices (i.e., initial steam cleaning of all the equipment and checking the equipment several times per day) would be followed to avoid the inadvertent risk of a discharge of pollutants into surface waters while the equipment is being used in the vicinity of the river. A CWA Section 404 permit and 401 water quality certification will be obtained from the Corps' Albuquerque District and the NMED, in compliance with the CWA,

which prohibits the discharge of dredged or fill material into waters of the United States without a permit (Corps 2014a,b). Meeting the final requirements outlined in the Section 404 permit and 401 water quality certification would also serve to minimize any negative effects on water quality.

Air Quality/Noise:

The Proposed Action would result in a temporary but negligible impact on air and noise quality due to exhaust, dust, and noise from the machinery used during construction. Dust abatement would be performed during maintenance activities. The temporary air quality impact would not create a non-attainment designation for the project areas. The Class 1 Areas nearby would not be significantly impacted and no impairments would occur to visibility in the area. Only minor very small and temporary impacts would occur in the adjacent Little San Pascual Wilderness.

Geomorphology:

Under the Proposed Action, permanent and temporary impacts would result when an approximately 1.6-mile segment of the existing river channel is filled in. A 300-foot corridor will be cleared of vegetation in the eastern floodplain, which includes grubbing and root-ripping, to create a new river channel. Most of the excavation will occur at the middle of the new channel. The realignment design attempts to work with the river's geomorphic and historical tendencies by creating a channel avulsion, a sudden change in the river location into a nearby floodplain or former disconnected channel. The goal is to provide more space for hydrogeomorphic processes in this segment of river that has a perched riverbed elevation and that has been subject to sediment plugs and blockages. Reducing perching and improving the connection between the channel and floodplain will improve water delivery and habitat by reducing stranding of water and fish. This new alignment also increases the distance from the western spoil levee and other west side Refuge infrastructure by an average factor of three. Temporary impacts while working on the inlet/outlet include sediment/turbidity in the water column when construction equipment would access the river. As much as possible, work will be completed in the dry (dewatered area with no connection to the active stream flow) with the main river impacts occurring during the connection of the inlet/outlet. Opening the inlet/outlet and connecting to the existing channel will be one of the last construction phases, thereby minimizing river impacts.

Vegetation:

Part of the proposed action is to remove most of the standing woody vegetation from the realignment corridor (approximately 100 acres) and also remove approximately 170 acres (200 acres max.) of monotypic exotic vegetation adjacent to the realignment corridor. Some large native trees may be left scattered throughout the realignment corridor along the margins. The preferential removal of non-native and noxious plant species will provide a greater opportunity for channel complexity and natural recruitment of native vegetation when the channel realignment is completed. At least 260 acres of vegetation proposed to be removed is monotypic exotic vegetation. This EA discusses the direct impact to vegetation that will be removed by

mowing and root clearing activities. Additional impacts to other vegetation, determined to be wetland vegetation, will be discussed in the wetlands section.

Wetlands:

Most impacts to wetlands would be temporary with an uplift in function occurring over time due to the removal of mostly monotypic exotic vegetation. After the implementation of the realignment project consistent soil saturation from the new river channel and groundwater should encourage native riparian plant species to replace the non-native vegetation that was removed. There may be a temporary reduction in the current wetland types at the site until the succession of wetland habitat types transition over time (i.e. emergent wetland initially until native riparian scrub-shrub and forest-type plant species replace the saltcedar stands that were removed). Approximately 166 acres of wetlands will be impacted by vegetation clearing activities outside of the 300-foot realignment corridor. Post-construction hydrologic conditions in the realignment area are expected to facilitate the improvement of native wetland vegetation in the project area.

Fish and Wildlife Resources:

The Proposed Action would have a short-term impact on wildlife species such as mammals, reptiles, insects, and various birds due to disturbance from construction activities. Disturbance would result from vegetation removal and from general presence of humans during construction. Wildlife would likely be displaced due to the soil disturbance/vegetation removal and would seek other adjacent areas for cover and future nesting. There may be direct impacts to small invertebrates that are not able to leave the area. No protected invertebrate species are known to be present in the project area.

To maintain compliance with the Migratory Bird Treaty Act, nesting bird surveys would be conducted when work occurs between April 15 and August 15. Other surveys will occur for the protected bird species discussed in Section 5 Environmental Commitments/Best Management Practices.

Threatened and Endangered Species (Critical Habitat):

In accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed and proposed threatened or endangered species. FONSI Table 1 lists the effects determination on the listed species in the project vicinity.

FONSI Table 1: Effect determinations on listed species in the project vicinity.

Species	Effect Determination	Critical Habitat Determination*
Rio Grande Silvery Minnow *Hybognathus amarus*	May affect, and is likely to adversely affect due to harm and harassment	May affect, and is likely to adversely affect
Southwestern Willow Flycatcher *Empidonax traillii extimus*	May affect, and is likely to adversely affect	May affect, and is likely to adversely affect
Western Yellow-billed Cuckoo *Coccyzus americanus*	May affect, and is likely to adversely affect	Will not destroy or adversely modify **proposed** critical habitat*

* This was the formal conference determination by the Service in the 2016 BO because cuckoo critical habitat is not designated yet.

Rio Grande Silvery Minnow Effect Determination

Since the project will consist of moving the Rio Grande from the existing channel to a new channel location, approximately 1.6 miles of existing wetted habitat will be lost. The remaining portion of the old channel will be dry at lower flows but may become a backwater at higher flows, similar to the San Acacia backwater projects constructed upstream by NMISC and Reclamation. In addition, construction activities will result in disturbance and potential stranding of silvery minnow. Because of this, a determination was made that the proposed project "may affect, and is likely to adversely affect" silvery minnow and its critical habitat. However, the realigned channel is expected to increase habitat for the species over the three miles and result in a net benefit to silvery minnow and to its critical habitat. To determine how minnow habitat would change due to the proposed pilot project, a habitat suitability index (HSI) model was constructed to compare the existing and initial pilot realignment conditions for the minnow at various life stages. The HSI results indicate that the pilot channel realignment for both the baseflow and 2-year return period with a 14-day flow duration would allow for more inundation and slower velocity conditions than the existing channel conditions. Although the proposed project "may affect, and is likely to adversely affect" silvery minnow and its critical habitat, the realigned channel is expected to provide a net increase in suitable habitat for all life stages of the species. The maintenance techniques and conservation measures in the proposed action are designed to minimize contact with any fish and minimize the potential for harm or harassment. Minnows present near the work area would be able to freely move to avoid contact with the equipment and are expected to do so similar to natural predator avoidance (e.g., from birds).

Southwestern Willow Flycatcher Effect Determination

Most of the proposed project activities occur in habitat that was designated in 2016 as unsuitable for the flycatcher and/or in areas outside of known flycatcher paired nesting territories and single

male residents delineated from survey detections from 2017 to 2019. Five to six nesting flycatcher territories have been located in suitable habitat and occupied unsuitable habitat which could be impacted by the proposed project (Moore and Ahlers 2017-2019). Near the center of the project area 0.73 acres combined of suitable and unsuitable habitat will be impacted by river channel fill. Nest territories, in suitable and unsuitable habitat, on the south end of the project area could be impacted by drain excavation and channel fill. Indirect effects to bird habitat are anticipated from mowing, with approximately 15 acres of vegetation clearing within moderately suitable bird habitat. Construction of the realignment channel, including staging areas and access, is expected to additionally affect approximately five acres of moderately suitable habitat, and will occur in proximity to five known flycatcher territories on the west side of the river.

The removal of the exotic vegetation, mainly saltcedar, adjacent to the pilot corridor and the realignment of the river into the floodplain would create additional opportunities for overbank flows, which would provide an environment for natural regeneration of native vegetation, and thus, an environment composed of young (and adjacent mature) successional age classes of vegetation for flycatchers. Increasing the availability of native vegetation dominated habitat has become important with the presence of the tamarisk beetle (Diorhabda spp.), which defoliates saltcedar. This defoliation often coincides with the flycatcher's breeding season, causing nest failure due to exposing the nests to predators and higher temperatures.

It is anticipated that the BDA pilot channel realignment will result in the addition of approximately 55 acres of flycatcher habitat. The rate of growth for native vegetation replacement of exotic species will depend on the timing, magnitude, frequency, and duration of stream flow, as well as availability of bare moist soil for seed beds. These conditions will be affected by weather conditions and water availability from snowpack and monsoon events. In addition, maintenance would occur in these areas to prevent the exotic species from returning. Work occurring after April 15 will be monitored for returning flycatchers. Should individuals be detected in the area, work will cease in the minimum buffer areas and further consultation will occur between Reclamation biologists and the Service to determine what actions can be taken by Reclamation construction crews.

Therefore, in considering the above effects, our determination is that the proposed action "may affect, and is likely to adversely affect" the flycatcher, and designated critical habitat.

Western Yellow-billed Cuckoo Effect Determination

In the initial analysis for the proposed project, the standard practice for evaluating suitable cuckoo habitat was to use the suitable flycatcher habitat as a surrogate. More currently, cuckoo suitable habitat was separated and reevaluated in the (Siegle et. al. 2018) Western Yellow-billed Cuckoo Habitat Suitability 2016, Middle Rio Grande, New Mexico. This change increased the calculated amount of suitable cuckoo habitat impacted from 15 acres to 72.5 acres in the channel realignment corridor. In addition, invasive saltcedar removal for BDA would result in an additional 128.5 acres of impact to suitable cuckoo habitat. Indirect effects to cuckoos are anticipated from mowing. Construction of the realignment, including staging areas and access, is

also expected to affect suitable habitat, and would occur in proximity to four known cuckoo territories.

The removal of approximately 142 acres of exotic vegetation, including the 128.5 acres of suitable cuckoo habitat, is composed mainly of saltcedar and is located adjacent to the pilot corridor and the realignment of the river so that it is more connected to the floodplain. This vegetation removal would create additional opportunities for natural regeneration of native vegetation. The rate of growth for native vegetation replacement of exotic species would depend on weather conditions and water availability from snow pack and monsoon events. In addition, maintenance would occur in these areas to prevent the exotic species from returning. Work occurring after April 15 will be monitored for returning cuckoos. Should cuckoos be detected in the area work will cease in the minimum buffer areas and further consultation will occur with Reclamation biologists and the Service to determine what actions can be taken by Reclamation construction crews.

Therefore, in considering the above effects, our determination is that the proposed action "may affect, and is likely to adversely affect" the cuckoo.

Indian Trust Assets

No Indian Trust Assets (ITA) were identified in the project area. There would be no effects to ITAs under the Proposed Action.

Environmental Justice

No negative effects to the local population are expected under either the Proposed Action or the No Action Alternatives. No adverse effects to low-income or minority populations are anticipated.

Cultural Resources

There would be no impacts to cultural resources under the Proposed Action and the No Action Alternatives. Reclamation's Archaeologist completed a pedestrian survey of the project area and no cultural resources were identified in the project area. Project construction activities will avoid known cultural resources that are primarily further east of the project areas outside of the floodplain construction zone and up on the adjacent uplands to the east.

Irreversible and Irretrievable Commitment of Resources of the Proposed Action

The implementation of this project would result in the irretrievable commitment of resources such as fossil fuels, construction materials, dust abatement water and labor. In addition, federal funds would be expended for the maintenance of the proposed project. Construction equipment would utilize fuel and lubricants that would be permanently used.

Construction activities have the potential for incidental take of the minnow, the flycatcher, and the cuckoo. Reclamation has the 2016 BO that covers Reclamation's river maintenance and restoration activities in the Middle Rio Grande following the standard Best Management Practices (BMPs). Incidental take for this project will be encompassed within Reclamation's annual accounting and reporting to the Service for the 2016 BO, which will include post-project refined acreages across these types of covered projects. We do not believe that this disturbance will jeopardize the existence of the species and this activity will not affect the designated critical habitat in the long run.

Cumulative Impacts

Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. (40 CFR, Part 1508.7).

When combined with the effects of other past, present and future foreseeable actions, the effects of the Proposed Action, i.e., realignment of the main channel into the east side floodplain, would largely be beneficial to this small reach of river. This proposed action is considered a test pilot to assess effects for a larger proposed realignment (approximately 5 miles) ending about one mile upstream. The Proposed Action will attempt to address part of a problematic reach that is perched and has had sediment plugs in the past by moving the river channel into a slightly lower topography.

The 2008 and 2016 BiOps called for a proposed realignment in BDA including the proposed pilot and the 5-mile realignment upstream of the pilot in BDA. These projects are included as part of a programmatic plan, Lower Reach Plan (2018) that is looking at 9 proposed activities downstream of Isleta Pueblo to the Delta Channel of Elephant Butte Reservoir. The 2018 Lower Reach Plan (2018) proposes a suite of conservation measures identified in the 2016 BiOp. Three of these proposals have actions that overlap with this proposed action. These include the above mentioned 5-mile realignment in BDA, the Tiffany Fire Habitat Restoration (HR) project and the River Mile 60 HR project.

Two other Reclamation projects originally proposed in the Lower Reach Plan, Escondida Fire HR and Rhodes Property HR were recently completed in 2018 and 2019 and are in a monitoring and adaptive management phase. The general goals of these projects included creation of low flow habitat for the minnow and some vegetation management to try and eliminate exotic invasive species and enhance re-establishment of native riparian trees and shrubs.

Other ongoing activities along the Rio Grande can negatively impact water quality, erosion, sediment levels and riverine habitats. These include municipal wastewater discharges, urban runoff, agricultural runoff, riparian clearing, and chemical use for vegetation control and crops. Recreation along and in the riparian zone, urban and industrial growth, stocking of exotic and predator fish, and riparian clearing without revegetation could also affect multiple resources.

When combined with the effects of other cumulative actions, the effects of the Proposed Action would be largely beneficial and not contribute to any permanent negative cumulative impacts on any resource or threatened or endangered species or critical habitat.

Environmental Commitments

The environmental commitments to minimize or mitigate potential adverse effects, listed in Section 5 of the EA, would be implemented or incorporated as part of the Proposed Action or post-construction activities. The referenced permits and coordination documents are provided in full as appendices to the EA. The U.S. Army Corps permit will be added to the final draft when it is received.

Conclusion

Based on the analysis presented in the EA, Reclamation finds that there would be no significant impacts associated with the Proposed Action. Reclamation makes this Finding of No Significant Impact (FONSI) pursuant to the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 et seq.) and the Council on Environmental Quality implementing regulations (40 CFR 1500). Reclamation has determined that the Proposed Action does not constitute a major Federal action that would significantly affect the human environment. Therefore, no environmental impact statement will be prepared.

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ACRONYMS AND ABBREVIATIONS

BDA	Bosque del Apache National Wildlife Refuge
Corps	United States Army Corps of Engineers
cfs	cubic feet per second
CWA	Clean Water Act
CY	Cubic Yards
EA	Environmental Assessment
FONSI	Finding of No Significant Impact
GW	Groundwater
ITA	Indian Trust Assets
LFCC	Low Flow Conveyance Channel
LIDAR	Light Detection and Ranging
MRG	Middle Rio Grande
NEPA	National Environmental Policy Act
O&M	Operation and Maintenance
PCE	Primary Constituent Elements
Reclamation	Bureau of Reclamation
Service	United States Fish and Wildlife Service
SHPO	State Historic Preservation Office
TCP	Traditional Cultural Property
U.S.C.	United States Code
EPA	Environmental Protection Agency

1 Purpose and Need

1.1 Introduction

In 1938, the states of Colorado, New Mexico and Texas signed the Rio Grande Compact which was signed into law in 1939. This agreement as amended provides a process by which the upper Rio Grande basin states have to deliver water downstream to New Mexico and Texas. New Mexico receives water from Colorado but also has to deliver water to Texas. This compact requires that activities that "deplete" water be accounted for and in some cases be replaced by water users in each state. Subsequently the Flood Control Acts of 1948 and 1950 gave the Bureau of Reclamation authority for river channel maintenance of the Rio Grande River from Velarde, New Mexico, south to the headwaters of Caballo Reservoir. Under this authority, Reclamation monitors maintenance sites along the river, which are locations where channel conditions could damage infrastructure, impede sediment transport or impair or interrupt water delivery.

The Rio Grande between San Antonio and San Marcial, NM has perched channel conditions where the floodplain is lower than the river channel. Concerns associated with the perched river system include: difficulty maintaining continuous low flows during drought, sediment transport imbalance leading to sediment plug formation, overbanking flows that are disconnected from the main channel during flood events causing potential water delivery issues, stranding of Rio Grande silvery minnows during high flows, loss of native riparian woody plant species resulting in declining habitat, and threats to existing infrastructure from an uncontrolled channel avulsion. The latter is of particular concern due to potential damage to the spoil levee and adjacent Bosque del Apache National Wildlife Refuge (BDA) lands and infrastructure (Maestas et al., 2014). Reclamation has proposed a pilot realignment project within BDA to address this perched river condition and associated sediment plugs, see Figure 1.

In 2017, during planning for this pilot realignment project, a new sediment plug formed in the project area. The risk from this plug to the Low Flow Conveyance Channel (LFCC) drain and spoil levee was the reason the BDA sediment plug was classified as a Class 2 river maintenance site (Maestas et al., 2014). This classification status implied that a future project was required to effectively convey water and sediment downstream and/or protect riverside infrastructure.

In August 2017, plans were implemented to create a pilot channel through the sediment plug. The goal of this channel was to allow the river to remove the remaining plug material through natural flow and sediment transport processes, similar to what occurred in response to the 2008 sediment plug and pilot channel. This project was analyzed in the "Sediment Plug Removal at Bosque del Apache National Wildlife Refuge 2017 Middle Rio Grande Project, New Mexico Environmental Assessment".

Sediment plugs have occurred six times since 1991 between San Antonio and San Marcial. Three of six plugs have been in the vicinity of San Marcial, NM and in 2008 a plug formed within the

current project area in BDA. In recent years the decreasing water level in Elephant Butte has lowered the channel bed around San Marcial below the adjacent floodplain, decreasing the risk of sediment plug formation. However, the Rio Grande channel upstream through the BDA is still perched above the adjacent floodplain and was the site of the fifth and sixth sediment plugs in 2017 and 2019 respectively that formed during the spring snow-melt runoff (Reclamation 2017, Reclamation 2017b). The 2008, 2017 and 2019 BDA sediment plugs formed during the only three suitable flow events to occur during that period; a sufficiently large high magnitude and long duration spring runoff is needed to create a sediment plug (Holste, 2014a). The channel at this location continues to be susceptible to sediment plugs and it is likely that one will occur whenever there is a suitably large flow event.

Reclamation had already analyzed this section to address this perched condition and had proposed an alternative for future realignment. This perched condition forms through a natural levee process that occurs when the channel over banks during higher flows. As the over bank flow hits the vegetated bank or floodplain the friction slows the water speed. This causes the heaviest sediment that leaves the channel during overbanking to deposit on the bank edge creating a sort of levee effect. This further channelizes the river allowing for the bed to build up over time because the higher banks can hold flow at a higher elevation. This is how the riverbed can slowly be elevated above the adjacent floodplain, see Figure 14. At some point if flows are high enough and the riverbed elevated enough the river may avulse (sudden meander) and create a new channel in the floodplain. In many areas on the Rio Grande this can threaten riverside infrastructure. An interagency and interdisciplinary team was formed and led by Reclamation to evaluate potential options for addressing river maintenance and water delivery concerns in the project reach. During this process six different alternative types were considered, totaling 17 different alternatives. A summary of these alternatives can be found in Section 2.2 Alternatives considered but eliminated from further study of the EA. These alternative types were described in the BDA Sediment Plug and River Restoration Project: Alternatives Analysis Synthesis Report (Holste, 2014a).

The alternative evaluation team considered engineering effectiveness related to levee integrity and water delivery, geomorphic response, environmental compliance ease, ecosystem function, constructability, and cost in the evaluation of alternatives. The RM 81 eastern river realignment alternative (RM 82/81 to RM 79) with some form of an excavated channel was the chosen alternative (Holste, 2014a).

During the initial design of the RM 81 river realignment, analysis of newly collected data (2012 LiDAR and 2013 hydrographic data) indicated that extension of an eastern river realignment further north would be possible. Two additional realignment starting locations were proposed for consideration of the team that evaluated the initial list of alternatives. These proposals extended the starting location to the BDA's northern boundary (~ RM 84, 2012 channel demarcations) or further north to RM 86. The team opted to pursue design work for the option that starts at ~ RM 86 (Holste, 2014b). The RM 86 proposal included two separate segments that intersected the existing channel creating a larger upstream portion and a shorter downstream portion. In October 2016 it was decided to construct a pilot segment, the smaller downstream portion, beginning

below RM 82 (the last 3 miles of the proposed realignment, which is approximately the extent of the preferred alternative). The pilot project will be used to observe the actual channel response and apply "'lessons learned' … to inform compliance and construction of larger, upper realignment" (Reclamation, 2016b).

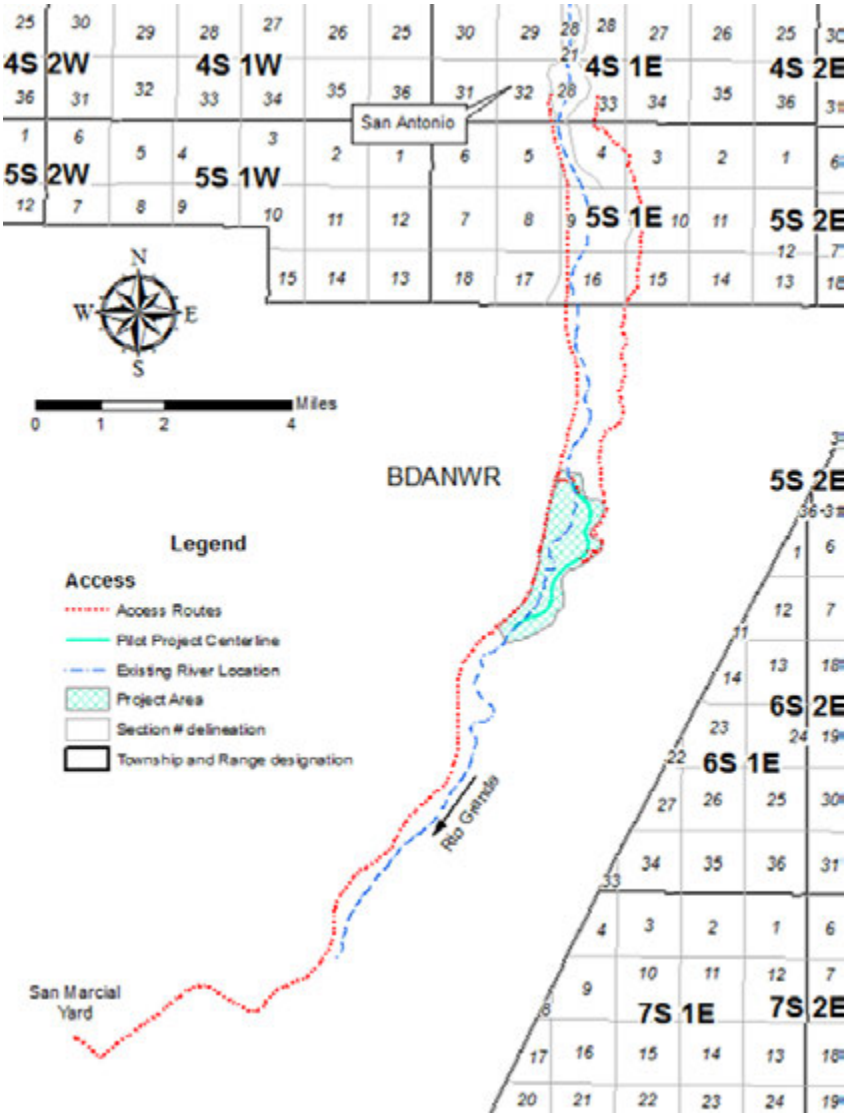


Figure 1: BDA pilot realignment project location and access routes.

1.2 No Action

The No Action Alternative assumes that the proposed pilot channel realignment project will not be implemented. Under the No Action, it is highly likely that sediment plugs will form whenever there is a sufficiently large spring runoff flow event. There have been three sediment plugs at BDA during the years 2008 – 2019, or an average of a plug every 4 years. A large spring runoff flow event coupled with a sediment plug carries a significant risk of breaching the LFCC spoil levee and the associated damage to BDA lands, infrastructure, and ecosystem services.

Regardless of the recurrence of future sediment plugs, the No Action will allow the continuation of current trends: channel narrowing, channel perching, channel drying and flow losses, disconnection between main channel and overbank flows, increasing channel uniformity, and habitat decline. Therefore, under the No Action Alternative, these trends will continue to develop into the future (e.g., 5, 10, 20 years) and are likely to lead to more frequent plugging issues verses current conditions.

1.3 Proposed Action

Reclamation is proposing to realign the river into an approximately three-mile channel to the east of the existing perched river channel. This area in the floodplain is lower in elevation than the adjacent perched riverbed. Fill from the realigned channel will be placed in the old channel. Analysis shows that this alignment will be less susceptible to sediment plug formation. If a plug does occur in the realigned channel, impacts to the spoil levee and water delivery will be reduced compared to when a plug occurs in the existing channel. A 300-foot corridor will be cleared with additional adjacent areas cleared of exotic vegetation, which are expected to encourage channel complexity and the growth of native riparian vegetation. The 300-foot width corresponds to the average channel width of 200 feet in the project area and an additional 100 feet to allow the channel room to move or avulse in a smaller fashion which provides for a restoration of natural river processes. These vegetation benefits will also develop into improved habitat conditions for the two listed bird species. Minnow habitat is also expected to benefit due to a reduction in stranding and an increase in areas with suitable depth and velocity that are connected to the new channel.

Under the Proposed Action, Reclamation would 1) clear an approximately three mile long, 300-foot-wide corridor as indicated in Figure 2; 2) clear selected areas next to the realignment corridor to remove exotic noxious vegetation such as saltcedar; 3) excavate an inlet channel near RM 82 and an outlet channel near RM 79; 4) create a blockage in the current river channel near the upstream inlet channel and fill a portion of the downstream river channel.

1.4 Purpose and Need for the Action

Reclamation has a need to maintain water delivery as described above in compliance with the Flood Control Act. Reclamation works in concert with other federal and state agencies to maintain water flow that meets the requirements laid out for the state in the Rio Grande Compact. These requirements demonstrate a need for Reclamation to address this reach that has plugged and impacted water delivery. This proposed project will also provide Reclamation a means to address additional agreed upon measures to support and enhance protected species and their respective habitat. This will also address habitat enhancements proposed in the 2016 BO (Service 2016).

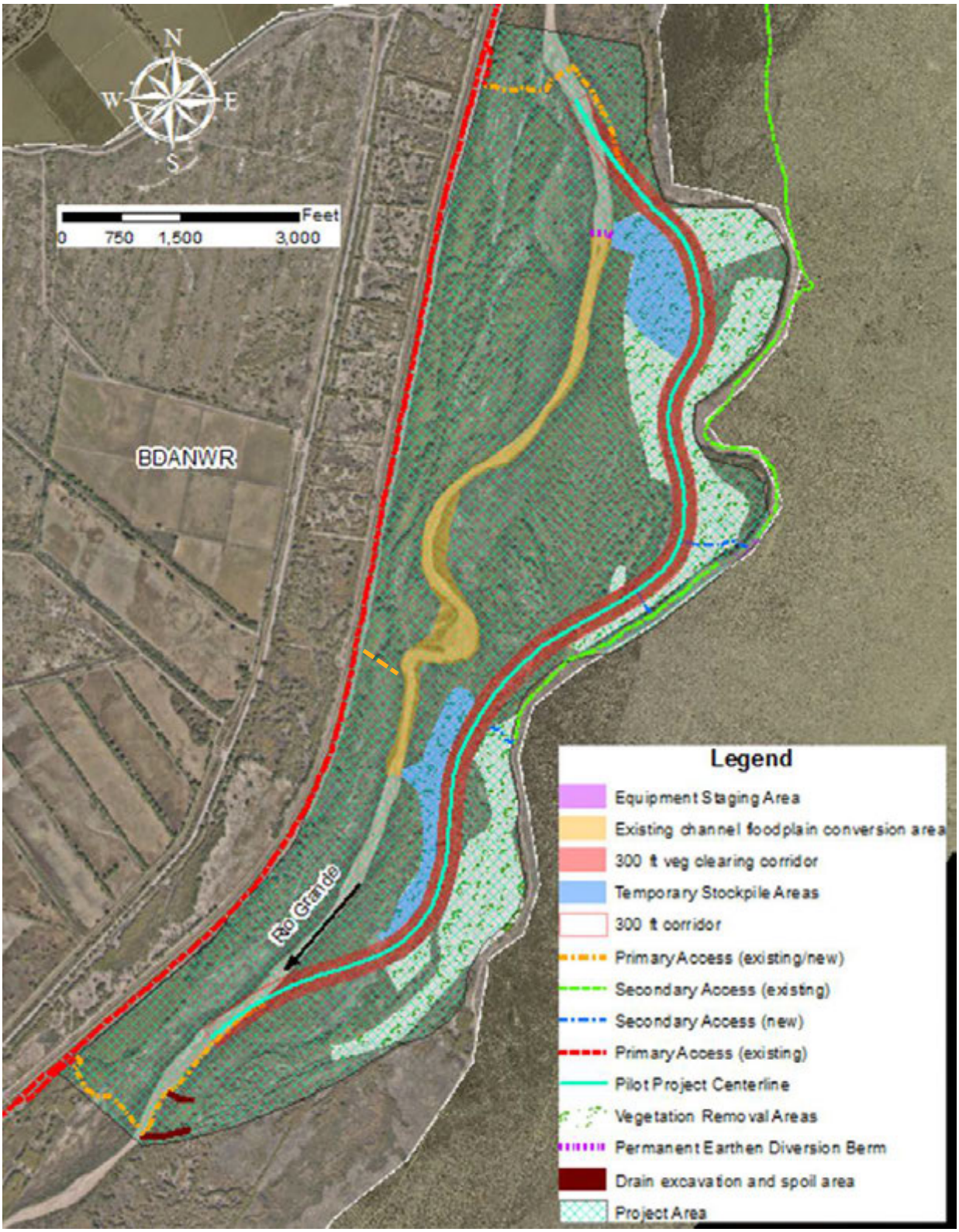


Figure 2: BDA pilot realignment project area. The area designated as Temporary Stockpile area overlaps directly with the Vegetation Removal Area. The Temporary Stockpile area is also

described as the Staging area later in Section 2. The background imagery is a combination of the 2016 and 2012 aerial photography (Reclamation).

The purpose of this pilot project is to promote long term effective conveyance of water and sediment through the reach while minimizing the potential for spoil levee and LFCC failure. It is expected that this project would reduce the potential for levee failure and improve water delivery, although upstream reaches may overbank and allow water to travel along the toe of the spoil levee. Furthermore, the purpose is to create and improve aquatic and native riparian habitat that would benefit listed species such as the minnow, flycatcher, and cuckoo. Specifically, the project would restore the surface water-floodplain connection to provide minnow nursery habitat, alleviate the potential for minnow stranding and increase wetted refugia during drying events, remove exotic noxious vegetation, support development of native early successional riparian vegetation that would provide future improved flycatcher and/or cuckoo habitat, preserve existing wetlands to the extent possible, and develop new wetlands. The development of this habitat would meet requirements specified in the BO addressing Reclamation's river maintenance activities (Service, 2016).

1.5 Relevant Statutes, Regulations, Permits, and other Plans

The funding and lead federal agency for this EA is Reclamation. This EA is prepared in compliance with all applicable federal statutes, regulations, and Executive Orders.

1.5.1 Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) and related Statutes and Orders

- Fish and Wildlife Coordination Act of 1958, as amended (16 U.S.C. 661 et seq.)
- Secretarial Order 3206, American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act

1.5.2 National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.) and related Statutes, Regulations and Orders

- American Indian Religious Freedom Act of 1978 (42 U.S.C. 1996)
- Archaeological Resources Protection Act of 1979 (16 U.S.C. 470)
- Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001 et seq.)
- Protection and Enhancement of the Cultural Environment (Executive Order 11593)

1.5.3 Other Statutes, Regulations and Orders

- Clean Air Act of 1972, as amended (42 U.S.C. 7401 et seq.)
- Clean Water Act (CWA) of 1972, as amended (33 U.S.C. 1251 et seq.)
- Executive Order 12898, Federal Actions to Address Environmental Justice in
- Minority Populations and Low-Income Populations, 1994
- Floodplain Management (Executive Order 11988)

- National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. 4321 et seq.)
- Protection of Wetlands (Executive Order 11990)
- Procedures for Implementing NEPA (33 CFR 230; ER 200-2-2)
- Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500 et seq.)

1.5.4 Other Plans

2016 Biological Opinion for Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico

Reclamation has committed to implementing large scale habitat restoration projects within what is identified as Isleta and San Acacia Reaches of the Rio Grande. One project example identified in the BO included an eight-mile realignment project within BDA. This project is a pilot project for this larger proposed project. The full realignment project is identified as conservation measure 70 in the BO.

BDA Control of Non-native Plant Species and Reestablishment of Native Riparian Forest, Wetlands, Grasslands and In-channel Habitats on the Active Floodplain of the Rio Grande, Bosque del Apache National Wildlife Refuge Plan

In 2005, BDA approved a long-term plan that identified multiple restoration sites along the river within the refuge. This project generally addresses some of the plans for floodplain and native riparian vegetation restoration activities proposed in BDA's "Control of Non-native Plant Species and Reestablishment of Native Riparian Forest, Wetlands, Grasslands, and In-channel Habitats on the Active Floodplain of the Rio Grande" Plan. The project area directly overlaps with Project #2b identified in the accompanying restoration plan. The proposed actions are not identical, but Reclamation's activities will accomplish some of the goals of BDA's restoration plan especially the removal of exotic monotypic vegetation. Some ground destabilization will also occur although it will not be directed at the riverbanks. BDA had proposed high flow channels whereas Reclamation's project will create one large channel that will allow for shallow flow and low flow elevations.

2 Alternatives

2.1 Introduction

This section is a description of the affected river reach, restoration techniques, timing, and phasing of the Proposed Action. The inclusion of the No Action Alternative serves as a benchmark against which project alternatives can be evaluated. This section also includes a short description of the alternative development process, alternatives that were considered but eliminated from further study, and a designation of the preferred alternative.

2.2 Alternatives Considered but Eliminated from Further Study

An interagency and interdisciplinary team was formed and led by Reclamation to evaluate potential options for addressing river maintenance and water delivery concerns. During this process six different alternative types were considered, totaling 17 different alternatives. The various alternative types are listed below with a brief explanation (Holste, 2014a).

- Ongoing maintenance without a pilot channel – One alternative that considered ongoing maintenance, but no action to remove the sediment plug once formed.

- Pilot channels – Three alternatives that considered a narrow channel excavation through the sediment plug. Alternatives looked at different channel excavation and spoiling options.

- Pilot channel with grade control – One alternative that considered placement of deformable riffles in the channel bed and also considered excavation of a pilot channel through the sediment plug, if and when it occurs.

- Levee improvements – Four alternatives that considered methods of reducing the hydraulic pressure against the spoil levee. One alternative considered changes to the spoil levee width and slope. The other three alternatives considered placement of bendway weirs separately or in conjunction with floodplain modifications such as vegetation clearing or excavation of small channels to route water away from the spoil levee toe.

- River realignments – Five alternatives that considered relocation of the river channel. Four alternatives were specific realignment locations to the east. These considered relocations around River Mile (RM) 83 and RM 81 (2012 channel demarcations) respectively. Each eastern location considered excavation at the inlet and outlet and also continuous channel excavation. The final alternative considered options of relocating the channel to the west.

- Preemptive channel work – Three alternatives that considered potential channel/floodplain work that may minimize the formation of sediment plugs. Potential work included widening the river channel and removing/destabilizing vegetation on islands and banks, breaking up of mud layers and smoothing out abrupt bends, and excavating the channel thalweg.

The alternatives evaluation team considered engineering effectiveness related to levee integrity and water delivery, geomorphic response, environmental compliance ease, ecosystem function, constructability, and cost in the evaluation of alternatives. The RM 81 eastern river realignment alternative (RM 82/81 to RM 79) with some form of an excavated channel was the chosen alternative (Holste, 2014a).

2.3 Proposed Action

The pilot channel realignment project consists of relocating the Rio Grande from its current location to the east, as shown in Figure 2. The realigned channel is approximately three miles in length and would address the area where sediment plugs occurred in 2008 and recently in 2017 and 2019. The work will involve the following project elements, described in more detail in the sections that follow.

- Vegetation mastication and removal for the length and width of the realignment corridor with an emphasis on removal of small vegetation and exotic species,
- Vegetation removal and soil destabilization, primarily of monotypic exotic species, adjacent to the realignment corridor, and
- Conversion of the existing river channel into a floodplain, which consists of the following elements:
    - Diverting the river into the realignment corridor,
    - Filling and stabilizing the existing channel, and
    - Providing bank stabilization along the upstream end, if needed, and
    - Excavation at the inlet and outlet of the realignment corridor.

2.3.1 Realignment Corridor Vegetation Destabilization

The BDA pilot project consists of an approximately three-mile-long channel realignment, measured along the centerline. The realignment corridor will have a 300-foot-wide swath, 150 feet on either side of the centerline. Both the centerline and the 300-foot swath are shown in Figure 2. All existing vegetation within this 300-foot corridor will be removed by mulching or through tree extraction. The estimated area for the vegetation removal and destabilization is about 100 acres.

Once the vegetation is removed, the soil will be loosened using a single or multi-shank ripper to dislodge roots and tree trunks within the first few feet of the existing ground elevation down the entire length of the realignment channel. It is estimated that the grubbing depth will be an average of 1 foot and will provide a volume of around 130,000 Cubic Yards (CY) of soil and woody material, 70% of which is expected to be organic. Woody material from the vegetation removal operations, except as discussed below, may be placed along the realignment centerline or in the temporary stockpile area (see Figure 2) and burned. Burning of cleared vegetation may be conducted by the BDA fire crews. Once the piles are burned, Reclamation crews will transfer the ashes, expected to be about 65% of the original organic volume component (Misra et al., 1993), and any remaining inorganic material to the temporary stockpile area. This remaining ash and inorganic material may then be mixed with sediment used to fill the existing channel, providing nutrients for planted material (see 2.3.6 Channel Fill with Vegetation Stabilization).

Some existing stands of native vegetation may be left intact at the exterior fringes of the 300-foot realignment corridor. This will be at the discretion of the project team with agreement by the project engineer. Large native tree species (greater than 40 feet in height) that are within the

realignment corridor and slated to be removed will be stockpiled in the temporary stockpile area. These trees may be used to help stabilize the bankline along the existing river channel if it is needed to help transition the flow into the realigned channel (see 2.3.7 Upstream Bank Stabilization). Native trees removed as part of this project will be replaced at a ratio of 10 new plants for each mature native tree removed, in accordance with the 2016 BO (Service, 2016). Replacement may occur through planned native tree plantings or natural recruitment.

Following removal of vegetation there may be a period of time before desirable native species become established. In order to prevent their establishment, Reclamation has entered into an Interagency Agreement with the Refuge to monitor and prevent the growth of noxious and undesirable plants (see Appendix K).

2.3.2 Inlet/Outlet Excavation

The proposed location of the BDA pilot channel realignment (see Figure 2) is at a lower elevation than the adjacent current river channel and bank elevation (see Figure 14), and east of the current river location. To facilitate a connection with the existing channel, both the inlet and outlet realignment locations will be excavated, as shown in Figure 4. The elevation profile, shown along the proposed realignment centerline in Figure 3, illustrates the inlet and outlet excavation areas as well as the design invert slope (~ 0.0007 ft/ft). Excavation, other than grubbing activities, will not occur in areas outside of the inlet and outlet areas. In these areas (roughly between stations[1] 24+00 to 66+00) the design invert slope will follow the natural topography. However, grubbing will lower the riverbed by an average of 1 ft in these areas. A 50-foot-wide section will be smoothed along the BDA pilot project corridor outside of the inlet and outlet excavation areas. This will facilitate the conveyance of flows at lower discharges. The rest of the corridor width would be left rough.

About 2,400 feet at the inlet and 9,000 feet at the outlet will need to be excavated at a width of up to 300 feet. The excavation top width ranges between 50 and 300 feet. Part of the excavation may require work in the existing channel, such as through existing river bars or other depositional features, to connect the realignment channel to the river channel. Part of the excavation may also be in the wet (area that has water connected to the active flowing channel), especially as the inlet and outlet realignment locations are connected to the existing channel to help guide flows into the realigned channel. The average excavation depth within the inlet and outlet excavation areas is 2 feet, with a range between 0 and 7 feet. The inlet/outlet excavation cross section is designed to help provide variable depths for the initial baseline conditions. The excavated cross section will be trapezoidal in shape with a minimum bottom width of 50 feet. The sides are graded to the existing ground at a minimum slope of 10 horizontal: 1 vertical (10H: 1V). Where the excavation depth is greater than 1.5 feet, a tiered channel, with up to three tiers, will be excavated with varying elevations and widths, as shown in Figure 4. Each tier is about

[1] Station designation denotes the linear distance along a line, from upstream to downstream. The distance is cumulative and provides a means of discussing specific locations within a long, linear feature.

1.5 feet higher in elevation than the previous, with a variable terrace width. The last tier will match the existing ground level.

The expected excavation volume, less grubbing, is about 13,000 CY at the inlet (max of 16,000 CY) and roughly 32,000 CY at the outlet (max of 38,000 CY). The total excavation volume, with grubbing, of the realignment corridor is 175,000 CY (max of 215,000 CY). Most of this material will be excavated in the dry, but a fraction (estimated at about 15,000 CY), may need to be excavated in the wet. Excavated material, both wet and dry, will be temporarily stockpiled at the designated temporary stockpile location (see Figure 2) and discussed in Section 2.3.9 Staging. All excavated material will be placed as fill in the existing channel (see 2.3.6 Channel Fill with Vegetation Stabilization).

2.3.3 Vegetation Removal outside the Realignment Corridor

It is desirable to remove other vegetation, in addition to the vegetation clearing within the pilot project realignment corridor (see 2.3.1 Realignment Corridor Vegetation Destabilization). The additional vegetation removal will focus on monotypic stands of non-native noxious plant species that are adjacent to and outside the 300-foot realignment corridor.

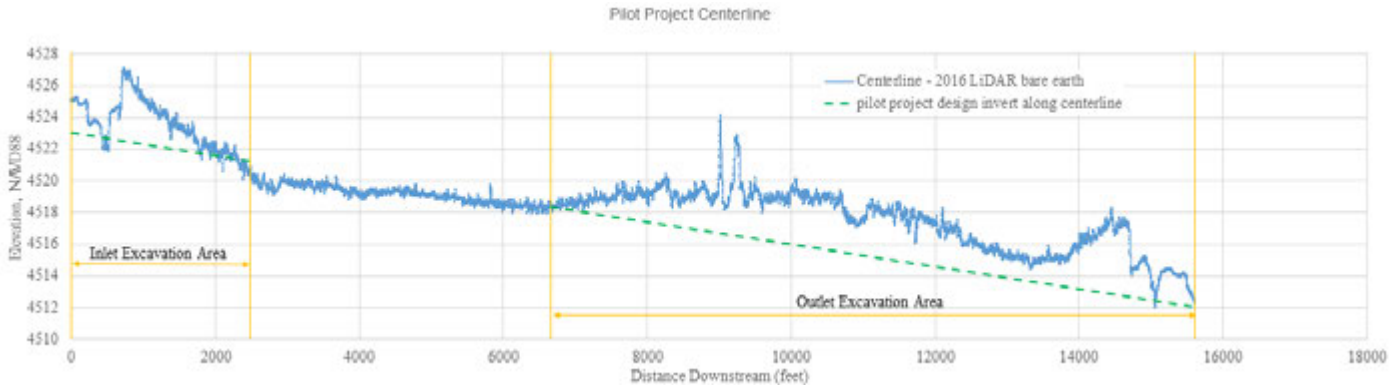


Figure 3: BDA pilot project realignment centerline showing existing and design surfaces. Stationing is from the upstream end of the pilot project. All elevation and distances are approximate. Grubbing depths of 1 to 3 feet are not shown.

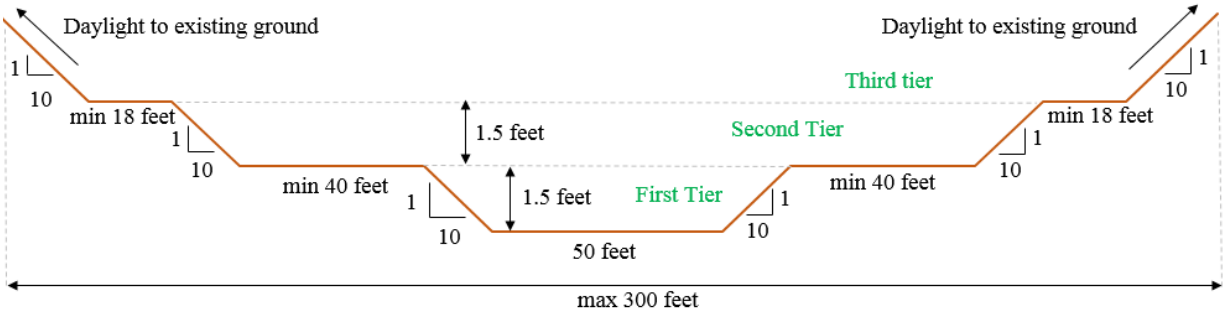


Figure 4: BDA pilot project typical excavation cross section at inlet and outlet. All dimensions are approximate. Second and third tiers are constructed as needed.

Figure 5 shows the proposed locations for additional vegetation removal. The additional vegetation removal locations are approximately 170 acres. By removing established vegetation outside of the 300-foot realignment corridor additional freedom is given to the river to adjust its morphology and encourage the development of a wide range of future active channel widths (Holste, 2016). The preferential removal of non-native and noxious plant species also provides greater opportunity for natural recruitment of native vegetation.

Large native vegetation, such as Rio Grande cottonwoods and Goodding's willows, will be left intact to the extent possible. Some removal of large native vegetation, however, will be required in order to facilitate access to the existing channel at both stockpile locations. Large native tree species (greater than 40 feet in height) that are within the realignment corridor and slated to be removed will be stockpiled in the northern temporary stockpile area (see Figure 2). These trees may be used to help stabilize the bankline, if needed, to help transition flow into the realigned channel (see 2.3.7 Upstream Bank Stabilization). Native trees removed as part of this project will be replaced at a ratio of 10 new plants for each mature native tree removed in accordance with the 2016 Biological Opinion (2016). Replacement may occur through planned native tree plantings or natural recruitment. Changes in groundwater in the long term will also contribute to increasing vegetation in the eastern floodplain but may reduce recruitment along the west side of the river due to a decrease in the groundwater table elevation because the main flow of water will be moved east lowering the groundwater level.

Vegetation will be removed through extraction of woody material or mastication and may be followed by burning. Once the vegetation is removed, the soil will be loosened using a single or multi-shank ripper to dislodge roots and tree trunks within the first few feet of the existing ground elevation. No grubbing, however, of this material would occur. Extracted woody material accumulated outside of the 300-foot pilot project corridor will be placed along the proposed realignment centerline or in the temporary stockpile area. Any burning of cleared vegetation will be conducted by the BDA fire crews. Once the piles are burned, Reclamation crews may transfer the ashes, expected to be about 65% of the original organic volume component (Misra et al., 1993), and any remaining inorganic material to the temporary stockpile area. This remaining ash and inorganic material may then be mixed with sediment used to fill the existing channel, providing nutrients for planted material (see 2.3.6 Channel Fill with Vegetation Stabilization).

2.3.4 Existing Channel Floodplain Conversion

To successfully relocate the Rio Grande into the BDA pilot channel realignment, the existing channel will be converted into a floodplain throughout the area. The following components will be required to facilitate the existing channel floodplain conversion.

- Diverting the existing channel into the realignment channel,
- Filling and stabilizing the existing channel corridor, and
- Stabilizing the "new river bankline," if needed.

The initial plan will be to place the spoil and grubbing material onto the north and south temporary stockpile areas while the outlet and inlet channels are constructed. If conditions allow (for example, during summer drying within BDA) some of this material may be placed within the existing river channel at the same time that material is being excavated. Hydrologic conditions will dictate the final plan for spoil placement.

2.3.5 Channel Diversion

A permanent earthen diversion dam/berm will be used to redirect river flows from the existing channel into the realignment channel. The permanent diversion will be an earthen berm located about 930 feet downstream of the inlet transition area between the existing and realigned channels. The permanent diversion berm location was chosen to avoid removing riparian vegetation along the existing banks through the inlet transition area and to avoid higher energy areas along the transition to the realigned channel. This provides an established stand of vegetation that can provide additional bank stability (Pollen, 2007; Pollen-Bankhead and Simon, 2008) and minimizes the extent of bank stabilization required for the existing channel floodplain conversion area. The permanent diversion berm will be placed when river flows are at a discharge of 1,000 cfs or less.

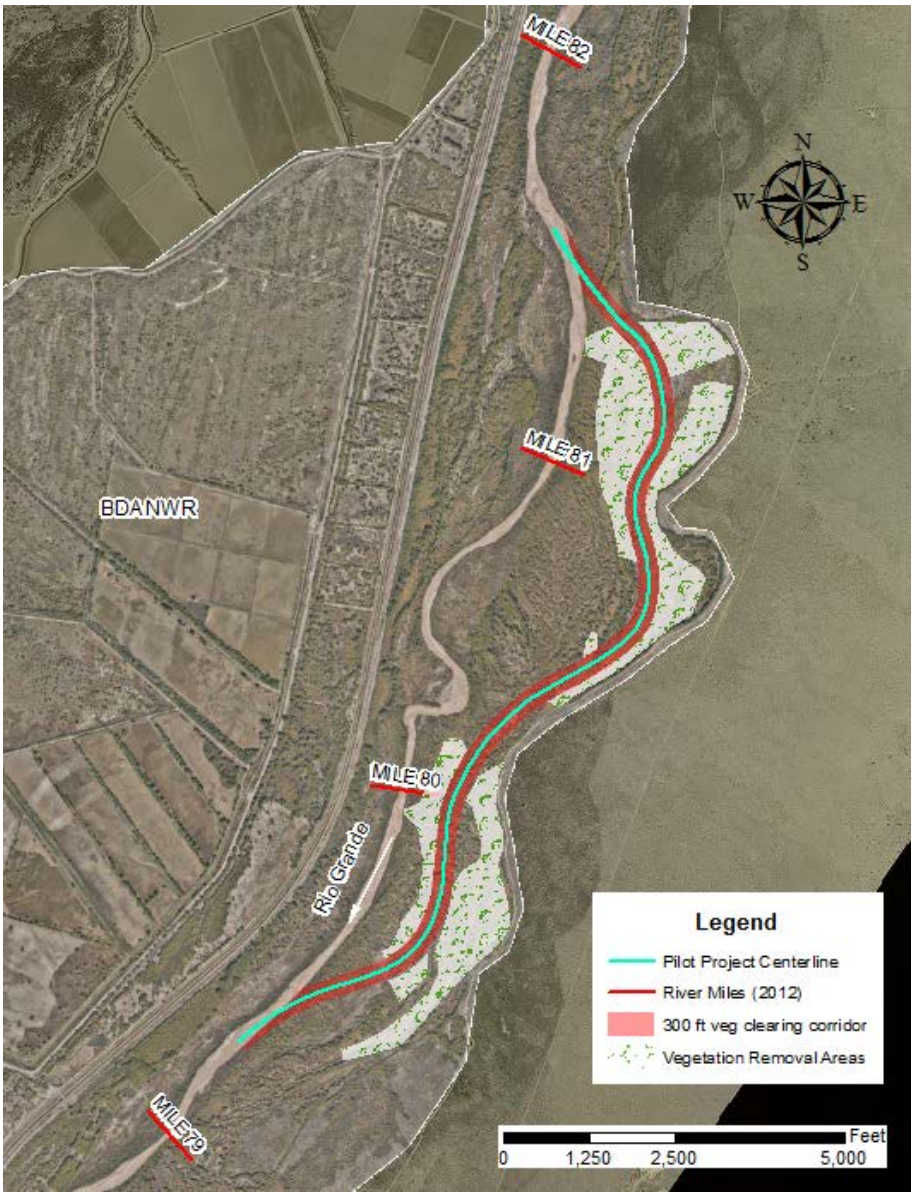


Figure 5: BDA pilot project centerline and 300-foot vegetation clearing corridor with vegetation removal areas outside of the realignment corridor.

The permanent berm will be part of the earthen channel fill (see 2.3.6 Channel Fill with Vegetation Stabilization) and may have additional bank stabilization across the upstream end of the existing channel floodplain conversion area, if needed. The bank stabilization, described in more detail in section 2.3.7 Upstream Bank Stabilization, consists of an engineered log jam. If the river is dry, the permanent diversion berm may be placed in conjunction with the engineered log jam.

The permanent diversion berm will have a trapezoidal shape and be constructed to have a height slightly above the tops of the existing riverbanks. The crest width will be approximately 20 feet, with a minimum of a 2:1 (H:V) side slope on each side. About 2,000 CY of material will be required to construct the permanent diversion berm. The permanent diversion berm is located

adjacent to the northwest edge of the northern temporary stockpile area, as shown in 6. The northern temporary stockpile area provides the space to store the material and facilitates the relatively rapid movement of the earthen material into the existing channel. The northern temporary stockpile location is currently an area of exotic vegetation that is slated to be removed as part of the vegetation removal locations outside the Realignment Corridor.

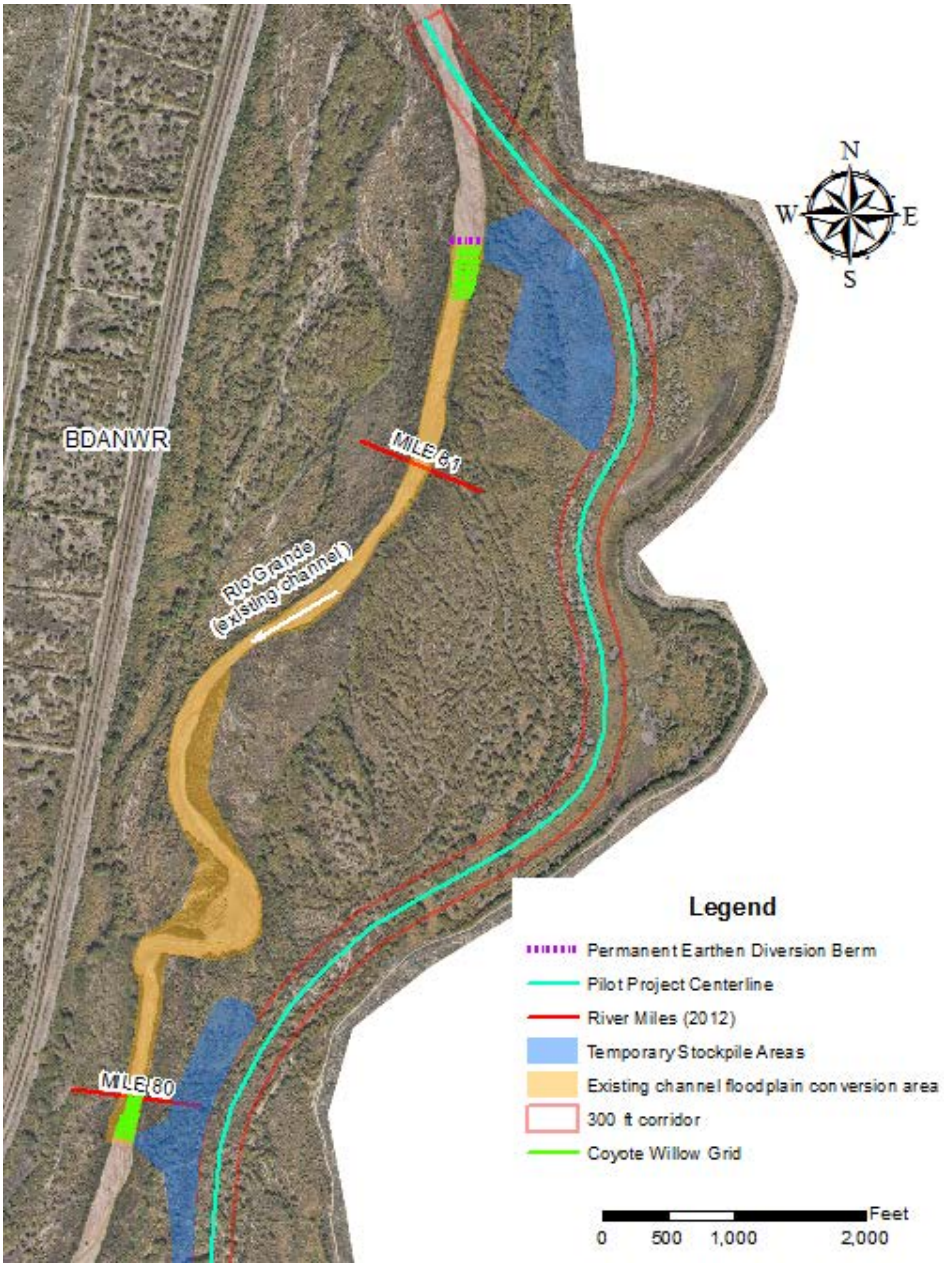


Figure 6: BDA pilot project centerline and 300 vegetation clearing corridor with existing channel floodplain conversion area and a view of coyote willow grids as part of the channel fill with vegetation stabilization. Coyote willow grids are shown at the upstream and downstream end of existing channel floodplain conversion area. The background imagery is the 2016 aerial photography (Reclamation).

2.3.6 Channel Fill with Vegetation Stabilization

The existing channel will be filled in and converted to a floodplain for almost 1.6 miles as shown in Figure 6 identified as the Existing channel floodplain conversion area. The stabilized channel fill will help ensure that the river flows transition into the realignment channel rather than returning to the existing channel. In addition, the fill provides a location to help manage material from the realignment excavation and vegetation clearing. Fill placement is high enough at the upstream transition between the existing and realigned channels to ensure overbanking occurs through the established riparian vegetation first, rather than over the top of the placed fill material.

Approximately 45 acres of the existing river channel will be filled. The expected fill volume is about 175,000 CY (max of 215,000 CY). The fill depth ranges from 0 to 7 feet. The fill will generally be placed to the current bankline elevations, but final fill elevations may vary to help preserve or create variable topography elevations through the channel fill area, creating an opportunity for a diversity of habitat communities. A typical fill cross section shown in Figure 7.

To encourage long term stability of the placed fill within the existing channel floodplain conversion area, vegetation planting will occur at the upstream and downstream ends of the fill, as shown in Figure 8. The vegetation planting will consist of a grid of coyote willows (Salix exigua). The coyote willow grid will be tied into the existing vegetation on either bankline. The grid formation provides additional resistance to overbanking flows encouraging a natural velocity reduction which helps to stabilize the channel fill. The length of the coyote willow grid at both the upstream and downstream locations will be approximately 300 feet, or twice the channel width. The coyote willow grid spacing will be about ¼ of the channel width, or approximately 45 to 50 feet on center, as shown in Figure 8.

Additional geotechnical stability in the existing channel fill corridor will be obtained by planting other native riparian species appropriate for the topography and climate at the project site, such as native grasses (species will vary based on availability and planting location), Goodding's willows (Salix gooddingii) or Rio Grande cottonwoods (Populus deltoides var. wislizenii). Use of these plants would also encourage habitat diversity. All plants will be installed using revegetation techniques specified under the General Best Management Practices (BMP's). If whips are used, lengths will be specified to ensure contact with the water table is made.

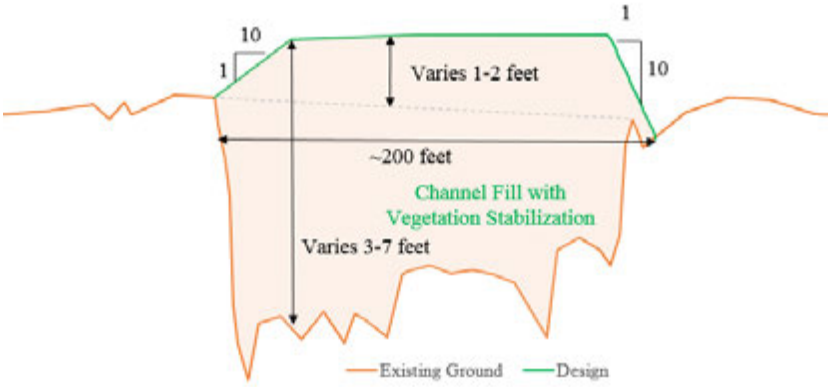


Figure 7: BDA pilot project typical fill cross section of river channel at upstream end of existing river channel stabilization. All dimensions are approximate.

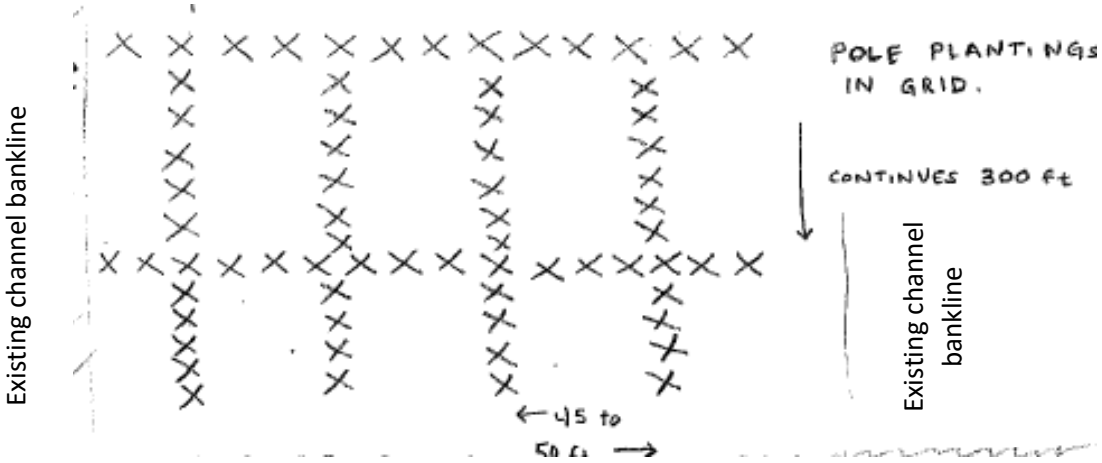


Figure 8 BDA pilot project planview of coyote willow grids on upstream end of existing channel floodplain conversion area. The coyote willow grids are part of the channel fill with vegetation stabilization. All dimensions are approximate.

2.3.7 **Upstream Bank Stabilization**

Bank stabilization may be required at the upstream edge of the channel floodplain conversion area (filled river channel). The channel floodplain conversion area is being setback from the transition area between the existing and realignment channel. Additional bank stabilization may be needed initially to help facilitate sediment deposition upstream and reduce hydraulic forces against the upstream face of the permanent diversion berm/dam. Additional bank stabilization, if needed, will be comprised of an Engineered Log Jam (ELJ), consisting of 5 woody structures, as described below.

The ELJ will be constructed using mature native trees removed as part of the vegetation stabilization along the realignment corridor or the additional vegetation removal areas. It is anticipated that the native trees used in the ELJ will include both the tree trunk and its root wad, although reference hereafter is made only to root wads or logs. The tree trunk will be a minimum of 40 feet in length with a minimum tree trunk diameter of 1-2 feet. The tree trunk length is in addition to the root wad length, estimated to be around 10 feet with an estimated diameter around 10-15 feet. The ELJ will be placed in the existing river channel at the upstream end of the existing channel floodplain conversion area while the river is dry or almost dry (< 100 cfs). The ELJ will be comprised of about 5 groupings of woody structures, spaced about 40 feet apart.

The woody structures will be placed along the upstream edge of the existing channel floodplain conversion area, providing additional erosion resistance while encouraging sediment deposition upstream of the existing channel floodplain conversion area. Each of these structures will consist of approximately 4-5 root wads with a minimum of one root wad buried beneath the existing channel bed with its root wad facing upstream. A minimum of two root wads in each woody structure will be anchored into permanent diversion berm. Of these anchored root wads, the root wad end will extend out perpendicular to the river flow a maximum distance of 15 feet beyond the "new riverbank." At least one log in each woody structure will be placed parallel to the flow with the root wad facing upstream. A typical cross section of these woody structures is shown in Figure 9. A planform view of a single woody structure is shown in Figure 10

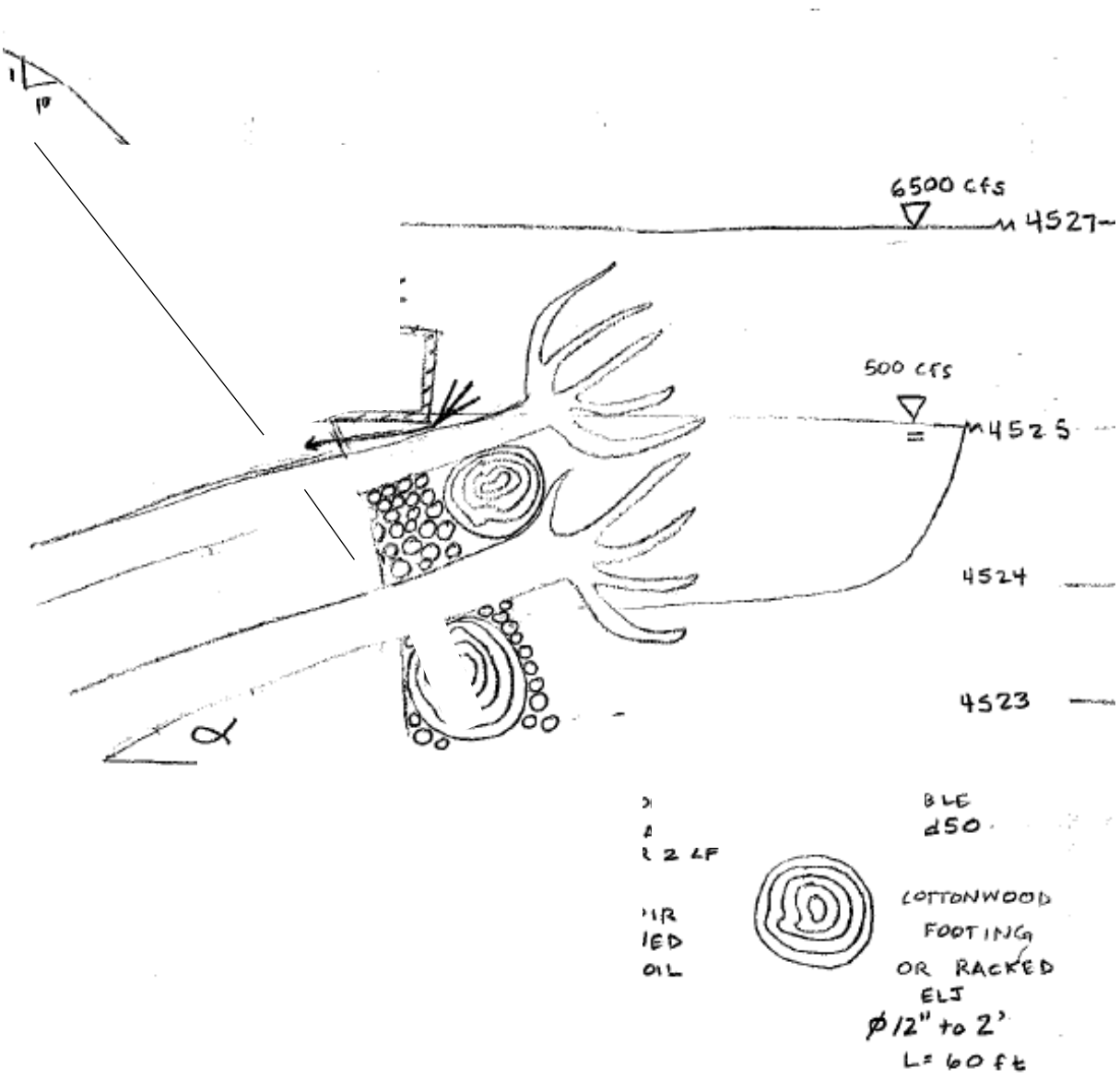


Figure 9 : BDA pilot project typical cross section of an ELJ at upstream end of existing channel floodplain conversion area. All dimensions are approximate.

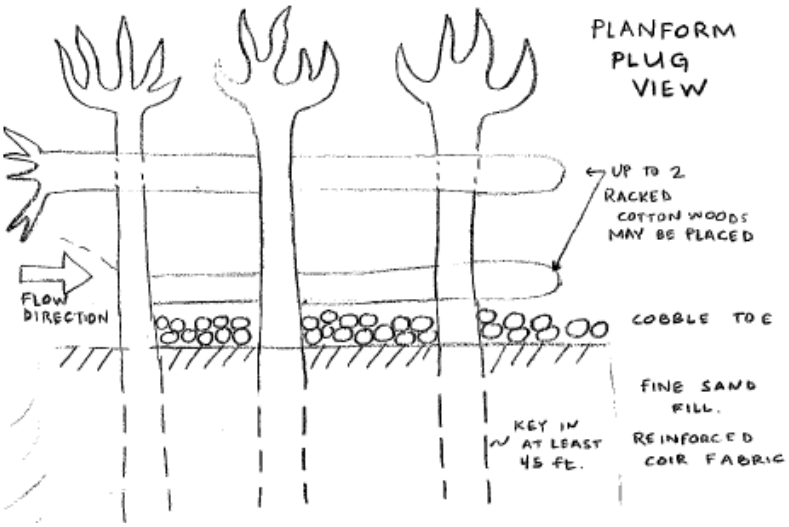


Figure 10 BDA pilot project planview of typical woody structure of ELJ anchored into permanent diversion berm at upstream end of existing channel floodplain conversion area. All dimensions are approximate.

2.3.8 **Access**

In order to perform construction of the project components, access is needed to the site. Access to the BDA pilot project will be via existing roads on the east and west side of BDA as shown in Figure 11. All access roads are only shown to major transportation corridors, like U.S. Highway 380, since necessary construction traffic will follow these established routes to the identified access routes. Two classes of access roads, primary and secondary, will be utilized for the BDA pilot project. The designation of primary and secondary access routes is illustrated in Figure 11 and explained in more detail in the following sections.

If necessary, to ensure safe and convenient access, road improvements (e.g. clearing, mowing and trimming, blading, widening, gravel cap placement, etc.) may be made to the dirt roads designated as primary or secondary access routes. Clearing involves the removal of vegetation within the roadway with some amount of subsurface disturbances to the vegetation roots. This is typically undertaken with new or minimally used access routes. A typical impact range for clearing is 20 to 30 feet per lineal foot of access road. Mowing is the process of cutting vegetation in and to the sides of the access route to provide line-of-sight and safe conditions for access, including increasing the reaction time to respond to wildlife and livestock within the access road corridor. Horizontal clearance also provides the ability for equipment to drive without hitting and damaging equipment. Trimming involves the selective cutting of tree branches in the vertical direction that will restrict vehicular access along the route. This is especially relevant when large trees are near the access routes that have a few branches that extend into the access route, making vehicular access difficult. The height from the road surface to be cleared varies with the type of equipment, with a range of 10 to 20 feet.

Primary Access

The primary access routes designated in the maps reflect those routes which will likely see the heaviest vehicle use. These are associated with transporting equipment into the project site. The primary access routes include the Operation and Maintenance (O&M) and spoil levee roads for the LFCC and two new access routes to the project site. One of the primary access routes follows the LFCC O&M road north from the San Marcial Yard and is approximately 13.8 miles in length. This access route would be utilized to transport the largest equipment including amphibious excavators, if they are required to complete the project. The other primary access route, following the LFCC O&M road from the Highway 380 Bridge is approximately 6.7 miles in length, and would be utilized to transport most of the expected project's construction equipment. This length consists of 6.2 miles along existing roads and 0.5 miles of temporary access roads. One of the new access routes follows a previously cleared access route that was used to facilitate the equipment access for the 2008 BDA sediment plug project (Rolland, 2008; USFWS, 2008) and the other follows rangeline 1557 and may need a ramp from the LFCC O&M road to facilitate entry and exit.

Access along these primary routes may require a temporary river crossing to facilitate mobilization/ demobilization of the tracked construction equipment across the Rio Grande. The river crossing for this project will be located between RM 82 and 81 (2012 channel demarcations). The banks at the crossing location will be sloped to create ramps into the river. The wetted river channel crossing will be placed, where possible, in a riffle. Riffle crossings are preferable to the narrower sections, which may have deeper water. Crossing locations will be located to minimize impacts to existing bank vegetation and avoid areas of vertical slopes. The ramps will be approximately 20 feet wide. The crossing distance of the channel at the primary crossing is approximately 100 – 250 feet in the wet (river flows). The exact width is dependent on the amount of water in the Rio Grande disregarding a snow-melt runoff or monsoonal event. The expected number of trips for the project duration is 20 up to a maximum of 40.

Secondary Access

The secondary access routes will be used for project site access other than tracked construction equipment. This will include pickup trucks, repair vehicles, and fuel trucks. This access will be on the east side of the Rio Grande, using the U.S. Highway 380 Bridge to cross the river. This route is approximately 8.7 miles along existing dirt roads. The last 0.2 miles will be new temporary road construction to access the BDA pilot project 300-foot corridor. Two options for the new temporary road construction into the BDA pilot project 300-foot corridor are presented, as shown in Figure 12 with the northern path being preferred. The southern one will be used in an emergency or in the event that construction site conditions favor the southern access path. These access paths will be constructed to take advantage of areas designated for exotic or other vegetation clearing, minimizing additional impacts to the existing vegetation. All secondary access routes may require some grading work to facilitate access to the project site. About 15-20 trips per day are expected for the secondary access roads.

2.3.9 **Staging**

Temporary staging and stockpile areas will be used to store equipment and materials, respectively (see Figure 122). The temporary stockpile site areas will be used to store fill material for the existing channel floodplain conversion area. There are two areas, totaling about 50 acres in size, located on the west side of the 300-foot pilot project corridor near RM 81. The temporary stockpile areas are placed in areas also slated for exotic vegetation removal. To the extent possible, native canopy vegetation will be left intact within the temporary stockpile areas. The one notable exception is where access is needed to the existing river channel. The northern temporary stockpile area will be used for stockpiling the material needed for the permanent diversion berm. This will require a wider access width to facilitate moving the material into the river.

An equipment staging area, around 1.0 acre in size, is located adjacent to the eastern secondary access route. This location will provide higher ground for storing the equipment during weekends and periods where equipment is not utilized. During the work week equipment will be staged throughout the construction site unless there is an expectation of flooding. There is some vegetation that will need to be removed to provide adequate space for equipment staging, these will be shrub or herbaceous vegetation, not mature, native trees.

Dust abatement typically occurs on access routes and in project areas during implementation when there is not sufficient moisture in the soil to inhibit the formation of dust. Dust abatement involves the distribution of water onto an earthen surface. If dust becomes a safety concern at the site, or while hauling cobble from the temporary stockpile areas to the priority site area roads will be wetted with water pumped from the Rio Grande or from the LFCC. The Rio Grande will be the primary pumping source since work activities are primarily on the eastern side of the Rio Grande away from the LFCC.

When pumping from the Rio Grande, the pump setup will utilize a 0.25-inch mesh screen at the opening to the intake hose to minimize entrainment of aquatic organisms. For areas where the depth to a water surface is too much for the pump setup, an intermediate area will be leveled to create a temporary surface for the pump. Water is typically distributed using a truck-based water unit that allows for a controlled and uniform spraying of the desired surface.

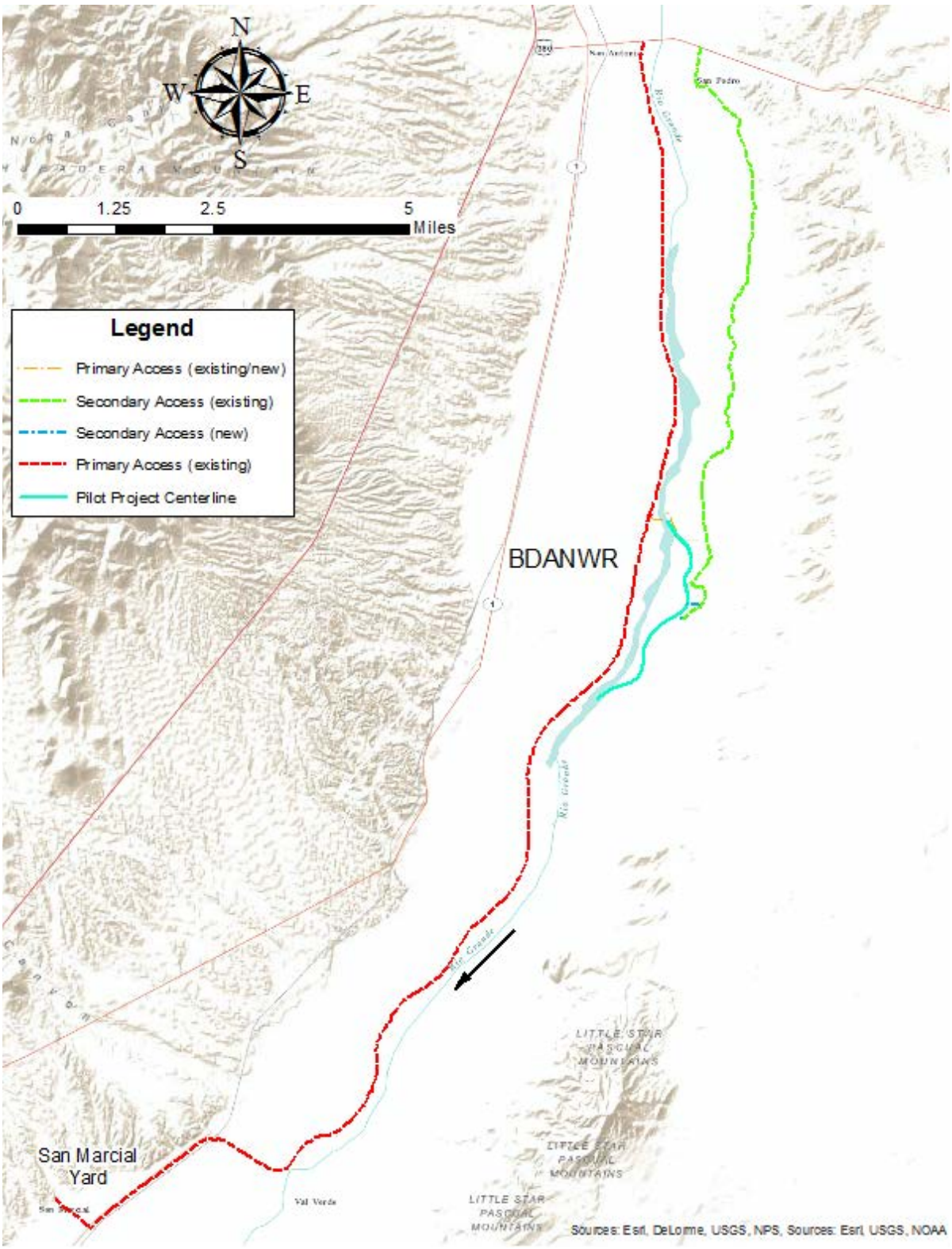


Figure 11: Primary access routes for the BDA pilot project. The background imagery is a terrain map generated by ESRI (accessed May 9, 2017).

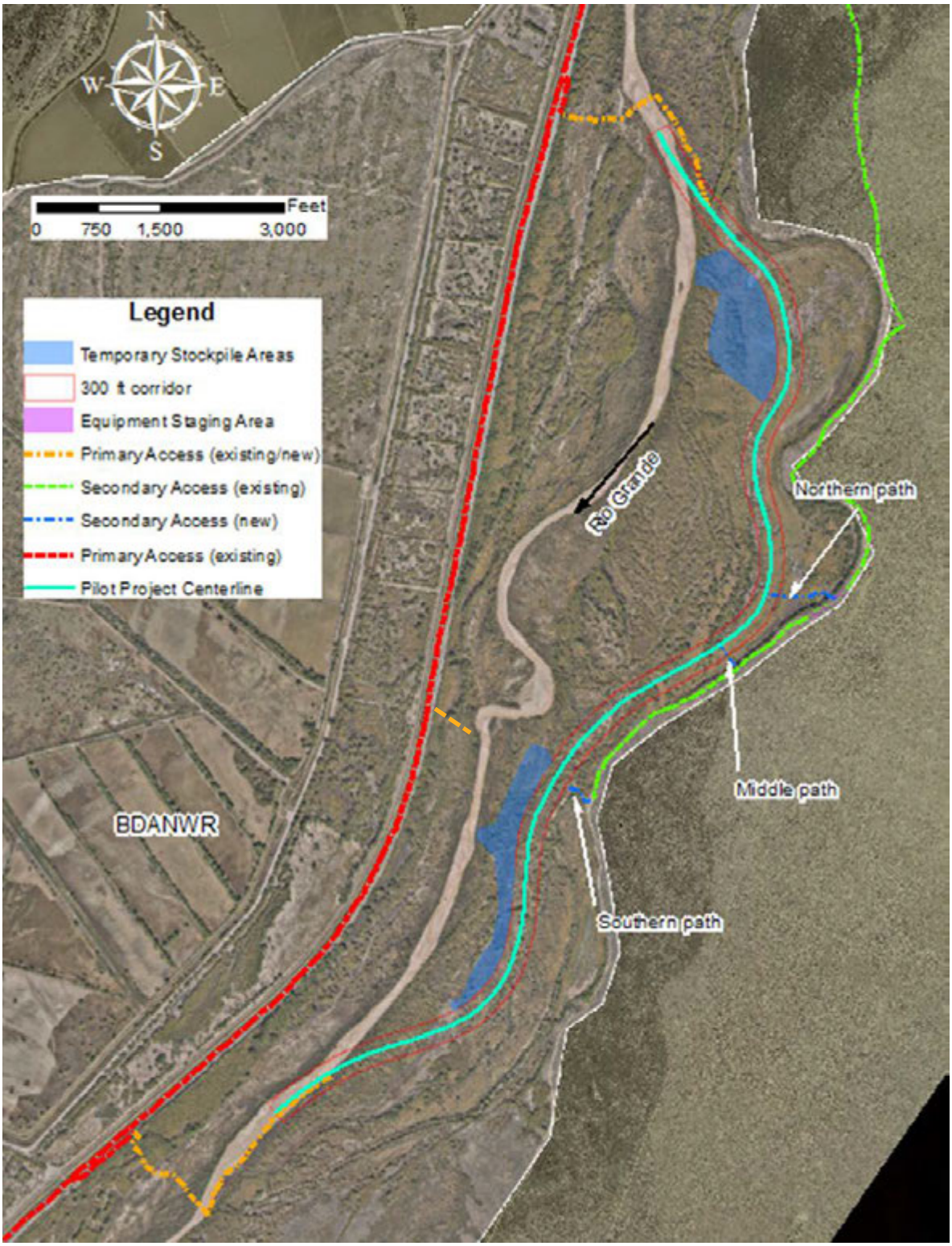


Figure 12: BDA pilot project centerline and 300-foot offset alignment with temporary stockpile and equipment staging areas. The background imagery is a combination of the 2016 aerial photography (Reclamation) and aerial imagery available from ESRI.

2.3.10 Impact Area

The total maximum project area is 1,100 acres as shown in Figure 2. This area is delineated larger than necessary to allow for field adjustments due to changes in conditions. The expected area of disturbance (BDA pilot project 300-foot realignment corridor, vegetation removal areas, existing channel floodplain conversion area, and new access roads) is approximately 300 acres (max of 400 acres). The expected disturbance area will be within the total maximum project area. This larger delineation allows flexibility in the field to make adjustments to specific locations. Although field adjustments are likely, the disturbance acreage will be equal to or less than the maximum disturbance acreage of 400 acres.

3 AFFECTED ENVIRONMENT

3.1 Introduction

This section describes the environment in which the Proposed Action would be implemented. The various associated environmental resources, including physical resources such as land use, water resources, water quality, air quality; and biological resources such as vegetation, wetlands, noxious weeds, fish and wildlife resources, and endangered species; and socio-economic resources such as Indian Trust Assets, environmental justice, cultural resources, are discussed.

3.2 Description of Relevant Affected Issues and Resources

The following is a full description of the relevant affected issues and resources that potentially could be impacted through this project. Any impacts for each identified issue or resource, both positive and negative is discussed in Section 4 Environmental Consequences.

Physical Resources

The project is located wholly within BDA along the Rio Grande approximately 16 miles south of Socorro, New Mexico. In New Mexico, the Rio Grande flows out of the Southern Rockies, through a large Basin and Range rift valley that stretches from southern Colorado south through the southern boundary of New Mexico into Mexico. The project area lies within what is described as the Middle Rio Grande Basin which ranges from Otowi, New Mexico to Elephant Butte Dam. In this reach the rift has filled with alluvial and fluvial sediments weathered from rock formations along the main and tributary watersheds. Topping these more ancient sediments in the bottom of the river valley are entisol soils in the floodplain that are derived from transported sediments that were historically deposited by overbank flooding (Scurlock, 1998).

The heart of BDA is located along the Rio Grande Riparian/Floodplain corridor in what is described as the largest cottonwood forest in North American known locally by the Spanish word for forest, “Bosque” (Whitney, 1996).

3.2.1 Land Use and Recreation

The project area is within BDA approximately 16 miles south of Socorro, New Mexico. The project is located near the center of BDA so no other public or private lands will be impacted by the project construction. Access routes are the only portions of the project that will reach the boundary or depart BDA. The portion of the refuge with most management activities and developed recreation occurs on the west side of the Rio Grande. The area just west of the Rio Grande contains the majority of the refuge infrastructure used to provide extensive habitat features that utilize water to create aquatic habitats for migratory bird species native to this region. Roads and trails that access this infrastructure are used intensively by visitors for wildlife viewing opportunities and constitute the majority of visitation to the Refuge, which is estimated at 200,000 visitors annually (Leeser, 2017, personal communication). The east side of the refuge, east of the river, is primarily undeveloped. There is access on the north, south and east boundaries of the refuge. The north and south gates, which are closed to the public, provide access to the east side service road which is primarily used for hunting and wilderness access. Generally, this area sees a low level of visitation with estimated visitation of less than 500 visitors per year (Leeser, 2017, personal communication). The east side offers limited front country hiking, wildlife observation, and photography opportunities. Other than the east side access road there are no developed recreation facilities on the east side of the refuge.

Land use in the project area is predominantly natural vegetation and access roads. Within the floodplain there are areas of native habitat of high value mixed with monotypic, exotic vegetation, predominantly saltcedar that provides some habitat benefits for listed species but is more marginal in habitat quality than areas that have a more native assemblage of vegetation. This area does not have any developed trails. The east side access road is the only development on this side of the river utilized by visitors to access this side of the refuge. Recreation in this area, off of the road, is primitive in nature.

3.2.2 Water Quality

The project area overlays a portion of the Rio Grande and floodplain, a perennial river and jurisdictional water of the U.S. Current information on the water quality of the river in the MRG is available from the U.S. Geological Survey (USGS), USACE, Reclamation, University of New Mexico, New Mexico Environment Department (NMED), and Service, as well as other sources. Water quality constituents that are typically monitored include surface water temperature, pH, turbidity, dissolved oxygen (DO), suspended sediments (SSED), conductivity/total dissolved solids (TDS), and fecal coliform. These data may be collected in the Rio Grande, in adjacent canals, or within reservoirs. Typically, personnel at specific riverine, canal, or reservoir locations collect the data with automatic data logging devices at stream gage stations. Long-term water quality data for the San Acacia Reach are lacking, but the nearest available data occurs in the Albuquerque Reach to the north of the Proposed Action. These data are characterized by a high degree of seasonal variability for several water quality measures, as detailed in Table 1.

Water quality standards for the MRG from the San Acacia diversion dam to the Escondida Drain outfall has designated uses of irrigation, marginal warm water aquatic life, livestock watering, wildlife habitat, and secondary contact (20.6.4.900 New Mexico Administrative Code).

Table 1: Average water quality data by constituent for the Central Avenue gage (1/2002 – 5/2018) (NMED, 2018)

Season	Turbidity (NTU)	DO (mg/L)	pH	Conductivity (mg/L)	Water Temp (C)	TDS (mg/L)*	Fecal Coliform (col/100mL)*	SSED (mg/L)
Nov-Feb	195.34	12.63	8.14	379.65	7.98	255.08	N/A	663.94
Mar-June	56.57	8.60	8.02	301.79	15.57	209.74	82.50	985.38
July-Oct	146.51	7.50	8.12	325.56	22.33	273.17	8.00	1807.81

*Data not available in updated information from NMED. From Average Data for Central Avenue Gage (1975-2001) San Acacia Habitat Restoration EA 2016.

Current water information collected by the United States Geologic Survey (USGS)is limited with the most recent information provided including discharge, gage height readings, water temperature and suspended sediment. Water quality typically contains high turbidity readings due to large amounts of sediment naturally present in the system. Turbidity readings are elevated especially when the river flows are high, and the adjoining arroyos are depositing additional sediment due to surface runoff. Additional information may be found at: http://waterdata.usgs.gov/nm/nwis.

3.2.3 Groundwater

The alluvial aquifer located in BDA is hydrologically connected to the Rio Grande. The geology in the area is mostly sand and has a high hydraulic conductivity that connects the Rio Grande to the shallow alluvial aquifer. The high hydraulic conductivity allows seepage to occur from the Rio Grande to the shallow alluvial aquifer and into adjacent drains. Groundwater recharge to the west side of the Rio Grande is affected by the Low Flow Conveyance Channel (LFCC). It is assumed that groundwater (GW) recharge migrates east from the Rio Grande as well, but at a much gentler gradient.

The shallow alluvial GW migrates from the Rio Grande west to the LFCC which is at a lower elevation than the Rio Grande throughout most of the BDA reach. Since the LFCC is at a lower elevation this creates a steep GW gradient through the project area. Aggradation of the Rio Grande has elevated the current channel elevation compared to historical conditions, causing the GW gradient to increase over time. The shallow alluvial aquifer contains a large amount of coarse sand which has high hydraulic conductivity. Thus, between the steep GW gradient and the naturally high hydraulic conductivity of the sediment in this area, there is a characteristically high seepage rate to the west of the Rio Grande into the LFCC.

3.2.4 Air Quality

Air quality is generally good in the project area due to its rural and semi-remote nature. Also, there is an absence of major air emission sources in the region, and ambient noise is generally

low in the project area. The project area is in the Southwestern Mountains-Augustine Plain Intrastate Air Quality Control Region (AQCR) 156 (covers 20, 256 square miles) (2017 NMED). Air Quality Control Regions were established in 42 U.S.C. § 7407 and are a federally designated area that is required to meet and maintain National Ambient Air Quality Standards (NAAQS). BDA is also designated as a Class 1 Area for Air Quality as discussed below.

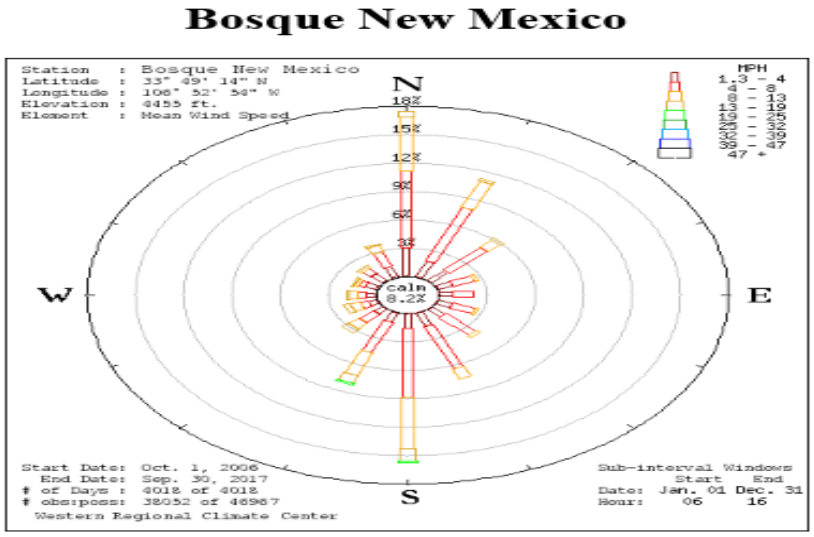
The EPA has developed NAAQS for six principal air pollutants (also called "criteria pollutants"). They are ground-level ozone (O3), particulate matter (PM), nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), and lead (Pb) (United States Environmental Protection Agency, 40 CFR 50) (EPA 2017a). Socorro County and adjacent counties in New Mexico are not listed as part of an EPA designated nonattainment area or maintenance area as designated under the Clean Air Act and the New Mexico Environment Department (NMED). AQCR 156 (Socorro County) is designated as "Unclassifiable/Attainment" with respect to NAAQS (Better than national standards 1971, Sulfur Dioxide; Cannot be classified or better than national standards, NO_2). This designation indicates that the status of attainment has not been verified through data collection (NMED 2017). The nearest nonattainment areas are south east in Anthony, New Mexico and a little further south in El Paso, TX. (NMED 2017, TCEQ 2017).

In 1977, Congress designated BDA Wilderness Area a Class 1 Area, affording it special protection under the Clean Air Act. Congress gave the Service, as the federal land manager of the refuge, the responsibility to protect the air quality and natural resources, including visibility, of the area from man-made air pollution. There are three wilderness areas on the refuge that are Class 1 Areas: Chupadera, Indian Wells and Little San Pascual Wildernesses. The main intent of this classification is to protect the visibility of Class 1 Areas. 40 CFR section 51.307 requires the operator of any new major stationary source or major modification that may affect visibility in Class I areas to provide written notification, including the visibility analysis and all information relevant to their permit application, to Federal Land Managers (FLMs) for that area.

One refuge management activity that may affect air quality is prescribed fire; however, the refuge complies with New Mexico Administrative Code, Title 20 (Environmental Protection), Chapter 2 (Statewide Air Quality), Part 65 (Smoke Management). Prescribed fire activities on the refuge meet federal and state regulations and are not violating air quality standards.

Wind patterns near the project area are derived from the Bosque New Mexico Remote Automated Weather Station (RAWS) approximately ½ mile west from the project area. Data was queried from October 1, 2006 through September 31, 2017 and from 0600 to 1600 hours, see Figure 13. This period was thought to approximate the work period for the proposed project. For the 10-year period and time listed above the winds at the nearby RAWS station come from the north 26.1% percent of the time. The third and fifth most common directions were north northeast and northeast at 11.1 % and 5.1% of the time respectively. During this period of data winds are predominantly from the north. The second, fourth and six most common directions are from the south, south southwest and south southeast at 11.4%, 7.6% and 5.0% respectively. The

strongest winds reported from this period generally come from the south, south southwest, and southwest at 0.1% to 0.2% of the time.



Bosque New Mexico - Wind Frequency Table (percentage)

Latitude : 33° 49' 14" N
Longitude : 106° 52' 54" W
Elevation : 4455 ft.
Element : Mean Wind Speed

Start Date : Oct. 1, 2006
End Date : Sep. 30, 2017
# of Days : 4018 of 4018
obs : poss : 38052 of 96432

Sub Interval Windows
Start End
Date Jan. 01 Dec. 31
Hour 06 16

(Greater than or equal to initial interval value and Less than ending interval value.)

Range (mph)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
1.3 - 4	3.0	1.8	1.5	1.0	0.9	1.0	1.1	1.6	1.6	1.0	0.6	0.5	0.5	0.7	0.9	1.1	18.8
4 - 8	8.1	6.1	3.3	1.5	1.2	1.5	2.7	4.8	7.3	3.5	1.2	0.5	0.5	0.4	0.7	1.6	44.7
8 - 13	5.7	3.0	1.0	0.2	0.1	0.2	0.2	1.1	5.4	2.6	0.9	0.6	0.5	0.3	0.2	0.7	22.8
13 - 19	0.7	0.2	0.2	0.1	0.0	0.0	0.0	0.1	1.3	0.9	0.5	0.4	0.2	0.1	0.1	0.2	4.9
19 - 25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.6
25 - 32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32 - 39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39 - 47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47 -	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total(%)	17.4	11.0	6.0	2.7	2.2	2.7	4.0	7.5	15.8	8.1	3.3	2.1	1.8	1.5	2.0	3.6	91.7
Calm (<1.3)																	8.2
Ave Speed	6.7	6.2	5.6	4.9	4.3	4.5	4.7	5.4	7.6	7.7	7.8	8.3	7.3	5.7	5.1	5.7	5.9

Figure 13: RAWS Mean Wind Speed Wind Rose for Bosque New Mexico for the period of Oct 1,2006 through September 30, 2017 from 0600 to 1600 each day.

3.2.5 Geomorphology

Sediment balance (sediment supply versus transport capacity) strongly affects channel processes and thus influences geomorphic conditions and trends. Sediment supply describes the volume and type of sediment delivered to a section of river, and transport capacity is the ability of a river to convey sediment downstream (Julien 1998). As the river attempts to achieve or maintain sediment balance, the channel dimensions, pattern, and profile adjust in an effort to transport the available sediment (Lane 1955, Schumm 1977, Watson et al. 2007).

The Rio Grande in the realignment project area is predominantly a capacity limited reach in which sediment supply exceeds transport capacity (Makar and AuBuchon 2012). However, this

is a general trend and is highly variable both spatially and temporally. Deposition occurs as the excess sediment cannot be carried downstream by the river, thereby raising the channel bed elevation over time, see Figure 14. The floodplain also experiences aggradation (to a lesser degree) as overbank flow deposits fine-grained silt and clay sediments. The greatest deposition within the floodplain typically occurs in overbank areas adjacent to the main channel. These vegetated banks are zones of high roughness where there is a significant reduction in flow velocity that induces deposition of sediment carried from the main channel during high flows. In this manner, there is a tendency for the elevation of the channel bed and banks to rise faster than that of the outer floodplain, creating a perched channel as seen in Figures 15 and 16.

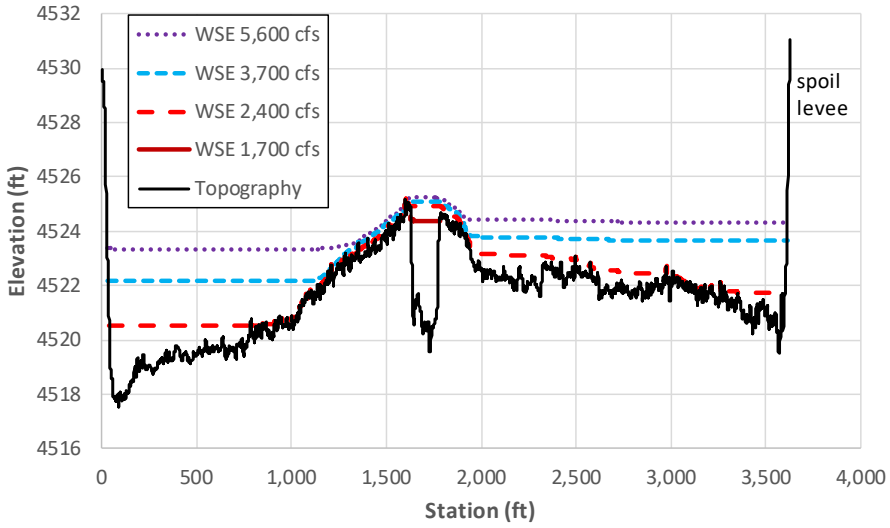


Figure 14: Example cross section (looking downstream) showing perched channel geometry for the existing perched channel in the proposed project area. Water surface elevation (WSE) from a two-dimensional model is shown at various flows. Note that when the channel water surface elevation rises above the top of banks at about 2,000 cfs, flow will spill out and travel to low elevation areas in the floodplain. The LFCC is not shown but would be at about Station 3,800 ft and Elevation 4,505 ft, the lowest point in the floodplain.

A perched channel causes floodplain surface water to be disconnected from main channel flows during flood events (Figures 14 and 15). Aquatic species are often stranded as flows recede because there is no return path back to the main channel. Additionally, the disconnected flows cause increased water losses and reduced sediment transport capacity. Seepage flows are lost from the river channel to nearby irrigation drains and low elevation areas. Channel perching has also been identified as one of the primary factors associated with sediment plug formation (Park 2013, Tetra Tech 2010). A primary goal of the realignment is to improve downstream water delivery by reducing or eliminating channel perching. The existing geomorphic conditions cause water losses for the following reasons:

- channel perching causes sediment plugs that block water flow through the main channel
- channel perching increases seepage losses
- channel perching does not allow for groundwater to re-enter the channel

- channel perching causes overbanking flow to be disconnected from the main channel so that when runoff events recede, water is stranded in the floodplain

Figure 15 Photo of perched channel when flow begins to enter the floodplain near BDA North Boundary (Nathan Holste, 5/26/2017). Blue arrow shows direction of flow into the low-lying floodplain areas.

In addition to the general long-term aggradation trend, sediment has plugged the channel several times since 1990 between San Antonio, NM and San Marcial, NM. Sediment plugs are the result of rapid and severe local channel aggradation. A higher concentration of sediment is transported near the bed, so that when overbanking occurs at the top of the water column a disproportionate volume of sediment is left in the main channel. Holste (2014a) summarized the channel characteristics that contribute to sediment plugs: backwater effects (reservoir pool, bridge, abrupt bends), narrow or constricted channel, low channel slopes (or sudden reduction in slope), limited main channel hydraulic and sediment transport capacity, and a perched channel. A high magnitude, long duration spring snowmelt runoff event is also required for a sediment plug to occur. Sediment plugs are driven by overbanking flow and the associated sediment transport imbalance caused by the channel characteristics listed above. This sediment imbalance must persist over some kind of minimum duration in order for a plug to form. The most recent sediment plugs occurred in 2017 and 2019 within BDA. These events demonstrate that the geomorphic and sediment conditions required for a plug are still present in this reach.

Figure 16 provides example photos of a sediment plug that occurred in the same location as the 2017 and 2019 plug during the spring snowmelt runoff of 2008. Without intervention, a new flow path would have developed, bypassing the old plugged channel as the entire river flow overbanked. Eventually, a new channel would establish a competent form to transport water and sediment thus creating a full avulsion and resetting the river (Massong et al. 2010). With the

current vegetation levels in the BDA sediment plug area, it would likely take several years or even decades for a natural avulsion to occur. Vegetation would need to die off through drowning or other means before it could be uprooted by scour from high flow events. It is possible that a breach of the western spoil levee would occur before a natural avulsion to the east. This occurred near downstream at RM60 in the late 1980s or early 1990s. There was a breach to the LFCC spoil levee, and the channel avulsed into the LFCC, thereby creating the "S-curve" bend that has existed since then. There was also a breach to the spoil levee caused by the 1991 sediment plug near Tiffany, but the levee was repaired, and the river remained in the existing alignment.

Figure 16 Sediment plug photos from 2008 (a) May 23, 2008: main channel is filled with sediment and all flow is forced around the plug into the floodplain (b) July 4, 2008: flows have receded and a large volume of water remains ponded in floodplain which will be the location of the new realigned channel .

A pilot channel was excavated through the 2008 BDA sediment plug in October 2008 before an avulsion or levee breach could occur. The pilot channel restored delivery of bed material sediment load (i.e., sand) to reaches downstream of the plug. Although the pilot channel was only about 25 ft wide, restoring sediment transport through the plug allowed for natural erosion of the remaining material over the course of a few months during winter 2008/2009. The channel essentially returned to pre-plug conditions by the summer of 2009. A similar pilot channel was excavated through the 2017 BDA sediment plug.

When a sediment plug occurs under existing conditions, given current anthropogenic constraints, mechanical intervention (i.e., constructed pilot channel through plug or constructed realignment) is required to restore the river's ability to transport its sand load downstream of the plug. The sediment plug acts as a dam by trapping sediment supplied from upstream. Deposition at the upstream plug interface continues as relatively clear water, carrying a lower concentration of silt and clay, is forced into the overbank. Scour occurs when flows return to the main channel downstream of the plug, similar to erosional processes that are commonly observed in rivers downstream of dams (Happ 1948, Tetra Tech 2010). This downstream erosion has been mitigated in recent years by removing plugs within a few months of formation and therefore restoring sediment transport continuity through the reach.

Regardless of the formation of a sediment plug, existing channel morphology is greatly simplified compared to historical conditions: average width and width variability have been reduced and the braided, dynamic planform is now a single thread channel in a fixed position.

There is a mild aggradational trend over time, with periods of degradation and events of localized, rapid deposition. With no sediment plug, the existing channel generally transports most of the sediment supply through the reach. When a plug occurs, there is a severe case of sediment discontinuity with deposition upstream and erosion downstream.

3.2.6 Water Delivery

The Rio Grande has an average annual loss of 43,000 ac-ft (10%) over the 19 river miles between the Highway 380 and San Marcial gages which includes the project area. There are three primary physical processes that cause water loss from the river: seepage, transpiration, and open water (OW) evaporation. West (2018) estimates a seepage loss of 5 cfs/mile for the existing channel within BDA, which would be 15 cfs over the 3-mile project reach. This rate results in a seepage loss of about 11,000 acre-ft from the existing channel when applied over a full year. A portion of this seepage enters the LFCC to the west, while some infiltrates to groundwater below and to the east of the river.

Transpiration is another important process that causes water loss from the river system. Water is absorbed by vegetation roots in the soil, travels up through the plant, and then is evaporated from the leaves. This causes water loss from the soil and groundwater, which contributes to overall water loss from the river system. Transpiration rates are similar to OW evaporation rates, but transpiration causes a much greater volume of water loss because vegetation occupies significantly more area in the riparian corridor than OW. Jasechko et al. (2013) found that transpiration accounts for 80 to 90% of terrestrial evapotranspiration, and that even in desert catchments, transpiration represents an average of 75% of the total evapotranspiration.

Biological Resources

3.2.7 Vegetation

The 23,162 ha (57,191 ac) at BDA consist of approximately 17,722 ha (43,791 ac) of upland mesa and desert mountain habitat. Most of the project area lies out of this zone although some minor impacts could occur to this zone from the maintenance of the East Side Access road. Uplands west of the river are dominated by creosote bush (Larrea tridentata), four-winged saltbush (Atriplex canescens), juniper (Juniperus monosperma), and Mormon tea (Ephedra spp.). Major grasses are black grama (Bouteloua eriopoda), sideoats grama (Bouteloua curtipendula) and fluffgrass (Tridens pulchellus). Shrubs include Apache plume (Fallugia paradoxa), snakeweed (Gutierrezia spp.), and varieties of cactus (Opuntia spp.). The uplands east of the river have soils much sandier than those of the west side. Dominant vegetative species are those included on the western uplands, but also include in greater densities sand sage (Artemisia filafolia), desert willow (Chilopsis linearis), and giant dropseed (Sporobolus giganteus) . (Service 2005)

The focus of this EA is within the active floodplain, but the description of common bottomland species describes the native forest, wetland and grassland areas identified in the active floodplain description below. Refuge river bottomlands include approximately 5,428 hectares (13,400

acres) consisting of varying habitat types. Native woodlands are characterized by an overstory of Rio Grande cottonwood and Gooddings willow with understories species including coyote willow (Salix exigua), saltcedar (Tamarix spp.), screwbean mesquite (Prosopis pubescens) and seep willow (Baccharis glutinosa). Meadow areas consist of saltgrass (Distichlis spicata) and alkali sacaton (Sporabolus airoides) as well as moist soil grasses such as Echinochloa sp. and Leptochloa sp. Non-native saltcedar has invaded much of the bottomland area since 1940 and now occurs in large monotypic tracts throughout the Refuge floodplain. Managed bottomland marshes and croplands are not part of the project area and occur on the west side of the Rio Grande.

The majority of the 1,608 ha (3,974 ac) active floodplain area on BDA consist of non-native dominated forest with heights ranging from approximately 3 to 10 meters (12 to 30 feet) (BDA unpublished data). These dense non-native thickets are considered a type III or type V stand structure as described by Hink and Ohmart (1984). Densities vary, but generally a 75% canopy cover occurs within these non-native forest areas. A limited amount of saltgrass provides the only herbaceous understory within monotypic saltcedar stands found on the active floodplain. Mixed non-native/native forest, wetlands, and grasslands occur over the remaining active floodplain area. Potential for flooding is considered high, complete inundation of floodplain area occurring at approximately 4,000 cfs (SOBTF 2004).

Two species of noxious weeds are known to occur within the floodplain area. These are perennial pepperweed (Lepidium latifolium) and Russian Knapweed (Acroptilon Repens). The pepperweed is likely present within the floodplain area where the realignment corridor and vegetation clearing areas are proposed. It can come in after disturbance as well. Knapweed is more prevalent along the high dike roads on the west side of the river and tends to favor a little drier environment when compared to pepperweed. Knapweed is not thought to be within the project area (Sanchez Email, 2017).

3.2.8 Wetlands

The U.S. Fish and Wildlife Service (FWS) is the principal U.S. Federal agency tasked with providing information to the public on the status and trends of our Nation's wetlands. The U.S. FWS National Wetlands Inventory (NWI) is a publicly available resource that provides detailed information on the abundance, characteristics, and distribution of U.S. wetlands. NWI data are used by natural resource managers, within the U.S. FWS and throughout the Nation, to promote the understanding, conservation and restoration of wetlands (FWS 2017).

NWI data is available through a National Wetland Mapper available online from the FWS. The mapper was viewed for the proposed project area, both current and new river alignments within the BDA and associated floodplain, which resulted in a number of NWI wetlands identified within or adjacent to project features. These wetlands are classified using the Cowardin system (Cowardin et al, 1979), are viewable on the map(s) provided in Appendix A (10.1) and are provided in the following list (FWS 2017).

PEM1A – Palustrine Emergent Persistent Freshwater Wetlands that are Temporarily Flooded. This wetland type occurs in the depressional area on the east side of the floodplain where the new alignment would be constructed. Typified by rush/sedge/cattail species and totals approximately 87 acres within or adjacent to the project area.

PEM1/SS1A – Palustrine Emergent Persistent/Palustrine Scrub-Shrub Broad-leaved Deciduous Freshwater Wetlands that are Temporarily Flooded. This wetland type occurs adjacent to the current river channel. Common plants include rush/sedge/cattail and willow species and totals approximately 50 acres within or adjacent to the project area.

PSS1A – Palustrine Scrub-Shrub Broad-leaved Deciduous Freshwater Wetlands that are Temporarily Flooded. This wetland type occurs in small patches, adjacent to the current river channel and in the proposed alignment corridor on the east side of the floodplain. Common plants include mature willow shrub and young willow/cottonwood tree species and totals approximately 50 acres within or adjacent to the project area.

PSS2A – Palustrine Scrub-Shrub Needle-leaved Deciduous Freshwater Wetlands that are Temporarily Flooded. This wetland type occurs in one small patch east of the proposed realignment corridor near the eastern edge of the floodplain. Dominated primarily by saltcedar shrubs and totals approximately 15 acres adjacent to the project area.

PSS1/2A – Palustrine Scrub-Shrub Broad-leaved and Needle-leaved Deciduous Freshwater Wetlands that are Temporarily Flooded. This wetland type occurs in narrow linear patches adjacent to the current river channel. Common plants include mature willow/saltcedar shrub and young willow/cottonwood tree species and totals approximately 56 acres within the project area.

PFO1/SS2A – Palustrine Forested Broad-leaved Deciduous/Palustrine Scrub-Shrub Needle-leaved Deciduous Freshwater Wetlands that are Temporarily Flooded. This wetland type occurs in small patches, adjacent to the current river channel and adjacent to the proposed realignment corridor on the east side of the floodplain. Common plants include mature willow/cottonwood trees and mature saltcedar shrub species and totals approximately 36 acres within and adjacent to the project area.

R2UBF – Riverine Lower Perennial Unconsolidated Bottom that is Semipermanently Flooded. This aquatic designation occurs within the current river channel and includes wetlands and deepwater habitats therein. Particles smaller than stones comprise the channel bottom and surface water persists throughout the growing season. A total of approximately 80 acres is found within the project area.

R2USA – Riverine Lower Perennial Unconsolidated Shore that is Temporarily Flooded. This aquatic designation occurs immediately adjacent to the current river channel and includes wetlands and deepwater habitats therein. Landforms such as beaches, bars and flats that are found near the channel edge are typical of this designation and surface water is present for brief

periods during the growing season. A total of approximately 75 acres is found within the project area.

Section 404 (Appendix B, 10.2) of the Clean Water Act identifies wetlands in New Mexico and at the project location as “areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.” – Definition of wetlands as used by the U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA) since the 1970s for regulatory purposes (EPA 2017).

The EPA and the Corps use the 1987 Corps of Engineers Wetlands Delineation Manual and Regional Supplements (Arid West Supplement [Version 2.0] for the project site) to define wetlands for the Clean Water Act Section 404 permit program. Section 404 requires a permit from the Corps or authorized state for the discharge of dredged or fill material into the waters of the United States, including wetlands (EPA 2017, EL 1987, Corps 2008).

The 1987 Corps of Engineers Wetlands Delineation Manual and Regional Supplements organizes characteristics of a potential wetland into three categories: soils, vegetation and hydrology. The manual and supplements contain criteria for each category. With this approach, an area that meets all three criteria is considered a wetland (EPA 2017).

Reclamation initiated a Wetland Delineation for the project area at the beginning of the 2017 growing season. Both the current river channel and the realignment corridor with associated buffers were included in the delineation effort. Spot checks for wetland indicators outside of the old and new channel buffers were incorporated into the survey, with the concept that wetland boundaries should go outside of the buffer line if it was adjacent for a reasonable distance and various ‘test’ soil pits between the old and new channels would create a better understanding of the extent of wetlands in the floodplain within or near the project area. The Wetland Delineation was completed for the project area by BIO-WEST on October 6, 2017. A copy of the report with data forms and maps is provided in Appendix 10.3 and a summary of delineated wetland resources within and adjacent to the project area is provided in the following paragraph. (BIO-WEST 2017).

Wetland and water resources within the project area include approximately 453.8 acres of Palustrine Forested Broad-leaved Deciduous Freshwater Wetlands, 473.1 acres of Palustrine Scrub-Shrub Broad-leaved and Needle-leaved Deciduous Freshwater Wetlands, 15 acres of Palustrine Emergent Persistent Freshwater Wetlands, and 55.4 acres (15,160 linear feet) of Riverine Lower Perennial (current river channel). An additional 66.9 acres of Uplands were identified near the edge of the floodplain. The total amount of acres of each resource that will be directly and indirectly impacted by project activities are discussed in Section 4 Environmental Consequences.

3.2.9 Fish and Wildlife Resources

Surveys have occurred on the Refuge in various habitat types for arthropods, small mammals, reptiles and amphibians, and passerine birds. Arthropod richness in saltcedar habitat was described as similar to that of cottonwood dominated sites at the ordinal level (Ellis, et al. 1993 and 1994). Greater variation was seen at the family and species levels, however (BDA unpublished data). Saltcedar sites had fewer families of insects than cottonwood sites, but saltcedar sites had greater numbers of families than cottonwood sites for spiders. Three centipede families were present at saltcedar sites, but none were represented at cottonwood sites. Seasonal trends were similar among both habitat types. Isopod and beetle families were variable among all sites (Service 2005).

Ellis et al. (1997) showed a greater number of species of small mammals at saltcedar sites than cottonwood sites due primarily to adjacent drier upland habitats. Abundance comparisons were not possible due to sample design differences. The most common species in both habitat types was the white footed mouse (Peromyscus leucopus). Dry upland edge habitat supported species such as Ord's kangaroo rat (Dipodomys ordii), silky pocket mouse (Perognathus flavus) and Northern grasshopper mouse (Onychomys leucogaster).

Avian species richness, species diversity and evenness comparisons for saltcedar and cottonwood sites were also influenced by edge effects. Overall values were similar but varied seasonally (Ellis, 1995). There was a greater abundance of birds in saltcedar than cottonwood in winter and saltcedar also supported more individuals than some cottonwood areas in other seasons. The abundance of sparrows recorded at saltcedar sites was probably due to adjacent areas of annual weeds during winter. A variety of species also used saltcedar edge habitat during fall and spring migrations.

Refuge biomonitoring studies conducted in 1995 to 1997 showed that restored cottonwood forests had the highest breeding avian species richness of any Refuge habitat including cottonwood gallery forests, mixed cottonwood forests, and saltcedar dominated habitats (Taylor and McDaniel 1998, BDA unpublished data). Species richness values in restored cottonwood forests doubled over a five-year period to 59 species detected during the 1996 breeding season. Reptile and amphibian species richness was also higher when compared with other Refuge riparian habitats during three years of Refuge biomonitoring (Taylor and McDaniel 1998). Site disturbance associated with saltcedar control and resulting pioneer herbaceous vegetation establishment added to the number of species found at restored sites (Stuart and Farley 1993). Common species captured were desert grassland whiptails (Cnemidophorus uniparens), New Mexico whiptails (Cnemidophorus neomexicanus), Eastern fence lizards (Sceloporus undulatus), and side-blotched lizards (Uta stansburiana).

Species of concern include the Texas horned lizard (Pyrynosoma cornutum), the white-faced ibis (Plegadis chihi), the ferruginous hawk (Buteo regalis), the western snowy plover (Charadrius alexandrinus), the spotted bat (Euderma maculatum), the occult little brown bat (Myotis lucifugus occultus), the Baird's sparrow (Ammodramus bairdi), the loggerhead shrike (Lanius

ludovicianus), the northern goshawk (Accipiter gentilis) and the grama grass cactus (Pediocactus papyracanthus). No adverse impacts are expected to occur for any of these species. Benefits associated with wetland improvement are expected for the white-faced ibis and the western snowy plover. The New Mexico jumping mouse and the occult little brown bat would benefit from increased area of native riparian, grassland and wetlands. Increased habitat diversity associated with conversion of existing non-native habitat to native riparian, wetland, savanna and grassland habitat would benefit the ferruginous hawk, an uncommon winter visitor, the loggerhead shrike, and the northern goshawk, a rare winter visitor. The Texas horned lizard and the Baird's sparrow are not known to occur in the project area. Existence of the spotted bat and the grama grass cactus on the Refuge is hypothetical.

The Refuge supports 79 species of mammals, 298 species of birds, 20 species of fish and 67 species of reptiles and amphibians. Habitat actively managed for species including waterfowl, marsh and waterbirds such as sandhill cranes and shorebirds occur on the historic floodplain. The Refuge also supports four endangered species including the Rio Grande silvery minnow (Hyboanathus amarus), the southwestern willow flycatcher (Empidonax traillii extimus), interior least tern (Sterna antillarum athalaesos), and the New Mexico meadow jumping mouse (Zapus hudsonius luteus). One threatened species, the yellow billed cuckoo (Coccyzus americanus) occurs on the Rio Grande floodplain within the Refuge. All of these species would benefit from the conversion of existing non-native dominated habitat to native riparian and wetland habitats. Rio Grande silvery minnows currently occur within the Refuge's active river channel. They would benefit from improved river channel/floodplain connectivity on the Rio Grande, improved channel/floodplain features such as wetlands, destabilized banklines and sand bars, and snag placement. Southwestern willow flycatchers would benefit from expanded native riparian habitats of different age classes as habitat conversion is implemented. The Yellow Billed Cuckoo would also benefit from the resulting diversity of forest stand age and structure. Finally, the interior least tern, an infrequent user of existing wetland habitats, would benefit from improved wetland condition.

3.2.10 Threatened and Endangered Species and their Critical Habitat

In accordance with Section 7(a) (2) of the Endangered Species Act of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally threatened, endangered and proposed species.

This proposed action tiers off of Reclamation's 2015 Programmatic Biological Assessment and the Service's 2016 Biological Opinion and Conference Report entitled, Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico (Service 2016).

As part of the ESA section 7 consultation process, Reclamation prepared a Memorandum for the U.S. Fish and Wildlife Service (Service) with Notification of the Included Project under the Middle Rio Grande Biological and Conference Opinion (02ENNM00-2013-F-0033) to address

the effects of the proposed pilot project on the Rio Grande silvery minnow (Hybognathus amarus) (silvery minnow), the Southwestern Willow Flycatcher (Empidonax traillii extimus) (flycatcher), and the Western D.P.S. of the Yellow-Billed Cuckoo (Coccyzus americanus)(see Appendix 10.2).

The FWS provides a searchable database online titled Information for Planning and Consultation (IPaC), a project planning tool which streamlines the FWS environmental review process in regard to threatened and endangered species. An IPaC review was completed for this project and a copy of the resource list is provided in Appendix C (Service 9/21/2017).

All of the federally listed species on the IPaC resource list for the project area in Socorro County were reviewed and assessed as to whether they could be expected to occur and/or could experience adverse impacts from proposed project activities. A variety of parameters were considered including elevation restrictions, lack of suitable soil types, topography and aspect, species mobility and range, and most importantly whether suitable habitat was present within the project area in relation to species habitat requirements.

Upon completion of review, the federally listed species with no potential to occur and/or no potential for adverse impacts from project activities in the project area and eliminated from further consideration include 2 plants, 4 invertebrates, 1 amphibian, 1 mammal, and 4 birds, see Table 2. The complete list with rationale for elimination from further consideration is provided in the following table.

Table 2: Federally listed species eliminated from further consideration.

Species	Federal Status and Type	Rationale for Elimination from Further Consideration
Wright's Marsh Thistle (*Cirsium wrightii*)	Candidate Plant	Known populations do not occur at the project location, nearest is about 40 miles southwest. No designated critical habitat for this species.
Pecos Sunflower (*Helianthus paradoxus*)	Threatened Plant	Known populations do not occur at the project location, nearest is about 15 miles north. Project area is outside of designated critical habitat.
Alamosa Springsnail (*Tryonia alamosae*)	Endangered Snail	Known populations do not occur at the project location, nearest is about 50 miles southwest. No designated critical habitat for this species.
Chupadera Springsnail (*Pyrgulopsis chupaderae*)	Endangered Snail	Known populations do not occur at the project location, species is found only in Willow Spring about 6 miles west. Project area is outside of
Socorro Isopod (*Thermosphaeroma thermophiles*)	Endangered Crustacean	Known populations do not occur at the project location, species is found only in Sedillo Spring about 15 miles northwest. No designated critical
Socorro Springsnail (*Pyrgulopsis neomexicana*)	Endangered Snail	Known populations do not occur at the project location, species is found only in Torreon Spring about 15 miles west. No designated critical habitat
Chiricahua Leopard Frog (*Rana chiricahuensis*)	Threatened Amphibian	Known populations do not occur at the project location. Project area is outside of designated critical habitat.
Least Tern (*Sterna antillarum*)	Endangered Bird	Known populations do not occur at the project location. No designated critical habitat for this species.
Mexican Spotted Owl (*Strix occidentalis lucida*)	Threatened Bird	Known populations do not occur at the project location. Project area is outside of designated critical habitat.
New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*)	Endangered Mammal	Known populations do not occur within the project location, species is found approximately 0.5 mile west in a wet drain on the wildlife refuge that is also
Northern Aplomado Falcon (*Falco femoralis septentrionalis*)	EXPN – Experimental Population Bird	Known populations do not occur at the project location. No designated critical habitat for this species.
Piping Plover (*Charadrius melodus*)	Threatened Bird	This species is only known as a rare spring migrant at the project location and has not been documented breeding on the refuge. Project area is outside of

Three federally listed species are present or potentially present in the project area in Socorro County, see Table 3. Two of the three species have designated critical habitat within the project area and are included in the following table.

Table 3: Federally Listed Species with Historical Records in the Project Vicinity

Species	**Listing Status**	**Critical Habitat**
Rio Grande Silvery Minnow *(Hybognathus amarus)*	Endangered	Designated critical habitat in the project area (U.S. Fish and Wildlife Service 2003)
Southwestern Willow Flycatcher *(Empidonax traillii extimus)*	Endangered	Designated critical habitat within the project area (Service 2013).
Western Yellow-billed Cuckoo *(Coccyzus americanus)*	Threatened	Critical habitat has not been designated.

Suitable habitat for the silvery minnow occurs in the project area within the river channel and in the adjacent floodplain. The project area is within designated critical habitat for the silvery minnow.

A vegetative mapping project to inventory suitable habitat for the flycatcher was completed in 2016 for the Middle Rio Grande and included the proposed project area for river realignment at BDA (Siegle and Ahlers, 2017 in press). In addition, a suitable habitat inventory is available to determine potential impacts for the cuckoo. While both species occupy dense riparian, mainly native, vegetation with successional age classes of vegetation, cuckoos will use taller or more mature age classes of vegetation (typically tree willow and cottonwood trees).

For the flycatcher, map units with classifications of suitable, moderately suitable and unsuitable habitat for the flycatcher were assigned to the river reach at the project area. Within the entire BDA Reach, 118 acres of suitable and 749 acres of moderately suitable habitat were available to this species in 2016. The majority of the area within the reach was considered unsuitable at 2,090 acres. The project area covers a subset of this reach and captures 5 of the survey units from the mapping effort with appropriate acreage provided on the following table.

Table 4: Vegetative survey units at BDA in the project area by flycatcher suitability class and acreage.

Map Survey Unit	Suitable Class	Moderately Suitable Class	Unsuitable Class
BA-5	0 acres	119 acres	169 acres
BA-6S	18 acres	5 acres	71 acres
BA-7	29 acres	123 acres	123 acres
BA-9	0 acres	17 acres	317 acres
BA-10	0 acres	77 acres	170 acres
Total*	**47 acres**	**341 acres**	**850 acres**

*Totals are the amount mapped in the survey units, not the projected acres of impact for the project (Siegle and Ahlers 2017).

For the cuckoo, map units with classifications of suitable, unsuitable, and non-habitat were assigned to the river reach at the project area. Within the entire BDA Reach, 1,052 acres of suitable habitat were available to this species in 2016. The majority of the area within the reach was considered unsuitable at 1,926 acres and 773 acres were considered non-habitat. The project area covers a subset of this reach and captures 5 of the survey units from the mapping effort with appropriate acreage provided on the following table.

Table 5: Vegetative survey units at BDA in the project area by cuckoo suitability class and acreage.

Map Survey Unit	Suitable Class	Unsuitable Class	Non-habitat
BA-5	71 acres	217 acres	40 acres
BA-6S	53 acres	41 acres	17 acres
BA-7	103 acres	176 acres	69 acres
BA-9	222 acres	114 acres	19 acres
BA-10	239 acres	13 acres	34 acres
Total*	**688 acres**	**561 acres**	**179 acres**

*Totals are the amount mapped in the survey units, not the projected acres of impact for the project (Siegle, Ahlers, and Dillon 2018).

Nearby vegetation ranges from patches of monotypic saltcedar in drier open areas, to mature Goodding's willow and Rio Grande cottonwood in moist or flooded soils. Surveys for both species have resulted in detections of flycatcher individuals and nesting pairs, and cuckoo detections that indicate possible nesting territories in the riparian vegetation at the project site.

Rio Grande Silvery Minnow

The silvery minnow is a federally and state listed endangered fish species. The species currently occurs in only 7% of its former geographic range and now exists as four fragmented sub-populations in four reaches of the Rio Grande that are separated by dams: 1) Cochiti Reach, 2) Albuquerque Reach, 3) Isleta Reach, and 4) San Acacia Reach. The silvery minnow was listed as endangered in 1994 due to habitat loss, declining abundance, and because the species could be expected to become extinct in the foreseeable future due to continued threats to the species and its habitats.

Critical habitat was designated on February 19, 2003 (Service 2003). The critical habitat designation extends from Cochiti Dam downstream to the utility line crossing the Rio Grande upstream of the Elephant Butte Reservoir delta in Socorro County, excluding all pueblo lands. Thus, the project area occurs within the critical habitat designation.

The silvery minnow is a moderate-sized minnow that reaches 3.5 inches in total length (Sublette et al. 1990). The species spawns in the late spring and early summer, coinciding with high spring snowmelt flows (Sublette et al. 1990, Dudley et al. 2017). The silvery minnow is omnivorous feeding on diatoms and invertebrates (Shirey et al. 2008, Magaña 2007, Watson et al. 2009). Silvery minnow travel in schools and tolerate a wide range of habitats (Sublette et al. 1990), but generally prefer low-velocity areas (<0.33 feet per second) over silt or sand substrate that are associated with shallow (<15.8 inches) braided runs, backwaters, or pools (Dudley et al. 2017). Habitat includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Stream reaches dominated by straight, narrow, incised channels with rapid flows are not typically occupied by silvery minnow (Bestgen and Platania 1991).

The silvery minnow produces semi-buoyant eggs (Platania and Altenbach 1996), which have been observed both in main river channel habitat (Platania 1995) and backwater and slower velocity floodplain habitats (Gonzales et al. 2014). The silvery minnow typically spawns during late spring and early summer, coinciding with high spring snowmelt (Dudley et al. 2017). Eggs hatch in 2 to 3 days, and the larvae may drift in the main channel (Platania and Altenbach 1998) or remain in low-velocity areas (Gonzales et al. 2014). Shallow, low- velocity areas formed on inundated floodplains may provide nursery habitat for the silvery minnow, as these habitats provide forage (periphyton) and cover (debris and emergent vegetation) for both larval and adult fish (Porter and Massong 2004; Gonzales et al. 2014). The creation of nursery habitat by lowering banklines and creating secondary channels into previously isolated floodplain habitats has been a major habitat restoration goal in the MRG (Porter and Massong 2004, Gonzales et al. 2014). Natural flow regimes, movement within the limited remaining range, and the availability of diverse habitats are important to completion of the life cycle.

The silvery minnow population has fluctuated widely since monitoring for the species began (Dudley et al. 2017). The abundance of the species appears to be closely related to the timing, magnitude, and duration of river flows during spring and summer (Dudley et al. 2017).

Prolonged and elevated spring flows result in overbank flooding of vegetated areas both within the river channel and along the river margins. These conditions delay the onset of low flows during summer irrigation season and help to ensure the availability of productive nursery habitats during spring runoff, which result in successful recruitment for the species (Dudley et al. 2017).

Southwestern Willow Flycatcher

The Southwestern Willow Flycatcher (Empidonax traillii extimus; flycatcher), a federally endangered species, is a small passerine bird and is one of 11 flycatchers in the genus Empidonax (Family Tyrannidae) breeding in North America and is one of four subspecies of the flycatcher currently recognized (Service 2002). The historical breeding range for the species included southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico, but the quantity of suitable habitat within that range is much reduced from historical levels (Service 2002). The flycatcher may inhabit areas from near sea level to over 8,500 feet, but it is primarily found in lower elevation riparian habitats. As of the 2012 breeding season, there were approximately 1,629 territories rangewide (Durst 2017). In the middle Rio Grande Basin of New Mexico 302 territories were found during the 2017 breeding season. In the 'Bosque del Apache Reach', which is defined as the area from the north boundary of the Bosque del Apache National Wildlife Refuge downstream to the southern boundary of the refuge and includes the project site, a total of 16 territories were found in 2017 (Moore and Ahlers, 2017 In Press).

The primary cause of the flycatcher's decline is loss and modification of its riparian nesting habitat, which tends to be uncommon, isolated, and widely dispersed. With increasing human populations and the related industrial, agricultural, and urban development, these habitats have been modified, reduced, and destroyed by various mechanisms (Service 2002). Riparian ecosystems have declined from reductions in water flow, interruptions in natural hydrological events and cycles, physical modifications to streams, modification of native plant communities by invasion of exotic species, grazing, and direct removal of riparian vegetation. Wintering habitat has also been lost and modified for this and other neo-tropical migratory birds (Service 2002).

The flycatcher usually breeds in patchy to dense riparian habitats along streams or other wetlands, near or adjacent to surface water or in areas underlain by saturated soil (Service 2002). General characteristics of flycatcher habitat usually consist of dense vegetation or an aggregate of dense patches interspersed with openings that create a mosaic. In almost all cases, slow moving or still surface water and/or saturated soil are present at or near breeding sites during wet or non-drought years.

Nest sites typically have dense foliage from the ground level up to approximately 13 feet above ground and have a dense canopy (Service 2002). The flycatcher nests in native vegetation such as willows or box elder, where available, but has also occasionally nested in non-native species (Service 2002). The flycatcher's riparian habitats are dependent on hydrological events such as scouring floods, sediment deposition, periodic inundation, and groundwater recharge for them to become established, develop, be maintained, and ultimately to be recycled through disturbance (Service 2002).

Flycatchers, a neo-tropical migrant, spend only three to four months on their breeding grounds. The remainder of the year is spent on migration and in wintering areas south of the United States

(Service 2002). The flycatchers typically arrive on breeding grounds between early May and early June and establish breeding territories that range in size from approximately 0.5 to 1.5 acres (Service 2002). This species builds a small open cup nest, constructed of leaves, grass, fibers, feathers, and animal hair. In general, a new nest is built every year (Service 2002). Typical nest placement is in the fork of small-diameter vertical branches at a height of 1.6 to 60 feet, usually lower than 20 feet above ground. Incubation begins after the last egg is laid and lasts 12 to 13 days (Service 2002).

Most eggs in a nest hatch within 48 hours of each other and the female provides most of the initial care of the young. Nestlings fledge 12 to 15 days after hatching. Fledglings typically stay in the general nest area a minimum of 14 to 15 days (Service 2002). Second clutches within a single breeding season are uncommon if the first nest is successful. Most attempts at re-nesting occur if the young fledge from the first nest by late June or very early July. Re-nesting is regularly attempted if the first nest is lost or abandoned due to predation, parasitism, or disturbance; a female may attempt as many as four nests per season (Service 2002). Replacement nests are built in the same territory. Adults that are successful in raising young may remain at breeding sites through mid-August to early September. Pairs with unsuccessful first, second, or both nests sometimes abandon their territories midway through the breeding season (Service 2002).

The flycatcher is an insectivore, catching insects while flying, hovering to glean them from foliage or capturing insects on the ground. Wasps and bees (Hymenoptera) are common food items, as are flies (Diptera), beetles (Coleoptera), butterflies/moths and caterpillars (Lepidoptera), and spittlebugs (Homoptera) (Service 2002). Predation of flycatcher eggs and nestlings is documented for several species of snakes and birds, raccoons, cats, and foxes. The species also experiences brood parasitism by the brown-headed cowbird (Molothrus ater), which lays its eggs in the nests of other species (Service 2002). The “host” species then incubate the cowbird’s eggs and raise the young. Because cowbird eggs hatch after relatively short incubation and hatchlings develop quickly, they often out-compete the host’s own young for parental care (Service 2002). Cowbirds may also remove eggs and nestlings of host species from nests or injure nestlings in nests, thereby typically acting as nest predators.

In both the final 2005 critical habitat designation (70 CFR 60886) as well as the most current final designated critical habitat from 2013 (Service 2013), the Service identified two Primary Constituent Elements (PCEs) that were recognized as the physical or biological features essential to the conservation of the flycatcher. Those PCEs are as follows:

PCE 1—Riparian Vegetation

Riparian habitat in a dynamic river or lakeside, natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (that can include Gooddings willow, coyote willow, Geyers willow, arroyo willow, red willow, yewleaf willow, Pacific willow, boxelder, saltcedar, Russian olive, buttonbush, cottonwood, stinging nettle, alder, velvet ash, poison hemlock, blackberry, seep willow, oak, rose, sycamore,

false indigo, Pacific poison ivy, grape, Virginia creeper, Siberian elm, and walnut) and some combination of:

a. Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 2–30 m (about 6–98 ft). Lower-stature thickets (2–4 m or 6–13 ft tall) are found at higher elevation riparian forests, and tall-stature thickets are found at middle and lower-elevation riparian forests,

b. Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 ft) above ground or dense foliage only at the shrub or tree level as a low, dense canopy.

c. Sites for nesting that contain a dense (about 50–100%) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground).

d. Dense patches of riparian forests that are interspersed with small openings of OW or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 ha (0.25 acre) or as large as 70 ha (175 acre).

PCE 2—Insect Prey Populations

A variety of insect prey populations found within or adjacent to riparian flood plains or moist environments, which can include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

Western Yellow-billed Cuckoo

The western yellow-billed cuckoo (Coccyzus americanus occidentalis), a federally threatened species, is one of two subspecies of Yellow-billed cuckoo currently recognized in the United States (Service 2014b). The historical breeding range for the species began in southwestern British Columbia and was generally west of the Continental Divide of the U.S. through the southern Rockies into New Mexico. The line then diverges from the Continental divide and follows the divide between the Rio Grande and Pecos River Basins in New Mexico and continues to the U.S.-Mexico border in the Big Bend Area of Texas (Service 2014b). Currently the species no longer breeds in Western Canada and the Northwestern U.S. The proposed critical habitat was posted on the Federal Register in August of 2014 (Service 2014c) and did not include the Pecos watershed. The boundary between the Eastern and Western Distinct Population Segment (DPS) in New Mexico is along the Eastern edge of the Rio Grande, making the population along the Pecos considered the Eastern population segment.

The cuckoo is a neotropical migratory bird of about 12 inches long. They are slender, long-tailed birds with white spots on the underside of their tail feathers, a white breast, brown backs and a long, curved, mainly yellow bill.

During the past 80 years, the population of western cuckoos have declined dramatically due to habitat loss and modification as well as a reduction of food resources due to pesticides (Gaines and Laymon 1984). The current population of cuckoos within the Bosque del Apache Reach along the middle Rio Grande in New Mexico (between the northern and southern boundaries of the National Wildlife Refuge) consists of 13 estimated territories (Dillon et al. 2017).

Cuckoos are neotropical migrant birds that arrive to the western United States in June and depart for their winter range towards the end of August. Not much is known about the winter range of the cuckoo. Based on the single cuckoo that was affixed with a geolocator and recaptured on the Rio Grande, it appears that it overwintered in eastern Bolivia, southwestern Brazil, Paraguay and northeastern Argentina (Sechrist et al. 2012). Cuckoo's nest in low to moderate elevation riparian woodlands that cover 50 acres or more within arid to semiarid landscapes (Hughes 1999).

In the Southwestern United States, cuckoo's nest in large, dense patches of riparian vegetation, particularly with a Rio Grande cottonwood and/or Goodding's willow overstory (Ehrlich et al. 1988). A dense understory, comprised of exotic saltcedar, Russian olive (Elaeagnus angustifolia) or native vegetation (e.g. Salix spp.) also appear to be an important component for territory establishment (Sechrist et al. 2009). In New Mexico, home range estimates for cuckoos within portions of the Rio Grande varied from 5 to 282 ha and averaged 82 ha based on their minimum convex polygon (MCP) (Sechrist et al. 2009). Nest heights range from 1.3 to 13 meters and nests are made up of loose twigs arranged in a shallow platform. The breeding cycle at each nest is very rapid, for example the time from egg laying to fledging takes approximately 17 days (Halterman 2001). Cuckoos typically lay between 3 and 4 eggs and they are a greenish-blue color. Incubation can occur by both male and female, and both male and female (and sometimes a 'helper juvenile male') will tend to the young.

The US Fish and Wildlife Service recently released a proposal for critical habitat for cuckoos in August 2014 (Service 2014c). Proposed critical habitat in New Mexico include areas along the Rio Grande, San Juan River, San Francisco River, Gila River and Mimbres River.

The US Fish and Wildlife Service identified 3 Primary Constituent Elements (PCE's) for the cuckoo that are listed as follows:

PCE 1 - Riparian Woodlands

Riparian woodlands with mixed willow-cottonwood vegetation, mesquite-thorn forest vegetation, or a combination of these that contain habitat for nesting and foraging in contiguous or nearly contiguous patches that are greater than 325 ft (100 m) in width and 200 ac (81 ha) or more in extent. These habitat patches contain one or more nesting groves, which are generally willow dominated, have above average canopy closure (greater than 70 percent), and have a cooler, more humid environment than the surrounding riparian and upland habitats.

PCE 2 - Adequate prey base

Presence of a prey base consisting of large insect fauna (for example, cicadas, caterpillars, katydids, grasshoppers, large beetles, dragonflies) and tree frogs for adults and young in breeding areas during the nesting season and in post-breeding dispersal areas.

PCE 3 - Dynamic riverine processes

River systems that are dynamic and provide hydrologic processes that encourage sediment movement and deposits that allow seedling germination and promote plant growth, maintenance, health, and vigor (e.g. lower gradient streams and broad floodplains, elevated subsurface groundwater table, and perennial rivers and streams). This allows habitat to regenerate at regular intervals, leading to riparian vegetation with variously aged patches from young to old.

Socio-Economic

3.2.11 Indian Trust Assets

Indian Trust Assets (ITA) are legal interests in assets held in trust by the United States Government for Native American tribes or individuals. Some examples of ITA are lands, minerals, water rights, hunting and fishing rights, titles, and money. ITA's cannot be sold, leased, or alienated without the express approval of the U.S. Government. Secretarial Order 3175 and Reclamation ITA policy require that Reclamation assess the impacts of its projects on ITA. An inventory of all ITA within the proposed project area is required. If any ITAs are impacted, mitigation or compensation for adverse impacts to these assets is required. ITAs were not identified in the project area.

3.2.12 Environmental Justice

EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," directs all federal agencies to develop strategies for considering environmental justice in their programs, policies, and activities. Additionally, the Council on Environmental Quality has issued the "Environmental Justice Guidance under the National Environmental Policy Act (NEPA)" to further assist federal agencies with their procedures under NEPA. Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no groups of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations of the execution of federal, state, local, and tribal programs and policies (EPA 2018). No known socio-economic impacts are associated with the ongoing project work.

Compared to the demographics in the state of New Mexico, Socorro County has a slightly greater percentage of persons living below the poverty level by 1.6%, and a greater Native

American and Hispanic population, by approximately 3% and 1.6%, respectively (Commerce 2017). The nearest Census Designated Places to the project are a small agricultural community named San Antonio CDP with a population of 46 and the city of Socorro with a population of 7,492. San Antonio is predominantly White (not Hispanic) 78.3% and 21.7% Hispanic, while the city of Socorro is predominantly Hispanic 56% (Commerce 2017).

3.2.13 Cultural Resources

Cultural resources include archaeological sites, sites eligible for the State Register of Cultural Properties and/or the National Register of Historic Places (NRHP), and properties of traditional religious or cultural importance (traditional cultural properties [TCPs]). The indigenous population in the Rio Grande valley of New Mexico dates back at least 12,000 years (Cordell 1997:67–68). The steady influx of peoples of European descent into the Rio Grande valley of present-day New Mexico from the sixteenth century onward has given rise to a diverse cultural mosaic and has left a multitude of varied cultural resources that are more than 50 years old throughout the state. The state was part of the Spanish Colonial Empire until Mexico won its independence in 1821. Twenty-five years later, in 1846, New Mexico was claimed by the United States. These successive cultures have left archaeological sites (habitation, mining, industrial, and other), standing structures, bridges, utilities, and a network of irrigation canals and acequias more than 50 years old (Arrowsmith 1963; Cordell 1997:67–68; Rivera 1998; Van Citters 2003).

However, archaeological resources in the Rio Grande floodplain are limited because of poor preservation, the result of flooding episodes, periodic fire, and a long history of agricultural use of the valley floor prior to the existence of a preservation ethic.

Reclamation conducted a search in the Archaeological Records Management Section (ARMS) and found no recorded sites within the proposed project site. This project will occur entirely on the active floodplain. No cultural resources were identified in the floodplain. LA-8743, LA-54005, LA-54006, LA-54007, LA-54009, LA-80057, and LA-158871 are within 200 meters of the project area and on the bench above the project floodplain.

If cultural resources are encountered during site construction, work would be halted immediately and the Reclamation Area Archaeologist, will be notified immediately. Work would recommence only after the necessary cultural resource clearance had been received.

4 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This section is an evaluation of the potential environmental effects of the Proposed Action and the No Action Alternative. This analysis includes likely beneficial and adverse effects on the human environment, including those that are short term or long term, direct or indirect, and cumulative. More detailed consideration is given to those resources that have a potential for environmental effects.

4.2 Predicted Effects on Each Relevant Issue and Resource

Physical Resources

4.2.1 Land Use

Under the Proposed Action, land use would not change. The project area will have a change in vegetation structure but will remain a floodplain riparian community. Minor foot traffic may occur in the post construction area due to the removal of dense vegetation but due to the general remote nature of this area this should be nonexistent to minimal. Once the new channel is constructed foot traffic will be limited due to the introduction of water into the realignment area. Existing visitation use is not expected to change appreciably. Public usage may be interrupted episodically due to daily construction traffic. This interruption cannot be predicted as use is low and intermittent. Measures that would be taken during construction work (to minimize temporary public use impacts) include the following: Place construction warning signs on roads, access points, or other key points affected by project related construction activities. Maintain the dirt roads through blading, wetting, placement of gravel cap, etc. to ensure that the existing dirt road conditions are maintained or improved.

A review of the New Mexico Department of Game and Fish 2017-2018 New Mexico Hunting handbook shows that this area is within GMU 20. This GMU has a two-week Deer Archery season from January 1-15. Work in the fall and winter could impact this and other hunting seasons. Hunters who come into the area may be impacted near the eastside access road due to temporary blockage by equipment or equipment traveling in or out. Generally, this would be minor as the public is not allowed to travel this road with vehicles once entering the refuge. The road is used for foot or bicycle travel only. They may also have game species temporarily disturbed due to construction noise along the road and the realignment corridor.

As these impacts are temporary in nature, with interruptions along the road with equipment traffic and short-term noise impacts that may displace game species during work periods the impacts are not considered significant due to the temporary nature. Where needed warning signs will be placed along the access road advising visitors using the area that construction work and traffic may be ongoing.

Under the No Action Alternative land use would not change and there would be no direct impacts due to construction. If a new sediment plug forms in the future, impacts to the river channel would occur and if the plug is removed construction impacts would also occur.

4.2.2 Water Quality

The No Action Alternative and Proposed Action would not result in negative changes to water quality where it currently meets applicable standards for physical constituents, such as surface water temperature, pH, turbidity, DO, SSED, conductivity/TDS, and fecal coliform. There would be temporary and localized change in turbidity and TDA under the Proposed Action

because of the mobilization and dispersal of sediments within the river channel during excavation work.

The Clean Water Act (CWA) provides protection for wetlands and waters of the United States from impacts associated with dredged or fill material in aquatic habitats, as defined under Section 404(b)(1). CWA compliance is required of all aspects of the Project and since most work associated with the Proposed Action would be completed within jurisdictional areas, a 404 permit from the USACE and 401 water quality certification from the State of New Mexico are required. Compliance with the CWA would ensure that the Proposed Action would have no adverse effect on the water quality of the MRG. Water quality would be monitored and evaluated for the duration of the Project.

Construction of the inlet and outlet and filling of the main channel will result in localized changes in the measures for physical constituents, particularly for turbidity and TDS, because of the mobilization and dispersal of sediments within the river channel. The new 300-foot channel will also create temporary impacts to water quality due to the bed being composed of more organic material from the mulching and grubbing and silt than the current sandy river bed, when it is exposed to the new flows after the new channel is connected to the existing river channel. This new bed condition is expected to only last a matter of weeks or a little more than a month as new sandy sediment is deposited converted the bed to a condition like the old river channel bed. As described in the geomorphology section, downstream impacts from erosion should be less under the new realignment as compared to the elevated riverbed and plug conditions. This new channel bed will replace a portion of the existing riverbed which is also generally lacking in vegetation and subject to erosion and sediment transport during higher flows. When the channel is opened and water flows into and through the realigned channel there will be immediate and temporary changes to water quality. These changes are all within parameters of the Rio Grande during runoff and monsoon seasons. Monitoring of water quality will be conducted to measure the impacts of the project implementation. Depending on the upstream flows and sediment loads that enter the reach after construction, bed elevation adjustments more than two or three years after construction should be relatively small and comparable to other reaches in the immediate area. Short-term and localized adverse effects to water quality may result but are not expected to exceed applicable standards. The high-volume flows would be expected to dilute the effects of added sediment load on water quality.

Best Management Practices (BMPs) shall be used during construction; see, Section 5 "Environmental Commitments/ Best Management Practices."

Applications for the CWA Section 404 permit and Section 401 water quality certification have been submitted to the Corps' Albuquerque District and the NMED (see Appendix 10.1), in compliance with the Clean Water Act, which prohibits the discharge of dredged or fill material into waters of the United States without a permit (Corps 2014) (NMED 2012). All permit conditions will be adhered to and no work would be conducted that requires a CWA permit or water quality certification until they have been issued. Meeting the final requirements outlined in

the Section 404 permit and 401 water quality certification would also serve to minimize any negative effects on water quality.

Under the No Action Alternative, water quality would not be impacted or change from existing conditions.

4.2.3 Groundwater

Once the pilot realignment occurs the groundwater-surface water interaction is expected to change. The realignment will lower the riverbed through some of this reach. Along most of the reach, the realignment bed elevation will be very similar to the existing channel and it is primarily the top of banks that will be lower. This realignment will also move the river east away from the current perched channel location.

The groundwater (GW) on the west side of the Rio Grande will be affected by the realignment more so than the GW on the east side. Since the riverbed elevation is going to be lowered through some of the reach and moved east away from the LFCC, it is expected that the GW gradient to the west towards the LFCC will be reduced. A corresponding drop in groundwater elevation on the west side is expected after the realignment. Figure 17 is a rough estimate of the GW gradient before and after the realignment based on GW flow from the existing/new channel to the LFCC. It should be noted that the existing GW gradient between the river and LFCC assumes that the river is wet. During low flow years (e.g., 2018) when the river goes dry for several months and for many miles north, the groundwater is below the bed elevation of the existing channel.

Groundwater that flows east from the river channel after the realignment will not be affected as much as the GW flowing west. The GW gradient should not deviate much from the existing gradient due to the lack of influential drainage, such as the LFCC on the west side. The GW elevation between the existing perched channel and the realigned channel could slightly drop and the GW gradient could be marginally less steep. This is due to the potential surface water elevation decrease after the realignment, which will cause the GW elevation to decrease as well. The groundwater table on the east side of the river will increase or decrease in elevation with the increase or decrease of the Rio Grande surface water elevation. Groundwater connection between the river and adjacent floodplain is expected to improve with the realignment, with a smaller distance between the top of banks and the water table. This change in groundwater may have beneficial and/or negative impacts to existing vegetation and wetlands, and in the long term contribute to future growth of new vegetation and wetlands.

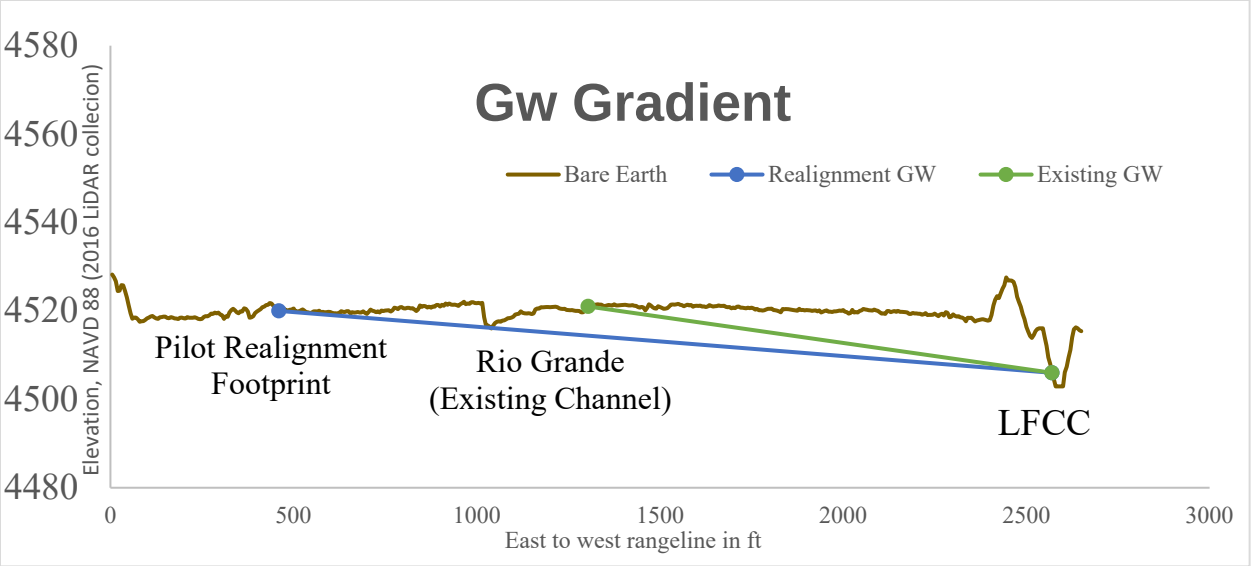


Figure 17: Expected GW gradient change before and after the realignment. Existing ground (bare earth) is 2016 LIDAR data from Reclamation. All distances and elevations are generalized. View is looking downstream.

4.2.4 Air Quality and Noise

Under the Proposed Action alternative, noise and air quality would undergo short-term minor impacts for the duration of the project. There would be limited exhaust, dust, and noise from the machinery used during construction. No homes or other facilities are near the project construction area. The RAW's data presented in Section 2 Affected Environment indicates that the predominant wind directions are from the north, pushing dust downstream. The second most frequent directions are from the south and southwest. This would push dust upstream and to the northeast. This is particularly true during the short periods of time where the highest measured winds blow from the south and southwest.

During construction, equipment will travel on unpaved roads which will create dust conditions subject to winds. Small particles below a PM10 size would remain in the air column longer than heavier dust particles allowing them to move beyond the immediate work zone. Additional soil will be exposed to wind action and mechanical disturbance in the following areas: during the removal and mastication of vegetation on the current flood plain, bare soil stored in staging areas and the final placement of the fill materials in the floodplain conversion zone (former channel). Some newly cleared areas will be left bare to allow higher flows to inundate these areas and allow the re-establishment of riparian vegetation over a period of 3-5 years. Eventually these areas will revegetate, and the soils would then be stabilized.

There would be no permanent or long-term impacts to the Class 1 Area. The project area comes within 500 feet of the San Pascual Wilderness boundary, a Class 1 Area. Dust particles that are small will be mobilized by construction activities and bare soil areas subject to wind. These particles could travel beyond the work area and into the Class 1 Area. Since this impact is small

in nature and temporary this will not impair the Class 1 Area air quality to the level that it would become a regulated activity. Because constituents that cause haze such as PM10 particles would not have a permanent long-term duration this project will not impair the protected Class 1 Area.

The RAW's data indicates that the predominant wind directions are from the north, pushing dust downstream. The second most frequent directions are from the south and southwest. This would push dust upstream and to the northeast. This is particularly true during the short periods of time where the highest measured winds blow from the south and southwest.

As best management practices and part of the environmental commitments Reclamation will utilize water trucks to help control fugitive dust from the access roads used to access the work site. Thus, the Proposed Action would result in a temporary but negligible impact on air and noise quality.

Under the No Action Alternative, air quality and noise would remain the same as current conditions.

4.2.5 Geomorphology

The realignment design attempts to work with the river's geomorphic and historical tendencies by creating a channel avulsion, which historically allowed the Rio Grande to convey water downstream when the channel became perched and/or plugged, an ineffective geometry for transporting water and sediment. The overall philosophy is to remove unnecessary constraints and allow for the natural riverine processes of channel migration, deposition, and flooding. It is not a project goal to maintain the newly constructed channel dimensions, but to allow for channel adjustment while reducing negative impacts to infrastructure and water delivery. Biron et al. (2014) discuss how providing "freedom space" for these hydro-geomorphic processes is a more sustainable approach to river management compared to traditional methods (e.g., bank stabilization, channelization, levees). The proposed realignment increases the average distance between the river and the western spoil levee from about 1,000 feet to about 2,300 feet increasing the available space for future channel and floodplain adjustments (Holste 2017).

Freedom space is essential to support the project goal of effectively transporting water and sediment. A confined channel in a depositional reach will have sediment deposition concentrated to the main channel and banks rather than providing opportunities for sediment storage throughout the floodplain. The confined or fixed channel location has increased perching in the existing river, thereby decreasing sediment transport and water delivery. The realigned channel will have an improved connection to the floodplain and ability to migrate, which increases both short-term and long-term water delivery. The floodplain connection and ability to migrate is especially important for long-term sustainable water delivery because the channel will need to adjust to changes in upstream hydrology and sediment loads while minimizing the tendency to become perched.

Habitat conditions are expected to improve as moving the river further from infrastructure provides increased opportunities for geomorphic processes to revitalize certain aspects of the

historical environment. Over the longer term (10 or 20 years), the variable flow and habitat conditions initially created by the realignment are expected to trend toward a more uniform channel that is similar to the existing planform and width. This does not mean that it will take 10 or 20 years for a channel to become established, but that variability in the initially constructed channel is expected to decrease as the realignment channel becomes more uniform over time. The realignment will have a greater ability to transport water and sediment than the existing channel on the first day after construction because the channel will no longer be perched. River maintenance needs, such as effectively transporting water and sediment to Elephant Butte Reservoir, are also addressed by reducing the need for dredging of pilot channels.

There is typically a large degree of uncertainty when estimating future river adjustments, and channel response is largely dependent on future hydrology and sediment loads. State-of-the-art design methods, modeling, and analysis tools were used in the development of this project, but they are only simplifications of a complicated, multi-dimensional physical process. Therefore, precise quantitative predictions are not appropriate given the variability, complexity, and uncertainty associated with the Rio Grande and fluvial systems in general.

The planform morphology of the realignment is expected to vary significantly during the first 10 years after construction, with the potential to approach some equilibrium condition after 10-20 years depending on hydrology and upstream sediment loads. The upstream and downstream portions of the constructed channel are not likely to be substantially different from the current channel within the project area. The excavated widths and depths of the constructed realignment inlet and outlet will facilitate a transition between the existing channel and the middle of the realignment. Surfaces at multiple elevations will be excavated in the new channel to provide effective sediment transport over a range of flows. The constructed cross section shape at the inlet and outlet areas will be relatively uniform, but complexity will increase after flow is introduced and preferential erosion and deposition occurs.

Constructed inlet and outlet areas will have a slightly steeper slope, and significantly greater depth, than in the middle of the project where excavation will be limited. This non-inlet/outlet area (about 1 mile long) has the greatest potential for developing a wide braided channel, or a network of multiple distributary channels. The initial combined width of the braided flow paths in this area may be 500 to 600 ft for locations where exotic vegetation is cleared adjacent to the 300-ft realignment corridor. The overall channel width is expected to narrow incrementally each year because of vegetation encroachment until it approaches the width of the upstream reaches over the longer term (10 – 20 years). Initially, the cross-section low point in the upper to middle portion of the project will often be at the toe of the east mesa. Therefore, flows that overbank the primary 300-ft realignment corridor will be conveyed along the east mesa toe, similar to flows that currently overbank the channel to the east. Vegetation clearing is not planned along the east mesa toe, so deposition is expected that will redirect flows to cleared areas near the center of the floodplain. Although the realignment provides opportunities for a wide braided channel or a distributary channel network, the project does not change the fundamental drivers of flow and sediment supplied from upstream. Given that the existing river has narrowed to a single thread channel, the realignment project will likely have a similar tendency over time. An important

difference is that the existing channel is constrained by its proximity to the spoil levee, while the realignment will have more freedom to adjust and accommodate flood events.

The anticipated planform adjustment described above is related to sediment movement through the realigned channel. About 2,000 ft downstream from the start of the realignment, the channel will become shallower and less confined. Flow will spread out in this wide shallow area and the sediment transport capacity will be reduced. A reduction in sediment transport capacity means that not all of the sediment supplied from upstream will be conveyed downstream, resulting in deposition. Initial deposition in the upper to middle portions of the realignment will have the effect of reducing sediment delivery downstream of the project. Reduced downstream sediment delivery has the potential to temporarily increase erosion downstream. The duration and magnitude of potential upstream deposition and downstream erosion is more a function of hydrology and is not a function of time. In a high flow year or wet hydrology scenario, almost all bed elevation changes would occur within the first year after construction. If a series of average to dry flow years occur after construction, bed elevation changes would be incremental (e.g., 1 ft of downstream erosion within the first year and an additional 1 to 2 ft of erosion in years 2 to 10 before approaching the existing channel elevation). Sediment discontinuity and imbalances within the realignment are expected to be most severe shortly after construction and will decrease over time due to channel adjustments (Holste 2017).

For example, expected deposition in the upper to middle realignment area would increase the local slope, thereby increasing sediment transport capacity. If a braided channel develops, the individual flow paths would also have increased transport capacity. In turn, this would increase or restore sediment delivery to the lower portion of the realignment and the existing channel downstream of the project. Over time, adjustments within the realignment channel will naturally attempt to balance the water and sediment delivered from upstream with what is conveyed through the project reach. Rates of sediment transport through the realignment will eventually exceed the rates through the existing, non-plugged channel. Floodplain surface material is variable in the realignment area, but typically has a high percentage of cohesive silt and clay (unpublished data). The realignment bed material is expected to transition to sand over a relatively short time period given the sand load supply from upstream and the predicted areas of deposition within the realignment (Holste 2017).

Upstream of the project, sediment modeling confirms that minimal changes to the existing channel are expected as a result of the realignment (Holste 2017). Primary causes of bed elevation change are the upstream water and sediment discharge and the downstream base level elevation (Knighton 1998). The realignment project does not change any of these factors, so there would be no reason for the project to cause a change to the upstream channel. The constructed realignment thalweg (invert) profile will be similar to the existing channel bed elevation, and the initial deposition expected in the realignment would also serve as a temporary control of the upstream bed elevation.

Downstream of the project, the effects of the realignment channel will depend on if the comparison is made to the existing channel without a plug, or the existing channel with a plug. If

the comparison is to the non-plugged existing channel, the realignment is expected to result in some erosion due to decreased sediment delivery as explained above. This effect would be most noticeable shortly downstream of the realignment outlet and would diminish at greater downstream distances. If the comparison is to the plugged existing channel, the realignment is expected to result in less downstream erosion. Considering the principles of sediment continuity, the realignment channel is expected to deliver more sediment downstream than what would occur with a plug in the existing channel. A sediment plug was not modeled for this study, but Tetra Tech (2010) documents the erosion that was measured downstream of the 2008 sediment plug. For all scenarios, the potential for downstream degradation would be mitigated by an increase in the Elephant Butte Reservoir pool elevation (Holste 2015).

Under the No Action Alternative, the current geomorphic trends would be expected to continue. The most important geomorphic trends in this reach are channel narrowing, vegetation encroachment, increased uniformity, channel plugging with sediment, and channel perching (Holste 2014a). Multiple sediment plugs would be expected in the future. If the plugs were removed (such as with pilot channel excavation) prior to a levee breach, the river would essentially return to pre-plug conditions and the cycle begins again. If a levee breach occurred, there would be water delivery losses, damage to BDA infrastructure, and a likely avulsion of the Rio Grande into the LFCC (such as downstream of RM 60). The effects of a plug become more similar to a dam across the river the longer that a plug remains in place. Downstream erosion increases because the plug cuts off sediment supply in the river flow, and there is no continuous channel at low flows likely causing fish habitat connectivity issues. For example, the 1995 plug remained for over a year causing degradation at San Marcial through September 1996 until the plug was removed and the bed elevation recovered. Unsafe working conditions and environmental compliance requirements may prevent a plug from being quickly removed and dependent on lower flows.

4.2.6 Water Delivery

The realignment will reduce the seepage gradient between the river and the LFCC as shown in Figure 17 above. Groundwater flow is proportional to this gradient as calculated by Darcy's Law, so a 50% reduction in seepage gradient has the potential to reduce seepage losses by about 5,500 acre-ft per year.

Transpiration is another important process that causes water loss from the river system. Vegetation removal that is part of realignment construction is expected to result in about 1,000 acre-ft per year of water savings, but this would be lower as new vegetation grows.

Holste (2019) analyzed the realignment effects on inundated area and OW evaporation. The report is attached in the appendices and is summarized here. LiDAR data flown on October 1, 2016, was used as the basis to create four topographic surfaces: existing conditions, existing conditions with a sediment plug, Realignment Design 1, and Realignment Design 2. A two-dimensional (2D) numerical model simulated the hydraulics for a range of flows with each

topographic surface. All modeling assumed a fixed bed and did not incorporate future geomorphic changes to the existing or realigned channels.

The primary result from the 2D model was determining inundated area for the range of flows and topographic surfaces. Only the inundated area beyond a 600-ft wide corridor (centered on the midline of the river) was included in the evaporation analysis based on guidance from NMOSE (2011). The computed evaporation volumes do not include seepage and transpiration. An OW evaporation rate was applied to the inundated area to estimate annual and monthly OW evaporation for existing conditions and the realignment design conditions. Two calculation methods and two evaporation rates were used to explore the sensitivity of the predicted evaporation volumes.

Figure 18 shows the inundated area at various flows that correspond to the four modeled topographic surfaces. The largest increase of inundated area is caused by a sediment plug in the channel, which substantially increases the inundated area at flows less than about 2,000 cfs. These flows would generally be confined to the main channel if there were no plug. There are four notable ranges of flows that are useful to consider when comparing the existing channel to the realignment design:

- **Less than 600 cfs:** realignment has small increase of inundated area
- **600 to 1,800 cfs:** realignment has moderate increase of inundated area
- **1,800 to 2,200 cfs:** realignment and existing channel have about the same inundated area
- **More than 2,200 cfs:** realignment has significant decrease of inundated area

OW evaporative losses are a function of the inundated area and the OW evaporation rate, which varies seasonally. Inundated area differences between the existing channel and the realignment are most significant at flows in the range of 600 to 1,800 cfs, and at flows above 2,200 cfs. The medium range flows have an increase of inundated area of about 150 acres for the realignment compared to the existing channel. The high flows have a decrease of about 250 acres of inundated area for the realignment compared to the existing channel. Figure 19 shows the monthly frequency of these flow ranges. The medium flows occur most frequently during the winter, while the high flows occur most frequently during the spring and early summer. Flows with the largest increase of inundated area typically occur during the winter months when evaporation and transpiration rates are low, and therefore don't result in large evaporative losses.

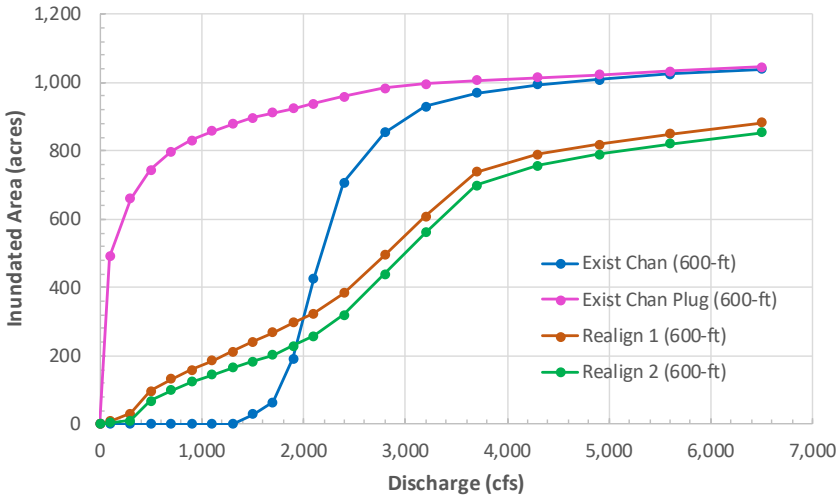


Figure 18: Inundated area beyond 600-ft channel corridor for various flow and geometry scenarios.

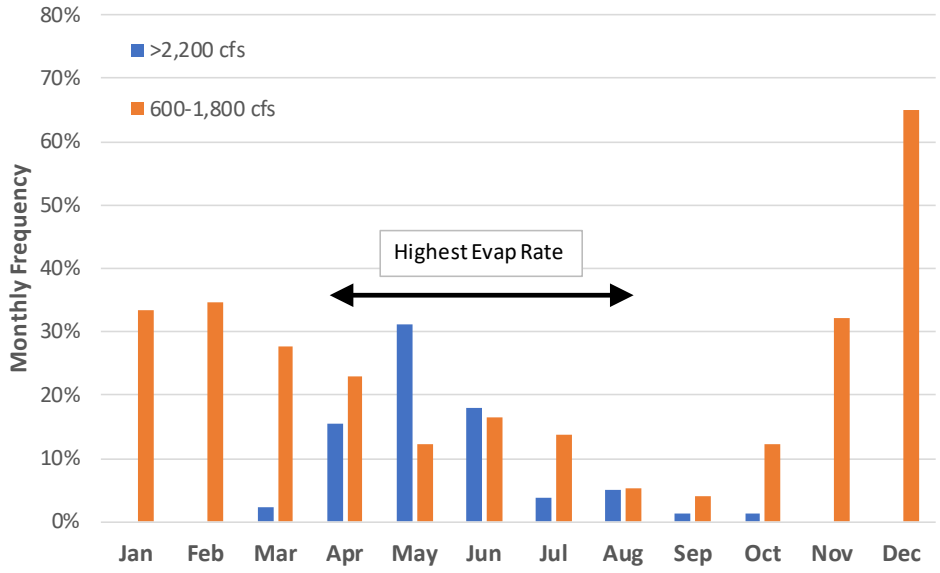


Figure 19: Monthly frequency of flows greater than 2,200 cfs and flows between 600 and 1,800 cfs. Channel realignment has the largest decrease of inundated area when flows are above 2,200 cfs and the largest increase of inundated area when flows are between 600 and 1,800 cfs.

OW evaporative losses were computed at a daily timescale using the hydrology mean daily flow data during calendar years 2006 to 2019. The seasonal evaporation rate was multiplied by the inundated area for a given flow to estimate the daily OW evaporation loss. Evaporation losses for the existing channel incorporated the frequency of sediment plug occurrence: for days when a sediment plug was in the river, the sediment plug inundation was used rather than the existing channel inundation. This method provided a comparison of the annual OW evaporation loss for the existing channel and the realignment, as shown in Figure 20. During relatively dry years with low to moderate spring runoff, the realignment increases the OW evaporation by about 150 acre-ft per year. During wet years with large spring runoff events, the realignment decreases the OW evaporation by about 1,200 acre-ft per year. On average, the realignment reduces the OW

evaporation by about 150 acre-ft per year based on the 14-year period of record. If the realignment had been in place during those 14 years (assuming a fixed bed), there would have been a net OW evaporation savings of about 2,000 acre-ft.

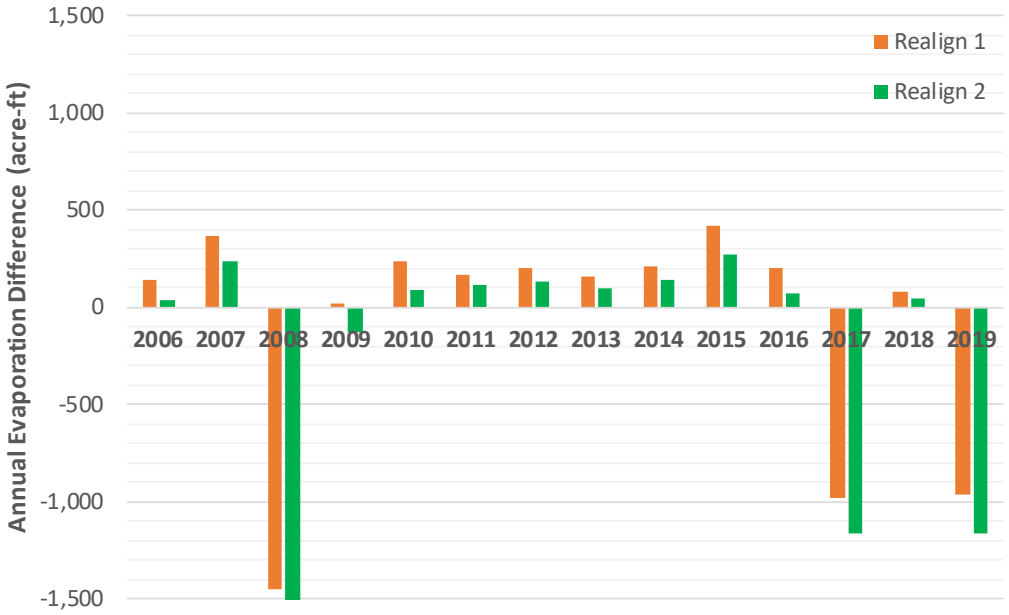


Figure 20: Annual OW evaporation difference (realignment minus existing) beyond the 600-ft corridor for the hydrology that occurred in calendar years 2006 to 2019. Positive values indicate that there would have been increased evaporation losses with the realignment. Negative values indicate that there would have been decreased evaporation losses with the realignment.

Biological Resources

4.2.7 Vegetation

The proposed action is to remove most of the standing woody vegetation from the realignment corridor (approximately 100 acres) and also remove approximately 170 acres of monotypic exotic vegetation adjacent to the realignment corridor. Some existing stands of native vegetation may be left intact at the exterior fringes of the corridor and individual trees within the 300 foot realignment corridor to provide some irregular edges which will create diversity. The 300-foot realignment area was estimated to have approximately 22.5 acres of scrub shrub wetland with greater than 50% cover of exotic or dead vegetation (saltcedar and Russian olive). The preferential removal of non-native and noxious plant species provides a greater opportunity for natural recruitment of native vegetation when the channel realignment is completed. Replacement may occur through planned native tree plantings or natural recruitment. The newly exposed surfaces within the project will coincide with the seed dispersal period of cottonwoods, willows and other native vegetation for at least five years following the completion of the project. The road work for the mowing action will not have any effect on upland vegetation since existing dirt roads will only be improved. The access routes to the floodplain are within the vegetation removal areas.

Vegetation clearing would occur outside of the realignment corridor on the east side floodplain in the project area. Non-native and/or noxious plant species (primarily saltcedar) growing in monoculture stands that are adjacent to the realignment corridor would be removed. Impacts to wetlands would be temporary, consistent soil saturation from the new river channel should encourage native riparian plant species to replace the non-native vegetation that was removed. There may be a temporary reduction in wetland classification at the site – more likely an emergent wetland at first until native riparian scrub-shrub and forest type plant species replace saltcedar stands that were removed.

The changes from the realigned channel to groundwater and a wider active floodplain will help existing vegetation and allow for new native plants to come in. A drop in groundwater elevation along the west bank of the existing channel could result in a reduced ability for trees to grow and recruit; however, it is possible that during certain runoff seasons there may be enough surface water flow from upstream on the west side of the former river channel to supply water to the young plants already established.

Perennial Pepperweed was identified as a likely noxious weed present in the river floodplain in the project area. Monitoring of nonnative plants will occur after the removal of the vegetation and will need to be monitored on equipment working in this area so that it is remove from vehicle undercarriages prior to being transported to other locations. Control will be conducted as needed to minimize the increase or new infestation of this species.

The No Action Alternative would result in no mowing of non- native vegetation and allow for few changes to the vegetation in the project area. Vegetation would continue to establish itself based on existing soil and water conditions. There would be no chance for improvement of native vegetation composition because the area would remain dominated by the monotypic exotic stands of vegetation such as saltcedar.

4.2.8 Wetlands

The proposed action is focused on restoration of the river channel and associated floodplain to include all of the adjacent wetlands that could directly or indirectly be impacted by the realignment. Following the wetland delineation results, it was determined that the entire floodplain in the greater project area is considered wetland as defined by the Corps. The proposed action footprint for activities is a smaller subset of the project area in regard to aquatic resources. Project features were separated out according to whether they could incur permanent or temporary impacts to wetlands under the jurisdiction of the Corps. CWA Section 404 individual permit authorizations from the Corps cover these activities and Reclamation will follow the conditions and stipulations in the permit received on August 20, 2019, Action Number SPA-2009-00520-ABQ (Appendix J). Table 6 presents the estimate of acreage of delineated wetlands according to project component and type of potential impact, followed by a description of these impacts by component.

Table 6: Wetland impacts from the proposed action.v

Project Action	Forested Wetland Temp	Forested Wetland Perm	Scrub-Shrub Wetland Temp	Scrub-Shrub Wetland Perm	Emergent Wetland Temp	Emergent Wetland Perm	Riverine Channel Temp	Riverine Channel Perm
Vegetation Clearing	23.00 acres	None	142.50 acres	None	0.30 acre	None	None	None
New River Realignment Corridor	32.20 acres	4.00 acres converted to riverine	50.90 acres	8.90 acres converted to riverine	2.50 acres	0.50 acre converted to riverine	None	None
Old River Channel Fill	2.00 acres	None	13.70 acres	None	None	None	58.02 acres channel conversion to wetland	None
Wet Meadow Drain Outlets (2)	None	None	1.3 acres	0.70 acre conversion to riverine	None	None	None	None
Access Roads	0.23 acre	None	2.36 acres	None	None	None	1.7 acres	None
Groundwater Fluctuation After Realign	38.80 acres possible indirect to wetlands	None	79.70 acres possible indirect to wetlands	None	None	None	None	None
Totals	96.23 acres	4.00 acres	290.46 acres	9.60 acres	2.80 acres	0.50 acre	59.72 acres	0.00 acres

*Impact Type by Wetland or Water Feature

Vegetation Clearing would occur outside of the realignment corridor on the east side of the floodplain in the project area. Non-native and/or noxious plant species (primarily saltcedar) growing in monoculture stands that are adjacent to the realignment corridor would be removed. Impacts to wetlands would be temporary, consistent soil saturation from the new river channel should encourage native riparian plant species to replace the non-natives that were removed. There may be a temporary reduction in wetland classification at the site more likely an emergent wetland at first until native riparian scrub-shrub and forest type plant species replace saltcedar stands that were removed.

It is expected that within the veg cleared area there might be an enhancement of approximately 142 acres of exotic dominated scrub/shrub wetlands. Monitoring of the entire project area will allow for future accounting of new or enhanced wetlands along the entire floodplain. The only

negative impacts for this project are approximately 52 acres of enhanced wetlands to compensate for approximately 13 acres of permanent loss of wetlands for the new channel alignment, which falls within the 142-acre enhancement area.

Realignment Corridor consists of an excavated channel down the center line and vegetation clearing to facilitate water movement down the realignment. Permanent impacts include a conversion of aquatic resource type, from scrub-shrub and forested wetland to riverine channel once the realignment is achieved. Temporary impacts via vegetation clearing between the new channel and the outer corridor line would convert scrub-shrub and forested wetland to an emergent wetland at first then river flows and inundation would dictate the resulting wetland classification within the corridor. This would most likely end up as a mosaic of emergent and scrub-shrub wetlands.

Once the river is diverted into the new alignment, the old channel would be filled with sediment and managed for wetlands, where possible. Permanent impacts include the conversion of riverine channel to emergent and scrub-shrub wetlands, and installation of a diversion berm in the old channel near the new inlet for the realignment corridor. Temporary impacts would occur to fringe wetlands between the old channel and realignment corridor line from changes in surface hydrology once the realignment is completed.

An area known as the wet meadow (Palustrine Emergent Wetland) on the south-east end of the project stays overly saturated, retaining surface water and/or ponding during high flow events in the river. To maintain this wet meadow but not retain additional surface water, two drain channels may be excavated out to facilitate surface water return/exchange between the wetland and the river channel. Some minor temporary and permanent impacts to scrub-shrub wetlands would occur from channel excavation and placement of fill.

Staging Areas and Access will be utilized as needed for the construction portion of the proposed action. Temporary impacts would occur to scrub-shrub and forested wetlands, and a small section of the current riverine channel. All of these impacts would cease upon completion of the project with no long term or permanent impacts to aquatic resources. These sites would be returned to pre-construction conditions and no loss of wetlands are anticipated.

There is the potential for indirect impacts to existing wetlands due to shifts in groundwater-to-surface depths. Greater depth to groundwater could adversely impact wetland plants at the surface. It is expected that wetland plants on the western side of the current river channel may be impacted due to the movement of the main river channel to the east, thus potentially lowering the water table along the current west bank of the river. Long term project activities include monitoring for changes in groundwater depth, and composition/density of wetland plants at the surface. Modeling to determine trends in groundwater shift was completed for this project and seemed to indicate that the existing river channel and immediately adjacent area would incur the greatest change in groundwater-to-surface depths. Monitoring efforts will be centered on the existing river channel, with other survey points scattered throughout the floodplain. Impacts (if they occur) would be in a mix of scrub-shrub and forested wetland.

The No Action Alternative would result in the persistence of the wetlands as shown in the current delineation dependent of hydrological conditions. Continued drought and minor runoff/monsoons will continue to impact existing wetlands.

4.2.9 Fish and Wildlife

The Proposed Action would have a short-term impact on wildlife species such as mammals, fish, reptiles, insects, and various birds due to disturbance from construction or maintenance related activities. Disturbance would also result from the general presence of humans during transport of machinery to the project site, daily work crews entering the project area, moving of equipment to the work site and to the staging at the end of the day if needed and the construction of the inlet and outlets, filling of the river channel and mowing of vegetation. This project will facilitate the realignment of this section of river which will connect river flows to the new channel alignment. This area cleared of exotic and or mature vegetation should have an increase in early successional riparian vegetation which should benefit many species that utilize floodplain habitats. When water is introduced to the new alignment some early or pioneering flood plain vegetation will return and in addition any surviving root stock or viable seed source from the previous vegetation on site may also sprout in the new alignment and cleared area. The new young vegetation will create improved habitat conditions compared to the extensive mature vegetation that has developed in the absence of historic flood and high flow conditions.

Under the No Action Alternative there would be no impact to the fish and wildlife resources from construction/mowing activities. If new plugs develop in this perched bed portion of the river then some aquatic species could be impacted. This could lead to stranding in overbank filled pools that lose connection with the river when the flow levels decrease. This would only occur intermittently if a plug would occur or during other overbanking flows. This would also impact other aquatic species that could become stranded as well.

4.2.10 Threatened and Endangered Species and their Critical Habitat

In accordance with Section 7(a) (2) of the Endangered Species Act of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed and proposed threatened or endangered species. Table 7 lists the effects determination on the listed species in the project vicinity. Potential relationships from the Proposed Action and No Action alternatives to these species are discussed below. Consultation with the Service is shown on Appendix E, 10.5.

This proposed pilot project was included in Reclamation's 2015 Programmatic Biological Assessment and the formal ESA consultation on effects to listed species and designated critical habitat covered in the Service's 2016 Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico (2016 BO).

Table 7: Effect determinations on the listed species in the project vicinity

Species	Effect Determination	Critical Habitat Determination
Rio Grande Silvery Minnow *Hybognathus amarus*	May affect, and is likely to adversely affect due to harm and harassment	May affect, and is likely to adversely affect
Southwestern Willow Flycatcher *Empidonax traillii extimus*	May affect, and is likely to adversely affect	May affect, and is likely to adversely affect
Western Yellow-billed Cuckoo *Coccyzus americanus*	May affect, and is likely to adversely affect	Will not destroy or adversely modify **proposed** critical habitat*

* This was the formal conference determination by the Service in the 2016 BO because cuckoo critical habitat is not designated yet.

Rio Grande Silvery Minnow

Construction is proposed to occur in a stretch of river that is typically dry during irrigation season (June–October). The pilot realignment of the channel would be approximately three miles in length and would address the area where sediment plugs form (e.g., in 2008 and again in 2017 and 2019). Project impacts will consist of channel excavation and vegetation clearing/removal along the new alignment, plus filling and stabilizing the existing river channel. The expected disturbance area is about 300 acres, with a maximum project area of 1,100 acres.

Since the project will consist of moving the Rio Grande from the existing channel to a new channel location, the existing wetted habitat of 1.6 miles will be lost. In addition, construction activities that are done while there is water in the river will result in disturbance and potential stranding of silvery minnow. Because of this, a determination was made that the proposed project "may affect, and is likely to adversely affect" silvery minnow and its critical habitat. However, the newly realigned channel is expected to increase habitat for the species over the three miles and result in a net benefit to silvery minnow and to its critical habitat.

To determine how minnow habitat would change due to the proposed pilot project, a habitat suitability index (HSI) model was used to compare the existing and initial pilot realignment conditions for the minnow at various life stages (Harris 2017, see Appendix D, 10.4). Relevant velocity and depth suitability targets for minnow habitat were identified and input into the model for the larval, juvenile, and adult life stages. A 2-year return period representing a 14-day flow duration during the spring snow-melt run-off season and a baseflow of 500 cfs were the two target discharges used for the habitat suitability model. The 14-day flow duration was selected as a minimum amount of time needed for minnow egg hatching and larval fish development to the free-swimming mesolarval stage (e.g., Platania 1995, Dudley and Platania 2007). The 2-year return period with a 14-day flow duration for years 1999–2016 was identified as 1,271 cfs. The 500 cfs simulation represents a baseflow condition that is exceeded 50% of the time in a given year, based on a flow frequency analysis (Bui 2014).

The HSI results indicate that the pilot channel realignment, for both the baseflow and 2-year return period with a 14-day flow duration, would increase the suitable habitat availability based on depth and velocity criteria. The current condition of the Rio Grande (based on 2016 LiDAR data) conveys discharges up to about 2,000 cfs with little overbanking. Therefore, higher velocities and depths occur in the existing channel, conditions that lead to fewer opportunities for RGSM minnow eggs to be retained in the floodplain. The channel realignment increases the acreage meeting the habitat suitability indices for all minnow life cycle phases, see Table 8. In addition, the realigned channel improves Rio Grande floodplain connectivity in the area. Improved floodplain connectivity is expected to increase the amount of habitat available for spawning and egg and larval development, which in turn would improve the recruitment potential of the river in this area for silvery minnow (Gonzales et al. 2014).

Although the proposed project "may affect, and is likely to adversely affect" silvery minnow and its critical habitat, the newly realigned channel is expected to provide a net increase in suitable habitat for all life stages of the species. In addition, the hydraulic analysis evaluated the anticipated reduction in seepage from the river channel to the LFCC due to the pilot realignment. The analysis indicated that although actual seepage reductions will vary depending on surface flows and subsurface condition, it is expected that the increased distance between the pilot realignment and LFCC will result, generally, in a reduction in subsurface seepage to the LFCC. This is anticipated to reduce the likelihood of river channel drying, which will benefit silvery minnow and its critical habitat.

Table 8: Habitat simulation results for the egg/larval, juvenile, and adult life stages of the minnow (compiled from Harris 2017; see Appendix D, 10.4). Unsuitable indicates the amount of habitat that did not meet depth and velocity criteria, Suitable indicates the amount of habitat that meets the velocity criteria, and Ideal habitat indicates the amount of habitat that meets both depth and velocity criteria.

Life Stage: Egg/Larval	**Unsuitable (acres)**	**Suitable (acres)**	**Ideal Habitat (acres)**
Existing Channel, 500 cfs	48.0	5.0	3.4
Realignment, 500 cfs	94.9	148.2	148.2
Existing Channel, 2-year, 14-day return (1,270 cfs)	55.6	4.6	2.3
Realignment, 2-year, 14-day return (1,270 cfs)	167.5	227.6	123.1
Life Stage: Juvenile			
Existing Channel, 500 cfs	48.0	5.0	3.5
Realignment, 500 cfs	75.2	167.9	143.5
Existing Channel, 2-year, 14-day return (1,270 cfs)	55.7	4.5	2.3
Realignment, 2-year, 14-day return (1,270 cfs)	167.5	227.6	123.1
Life Stage: Adult			
Existing Channel, 500 cfs	43.3	9.7	7.0
Realignment, 500 cfs	58.8	184.3	157.1
Existing Channel, 2-year, 14-day return (1,270 cfs)	53.4	6.8	3.2
Realignment, 2-year, 14-day return (1,270 cfs)	126.9	268.2	197.1

The proposed location of the BDA pilot project realignment is at a lower elevation than the adjacent floodplain and current bank elevation and is east of the current river location. To facilitate a connection with the existing channel, both the inlet and outlet realignment locations will be excavated. About 2,400 feet at the inlet and 9,000 feet at the outlet will need to be excavated at a width of up to 300 feet (up to 79 acres). Part of the excavation may require work in the existing channel, such as through existing river bars or other depositional features to facilitate the river realignment. Part of the excavation may also be in the wet, especially as the inlet and outlet realignment locations are connected to the existing channel or the existing channel is diverted and filled to help guide flows into the realigned channel. The average excavation depth within the inlet and outlet excavation areas is 2 feet, with a range between 0 and 7 feet. If flowing water is present, then the species will likely be present in the project area.

If flowing water is present in the project area, fish may strand in the existing channel after excavation of the inlet and outlet realignment locations and when main channel flows are

diverted through the pilot realignment. Since fish may strand and there is a significant potential for harm and harassment during inlet and outlet excavation the proposed project "may affect, and is likely to adversely affect" the silvery minnow. Reclamation will utilize construction techniques and implement the standard Best Management Practices (BMPs) identified in the 2016 BO for the proposed pilot project, which will minimize contact with fish and minimize potential for harm or harassment. In addition, Reclamation will coordinate with the Service to identify the need for silvery minnow rescue activities to occur in the existing channel area when flows are diverted into the realignment area to minimize the risk from stranding as flows recede downstream out of the existing channel area. Ideally, inlet outlet construction and the diversion of main channel flows into the realignment would be constructed when the reach is dry during irrigation season, which would eliminate or minimize the effects of the proposed project on the species.

Because silvery minnows are likely to occur in the vicinity of the proposed project, Reclamation has determined that the proposed pilot project "may affect, and is likely to adversely affect" the species during construction. Since silvery minnow could be incidentally harassed or harmed during construction activities, Reclamation included this project in the formal ESA consultation resulting in the 2016 BO, which authorizes this incidental take. The pilot project also "may affect, and is likely to adversely affect" silvery minnow critical habitat due to the relocation of the current channel to the realigned channel, and these effects are also covered in the 2016 BO.

Despite the adverse effect on silvery minnow and its critical habitat, the newly realigned channel is expected to provide a net increase in suitable habitat for all life stages of the species, which will likely result in increased recruitment potential of the reach from current conditions. Analysis shows that in general, the anticipated greater connection of the channel to the floodplain and the lower bank height in the realignment channel geometry, would improve silvery minnow habitat by increasing inundation at low discharges. The inundated areas are also less likely to cause stranding conditions as a result of this project, and the realignment is expected to reduce seepage losses to the LFCC resulting in reduced likelihood of drying. Therefore, the pilot project is expected to provide net benefits to the species and its critical habitat over the long term.

Southwestern Willow Flycatcher

Most of the proposed project activities occur in habitat that was designated in 2016 as unsuitable for the flycatcher and/or in areas outside of known flycatcher paired nesting territories and single male residents delineated from survey detections from 2017 to 2019. Nesting flycatcher pairs and resident flycatcher males have been found within 0.25 miles of the immediate project (Moore and Ahlers, 2017-2019).

- Nesting pairs have been found near the center of the project area in moderately and unsuitable habitat and may be impacted by channel fill.
- Nesting pairs that have been located in the south end of the project in moderately suitable habitat may be impacted by drain excavation.

- Resident males have been found near the realignment outlet on the south end of the project in moderately suitable habitat. No project impacts are expected to occur in this habitat.

The channel realignment project at BDA is included in the 2016 BiOp from the Service as Conservation Measure 70. This realignment will widen the channel, provide areas for overbanking, and temporarily reverse the narrowing conditions in the most populated flycatcher area within this river reach. This would create additional opportunities for overbank flows, which would provide an environment for natural regeneration of vegetation, and thus, an environment composed of young (and adjacent mature) successional age classes of vegetation for flycatchers. Implementation of this realignment will address the sediment plugging conditions, which have historically been remedied by dredging a pilot channel through the plugged portion of the channel. The goal of the realignment is to increase wetted habitat and decrease the frequency of sediment plugging (Reclamation 2016a). It is anticipated that the BDA pilot channel realignment will result in the addition of approximately 55 acres of flycatcher habitat. This acreage was calculated using an estimated 150-foot width of bank vegetation extending the length of the proposed 3-mile realignment. The Service found that the proposed action with conservation measures will not appreciably reduce the likelihood of both survival and recovery of the flycatcher and will not destroy or adversely modify designated critical habitat (Service 2016). While the project would ultimately be beneficial to flycatchers and their habitat, there would be an initial adverse effect from the loss of suitable habitat until the native vegetation has established.

Therefore, in considering the above effects, our determination is that the proposed action "may affect, and is likely to adversely affect" the flycatcher, and designated critical habitat.

Western Yellow-billed Cuckoo

Much of the proposed project activities occur in habitat that was designated in the Western Yellow-billed Cuckoo Habitat Suitability 2016, Middle Rio Grande, New Mexico report as suitable for the cuckoo. In addition, from 2017 to 2019, an average of four cuckoo territories have been located within 0.25 mile of the immediate project site – on the north end near the realignment inlet and staging area, in the center on either side of the existing river channel, and at the south end across the current river channel from the realignment outlet (Moore and Ahlers, 2017-2019). Cuckoo territories in these areas could be impacted by project activities.

The channel realignment project at BDA is included in the 2016 Biological Opinion from the Service as Conservation Measure 70. This realignment will widen the channel, provide areas for overbanking, and temporarily reverse the narrowing conditions within this river reach. This would create additional opportunities for overbank flows, which would provide an environment for natural regeneration of vegetation, and thus, an environment composed of young (and adjacent mature) successional age classes of vegetation for cuckoos. Implementation of this realignment will address the sediment plugging conditions, which have historically been remedied by dredging a pilot channel through the plugged portion of the channel. The goal of the realignment is to increase wetted habitat and decrease the frequency of sediment plugging

(Reclamation 2016a). It is anticipated that the BDA pilot channel realignment would result in the addition or enhancement of approximately 142 acres of cuckoo habitat. This acreage was calculated using the estimated amount of vegetation clearing and management for the establishment of native species. The Service found that the proposed action with conservation measures will not appreciably reduce the likelihood of both survival and recovery of the cuckoo and will not destroy or adversely modify proposed critical habitat (Service 2016). While the project would ultimately be beneficial to cuckoos and their habitat, there would be an initial adverse effect from the loss of suitable habitat until the native vegetation has established.

Therefore, in considering the above effects, our determination is that the proposed action "may affect, and is likely to adversely affect" the cuckoo.

Socio-Economic

4.2.11 Indian Trust Assets

No ITAs were identified in or near the project area. There would be no effects to ITAs under the proposed action.

There would be no effects to ITAs under the No Action Alternative.

4.2.12 Environmental Justice

No effects of any kind to the local disadvantaged population are expected under the Proposed Action. No adverse effects to low-income or minority populations are anticipated.

No effects of any kind to the local population are expected under the No Action alternative. No adverse effects to low-income populations are anticipated.

4.2.13 Cultural Resources

The project area is within the active floodplain, except for the access roads. The floodplain did not have any historic properties or cultural resource sites identified. Known sites were located nearby in the upland area but were not within the area of potential affect for this project. It was determined the proposed action would have no effect to cultural resources due to the previous disturbance of the project location. The New Mexico State Historic Preservation Office concurred with these findings on May 2017 (Appendix F, 10.6).

Under the No Action Alternative, there would be no impacts to cultural resources.

4.3 Irreversible and Irretrievable Commitment of Resources of the Proposed Action

The implementation of this project would result in the commitment of resources such as fossil fuels, construction materials, dust abatement water and labor. In addition, federal funds would be expended for the construction of the proposed project. Construction equipment would utilize fuel and lubricants that would be permanently used.

Project surveys indicate the Minnow will be present in the Rio Grande during construction if water is present and the segment of the river to be filled is critical habitat. While it is believed that minnows would be free to escape the area of disturbance, it is thought that the fish could be harassed by construction activities in the channel. The December 2016 Final Biological Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico covers Reclamations' river maintenance and restoration activities in the Middle Rio Grande following the standard Best Management Practices (BMPs). Incidental take for this project will be encompassed within Reclamation's annual accounting and reporting to the Service for the 2016 BO, which will include post-project refined acreages across these types of covered projects. If conditions for this Project change significantly, or the applicable standards BMPs cannot be followed, we will coordinate further with the Service to ensure appropriate ESA coverage is in place. Reclamation does not believe that incidental take of this species by disturbance in the channel during construction will jeopardize the existence of this species.

4.4 Cumulative Impacts

Cumulative effects under NEPA are the direct and indirect effects of a proposed project alternative's incremental effects, when they are added to other past, present, and reasonably foreseeable actions regardless of who carries out the action (40 CFR, Part 1508.7).

Other ongoing activities along the Rio Grande can negatively impact water quality, erosion, channel maintenance, sediment levels and riverine habitats. These include arroyo runoff, agricultural runoff, riparian clearing, and chemical use for vegetation control and crops. Recreation along and in the riparian zone, and riparian clearing without revegetation could also affect multiple resources.

The land use surrounding the area of the realignment is also under the management of the Fish and Wildlife Service's wildlife management and recreational program. Recreational activities occur adjacent to the project area, although primarily on the west side of the river. North of the power lines (approx. RM 62), all the way to Cochiti reservoir there are many local and state agencies, private entities and landowners, and Pueblos that are participating with the federal agencies in the Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program). The Collaborative Program will likely continue to fund habitat restoration projects and conduct research that will benefit minnows, flycatchers, cuckoos, and mice. Outside of the

Collaborative Program, there are state, city, other groups, and Pueblos that are improving riparian and riverine conditions along the MRG.

The 2008 Biological Opinion for the sediment plug removal at BDA called for an in-depth analysis of alternatives to (within) pilot channel construction which included looking at opportunities for river realignment within the reach. The proposal was for the realignment of approximately 8 miles of the river which includes two separate segments approximately one mile apart. This proposed project is a pilot to study the impacts of the realignment activities. A future proposed action is to complete the realignment of the upstream approximately 5-mile segment.

This 5-mile realignment is included as part of the Lower Reach Plan (2018) that is looking at nine proposed activities downstream of Isleta Pueblo to the Delta Channel of Elephant Butte Reservoir. The 2018 Lower Reach Plan (2018) proposes a suite of conservation measures identified in the 2016 BiOp. Three of these proposals have a suite of actions that overlap with this proposed action. These include the above mentioned 5-mile realignment in BDA, the Tiffany Fire Habitat Restoration (HR) project and the River Mile 60 HR project. The 5-mile realignment will have very similar impacts just upstream of this pilot channel. River Mile 60 and the Tiffany Fire HR will include similar measures to remove invasive, nonnative vegetation such as salt cedar; propagation of native riparian shrub and tree species; and work on the banks and possible side channels to improve habitat for the minnow. These projects would have similar impacts as the current pilot realignment proposal.

Two other Reclamation projects originally proposed in the Lower Reach Plan, Escondida Fire HR and Rhodes Property HR were recently completed in 2018 and 2019 and are in a monitoring and adaptive management phase. The general goals of these projects included creation of low flow habitat for the minnow and some vegetation management to try and eliminate exotic invasive species and enhance re-establishment of native riparian trees and shrubs.

When combined with the effects of other cumulative actions, the effects of the Proposed Action, i.e., relocation of approximately three miles of the existing channel into the adjacent floodplain to the east, these cumulative factors would not create a significant impact to the human environment and will likely be beneficial over all with some negative impacts to the minnow and its critical habitat. Mitigating factors described above should provide a long-term benefit to the minnow in this segment of the river. Negative impacts may occur to the fly catcher and the cuckoo due to temporary disturbance of individuals that migrate into the project area. The bird's critical habitat will be modified as described in the EA with impacts to some suitable habitat. These impacts are believed to be temporary. When water enters the new alignment it is believed that the shallow increased wetted area will stimulate new growth of riparian vegetation. Overtime this vegetation should develop into more suitable habitat for these listed bird species. Overall, the Proposed Project would not contribute to any significant negative cumulative impacts on any resource or threatened or endangered species or critical habitat.

5 ENVIRONMENTAL COMMITMENTS

Following are the environmental commitments (Conservation Measures) that will be carried out as part of this project. In addition, Reclamation will follow commitments that are derived from the following: 1) U.S. Army Corps of Engineers 404 permits, 2) New Mexico Environment Department 401 Water Quality Certification, 3) U.S. Fish and Wildlife Service 2016 Biological Opinion:

- Work would comply with all terms and conditions of the Clean Water Act Section 404 permit and Section 401 Certification (Attachment 10.1).
- Work will follow all requirements and BMP's as laid out in the 2016 Middle Rio Grande Biological Opinion received from the Service pursuant to Section 7 of the Endangered Species Act (Attachment 10.2).

Reclamation proposes these commitments (Conservation Measures) to minimize or avoid adverse effects of implementing the river realignment project. Other laws create environmental commitments and will be followed as required.

A variety of qualitative and quantitative data will provide information to determine if the project goals and objectives are being met. This data will be used to implement appropriate maintenance actions if the project is not responding as intended. A brief description of each data collection activity is provided as an outline for monitoring. It should be noted that while some of the monitoring activities are currently budgeted for, funding for other activities is not, and will need to be secured prior to implementation.

Each element provides an overview of the given activity, but there may be additional details that are not described or currently known.

1. *Compare yearly discharge measurements at the Highway 380 Bridge, at San Marcial, NM, and in the LFCC near San Marcial, NM with historical measurements to verify deliveries (relationship between upstream and downstream gages) are within previously observed ranges.* Informs following objectives: reduce water loss, connect surface flows, reduce drying, and minimize water near spoil levees.
2. *River drying monitoring*— Assessment of extent of drying on the Rio Grande between the Highway 380 Bridge and San Marcial. The assessment includes documentation of river conditions, length of daily drying, and occasionally discharge measurements. Informs following objectives: reduce water loss, connect surface flows, and reduce drying.
3. *Groundwater elevation monitoring and hydraulic profiling*— Collection of groundwater elevation on a regularly timed interval within the proposed realignment corridor. Informs following objectives: reduce water loss and reduce drying.
4. *Time-lapse cameras*— Compare elevated (mounted on a tree) photographs from same vantage point over time to provide qualitative assessment of change. Informs following objectives: connect surface flows, reduce drying, prevent excessive erosion/deposition, reset river planform, establish new channel, and increase width variability.

5. *Periodic river flights and site visits to supplement river drying monitoring as needed*— Visual observations of flow conveyance at additional flows above drying conditions to check for areas of ponded water. Informs following objectives: connect surface flows.
6. *Aerial Photography* — Collection of geo-rectified, aerial photography within the BDA realignment area (mesa to LFCC) is proposed via fixed-wing or drone flights. Informs following objectives: reduce drying, prevent excessive erosion/deposition, reset river planform, establish new channel, and increase width variability.
7. *Establish Photo Points*— Compare ground photographs from same vantage point over time to provide qualitative assessment of change. Photo points on both the east and west side of the realignment following established rangelines (8 lines) would be the most convenient. Informs following objectives: reduce water loss, connect surface flows, prevent excessive erosion/deposition, reset river planform, establish new channel, and increase width variability.
8. *LiDAR or SfM surface generation*— Collection of ground elevation data with a vertical accuracy of 10 cm (~4 inches) or less. Informs following objectives: prevent excessive erosion/deposition, reset river planform, establish new channel, minimize water near spoil levees, increase width variability, increase river-floodplain connectivity, and increase minnow habitat.
9. *Bathymetric channel surveys*—Collection of topography and bathymetry data along established rangelines between the Highway 380 bridge and RM 78 (2012 demarcation). Informs following objectives: prevent excessive erosion/deposition, reset river planform, establish new channel, minimize water near spoil levees, increase width variability, and increase river-floodplain connectivity.
10. *Staff gage installation*—Installation of staff gages at 3-4 locations within the realignment areas. These would be placed in the left and right floodplains. Staff gages would need to be surveyed to facilitate correlation with bathymetric channel surveys. Once an initial survey is done, subsequent measurements would record sediment and/or flow depth. Informs following objectives: prevent excessive erosion/deposition and minimize water near spoil levees.
11. *Bed material samples*—Collection of bed material samples across the active channel along established rangelines between the Highway 380 bridge and RM 78 (2012 demarcation). Informs following objectives: prevent excessive erosion/deposition and establish new channel.
12. *Longitudinal profiles*—Collection of bed elevation profiles through the realignment. Informs following objectives: prevent excessive erosion/deposition, reset river planform, establish new channel, and minimize water near spoil levees.
13. *Total sediment load at the Highway 380 Bridge* — Collection of suspended sediment and bed material samples at the Highway 380 Bridge. Approximately 12 samples would be collected annually, resulting in suspended sediment and bed material samples that could be used to calculate the total load. Informs following objectives: prevent excessive erosion/deposition.
14. *Visual observations*— Work includes periodic site visits during higher flow periods to assess conditions along the spoil levee within the vicinity of the BDA realignment project. Site visits would detail observations in a trip report. Informs following objectives: minimize water near spoil levees.
15. *Temporal Bathymetric Surveys*— Collect field data for depths and velocities in realigned channel under target flow rates to ground-truth analyses. Informs following objectives: increase minnow habitat.
16. *HSI analysis (Harris 2017) for minnow* — Based on data from temporal bathymetric surveys at target depths and velocities, using actual site data from the realignment (bathymetry

and LiDAR surveys described above), determine how the modeled habitat suitability changes over time, while also increasing certainty of the appropriateness of this tool for predicting habitat suitability for minnow. Informs following objectives: increase minnow habitat.

17. *Fish monitoring (juveniles and adults)—* Compare pre- and post-realignment fish presence and use of channel. Establish, if warranted, egg monitoring sites at the realignment site. Support other parties who plan to conduct larval monitoring, to include the realignment channel location. Informs following objectives: increase minnow habitat.

18. *Vegetation surveys and bird surveys (annually)—* TSC is contracted to collect habitat suitability data by identifying the areas of vegetation that are suitable or unsuitable habitat. Also, bird surveys are conducted annually to identify the location of endangered species and other migratory birds. Informs following objectives: increase SWFL and/or YBCU habitat.

19. *Project feature vegetation survey spot checks—* Conduct vegetative surveys at key features or sites along the realignment to evaluate vegetation establishment and compare to vegetation modeling in 4e below. Suggest use of drone technology and photogrammetry if data from these methods are informative (see Objective 1c for description of Aerial Photography). Informs following objectives: increase SWFL and/or YBCU habitat.

20. *Post-project nonnative vegetation control and removal—* Following completion of the project, conditions will be optimal for growth of new vegetation in the areas that were cleared. Such areas will be monitored and treated (physically and/or chemically) annually for non-native vegetation for at least five years or until these areas are sufficiently recovered with native vegetation. Informs following objectives: increase SWFL and/or YBCU habitat, minimize re-colonization by non-native vegetation, and ensure presence of sufficient wetlands.

21. *Wetland delineation monitoring—* Regular wetland delineations will help to determine trends in wetland creation and stability. The data will be used to determine the wetland acreage created by the realignment in compliance with CWA requirements. Informs following objectives: ensure presence of sufficient wetlands.

22. *Wetland mitigation monitoring—* Compensatory mitigation under the CWA will be required for direct and permanent impacts to wetland habitat and formal monitoring will be required to track indirect and temporary impacts for compliance. The mitigation area source will be located on-site including both the existing Rio Grande riverine channel and the areas adjacent to the new realignment channel cleared of monocultures of exotic and invasive plant species. Mitigation sites would be monitored for success for a period of at least 5 years following the end of construction activities, including submittal of annual monitoring reports at the end of each growing season, until the USACE has determined that compensatory mitigation for the proposed project has been completed. Performance standards would evolve with the site through monitoring and adaptive maintenance, using vegetation surveys and groundwater monitoring wells to track the development of wetland characteristics or the lack thereof. Informs following objectives: ensure presence of sufficient wetlands.

6 SUMMARY

The purpose and goals of this project are to address perched channel conditions in this reach of the river. The channel realignment should mitigate the conditions that have led to three channel plugs in the last 12 years. Other goals that will be accomplished by this project include removal of exotic non-native vegetation, creation of shallow aquatic habitat for the listed minnow and future development of early successional riparian vegetation that will eventually develop into suitable habitat for the flycatcher and the cuckoo.

The analysis in this EA addresses Land Use, Water Quality, Air Quality, Noise, Geomorphology, Vegetation, Wetlands, Fish and Wildlife, Threatened and Endangered Species, Socioeconomics, Indian Trust Assets, Environmental Justice, and Cultural Resources. No other resources are expected to be affected. With mitigations and the implementation of environmental commitments, effects are largely beneficial and only minor and/or temporary negative impacts have been identified.

Based on the analysis in this EA, implementing the entire Proposed Action would have no potentially significant direct, indirect, or cumulative effects on the quality of the natural or human environment. In accordance with the NEPA of 1969, as amended, and based on the analysis in this EA, Reclamation has determined that implementing the Proposed Action would not result in a significant impact on the human environment and does not require preparation of an Environmental Impact Statement.

7 CONSULTATION AND COORDINATION

Reclamation completed a BA that identified this proposed project as part of a programmatic assessment of future proposed river maintenance and habitat restoration activities for the Middle Rio Grande. Reclamation received a BO in 2016 that included this project as an identified large-scale restoration project that would help mitigate for impacts to the listed species on the Middle Rio Grande pursuant to Section 7 of the Endangered Species Act of 1973. Reclamation submitted a memo to the Service as part of the 2016 BO for the proposed project pursuant to Section 7 of the Endangered Species Act of 1973. Coordination is in progress with the Corps and has received an individual permit under the CWA and a New Mexico Environmental Division Section 401 Certification. This project was presented to the New Mexico Office of the State Engineer. The BDA Staff were consulted and involved in the planning of this project and are supportive of this project.

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10 APPENDICES

10.1 Appendix A: Wetland Delineation

10.2 Appendix B: 404 Application

10.3 **Appendix C: IPAC Information**

10.4 Appendix D: HSI for the Rio Grande Silvery Minnow

10.5 Appendix E: US Fish and Wildlife Consultation

10.6 **Appendix F: NM State Historic Preservation Office**

10.7 Appendix G: BDANWR Sediment Plug and River Restoration Project: Alternatives Analysis Syntheses Report

10.8 Appendix H: 2D Hydraulic Modeling and Evaporation Analysis for Bosque del Apache Pilot Realignment

10.9 Appendix I: DRAFT Final Bosque del Apache Pilot Realignment Monitoring Plan

10.10 Appendix J: 404 Permit

10.11 Appendix K: Interagency Agreement with BDA