US Army Corps
of Engineers®
Los Angeles District
South Pacific Division

LITTLE COLORADO RIVER AT WINSLOW, NAVAJO COUNTY, ARIZONA

FLOOD RISK MANAGEMENT PROJECT

INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT

FINAL REPORT

October 2018

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DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, U.S. ARMY CORPS OF ENGINEERS
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Little Colorado River at Winslow, Navajo County, Arizona

Flood Risk Management Project

Integrated Feasibility Report and Environmental Impact Statement

Final Report

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Little Colorado River at Winslow, Navajo County, Arizona
Flood Risk Management Project
Final Integrated Feasibility Report and Environmental Impact Statement

Lead Agency: U.S. Army Corps of Engineers, Los Angeles District (Corps).

Syllabus: This Final Integrated Feasibility Report (Final IFR) evaluates alternatives to reduce the risk of damages and to reduce the life, safety, and health risks caused by flooding of the Little Colorado River (LCR) to the City of Winslow, surrounding community, and public and private infrastructure. The Final IFR documents the plan formulation and environmental impact analysis conducted by the Corps in close cooperation with the Navajo County Flood Control District, the non-Federal sponsor for this study. The LCR at Winslow study area is located in the middle of the LCR watershed, in and near the City of Winslow in western Navajo County, Arizona. The study area includes the floodplain of the LCR from the Clear Creek confluence downstream (northwest) to the northern end of the existing Winslow Levee. The 49-square-mile study area encompasses the City of Winslow, including the Ruby Wash Diversion Levee, and portions of unincorporated Navajo County. Alternatives include combinations of structural and non-structural measures such as reconstruction of portions of the existing Winslow Levee and Ruby Wash Diversion Levee, levee setbacks, flood warning system and elevation of residential structures, and river channel conveyance improvements. The Final IFR evaluates the No Action Alternative and ten action alternatives, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4, in detail. The Recommended Plan is Alternative 10.1. Alternative 10.1 includes approximately 4.25 miles of reconstructed or new levees, conveyance improvements consisting of sediment and saltcedar removal, and a flood warning system. The project is designed at a scale that provides a 90 percent assurance of conveying the 1 percent annual chance of exceedance flood. Alternative 10.1 would have temporary and/or permanent impacts, for example, to geology and soils, water quality, groundwater, biological resources, air quality, traffic, noise, utilities, aesthetics, and socioeconomics. The project could also result in adverse and significant impacts to cultural resources; however, most of these impacts are anticipated to be avoided or minimized to below a significant level. Implementation of Alternative 10.1 would reduce the risk of levee overtopping and failure, providing life-safety benefits while lowering the flood risk to critical facilities and infrastructure.

Public Review and Comment: The Draft IFR was posted on the Los Angeles District website on May 26, 2016, and in the *Federal Register* on June 3, 2016; the official closing date for receipt of comments was July 18, 2016. All comments received were considered and incorporated into the Final IFR, as appropriate. The official closing date for the receipt of comments is 30 days from the date on which the Environmental Protection Agency publishes the Notice of Availability of this Final IFR in the *Federal Register*.

Comments should be addressed to: Headquarters, U.S. Army Corps of Engineers, ATTN: CECW-P (IP), 7701 Telegraph Road, Alexandria, VA 22315-3860. For further information, please contact the Corps at the following address: U.S. Army Corps of Engineers, Los Angeles District; Attn: Kirk Brus, Environmental Coordinator; 915 Wilshire Blvd., Suite 930, Los Angeles, California 90017, or by email at LCRWinslow@usace.army.mil, or by phone at (213) 452-3876.

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EXECUTIVE SUMMARY

This Final Integrated Feasibility Report and Environmental Impact Statement (Final IFR) presents the findings and recommendations of the Little Colorado River at Winslow, Navajo County, Arizona (LCR at Winslow) Flood Risk Management Feasibility Study conducted by the U.S. Army Corps of Engineers (Corps), Los Angeles District, in close cooperation with the Navajo County Flood Control District, the non-Federal sponsor for the study. The Final IFR documents and presents the plan formulation process and National Environmental Policy Act (NEPA) analysis for the study, evaluating alternatives to reduce the risk of damages and life, safety, and health risks caused by flooding of the Little Colorado River (LCR) to the City of Winslow, surrounding community, and public and private infrastructure.

The study is being conducted as an interim response to authority provided by Section 5.0 of the Flood Control Act of 1937, which permits the Secretary of the Army to conduct preliminary examinations and surveys for flood control "at the Little Colorado River upstream from the boundary of the Navajo Indian Reservation." In addition, House Committee on Public Works Resolution dated May 17, 1994, provides that, "The Secretary of the Army is hereby requested to review reports of the Chief of Engineers on the State of Arizona…in the interest of flood damage reduction, environmental protection and restoration, and related purposes."

The feasibility phase of the study began in 2008 when the Corps and non-Federal sponsor entered into a Feasibility Cost Sharing Agreement.

ES 1. Study Area

The LCR at Winslow study area is located in northeastern Arizona in the middle of the LCR watershed, in and near the City of Winslow in western Navajo County. The LCR originates in the White Mountains and flows in a north/northwesterly direction through Winslow and eventually joins the Colorado River in the Grand Canyon National Park. The total drainage area is 30,800 square miles. The focus of this report is a 49-square-mile study area, which encompasses the majority of the City of Winslow. The drainage area of this portion of the watershed is 16,192 square miles and includes the floodplain of the LCR in the vicinity of an existing levee system. The existing levee system includes the Winslow Levee and the Ruby Wash Diversion Levee (RWDL). The study area also includes a portion of Homolovi State Park, a cluster of four archeological sites that include seven separate pueblos built between 1260 and 1400 AD, east of the Winslow Levee and LCR.

ES 2. Purpose and Need Summary

The City of Winslow, Arizona, and vicinity are at risk of flooding under moderate to high flow events on the LCR mainstem. While an existing levee system has been built to reduce the flood risk to the City of Winslow and immediate vicinity, this levee system is at risk of overtopping or failure under current conditions. Levee failure may occur for both overtopping and non-overtopping flood events. With each flood risk, there is a life loss risk.

The approximately 7.2-mile-long Winslow Levee was built along the west side of the LCR between 1986 and 1989 by the Arizona Department of Water Resources and Navajo County. The levee was originally designed and constructed to contain the one percent annual chance of exceedance (ACE) flood, or the "100-year" flood. The 5.3-mile-long RWDL was constructed by the Corps between 1968 and 1971 and is operated and maintained by the City of Winslow. The purpose of the RWDL is to divert Ruby Wash flows away from downtown Winslow and eastward into the LCR mainstem.

The Winslow Levee no longer provides the level of flood risk reduction for which it was designed and is at risk of failure or overtopping under current conditions. Although the levee was originally designed to contain a one percent ACE event, a Corps reanalysis of watershed hydrology has increased the estimated discharge at Winslow for specific flood events. Lateral channel migration by the LCR also threatens the integrity of the levee. In addition, reduced channel capacity due to sediment accumulation in the floodplain and obstruction of flow by vegetation in the channel contribute to the risk of failure or overtopping of the existing levee. An existing Burlington Northern Santa Fe (BNSF) Railroad Bridge also limits channel conveyance capacity.

The RWDL is also at risk of overtopping or failure. While the RWDL continues to serve its intended purpose of diverting damaging Ruby Wash flows away from Winslow, this levee was not designed or intended to address flooding along the mainstem of the LCR. The easternmost portion of the diversion levee is subject to overtopping from mainstem LCR flows. The diversion levee could also fail before overtopping during relatively frequent flood events along the LCR mainstem. A levee failure at this location due to LCR mainstem flooding could cause damage to the City of Winslow and other areas behind the levee.

Approximately 1,670 structures, including almost the entirety of the city's critical public facilities including hospitals, schools, nursing homes, and utilities, are located within the one percent ACE floodplain. Expected average annual damages for the current condition due to flooding exceed $10 million. Thousands of residents are at risk from failure or overtopping of the levee system. Many areas would be quickly inundated with several feet of water, leading to significant public health and safety risks. In some parts of northeastern Winslow, flood depths would exceed 10 feet for the one percent ACE flood event.

The purpose of the proposed project and alternatives is to reduce risk of property damages and the life, safety, and health risks caused by flooding from the LCR to the City of Winslow, surrounding community, and public and private infrastructure.

More detail on the purpose and need is provided in Sections 2.1 and 2.2 of this Final IFR.

ES 3. Alternative Plans Considered

Plan Formulation and Development of Focused Array

Several strategies were applied to the formulation and evaluation of alternatives. Initially, after identification of problems, opportunities, constraints, and study objectives, a set of management measures were identified during a planning charrette with Federal, state, and local stakeholders. The study area was segmented into two reaches for plan formulation purposes, Reach 1 and Reach 2. Reach delineation was based on flooding characteristics and economic activity. From an economic standpoint, the boundary between Reach 1 and Reach 2 was a natural separation. The upstream Reach 1 includes the majority of the City of Winslow located south of Interstate 40 (I-40). The downstream and adjacent Reach 2 includes the rest of the structures north of I-40.

Based on input at the charrette and follow-up information, a preliminary array of seven alternatives was developed. These alternatives were evaluated, screened, and in several cases, modified or combined to form three effective plans for inclusion in the focused array. In addition, three new alternatives were developed and included in the focused array. These three alternatives consisted of a plan provided by the non-Federal sponsor, and two incremental plans that would address focused segments of the levee system. The focused array of alternatives was further evaluated through hydraulic and economic modeling to assess flood damages reduced (benefits of the alternative), residual flood risk, and life safety considerations. Implementation costs for each alternative in the focused array were also developed. The following describes the alternatives in the focused array. All the alternatives in the focused array include improvements to the flood warning system in addition to the features outlined below.

- **Alternative 1.1 – Rebuild Levee System along Current Alignment.** Rebuild the Winslow Levee and the eastern end of the RWDL along their current alignments, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge.
- **Alternative 3.1 – Rebuild Levee System with Extensive Winslow Levee Setback.** Rebuild part of the Winslow Levee along its current alignment, set back part of the Winslow Levee, remove the original Winslow Levee in the setback areas, rebuild the eastern end of the RWDL along its current alignment, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge.
- **Alternative 7 – Nonstructural Measures.** Non-structural measures include floodproofing the residences located north of I-40 and east of North Park Drive. This area includes the Bushman Acres and Ames Acres subdivisions. A total of 117 homes in Reach 1 and 29 homes in Reach 2 would be elevated above the one percent ACE water surface elevation. The range of elevations required to elevate these homes above the one percent ACE water surface elevation is between 0 and 4.74 feet.
- **Alternative 8 – Rebuild Levee System with Homolovi I Levee Setback.** Rebuild most of the Winslow Levee along its current alignment, set back a short segment of the Winslow Levee across the LCR from the Homolovi (traditionally spelled “Homol’ovi”) I Pueblo, remove the original Winslow Levee in the setback area, rebuild the eastern end of the RWDL, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge.

- **Alternative 9 – Reconstruct Ruby Wash Diversion Levee East.** This alternative was developed to represent a smaller increment plan and focuses on one of the levee segments most susceptible to failure. Alternative 9 entails rebuilding the eastern end of the RWDL at its existing height and use of nonstructural measures for residences north of I-40. This alternative does not include improvements to the Winslow Levee or conveyance improvements.
- **Alternative 10 – Rebuild RWDL and Winslow Levee to North Road includes Nonstructural Measures.** This alternative includes rebuilding the eastern end of the RWDL, removal and reconstruction of the Winslow Levee from its abutment with the RWDL to I-40, construction of a levee parallel to I-40, and conveyance improvements at the BNSF Railroad Bridge. This alternative also includes removal and reconstruction of the Winslow Levee from the new levee parallel to I-40 to just north of North Road, including a setback levee across from the Homolovi I Pueblo. Alternative 10 also includes elevating residences north of North Road.
- **Alternative 11 – No Action Alternative.** The No Action Alternative assumes that no Federal action would be undertaken to address the flood risk to the Winslow community. The Navajo County Flood Control District and the City of Winslow will continue operation and maintenance activities for the existing Winslow Levee and RWDL, respectively. Repairs and improvements to the Winslow Levee are typically completed on a reactionary, post-flood basis by Navajo County. Under the No Action Alternative, the flood risk in the Winslow area is expected to remain essentially unchanged over the 50-year period of analysis. The No Action Alternative is synonymous with the future without-project condition.

Economic Considerations and Optimization of Alternative 10

The economic benefits and costs were calculated for the alternatives listed above. These benefits and costs are used to compute two key economic indicators: the benefit/cost ratio and net benefits. The most economically optimal plan is the one that maximizes net benefits; this plan is referred to as the National Economic Development (NED) Plan. Table ES-1 displays the project costs and benefits for the focused array of alternatives at 2014 price levels.[1]

Table ES-1 Costs and Benefits for the Focused Array of Alternatives

FY 2014 Price Levels

Category	Alt 1.1	Alt 3.1	Alt 7	Alt 8	Alt 9	Alt 10
First Cost	$87,305,000	$91,704,000	$19,172,000	$81,732,000	$21,221,000	$64,155,000
Total Annual Cost	$4,381,000	$4,589,200	$875,000	$4,104,000	$974,850	$3,101,800
Annual Benefits	$8,381,000	$8,381,000	$264,000	$8,381,000	$1,906,000	$8,305,000
Net Benefits	**$4,000,000**	**$3,791,800**	**-$611,000**	**$4,277,000**	**$931,150**	**$5,203,200**
Benefit/Cost Ratio	1.91	1.83	0.30	2.04	1.96	2.68

Based on this analysis, Alternative 10 clearly shows the highest net benefits and benefit-to-cost ratio and was therefore identified as the optimal levee alignment from an NED perspective. This alternative includes two major components—levee improvements in the upstream Reach 1 and a

[1] Updated costs and benefits for the Recommended Plan using October 2017 price levels and a 2.75 percent discount rate are provided in Section ES 4 below, in Chapter 8, and in Appendix C - Economic.

non-structural plan, which features raising floodplain structures above the one percent ACE flood elevation in the downstream Reach 2. Since these two components are separable, an incremental analysis was conducted to show the economic justification of each. Based on this analysis, only Reach 1 was determined to be economically justified.

Optimization of Alternative 10 was then conducted to assess net economic benefits of different levee heights or scales for the Reach 1 structural improvements. In addition to the one percent ACE from Alternative 10 Reach 1, identified as Alternative 10.1, other scales evaluated were designs equal to the 4, 2, and 0.5 percent ACE water surface elevation. These scales are identified as Alternatives 10.2, 10.3, and 10.4, respectively. These alternatives have been included in the focused array.

The average annual benefits and costs for the different scales of Alternative 10 are shown in the following table (Table ES-2).

Table ES-2 Optimization of Alternative 10

FY 2014 Price Levels

Category	10.1 (1% ACE)	10.2 (4% ACE)	10.3 (2% ACE)	10.4 (0.5% ACE)
First Cost	$59,905,000	$39,260,000	$59,356,000	$68,576,000
Interest During Const.	$6,535,385	$3,819,554	$6,011,943	$7,017,805
Investment Cost	$66,440,385	$43,079,554	$65,367,943	$75,593,806
Annualized Investment Cost	$2,833,000	$1,837,000	$2,787,000	$3,223,000
Operations, Maintenance, Repair, Replacement & Rehabilitation	$67,800	$24,800	$67,000	$91,300
Total Annual Cost	$2,900,800	$1,861,800	$2,854,000	$3,314,300
Average Annual Benefits	$8,250,000	$5,067,000	$7,079,000	$9,068,000
Net Benefits	**$5,349,200**	**$3,205,200**	**$4,225,000**	**$5,753,700**
Benefit/Cost Ratio	2.84	2.72	2.48	2.74

As shown above, the plan and scale that maximizes net NED benefits is Alternative 10.4, which is designed to convey the 0.5 percent ACE discharge. This alternative has net benefits of about $5.8 million, a benefit-to-cost ratio of 2.74, and is expected to reduce without project damages by approximately 90 percent in Reach 1. While Alternative 10.4 has the highest net benefits of the alternatives, it is possible that a slightly larger scale plan could result in even higher net benefits, i.e., the NED Plan may be larger than Alternative 10.4.

Focused Array of Alternatives

The focused array of alternatives, shown in Table ES-3, includes the alternatives from the focused array and the alternatives resulting from optimization of Alternative 10.

Comparison among Alternatives

In addition to the evaluation and comparison of NED benefits described above, the plans were evaluated and compared for life safety and environmental considerations.

Table ES-3 Final Array of Action Alternatives

Feature or Measure	Alternative									
	1.1	**3.1**	**7**	**8**	**9**	**10**	**10.1**	**10.2**	**10.3**	**10.4**
No Levee Improvements			X							
Rebuild Winslow Levee – Full Length of Existing	X	X		X						
Rebuild Winslow Levee – North Road						X	X	X	X	X
Homolovi I Winslow Levee Setback				X		X	X	X	X	X
I-40 to North Road Winslow Levee Setback		X								
Levee Parallel to North Side of I-40	X	X		X		X	X	X	X	X
Rebuild 2000' of Ruby Wash Diversion Levee	X	X		X	X	X	X	X	X	X
LCR Channelization at BNSF for 1% ACE Flood	X	X		X		X	X		X	
LCR Channelization at BNSF for 0.5% ACE Flood										X
Elevate Residences North of I-40 (Nonstructural)			X		X					
Elevate Residences North of North Road (Nonstructural)						X				
Improved Flood Warning System (nonstructural)	X	X	X	X	X	X	X	X	X	X
Levee Height										
Levee Height for 44,780 cfs (~2.8% ACE Flood)					X					
Levee Height for 4% ACE Flood								X		
Levee Height for 2% ACE Flood									X	
Levee Height for 1% ACE Flood	X	X		X		X	X			
Levee Height for 0.5% ACE Flood										X

Life Safety Considerations

Each of the structural alternatives would reduce the risk of levee overtopping and failure and lower the risk to critical facilities and infrastructure. Alternatives 1.1, 3.1, 8, 10, and 10.1 include measures that would reduce the flood risk for up to the one percent ACE event. Reduction in life safety risks of Alternative 10.2 and 10.3 would be somewhat lower than Alternative 10.1. Other than the flood warning system, the life safety risk reduction provided by Alternative 7 would be limited to elevation of residences north of I-40. Alternative 9 rebuilds only a segment of the RWDL upstream from Winslow. Failure or overtopping of this levee segment could flood two-thirds of the City of Winslow, including critical public facilities. Elevating residences north of I-40 included in Alternatives 9 and 10 would provide minor additional life safety benefits. Alternative 10.4 reduces the risk to life safety and critical public infrastructure for up to the 0.5 percent flood. This alternative would provide the greatest life safety benefits of all alternatives under consideration.

Environmental Analysis

Chapter 4.0 of this Final IFR presents the affected environment, and Chapter 5.0 presents the environmental impact analysis for all alternatives in the final array. Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 are feasible alternatives for purposes of NEPA. Alternative 11 is the No Federal Action Alternative and is included in the final array of alternatives. Table 5-1 in Chapter 5.0 provides a summary comparison of environmental impacts by resource category. General environmental impacts and areas of stakeholder interest are summarized below.

Alternatives 1.1, 3.1, 8, 10, 10.1, 10.2, 10.3, and 10.4 are similar as they include reconstructing portions of the Winslow Levee and RWDL and construction of a new segment of the Winslow Levee along I-40. These alternatives would result in similar temporary construction impacts to geology and soils, water quality, groundwater, biological resources, air quality, traffic, utilities, and socioeconomics. Alternatives 8, 10, 10.1, 10.2, 10.3, and 10.4 include a levee setback near the impingement point across from the Homolovi I Pueblo, and Alternative 3.1 includes a larger levee setback along two segments of the Winslow Levee.

Although Alternatives 8, 10, 10.1, 10.2, 10.3, and 10.4 are anticipated to avoid the need for removal of structures through minor adjustments to the levee alignment and construction corridor during the design phase; removal of one residence is possible. Alternative 3.1 would require the removal of about eight residences. Alternative 3.1 would also result in a greater land use and aesthetics impact due to the larger levee setback.

Alternative 3.1 would have unavoidable significant impacts to cultural resources and land use. For cultural resources, where removal of structures cannot be avoided and the structures are determined to be eligible for the National Register of Historic Places (NRHP), then the alternative would result in an unavoidable significant impact under NEPA. Alternative 3.1 would also adversely affect at least one prehistoric archaeological site. With respect to land use, Alternative 3.1 would convert a substantial amount of rural residential and commercial land to other uses, resulting in major incompatibilities with planned uses, which would not be mitigable to a less than significant level.

Alternatives 8, 10, 10.1, 10.2, 10.3, and 10.4 could also result in adverse and significant impacts to cultural resources. Most impacts are anticipated to be avoided or minimized to below a significant level under NEPA. While removal of structures is anticipated to be avoided through design refinements, if one or more structures cannot be avoided by the levee construction and the structures are determined to be eligible for the NRHP, adverse impacts would be significant.

One issue raised by public agencies is concern over potential impacts to the Homolovi I Pueblo site. They have expressed concern that the existing levee system has caused adverse erosion-related impacts on the Pueblo. Analysis has shown that, under existing conditions, the pueblo site is subject to flooding. With respect to hydraulic impacts of the action alternatives to the Homolovi site, the Corps compared hydraulic models of each alternative to two discrete baseline conditions. Under the first baseline condition, which is the more-likely scenario, the Corps assumed that the existing levees would not fail prior to overtopping. In the second baseline condition, the Corps factored in the probability that the existing levees could perform unsatisfactorily (i.e. fail) through slope failure, impingement, or piping. When compared to the first baseline scenario, the water surface elevation, velocity, and floodplain extent at Homolovi I slightly decreased or did not change for Alternatives 1.1, 3.1, 8, 10, 10.1, 10.2, 10.3, and 10.4. No increase in flooding at Homolovi I is expected from any of the alternatives compared to the first baseline condition.

The second baseline condition, in which the levees fail, is much less likely to occur than the baseline condition in which the levees do not fail but are overtopped. When compared to this second, less-likely scenario, Alternatives 1.1, 8, 10, 10.1, 10.2, 10.3, and 10.4 could result in minor increases in water surface elevation and floodplain extent, resulting in minor adverse effects to the Homolovi I Pueblo. Alternative 3.1 would reduce average water surface elevations and floodplain extent at Homolovi I Pueblo when compared to the same baseline scenario. Alternatives 7 and 9 would result in no change. However, the levee would need to simultaneously fail at four locations for this to be the case, which brings the likelihood that this second baseline condition would occur to a less than five percent chance in any given flood event. Therefore, it is not reasonably foreseeable that the alternatives would result in an adverse effect or a significant impact to Homolovi I.

Identification of the Recommended Plan

Based on the evaluation and comparison of the alternative plans, and taking into account the view of the non-Federal sponsor, Alternative 10.1 has been identified as the Recommended Plan.

This plan has a higher benefit-to-cost ratio than Alternative 10.4, although it has slightly lower net benefits. Corps policy provides that a plan other than the NED Plan may be selected if it qualifies for a Categorical Exemption from identifying and selecting the NED Plan (Planning Guidance Notebook [PGN], Engineer Regulation [ER] 1105-2-100, paragraph 3-3.b (11) (2000)). Alternative 10.1 meets the criteria for a Categorical Exemption as it (1) provides the non-Federal Sponsor's desired maximum level of protection; (2) has with-project residual risks that are not unreasonably high; (3) features levee improvements designed to meet flood insurance requirements; (4) has greater net benefits than smaller scale plans; and (5) does not contain uneconomical increments.

The primary goal of the non-Federal sponsor is to provide a levee that is capable of being accredited by the Federal Emergency Management Agency (FEMA) for the one percent ACE, or "100-year" flood event. Alternative 10.1 provides for reconstruction of an economically justified levee segment that reduces the flood risk for the most densely populated parts of the Winslow area. Alternative 10.1 best meets local objectives and provides an appropriate level of flood risk management in consideration of the non-Federal sponsor's fiscal capability.

ES 4. Recommended Plan

Description

The Recommended Plan, Alternative 10.1, includes the following components:

- Removal and reconstruction of approximately 2,000 feet of the RWDL to its abutment with the Winslow Levee
- Removal and reconstruction of approximately 3,500 feet of the Winslow Levee from its abutment with the RWDL to I-40 (accounting for the alignment under the bridges)
- Improvement of conveyance under the BNSF Railroad Bridge through channelization and saltcedar removal
- Construction of a new levee segment parallel to I-40 (approximately 3,700 feet)
- Removal and reconstruction of the Winslow Levee from I-40 to a point 0.8 miles north of North Road, including setback of 1,600 feet
- Flood warning system

The total length of new and reconstructed levees would be approximately 22,570 feet. New levee construction would be designed to provide an approximately 90 percent assurance of containing the one percent ACE event. The non-Federal sponsor specified that their plan of interest was one that would meet FEMA certification criteria. This plan scale was one of the scales analyzed as part of our NED analysis, and was ultimately identified as the Recommended Plan.

No improvements would be made to the Winslow Levee downstream of the proposed Federal project. In addition to the components listed above, a flood warning system would be implemented as part of the Recommended Plan. A more detailed description of the Recommended Plan is included in Chapter 8.0. Figure 8-1 provides a map of the Recommended Plan.

Benefits for the Recommended Plan were updated to reflect October 2017 price levels and the current Federal discount rate of 2.75 percent. The results of the updated analysis are shown in the table below.

Table ES-4 Expected Annual Damages and Benefits – Recommended Plan ($1,000s)

October 2017 Price Levels

	Without Project	With Project	Benefits
Structure and Contents	$8,162	$1,484	$6,678
Auto	$690	$130	$560
Clean-up	$1,066	$186	$880
Land	$173	$32	$141
TOTAL	**$10,091**	**$1,832**	**$8,259**

Project costs were also updated based upon design refinements, updated price levels, and the results of a detailed cost and schedule risk analysis. The updated costs are shown in Table ES-5.

Table ES-5 Average Annual Costs – Recommended Plan ($1,000s)

October 2017 Price Levels

Category	
Total First Cost	$77,202
Interest During Construction	$4,012
Total Investment Cost	$81,214
Annualized Investment Cost	$3,008
OMRR&R	$50
Total Average Annual Cost	$3,058

Table ES-6 below presents the results of the benefit/cost analysis for the Recommended Plan. As shown, the Recommended Plan is economically justified with a benefit/cost ratio of 2.70.

Table ES-6 Benefit/Cost Analysis Results – Recommended Plan ($1,000s)

October 2017 Price Levels

Category	
Average Annual Benefits	$8,259
Average Annual Costs	$3,058
Net Benefits	$5,200
Benefit/Cost Ratio	*2.70*

The Recommended Plan also generates substantial regional economic development and other social effects benefits. The Recommended Plan is projected to generate over 1,966 jobs, over $50 million in labor income and about $58 million in value added to the regional economy during project construction, and will also significantly reduce life and safety risks to a large portion of the study area.

Residual Flood Risk

Implementation of the flood risk management project would greatly reduce the threat to life and safety in Reach 1 of the study area. Regardless of the actions taken, some level of risk would remain. The risk of levee failure is addressed by Alternative 10.1, which rebuilds and strengthens the Winslow Levee in Reach 1, but provides no new structural flood risk measures in Reach 2. This alternative also addresses levee overtopping risk to some extent, since it would include a levee higher than the existing levee for Reach 1. Residual flood risk in Reach 1 will be primarily related to levee overtopping events, which are more reliably forecast in advance. The levee height of Alternative 10.1 has been designed to have a 90 percent assurance level of containing the one percent ACE event. Alternative 10.1 would allow for improved safety to residents in Reach 1 by reducing risk of inundation of public infrastructure. The flood risk posed by a levee failure or overtopping in Reach 2 would not be affected by implementation of Alternative 10.1. Reach 2 has a residual risk to health and life safety from flooding and levee failure at the Winslow Waste Water Treatment Plant (WWTP). The City of Winslow recently constructed a ring levee around the WWTP to prevent damages up to the one percent ACE flood. This local action has reduced the flood risk to the WWTP. There is still a residual risk that an event larger than the one percent ACE flood would inundate the plant and release raw sewage into the floodwaters. In Reach 2, most of the area would still be subject to flood risks from potential

levee failures downstream of the proposed improvements for Alternative 10.1. However, the risk in this area would not be any worse than under the No Action Alternative.

During the Preconstruction Engineering and Design (PED) phase, further investigations will be conducted for the most-likely overtopping location (upstream of BNSF Railroad) to develop and design features, which will incorporate managed overtopping and resiliency in accordance with Corps design criteria, Engineering and Construction Bulletin (ECB) 2017-15. The managed overtopping location would be capable of absorbing energy during loading without experiencing permanent deformation, extensive damage, cumulative degradation, or catastrophic failure. Scour protection will be provided on the protected side of the levee for the purpose of minimizing erosion during flood events that exceed the top of levee.

Environmental Impact Conclusions and Compliance

The environmental impacts of the Recommended Plan along with other alternatives are summarized in Table 5-1. All impacts of the Recommended Plan would be less than significant, with the exception of impacts to cultural resources. While removal of structures is anticipated to be avoided through design refinements, it is possible that removal of one or more structures will be required. If one or more structures cannot be avoided by the levee construction, and the structures are determined to be eligible for the NRHP, adverse impacts would be significant. Compliance with other environmental laws is addressed in Chapter 6.0.

Economic Summary and Cost Apportionment for the Recommended Plan

The construction costs and operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs for the Recommended Plan were developed using the MII cost estimating system. These costs, along with annualized costs, annualized benefits, net economic benefits, and the benefit-to-cost ratio are shown below. These costs are based on FY 2018 price levels, an interest rate of 2.75 percent, a 50-year period of analysis, and a 5.5-year PED and construction period.

Table ES-7 Total First Cost and Average Annual Cost – Recommended Plan ($1,000s)

October 2017 Price Levels

Category	Cost
Lands & Damages	$193
Relocations	$1,065
Total LERRD	***$1,258***
Construction	$56,540
Preconstruction Engineering and Design (PED)	$15,160
Construction Management (S&A)	$4,043
Cultural Resources	$201
Total Construction	***$75,944***
Total First Cost	**$77,202**
Interest During Construction	$4,012
Total Investment Cost	**$81,214**
Annualized Investment Cost	**$3,008**
OMRR&R	**$50**
Total Average Annual Cost	**$3,058**

Cost sharing for construction of the Recommended Plan would be consistent with the requirements of Section 103 of the Water Resources Development Act of 1986, as amended Table ES-8 shows the cost apportionment.

Table ES-8 Cost Apportionment of the Recommended Plan ($1,000s)

October 2017 Price Levels

Item	Federal	Non-Federal	Total
Lands and Damages		$193	$193
Relocations - Utilities		$1,065	$1,065
Levees & Floodwalls	$56,540		$56,540
Cultural Resources	$201		$201
Preconstruction Engineering and Design (PED)	$15,160		$15,160
Construction Management (S&A)	$4,043		$4,043
Subtotal	**$75,944**	**$1,258**	**$77,202**
Adjustments			
5% Minimum Cash Contribution	-$3,860	$3,860	
Additional Cash Contribution	-$21,903	$21,903	
TOTAL	**$50,181**	**$27,021**	**$77,202**
	65%	35%	100%

Public Review

The Draft IFR was circulated to the public for a 45-day review period pursuant to NEPA. During and subsequent to the 45-day public review period, the Draft IFR was also be reviewed by an Agency Technical Review team, an Independent External Peer Review team, and Corps policy reviewers. All comments received have been responded to, as appropriate, in Section 4 of Appendix I - Environmental Resources.

1.0 STUDY INFORMATION

1.1. Study Authority

The Little Colorado River (LCR) at Winslow Feasibility Study is being conducted under the authority provided by Section 5 of the Flood Control Act of 1937. This authority amends Section 6 of the Flood Control Act of 1936 to permit the Secretary of the Army, through the Chief of Engineers, to conduct preliminary examinations and surveys for flood control at the LCR upstream from the boundary of the Navajo Indian Reservation.

Further authority is provided under House Committee on Public Works Resolution (Docket 2425) May 17, 1994 which states:

> *"… The Secretary of Army is hereby requested to review reports of the Chief of Engineers on the State of Arizona… in the interest of flood damage reduction, environmental protection and restoration, and related purposes."*

1.2. Study Purpose and Scope

The LCR at Winslow Feasibility Study is an interim response to the study authorities. The purpose of this study is to formulate and evaluate flood risk management (FRM) alternatives that reasonably maximize net economic benefits consistent with protecting the Nation's environment to address flood related damages and life safety risk to the City of Winslow and vicinity. This study documents the plan formulation studies conducted by the U.S. Army Corps of Engineers (Corps), Los Angeles District (District) in cooperation with the Navajo County Flood Control District (Navajo County), the non-Federal Sponsor.

The study team collected and evaluated pertinent engineering, economic, social, and environmental information needed to accomplish the study objectives. An array of possible FRM plans are considered and evaluated in this report based on costs, benefits, and impacts to the study area.

The study report is a decision document in the form of an integrated feasibility report and National Environmental Policy Act (NEPA) Environmental Impact Statement (EIS) in accordance with the Corps' Planning Guidance Notebook, Engineer Regulation (ER) 1105-2-100 (22 April 2000) and Procedures for Implementing NEPA, ER 200-2-2 (4 March 1988).

1.3. Study Area and Location

1.3.1. Study General Location

The LCR watershed occupies most of the northeastern quarter of Arizona and a small portion of northwestern New Mexico [Arizona Department of Environmental (ADEQ), 2009]. The LCR originates in the White Mountains south of Springerville, Arizona. It flows in a north/northwesterly direction in a well-defined canyon until reaching the City of Holbrook, Arizona, where the river continues westerly and flows another 30 miles on a broad, open

floodplain before it reaches the City of Winslow. It then continues in a generally northwestern direction towards Grand Falls, before eventually joining the Colorado River in the Grand Canyon National Park. The total drainage area of the LCR varies from 11,462 square miles at Holbrook, to 16,192 square miles at Winslow, to 21,068 square miles at Grand Falls. The drainage area increases to 30,800 square miles by the time the LCR joins the Colorado River in the Grand Canyon National Park.

The City of Winslow is the largest city in Navajo County, approximately twice the size of the county seat of Holbrook. The population of Winslow was 9,754 (US Census 2016). The area is supported by tourism, manufacturing, trade, and retail.

1.3.2. Study Area

The LCR at Winslow study area (Figure 1-1) is located in northeastern Arizona, in the middle of the Little Colorado River watershed, in and near the City of Winslow in western Navajo County. The study area includes the floodplain of the LCR from the Clear Creek confluence downstream (northwest) to the northern end of the existing Winslow Levee. The 49-square-mile study area encompasses the majority of the City of Winslow and includes the Ruby Wash Diversion Levee (RWDL) and the Ruby Wash Levee. The tributaries of Ruby Wash, Clear Creek, Cottonwood Wash, Chevelon Creek, and Salt Creek/Jacks Canyon join the LCR mainstem within the study area. Transportation infrastructure crossing the LCR includes Interstate 40 (I-40), State Highway 87 (Historic U.S. Route 66), and the Burlington Northern Santa Fe (BNSF) Railroad. The study area also includes a portion of Homolovi State Park, a cluster of four archeological sites that include seven separate pueblos built between 1260 and 1400 AD east of the Winslow Levee and LCR. Figure 1-2 includes these features within the study area.

1.4. History of the Study

The Little Colorado River Watershed, Arizona and New Mexico 905(b) Reconnaissance Report was approved by the South Pacific Division (SPD) and U.S. Army Corps of Engineers Headquarters (HQUSACE) on November 5, 1999. The study documented in the 905(b) Report identified Federal interest in water resource issues including flood risk management, ecosystem and environmental restoration, storm water retention, water conservation and supply, and recreational needs within the LCR watershed.

A revised 905(b) Report for the LCR watershed was approved by SPD on August 11, 2008. The purpose of the revised document was to update and supplement the information in the previously approved 905(b) Report. The Feasibility Cost Sharing Agreement for this study was signed on August 28, 2008.

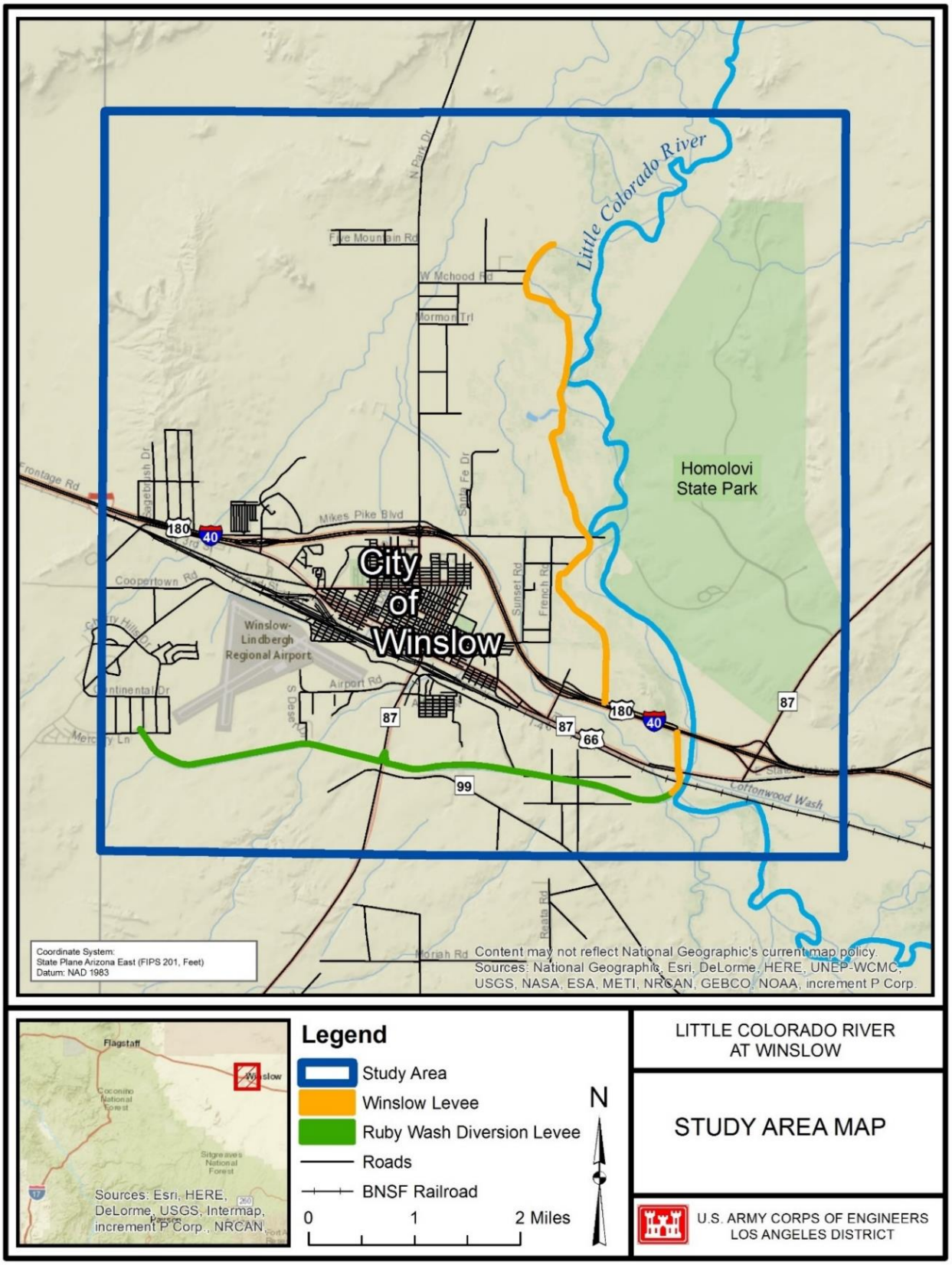

Figure 1-1 LCR Winslow Study Area in the Vicinity of Winslow, Arizona

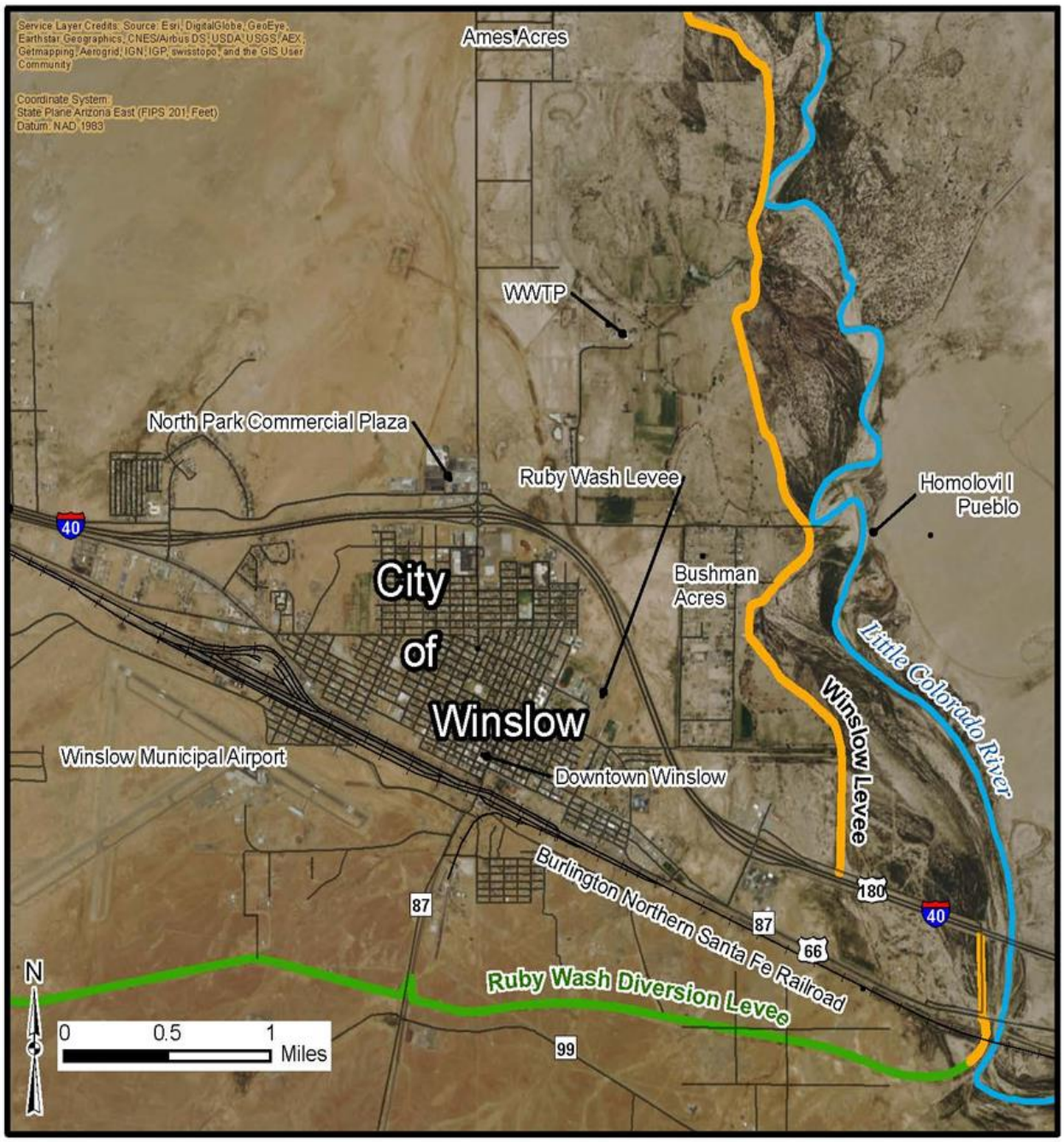

Figure 1-2 Study Area Existing Features

1.5. Prior Reports and Existing Projects

The following studies have been conducted within the study area in the past and are relevant to the current effort. The list includes several reports prepared by the Corps in addition to other agencies and the sponsor.

Table 1-1 Prior Studies and Reports

Little Colorado River Watershed, Arizona and New Mexico, Supplemental Information to the 1999 Section 905(b). USACE, 2008.
Analyses of Little Colorado River Stability Between Holbrook and Winslow, Arizona, Report of Findings, Little Colorado River Sediment Study, U.S. Bureau of Reclamation (USBR), May 23, 2003.
Little Colorado River Watershed, Arizona and New Mexico 905(b) Reconnaissance Report. USACE, 1999.
A Report on Regional Focus Groups to Define Watershed Problems, Opportunities and Concerns in the Little Colorado River Watershed, 1999. L.D. & P. J. Garrett, M3 Research. This report provides results of focus group/workshops conducted by the Little Colorado River Multi-Objective Management group (LCR-MOM) and the Corps in 1999 to request public input on the water resource problems and opportunities of the Watershed.
Little Colorado River Geomorphology and River Stability Study, Reconnaissance Level Engineering Report, 1993, George C. Sabol Consulting Engineering, Inc., Scottsdale, Arizona, for Navajo County, Department of Public Works. This report provides an analysis of the flooding and drainage problems in the Little Colorado River Basin.
Feasibility Report, Little Colorado River Flood Control Project, Winslow, Arizona. Prepared by the Arizona Department of Water Resources for Navajo County Flood Control District, November, 1980.
Little Colorado River at Holbrook, Arizona, Review Report for flood control and recreational development, 1980, USACE, Los Angeles District. This is a feasibility report proposing construction of a levee on the Little Colorado River at Holbrook, Arizona.
Flood Plain Information, Little Colorado River, Vicinity of Winslow, Navajo County, Arizona, 1976, USACE, Los Angeles District. Prepared for the City of Winslow.
Winslow, Arizona and Vicinity, Review Report for Flood Control, Little Colorado River, Arizona and New Mexico, USACE, Los Angeles District, 1961.
Report on Survey, Flood Control, Little Colorado River and its Tributaries Upstream from the Boundary of the Navajo Reservation in Arizona, 1940, USACE, Los Angeles District. Recommended and completed construction of the first Holbrook Levee in 1948.

1.6. Planning Process and Report Organization

1.6.1. Planning Process

The Corps planning process follows the six steps defined in *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implemental Studies*, also known as the Principles and Guidelines (Water Resources Council, March 10, 1983), and as specified in ER 1105-2-100. The process identifies and responds to problems and opportunities associated with the Federal objective and specified state and local concerns. The process provides a flexible, systematic, and rational framework to make determinations and decisions at each step. This allows the interested public and decision makers to be fully aware of the basic assumptions employed, the data and information analyzed, the areas of risk and uncertainty, and the significant implications of each alternative plan. Iterations of steps are conducted as necessary to formulate efficient, effective, complete, and acceptable plans.

The six steps used in the plan formulation process are as follows:

- **Identify Problems and Opportunities –** The specific problems and opportunities are identified, and the causes of the problems discussed and documented. Once the problems and opportunities are properly defined, the study planning objectives and constraints that will guide efforts to solve these problems and achieve these opportunities are defined.
- **Inventory and Forecast Resource Conditions –** This step characterizes and assesses existing conditions in the study area and forecasts the most probable future without-project condition — hereinafter referred to as the "No Action Alternative" or "No Federal Action Alternative"— over the period of analysis. The No Action Alternative is what the area and its uses are anticipated to be like over a 50-year period of analysis without any implemented Federal project as a result of this study. The No Action Alternative provides the basis from which alternative plans are formulated and impacts are assessed.
- **Formulate Alternative Plans –** Potential features are proposed to meet the identified objectives. Specific design measures are developed for these features. These measures are combined into alternative plans in a systematic manner to ensure that reasonable alternatives are evaluated.
- **Evaluate Alternative Plans** – The evaluation of effects is a comparison of the future with-project condition and future without-project condition of each alternative.
- **Compare Alternative Plans** – Alternative plans, including the No Action Alternative, are compared against each other with emphasis on the outputs and effects that will have the most influence in the decision making process. The comparison step can be defined as a reiteration of the evaluation step, with the exception that plans are compared against each other and not against the future without-project condition.
- **Select Alternative –** A single alternative plan is selected for recommendation from among all those plans that have been considered. The culmination of the planning process is either a Tentatively Selected Plan and ultimately a Recommended Plan or the decision to take no action. In general, the alternative plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment, the National Economic Development (NED) Plan, shall be selected. The Assistant Secretary of the Army for Civil Works [ASA(CW)] may grant an exception when there are overriding reasons for selecting another plan based on other Federal, state, local, and international concerns. In addition, a categorical exemption to the above NED Plan selection, as described in ER 1105-2-100, paragraph 3-3b(11) applies if the non-Federal sponsor identifies a constraint to maximum physical project size or a financial constraint due to limited resources, and if net benefits are increasing as the constraint is reached. In that case, the requirement to formulate larger scale plans in an effort to identify the NED Plan is suspended, and the constrained plan may be recommended.

The LCR at Winslow Feasibility Study followed the six-step planning process previously described to develop a wide array of FRM features, measures, and alternative plans to address one or more of the planning objectives.

1.6.2. Report Organization

This report is an Integrated Feasibility Report and Environmental Impact Statement (IFR). As an IFR, it documents the six-step planning process described above and meets requirements of NEPA, 42 United States Code 4321 et seq., the Council on Environmental Quality's Regulations for Implementing NEPA, 40 Code of Federal Regulations (CFR) Parts 1500 to 1508, and the Corps' regulations for implementing NEPA, 33 CFR part 230 and ER 200-2-2. Chapters noted with an asterisk (*) are compliant with and required by NEPA.

- **Executive Summary***, summarizes the IFR. It stresses the major conclusions, areas of controversy (including issues raised by agencies and the public), and the issues to be resolved (including the choice among alternatives).
- **Chapter 1 Study Information**, provides background information concerning the project, project authorization, project status, and the scope of the study. The chapter also notes other previous related reports.
- **Chapter 2* Purpose and Need**, provides background information concerning the purpose and need, identifies problems and opportunities, study objectives, and planning constraints.
- **Chapter 3* Plan Formulation**, describes the planning process with respect to the selection of alternative plans. In this chapter, the formulation, analysis, and comparison of alternatives are described. Descriptions of the alternatives under consideration are also provided.
- **Chapter 4* Affected Environment**, provides a detailed presentation of the existing environmental conditions within the study area. This chapter also includes a discussion of the environmental resources that may be affected by implementation of project alternatives.
- **Chapter 5* Environmental Impacts**, describes the potential environmental consequences. This chapter qualitatively and quantitatively describes the impacts as a result of implementation of alternative plans relative to the No Action Alternative.
- **Chapter 6* Compliance**, addresses compliance with environmental laws, regulations, and policies.
- **Chapter 7* Public Involvement, Review, and Coordination**, summarizes the coordination with agencies and the public that has taken place during the study.
- **Chapter 8* Recommended Plan**, provides the cost sharing for the recommended plan, the steps for the study prior to project authorization, and the Federal and non-Federal responsibilities for the project.
- **Chapter 9: Recommendations**
- **Chapter 10* List of Preparers**, provides a listing of preparers of this report.
- **Chapter 11* References**, lists the references cited throughout the report.
- **Chapter 12* Mailing List**, provides the list of agencies, organizations, and persons to whom copies of the report are sent.
- **Chapter 13* Index**

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2.0 PURPOSE AND NEED *

2.1. Statement of Need

The City of Winslow, Arizona, and vicinity are at risk of flooding under moderate to high flow events on the LCR mainstem. An existing levee system has been built to reduce the flood risk to the City of Winslow and immediate vicinity; however, this levee system is at risk of overtopping or failure under current conditions.

The existing levee system consists of the Winslow Levee and the RWDL. The Winslow Levee is owned and maintained by Navajo County, while the City of Winslow owns and maintains the RWDL. The Winslow Levee is an approximately 7.2-mile-long structure built along the west side of the LCR between 1986 and 1989 by the Arizona Department of Water Resources (ADWR) and Navajo County. Its upstream terminus is located approximately 0.2 miles southwest of the BNSF Railroad Bridge, where it ties into the RWDL. The downstream terminus is located approximately seven river miles downstream. The Winslow Levee was designed to contain the one percent annual chance exceedance (ACE) (100-year) flood on the LCR mainstem. The one percent ACE flood, when the levee was constructed, was estimated to have a flow of 65,000 cubic feet per second (cfs). The 5.3-mile-long RWDL was built by the Corps between 1968 and 1971. The purpose of this levee is to divert Ruby Wash flows away from downtown Winslow and eastward into the LCR mainstem.

The Winslow Levee no longer provides the level of flood damage reduction for which it was designed, and is at risk of failure or overtopping under current conditions. Reduced channel capacity due to sediment aggradation, accumulation of Aeolian deposits (sand dunes) in the floodplain, and obstruction of flow by vegetation in the channel contribute to the risk of failure or overtopping of the existing levee. In addition, lateral channel migration by the LCR threatens to undercut the levee foundation (a process called impingement). There are multiple impingement points along Ruby Wash and LCR. The BNSF Railroad Bridge crossing the LCR also limits channel conveyance capacity. The current elevation of the railroad bed at the west end of the bridge further limits the vertical extent to which the existing levee can be raised to convey damaging floods. Finally, a Corps reanalysis of watershed hydrology has increased the estimate for the one percent ACE discharge at Winslow to 69,200 cfs.

On January 8, 1993, a flood event with an estimated peak discharge between 70,000 cfs and 75,000 cfs overtopped the Winslow Levee (Sabol, 1993; Delph Engineering, 2009). As a result, a 3,000-foot section of levee was damaged, including a 400-foot section that was washed out entirely. Properties were flooded in Ames Acres, Bushman Acres, and other areas behind the levee. Of the 204 structures inundated by this event, 140 of them sustained substantial damages.

On December 31, 2003, the Winslow Levee experienced a second failure caused by lateral movement of water through a sand layer in the levee foundation. This water flowed under the impermeable cutoff wall in the levee core, and boiled up on the land side of the levee (piping failure). There was little or no damage to the surrounding community from this event due to its

quick discovery and immediate action to address the failure by Navajo County. However, this event suggests that the levee remains at risk of failure from similar events.

The City of Winslow is at risk of flood damage due to failure of the Winslow Levee before the LCR rises high enough to overtop the levee. This levee failure may occur for events more frequent than the two percent ACE (50-year) flood, with an increasing probability of failure for larger events.

A Winslow Levee failure similar to the one experienced in 1993 would cause greater damages today, as it would threaten additional structures. A larger flood or levee failure could threaten approximately two-thirds of the City of Winslow. The history of flooding along the LCR at Winslow led the Federal Emergency Management Agency (FEMA) to review and ultimately decertify the Winslow Levee on September 26, 2008. This was a result of the frequent levee breaches from channel migration and underseepage that occurred during a greater than one percent chance of occurrence in any given year. The levee does not meet FEMA requirements of containing the one percent ACE event because of its insufficient capacity and levee competence (susceptibility to failure).

The RWDL is also at risk of failure due to the changed conditions on the LCR mainstem described for the Winslow Levee above. While the RWDL continues to serve its intended purpose of diverting damaging Ruby Wash flows away from Winslow, this levee was not designed or intended to address flooding along the LCR mainstem. Any improvements to the Winslow Levee would not prevent a breach at the junction with RWDL because their hydraulics are conjoined, i.e., their water surface profiles are the same. The easternmost portion of the RWDL is subject to overtopping from LCR mainstem flows. The RWDL could also fail before overtopping during a flood as frequent as the four percent ACE (25-year) event. A levee failure at this location could cause damage to the City of Winslow and other areas behind the levee.

The RWDL is included in the USACE Levee Rehabilitation and Inspection Program (RIP). Levees included in the RIP are periodically inspected by the USACE to assess the integrity of the levee, and recommend actions to reduce flood risks to the public, property and the environment. The RWDL was last inspected by the USACE on April 7, 2014. This inspection identified multiple deficiencies with the RWDL, including severe erosion rills, presence of non-compliant vegetation, and uncompleted video inspections for several siphons that penetrate the levee. As a result of this inspection, the RWDL was given a USACE System Rating of Unacceptable. The findings of this inspection were provided to the City of Winslow in a Periodic Inspection Report dated June 4, 2015. The City of Winslow has since corrected the levee deficiencies listed in the inspection report. The City is coordinating with the Los Angeles District, Dam and Levee Safety Section to document the corrections in accordance with Los Angeles District Levee Deficiency Correction Procedures. The Dam and Levee Safety Section will review the Deficiency Corrections submittal to determine if the deficiencies have been adequately addressed

Approximately 1,600 structures, including almost the entirety of the city's critical public facilities (hospitals, schools, nursing homes, utility infrastructure, etc.), are located within the one percent ACE (100-year) floodplain. Expected average annual damages for the current condition due to flooding exceed $10 million.

Thousands of residents are at risk from failure or overtopping of the levee system. Many areas would be quickly inundated with several feet of water, leading to significant public health and safety risks. Some of these risks include the potential for physical injury, vehicular entrapment, and/or drowning. In some areas along the RWDL, flood depths for the one percent ACE flood can exceed 10 feet. Therefore, there is potential for loss of life and property due to flooding and repeated failure of the Winslow Levee or failure of the RWDL.

2.2. Statement of Purpose

The purpose of the proposed project is to reduce risk of property damages and the life, safety, and health risks caused by flooding from the LCR to the City of Winslow, surrounding community, and public and private infrastructure.

2.3. National Objectives

The National or Federal objective of water and related land resources planning is to contribute to NED consistent with protecting the Nation's environment pursuant to national environmental statutes, applicable Executive Orders, and other Federal planning requirements. Contributions to NED include increases in the net value of the national output of goods and services, expressed in monetary units. These contributions are the direct net benefits that accrue in the study area and the rest of the Nation.

2.4. Public Concerns

As described in the 905(b) Reconnaissance Report, the primary flood-related problems in the study area are the potential for loss of life and property due to flooding and repeated failure of the Winslow Levee. Additional problems include lateral channel migration, reduced channel capacity due to sedimentation, and obstruction of flow by vegetation. Primary ecosystem problems are invasive, non-native saltcedar that impedes conveyance and results in loss of native riparian habitat and wetlands. Cultural resources are also at risk of being damaged by flood events and associated soil erosion. The Hopi Tribe and the Arizona State Museum have also expressed concern regarding potential impacts of flooding and erosion to Homolovi State Park located on the east bank of the LCR.

A public scoping meeting was held on March 24, 2009, and attended by 38 people. Attendees consisted of representatives from the Corps, non-Federal sponsor, other local, state, and Federal agencies, and the general public. The primary public concern is the threat of levee failure and flooding to the Winslow area and vicinity. Deaccreditation of the Winslow Levee by FEMA is another important concern. Due to the levee deaccreditation, residents with federally-backed mortgage loans are required to purchase flood insurance.

2.5. Problems and Opportunities

The evaluation of public concerns reflects a range of needs and desires perceived by the public. This section describes these needs in the context of problems and opportunities.

2.5.1. Problems

- The existing levee system is at risk of overtopping and does not provide the flood risk reduction for which it was designed, exposing the City of Winslow, the surrounding community, and critical facilities (e.g., hospitals, schools, nursing homes, utility infrastructure, etc.), and cultural/historic resources to significant flood risk, flood related damages, and life, safety, and health impacts.
- The existing levee system includes components of older, non-engineered levees that do not meet current design, construction, or reliability analyses, leading to a risk of underseepage and piping failure, leading to the risks and damages listed above.
- Lateral channel migration, reduced channel capacity due to sedimentation, and obstruction of flow by vegetation such as saltcedar contribute to the risk of levee overtopping and failure.

2.5.2. Opportunities

- Reduce the probability and severity of flood damages from the LCR to the City of Winslow, the surrounding community, critical public and private facilities, and cultural/historic resources.
- Reduce life, safety, and health risks and impacts within the study area due to flooding of the LCR.
- Restore natural and beneficial uses of the floodplain.

2.6. Planning Objectives

The goal of the study is to identify a sustainable flood risk management solution for the City of Winslow and vicinity regarding flooding caused by the LCR. Specific planning objectives have been identified to solve the problems by taking advantage of opportunities. These planning objectives are as follows:

- Reduce the life, safety, and health risks caused by flooding of the LCR to the City of Winslow, surrounding community, and critical infrastructure through the 50-year period of analysis.
- Reduce risk of damages caused by flooding of the LCR to the City of Winslow, surrounding community, and critical infrastructure through the 50-year period of analysis.

2.7. Planning Constraints

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. Further, plan formulation must provide safe conditions in the interest of public safety. The planning constraints considered to this point are as follows:

- Minimize adverse hydraulic effects (increased water surface elevations) that induce flood damages.
- Minimize adverse flood inundation and erosion impacts to the Homolovi I Pueblo and other cultural/historic resources.

- Minimize adverse impacts to existing transportation corridors (i.e., I-40, State Highway 87, and the BNSF Railroad).
- Minimize adverse impacts to threatened, endangered, and special status species, if found in the project area.

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3.0 PLAN FORMULATION

Plan formulation, encompassing the six-step planning process, develops and evaluates alternative plans to address the planning objectives that were described in Chapter 2.0. Development, evaluation/comparison of alternative plans, and the identification of a Recommended Plan are described in this section of the report.

3.1. Plan Formulation Strategy

Several strategies were applied to the formulation and evaluation of alternatives. Initially, after identification of problems, opportunities, constraints, and study objectives, a set of management measures were identified during a planning charrette and considered in the study. Based on input at the charrette and follow up information, management measures were identified, and a preliminary array of alternatives was developed. These alternatives were evaluated, screened, and in several cases modified or combined to result in a focused array of alternatives. In addition, three alternatives were developed and included in the focused array. The focused array of alternatives was further evaluated, which included hydraulic and economic modeling to assess flood damages reduced (benefits of the alternative), and residual damages and flood risk with the alternative plans in place. Implementation costs for each of the focused array of alternatives were also developed. The plan with the greatest net benefits was then selected for optimization. The following sections detail the measures and alternatives developed and the evaluation of alternative plans.

The study was conducted to be in compliance with Executive Order (EO) 11988, Floodplain Management. EO 11988 requires Federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of natural floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, “each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities.” To comply with EO 11988, projects are formulated and recommended that, to the extent possible, avoid, minimize and/or mitigate adverse effects associated with use of the floodplain, and avoid inducing incompatible development in the floodplain unless there is no practicable alternative.

3.2. Planning Process Initial Array

A three-day planning charrette was held in Winslow, Arizona, on May 29-31, 2012. The primary purpose of this charrette was to use a collaborative process to expedite plan formulation for the preliminary array of alternatives. Participants in the charrette workshop included representatives from the Corps, Navajo County Flood Control District, City of Winslow, Arizona Game and Fish Department, Arizona Department of Environmental Quality, Arizona Department of Water Resources, Hopi Tribe, Navajo Nation, Pueblo of Zuni, Arizona State Parks, U.S. Geologic Survey, Arizona State Museum, and BNSF. Forty-five participants attended the workshop for one or more of the three days.

3.2.1. Management Measures

A management measure is a feature or activity at a site that addresses one or more planning objectives. Many measures are ineffective as stand-alone alternatives or do not meet objectives, but can be combined with other measures. The following management measures were identified during or following the charrette.

a. Nonstructural

- Flood-prone property acquisition. The purchase of property from willing sellers in flood-prone areas.
- Improve existing flood warning and evacuation system. Flood Warning Systems alert inhabitants in flood prone areas of impending high water. Depending on the type of warning system and advance time, inhabitants have the opportunity to evacuate damageable property and themselves from the flood prone area.
- Elevate homes. Elevation involves raising the buildings in place so that the structure sees a reduction in frequency and/or depth of flooding during high-water events. Elevation can be done on fill, foundation walls, piers, piles, posts or columns. Selection of proper elevation method depends on flood characteristics such as flood depth or velocity.
- Relocate structures. Relocation involves moving the structure to another location away from flood hazards. Relocation is the most dependable method of protection and provides the benefit of use of the evacuated floodplain.
- Floodplain regulations. Land use regulations are effective tools in reducing flood risk and flood damage. The principles of these tools are based in the National Flood Insurance Program (NFIP), which requires minimum standards of floodplain regulation.
- Wet Floodproofing. Allows floodwater to enter the structure, equalizing hydrostatic forces on the inside and outside of the structure to reduce the risk of structural damage. Vulnerable items such as utilities appliances and furnaces are relocated or waterproofed to higher locations.
- Dry Floodproofing. Involves sealing building walls with waterproofing compounds, impermeable sheeting, or other materials to prevent the entry of floodwaters into damageable structures. Dry floodproofing is applicable in areas of shallow, low velocity flooding.
- Floodplain Restoration. Fully or partially restoring a river's floodplain to its original conditions before having been affected by the construction of levees and the draining of wetlands. The objectives of restoring floodplains include the reduction of flood risk, aquatic habitat restoration, and the improvement of water quality.

b. Structural Non-Levee Measures

- Upstream detention on the LCR and/or tributaries (i.e., Clear Creek and Chevelon Creek). Construction of one or more upstream earthen detention dams on LCR tributaries, Clear Creek and/or Chevelon Creek, to attenuate flood flows from the south only.

- In-Channel measures
  - * Sediment removal. Excavation of in-channel sediment accumulation.
  - * Invasive species (e.g., saltcedar) removal.
  - * Channelization. A method of river engineering that widens or deepens rivers to increase the capacity for flow volume at specific sections of the river. As a result, during flood times, watercourses can move more efficiently and facilitate more water, which results in less damage to banks.
  - * Concrete-lined channel. A channel that has concrete invert and concrete side slopes.
  - * Channel training structures. Dikes or energy dissipators to slow water down and train the flow toward the main channel and away from the levee.
  - * Improve conveyance at bridges. Removal of obstructions, such as accumulated sediment and vegetation, to increase the volume of floodwater that can be transported downstream with little or no damage.
  - * Grade control structure. A grade control structure is an earthen, wooden, concrete, or other type of structure built across a drainageway that reduces channel bed erosion and headcutting.
  - * Diversion upstream of bridges. Diversion of a portion of river flows under the BNSF Railroad into Cottonwood Creek, then east into the LCR on the downstream side of the BNSF Railroad Bridge. The purpose of this measure is to divert some floodwater around the flow constriction at the railroad bridge.
  - * Elevate BNSF Railroad Bridge. This measure consists of the actions needed to raise the existing BNSF Railroad Bridge, such as increasing pier height, raising the track bed, making needed modifications to bridge approach tracks, and either accommodating live rail traffic during the bridge work, or constructing a temporary shoofly. Elevation of the railroad bridge would increase the volume of water that can be conveyed under the bridge while allowing the height of the Winslow Levee to be raised where it is crossed by the railroad bed.
  - * Channelize Ruby Wash. Excavation of sediment from Ruby Wash, an Arizona Department of Transportation (ADOT)-constructed and maintained interior drainage feature east of downtown Winslow.

c. Structural Levee Measures

- Ring levee at individual structures as appropriate. Levee that completely encircles or “rings” an area subject to inundation from all directions.
- Floodwall. A wall usually constructed of stone or reinforced concrete, which may occasionally have plastic or steel components. Floodwalls are normally constructed in lieu of or supplement levees where the land required for levee construction is too expensive or not available.
- Bank armoring (e.g., soil cement, riprap/gabions, articulated concrete blocks). Various methods to harden earthen embankment to protect it from erosion and scour due to moving water.

- Sheet piles. Sections of sheet materials with interlocking edges that are driven into the ground to create a continuous wall that provides water or earth retention and excavation support. Sheet piles are most commonly made of steel, but can also be formed of timber or reinforced concrete.
- Sand filter. Dikes or energy dissipators to slow water down and train the flow toward the main channel and away from the levee.
- Extend bentonite core. Impermeable bentonite clay is used to fill a trench that is cut along the centerline of a levee that extends downward to an impervious material. An impervious material is any material that water cannot seep through.
- Slurry wall. A civil engineering technique used to build reinforced concrete walls in areas of soft earth close to open water, or with a high groundwater table to prevent under seepage in levee and dam construction.
- Toe drain. A subdrain installed along the downstream toe of a levee or dam to intercept seepage through the structure.
- Dike. An embankment constructed of earth or other suitable materials to protect land from overflows or to regulate water.
- New levee. A levee is a manmade structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. The "New levee" measure would entail construction of a levee along an alignment where a levee previously did not exist (see also "New setback levee" below).
- Raise levee height. The levee height will have a higher elevation than the existing condition.
- Levee reconstruction. Complete demolition of an existing levee down to the native soil, followed by construction of a new levee along the same or similar alignment. Materials in the demolished levee can either be wasted to a disposal location, reprocessed for the new levee construction, or some combination thereof.
- Levee rehabilitation. The improvement of an existing levee through replacement of deficient materials or construction for the purpose of improving the reliability and/or level of flood risk reduction provided; rehabilitation can consist of actions such as replacement of slope protection, installation of an impermeable core, or repairs to a levee damaged by a flood event.
- Realign levee/setback levee. A new levee constructed to replace all or part of an existing levee at a greater distance from a river channel in such a way to allow the river to meander in a more natural manner and occupy some or all of its natural floodplain during high water events (see also new levee).
- Floodgates at underpasses. A floodgate is a gate that can be opened or closed to admit or exclude water.
- Stoplogs. Logs, planks, cut timber, steel, or concrete beams fitting into end guides between walls or piers to temporarily close openings in levees, floodwalls, dams, or other hydraulic structures.

3.2.2. Refinement and Screening of Management Measures

Refinement of measures took place following the charrette. The feasibility study process involves successive iterations of alternative solutions to the defined problems. These solutions are based upon the study objectives and constraints, and address problems and opportunities that have been previously defined. As part of Federal guidelines for water resources projects, there are general feasibility criteria that must be met. According to the Planning Guidance Notebook, ER 1105-2-100, a project in a feasibility report must be analyzed with regard to the following four criteria:

- **Completeness** – The extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.
- **Effectiveness** – The extent that the plan meets the objectives.
- **Efficiency** – The extent to which an alternative plan is the most cost-effective means of alleviating risk to the public.
- **Acceptability** – The workability and viability of the alternative plan with respect to acceptance by Federal and non-Federal entities and the public, and compatibility with existing laws, regulations, and public policies.

In the initial phase of the study, the team developed measures to satisfy the four feasibility criteria.

Table 3-1 Measure Screening

Measures	Screening	Further Consideration
Nonstructural		
Flood-prone property acquisition	Incomplete and likely not feasible. Would need to relocate all structures to be effective.	N
Ring levee/floodwall at individual structures as appropriate	Incomplete and ineffective. Could be combined with other measures.	N
Improve existing flood warning/evacuation system	Incomplete, could be combined with other measures.	Y
Elevate homes	Incomplete, could be combined with other measures.	Y
Relocate structures out of flood prone areas	Incomplete and ineffective. Difficult finding suitable relocation sites.	N
Floodplain regulations	Incomplete and ineffective. Does not meet objectives on their own, could be combined with any other measures.	Y
Wet Floodproofing	Not permitted under NFIP regulations.	N
Dry Floodproofing	Not recognized by the NFIP for insurance premium rate reduction. Ineffective for construction typical of the Winslow area.	N
Restore Floodplain	Does not meet objectives.	N
Structural		
Upstream detention on LCR or tributaries	Incomplete, does not address objectives but may be combined with other measures.	Y

Table 3-1 Measure Screening

Measures	Screening	Further Consideration
In Channel		
Sediment removal/sediment basin	Could be combined with other measures, high O&M costs.	Y
Saltcedar removal	Could be combined with other measures, high O&M costs.	Y
Channelization	Could be combined with other measures, high environmental impact and O&M costs.	Y
Concrete-lined channel	Could be combined with other measures.	Y
Channel training structures	Could be combined with other measures.	Y
Grade control structure	Could be combined with other measures.	Y
Improve conveyance at bridges	Could be combined with other measures.	Y
Diversion upstream of bridges	Incomplete, ineffective, may not be technically feasible.	N
Elevate BNSF Railroad Bridge	Incomplete, inefficient and unacceptable.	N
Channelize Ruby Wash	Ineffective, incomplete.	N
Levee		
Bank armoring	Could be combined with other measures.	Y
Soil cement		
Grouted stone		
Riprap/Gabions		
Articulated concrete blocks		
Sheet pile	Ineffective due to depth of impermeable soil/bedrock.	N
Sand filter	Could be combined with other measures.	Y
Extend bentonite core	Ineffective due to depth of impermeable soil/bedrock.	N
Slurry wall	Ineffective due to depth of impermeable soil/bedrock.	N
Toe drain	Could be combined with other measures.	Y
Raise levee height	Could be combined with other measures.	Y
Rebuild levee	Complete, effective.	Y
Realign Levee/Setback Levee	Complete, effective.	Y
Rehabilitate levee	Complete, need further information on feasibility.	Y
Floodgates at underpasses	Block evacuation routes to be effective, high O&M costs.	Y

Measures eliminated from further study or eliminated from standalone consideration include the following:

- Flood-Prone Property Acquisition. While the buyout of at-risk structures would address the planning objectives, it would also require all property owners to voluntarily participate to be effective. This is unlikely to be the case and therefore would not provide a complete solution to the problem. Costs of this measure were also determined to not be incrementally justified. For these reasons, acquisition of flood-prone properties does not appear to be a viable measure for further consideration.
- Ring Levees. Ring levees were not considered practicable for widespread implementation due to logistics and cost but could be used on a case-by-case basis where nonstructural measures (e.g., elevation of residential structures) are proposed.
- Relocate Structures. Relocation, much like buyouts, would require extensive voluntary participation to be effective. In addition, there would need to be sufficient sites identified for the replacement structures, as significant new public infrastructure would be required to be relocated to the properties. This may be combinable with other measures on a case-by-case basis but further evaluation of relocation does not appear to be viable. Many of the properties in this area are ranchettes with livestock and equestrian interests. This makes relocation difficult because the replacement properties would need to have suitable zoning, size, and appropriate soils/vegetation for supporting grazing livestock. There are also numerous nonresidential outbuildings, fences, and other livestock-related infrastructure that would need to be moved or replaced.
- Wet Floodproofing. Wet floodproofing of residential structures would not be adequate to meet National Flood Insurance Program (NFIP) requirements for reduction or elimination of flood insurance, suggesting the measure would not be acceptable or effective; therefore, this measure was not carried forward.
- Dry Floodproofing. Dry floodproofing achieves flood risk reduction, but it is not recognized by the NFIP for any flood insurance premium rate reduction if applied to a residential structure. Based on laboratory tests, a “conventional” built structure can generally only be dry floodproofed up to three feet in elevation. The average height that those residential structures north of I-40 would be raised is 7.5 feet. A structural analysis of the wall strength would be required if it was desired to achieve higher protection. This concept also does not work with basements or crawl spaces. Flood depths in the downtown Winslow area vary between one and 10 feet. Many structures are very old, in poor condition, and are not suitable candidates for floodproofing. Sump pumps and perhaps French drain systems would likely be needed to be installed as part of the measure. Closure panels are used at openings below one percent ACE elevation. This concept does not work with basements nor does it work with crawl spaces. For buildings with basements and/or crawl spaces, the only way that dry floodproofing could be considered to work is for the first floor to be made impermeable to the passage of floodwater.
- Restore Floodplain. This measure recommends removing the levee and restoring the LCR floodplain. Floodplain restoration would not meet the objectives of the study, thus this measure is not carried forward as a standalone measure. The flood risk would remain.

However, if levee realignment or setback levees were to be found feasible, floodplain restoration could be part of those alternatives.

- Sediment Removal/Basin. This measure proposes removal of sediment from the LCR or construction of sediment basins upstream of the bridges. Removing sediment from the channel alone does not address the planning objectives nor does it fully address flood risks associated with the levee. Sediment basins would likely fill quickly during a flood event, be very expensive to maintain, and may not be technically, economically, or environmentally feasible. For these reasons this measure is not deemed viable for further consideration as a standalone measure. However, sediment removal could be effective when combined with other alternatives to further increase capacity of the channel and to reduce flood risks.
- Diversion Upstream of Bridges. This measure proposes to divert a portion of LCR flows upstream of the bridges to a new channel alignment under the BNSF railroad near the original alignment of Cottonwood Wash. This measure would not address problems associated with the levee or the planning objectives since the diverted water would rejoin the LCR mainstem on the downstream side of the BNSF Railroad Bridge. Aside from the hydraulic conflict (merging flows from two different directions at the bridge), the total flood flow from the BNSF Railroad Bridge downstream would remain unchanged. Furthermore, excavation work under the BNSF Railroad for the new channel might not be possible without temporarily closing the rail line. This measure is incomplete, ineffective, and may not be technically feasible. Therefore, it is not carried forward for additional evaluation.
- Elevate BNSF Railroad Bridge Elevating the railroad bridge would not address the problems with the levee system. Furthermore, it may not be technically feasible without closing a rail line that carries more than 100 trains per day. This measure is also likely to be rejected by the BNSF Railroad, and has an extremely high cost. For these reasons, raising the BNSF Railroad Bridge was eliminated from consideration.
- Channelize Ruby Wash. This measure does not address the planning objectives because it would only reduce localized impacts from an interior drainage feature, not from LCR mainstem flooding. For these reasons it is not viable to carry forward for additional evaluation.
- Sheet Pile. Use of sheet pile would provide deep scour protection for the riverside levee toe. This measure would also provide an impermeable underseepage cutoff if installed deep enough to reach an impermeable stratum under the levee foundation. A seismic refraction survey performed in 2013 indicated that bedrock was 50 to 100 feet deep in many areas along the Winslow Levee. It is likely not feasible to install sheet pile to the depth needed to achieve complete underseepage cutoff. A partial cutoff (not tied into bedrock or a continuous relatively impermeable stratum) was also considered; however, based on preliminary analysis, even a relatively deep (40+ feet) partial sheet pile cutoff would not be expected to significantly reduce levee underseepage in times of flood. Given the high costs associated with sheet pile installation and ineffectiveness of partial cutoffs in permeable soils, this measure was eliminated from further consideration.
- Extend Bentonite Core/Slurry Wall. A bentonite levee core or slurry wall would function the same as sheet pile; by providing an impermeable barrier to levee underseepage. Both of these measures were found to be unacceptable for the reasons described for sheet pile above.

- Floodplain Regulations. Navajo County already has floodplain regulations in place. For this reason, the measure was not considered for inclusion in alternatives. Both the non-Federal sponsor and the City of Winslow participate in FEMA's NFIP and have existing floodplain management/land use regulations or ordinances that are in compliance with the NFIP (44 CFR Ch. 1 et seq.) and the Arizona Revised Statutes Sections 48-3601 through 48-3650. Navajo County did not see the need to recommend updates to its floodplain management/land use regulations to identify where development can and cannot occur, or to what (higher) elevation structures should locate their lowest habitable floor to. The non-Federal sponsor will still be required to participate in and comply with applicable Federal floodplain management and flood insurance programs as a condition of implementation of any recommended plan.
- Stoplogs. Corps staff coordinated with the BNSF Railroad regarding the possibility of installing a stoplog across their tracks to serve as a levee closure in time of flood. BNSF stated that it does not employ stoplogs on any mainline rail line anywhere in their system, and would not allow one to be used as part of a flood risk reduction project for the City of Winslow. For this reason, use of stoplogs was screened from the array of potential measures.

3.2.3. Preliminary Alternatives

Management measures formulated at the charrette and not dismissed from further consideration were used and combined to develop seven preliminary action alternatives, which are described below. Conceptual designs and opinions of probable project and construction cost of major features were developed for each alternative soon after the charrette. Seepage measures were determined to be necessary for all alternatives, which included improvements to the levees, to prevent underseepage.

a. No Action Alternative

When formulating plans, NEPA regulations (40 CFR 1502.14(d)) and Corps guidance require that the No Action Alternative always be considered a viable alternative in any final array of plans. The without-project condition describes the future of the project area if no Federal action is taken to solve the problem at hand. The expected without-project conditions including expected annual flood damages were developed as part of the economic evaluation and serve as the basis for comparison against all potential Federal actions proposed to solve identified problems and take advantage of identified opportunities.

The No Action Alternative (referred to as Alternative 11 in Chapter 5.0) assumes that no Federal action would be undertaken to address the flood risk to the Winslow community. The Navajo County Flood Control District and the City of Winslow will continue operation and maintenance (O&M) activities for the existing Winslow Levee and RWDL, respectively. Repairs and improvements to the Winslow Levee are typically completed on a reactionary, post-flood basis by Navajo County. Under the No Action Alternative, the flood risk in the Winslow area is expected to remain essentially unchanged over the period of analysis, which is 50 years. The No Action Alternative is synonymous with the future without-project condition.

b. Alternative 1, Construct New Levee near Existing Alignment

Alternative 1 consists of the removal of the entire existing Winslow Levee and construction of a new 35,200-linear-foot levee that meets current engineering standards. The new levee would include a segment north of and parallel to I-40 to replace the section of I-40 that currently serves as part of the levee system. The I-40 highway embankment was not engineered to serve as a levee. The new levee would include excavation to establish adequate mitigation of potential seepage, erosion protection, and sufficient elevation to address the current height deficiencies. For this alternative, the conceptual seepage measure was an impervious slurry wall. This measure was previously determined as the feasible option to control seepage (ADWR, 1980). Erosion protection is assumed to be provided by soil cement, placed in 9-foot-wide, 8-inch-thick, horizontal lifts, prior to compaction and extending below the maximum scour depth. An advantage of soil cement over riprap revetment is its imperviousness. Soil cement will overlap the slurry wall and act as an extension to the impervious slurry wall to extend the boundary to the top of the levee. This will also have the economic benefit of reducing the amount of material required for the cutoff trench for the slurry wall. One drawback to this approach is the difficulty of access in the removal and replacement of the slurry wall if required during O&M.

c. Alternative 2, Rehabilitate Winslow Levee

Alternative 2 includes rehabilitation of approximately 35,200 linear feet of the Winslow Levee within and along the existing alignment to current engineering standards. The conceptual seepage mitigation measure for this alternative was assumed to include an impervious slurry wall. Erosion protection is assumed to be provided by soil cement, extending beyond the maximum scour depth. Soil cement is impervious and will overlap the slurry wall and serve as an extension to the impervious boundary to the top of levee. This approach will reduce the quantity of slurry wall required for the cutoff trench similar to Alternative 1.

d. Alternative 3, Realign Levee/Setback Levee

Alternative 3 includes the realignment and construction of a setback levee between RWDL and North Road and the rehabilitation of the existing levee downstream of North Road. The setback levee would continue across North Road and rejoin the existing Winslow levee alignment 2,800 feet north of North Road. Some of the levee deficiencies are exacerbated by the floodplain constriction of the existing levee alignment in several locations. In this alternative, the levee is proposed to be set back from the impingement point at the North Road alignment.

The realigned/setback levee includes both the construction of a new levee along a new alignment in the upstream segments, where the flood risk to Winslow is the greatest, and the rehabilitation in the downstream reach (north of North Road). This alternative requires construction of 20,500 linear feet of new levee and 15,900 linear feet of rehabilitated levee. Both the rehabilitated and new sections would provide adequate mitigation of potential seepage, erosion, and levee height deficiencies. The conceptual seepage mitigation measure for Alternative 3 was an impervious slurry wall similar to Alternatives 1 and 2. Erosion protection would be provided by soil cement extending beyond the maximum scour depth.

e. Alternative 4, New Levee Parallel to I-40, Floodgates at Underpasses, and Structure Elevation

Alternative 4 consists of a combination of structural and nonstructural measures. These include a new levee along the north side of I-40 and installation of flood gates at the three road underpasses (i.e., Transcon Lane, Oak Road-East Maple Street, and North Park Drive) and on two drainage channels. Flood closures for several other interior drainage features that penetrate the I-40 embankment would also be required. This alternative proposes a setback levee, approximately 21,700 linear feet extending southward from I-40 to the RWDL. The same typical levee design as the above alternatives has been assumed for this alternative.

Nonstructural measures, specifically, elevation of residential structures, would be implemented in areas north of I-40. Review of HEC-FDA results and assessor's data identified approximately 156 structures that may be elevated, or floodproofed. Additional information is described under Alternative 7 discussed later in this report.

f. Alternative 5, Upstream Detention

Alternative 5 proposes construction of one or more upstream detention dams on LCR tributaries, Clear Creek, and/or Chevelon Creek, to attenuate floodflows from the south only.

g. Alternative 6, Channelization of the Little Colorado River

Alternative 6 proposes to channelize the LCR to convey the 100-year peak discharge. Channelization would include saltcedar removal, excavation, and bank protection. The conceptual level channelized cross-section of the river would extend approximately 35,000 feet beginning near where the RWDL and Winslow levees meet and extend near downstream toward the end of the Winslow Levee.

h. Alternative 7, Nonstructural North of I-40

Alternative 7 proposes to elevate structures within the floodplain north of I-40. Elevation of residential structures was assumed at this time. This would include lifting and retrofitting the entire structure, or habitable area, to an elevation above a designated flood event. Each structure and specific requirements for elevating them are different; however, for this preliminary analysis, an average cost per structure was applied. It is assumed that most foundations are slab on grade but to account for differences in structure types, a distribution of costs (i.e., average cost per height elevated) was utilized in estimating costs.

Through review of HEC-FDA modeling results and assessor's parcel data, roughly 156 residential structures were identified for elevation or floodproofing. Because of existing conditions and anticipated flood impacts from flood events, it was assumed that each structure would have to be raised one foot above the modeled 100-year flood elevation. The average cost per structure would range between $115,700 and $131,700.

3.2.4. Preliminary Cost Estimates

Preliminary cost estimates, shown below in Table 3-2, were developed for all the alternatives except for Alternative 5. Alternative 5 was eliminated from further study prior to development of costs, as discussed in Section 3.3.1 below.

Table 3-2 Preliminary Costs

Alternative	Costs[1]
1	$87,952,900
2	$85,910,700
3	$82,783,300
4	$81,342,400[2]
6	$129,042,200
7	$28,346,800

[1] Price level 4th Quarter Fiscal Year 2012.
[2] Estimated costs include nonstructural costs shown under Alternative 7.

3.3. Alternative Evaluation and Comparison

The seven preliminary alternatives were evaluated and compared following the planning charrette. Alternatives 1 and 3 appeared viable for additional study. It should be noted that while both Alternatives 1 and 3 are assumed to be efficient, a comparison of costs to benefits was not conducted at this screening step. The Alternative 1 and 3 levee alignments may provide different levels of flood damage reduction when compared to the economic damages within the study area. Alternative 7 was also carried forward as a nonstructural alternative that could be combined with other alternatives. In addition, it was determined that any of the various nonstructural measures carried forward for further consideration could be added to any of the structural alternatives. Table 3-20 provides an overview of the alternative screening from the initial array to the focused array of alternatives.

3.3.1. Alternatives Eliminated from Further Study

The initial array of alternatives evaluated following the charrette resulted in several alternatives being eliminated from further consideration because they were found to be infeasible and/or due to obviously high environmental impacts. Based on the initial evaluation, the following alternatives were eliminated from further analysis.

a. Alternative 2, Rehabilitate Winslow Levee

Rehabilitating the Winslow Levee is not considered technically feasible for a number of geotechnical issues. There is no foundation or construction report available for the Winslow Levee, only drawings. These drawings show that unengineered 1960s-era levee remains in place beneath most of the length of the engineered 1989 Winslow Levee. The only levee section the drawings show as fully rebuilt is between I-40 and the Oak Drive drain (approximately 3,000 feet of the 7.5-mile levee). Seepage paths may exist anywhere under the engineered Winslow Levee. The Corps would need to expose and test these multiple contact planes at numerous locations along the levee.

All auto bodies and vegetation used to construct the original Winslow Levee were supposed to have been removed from the levee; however, both auto bodies and vegetation protrude from the levee embankment in the vicinity of McHood Road. This indicates that the section of the levee near McHood Road was not rebuilt. Thus, there is a conflict between the drawings showing that the levee was rebuilt and what can be observed on the ground.

Finally, there is no testing record from levee construction. The Corps will not increase the height of an existing levee without first verifying the existence of a processed foundation and removal of potential seepage planes. To access the foundation to process it, then verify sufficient processing with testing, the existing levee would need to be demolished.

For the reasons stated above, the measure on which Alternative 2 was proposed was found to not be technically feasible. Therefore, Alternative 2 was not effective or implementable and was screened from further consideration. Note that the similar Alternative 1, Construct New Levee near Existing Alignment, was retained for further consideration.

b. Alternative 4, New Levee Parallel to I-40, Floodgates at Underpasses, and Structure Elevation

In addition to a new levee parallel to I-40 from the LCR floodplain west to North Park Drive (a distance of 3.5 miles), this alternative included floodgates at two I-40 underpasses, and nonstructural measures north of I-40. The alternative was not efficient as its costs were high compared to other alternatives in relation to the amount of flood protection provided and would transfer flood risks. It would place some residences (Bushman Acres and Ames Acres) in the floodplain that are currently on the land side of the existing levee and would have substantial maintenance obligations and operational impacts. Alternative 4 would require closeable floodgates at the North Park Drive, East Maple Street, and Transcon Lane I-40 underpasses, negatively affecting evacuation routes. This alternative could also create interior drainage issues because it would require temporary closure of stormwater drainage routes under I-40. Extending the levee north along the current alignment would provide greater flood risk reduction benefits than the levee alignment proposed for Alternative 4. The cost of levee and floodgate construction was also determined to exceed the possible costs of levee construction along the current alignment. Therefore, this alternative was dismissed from further consideration.

c. Alternative 5, Upstream Detention

Although hydrological data indicate that some flood discharges in Winslow have originated in the Clear and Chevelon Creek watersheds, construction of detention dams in these watersheds would not address the overall flood risk to the City of Winslow and within the study area, or meet the planning objectives to a high degree. Dams would not address existing issues with the levee or floods on the LCR mainstem. They may not be effective at controlling peak flow or duration of flows along the LCR at the Winslow Levee, since the source and timing of floods vary with each storm event. In addition, it would likely be impracticable to site dams in the watersheds without significant environmental impacts including those to critical habitat for endangered species.

One of the best potential dam sites in the upstream watersheds would displace a 215-acre-in-lieu-fee mitigation site administered by the Arizona Game and Fish Department for impacts to Waters of the U.S. authorized under Section 404 of the Clean Water Act. Mitigation work on the site entailed the restoration of 120 acres of emergent wetland and 55 acres of riparian gallery forest from impacts caused by overgrazing and introduction of exotic species. The site has documented use by 44 different bird species, including the federally endangered Southwest willow flycatcher. The federally threatened Little Colorado Spinedace is also known to exist in the area. Additionally, the project area includes numerous historic and prehistoric sites.

There is no intuitive site for a dam on the LCR mainstem, and any site would likely have similar environmental impacts and require a significant amount of real estate. Upstream detention would not address the history of the Winslow Levee failures and existing deficiencies. The levee would still be subject to flood threat from the LCR mainstem. This alternative would have low potential to meet the planning objectives and would likely have significant environmental impacts; therefore, it is not carried forward.

d. Alternative 6, Channelization of the LCR

While channelization may alleviate the issue of impingement and erosion, the risk of levee overtopping and piping failure would remain. Channelization of the river in this reach would also have several impacts likely violating constraints and making the alternative unacceptable. These include the potential to increase flooding downstream. Channelization would also likely have substantially greater impacts to waters of the United States than other alternatives. The preliminary cost for Alternative 6 was approximately $129 million and would not be economically justified. To be complete, Alternative 6 would require levee improvements and mitigation requirements, and costs would have been prohibitive. Therefore, this alternative was dismissed from further consideration.

Screening of the seven alternatives in the preliminary array is summarized in the following table.

Table 3-3 Screening of Preliminary Array of Alternatives

Alternative	Effectiveness	Efficiency	Acceptability	Completeness	Carry Forward
1	Meets objectives	Northern levee segment may not be economically justified	Supported by the non-Federal sponsor	Complete	Yes
2	Levee rehabilitation is not technically feasible; existing levee would need to be demolished to complete necessary testing	Northern levee segment may not be economically justified	Levee rehabilitation is not technically feasible	Incomplete	No
3	Meets objectives	Northern levee segment may not be economically justified	Requires highest number of residential relocations	Complete	Yes
4	Meets objectives	Includes uneconomical increment	Requires closure of I-40 access points in times of flood; high residual risks and risk transfer	Incomplete	No
5	Does not meet objectives.	Preliminary cost not developed, but may be the highest cost of all plans considered	Logical dam sites would have very high environmental impacts; possibility of transferred risks	Incomplete; does not address levee system deficiencies	No
6	Does not meet objectives.	Has highest cost of all alternatives considered	Very high environmental impacts; not supported by the non-Federal sponsor	Incomplete; does not address levee system deficiencies	No
7	Partially meets objectives; may be combinable with other plans	Cost may exceed benefits; requires voluntary participation	Includes features that the non-Federal sponsor does not want to participate in; low environmental impacts	Incomplete; does not address levee system deficiencies	Yes

3.4. Refined Preliminary Array of Alternatives

Following the preliminary formulation and initial assessment of the preliminary array of plans, Alternatives 1, 3, and 7 were carried forward for further consideration. Alternatives 1 and 3 were refined using newly collected information. In addition, Alternatives 8, 9, and 10 were developed and included in the refined array. Table 3-20 provides a summary of the preliminary array as well as the screening criteria.

3.4.1. Refinement of Alternatives

The alternatives carried forward were refined to provide a similar level of flood risk reduction, as measured by an approximately 90 percent assurance of containing the one percent ACE event. Alternatives that included levee rehabilitation were also refined to substitute rebuilding for rehabilitation since rehabilitation is not considered feasible. Alternatives 1 and 3 were refined to address several issues based on site conditions, as described below.

a. Seismic Profiling

After the team completed seismic profiling, alternatives were refined to eliminate use of physical cutoffs such as slurry walls initially contemplated in Alternatives 1 and 3. Competent bedrock is far too deep to tie into with any affordable means of a physical cutoff, such as slurry walls, concrete walls, bentonite cores, or sheet pile. Consequently, the conceptual design for a rebuilt/more robust levee changed from one with a deep cutoff wall to one that would function under conditions of deep, highly permeable foundation materials. That conceptual design is a levee with a high-permeability gravel drain that outlets on the landside. This drain would serve to drop seepage pressures and allow the levee to perform acceptably even with its deep, permeable foundation material. Some of the RWDL could be tied into bedrock below the levee base but is a very small part of the total levee length being assessed in this study. The seepage-stabilized design was incorporated into Alternatives 1 and 3.

b. BNSF Bridge Constriction

Since elevating the BNSF Bridge was eliminated during preliminary formulation due to excessive cost, preliminary alternatives included a moveable stoplog that would effectively extend the Winslow Levee across the railbed when closed to address flooding and elevation changes. Such a stoplog would normally remain open, allowing free passage of rail traffic. When flooding threatens, the stoplog would either swing or slide shut, temporarily eliminating the gap in the levee system. Closure of the stoplog would also require closing the railroad tracks to train traffic until the floodwaters receded, and the stoplog could be safely opened.

Corps staff coordinated with the BNSF Railroad regarding installation of a stoplog across their tracks at the west end of the railroad bridge crossing the LCR. BNSF stated that it does not employ stoplogs on any mainline rail line anywhere in their system, and would not allow one to be used for the proposed alternative.

With the stoplog eliminated from consideration, the vertical height of the existing levee is limited to its crest elevation under the tracks at the west end of the BNSF Railroad Bridge, and

the only other option was to increase conveyance and lower the elevation of floodwaters. The Corps conducted hydraulic analysis of measures to decrease the flood hazards caused by the overtopping of the bridge, as well as the Winslow Levee on the west bank of the LCR. These measures consisted of excavating and widening the channel, removing saltcedar, lining a portion of the river bottom with concrete, extending the railroad bridge opening, and installing culverts on either side of the railroad bridge. The measures were intended to convey the one percent ACE flood (69,200 cfs). Saltcedar removal alone was determined to be insufficient to provide adequate conveyance. After evaluating the channel lengths and depths necessary to provide conveyance, approximately 2,500 feet of earth-lined LCR channel excavation and widening with 96 acres of additional saltcedar removal was incorporated into Alternatives 1 and 3. Analysis of the alternatives for improving conveyance under the BNSF Railroad Bridge is provided in Appendix B - Hydraulics, Section 10.2, and in Attachment 5.

c. Additional Refinement of Alternative 3

As described above, preliminary Alternative 3 included setting back the Winslow Levee south of I-40 approximately 0.8 miles to the west from its current location. The setback levee would join the RWDL approximately 0.9 miles west of the current abutment between the RWDL and the Winslow Levee.

The rationale behind the proposed levee setback south of I-40 was to realign the levee to the west in order to tie into higher ground. It was initially anticipated that the elevation of the BNSF railroad tracks would gradually increase to the west as distance from the LCR increased. Setting back the levee to the west was expected to eliminate the need to install a stoplog structure across the railroad at the Winslow Levee. However, surveys of the railroad grade determined that the elevation of the railbed actually decreased. Thus, the setback levee alignment would require a higher stoplog than the one eliminated from consideration above.

Because a stoplog is impractical, the portion of the Winslow Levee setback south of I-40 was deleted from Alternative 3. The setback levee south of I-40 would have tied the Winslow Levee north of I-40 into the RWDL south of I-40, providing a complete levee system to reduce the risk of flooding. Without this setback levee, the segments of the levee system would be offset by 0.7 miles at I-40 (leaving a gap along I-40, between levee segments). To provide a continuous levee, the 0.7-mile offset can be closed by constructing a levee north of and parallel to I-40 to join the offset segments of the Winslow Levee. Therefore, construction of a new levee segment parallel to I-40 was incorporated into the refined Alternative 3 to provide a continuous levee.

With these aforementioned refinements, Alternatives 1 and 3 were renumbered as Alternatives 1.1 and 3.1, respectively, and included in the focused array.

d. Flood Warning System

All alternatives carried forward would include a flood warning system, consisting of a flood detection network (including a communication system) and an emergency response/evacuation plan.

3.4.2. Development of Alternatives 8, 9, and 10

Alternative 8 was formulated by the non-Federal sponsor, following availability of the new information regarding depth to bedrock, infeasibility of rehabilitating the existing levees, the elevation of the BNSF Railroad grade, and the hydraulic measures at the railroad bridge. Navajo County proposed a plan that would provide a FEMA-accredited levee system that closely follows the existing levee alignment, with a setback levee across from Homolovi I. Alternative 8 consists of the following components: rebuild most of the Winslow Levee along its current alignment; set back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo; remove the original Winslow Levee in the setback area; rebuild the eastern end of the RWDL to protect against seepage from flows backing up from the constriction on the LCR mainstem; construct a new levee parallel to I-40; and improve conveyance under the BNSF Railroad Bridge through saltcedar removal and excavation of accumulated sediment (channelization). The levee setback at Homolovi I would provide additional floodplain width at a location where the LCR has persistently impinged upon the Winslow Levee. New levee construction would be designed to provide an approximately 90 percent assurance of containing the one percent ACE event. Alternative 8 would also include a flood warning system.

Alternative 9 would consist of a smaller increment of Alternatives 1.1 and 3.1. Alternative 9 addresses the levee segment most susceptible to failure and would cause the most damage to Winslow if it does fail. Under Alternative 9, the easternmost 2,000 feet of the RWDL would be reconstructed at its existing height. Alternative 9 would also include a flood warning system.

Alternative 10 was developed as an alternative based on the damage centers, looking at economic breakpoints based on reaches. Reach 1 includes the majority of the City of Winslow located south of I-40. Reach 2 includes the rest of the structures north of I-40 (refer to Section 3.5.1 and Figure 3-6 for additional information on Reaches 1 and 2). Alternative 10 includes two major increments: levee improvements in the upstream reach that provide risk reduction throughout Reach 1 and a nonstructural plan that features raising floodplain structures above the one percent ACE flood elevation in the downstream Reach 2.

The extent of structural levee improvements was determined utilizing hydraulic and economic analysis. The Corps conducted two-dimensional hydraulic analyses using FLO-2D to model levee failures at locations along the Winslow Levee and RWDL. Multiple scenarios were modeled to simulate one or more levee breaches at various locations along the levees. Through comparison of the floodplains resulting from different scenarios, economic damages were calculated for the various levee failure scenarios. Using this analysis, an economic breakpoint was identified where a levee breach was sufficiently far enough downstream such that the floodwaters would not reach the most developed parts of the City of Winslow. Levee reconstruction from this point downstream would produce far less economic benefit than levee reconstruction further upstream. The nonstructural measure of elevating residential structures was included in Alternative 10 for the downstream Reach 2.

3.5. Focused Array of Alternatives

The focused array of alternatives is summarized in Table 3-4 and described in the following pages. All of the alternatives include the nonstructural measure of a flood warning system. Detailed alternative descriptions may be found in the Appendix D - Design.

Table 3-4 Focused Array of Alternatives

Feature or Measure	Alternative					
	1.1	3.1	7	8	9	10
No Levee Improvements			X			
Rebuild Winslow Levee – Full Length of Existing	X	X		X		
Rebuild Winslow Levee – North Road						X
Homolovi I Winslow Levee Setback				X		X
I-40 to North Road Winslow Levee Setback		X				
Levee Parallel to North Side of I-40	X	X		X		X
Rebuild 2000' of Ruby Wash Diversion Levee	X	X		X	X	X
LCR Channelization at BNSF for 1% ACE Flood	X	X		X		X
Elevate Residences North of I-40 (Nonstructural)			X		X	
Elevate Residences North of North Road (Nonstructural)						X
Flood Warning System (nonstructural)	X	X	X	X	X	X
Levee Height for 44,780 cfs (~2.8% ACE Flood)					X	
Levee Scale for 1% ACE Flood	X	X		X		X

Alternative 1.1, Rebuild Levee System along Current Alignment (1 Percent ACE Flood)

Rebuild the Winslow Levee and the eastern end of the RWDL along their current alignments, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge by removing saltcedar and accumulated sediment. The project would be designed to contain the one percent ACE flood with an approximately 90 percent level of assurance.

Alternative 3.1, Rebuild Levee System with Extensive Winslow Levee Setback (1 Percent ACE Flood)

Rebuild part of the Winslow Levee along its current alignment, set back part of the Winslow Levee north of I-40, remove the original Winslow Levee in the setback areas, rebuild the eastern end of the RWDL along its current alignment, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge by removing saltcedar and accumulated sediment. The project would be designed to contain the one percent ACE flood with an approximately 90 percent level of assurance.

Alternative 7, Nonstructural Measures Only

Employ nonstructural flood risk management measure of elevation of residences located north of I-40 only. The project would not include levee or conveyance improvements.

Alternative 8, Rebuild Levee System with Homolovi I Levee Setback (1 Percent ACE Flood)

Rebuild most of the Winslow Levee along its current alignment, set back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo, remove the original Winslow Levee in the setback area, rebuild the eastern end of the RWDL, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge by removing saltcedar and accumulated sediment. The project would be designed to contain the one percent ACE flood with an approximately 90 percent level of assurance.

Alternative 9, Rebuild RWDL at its Current Height (2.8 Percent ACE [36-Year] Flood)

Rebuild the eastern end of the RWDL at its existing height, no improvements to the Winslow Levee, no conveyance improvements, and use of nonstructural measure of elevation of residences north of I-40. This alternative would reduce the risk of flooding for events up to the 2.8 percent ACE (36-year) flood (LCR flows up to 44,780 cfs).

Alternative 10, Rebuild RWDL & Winslow Levee (to North Road) with Nonstructural Measures (1 Percent ACE Flood)

Rebuild the Winslow Levee from the RWDL downstream to a point 0.8 miles north of North Road, no improvements to the Winslow Levee downstream of this point, set back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo, remove the original Winslow Levee in the setback area, rebuild the eastern end of the RWDL, construct a new levee parallel to I-40, improve conveyance under the BNSF Railroad Bridge by removing saltcedar and accumulated sediment, and employ nonstructural measures for residences downstream of North Road. Alternative 10 would provide structural measures to address the flood risk for the most densely developed portions of Winslow, with use of nonstructural measures to reduce the risk further downstream. The project would be designed to contain the one percent ACE flood with an approximately 90 percent level of assurance.

Alternative 11, No Action Alternative

The No Action Alternative is synonymous with the without-project condition. No Federal action would be undertaken to address the flood risk for the Winslow community. With the “No Action Alternative,” the flood risk in the Winslow area is expected to remain essentially unchanged over the next 50 years.

The focused array of six alternatives has been compared (Table 3-5) based on the four criteria recommended by the Water Resource Principles and Guidelines (Planning Guidance Notebook [PGN] ER 1105-2-100).

Table 3-5 Focused Array of Alternatives

Plan	Effectiveness	Efficiency	Acceptability	Completeness
1.1	Meets objectives	Includes uneconomical increment	Supported by the non-Federal sponsor	Complete
3.1	Meets objectives	Includes uneconomical increment; less expensive plan has higher benefits	Requires highest number of residential relocations	Complete
7	Does not substantially meet objectives	Cost greatly exceeds benefits; significant residual flood risk remains	Includes features that the non-federal sponsor does not want to participate in; low environmental impacts	Incomplete; does not address levee system deficiencies
8	Meets objectives	Includes uneconomical increment	Supported by the non-Federal sponsor	Complete
9	Does not substantially meet objectives	Includes uneconomical increment	Does not provide level of flood risk reduction desired by non-Federal sponsor	Incomplete; does not address levee system deficiencies
10	Meets objectives	Includes uneconomical increment	Includes features that the non-Federal sponsor does not want to participate in	Complete

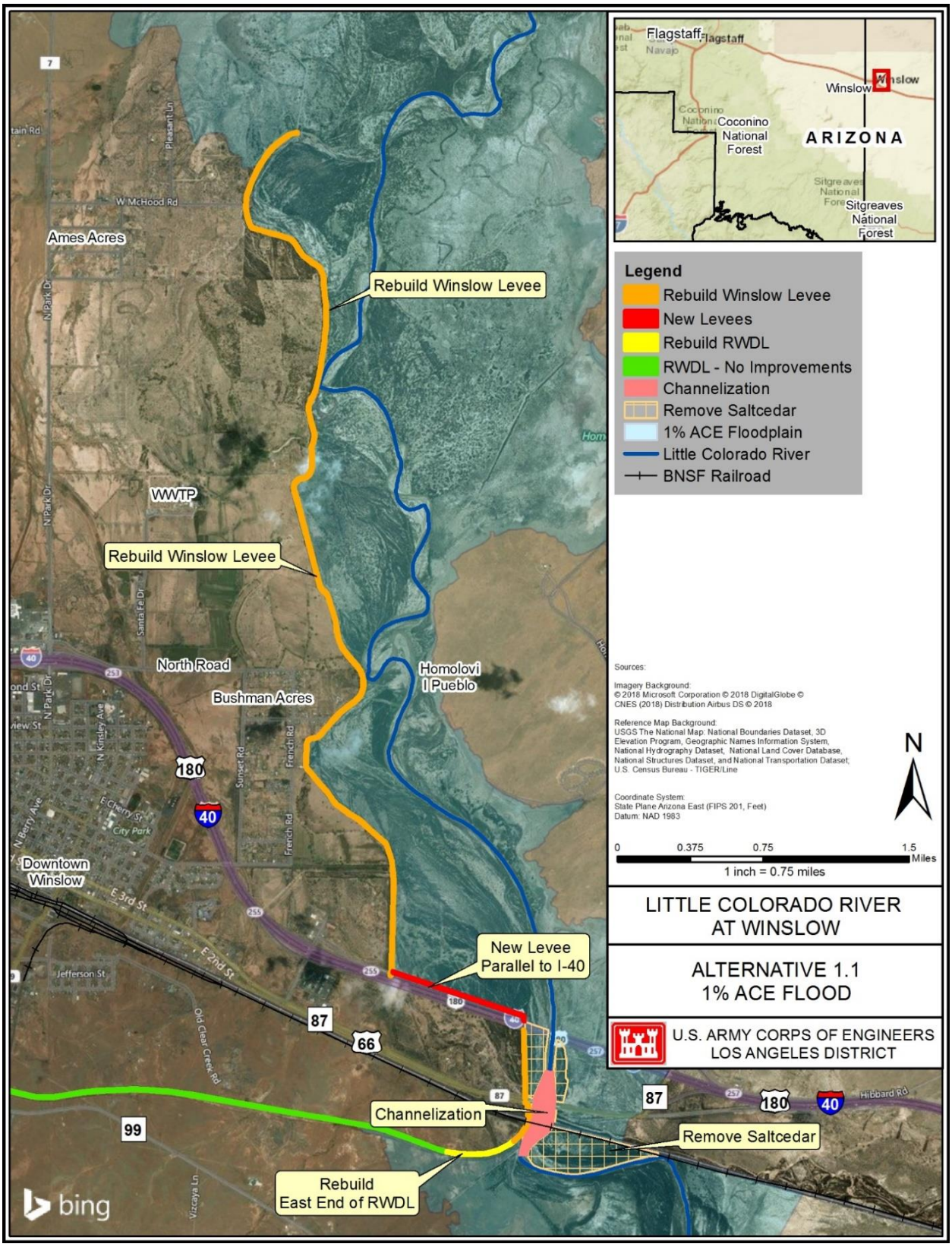


Figure 3-1 Alternative 1.1

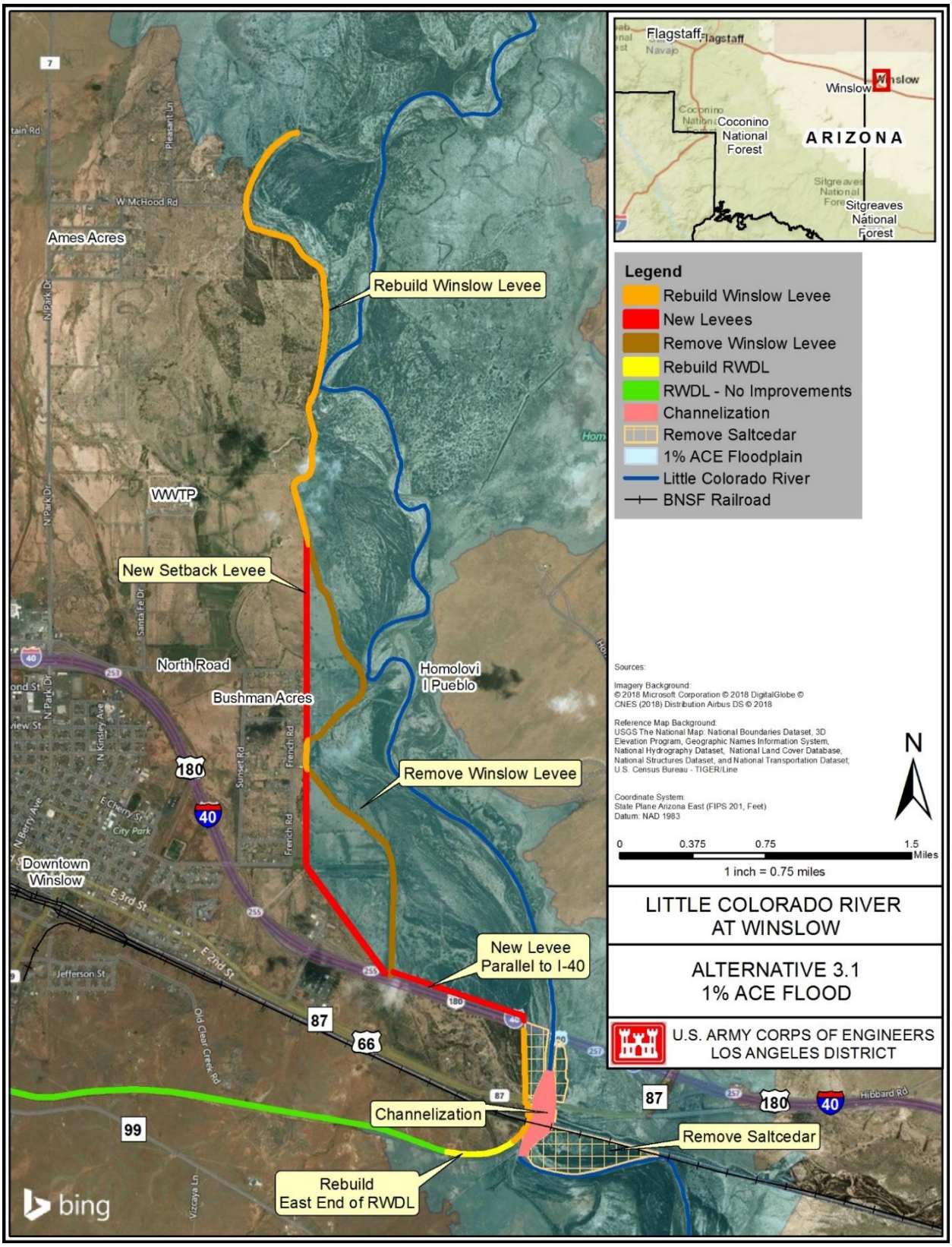


Figure 3-2 Alternative 3.1

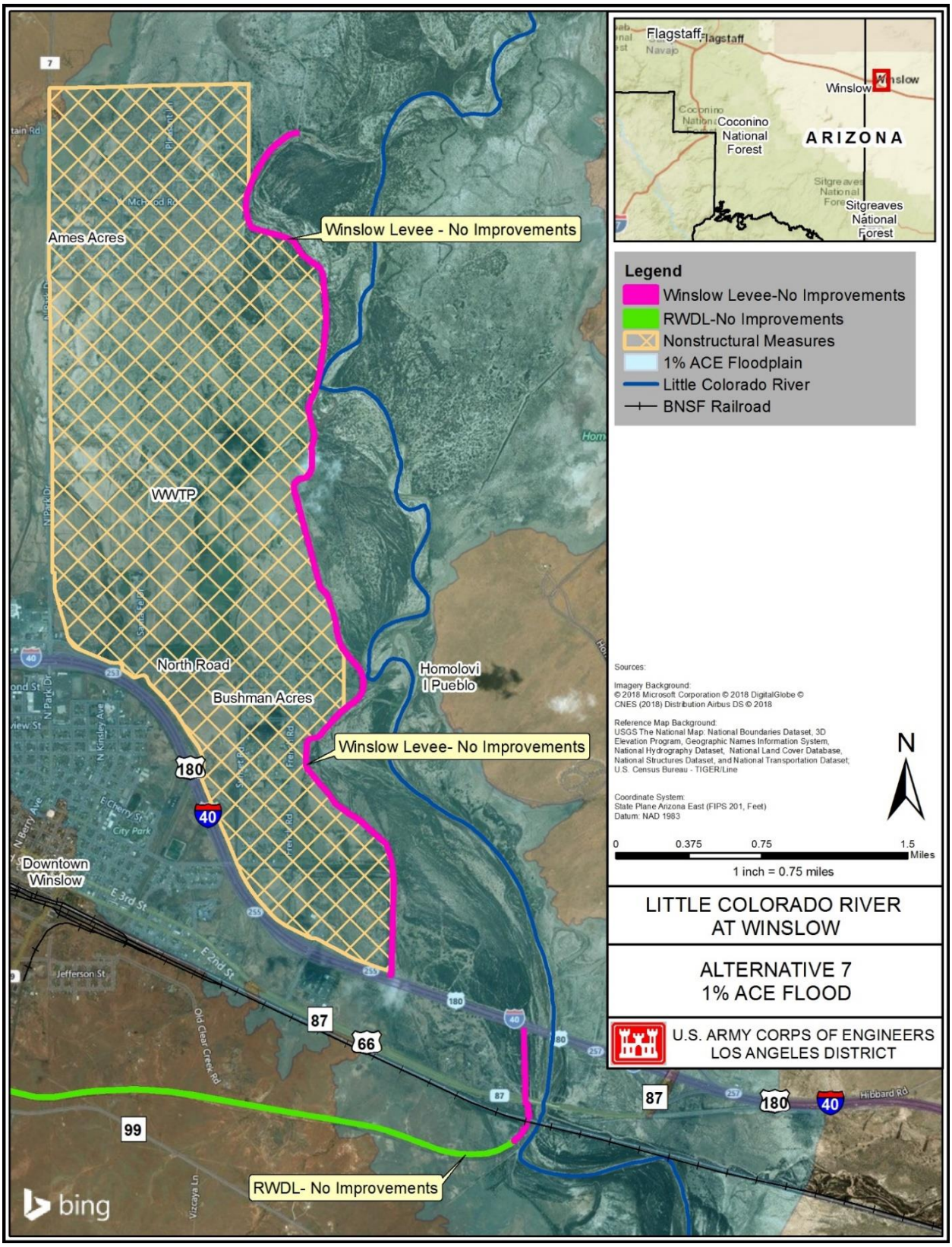


Figure 3-3 Alternative 7

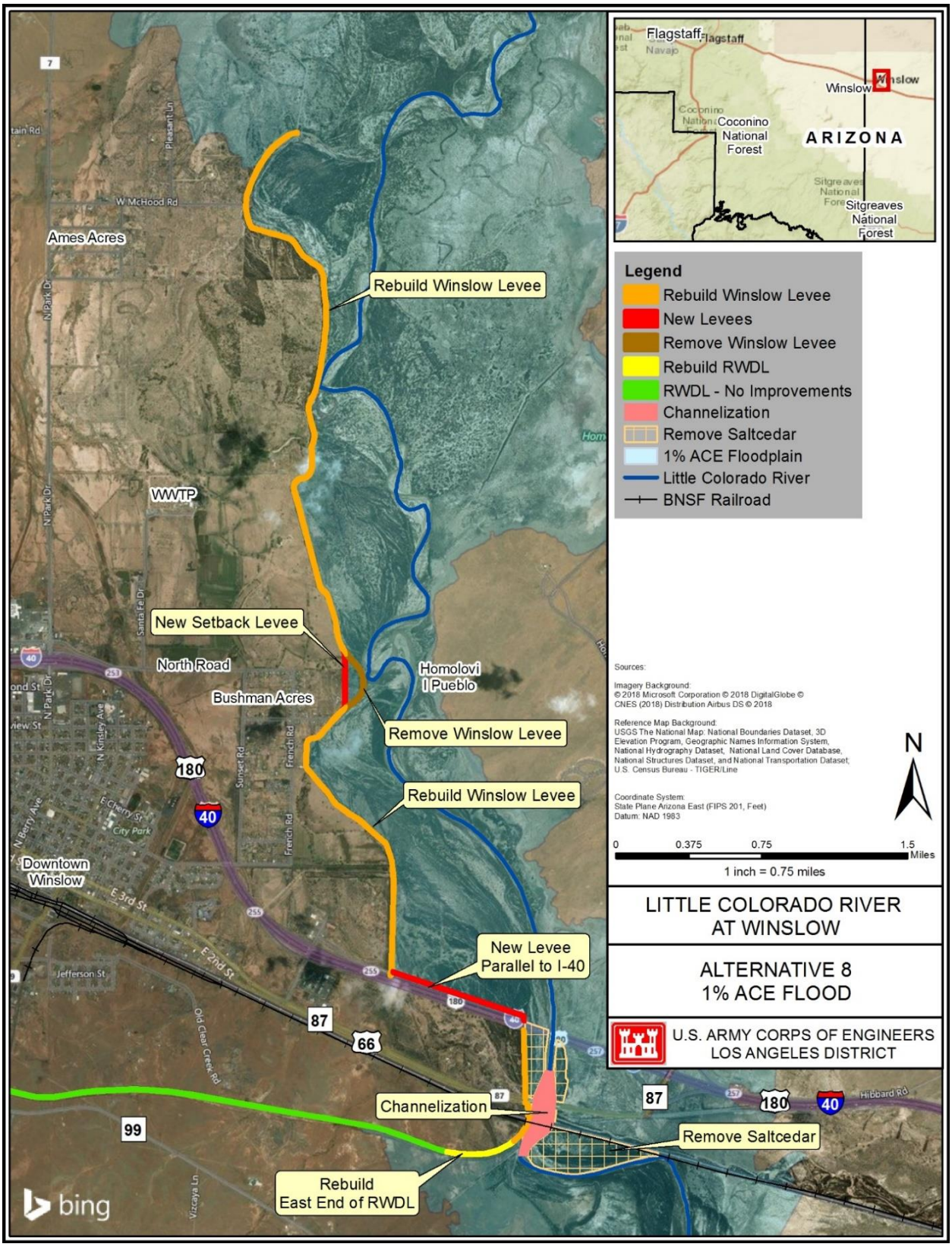


Figure 3-4 Alternative 8

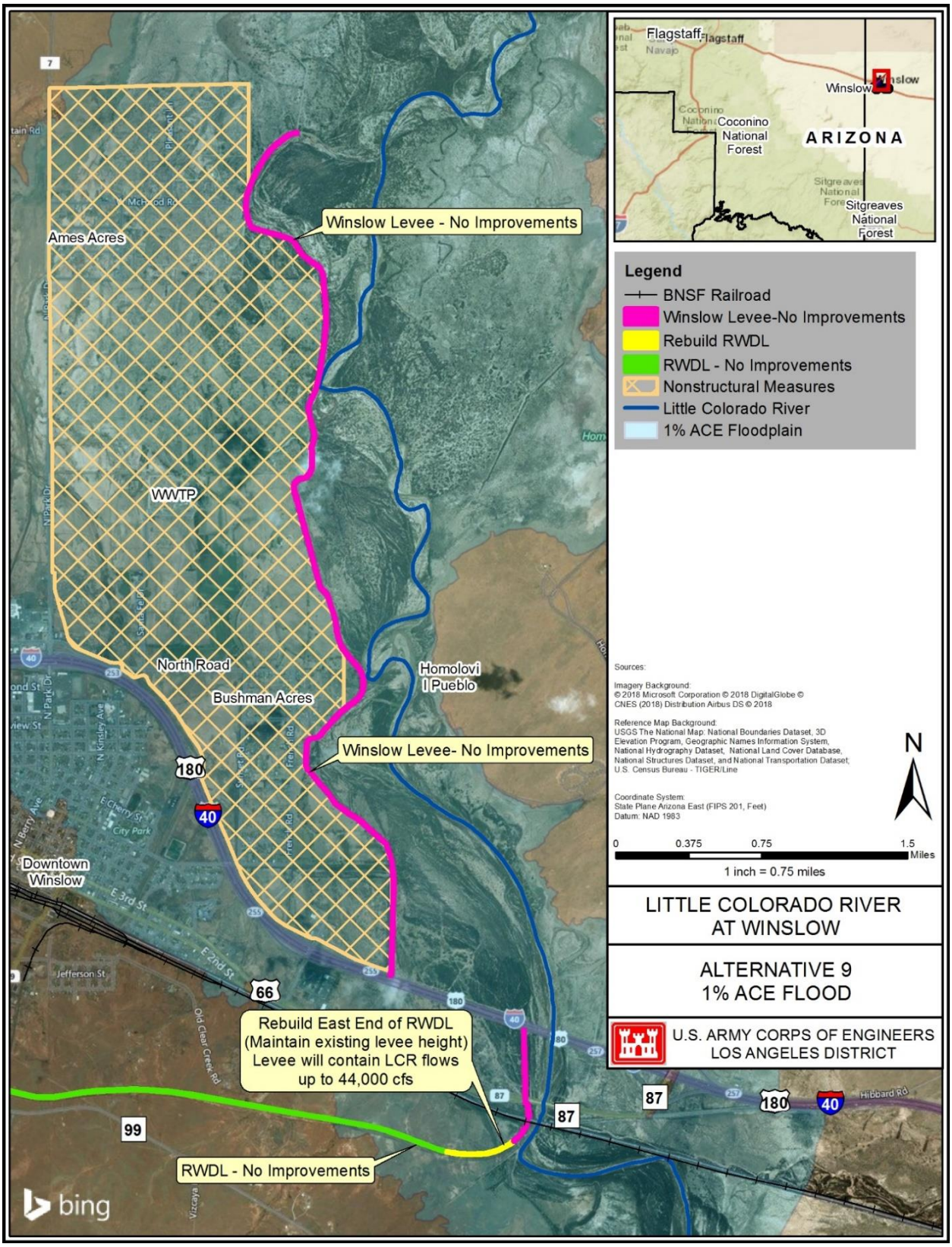


Figure 3-5 Alternative 9

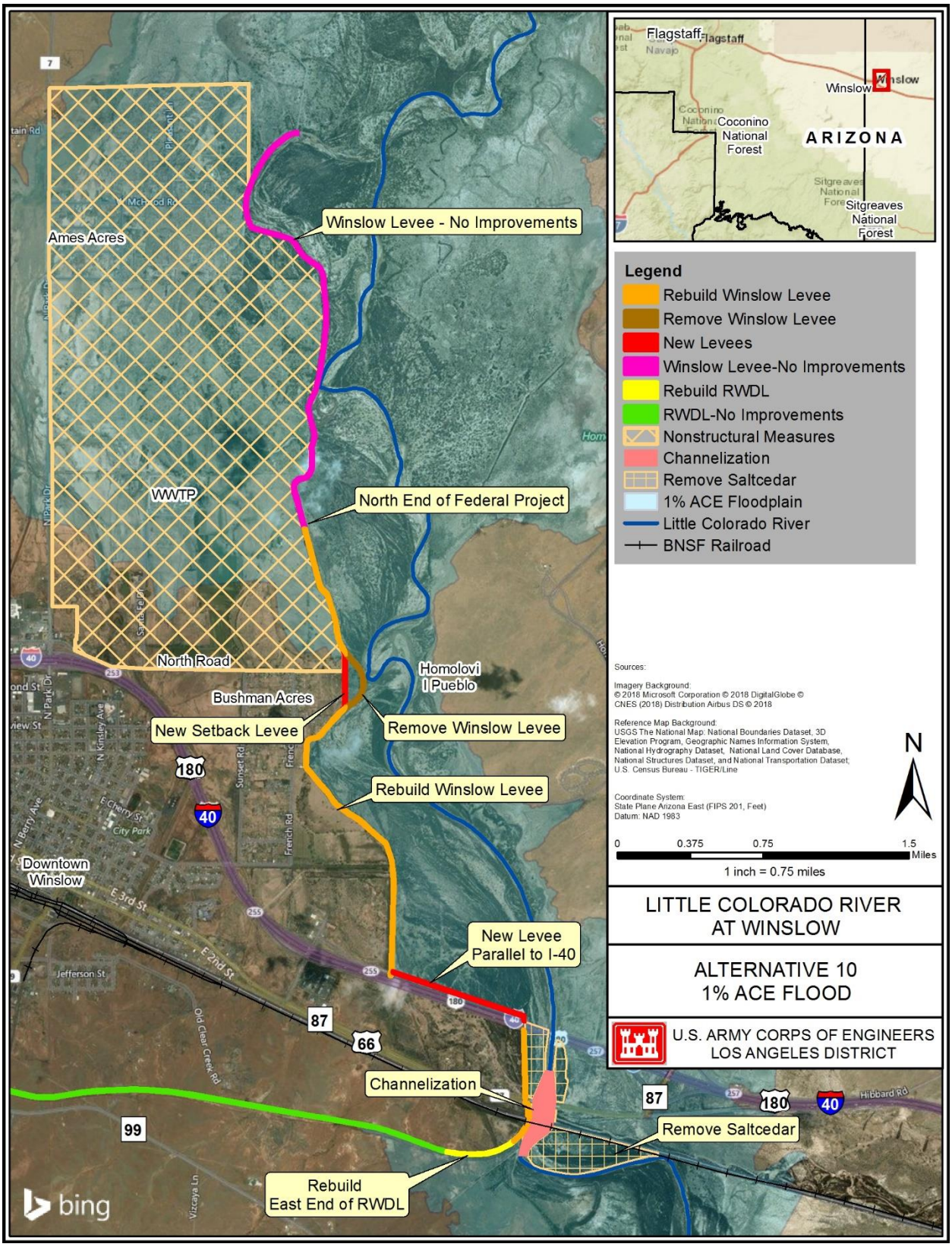


Figure 3-6 Alternative 10

3.5.1. Proposed Project Area

The "proposed project area," as that term is used later in this report in describing the affected environment, encompasses the portion of the study area in which structural or nonstructural measures are proposed, along with any borrow, disposal, staging, stockpiling, and access areas, for the array of alternatives carried forward for detailed consideration. The proposed project area includes parts of the LCR mainstem channel and the one percent ACE floodplain, the Winslow Levee, the eastern end of the RWDL, and the Ames Acres and Bushman Acres subdivisions.

Figure 1-2 includes an overview of the proposed project area and existing features and locations that are discussed throughout this report.

3.5.2. Operation and Maintenance Requirements for all Alternatives

The operations and maintenance requirements for all structural and nonstructural components of the alternatives are described below. Where an alternative does not include a feature discussed below, the operation and maintenance requirements would not apply.

a. Vegetation Control

Active or passive establishment of vegetation on the earthen portions of the levee would attenuate erosion. However, vegetation maintenance may be required to ensure levee integrity. Structures to be maintained include the landside face of the levee, top of the levee, and access roads along the levee. Saltcedar growth on the structure through natural recruitment is likely (especially the access roads). Removal of accumulated saltcedar at the BNSF Railroad Bridge may be required for hydraulic conveyance. The plant can grow from seedling to several feet within the span of one year. Hand removal and herbicide application would be sufficient in most cases. Spot mechanized mowing or mechanized removal could be required on a periodic basis. Mechanized equipment could consist of a mower, dump truck, back hoe, and a loader as well as crew vehicles. Annual vegetation management could require up to five laborers for a period of 15 days.

The following are proposed vegetation control methods applicable in the LCR at Winslow project area:

<u>Vegetation Control for Saltcedar Removal</u>: Mechanical removal is the use of heavy equipment to physically remove saltcedar. For this site, it is recommended that mechanical cutting with herbicide application to the cut stump be used. This method includes the mechanical removal of aboveground biomass accompanied by herbicide treatment of the cut stump. This approach is accomplished with either equipment that cuts and mulches the trees or grabs and cuts the trees for removal. Specialized mulching/chipping equipment has been shown to be effective. The trees are typically mulched in a six-foot-wide path at a rate of 0.25 to 1.5 acres per hour depending on density, terrain, and equipment. It is highly suggested that, if mulching/chipping onsite, depth should not exceed two inches.

Herbicide application would be used after mechanical treatment of saltcedar. The preferred herbicides to use are Garlon®3A (for treatment of resprouts) and Garlon® 4 (for initial treatment).

These are both selective herbicides, which means that they can kill certain groups of plants and have little or no effect on other plants. These herbicides should not be used near surface water or saturated soils, unless certified by the Environmental Protection Agency (EPA) for aquatic use. In areas within or adjacent to water, only aquatic approved herbicide would be used (Renovate 3® [triclopyr] is the preferred herbicide). Herbicides not certified for aquatic use cannot be used within 50 feet of the bank of the river. Herbicides would only be used between October and April to protect amphibian species from potential exposure and to allow work to take place outside of the avian migratory nesting season.

Garlon® is the commercial version of triclopyr and generally contains one or more inert ingredients. The contents of two triclopyr formulations are: Garlon® 3A: triclopyr (44.4 percent), and inert ingredients (55.6 percent) including water, emulsifiers, surfactants, and ethanol (1 percent); and Garlon®4: triclopyr (61.6 percent), and inert ingredients (38.4 percent) including kerosene. Triclopyr acts by disturbing plant growth. It is absorbed by green bark, leaves and roots, and moves throughout the plant. Triclopyr accumulates in the meristem (growth region) of the plant. Surfactants used would include non-ionic surfactants that have been approved for use in aquatic habitats (such as Induce).

Basal bark and cut surface treatments can be done at any time of year. Triclopyr should be applied only when there is little or no hazard of spray drift. It should be applied immediately to the stump of the cut tree (within two hours). Triclopyr is active in the soil, and is absorbed by plant roots. Microorganisms degrade triclopyr rapidly; the average half-life in soil is 46 days. Triclopyr degrades more rapidly under warm, moist conditions. The potential for leaching depends on the soil type, acidity, and rainfall conditions. This herbicide is selective to woody plants and has little to no effect on grasses (Parker et al., 2005). It has been certified and labeled to be used near water by the EPA (EPA, 1998). After use, the public must remain away from the area for 48 hours. Signage would be placed at areas after they have been treated.

Herbicide application would occur using a backpack, truck mounted sprayer, or hand application with a brush to limit drift and minimize exposure to non-target species. For this particular site, a truck mounted sprayer would be most efficient due to the large area that needs to be sprayed.

Vegetation Control for Saltcedar Removal in Conveyance Improvement Area: Because the size of this area, it is proposed that mechanical removal without herbicide be used. Root crown removal is the extraction of the root crown by either root plowing and raking or extraction of the entire plant.

For root plowing and raking a large caterpillar D-7 or D-8 bulldozer equipped with brush bars used to remove the aboveground vegetation, root plows to cut the root system below the crown, and root rakes to remove the root crown. This approach is extremely disruptive to the soil and not recommended in areas where there are stands of native vegetation.

Extraction of the root crown by extraction is another root crown removal technique that uses a large excavator (such as a CAT 320 or larger) to pluck individual trees from the ground. This approach has been used in mixed stands of saltcedar, Russian olive, Siberian elm, and native cottonwood. This mechanical process completely removes target trees and their root balls from

the soil, along with significant amount of their lateral roots. This approach provides an advantage for projects working to clear ditches and step river banks where other mechanical equipment cannot gain access. It also removes only the target species and does not require herbicide. The rate of removal with an experienced operator is three to eight acres per day.

Resprouting of saltcedar is a recurring problem when initially treated. Resprouts should be treated with either direct herbicide application (cut-stump, basal, and/or foliar application) or a cut-stump method utilizing chain saws or equipment that can easily cut the resprouts without damaging native vegetation. Resprout management is typically required one to two times a year and can be accomplished with a small crew by hand. Ongoing removal may be necessary.

b. Rodent Control

Burrowing animals are capable of perforating a levee with holes to the extent that the structural integrity of the levee may be jeopardized. To alleviate this problem, the rodent population should be kept under control by placing poison or traps in the burrows. Rodent problems should be identified during the quarterly inspections. Controlling this problem would require two laborers with a pickup truck and a supply of rodent poison or traps. It is estimated this program would require 48 hours per year per person.

c. Levee and Interior Drainage Structures Repair

In order to maintain the integrity of the levee and interior drainage structures, it is anticipated some repairs will be required after periods of significant flooding. This would include replacement of earth fill along eroded sections of the levee and interior drainage structures, repairs to gated outlets, and replacement of any damaged sections of soil cement, grouted/ungrouted riprap and gravel. It is estimated that the majority of these repairs could be accomplished by a basic maintenance crew consisting of four workers utilizing one dump truck, one bulldozer, one frontend loader, and a pickup truck. It is anticipated this crew would be engaged in levee and interior drainage structure repair work for two weeks per year over the life of the project.

d. Sediment Removal Under the BNSF Railroad Bridge

Removal of accumulated saltcedar at the BNSF Railroad Bridge when required for hydraulic conveyance. The estimated channel length that requires sediment removal extends 2,450 feet (1,225 feet immediately upstream and 1,225 feet immediately downstream of the bridge centerline). It is estimated the majority of the work could be accomplished by a sediment removal crew of six members utilizing two front-end loaders, one excavator, and two dump trucks. It is expected that annual sediment removal could require a period of 15 days to complete the work.

e. Survey River Cross Section

This item provides a means for determining the reaches of the river where significant sedimentation is occurring. Survey monuments would be established at several selected levee stations with respect to the river as part of levee construction. Thereafter, the cross sections of the river would be surveyed on a periodic basis and after each significant flood. The results of

the survey would be compared to the original cross sections and a determination made regarding the loss of channel capacity due to sediment build-up. These periodic surveys would provide an indicator of the rate of freeboard loss or gain resulting from the sediment transport processes occurring in the river. It is estimated that the necessary survey work could be completed by a five-man survey crew working an average of two weeks per year.

f. Flood Warning System

The flood warning system would be required to be maintained in working order for all alternatives.

3.5.3. Analysis of Focused Array

This section describes the analysis of the focused array of alternatives listed above. It includes hydraulic and economic modeling of each of the alternatives along with development of costs for each of the alternatives. These items provide the basis for evaluating and comparing benefits and costs of the alternatives in the focused array. Expected annual damages under without-project conditions and other performance metrics are compared to damages under each of the alternative plans. The reduction in damages are the benefits of the alternative, which are then compared to the cost of each alternative. Additional detail can be found in Appendix C - Economics.

a. Reaches

For the hydraulic and economic evaluation, the study area was segmented into distinct reaches based upon homogenous land based flooding characteristics. Critical factors included discharge/frequency characteristics, overflow topographic characteristics, and economic activity. Reach 1 includes the majority of the City of Winslow located south of I-40. Reach 2 includes the rest of the structures north of I-40. These structures north of I-40 are less densely developed and separate from downtown Winslow.

The delineation between Reach 1 and Reach 2 was a natural separation from an economic standpoint. Of the two, Reach 1 is more susceptible to flooding from failure or overtopping of the easternmost portion of the RWDL and the Winslow Levee; therefore, damage potential in Reach 1 is greater than Reach 2. Figure 3-7 shows the location of these reaches on a map. The red line represents the delineation of the 0.2 percent ACE (e.g. 500-year) floodplain.

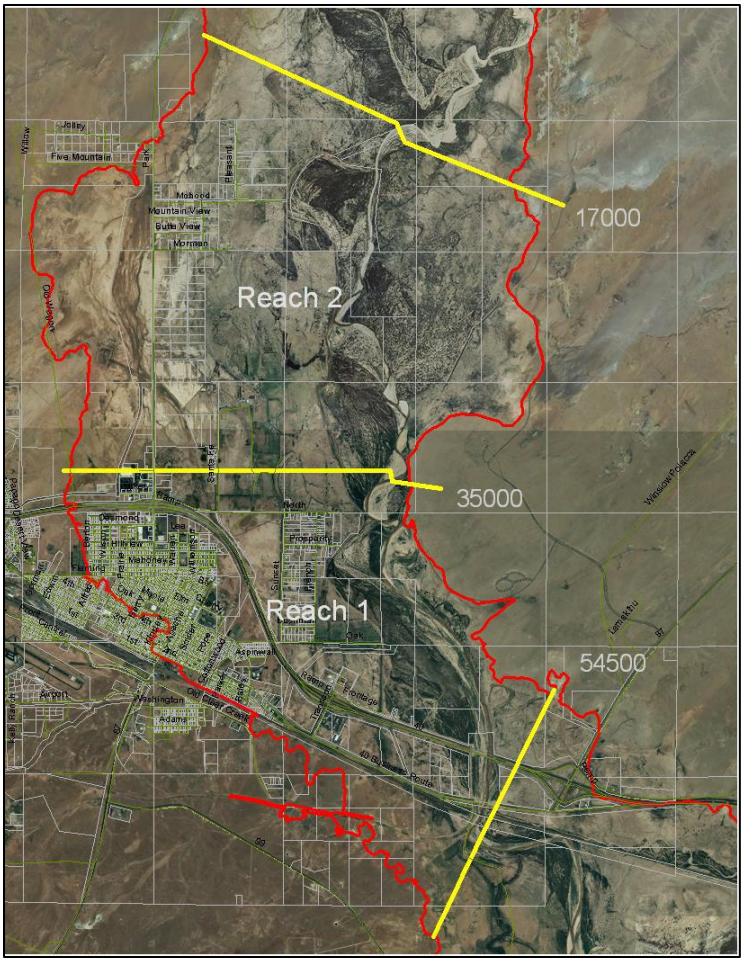


Figure 3-7 500-Year Floodplain and Reach Delineation

b. Without-Project Conditions

A structural inventory was completed based on data gathered from the City of Winslow's Tax Assessor's parcel data and onsite inspection of structures within the floodplain. Structures were determined to be within the economic study area by using Geographical Information Systems (GIS) to compare the 0.2 percent ACE floodplain boundary with the spatially referenced assessor parcels. The total number of structures within the floodplain is presented in Table 3-6.

Table 3-6 Number of Structures in the 500-Year Floodplain

Reach	Single Family Residence	Multiple Family Residence	Mobile Homes	Commercial	Industrial	Public	Total
1	1,208	63	158	115	49	34	1,627
2	48	0	10	3	1	1	63
TOTAL	1,256	63	168	118	50	35	1,690

Expected annual damages (EAD) are defined as the monetary value of NED flood losses in any given year based on the magnitude and probability of loss from all possible flood events. The calculation of expected annual damages was computed with the HEC-FDA[2] model. The model uses computerized simulation for estimating expected annual flood damages, further explanation of the modeling can be found in Appendix C - Economics. Table 3-7 presents a listing of expected annual damages by study damage reach and damage category.

Table 3-7 Existing Condition Without-Project Expected Annual Structure and Content Damages by Reach ($1,000s) – Analysis Year 2014

Reach	Residential	Commercial	Industrial	Public	Total
1	3,594	3,153	138	700	7,585
2	87	19	0	2	108
TOTAL	3,681	3,172	138	702	7,693

As shown above, the without-project EAD to structures and structure contents total to approximately $7.7 million with nearly 99 percent occurring within Reach 1. Approximately $3.7 million (48 percent) of these damages are attributed to residential structures; $3.3 million (43 percent) to commercial and industrial structures; and $707,000 (9 percent) to public structures.

In addition to damages directly related to structures and their contents, losses were also estimated for other categories including damages to automobiles, cleanup costs, displacement costs, and landscape cleanup costs. The results are summarized below.

Table 3-8 Existing Condition Without-Project Expected Annual Damage Summary ($1,000s)

Category	EAD	Percentage of Total
Structure & Content	7,693	75%
Automobile Damages	579	6%
Clean-up Costs	1,066	10%
Displacement Costs	728	7%
Landscape	163	2%
TOTAL	10,229	100%

As shown, without-project EAD total over $10 million. Over 96 percent of the structures and 99 percent of the damages occur within Reach 1 and the City of Winslow. Damages to structures and their contents account for 75 percent of the total without-project annual damages.

[2] Hydraulic Engineering Center Flood Damage Assessment Model (HEC-FDA)

c. Without-Project Condition Performance

In addition to expected annual damage estimates, HEC-FDA reports flood risk metrics in terms of expected performance. Three statistical measures are provided, in accordance with ER 1105-2-101, to describe performance risk in probabilistic terms. These include annual exceedance probability, long-term risk, and assurance (formerly referred to as conditional non-exceedance probability).

1. Annual exceedance probability (AEP) measures the chance of having a damaging flood in any given year.
2. Long-term risk provides the probability of having one or more damaging floods over a period of time.
3. Assurance indicates the chance of not having a damaging flood given the occurrence of a specific magnitude event. Assurance is measured by the ACE of a certain flow or water surface elevation.

For example, in Reach 1, data in Table 3-9 indicates the following: (a) there is a 4.1 percent chance of having a damaging flood event in any given year; (b) there is a 72 percent chance of a damaging event occurring over any given 30-year period; and (c) there is a 7 percent chance that a one percent ACE flood event will not cause any damages (as defined in this analysis), or equivalently there is a 93 percent chance that the occurrence of a one percent ACE event would result in flood damages. Reach 2 provides a similar but slightly higher level of performance than Reach 1. However the likely consequences associated with any given flooding event are greater in Reach 1.

Table 3-9 Existing Conditions Without-Project Performance

Economic Impact Area	Annual Exceedance Probability		Long-Term Risk			Assurance			
	Median	Expected	10-Year Period	30-Year Period	50-Year Period	10% ACE	2% ACE	1% ACE	0.2% ACE
Reach 1	0.0380	0.0410	0.3420	0.7150	0.8766	0.9337	0.2629	0.0715	0.0025
Reach 2	0.0692	0.0696	0.5137	0.8850	0.9728	0.8781	0.6728	0.5058	0.1837

d. Emergency Action Plan

There is significant risk to life and property in the Winslow study area without a Federal action to reduce the flood risk to the community. There are three areas of flood risk - levee overtopping, levee failure, and flood-related health risks.

To protect lives and address the risk of levee overtopping or failure, Navajo County has developed an Emergency Action Plan (EAP). The EAP is based on National Weather Service forecasting and real time stream gage levels reported at the I-40 bridges. Approximately 12 to 30 hours of advance notice of possible flooding can be provided using weather forecasts; however, weather forecasts can be unreliable and have resulted in several unneeded flood fighting mobilizations. The EAP also includes a sequence of predetermined responses based on real time stream gage levels at the I-40 bridges. There is no formal flood warning system or evacuation plan in place. In the event of an actual levee failure, warning time for the central core of

Winslow can be as little as an hour. With no evacuation plan in place and limited warning time, the risk is increased.

e. Floodplain Population

The City of Winslow had 9,655 residents (US Census, 2010). Based upon projections from the Arizona Office of Economic Opportunity, the population of Winslow is not projected to increase through the year 2050. There are currently about 5,000 residents living in the 0.2 percent ACE floodplain. Of that, approximately 4,000 are at risk from a one percent ACE event in Reach 1. In Reach 2, there is a much smaller population of only a few hundred residents with lower potential flood depths and risk. The estimates for risk were made for all floodplain depths greater than zero feet.

The demographics of the floodplain population provide further understanding of their vulnerability to flood risk due to age, lack of transportation, or potential language barriers. While 10.2 percent of Winslow's residents are over 65, twenty-six percent are under 18, and 7 percent are under five years of age. In addition, at least 25 percent of Winslow's children live in households where income is below the poverty level. Most are Native American (Hopi and Navajo) families living just off the borders of their reservations, but many are Hispanic.

f. Life Safety

As noted in Section 1.0 of Appendix C - Economic, the City of Winslow has a history of flooding dating back to 1923. The most damaging recent flood occurred in 1993, when overtopping of the Winslow Levee caused flooding of several hundred homes in the Ames and Bushman Acres subdivisions. In 2003, a levee piping failure occurred close to where the levee had overtopped in 1993. Emergency response actions taken by Navajo County narrowly averted the threat to lives and property that could have been caused by a complete levee failure.

The Winslow area has a critical shortage of flood-safe housing. More than half of the housing units in the area (1,256 single family homes, 63 multi-family residences, and 168 mobile homes) are located within the 0.2 percent ACE floodplain. Most of the housing stock within the floodplain consists of buildings that are 50 or more years old. There are only a handful of recently constructed homes that have been elevated above the one percent ACE flood level. Some new construction is occurring outside of the floodplain toward the west end of the city. However, the available flood-safe housing cannot accommodate the current population of the area.

In the absence of flood risk reduction improvements, thousands of residents would remain at risk from failure or overtopping of the existing levee system. Many areas would be quickly inundated with several feet of water, leading to significant public health and safety risks. Some of these risks include the potential for physical injury, vehicular entrapment, and/or drowning. In some areas of Reach 1, flood depths for the one percent ACE flood can exceed 10 feet. Flood depths may be as high as five feet in Reach 2. Even where depth of water is not expected to exceed five feet, the velocity of water makes flooding a significant life safety risk. For example, six inches of fast-moving floodwater can knock over an adult and a depth of two feet can float a car (http://www.srh.noaa.gov/images/fwd/pdf/floodsandfloods.pdf).

If a levee failure were to occur, there could be very little warning time. The limited warning time would make notification and evacuation of residents difficult. For those able to evacuate, I-40 is the preferred evacuation route. The LCR closely parallels I-40 from Winslow east to Holbrook. Several large tributaries of the LCR cross I-40 between the two cities. It is possible that communities east of Winslow could be affected by the same flood event requiring evacuation of Winslow. Thus, the safest evacuation route for all flood scenarios is I-40 to the west toward Flagstaff. First responders would need to direct residents from the low-lying local surface streets to the best travel routes accessing I-40.

Three interchanges provide access to I-40 in the Winslow area. However, local roads that would provide access to I-40 in the event of a flood evacuation are at risk. Furthermore, two of the three I-40 interchanges are subject to flooding in the event of a levee breach close to or upstream of Winslow. The Highway 87 underpass, adjacent to the City Hall, drops 14 feet below grade to allow traffic to pass under the BNSF Railroad. Flooding of this underpass would cut off one side of Winslow from the other, requiring drivers to navigate a seven-mile detour to cross the tracks. This limits the evacuees' access to I-40.

Having the ability to evacuate if needed is vital to the lives and safety of many Winslow residents. The limited resources and physical mobility of Winslow's most vulnerable individuals (500 people who are sick and/or seniors with low incomes) would make their flood evacuation and recovery exceptionally difficult in the event of a levee breach. Many of the elderly and/or infirm are Navajo, Hopi, and Hispanic people for whom English is a non-native language. Fewer of these individuals have their own vehicles than the general population. Winslow has no rapid transit system. Only three ambulances that could evacuate the sick and elderly serve the area.

Some examples of facilities within the one percent ACE floodplain that would be difficult to evacuate quickly are the Little Colorado Medical Center Hospital, the Winslow Campus of Care, Winslow Manor, and Henderson Square. The hospital is a regional facility serving 30,000 people. The Winslow Campus of Care is a 120-bed skilled nursing facility with approximately 100 elderly residents, many with serious illnesses or disabilities.

Winslow Manor and Henderson Square are both federally assisted (Section 8 of the Housing Act of 1937, as amended) rental housing facilities. These facilities provide housing for low-income and mobility-impaired individuals. The Manor is a 41-unit apartment complex for individuals who are 62 years or older, or are 18 years or older and are mobility impaired. Only about 25 percent of the tenants have their own vehicle. The rest rely upon a local taxi service and twice-weekly transportation provided by the Winslow Active Adult Community Center. Henderson Square is a 55-unit housing facility managed by the City of Winslow Public Housing Department. Its residents are also impacted by general lack of personal transportation for evacuation.

For those unable to evacuate due to the short warning times, especially for those with vulnerability due to age, disability, or lack of personal transportation, there would be added risk. These include risk of exposure, waterborne diseases, and the mental health risks related to disasters. Exposure to floodwaters, whether trapped in their vehicle, in homes or in business

areas, would bring risks of lowering of the body's core temperature (hypothermia). In its 2008 study of flood risks in Winslow, FEMA identified Pacific storms in January and February as a major cause of flooding concern. While Winslow's average low temperature in January and February ranges from 21°F to 25°F, temperatures have been known to drop below 0°F during the winter months (www.weather.com). With expected water temperatures below 40°F in a winter storm, exhaustion or unconsciousness would occur within 15 to 30 minutes. This would be fatal in 30 minutes to three hours (USCG, boatsafe.com, 27 Feb 2015). If Winslow's levees breached or overtopped in January or February, residents not able to evacuate would incur a significant risk of hypothermia.

g. Critical Infrastructure

Related to the issue of life and safety is the risk to critical infrastructure. Critical infrastructure typically includes fire stations, police stations, hospitals, senior living facilities, schools, and prisons.

The critical public and private facilities in the Winslow area include utility service providers and infrastructure, police and fire stations, medical facilities, assisted care facilities, schools, government buildings, and the Arizona State Prison-Winslow. Most of Winslow's critical infrastructure is located within the one percent ACE floodplain, displayed on Figure 3-8 and listed in Table 3-10.

The Winslow Wastewater Treatment Plant (WWTP) is a critical facility shown on Figure 3-8; however, the City of Winslow recently constructed a ring levee around the WWTP to prevent damages up to the one percent ACE flood. This local action has reduced the flood risk to the WWTP. There is still a residual risk that an event larger than the one percent ACE flood would inundate the plant and release raw sewage into the floodwaters. The gravity system for the WWTP has five lift station pumps that carry Winslow's sewage from lower to higher elevations. All five pumps are within the one percent ACE flood zone.

In addition to the facilities listed in Table 3-10, supporting outpatient doctors' offices and most of Winslow's pharmacies are also subject to flood risk. The City of Winslow municipal government complex, Winslow Police Department, Indian Health Services Medical Center, and the Arizona State Prison Complex-Winslow are located outside of the one percent ACE floodplain. These facilities would still be impacted by the incapacitation of the transportation network, and/or displacement of employees by floodwaters.

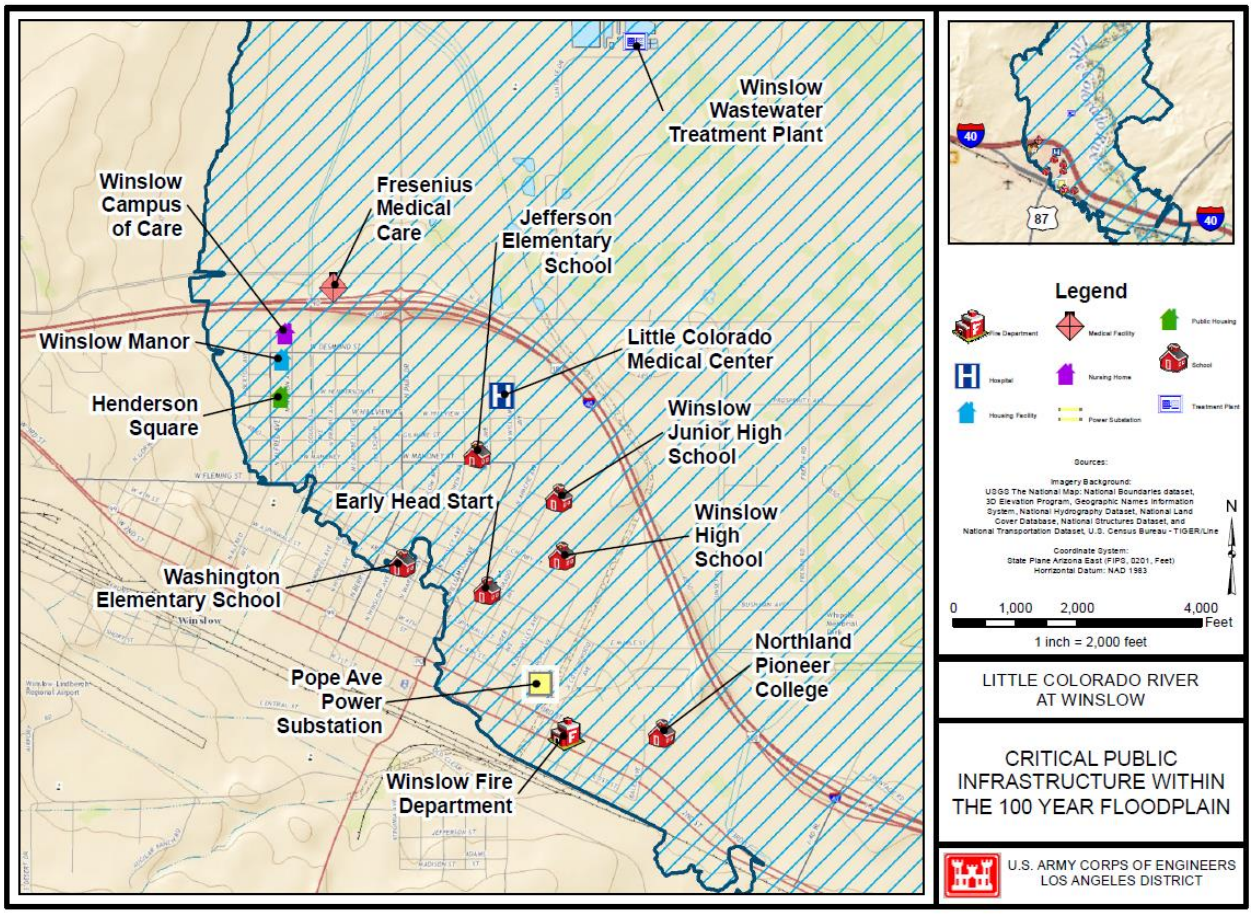


Figure 3-8 Critical Public Infrastructure in the 1 Percent ACE Floodplain

Table 3-10 Critical Public Facilities Located in the 1 Percent ACE Floodplain

Critical Facility	Address	Services Provided
Little Colorado Medical Center	1501 North Williamson Ave Winslow, AZ 86047	Regional hospital serving 30,000 people
Fresenius Medical Care	1313 E 3rd St Winslow, AZ 86047	Outpatient dialysis services
Winslow Campus of Care	826 West Desmond Street Winslow, AZ 86047	120 bed skilled nursing facility that has approximately 100 injured, disabled, sick and elderly residents whose serious illnesses or disabilities require skilled medical care
Winslow Manor	901 West Desmond Street Winslow, AZ 86047	41-unit apartment complex for elderly and/or mobility impaired persons
Henderson Square	900 West Henderson Street Winslow, AZ 86047	55-unit housing facility managed by the City of Winslow Public Housing Department; many residents need transportation during evacuation
Winslow Fire Department	215 N Taylor Ave Winslow, AZ 86047	Firefighting and emergency medical response services
Pope Avenue Power Substation	400 block, N. Pope Ave. Winslow, AZ 86047	Arizona Public Service (APS) electrical substation

Most of Winslow's schools also lie within the one percent ACE floodplain and are at risk from flooding (Table 3-11). This includes Head Start, primary, junior high, and high schools. Winslow has three elementary schools that share responsibility for 1,168 children ages of 4 to 11. Two of these schools with 706 children are located in the floodplain. Flood depths at Jefferson Elementary School range from almost 4.5 feet for the one percent ACE flood to nearly six feet for the 0.2 percent ACE flood.

Winslow's secondary school system consists of Winslow Junior High School and Winslow High School. These schools are located adjacent to each other in some of Winslow's lowest lying areas. Over 1,100 students attend these schools. Flood depths range from approximately four feet for the one percent ACE flood to five feet or more for the 0.2 percent ACE flood. The high school includes a below-grade performing arts center where the flood risk is even greater.

Winslow has an Early Head Start Center and a Preschool Head Start Center. The Early Head Start facility serves 19 children ages 1 to 2 who attend full day sessions. It is located within the one percent ACE floodplain. The preschool Head Start has 126 children ages 3 to 5 who attend half-day sessions. It is located at south of the BNSF Railroad tracks at 300 Airport Road, a location that lies outside of the floodplain. However, if the Highway 87 underpass is flooded by a levee breach, parents would need to navigate a lengthy detour to reach the Head Start Center.

Table 3-11 Educational Facilities Located Within the 1 Percent ACE Floodplain

Critical Facility	Address	Student Body
Jefferson Elementary School	100 West Mahoney Street Winslow, AZ 86047	Approx. 324 students
Washington Elementary School	300 West Oak Street Winslow, AZ 86047	Approx. 310 students
Winslow Junior High School	1100 Colorado Avenue Winslow, AZ 86047	Approx. 331 students
Winslow High School	600 East Cherry Street Winslow, AZ 86047	Approx. 627 students
Northland Pioneer College	1400 E 3rd St Winslow, AZ 86047	Two year community college serving northern Arizona at nine different locations; 600 students at Winslow as of Spring 2018 semester (www.npc.edu)
Early Head Start	710 Apache Road Winslow, AZ 86047	Approx. 19 children up to age 2

Figure 3-9 and Figure 3-10 provide an illustration of flood risk (potential floodwater depth) for selected critical infrastructure located in the one to 0.2 percent ACE floodplains, respectively.

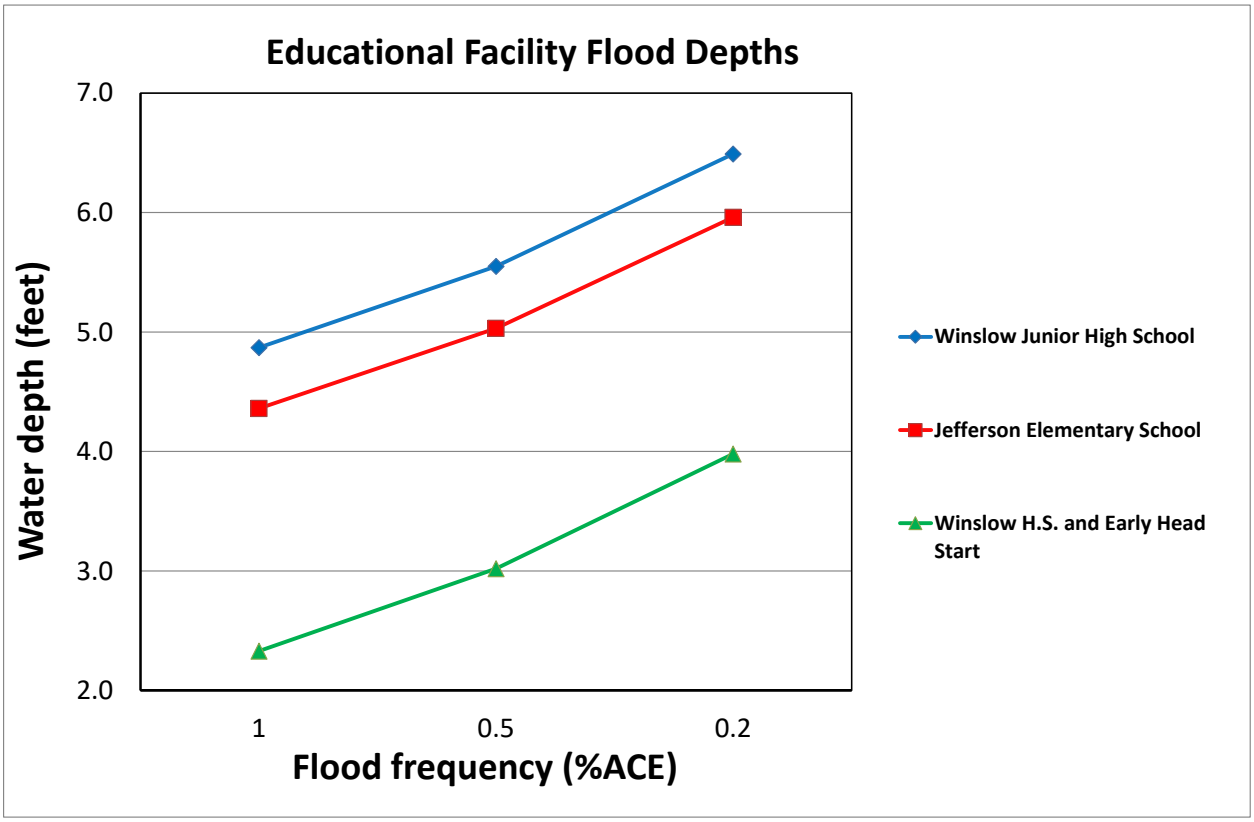


Figure 3-9 Educational Facility Flood Depths

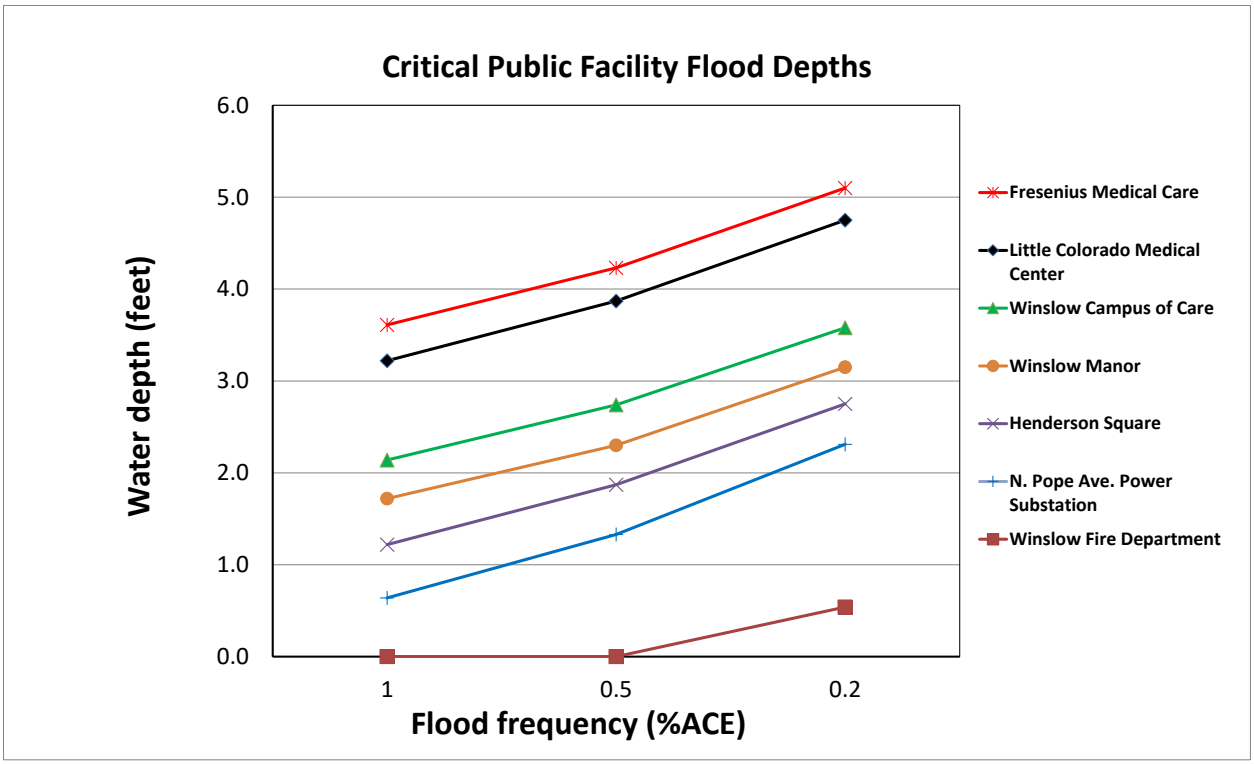


Figure 3-10 Critical Public Facility Flood Depths

h. NED Benefit, Costs, and Residual Damages

The intent of comparing alternative plans in terms of NED is to evaluate the beneficial and adverse effects that the plans may have on the national economy. Beneficial effects are considered to be increases in the economic value of the national output of goods and services attributable to a plan. Increases in NED are expressed as the plan's economic benefits, and the adverse NED effects are the investment opportunities lost by committing funds to the implementation of a plan.

Under the with-project condition, flood risks are reduced but not eliminated. Accordingly, residual flood risks and expected annual with-project damages remain. Table 3-12 shows residual expected annual damages for each alternative. Larger residual damages indicate less flood risk reduction while smaller residual damages indicate more flood risk reduction. The FY 14 price levels are listed because they were applicable rates when these estimates were developed, and do not change the alternatives evaluation.

Table 3-12 Residual Expected Annual Damages ($1,000s) (FY 14 Price Level)

Alternative	Structure & Content	Auto	Cleanup	Displacement	Land	Total
1.1	1,406	109	187	117	29	1,848
3.1	1,401	110	188	119	29	1,847
7	7,432	578	1,065	727	162	9,964
8	1,406	109	187	117	29	1,848
9	6,198	488	894	607	137	8,324
10	1,446	117	200	128	32	1,923

As shown, the without-project damages are reduced significantly under Alternatives 1.1, 3.1, 8, and 10, each of which include levee improvements that would convey water surface elevations higher than those produced during the average one percent ACE event. Alternative 7, which is the nonstructural only plan, results in the highest residual damages.

The flood damage reduction benefits associated with each alternative are presented in Table 3-13. As shown, Alternative 1.1, 3.1, and 8 produce similar benefits. Over 98 percent of these benefits are produced in Reach 1. Alternative 10 produces slightly lower benefits because fewer benefits are realized in Reach 2. Alternative 9 produces the lowest benefits of the five alternatives involving levee reconstruction. In contrast, Alternative 7 provides the lowest level of flood damage reduction benefits.

Table 3-13 Flood Damage Reduction Benefits ($1,000s) (FY 14 Price Levels)

Reach	Without-Project Damages	Damages Reduced ($1,000)					
		1.1	3.1	7	8	9	10
1	10,079	8,249	8,248	209	8,249	1,851	8,250
2	151	132	133	55	132	55	55
TOTAL	10,230	8,381	8,381	264	8,381	1,906	8,305

Life cycle project costs were developed for the focused array of alternatives for the purpose of comparing the costs to benefits. The implementation (referred to as first) costs including construction and real estate costs were amortized over the 50-year period of analysis using the FY 14 Federal discount rate of 3.5 percent. Assuming uniform expenditure over each construction period, interest during construction (IDC) is based on the following construction periods:

- Eight years for Alternatives 1.1, 3.1, and 8
- Four years for Alternatives 7 and 9
- Six years for Alternative 10

The annualized investment costs were then combined with an estimate for annual OMRR&R to arrive at a total annual cost for each alternative.

Annual net benefits are defined as the difference between the annual benefits and the annual costs of an alternative. For an alternative or increment thereof to be economically feasible, its benefits must exceed the costs. The alternative that offers the greatest net benefits is referred to as the NED Plan, if one is designated for a study. Table 3-14 presents the projects costs, benefits, and benefit-to-cost ratios for each alternative.

Table 3-14 Annual Benefits and Costs (FY 14 Price Levels)

Category	Alternatives					
	1.1	**3.1**	**7**	**8**	**9**	**10**
First Cost	$87,305,000	$91,704,000	$19,172,000	$81,732,000	$21,221,000	$64,155,000
IDC	$13,052,000	$13,710,000	$1,352,000	$12,219,000	$1,497,000	$6,999,000
Investment Cost	$100,357,000	$105,414,000	$20,524,000	$93,951,000	$22,718,000	$71,154,000
Annualized Investment Cost	$4,279,000	$4,494,000	$875,000	$4,005,000	$969,000	$3,034,000
OMRR&R	$102,000	$95,200	$0	$99,000	$5,850	$67,800
Total Annual Costs	$4,381,000	$4,589,200	$875,000	$4,104,000	$974,850	$3,101,800
Average Annual Benefits	$8,381,000	$8,381,000	$264,000	$8,381,000	$1,906,000	$8,305,000
Net Benefits	**$4,000,000**	**$3,791,800**	**-$611,000**	**$4,277,000**	**$931,150**	**$5,203,200**
B/C Ratio	*1.91*	*1.83*	*0.30*	*2.04*	*1.96*	*2.68*

As shown above, the Alternative 10 levee alignment maximizes NED benefits compared to the other alternatives presented above.

i. Incremental Evaluation and Justification

Alternative 10 is the levee alignment that maximizes net NED benefits. This alternative includes two major increments: levee improvements in the upstream reach that provide risk reduction throughout Reach 1, and a nonstructural plan that features raising floodplain structures above the one percent ACE flood elevation in the downstream Reach 2. Since these two components are separable, an incremental analysis has been conducted to show the economic justification of each. Table 3-15 presents the results of the incremental analysis.

Table 3-15 Incremental Analysis of Alternative 10 (FY 14 Price Levels)

Category	Structural Reach 1	Nonstructural Reach 2
First Cost	$59,905,000	$4,249,000
IDC	$6,535,000	$143,000
Investment Cost	$66,440,000	$4,392,000
Annualized Investment Cost	$2,833,000	$187,000
OMRR&R	$67,800	$0
Total Annual Costs	$2,901,000	$187,000
Average Annual Benefits	$8,250,000	$55,000
Net Benefits	**$5,349,000**	**-$132,000**
B/C Ratio	*2.84*	*0.29*

As illustrated above, the structural improvements in Reach 1 are well justified from an economic perspective, with net benefits exceeding $5.3 million. However, the second increment with nonstructural components in Reach 2 produces a negative net benefit with a B/C ratio of 0.29. It should be noted that due to the low number of structures (29) and the high cost of any alternative that would protect the structures in Reach 2, no other alternatives are economically justified for this reach. With the exclusion of the second increment, the B/C ratio for Alternative 10 would increase from 2.68 to 2.84. As a result, the nonstructural (residence elevation) increment is not justified as part of Alternative 10 and is eliminated from further consideration related to identification of an NED Plan.

3.5.4. Alternative Scale Optimization

As noted above, damages reduced for smaller and larger scale levees were evaluated using the Alternative 10 levee alignment (Figure 3-6) to help optimize the level of flood risk reduction for the Reach 1 structural improvements. Alternative 10.1 reflects a design for the one percent ACE in Alternative 10 as initially formulated, with the aforementioned nonstructural increment in Reach 2 deleted. Three additional scales as measured by the ACE probability were selected for evaluation. These designs correspond with rebuilding the levees with sufficient levee height above the 4, 2, and 0.5 percent ACE water surface elevation for a 90 percent assurance of containing the design flood. The alternative scales are designated as:

- Alternative 10.1, the 1 percent ACE (Figure 3-11)
- Alternatives 10.2, the 4 percent ACE (Figure 3-12)
- Alternative 10.3, the 2 percent ACE (Figure 3-13)
- Alternative 10.4, the 0.5 percent ACE (Figure 3-14)

Each of these alternatives also includes a flood warning system as a nonstructural measure. Descriptions of Alternatives 10.1, 10.2, 10.3 and 10.4 can be found below.

a. Alternative 10.1, Rebuild RWDL and Winslow Levee (to North Road) (1 Percent ACE Flood)

Rebuild the Winslow Levee from the RWDL downstream to a point 0.8 miles north of North Road, no improvements to the Winslow Levee downstream of this point, set back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo, remove the original Winslow Levee in the setback area, rebuild the eastern end of the RWDL, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge by removing saltcedar and accumulated sediment. The project would be designed to contain the one percent ACE flood with an approximately 90 percent level of assurance. Alternative 10.1 is identical to Alternative 10 except that it does not include the nonstructural measures for residences downstream of North Road.

b. Alternative 10.2, Rebuild RWDL and Winslow Levee (to North Road) (4 Percent ACE Flood)

Rebuild the Winslow Levee from the RWDL downstream to a point 0.8 miles north of North Road, no improvements to the Winslow Levee downstream of this point, set back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo, remove the original Winslow Levee in the setback area, rebuild the eastern end of the RWDL, construct a new levee parallel to I-40. Conveyance improvements at the BNSF Railroad Bridge would not be required. The project would be designed to contain the four percent ACE flood with an approximately 90 percent level of assurance.

c. Alternative 10.3, Rebuild RWDL and Winslow Levee (to North Road) (2 Percent ACE Flood)

Rebuild the Winslow Levee from the RWDL downstream to a point 0.8 miles north of North Road, no improvements to the Winslow Levee downstream of this point, set back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo, remove the original Winslow Levee in the setback area, rebuild the eastern end of the RWDL, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge by removing saltcedar and accumulated sediment. The project would be designed to contain the two percent ACE flood with an approximately 90 percent level of assurance.

d. Alternative 10.4, Rebuild RWDL and Winslow Levee (to North Road) (0.5 Percent ACE Flood)

Rebuild the Winslow Levee from the RWDL downstream to a point 0.8 miles north of North Road, no improvements to the Winslow Levee downstream of this point, set back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo, remove the original Winslow Levee in the setback area, rebuild the eastern end of the RWDL, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge by removing saltcedar and accumulated sediment. Alternative 10.4 would require a greater volume of sediment removal at the railroad bridge than Alternatives 10.1 or 10.3 to provide the additional conveyance needed to pass the 0.5 percent ACE flood. The project would be designed to contain the 0.5 percent ACE flood with an approximately 90 percent level of assurance.

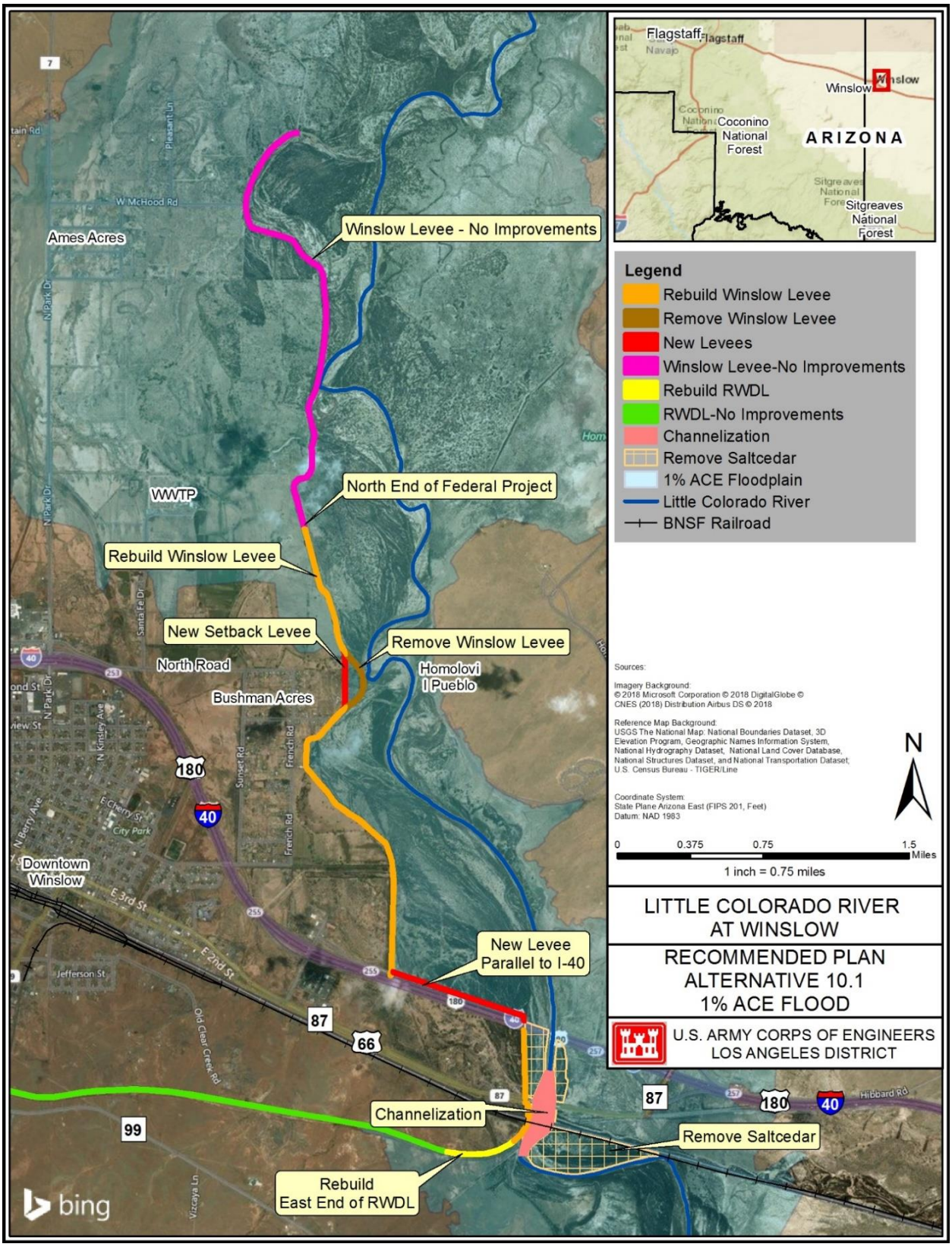


Figure 3-11 Alternative 10.1

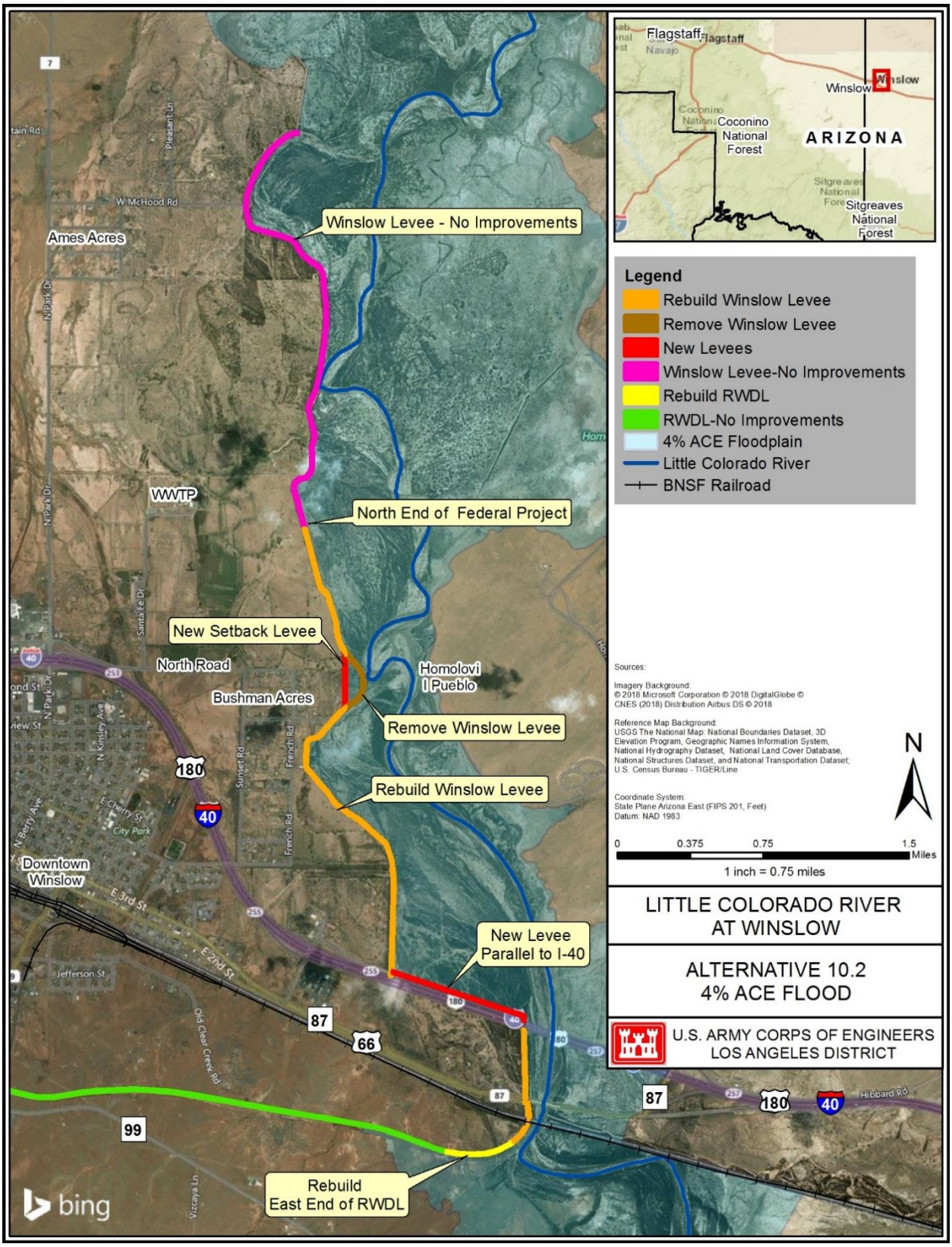


Figure 3-12 Alternative 10.2

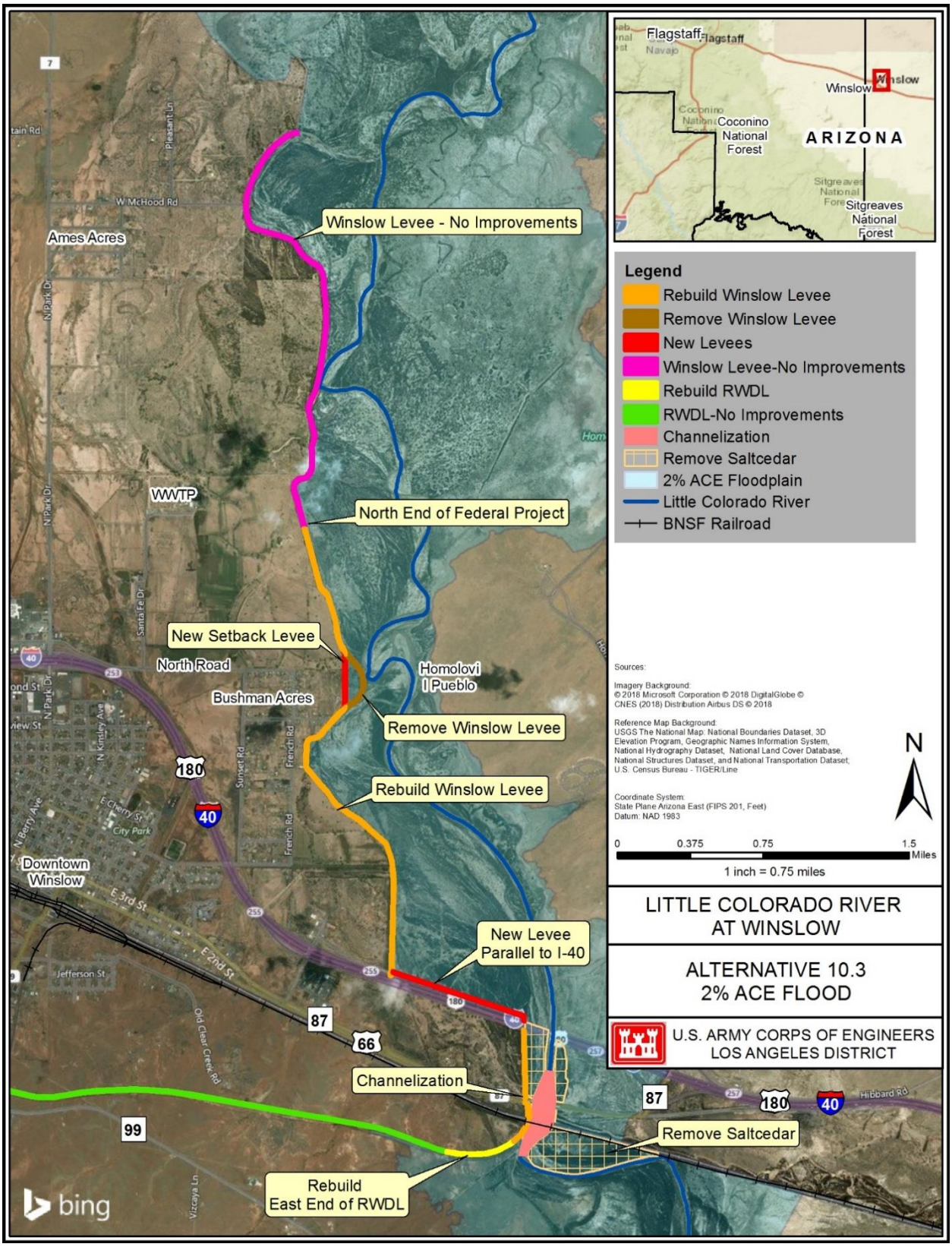


Figure 3-13 Alternative 10.3

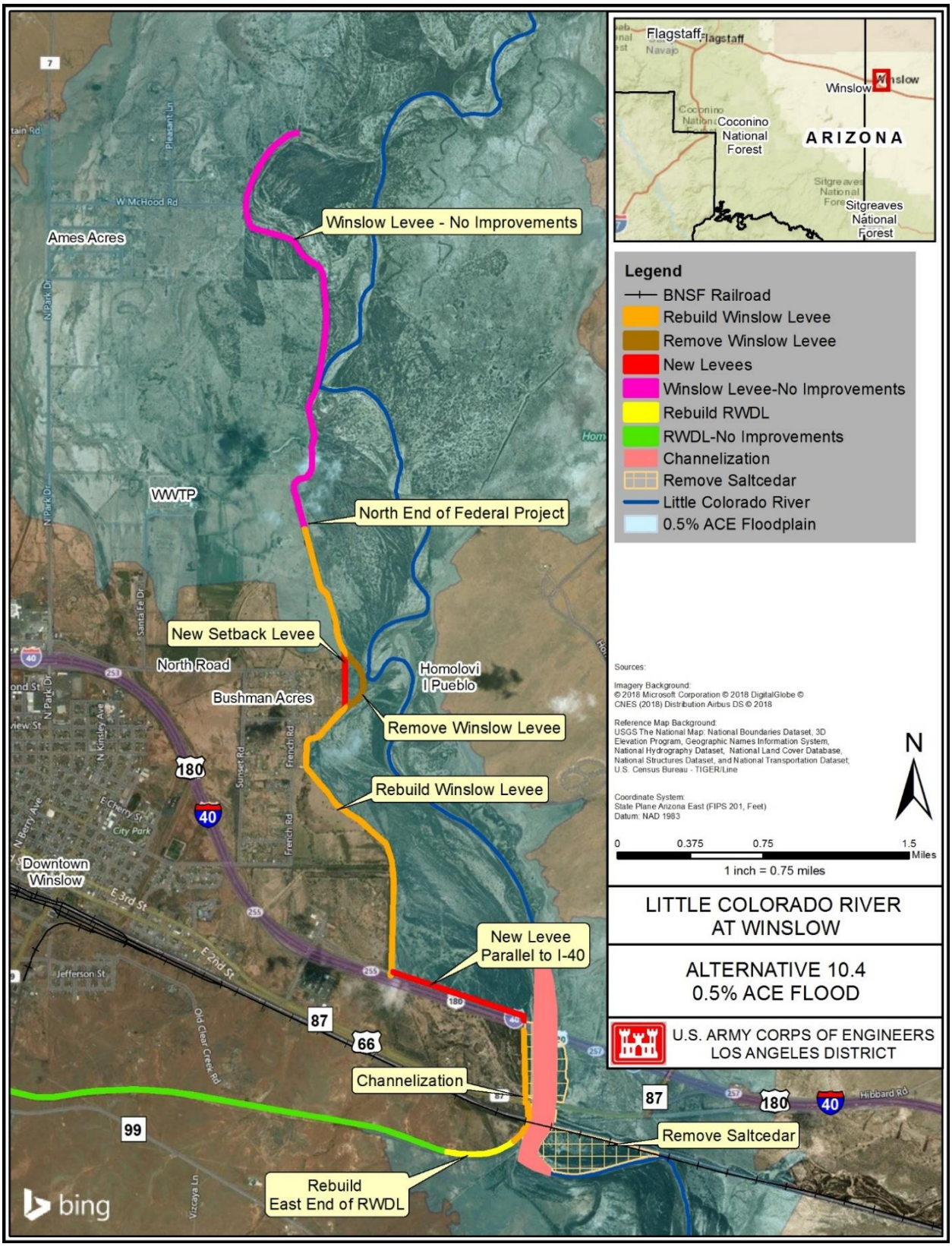


Figure 3-14 Alternative 10.4

3.5.5. NED Net Benefit Evaluation

Each of the optimized alternatives includes rebuilt RWDL and Winslow levee segments south of I-40 along with a combination of new, rebuilt, and setback levee components north of I-40, as previously described. In addition, Alternatives 10.1, 10.3, and 10.4 include channel conveyance improvements. Each alternative was modeled to assess damages reduced and residual damages compared to the No Action Alternative. Annual life cycle costs were also developed for each alternative. The average annual benefits and costs for the different levee design elevations are shown in Table 3-16.

Alternatives 10.2 and 10.3 include smaller scale improvement, thus resulting in lower net benefits. As the largest-scale plan, Alternative 10.4 produces the highest level of net flood damage reduction benefits. Alternative 10.4 is expected to reduce without-project damages by approximately 90 percent in Reach 1. In addition, this plan reduces the AEP in Reach 1 to about 0.2 percent and has over 96 percent assurance of containing the one percent ACE flood. While Alternative 10.4 produces the highest net benefits among the four levee scales, it is possible that a slightly larger scale plan could result in even higher net benefits.

Table 3-16 Annual Benefits and Costs for Alternative 10 Scales

(FY 14 Price Levels)

	Alternatives			
Category	**10.1 – 1% ACE**	**10.2 – 4% ACE**	**10.3 – 2% ACE**	**10.4 – 0.5% ACE**
First Cost	$59,905,000	$39,260,000	$59,356,000	$68,576,000
IDC	$6,535,385	$3,819,554	$6,011,943	$7,017,805
Investment Cost	$66,440,385	$43,079,554	$65,367,943	$75,593,806
Annualized Investment Cost	$2,833,000	$1,837,000	$2,787,000	$3,223,000
OMRR&R	$67,800	$24,800	$67,000	$91,300
Total Annual Cost	$2,900,800	$1,861,800	$2,854,000	$3,314,300
Average Annual Benefits	$8,250,000	$5,067,000	$7,079,000	$9,068,000
Net Benefits	**$5,349,200**	**$3,205,200**	**$4,225,000**	**$5,753,700**
Benefit Cost Ratio	2.84	2.72	2.48	2.74

However, since Alternative 10.4 reduces without-project damages by about 90 percent, it is unlikely that significant additional net benefits would result from any larger scale plan. In addition, the non-Federal sponsor has expressed interest in constructing a smaller-scale levee (Alternative 10.1). Alternative 10.1 meets the criteria for a Categorical Exemption from identifying and selecting the NED Plan, as provided in the PGN, ER 1105-2-100, paragraph 3-3.b(11). This categorical exemption is further described in Section 3.7 below. The rationale for not evaluating additional plans larger than Alternative 10.4 is summarized in Table 3-17. Therefore, no plans of larger scale than Alternative 10.4 were formulated.

Table 3-17 Rationale for Not Evaluating a Plan Larger than Alternative 10.4

Consideration	Discussion
Financial Capability	The non-Federal sponsor has advised that it does not have the financial capability to participate in Alternative 10.4, much less a plan that is even larger.
Hydraulic Capacity	District engineering staff has advised that it is likely not possible to convey anything larger than the 0.5% ACE discharge under the BNSF Railroad Bridge without addressing the stability of the bridge piers for the railroad and State Highway 87 bridges, or widening the bridge abutments to increase conveyance in lieu of further channel excavation.
Environmental Consideration	The channelization that would be needed to convey events larger than the 0.5% ACE flood under the bridges would impact a much larger area of active floodplain, increase the possible need for grade control and accommodations for fish passage, and require a greater volume of material disposal during construction and maintenance. Increased mitigation requirements can be expected due to the greater project impacts within the active river floodplain.
Local Consideration	The non-Federal sponsor would find it difficult to participate in a project that can contain floods less frequent than the 1% ACE event in upstream areas without first addressing the current levee deficiencies downstream.
Floodplain Rule	Due to the increasing slope along the west side of the floodplain, projects larger than the 0.5% ACE are not expected to reduce flood risk enough to offset the additional construction, environmental, and O&M costs.

3.5.6. Life Safety—Comparison among Alternatives

Since the critical public infrastructure is broadly distributed across the floodplain (Figure 3-8), every alternative that reduces the risk of levee overtopping and failure would reduce the flood risk to this infrastructure. Alternatives 1.1, 3.1, 8, 10 and 10.1 include measures that would reduce the flood risk for up to the one percent ACE event. All of these alternatives would reduce the risk to life safety and critical public infrastructure in the City of Winslow by approximately the same extent. Alternatives 1.1, 3.1, and 8 rebuild the entire length of the Winslow Levee, while Alternatives 10 and 10.1 only address deficiencies with the southern part of the levee. Alternatives 1.1, 3.1 and 8 would add minor additional life safety benefits (compared to Alternatives 10 and 10.1) by reducing the threat of levee overtopping and failure that might have affected the less developed areas downstream.

Alternative 10.2 provides measures for up to the four percent ACE flood. While this alternative would reduce the risk to critical public infrastructure and have substantial life safety benefits, those benefits would be somewhat less than those for the plans including the one percent ACE flood. Alternative 10.3 reduces the risk to life safety and critical public infrastructure for up to the two percent ACE flood. This alternative would provide greater life safety benefits than Alternative 10.2 but less than Alternative 10.1. Alternative 10.4 reduces the risk to life safety and critical public infrastructure for up to the 0.5 percent ACE flood. This alternative would provide the greatest life safety benefits of all alternatives under consideration.

Alternative 9 rebuilds only a segment of the RWDL upstream from Winslow. Failure or overtopping of this levee segment could flood two-thirds of the City of Winslow, including all of the critical public facilities identified.

Alternatives 9 and 10 include elevation of residences north of I-40. Reducing the flood risk to these homes would add minor additional life safety benefits to each of these alternatives.

It should be noted that the alternatives that do not include reconstruction of the entire Winslow Levee, excluding Alternative 7, would still provide life safety benefits for the downstream areas. This is because there is lower risk of floodwaters reaching those areas on the landside of the Winslow Levee from failure and overtopping that might have occurred upstream.

Alternative 7 includes only nonstructural measures, with no structural improvements. Other than the flood warning system, Alternative 7's contributions to reducing life safety risk would be limited to elevation of residences north of I-40.

3.6. System of Accounts

The *Economic and Environmental Principles for Water and Related Land Resources Implementation Studies*, established by the Water Resources Council in 1983, created four criteria known as "accounts" to facilitate evaluation and effects of alternative plans.

- The NED account displays changes in the economic value of the national output of goods and services.
- The Environmental Quality (EQ) account displays non-monetary effects on significant natural and cultural resources.
- The Regional Economic Development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan.
- The Other Social Effects (OSE) account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

For flood damage reduction studies, the NED and EQ accounts are required. RED and OSE are discretionary. Here, NED and EQ are compared for all alternatives in the focused array, while RED and OSE are evaluated for Alternative 10.1.

3.6.1. National Economic Development

The intent of comparing alternative plans in terms of NED is to evaluate the beneficial and adverse effects that the plans may have on the national economy. Beneficial effects are considered to be increases in the economic value of the national output of goods and services attributable to a plan. Increases in NED are expressed as the plan's economic benefits, and the adverse NED effects are the investment opportunities lost by committing funds to the implementation of a plan. Comparison of the focused array is shown above in Table 3-14, and comparison of the optimized plans is shown above in Section 3.5.5.

3.6.2. Environmental Quality

The EQ account is another means of evaluating the alternatives to assist in making a plan recommendation. The EQ account is intended to display the long-term effects that the alternative plans may have on significant environmental resources. Significant environmental resources are

defined by the Water Resources Council as those components of the ecological, cultural, and aesthetic environments which, if affected by the alternative plans, could have a material bearing on the decision-making process. Significance is derived from institutional, public, or technical recognition that a resource or an effect is significant. Chapter 5.0 describes the effects that alternative plans have on environmental resources. Table 5-1 summarizes the effects of each alternative in the final array for each resource category.

Avoidance and Minimization

Minimization and avoidance measures have been a major focus during the plan formulation phase for the proposed project. Such measures often have dual benefits, in that they not only reduce environmental impacts, but also lower the construction cost. There is further cost savings through reduction or elimination of environmental mitigation requirements, which would otherwise be implemented to offset adverse effects. Efforts to avoid and minimize environmental impacts have been productive during the plan formulation phase of this study. Several examples are provided in the following paragraphs.

- Modification to the BNSF Railroad Bridge to allow higher flows is cost prohibitive for this study. Therefore, any alternative that reduces flood risk for events larger than the four percent ACE flood must include measures to increase hydraulic conveyance under the bridge. The single greatest environmental impact needed for most of the alternatives consists of the work needed to increase this conveyance. The Los Angeles District Engineering Division evaluated six different sets (scales) of measures for conveying increased flows under the BNSF Railroad Bridge. Individual measures included channel excavation to the existing river thalweg depth, saltcedar removal, bank stabilization, and lining the excavated channel with concrete. The lowest-cost and least-environmentally-damaging design that was able to pass the one percent ACE flow under the bridge was selected for implementation with all alternatives requiring increased conveyance. This process was later repeated to develop measures that can increase the capacity at the bridge to pass the 0.5 percent ACE flood.
- Since the LCR impinges on the levee at two different locations, rebuilding the levee along its exact current alignment would have required measures to separate the construction area from river flows. Preliminary plans included excavation of two miles of temporary channels to divert river flows away from the levee at the impingement points. Aside from the obvious concerns regarding construction cost and sustainability, these channels would have caused major environmental impacts and increased mitigation requirements. Since there is an existing levee system in place, the study team believes the construction area can be separated from the LCR at the impingements utilizing the existing levee. In practice, the new levee would be constructed immediately behind the existing levee at these two locations, and then the original levee would be removed.
- Geotechnical team members have identified several possible sources of borrow material for new levee construction. These sources include the materials in the existing levee embankment, native soils along both sides of the levee, dust dunes that have formed in the LCR floodplain, the sediments excavated from the LCR at the BNSF Railroad Bridge, an offsite borrow pit that has been used for levee construction in the past, and a commercial borrow pit on the east side of the LCR. Geotechnical testing is still needed to determine which of these borrow sources meet materials requirements for project construction. Once

this testing is completed, the borrow sources having the least environmental impact, taking into consideration construction staging and haul distances, would be used for the project. Navajo County has already coordinated with local property owners, confirming the likely availability of three to five disposal sites, depending on the alternative.

- The existing Winslow Levee is already armored with a large amount of desirable basaltic riprap. The study team and non-Federal sponsor believe that this stone can be removed from the existing levee prior to demolition, stockpiled, and reused during levee reconstruction. Reuse of the riprap would reduce the environmental impact associated with hard rock mining and long distance hauling of large quantities of rock by truck.

3.6.3. Regional Economic Development

The RED account is intended to illustrate the effects that the proposed plans would have on regional economic activity, specifically, regional income and regional employment. To estimate RED impacts, the RECONS model was used. The RECONS model is developed by the Institute of Water Resources along with the Minnesota Planning Group, and it is used to evaluate RED impacts of Corps projects. The model uses estimated project construction cost as an input (influx of spending to the region) and relies upon regional cost multipliers to generate estimates of impact to regional income and employment based on the influx of revenue to industries related to the construction and to the regional economy as a whole. To run the analysis, the economic region must be defined. The region boundary for the analysis is a composite of rural communities in Arizona. This means regional impacts that have been measured are similar to those within rural areas of Arizona in general, and not specifically for Navajo County and the City of Winslow. The state-level impacts are for Arizona and the national impacts are for the contiguous United States.

RECONS accounts for the type of construction project through specification of the Corps business line, in this case the Flood Damage Control/Flood Management Risk business line. The construction cost input to the model includes contingency and PED, but excludes O&M and IDC. The RED analysis assumes impacts will be incurred over approximately six years.

As described in Appendix C - Economics, employment and income impacts can be segregated into three types: direct, indirect, and induced. In the context of this analysis, direct effects are increases in income and employment for industries supporting construction directly, such as construction contractors providing equipment and labor. Following that, indirect effects are increases in income and employment to those industries supplying the directly affected industries, such as concrete suppliers who sell to the construction company. Finally, induced effects are increases spending on local goods and services such as restaurants and stores due to the increased income and employment within industries impacted by the direct and indirect effects.

The comparison of possible effects that Alternative 10.1 may have on these resources is shown in Table 3-18. The table shows direct impact, then the total impact (sum of direct, indirect, and induced). Detailed documentation of the RED analysis is available in Appendix C - Economics.

Table 3-18 Overall RED Impacts from Alternative 10.1

(FY 14 Price Levels)

		Regional	State	National
Total Spending		$77,202,000	$77,202,000	$77,202,000
Direct Impact	**Output**	$53,308,174	$71,211,212	$76,925,121
	Jobs	$1,495	$1,868	$1,900
	Labor Income	$44,816,086	$49,590,832	$51,786,926
	Value Added	$47,538,410	$57,302,639	$60,596,279
Total Impact	**Output**	$71,790,752	$138,239,263	$203,122,105
	Jobs	$1,966	$2,367	$2,685
	Labor Income	$50,103,606	$72,653,141	$94,043,119
	Value Added	$58,376,866	$97,499,609	$133,835,160

Based on the estimated direct impacts we can expect about 1,795 jobs to be created within the Winslow, Arizona, region from the implementation of Alternative 10.1. These impacts are anticipated to occur over a span of about 5.5 years. Overall there would be an additional 1,966 jobs created (direct, indirect, and induced) primarily in labor, commercial and industrial machinery and equipment rental and leasing, and wholesale trade businesses sectors. In addition to these jobs, ongoing post-construction O&M expenses are projected to support one additional full time equivalent within the local economy throughout the study period. Overall, construction of Alternative 10.1 is expected to lead to an increase in labor income to the region of about $50 million.

3.6.4. Other Social Effects

The purpose of this OSE analysis is to show the beneficial and adverse effects of a flood risk management alternative on the social wellbeing of the city and the surrounding area. The OSE account typically includes long-term community impacts in the areas of public facilities and services, recreational opportunities, transportation and traffic, and manmade and natural resources. The OSE account also integrates information into the planning process that is not reflected in the other three accounts used by the Corps to evaluate projects and alternative plans.

The analysis of OSE for this categorized impacts into OSE “dimensions of interest” typical to Corps evaluations, including public health and safety, economic vitality, community cohesion, identity, social vulnerability, and resiliency. The following briefly describe each dimension. A detailed discussion of each dimension and of the analysis is provided in Appendix C - Economics.

- The public health and safety dimension considers effects on mental health, physical health, and physical safety.
- The economic vitality dimension considers effects on the business climate, employment opportunities, financial status/standard of living, and municipal services.
- The community cohesion dimension considers effects on social connectedness (personal social networks) and local community facilities.
- The identity dimension considers effects the sense of cultural and community identity.

- The social vulnerability and resiliency dimensions consider effects on the overall population of residents as well as socially vulnerable groups, and assess impacts to the vulnerability of these populations and their ability to recover from them.
- The Federal government relocated American Indian families to Winslow to enforce the Navajo Hopi Land Settlement Act of 1974, Public Law 93-531, which created a Federal commission to remove Hopis and Navajos from contested tribal lands and relocate them to urban communities outside their reservations. The City of Winslow received the third highest number of Navajo relocatees. According to the Office of Navajo Hopi Indian Relocation, as of April 2015 there were 694 individuals living in 131 homes throughout Winslow.

Table 3-19 summarizes and compares the OSE benefits of Alternative 10.1 to the without-project condition.

Table 3-19 OSE Impacts Summary

Category	Adverse Effect from Flooding for the Without-Project Condition	Beneficial Effect With Alternative 10.1
Public Health and Safety	Strong/Moderate	Strong/Moderate
Economic Vitality	Moderate	Moderate
Community Cohesion	Moderate/Small	Moderate
Identity	Small	Small
Social Vulnerability	Strong/Moderate	Moderate
Resiliency	Moderate	Minimal

3.7. Identification of the Recommended Plan

The average annual benefits and costs for the different scales for Alternative 10 are shown in Section 3.5.5. Note that these benefits and costs are for Reach 1 only, since the nonstructural improvements for Reach 2 are not economically justified.

As shown, the plan and scale that maximizes net NED benefits is Alternative 10.4, which is designed to convey the 0.5 percent ACE discharge with a 90 percent assurance. This alternative has net benefits of about $5.8 million, a benefit-to-cost ratio of 2.74, and is expected to reduce without-project damages by approximately 90 percent in Reach 1.

While Alternative 10.4 has the highest net benefits of the alternatives, it is possible that a slightly larger scale plan could result in even higher net benefits, i.e., the NED Plan may actually be somewhat larger than Alternative 10.4. The non-Federal sponsor has expressed a preference for Alternative 10.1 as the Recommended Plan. Although this plan has a higher benefit-to-cost ratio than Alternative 10.4, it has slightly lower net benefits. The PGN, paragraph 3-3.b (11) specifies that a plan other than the NED Plan may be selected if it qualifies for a Categorical Exemption. Specifically, the PGN (p. 3-13, 3-14) states:

> *Categorical Exemption to NED Plan: For flood damage reduction studies, where the non-Federal sponsor has identified a desired maximum level of protection, where the project residual risk is not unreasonably high, and where the plan desired by the sponsor has greater net benefits than smaller scale plans, it is not required to analyze project plans providing higher levels of protection than the plan desired by the sponsor. For example, if a sponsor desires a levee of sufficient height to meet FEMA's flood insurance requirements and it is*

determined that the levee to accomplish this has higher net benefits than smaller levees, then the levee desired by the sponsor can be recommended without having to analyze larger levees to identify the NED Plan. The recommended plan must have greater net benefits than smaller scale plans, and a sufficient number of alternatives must be analyzed to insure that net benefits do not maximize at a scale smaller than the recommended plan. If the plan proposed to be recommended contains uneconomical increments an exception from the ASA(CW) must be obtained. An essential element of the analysis of the recommended plan is the identification of residual risk for the sponsor and the flood plain occupants, including residual damages and potential for loss of life, due to exceedance of design capacity. The analysis of alternatives must be comprehensive enough to meet the requirements of NEPA.

The selection of Alternative 10.1 as the Recommended Plan meets the above criteria. Specifically, this plan: (1) provides the non-Federal Sponsor's desired maximum level of protection; (2) has with-project residual risks that are not unreasonably high; (3) features levee improvements designed to meet FEMA's flood insurance requirements; (4) has greater net benefits than smaller scale plans; and (5) does not contain uneconomical increments. Therefore, larger scale plans than Alternative 10.4 are not required to be analyzed, and Alternative 10.1 is identified as the Recommended Plan.

3.7.1. Residual Risk

Construction of a flood risk management project would greatly reduce the threat to life and safety in Reach 1 of the study area. Regardless of the actions taken, some level of risk would remain. The risk of levee failure is addressed by Alternative 10.1, which rebuilds and strengthens the Winslow Levee in Reach 1, but provides no flood risk measures in Reach 2 beyond the flood warning system. This alternative would also address levee overtopping risk to some extent, since it would include a levee higher than the existing levee for Reach 1. Residual flood risk in Reach 1 would be primarily related to levee overtopping events, which are more reliably forecast in advance. Alternative 10.1 was conceived with a three-foot increase in levee height above the one percent ACE elevation, which provides an 88 percent assurance of containing the one percent ACE event. On further analysis, only a slight (0.3 feet) increase in levee height was needed to reach a 90 percent assurance level (see Appendix C - Economics), and levee height needed to reach 90 percent assurance has been incorporated into this alternative. Alternative 10.4 provides added protection but is very similar in its level of flood risk reduction for Reach 1. If a failure occurs for an event exceeding the project design, the residual risk would be very similar to the without-project condition. Alternatives 10.1 and 10.4 do not address the levee deficiencies in Reach 2.

It should be noted that the alternatives that do not include reconstruction of the entire Winslow Levee, excluding Alternative 7, would still provide life safety benefits for the downstream areas. This is because there is lower risk of floodwaters reaching those areas on the landside of the Winslow Levee from failure and overtopping that might have occurred upstream.

Reach 2 has a residual risk to health and life safety from flooding and levee failure at the Winslow WWTP. The City of Winslow recently constructed a ring levee around the WWTP to prevent damages up to the one percent ACE flood. This local action has reduced the flood risk to the WWTP. There is still a residual risk that an event larger than the one percent ACE flood

would inundate the plant and release raw sewage into the floodwaters. The gravity system for the WWTP has five lift station pumps that carry Winslow's sewage from lower to higher elevations. All five pumps are within the one percent ACE flood zone. Manholes throughout town in both Reach 1 and Reach 2 present further risks of raw sewage spillage. Exposure to untreated sewage has the potential to cause illness and other health concerns.

Alternative 10.1 would allow for improved safety to residents in Reach 1 by reducing risk of inundation of public infrastructure. Flood threats to public health facilities, such as the Little Colorado Medical Center and associated health care facilities would also be reduced. Alternative 10.1 would further minimize negative impacts to emergency response efforts that occur when floodplain transportation infrastructure is inundated. While Alternative 10.4 provides greater reduction in risks to public health and safety, both plans provide a high level of risk reduction. In Reach 2, most of the area would still be subject to flood risks from potential levee failures downstream of proposed improvements for Alternative 10.1 and Alternative 10.4. However, the risk in this area will not be any worse than under the No Action Alternative.

3.7.2. Non-Federal Sponsor's View

The primary goal of the non-Federal sponsor is to provide a levee that is capable of being accredited by FEMA for the one percent ACE or "100-year" flood event. The interest in supporting such a plan is to remove the City of Winslow and surrounding communities from the FEMA designated "100-year floodplain" of the LCR. Another associated interest is to eliminate the need for flood insurance for federally-backed loans, if houses are taken out of the "100-year floodplain."

Alternative 10.1 provides for reconstruction of an economically justified levee segment that reduces the flood risk for the most densely populated parts of the Winslow area. Alternative 10.1 best meets local goals and provides an appropriate level of flood risk management in consideration of the local sponsor's fiscal capability. Alternative 10.1 limits the environmental effects and provides for a levee setback that increases hydraulic conveyance at Homolovi I. For these reasons Navajo County endorses Alternative 10.1 as the preferred plan for selection and implementation. The City of Winslow joins Navajo County in supporting the implementation of Alternative 10.1.

3.7.3. Stakeholder Perspectives and Differences

The major goal of the non-Federal sponsor is to provide a levee system that can be accredited by FEMA for the one percent ACE flood. The Corps is generally required to formulate for the NED plan, which may not meet the full expectation of the non-Federal sponsor.

The public and other agencies had multiple opportunities to participate in this study. The earliest opportunity for formal public comment occurred at the public scoping meeting in Winslow, Arizona, on March 24, 2009. The Draft IFR/EIS was released for Agency Technical Review (ATR), Independent External Peer Review (IEPR), public, policy and legal review with publication of the Notice of Availability in the Federal Register (81 FR 35756) on June 3, 2016. The Draft IFR/EIS was made available to the public through the use of the District's website on May 26, 2016, and notices that information was available to interested parties and stakeholders

were mailed. Two public meetings were held in Winslow on June 9, 2016, concurrent with release of the Draft IFR/EIS. The public had opportunities to provide oral and/or written comments during these meetings. Comments on the Draft IFR/EIS were also accepted in writing for a 45-day period extending from June 3, 2016 through July 18, 2016.

The non-Federal sponsor has developed a public involvement plan that outlines both formal and informal opportunities for public participation in this study. Many sponsor coordination meetings are held concurrently with quarterly meetings of the Winslow Levee Advisory Board. These meetings are attended by the Navajo County Board of Supervisors and are open to the public for comment.

Comments received to date have been minimal. The most significant comments have been provided by the Arizona State Museum and Homolovi State Park. Their comments pertain to possible impact of the project on flood risk to the Homolovi I Pueblo, located across the LCR from the levee. Their perception is that construction of the existing Winslow Levee along its current alignment has increased the flood risk to the Homolovi I site. Flooding at the Homolovi I Pueblo begins at approximately the 10 percent ACE (10-year) flood under current conditions. See Sections 5.2 and 5.6 for further details on potential impacts of the action alternatives. The potential impacts of the proposed project on the Homolovi I Pueblo may continue to be of public concern through completion of the study. The Corps will continue to work closely with the Hopi Tribe, Arizona State Parks, Arizona State Museum, and the Arizona SHPO to ensure that potential impacts to Homolovi I are addressed.

3.8. Refinement of the Recommended Plan

Following identification of Alternative 10.1 as the Recommended Plan, the PDT refined this plan further with respect to scour depth assumptions, materials, and timing/duration of construction, and other minor clarifications. A summary of the refinements made to the Recommended Plan is provided below:

The station numbers used for identifying the stationing along the levees were revised, resulting in an increase of the estimated length of the levees to be reconstructed from 22,552 feet to 22,570 feet.

The assumptions regarding scour depth for reconstruction of the levees were refined to apply actual scour depth when feasible rather than assuming consistent scour depth along the length of the levee. This refinement resulted in increased quantities of riprap and soil cement associated with scour protection and increased excavation volumes to place those materials. In conjunction with the updated assumptions regarding scour depth, the plan was refined to utilize launchable stone at locations where the maximum scour depth needed is more than 15 feet. This minimizes the additional excavation needed to reach full scour depth described above. Therefore, even with the refined scour depth assumptions, overall excavation would not be significantly different than original assumptions. Launchable stone is defined as stone that is placed along the expected erosion areas at an elevation above the zone of attack. As the attack and resulting erosion occur below the stone, the stone is undermined and rolls/slides down the slope, stopping the erosion.

In addition, cumulative reuse assumptions for the material in the existing levee embankment and material excavated from the LCR, exclusive of material excavated for flood conveyance near the BNSF Railroad Bridge, have been revised from 70 percent to approximately 78 percent. This reduced the amount of material that requires a designated offsite disposal location.

The previous assumption of use of either grouted stone or soil cement for river-side levee protection from scour was refined so that now use of only soil cement is assumed. Soil cement was determined to be less expensive and more effective with regard to structural integrity.

The assumed PED duration is three years. The assumed construction duration was shortened from 6 years to 2.5 years for efficiency purposes. The adjustment to construction duration is based on allowing construction on a year-round basis, with work suspensions accounted for during adverse weather, the monsoon season, and national holidays. Construction would generally be suspended during the summer monsoon season of July, August, and September, depending on anticipated weather conditions. This would result in the overall work being completed faster with no designated seasonal breaks, but without increasing the intensity of work on a daily basis. Work would continue to be subject to the environmental restrictions identified in Chapter 5.0.

The updated total project cost and economic evaluation were updated to October 2017 price levels and a discount rate of 2.75 percent.

The above refinements were developed specifically for the Recommended Plan, Alternative 10.1. Proportional refinements were assumed for the other action alternatives. These refinements are, where relevant, discussed in the environmental consequences analysis in Chapter 5.0.

Appendices to the IFR were updated only where relevant to the analysis and conclusions contained therein.

Table 3-20 Summary of Alternative Evaluation, Screening, Comparison, and Tentative Selection

	Preliminary Array – Post-Charrette Report			Preliminary Array				Focused Array				Alternative 10 Optimization			
	Post-Charrette Report Alternatives	**Evaluation**	**Screening**	**Evaluation**	**Comments**	**Action**	**Screening**	**Alternatives**	**Evaluation**	**Comments**	**Screening**	**Alternatives**	**Evaluation**	**Comments**	**Screening**
Levees along Existing Alignment	ALT 1 – – Construct New Levee Near Existing Alignment = "Rebuild Winslow Levee", Build New Levee Parallel to I-40	Conceptual design and cost completed for post-charrette report.	Carry forward as ALT 1.	Geotech assessment indicates Winslow Levee should be rebuilt vs. rehabilitated; levee height is limited by the current elevation of the BNSF Railroad.	Will need LCR conveyance improvements at BNSF Bridge for most/all levee alternatives.	Merge ALT 1 and ALT 2 into single "Rebuild Winslow Levee" alternative; separately optimize conveyance improvements at BNSF Bridge and include least cost solution in most/all levee alternatives,	Carry forward as ALT 1.1.	ALT 1.1 – Rebuild Winslow Levee, Build New Levee Parallel to I-40, Conveyance Improvements at BNSF Railroad.	Conduct hydraulic and economic evaluation of alternative.	Cost effective but ALT 10 provides higher NED benefits.	Included in focused array but not selected for optimization.				
	ALT 2 Rehabilitate Winslow Levee, Build New Levee Parallel to I-40	Conceptual design and cost completed for post-charrette report.	Carry forward as ALT 2.	Geotech assessment indicates Winslow Levee should be rebuilt vs. rehabilitated; (assume must rebuild); levee height is limited by the current elevation of the BNSF Railroad.	Since levee must be rebuilt rather than rehabilitated, would not be different from ALT 1.	Merge ALT 1 and ALT 2 into single "Rebuild Winslow Levee" alternative; separately optimize conveyance improvements at BNSF Bridge and include least cost solution in most/all levee alternatives	ALT 2 – SCREENED OUT.								
Setback Levees	ALT 3 – Realign Levee/Setback Levee	Conceptual design and cost completed for post-Charente report.	Carry forward as ALT 3.	Cannot set back levee south of I-40 due to elevation of BNSF Railroad; would require use of a stop log, which is not acceptable to BNSF.	Will need LCR conveyance improvements at BNSF Bridge for most/all levee alternatives.	Retain alternative but delete portion of setback levee south of I-40; using existing levee alignment for levee improvements south of I-40.	Carry forward as ALT 3.1 – Setback Levee, Build New Levee Parallel to I-40, and Conveyance Improvements at BNSF Railroad Bridge.	ALT 3.1 - Rebuild Winslow Levee With Setback, Conveyance Improvements at BNSF Railroad Bridge.	Conduct hydraulic and economic evaluation of alternative.	Cost effective but ALT 10 provides higher NED benefits.	Included in focused array but not selected for optimization.				

Table 3-20 Summary of Alternative Evaluation, Screening, Comparison, and Tentative Selection

	Preliminary Array – Post-Charrette Report			Preliminary Array				Focused Array				Alternative 10 Optimization			
	Post-Charrette Report Alternatives	**Evaluation**	**Screening**	**Evaluation**	**Comments**	**Action**	**Screening**	**Alternatives**	**Evaluation**	**Comments**	**Screening**	**Alternatives**	**Evaluation**	**Comments**	**Screening**
	ALT 4 – New Levee Parallel to I-40, Floodgates at Underpasses, Nonstructural Measures North of I-40	Conceptual design and cost completed for post-Charente report.	Carry forward as ALT 4.	Would have substantial costs for levee construction and floodgate installation along north side of I-40; expending the same funding extending the levee north along the current alignment would provide greater flood risk reduction benefits. Would place some residences in floodplain and transfer flood risk.	Not efficient, residual risks, transferred risks.	Do not carry forward.	ALT 4 – SCREENED OUT.								
Detention	ALT 5 – Upstream Detention, No Levee Improvements	Source and timing of flood varies with each storm event, no intuitive dam site on the LCR mainstem, real estate requirements, environmental impacts, conflict with mitigation site, possibility of transferred risk.	ALT 5 – SCREENED OUT.												
Channelization	ALT 6 – Channelization of LCR, No Levee Improvements	Not a complete or cost effective solution, does not address issues with existing levee, greater impacts to jurisdictional waters.	ALT 6 – SCREENED OUT.												

Table 3-20 Summary of Alternative Evaluation, Screening, Comparison, and Tentative Selection

	Preliminary Array – Post-Charrette Report			Preliminary Array				Focused Array				Alternative 10 Optimization			
	Post-Charrette Report Alternatives	**Evaluation**	**Screening**	**Evaluation**	**Comments**	**Action**	**Screening**	**Alternatives**	**Evaluation**	**Comments**	**Screening**	**Alternatives**	**Evaluation**	**Comments**	**Screening**
Nonstructural	ALT 7 – Nonstructural Measures North of I-40 (elevate residences), Flood Warning System	May be cost effective but is incomplete and likely not acceptable.	Carry forward as ALT 7 as a nonstructural measure plan.	Economist visited study area to prepare structure inventory.			ALT 7 – Nonstructural Measures North of I-40, Evacuation Plan, Flood Warning System.	ALT 7 – Nonstructural Measures North of I-40, Evacuation Plan, Flood Warning System.	Conduct economic evaluation of alternative.	Not cost effective as standalone.	Included in focused array but not selected for optimization.				
Alternatives Added to the Initial Array					Navajo County supports a plan that will provide an accredited levee system that closely follows the existing levee alignment, with a setback levee across from Homolovi I.	Add Navajo County's preferred alternative to array as ALT 8 – Rebuild Winslow Levee, Setback Levee at Homolovi I, New Levee Parallel to I-40, Conveyance Improvements at BNSF Railroad Bridge; Levee scale to contain 1% ACE flood with 90% assurance.	Carry forward as ALT 8.	ALT 8 – Rebuild Winslow Levee, Setback Levee at Homolovi I, New Levee Parallel to I-40, Conveyance Improvements at BNSF Railroad Bridge; Levee scale to contain 1% ACE flood with 90% assurance.	Conduct hydraulic and economic evaluation of alternative.	Cost effective but ALT 10 provides higher NED benefits.	Included in focused array but not selected for optimization.				
					Vertical Team advised evaluating incremental alternatives to determine the best Federal investment.	Add incremental alternatives to the array to maximize NED benefits.	ALT 9 –Rebuild RWDL at Existing Height, No Conveyance Improvements, Nonstructural Measures North of I-40.	ALT 9 –Rebuild RWDL at Existing Height, No Conveyance Improvements, Nonstructural Measures North of I-40.	Conduct hydraulic and economic evaluation of alternative.	Cost effective but ALT 10 provides higher NED benefits.	Included in focused array but not selected for optimization				
					Vertical Team advised evaluating incremental alternatives to determine the best Federal investment.	Add incremental alternatives to the array to maximize NED benefits.	ALT 10– Rebuild & Setback Levees, New Levee Parallel to I-40, Conveyance Improvements at BNSF Railroad, Nonstructural Measures North of I-40.	ALT 10 – Rebuild & Setback Levees, New Levee Parallel to I-40, Conveyance Improvements at BNSF Railroad, Nonstructural Measures North of I-40.	Conduct hydraulic and economic evaluation of alternative; evaluate alternative with and without nonstructural measures.	Alignment has greatest NED benefits of the plans evaluated. Benefits further maximized by eliminating elevating residences to create ALT 10.1	Optimize ALT 10.1 by evaluating three additional levee scales for the 4%, 2%, and 0.5% ACE flood: ALT 10.2, ALT 10.3, and ALT 10.4.	ALT 10 = ALT 10.1 for optimization; levee scale to contain 1% ACE flood with 90% assurance.	Conduct economic evaluation of alternative; evaluate alternative without nonstructural measure of elevating residences.	Cost effective but ALT 10.4 provides higher net benefits.	Navajo County endorses ALT 10.1. ALT 10.1 meets categorical exemption requirements. ALT 10.1 identified as Recommended Plan.

Table 3-20 Summary of Alternative Evaluation, Screening, Comparison, and Tentative Selection

	Preliminary Array – Post-Charrette Report			Preliminary Array				Focused Array				Alternative 10 Optimization			
	Post-Charrette Report Alternatives	Evaluation	Screening	Evaluation	Comments	Action	Screening	Alternatives	Evaluation	Comments	Screening	Alternatives	Evaluation	Comments	Screening
												ALT 10.2 for optimization; levee scale to contain 4% ACE flood.	Conduct economic evaluation of alternative; evaluate alternative without nonstructural measures of raising residences.	Cost effective but ALT 10.4 provides higher NED benefits; coordinate results with Navajo County to see if they want to offer a Locally Preferred Plan. No LPP requested.	ALT 10.2 – NOT TSP.
												ALT 10.3 for optimization; levee scale to contain 2% ACE flood.	Conduct economic evaluation of alternative; evaluate alternative without nonstructural measures of raising residences.	Cost effective but ALT 10.4 provides higher NED benefits; coordinate results with Navajo County to see if they want to offer a Locally Preferred Plan. No LPP requested.	ALT 10.3 – NOT TSP.
												ALT 10.4 for optimization; levee scale to contain 0.5% ACE flood.	Conduct economic evaluation of alternative; evaluate alternative without nonstructural measures of raising residences.	Greatest net benefits of the plans evaluated but not confirmed as the NED Plan because a plan for a larger flood may have higher net benefits.	ALT 10.4 – Not TSP, as ALT 10.1 meets requirements for categorical exemption.
	ALT 11 - NO ACTION					Required by NEPA; allows for determination that no plan has Federal interest – carry forward.	Carry forward as ALT 11 – No Action.	ALT 11 – No Action.							

4.0 AFFECTED ENVIRONMENT

The environmental settings for both the existing and future without-project conditions are described in this section by environmental resource. The future without-project conditions are more fully detailed as Alternative 11, No Federal Action Alternative in Chapter 5.0. Below is a general description of the project setting.

The proposed project area is located adjacent to the City of Winslow. Much of it is located outside city limits within an unincorporated area of Navajo County. Major transportation corridors through the project area include the BNSF Railroad Bridge located east of the RWDL, and I-40 and SR-87 that cross the LCR. Land use surrounding the project area is primarily rural residential and open space with some commercial, industrial, and transportation uses.

The surrounding desert area is characterized by low topographic relief, broad and flat mesas with remnants of smaller, eroded mesas on top of them. The larger and more extensive mesas, such as Ives Mesa, which comprises the eastern bank of the Little Colorado River on the opposite side of the river from the Winslow Levee, typically are at an elevation of 5,000 feet above sea level, while other, smaller mesas on top reach as much as 5,040 feet.

The primary drainage is the Little Colorado River, which has a system of highly mature river meanders, with switchbacks and cut offs, and follows a low-gradient, north-northwest trend on the way to the confluence with the Colorado River, over 100 river miles farther to the north from the subject area. The Little Colorado River (LCR) at Winslow is an ephemeral stream, as shown on the U.S Geological Survey topographic maps of the area, and recent field observations by the Corps, reports from local residents, and from the historical record. The LCR at Winslow is susceptible to large-volume flows of short duration. The flows from the Little Colorado River are increased considerably just before this watercourse reaches the Winslow Levee by tributary flow contributions from Clear Creek, Jacks Canyon, and Cottonwood Wash, and another 8.6 straightline miles to the southeast, flows of Chevelon Creek.

The project area is located within the Colorado Plateau ecoregion, which is characterized by dominant shrubs including big sagebrush (*Artemisia tridentata*), blackbrush (*Coleogyne ramosissima*), and shadescale (*Atriplex confertifolia*). Because the project area includes the LCR, riparian vegetation exists at a larger extent than what would normally be seen within the Great Basin Desert scrub biotic community. Within the project area, saltcedar is the dominant species.

4.1. Geology and Soils

4.1.1. Levee Alignment

In general, the substrate which characterizes the streambed of the LCR at Winslow has been deposited by natural riverine processes. Surficial alluvial and sand deposits cover extensive areas of bedrock outcrops throughout the entire Winslow quadrangle [U.S. Geological Survey (USGS), 2013]. The LCR meanders within a three-mile- (5-kilometer [km]) wide valley between Winslow and Leupp where soft strata of mudstone and sandstone is largely covered by an unknown thickness of floodplain deposits. The LCR west of Winslow is comprised of old layers of terrace-

gravel deposits and volcanic substance while younger terrace-gravel deposits along the margins of the LCR Valley. The LCR is the principal drainage within the Winslow quadrangle.

The Winslow Levee and easternmost RWDL, in addition to the proposed realignments of part of Winslow Levee and most potential sources of borrow for levee fill, are all entirely founded on alluvium deposits of the LCR (Corps, 2015). Bedrock under the northern half of the Winslow Levee occurs in the depth range of 50 to 100 feet, slowly deepening on a one-to-three degree dip to the north. Near the southern end of the Winslow Levee, bedrock is exposed, but the levee footprint remains on relatively deep alluvium; typically 30 to 40 feet of sediment remain there beneath the levee and above the bedrock. The cause of this difference in depths to bedrock is the fact that LCR once had eroded a 30- to 100-foot-deep canyon through the area, but subsequently backfilled that canyon with alluvium after the local depositional environment changed from eroding to aggrading.

Fine-grained, silty soils generally comprise the most recent deposits in the study area and the material deposited in local dust storms (Corps, 2015). Fine-grained deposition from floods also exists along with ½-inch to 3-inch-diameter gravels, cobbles, sand, and silty sand at shallow depths and over a wide area. The existence of shallow, fine grained (silt and clay) blankets is likely in some areas based on the limited available boring information. These soils are found on alluvial fans, floodplains, and drainage areas in central and north central Arizona [Natural Resources Conservation Service (NRCS), 2012, 2003].

4.1.2. BNSF Railroad Bridge, Interstate 40, and State Route 87

The substrate and soils around the BNSF Railroad Bridge, I-40, and SR-87 are similar to those described above in the levee alignment section.

4.1.3. Borrow Sites

Most borrow for the proposed levee construction would come from onsite sources such as the river channel and the fine-grain (silt) deposits discussed above. Significant blending and mixing of soils from required excavations and borrow sources will be necessary to achieve suitable fill and soil cement material. If offsite borrow sources are needed, potential offsite borrow sites identified for the alternatives are shown in Figure 4-1 through Figure 4-8 and described below.

a. Riverine Borrow Sites

There are two potential borrow sites on the riverside of the Winslow Levee. The first consists of the LCR floodplain in the vicinity of the BNSF Railroad Bridge, as well as existing levee embankments and trench drain excavation. This BNSF Bridge excavation area would be excavated for most of the alternatives under consideration (see impact analysis of alternatives in Chapter 5.0) to increase conveyance under the railroad bridge. For alternatives requiring increased conveyance, the excavated area would be either ±26 acres or ±81 acres. For planning purposes, the Corps assumed that up to half of the material excavated from the floodplain could be used for levee construction. The area that would be excavated consists of the LCR itself, unvegetated eolian (wind-deposited) and river run materials, and a dense saltcedar monoculture. It is anticipated that excavated soils would consist of alluvial sand, fines, and coarse gravel.

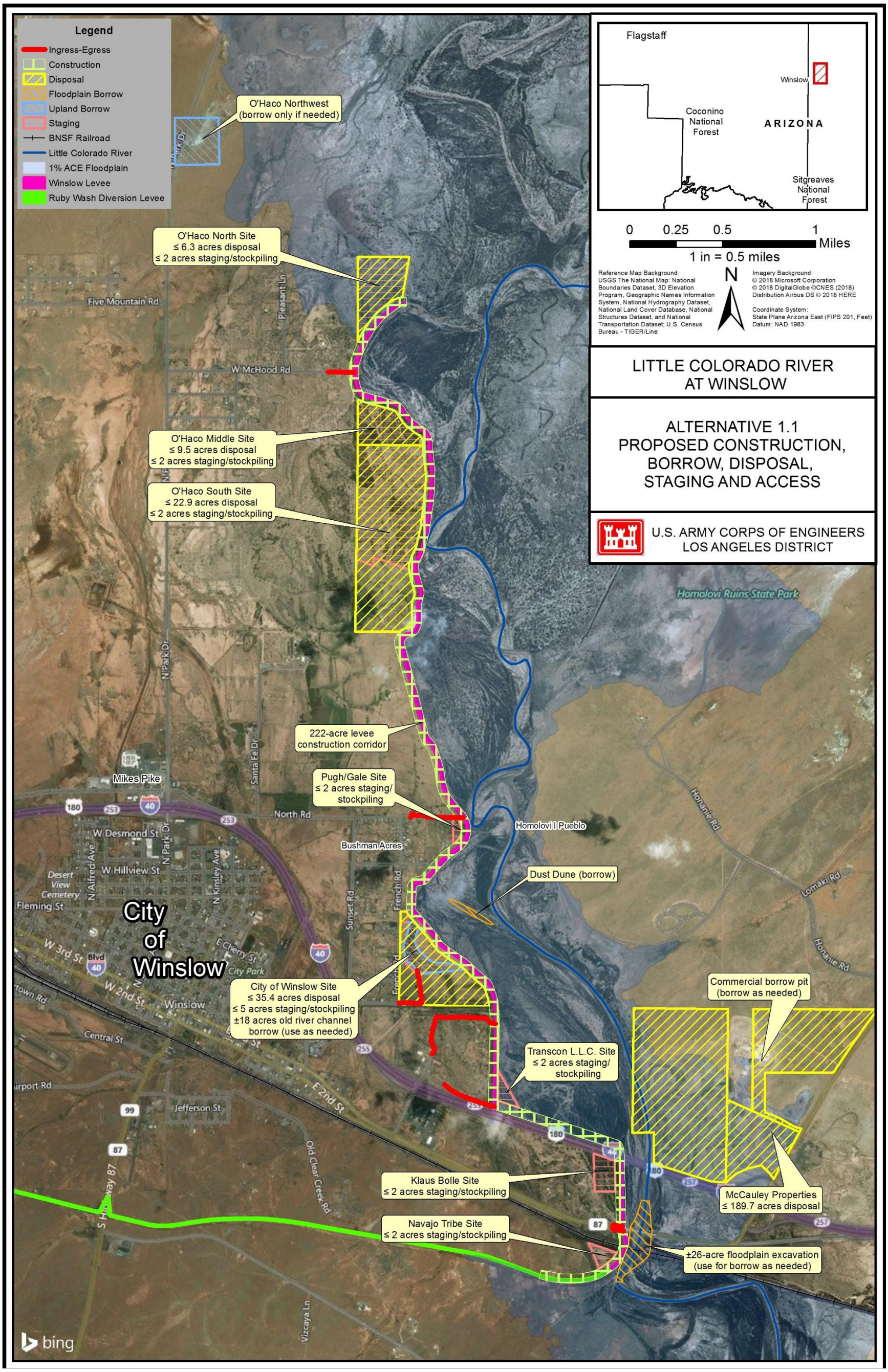


Figure 4-1 Alternative 1.1, Proposed Construction, Borrow, Disposal, Staging, and Access

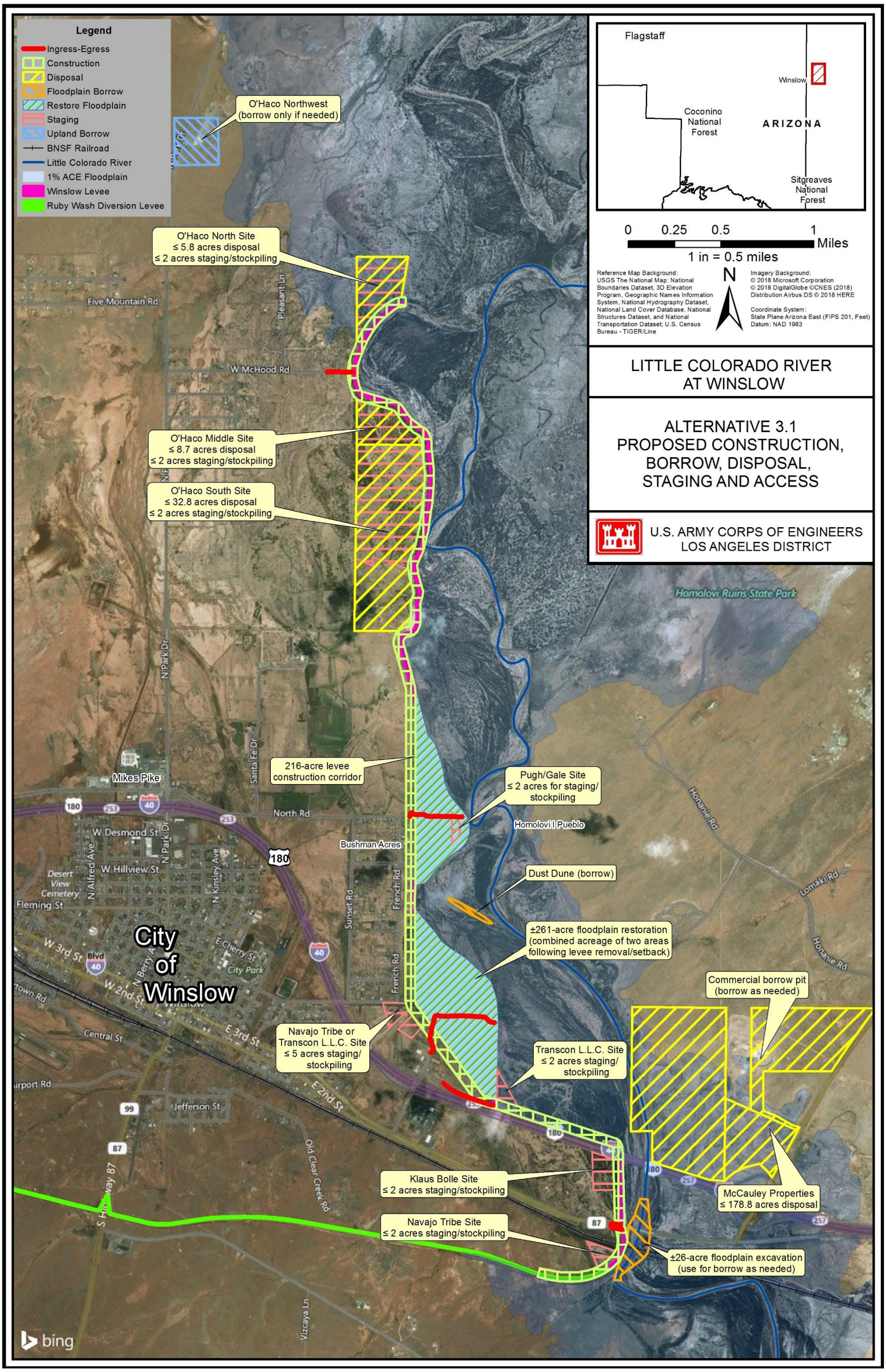


Figure 4-2 Alternative 3.1, Proposed Construction, Borrow, Disposal, Staging, and Access

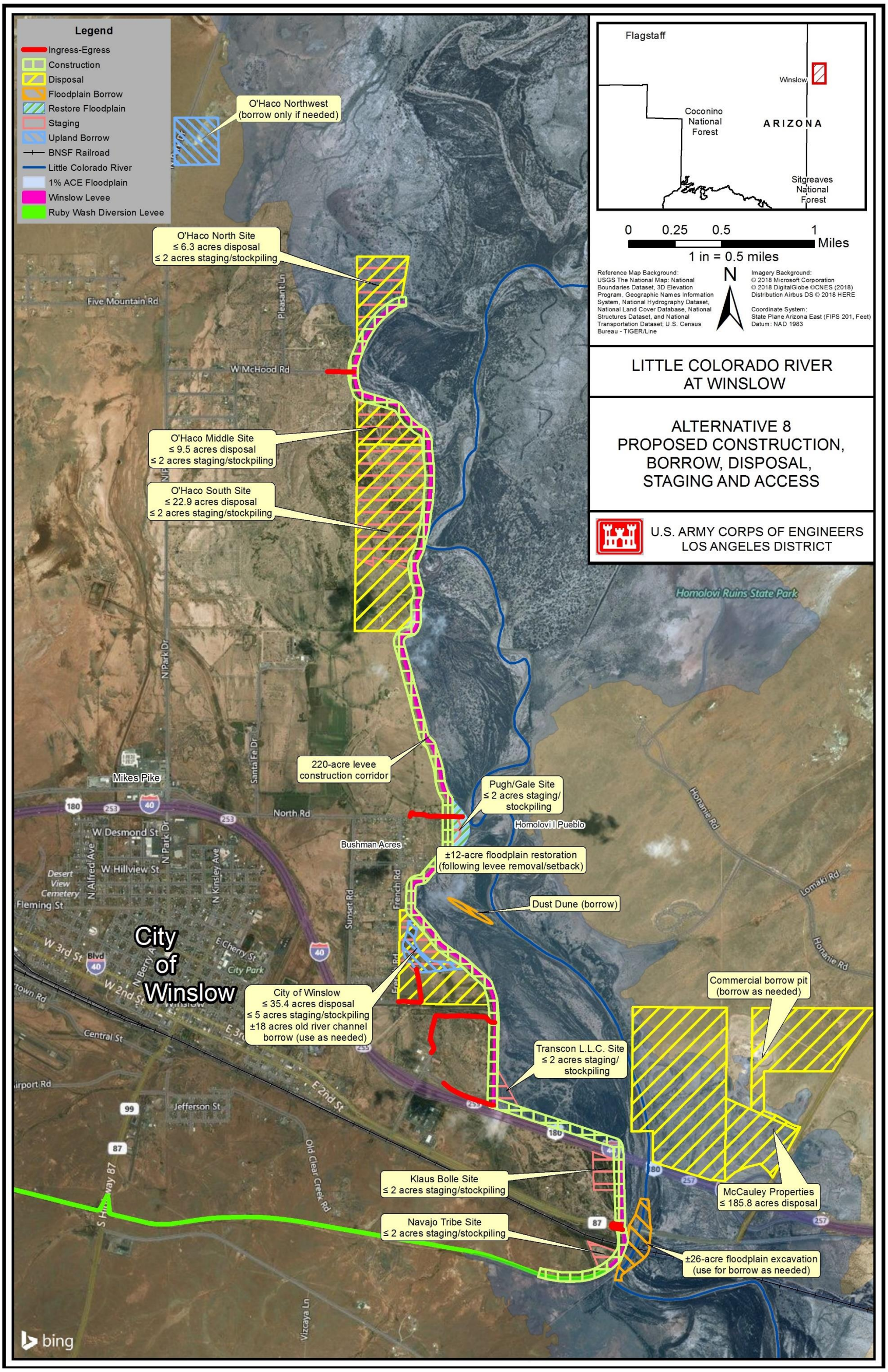


Figure 4-3 Alternative 8, Proposed Construction, Borrow, Disposal, Staging, and Access

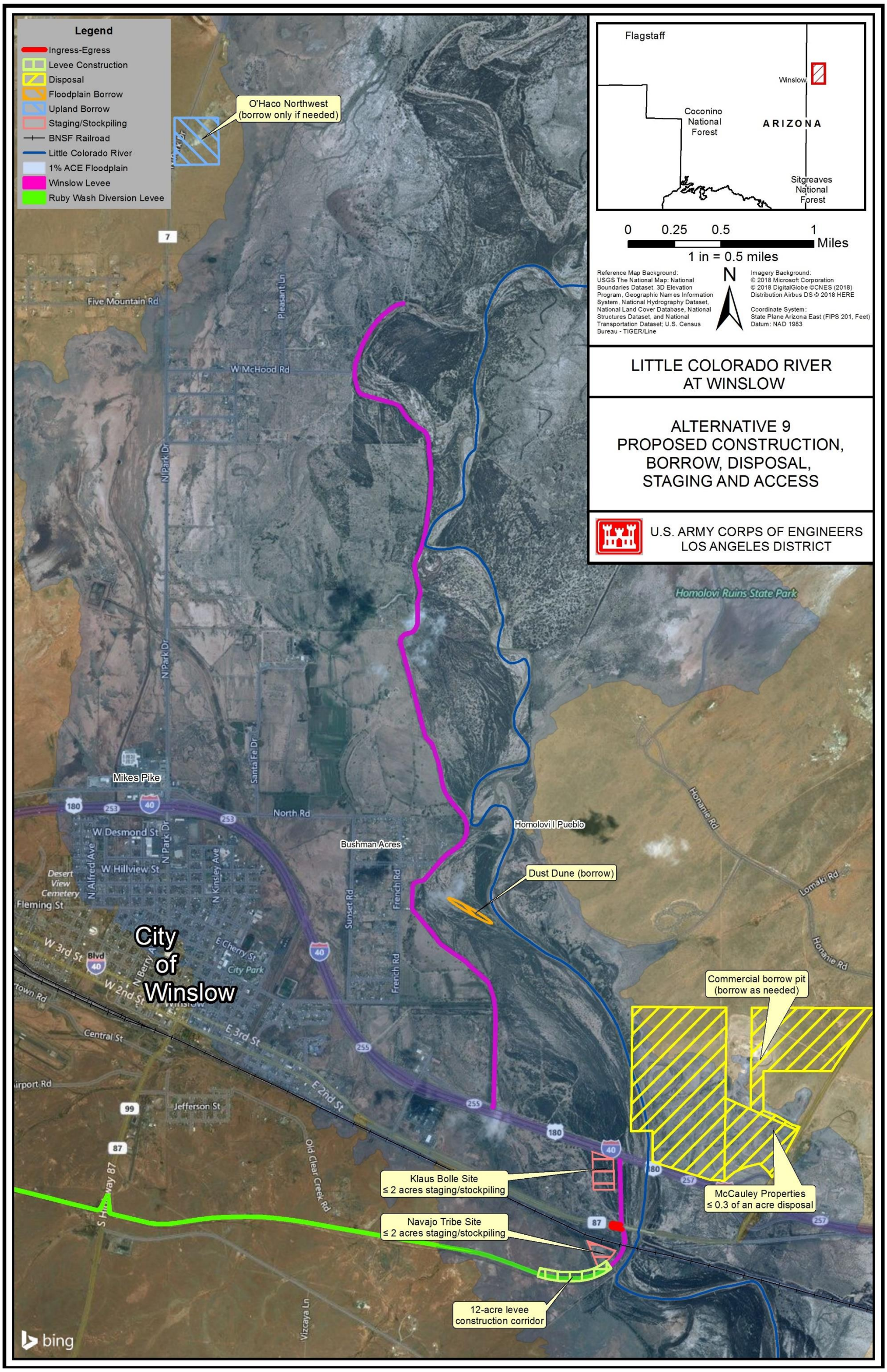


Figure 4-4 Alternative 9, Proposed Construction, Borrow, Disposal, Staging, and Access

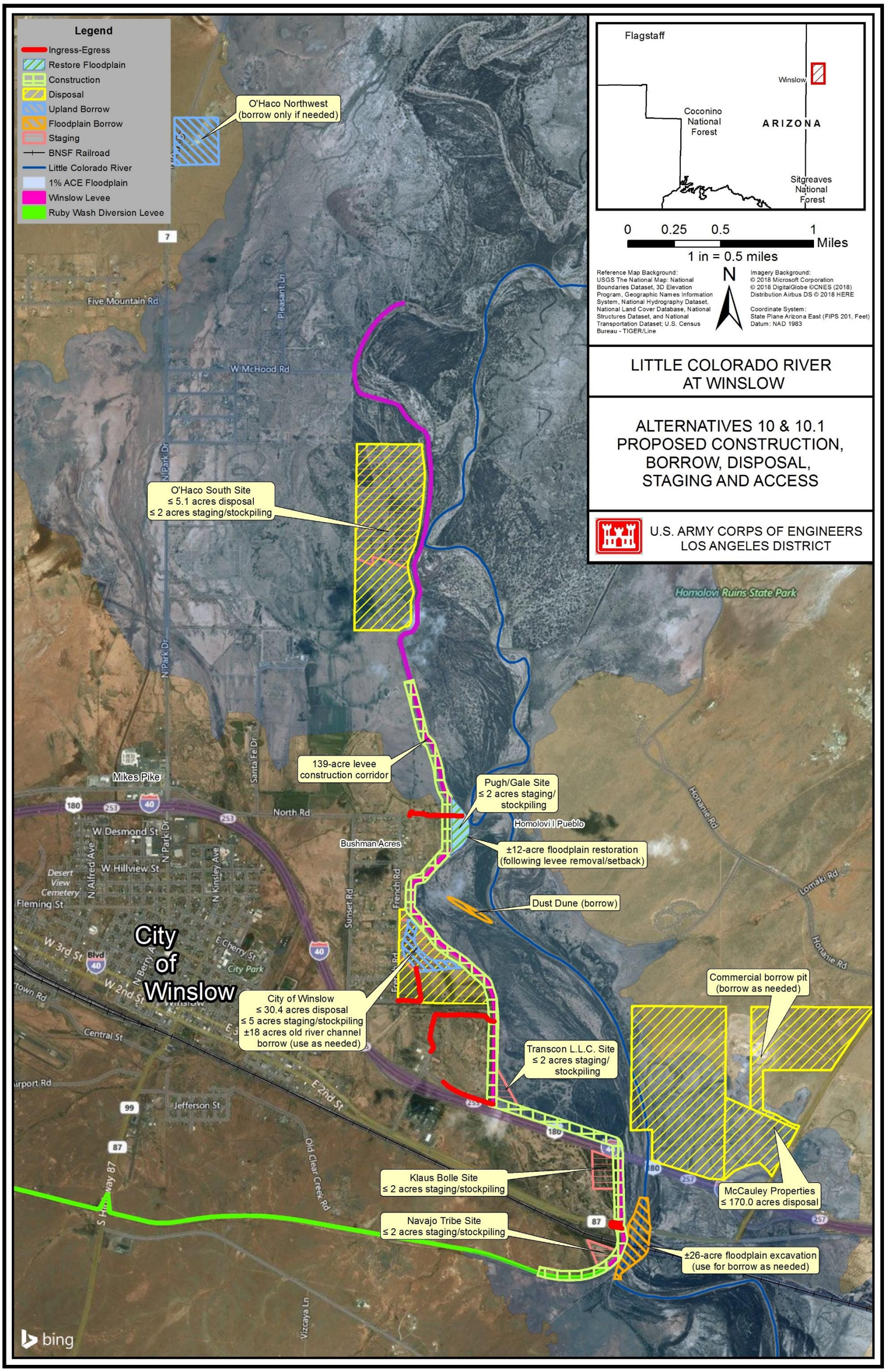


Figure 4-5 Alternative 10 & 10.1, Proposed Construction, Borrow, Disposal, Staging, and Access

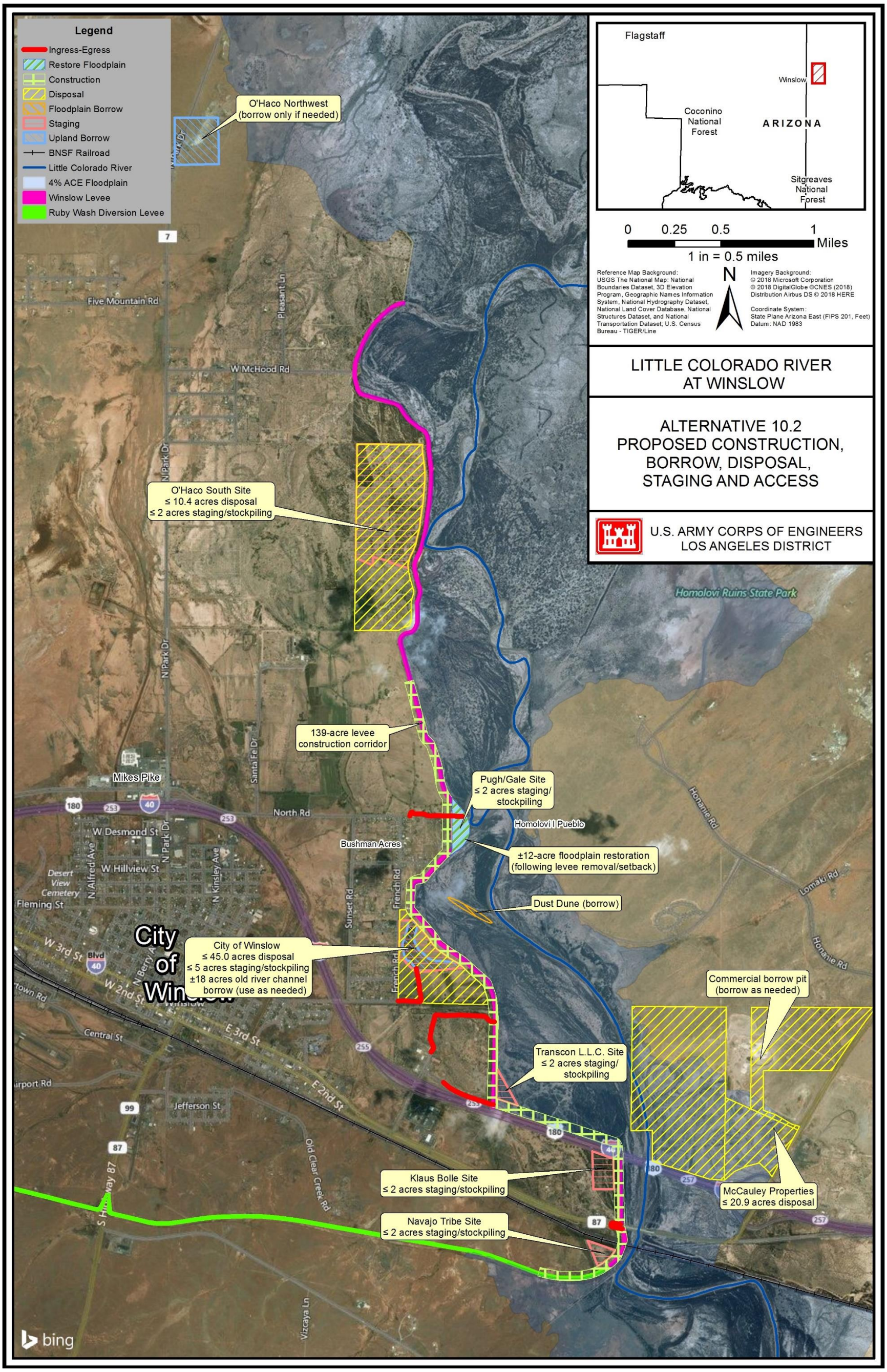


Figure 4-6 Alternative 10.2, Proposed Construction, Borrow, Disposal, Staging, and Access

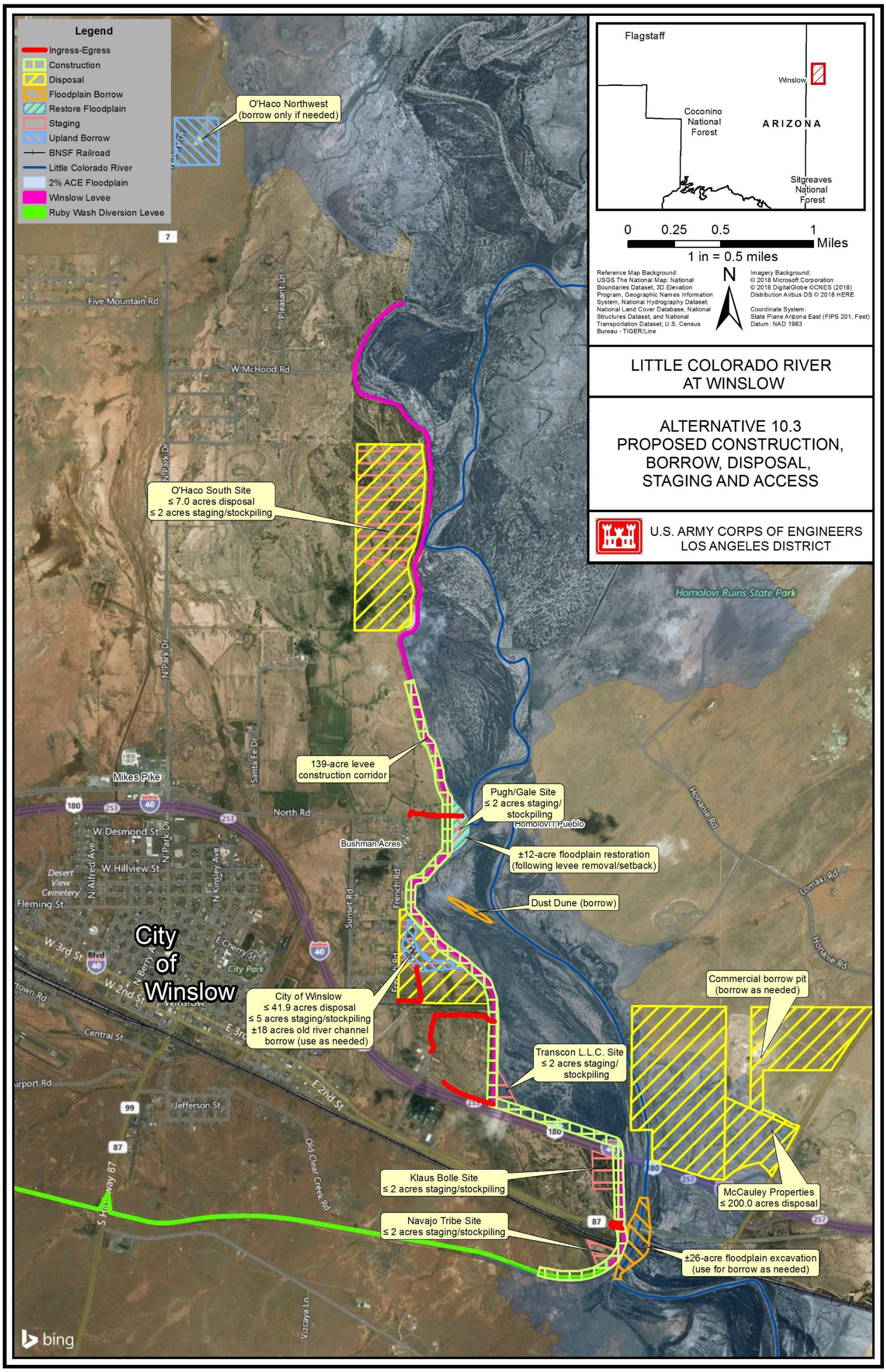


Figure 4-7 Alternative 10.3, Proposed Construction, Borrow, Disposal, Staging, and Access

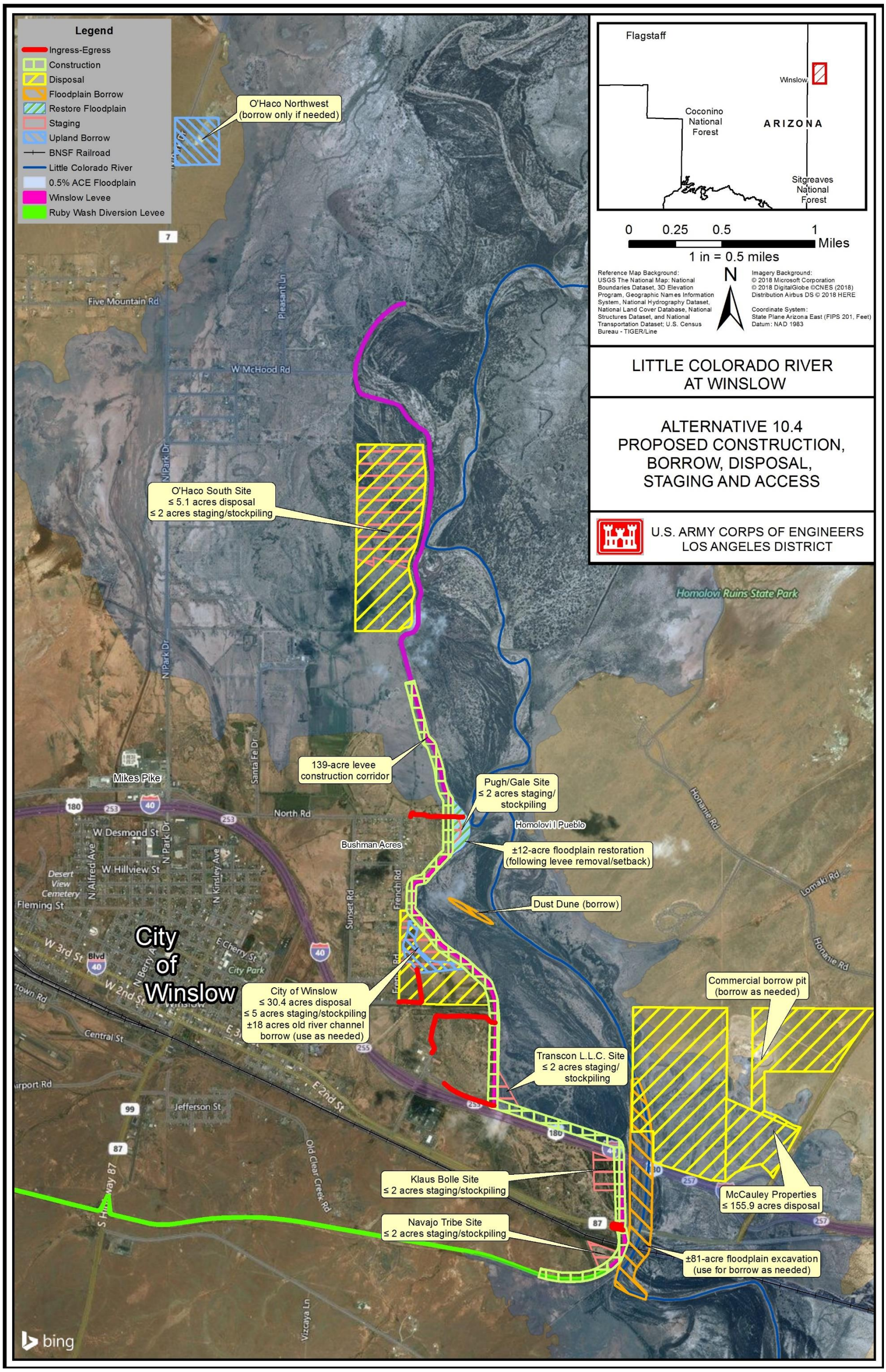


Figure 4-8 Alternative 10.4, Proposed Construction, Borrow, Disposal, Staging, and Access

Windblown deposits established by strong and consistently oriented dust storms are a second potential source of construction material. Corps geotechnical staff have identified an approximately 125-foot-wide by 1,500-foot-long (±3.5-acre) dust dune composed mostly of silt and fine-grained sandy silt, located within the LCR floodplain east of Bushman Acres. Although no sampling or testing of this material was done, the dust dune material represents a potential source of fines. A saltcedar monoculture was established on the dune in the past, but has since died off. The woody remnants of the saltcedar are helping to stabilize the dune in its current location.

b. Upland Borrow Sites

Four potential upland borrow sites from which construction material could be obtained have been identified. The first is a property located east of French Road and north of Oak Road that is owned by the City of Winslow. The site consists of two contiguous 80-acre parcels used for grazing and irrigated row crop agriculture. Almost half of this property is occupied by the existing Winslow Levee, or is located on the east side of the levee in the LCR floodplain. The French Farm and associated irrigation infrastructure preclude use of the southern portion of the property. Of the total 160 acres, ±45 acres is potentially available for use. Within the ±45 acres available for use is a ±18-acre C-shaped two- to four-foot-deep depression that was once a meander of the LCR. The fine-grained sediments in the old river channel could be used as fines for levee construction, as needed.

The second site, known as the "O'Haco Northwest" pit, provides a second source of upland borrow material. Only 1.5 acres of the 39.2-acre tract has been noted as available for mining. Aside from the currently-idle borrow area, the remainder of the property consists of rangeland. The deposit has been described as being as much as 40 feet thick and containing 50,000 tons of fill. The precise location of the 1.5 acres available for mining was not indicated to the Corps. No site geology has been provided. The site material is described as "silty sandy clay" by Navajo County personnel. The material has been used to repair the Winslow Levee in the past. No materials testing from that effort is known or thought to exist. The Corps examined available geologic maps, studied aerial photographs, and made conclusions regarding the likely site geology. Although this site is available, it is located from 2.5 to 8 roadmiles from the locations where the borrowed material would be used. This site would likely not be used unless it can provide construction materials that are not available closer to the work sites.

Near the southern end of Winslow Levee is an operating gravel and sand quarry, the Dyna Sand and Rock/Winslow Ready Mix site, owned by John McCauley (McCauley Development, LLC), of Winslow. The site is approximately 0.7 miles east of the southern extent of Winslow Levee, and approximately nine roadmiles south of the most distant, northern part of the levee. It is the closest existing and operating commercial fill source to the levee. Navajo County reported to the Corps that the site has 100,000 tons of fill available, and that more could be mined from the property. A potential source for launch stone is an existing commercial quarry, Brimball Hardluck Quarry, located at Indian Wells, Arizona, approximately 43 miles northeast of Winslow levee (a 55-mile, one-way haul distance along existing but indirect roads). The source is not pictured on the maps below due to distance from the proposed project area.

4.1.4. Disposal Sites

Five sites have been identified for disposal of excess and/or waste material resulting from the project. These shown in Figure 4-1 through Figure 4-8 and are described as follows:

- McCauley Site: John McCauley (McCauley Development, LLC) has offered the Dyna Sand and Rock/Winslow Ready Mix site for disposal. The property consists of three contiguous parcels totaling approximately 190 acres on the north side of I-40 between State Route 87 and the LCR. This is the only proposed disposal site located on the east side of the LCR. Current land use consists of the active borrow pit, concrete and aggregate processing facilities, materials storage and disposal, truck loading and parking, and a half-mile long unpaved access road. The remainder of the property consists of open space, including old meanders from the LCR and inflowing tributaries. The substrate and soils are similar to those described above in the levee alignment section. The approximate range of mean haul distance from the McCauley disposal site to the LCR is approximately 1.2 miles to about 2.1 miles depending on where the material is disposed.
- City of Winslow Site: Consists of the same two contiguous 80-acre parcels proposed for borrow above. As described above, approximately 35 acres of the total 160 acres is available for disposal. The agricultural areas located on the south end of the property (the French Farm) would be avoided. If fine-grained construction material is needed from the old LCR meander, this would increase the capacity of the property for disposal, since use of borrow material would add to the capacity for additional disposal. The substrate and soils are similar to those described above in the levee alignment section. The approximate mean haul distance from the Winslow disposal site to the LCR is approximately 0.25 miles.

The three remaining disposal sites consist of essentially undeveloped rangeland. These sites are referred to as “O’Haco North,” “O’Haco Middle,” and “O’Haco South.”

- O’Haco North Site: Consists of a ±6.3-acre portion of a 242-acre parcel located at the far northern end of the Winslow Levee. The substrate and soils are similar to those described above in the levee alignment section. The approximate mean haul distance from the O’Haco North disposal site to the LCR is approximately 0.3 miles.
- O’Haco Middle Site: A ±9.5-acre portion of the same 242-acre property on which the O’Haco North site is located. The O’Haco North and O’Haco Middle sites are separated by a C-shaped bend in the Winslow Levee. The substrate and soils are similar to those described above in the levee alignment section. The approximate mean haul distance from the O’Haco Middle disposal site to the LCR is approximately 0.3 miles.
- O’Haco South Site: A 400-acre parcel that extends across the Winslow Levee into the LCR floodplain. Of the 400 acres, approximately 228 acres are located on the landside of the levee. Areas within the levee easement or in the floodplain east of the levee would not be used for disposal. In addition, the residence, livestock facilities, ponds and associated fields on the south end of the property would be avoided. Deletion of these areas reduces the land available for material disposal to ±22.9 acres. The substrate and soils are similar to those described above in the levee alignment section. The approximate range of mean haul distance

from the McCauley disposal site to the LCR is approximately 0.5 miles to about 1.9 miles depending on where the material is disposed.

4.1.5. Stone Sources

Stone for riprap and launch stone would come from the nearest source of suitable quality stone located at Indian Wells, Arizona, approximately 43 miles northwest of Winslow levee (a 55-mile, one-way haul distance along existing roads).

4.1.6. Staging/Stockpiling Areas

Six staging/stockpiles areas are identified along the project construction corridor, four of which are located on the same properties used as disposal areas (O'Haco North, O'Haco Middle, O'Haco South, and City of Winslow). Current land use and area needed at each staging area is provided in Table 4-1.

Table 4-1 Proposed Staging Areas

	O'Haco South	City of Winslow	Pugh/Gale	Transcon LLC	Klaus Bolle	Navajo Tribe
Area (Acres)	2	5	2	2	2	2
Current Land Use	Rangeland	Pasture	Rangeland	Vacant Floodplain	Vacant	Vacant

A batch plant would be located on the five-acre City of Winslow staging area. This plant would provide the grout needed for installation of soil cement.

The Pugh/Gale staging area is located behind the existing Winslow Levee at the North Road alignment. During construction of the proposed project, this staging area would end up on the riverside of the new levee alignment. However, this site would remain behind the existing Winslow Levee until the levee embankment is demolished. The Transcon LLC staging area is located on the riverside of the levee, adjacent to the north side of I-40. Heavy construction equipment would need to pass under the BNSF Railroad Bridge for access to the proposed staging area owned by the Navajo Tribe. Measures required to ensure equipment access without bog down have been addressed in the discussion of Channel Construction Features above. Limited equipment staging and stockpiling would also take place along the 50-foot-wide construction corridor, as cost-effective and appropriate.

4.1.7. Construction Equipment and Construction Schedule

Typical equipment to be used during the construction period include loaders, scrapers, dozers, trucks, blades, roller compactors, a soil-cement batch plant, concrete mixers, water trucks, and backhoes. Construction equipment would generally be operated 10 hours a day, six days a week. If acceleration of work is required to ensure flood control the daily work schedule may be extended.

4.2. Hydrology and Hydraulics and Public Safety

The LCR watershed occupies most of the northeastern quarter of Arizona, and a small portion of northwestern New Mexico [Arizona Department of Environmental (ADEQ), 2009]. The drainage area of the LCR is 16,192 square miles at Winslow, increasing to 30,800 square miles by the time the LCR joins the Colorado River in Grand Canyon National Park.

The hydrology and hydraulics of the LCR watershed in the vicinity of Winslow includes the LCR and major tributaries, including Chevelon Creek, Ruby Wash, Clear Creek, Cottonwood Wash, Salt Creek, and Jacks Canyon (Corps, 2012). The primary hydrology and hydraulic features of the LCR at Winslow include the main channel and floodplain of the LCR from Chevelon Canyon downstream (northwest) to the north end of the Winslow Levee, in and near the City of Winslow. Ruby Wash drains into the LCR just upstream or south of the BNSF Railroad Bridge crossing.

In the Winslow area, the LCR meanders across a broad, alluvial floodplain ranging from 1,600 feet to 20,500 feet in width. The reduction in floodplain width at its narrowest point along the existing levee is approximately 90 percent less than without the levee in place. The LCR has adjusted to the effects of an extreme flood in 1923 and a subsequent decline in peak discharge and mean annual flow by channel narrowing; the channel width and area of the river have decreased by approximately 90 percent over the period 1936-2010 (USGS, 2014). Although deposition historically exceeds erosion, lateral migration exacerbates localized erosion, particularly near hydraulic controls (levees). Despite repeated cutoff and avulsion, the LCR has steadily increased in length and sinuosity over a period of 74 years (USGS, 2014). Changes in temperature and precipitation are likely affecting the discharge of the LCR near and downstream of Winslow, Arizona (Corps 2015).

Surface flow in all the washes of LCR at Winslow is intermittent (Corps, 2012). Average stream flows in the LCR and its tributaries are minimal, and periods of no flow have been observed. Table 4-2 shows the United States Geological Service (USGS) stream gauge records for the LCR near Winslow and the maximum daily average flows, in cubic feet per second (cfs), and the maximum observed discharge (cfs).

Table 4-2 summarizes maximum flows and discharges from the LCR in 1905, 1923, 1929, 1952, 1957, 1978, 1983, and 2004 that flooded Holbrook, Grand Falls, Winslow and surrounding areas. Floodwaters from Chevelon and Clear Creeks near Winslow are responsible for substantial flooding including the December 1978 flood when the original Winslow Levee, built in the late 1960s by Navajo County Flood Control District, was overtopped and breached, flooding residential, public, and agricultural developments along the LCR, and incurring heavy damages from the flows.

Table 4-2 Maximum Daily Average Flows and Maximum Observed Discharge for the LCR in the Vicinity of Winslow

USGS Gage Number	Location	Maximum Daily Average Flow		Maximum Observed Discharge	
		cfs	Date	cfs	Date
09397000	LCR at Holbrook AZ. (approx. 34 mi. upstream of Winslow)	20,200	11/27/1905	60,000	9/19/1923
09401000	LCR at Grand Falls, AZ (approx. 47 mi. downstream of Winslow)	27,100	4/5/1929	120, 000	9/19/1923
09398000	Chevelon Creek near LCR (at Winslow and south of Interstate-40)	10,200	1/19/1952	33,600	12/18/1978
09399000	Clear Creek (near Chevelon Butte Road) near Winslow	21,500	12/19/1978	50,000	4/4/1929
09397500	Chevelon Creek Below Wildcat Canyon, near Winslow	6,860	1/9/1957	24,700	1/8/1993
09398500	Clear Creek Below Willow Creek, near Winslow	9,300	12/18/1978	29,100	1/8/1993
09400350	LCR near Winslow	15,200	12/30/2004	20,000	12/30/2004

Source: Corps, 2012

As detailed in Appendix B - Hydraulics, the original Winslow Levee was rebuilt during 1986 to 1989, and is maintained and owned by the Navajo County Flood Control District. The levee design included bank protection and cutoff walls and it was designed to contain the estimated one percent ACE flood event, identified to be about 65,000 cfs at the time. On January 8, 1993, the Winslow Levee was overtopped by a flood with an estimated peak discharge between 70,000 cfs and 77,000 cfs (Appendix B - Hydraulics), which resulted in a washout of a 400-foot section of levee and damage to a 3,000-foot length segment. Properties were flooded on the landside of the Winslow Levee. Temporary repairs to the levee, including the addition of riprap to both sides of the levee along a 3,000-foot reach segment near the failure, were completed immediately following the flooding.

On December 31, 2003, the Winslow Levee experienced a piping failure around the four to two percent ACE flood event. Levee failure was avoided by immediate placement of material on the river side of the levee by the Navajo County Flood Control District.

Based on hydraulic models completed for the Navajo County Flood Control District in 2009, the Winslow Levee, in its current condition, would overtop at the same location as the 1993 flood at a discharge rate of 55,000 cfs (about a 1.7 percent ACE flood event) (see Appendix B - Hydraulics. The Corps completed a hydrologic analysis in 2010, which revealed the one percent ACE discharge to be about 69,200 cfs. Based upon the geotechnical analysis conducted for this study, the existing levee system is susceptible to potential failure before overtopping at certain locations for certain levels of flood events. At the most likely failure point with the greatest risk to the city of Winslow, there is approximately a 16 percent chance of failure at a water surface elevation that corresponds with about the four percent ACE event. This probability of failure increases with increases in water surface elevations or lower probability flood events.

The Corps designed and constructed the RWDL, with construction completed in 1970. Flows in Ruby Wash are diverted east by the RWDL to the LCR. The RWDL reduces the risk of flooding for the Winslow Airport and approximately 500 residents, but was not designed or intended to address flooding along the LCR mainstem. The easternmost portion of the RWDL is subject to overtopping from the LCR mainstem flows. Based on geotechnical analysis, the RWDL could also fail prior to overtopping during a flood. For flows with water surface elevations corresponding to about the four percent ACE flood event (25-year), the probability of levee failure is about 16 percent.

4.2.1. BNSF Railroad Bridge, Interstate 40, and State Route 87

The hydrology and hydraulics around the BNSF Railroad Bridge, I-40, and SR-87 are similar to those described above in the levee alignment section. The LCR mainstem channel is populated with saltcedar in the vicinity of the BNSF Railroad Bridge.

4.2.2. Riverine Borrow Sites

There are two potential borrow sites riverside of the Winslow Levee discussed in 4.1.3 above. The hydrology and hydraulics are similar to those described above in the levee alignment section. Both areas are populated with saltcedar.

4.2.3. Upland Borrow Sites

Three upland borrow sites are discussed in 4.1.3 above. The hydrology and hydraulics are similar to those described above in the levee alignment section.

4.2.4. Disposal Sites

Five disposal sites are proposed for use and discussed in 0 above. In all cases, the hydrology and hydraulics are similar to those described above in the levee alignment section.

4.2.5. Climate Change

Changes to these existing conditions from climate change were analyzed (Corps 2015). The main change expected to the study area is a temperature increase. The average temperatures are projected to rise by as much as 3.5 to 8.5 degrees Fahrenheit by the year 2100. Temperature increases are likely to drive evaporation increases. Changes in precipitation are less certain, although winter precipitation is likely to decrease. Summer precipitation may increase in intensity, resulting in stronger, wetter storms interspersed with longer dry periods. Overall, due to the large size of the LCR watershed upstream of the study area and attenuation of the flows in the river itself, even if there are more intense periods of precipitation, they will most likely not cover the entire watershed. Impacts to the study are not expected to be significant and therefore discharge-frequency and/or volume frequency from climate change are not assumed as part of this study.

4.3. Water Quality

The LCR watershed occupies much of the northeastern portion of Arizona (ADWR, 2015). The LCR headwaters originate in the White Mountains along the northern and eastern slopes of Mount Baldy. The river is a perennial waterway that responds primarily to two seasonal events: winter-spring snowmelt season and the summer-fall monsoon season. Two distinct rainy seasons are observed from the streamflow data for the LCR, Clear Creek, and Chevelon Creek. The season that extends from July to November includes "monsoons" and dissipating tropical cyclones; and the other season, extending from December to April, includes frontal "winter" storms (USACE, 2001). The rest of the months in any given year can be considered as more or less "dry." The dry period for LCR, Clear Creek, and Chevelon Creek has generally occurred from May to July and November, with July and November having a potential monsoonal or dissipating tropical cyclone impact. Historically the extreme streamflow events for the LCR at Holbrook and near Joseph City were found to occur during the months of August through December. The extreme events for the LCR at Grand Falls were found to occur during the months of December through April. The difference in seasonality at Grand Falls may be due to the period of record for that gage. Most of the data was collected between 1923 and 1959, and covers a period that had wet years as well as drought years. Most of the data for the LCR at Holbrook was collected between 1950 and 1972, and represents a period that was influenced by drought. The extreme events for Chevelon Creek and Clear Creek were found to occur from December through March. Chevelon Creek and Clear Creek are large tributaries (785 and 621 square miles, respectively) that contribute flow to the LCR near Winslow (16,192 square miles). The extreme events for LCR at Winslow (15-year period of record) have occurred primarily from August to January. The historical flood events for Ruby Wash have occurred in July and August. Average flow rates during the winter–spring season (November 1 to May 31) is 28.9 cfs. Average flow rates during the summer–fall season (June 1 to October 31) is 13.1 cfs. The average base flow is 11.0 cfs.

The reach of the LCR within the NEPA scope of analysis is in compliance with all water quality standards with the exception of turbidity (ADEQ, 2010). Turbidity is the most common constituent that exceeds water quality standards in the LCR Plateau Basin (ADWR, 2009). Turbidity impairment is a result of excessive sediment from natural and anthropogenic sources that is flushed into the waterway. In particular, historic and current grazing practices within the watershed has reduced the amount of vegetative cover, especially riparian, resulting in increased runoff, soil erosion, and bank destabilization (ADEQ, 2002). Loss of vegetation and increased surface runoff causes down cutting within tributaries and sedimentation downstream.

4.3.1. Climate Change

As noted in Section 4.2.5, changes to these existing conditions from climate change were analyzed (Corps 2015). The main change expected to the study area is a temperature increase, which could lead to an increase in evaporation. Changes in precipitation are less certain, although winter precipitation is likely to decrease. Summer precipitation may increase in intensity, resulting in stronger, wetter storms interspersed with longer dry periods. Higher intensity summer storms could result in higher energy flows which in turn could increase sediment load within the water column resulting in more turbid surface waters. Water quality would be minimally affected by increased turbidity in surface flows.

4.4. Groundwater

4.4.1. Levee Alignment

Aquifers of the LCR Plateau basin contain large quantities of groundwater in storage; however, they are in a sensitive relationship with the LCR and its perennial tributaries (ADWR, 2009). Lowering of hydrostatic heads by excessive groundwater withdrawals may cause some perennial reaches of the streams to dry up. Depth to water in the regional C-aquifer wells that include LCR at Winslow ranges from approximately 37 to 1,600 feet below land surface (bls).

Groundwater in the vicinity of Winslow is primarily within the alluvium and sedimentary rock of the LCR drainage (ADWR, 2009). The local aquifer is comprised of alluvial deposits that occur along washes and stream channels, including the LCR and its tributaries, sedimentary formation, and some sandstones. Flow direction of the local aquifer is generally south to north. Depths to groundwater in the vicinity of Winslow were found to range from 37 to 280 feet bls. Groundwater is approximately 30 feet beneath the Winslow Levee (Corps, 2015).

The City of Winslow relies entirely on groundwater pumped from the aquifer (ADWR, 2009). Municipal groundwater is pumped from six wells in the aquifer located southwest of the city. Table 4-3 shows the amount of groundwater in acre-feet per year drawn from the aquifer.

Table 4-3 Amount of Groundwater in Acre-Feet (AF) per Year Drawn from Aquifer

Water Provider	Year 1991 (in AF)	Year 2000 (in AF)	Year 2006 (in AF)
Winslow Municipal	2,000	1,863	1,744

Source: ADWR, 2009.

Factors such as seasonal monsoon storms and rainfall, discharges of flows from the LCR, and groundwater pumping for residential, commercial, industrial, and irrigation uses including for farming and ranching all affect groundwater levels. Water withdrawals such as groundwater pumping and irrigation would decrease groundwater levels, while precipitation in the watershed and discharges from the LCR would allow recharge of the groundwater aquifer.

4.4.2. BNSF Railroad Bridge, Interstate 40, and State Route 87

The groundwater around the BNSF Railroad Bridge, I-40, and SR-87 is similar to that described above in the levee alignment section.

4.4.3. Riverine Borrow Sites

There are two potential borrow sites riverside of the Winslow Levee discussed in Section 4.2.2 above. The groundwater condition in these areas is similar to that described above in the levee alignment section.

4.4.4. Upland Borrow Sites

The four proposed upland borrow sites are discussed in Section 4.2.3 above. The groundwater condition in these areas is similar to that described above in the levee alignment section.

4.4.5. Disposal Sites

Five disposal sites are proposed for use and are discussed in Section 4.2.3 above. In all three cases, the groundwater condition is similar to that described above in the levee alignment section.

4.4.6. Groundwater Quality

A total of 237 wells, springs, and mine sites are being monitored in the LCR Plateau Basin due to constituent concentrations that have equaled or exceeded drinking water standards (DWS) (ADWR, 2009). Two wells in the vicinity of the LCR at Winslow study area have equaled or exceeded DWS. One of these two wells has cadmium and a radionuclide as the two parameters that have equaled or exceeded the DWS, while the other well has arsenic levels equaling or exceeding the DWS. In the LCR Plateau Basin and south of I–40, where most of the LCR at Winslow is located, the parameters most frequently exceeded for DWS are arsenic and cadmium. For the entire LCR Plateau Basin, the most frequently exceeded constituents measured, in order of greatest occurrence, are arsenic, radionuclides, thallium, lead, and total dissolved solids (TDS). Water supply management activities, such as urbanization and nonpoint agricultural sources throughout the watershed, enhanced groundwater recharge, and the discharge of treated wastewater within the LCR Plateau Basin, are among many additional factors affecting groundwater quality. The two wells in the vicinity of the LCR at Winslow with constituents that have equaled or exceeded DWS do not contain parameters that are out of the ordinary when compared to the constituents exceeding DWS in all 237 wells, springs, and mine sites located in the entire LCR Plateau Basin that have parameter concentrations exceeding DWS.

4.5. Biological Resources

4.5.1. Vegetation

a. History

The study area is located in the Colorado Plateau ecoregion. Ecoregions are defined as large geographic areas of land and water with landscape features that are distinct from neighboring lands—differences in vegetation, geology or soils, range of elevation, annual rainfall, and/or unique ecological or environmental patterns. Within the Colorado Plateau ecoregion many habitat types are present. The study area is located within the Great Basin Desert Scrub habitat type (Pronatura Noreste et al., 2004) or biotic community as described by Brown (1982). The most northerly of the four American deserts, the Great Basin Desert, evolved from both warm and cold-temperate vegetation. Brown describes that species diversity is characteristically low in all major communities of this biome with dominant shrubs occurring to the virtual exclusion of the other woody species. Dominant shrubs include big sagebrush (*Artemisia tridentata*), blackbrush (*Coleogyne ramosissima*), and shadescale (*Atriplex confertifolia*). The HabiMap, an Arizona web-based data viewer, uses the Modified USGS Regional GAP land cover as a vegetation model (www.habimap.org/).

Within the study area, several vegetation classifications are identified, which include Riparian, Southern Colorado Plateau Sand Shrubland, and Inter Mountain Basins Mixed Salt Desert Scrub. The Great Basin Desert scrub has vegetation that consists mostly of scattered low, small-leafed shrubs, and almost no trees or succulents. Indicator species are big sagebrush and shadscale. Other conspicuous species present within this biotic community include: blackbrush (*Coleogyne ramosissima)*, Mormon-tea (*Ephedra nevadensis*), four-wing saltbush (*Atriplex canescens*), greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnus viscidiflorus*), horsebreush (*Tetradymia canescens*), and winterfat (*Krascheninnikovia lanata*) (Turner, 1994c). This area occupied by Great Basin desert scrub has remained largely unchanged within the historic times. However, from the late 1800s through the early 1900s intensive grazing practices caused widespread habitat degradation across its range (Tuhy et al. 2002). Because the proposed project area includes the Little Colorado River, riparian vegetation exists at a larger extent than what would normally be seen within the Great Basin Desert scrub biotic community. The principal plant species expected to be observed within the riparian zone are saltcedar (*Tamarix chinensi*s), coyote willow (*Salix exigua*), seepwillow (*Baccharis salicifolia*), arroweed (*Tessaria sericea*), cattail (*Typha latifolia*), giant reed (*Phragmites australis*), and the introduced species, camelthorn (*Alhagi camelorium*).

b. Existing Vegetation

Vegetation was observed in the proposed project area by Corps biologists during a site visit on May 20, 2014. Saltcedar was the dominant species throughout most of the proposed project area. Other species present included greasewood (*Sacrobatus vermiculatus*), big sagebrush (*Artemisia tridentata*), coyote willow (*Salix exigua*), rabbitbrush (*Ericameria nauseosa*), four-wing saltbush (*Atriplex canescens*), New Mexico olive (*Forestiera neomexicana*), camelthorn (*Vachellia erioloba*), seepwillow (*Baccharis salicifolia*), sweet clover (*Melilotus officinalis*), winterfat (*Krascheninnikovia lanata*), tumble mustard (Sisymbrium altissimum), filaree (*Erodium botrys*), kochia (*Bassia scoparia*), and tumbleweed (*Salsola tragus*). Of these observed species, desirable, native species include coyote willow, New Mexico olive, and seepwillow. Native species that were observed in the area, but are considered weedy species include, greasewood, big sagebrush, rabbitbrush, four-wing saltbush, seepwillow, sweet clover, and winterfat, tumble mustard, and filaree. Kochia is a non-native weed species and camelthorn is a non-native and invasive species within the proposed project area, and saltcedar and tumbleweed are non-native invasive species (see below).

Based on the percentage of species dominance within a given area, polygons were created throughout the proposed project area to differentiate/map the vegetation (Figure 5-1) for LCR Winslow Levee Vegetation Map). Out of the twelve polygons that were created, saltcedar (SC) was the dominant species (>75%) in eight of them. These eight polygons, although all saltcedar dominant, are distinct between one another based on the other vegetation found within the given polygon. Dominant species in the other four polygons consisted of greasewood (GW), an open area with native and non-native weeds (OW) (weeds mentioned in the previous paragraph), camelthorn (CT), and a polygon that had an equal amount saltcedar and an open area with weeds (SC/OW). Although seepwillow and New Mexico olive were present, they were seen only occasionally. Coyote willow was present, especially along the banks where the impingement areas are located.

c. Invasive Plants

Invasive non-native species are plants, animals, or other organisms that are introduced to a given area outside their original range and cause harm in their new environment. Because they have no natural enemies to limit their reproduction, they usually spread rampantly. Invasive non-native species are recognized as one of the leading threats to biodiversity and impose enormous cost to agriculture, forestry, fisheries, and other human enterprises, as well as human health. Arizona has been infested with a number of harmful exotic plants and animals. The following is a short list of some of the non-native, invasive species of greatest concern: saltcedar, tumbleweed, knapweed (diffuse, spotted, and Russian), fountain grass, buffelgrass (downy brome), and yellow star thistle.

Within the proposed project area, two invasive non-native plant species of particular concern are saltcedar and camelthorn. Both of these species can out-compete the native species and can convert riparian habitat to a drier, more upland habitat. Left unchecked, these invasive species would become increasingly problematic. This shift has already caused a threat to the Great Basin desert scrub native plant community.

d. Noxious Weeds

Executive Order 13112 directs Federal agencies to prevent the introduction of invasive (exotic) species; minimize the economic, ecological, and human health impacts that they cause; and provide for their control. In addition, the State of Arizona designates and lists certain weed species as noxious (Arizona State Legislature, Title 3 – Agriculture, the Arizona noxious weed law is set out in 3-201 et seq.).

“Noxious” in this context means any species of plant that is, or is liable to be, detrimental or destructive and difficult to control or eradicate. Arizona state-listed noxious weeds are weeds that are defined as prohibited, regulated and restricted. Prohibited noxious weeds are not allowed entry into the state. Regulated noxious weeds are common, widespread species that are fairly well established within the state. If found within the state, regulated noxious weeds may be controlled or quarantined to prevent further infestation or contamination. Restricted noxious weeds occur in isolated and low populations and if found, they shall be quarantined to prevent further infestation or contamination. Currently, there are nine regulated, 16 restricted, and 55 prohibited noxious weeds in Arizona.

In the Arizona Department of Agriculture List of Prohibited, Regulated, and Restricted Noxious Weeds, camelthorn is listed as a restricted noxious weed. Within the proposed project area, there is a 30-acre area that is primarily dominated by camelthorn (see polygon 7 on map). It looks as though the camelthorn has been treated in the past. However, it is still thriving within the area of polygon 7. Although saltcedar is not on this list, it is highly aggressive, invasive, and a non-native plant that outcompetes native vegetation for sunlight, moisture, and nutrients. Saltcedar is dominant throughout the proposed project area and is at a level that should be managed or controlled before its population further expands.

4.5.2. Existing Conditions by Project Feature

a. Levee Alignment

The existing vegetation present is similar to that described above. Saltcedar is the dominant species in this area.

b. BNSF Railroad Bridge, Interstate 40, and State Route 87

The existing vegetation near the BNSF Railroad Bridge, I-40, and SR-87 is similar to that described above. Specifically the BNSF Railroad Bridge area is dominated by saltcedar and greasewood. The area near I-40 and SR-87 is dominated primarily by saltcedar.

c. Riverine Borrow Sites

There are two potential borrow sites riverside of the Winslow Levee discussed under Section 4.1.3 above. Vegetation within this area is dominated by saltcedar.

d. Upland Borrow Sites

The upland borrow sites are discussed under Section 4.1.3 above. This area consists predominantly of bare land and an assortment of weeds.

e. Disposal Sites

Three disposal sites are proposed for use:

- McCauley Site: Encompasses three parcels covering approximately 503 acres on the north side of I-40 between State Route 87 and the LCR. Existing vegetation is similar to what occurs in the levee alignment section, with the exception of more bare land in this area. Riparian areas, where native riparian vegetation exists, would be avoided.
- City of Winslow Site: Consists of two contiguous 80-acre parcels along the east side of French Road. Approximately 45 acres of the total 160 acres is available for disposal. The agricultural areas located on the south end of the property (the French Farm) would be avoided. Vegetation is scattered within this area with extensive open land. Existing vegetation consists of weeds that are described above.
- O'Haco Sites: These consist of the ±50-acre O'Haco North site, the ±37-acre O'Haco Middle site, and ±141 acres available on the O'Haco South property. The existing vegetation in the two most northern parcels are very similar to what occurs in the levee alignment section. The existing vegetation in the southernmost parcel also is similar to the levee alignment section, however, with more bare land.

f. Staging, Stockpiling, and Access Sites

Construction equipment is proposed to be staged at specified locations along the project construction corridor. Four of these sites are located on the same properties used as disposal areas (O'Haco North, O'Haco Middle, O'Haco South, and City of Winslow). The four sites are vacant with disturbed vegetation. The Pugh staging area is located on the riverside of the proposed new levee alignment, but would remain behind the existing Winslow Levee until the levee embankment is demolished. The vegetation within this area is mostly saltcedar and weeds.

4.5.3. Wildlife

The proposed project area is located in the Colorado Plateau ecoregion. Some fish and wildlife species are only found in one particular ecoregion, while other species are able to live in and among multiple ecoregions. Within these ecoregions are 14 vegetative communities (Brown and Lowe, 1994). As discussed in the vegetation section above, the proposed project area is within the Great Basin Desert Scrub vegetative community.

An estimated 59 Species of Greatest Conservation Need (SGCN) may occur within the Colorado Plateau ecoregion, according to Arizona's Comprehensive Wildlife Conservation Strategy: 2005-2015 Report. This estimate includes 12 species of fish, three species of amphibian taxa, two species of reptiles, 30 species of birds, and 12 mammalian taxa. Birds are the most important group, based on number of taxa, comprising 50 percent of all vertebrate species in the estimate.

a. Fish

According to HabiMap, the following fish species have the potential to inhabit the section of the LCR in the proposed project area: Little Colorado sucker (*Catostomus sp*.), Little Colorado spinedace (*Lepidomeda vittata*), speckled dace (*Rhinichthys osculus*), and the bluehead sucker (*Catostomus discobolus*). Other fish species (not listed above) that are listed as SGCN, and are known to occur in the Colorado Plateau ecoregion include: flannelmouth sucker (*Catostomus latipinnis*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), roundtail chub (*Gila robusta*), Apache (Arizona) trout (*Oncorhynchus gilae apache*), Colorado pikeminnow (*Ptychocheilus lucius*), and razorback sucker (*Xyrauchen texanus*). Although these species occur within the Colorado Plateau ecoregion, it is unlikely that they inhabit the section of the LCR within the proposed project area, with the exception of the flannelmouth sucker *(Catostomus latipinnis)* that was observed during the Arizona Game and Fish Department (AZGFD) formal fish surveys from May 6-29, 2014, in the LCR at Winslow project area.

The formal fish protocol surveys conducted by the AZGFD in May 2014 found the following species in the LCR within the project area: Plains killfish (*Plancterus kansae*), fathead minnow (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*), flannelmouth sucker (*Catostomus latipinnis*), common carp (*Cyprinus carpio*), red shiner (*Cyprinella lutrensis*), channel catfish (*Ictalurus punctatus*), and bluegill (*Lepomis macrochirus*).

There are no federally-listed threatened or endangered fish species are expected to occur in the project area (including all borrow and disposal areas, as well as all staging, stockpiling, and access areas).

b. Amphibians and Reptiles

Examples of amphibians and reptile species that occur within the Colorado Plateau ecoregion include the following: Pai striped whiptail (*Aspidoscelis pai*), Arizona toad (*Bufo microscaphus*), Chiricahua leopard frog (*Rana chiricahuensis*), northern leopard frog (*Rana pipiens*), and relict leopard frog (*Rana onca*). Formal inventories of amphibians and reptiles were not conducted for this study because there are no Federal or state threatened or endangered amphibians and reptiles within the proposed project area. However, an observational species survey was conducted by Corps' biologists during their site visit limited to species observed on May 20, 2014. Although many amphibian and reptile species were predicted to occur in the area by HabiMap, they were not observed during the site visit. Their absence is likely explained by lack of species-specific survey efforts and habitat degradation. Decreases in habitat quality can eliminate the ability of that habitat to support a particular species. Habitat changes can also increase competition pressure by more generalist species, or cause extirpation due to increased predation. A more reasonable explanation for not finding more amphibian or reptile species could also be due to the one-day survey that also included a survey for bird and mammal species that is a very limited effort and could easily miss any amphibian or reptile species present. During the site visit, a Great Basin gopher snake (*Pituophis melanoleucus deserticola*) was seen.

c. Birds

Every year in May, a North American Migration Count (NAMC) takes place across North America. The area of a count is not a circle, but the boundaries of a County. In 2014, a total of 4,726 total individuals were reported in Navajo County. Total species reported was 154. Only four other counties within Arizona reported higher numbers of total individuals and species for the 2013 NAMC. Field observations were limited to species observed during a May 20, 2014 site visit by Corps biologists that included the following birds: spotted towhee, yellow-breasted chat, turkey vulture, and crow.

In addition to a high number of birds present within Navajo County, an active bird community exists within the riparian vegetation located adjacent to the LCR. The following is an example of bird species provided by HabiMap that are known to exist within or nearby the proposed project area during the breeding or migratory season: cliff swallow (*Petrochelidon pyrrhonota*), common raven (*Corvus corax*), house sparrow (*Passer domesticus*), loggerhead shrike (*Lanius ludovicianus*), mourning dove (*Zenaida macroura*), northern mockingbird (*Mimus polyglottos*), northern rough-winged swallow (*Stelgidopteryx serripennis*), Say's phoebe (*Sayornis saya*), western kingbird (*Tyrannus verticalis*), American peregrine falcon (*Falco peregrinus*), common nighthawk (*Chordeiles minor*), ferruginous hawk (*Buteo regalis*), golden eagle (*Aquila chrysaetos*), yellow warbler (*Dendroica petechia*), blue grosbeak (*Passerina caerulea*), sage thrasher (*Oreoscoptes montanus*), spotted towhee (*Pipilo maculatus*), northern goshawk (*Accipiter gentilis*), Swainson's thrush (*Catharus ustulatus*), southwestern willow flycatcher (*Empidonax traillii extimus*), western burrowing owl (*Athene cunicularia hypugaea*), and yellow-breasted chat (*Icteria virens*).

North and south travel along waterways is characteristic of migratory birds that nest in North America. River corridors may be more important to migrating birds in deserts than in other regions of the North America. During spring and fall migration, riparian habitats can attract more than 10 times the number of migratory birds compared to surrounding uplands (Stevens et. al., 1977; Hehnke and Stone, 1979; Hink and Ohmart, 1984). The riparian habitats along the LCR are potential stopover sites for migratory land birds.

d. Mammals

Mammals in the Colorado Plateau ecoregion, and in the Great Basin Desert Scrub specifically, that are known to occur within or near the proposed project area include the following: Arizona myotis (*Myotis occultus*), Allen's big-eared bat (*Idionycteris phyllotis*), American beaver (*Castor canadensis*), black-footed ferret (*Mustela nigripes*), banner-tailed kangaroo rat (*Dipodomys spectabilis*), Gunnison's prairie dog (*Cynomys gunnisoni*), kit fox (*Vulpes macrotis*), Mexican free-tailed bat (*Tadarida brasiliensis*), pale Townsend's big-eared bat (*Plecotus townsendii pallescens*), rock pocket mouse (*Chaetodipus intermedius*), spotted bat (*Euderma maculatum*), western red bat (*Lasirurs blossevillii*), Yuma myotis (*Myotis yumanensis*), Mexican vole (*Microtus mexicanus*), Stephen's woodrat (*Neotoma stephensi*), and big free-tailed bat (*Nyctinomops macrotis*).

Formal or informal inventories of mammals were not conducted. Field observations were limited to species seen during the May 20, 2014 site visit by the Corps biologists that included the following: Black-tailed jackrabbit (*Lepus californicus*) and a Townsends's ground squirrel (*Spermophilus townsendi*).

4.5.4. Special Status Species

Several agencies have primary responsibility for protecting and conserving plant and animal species within the proposed project area. The United States Fish and Wildlife Service (USFWS), under authority of the Endangered Species Act of 1973 (16 U.S.C. 1531, et seq.), as amended, has the responsibility for federally-listed species. The AZGFD has the responsibility for state designated "species of greatest conservation need." Arizona Department of Agriculture has the responsibility for state-listed plant species (2008 AZ Native Plant Law). Each agency maintains a continually updated list of species that are classified, or are candidates for classification, as protected based on their present status and potential threats to future survival and recruitment into viable breeding populations. The types of status rankings represent an expression of threat level to a given species survival as a whole and/or within local or discrete populations, and are further described in the footnotes in Table 4-4. Special status species listed by USFWS (USFWS, 2015) and AZGFD (AZGFD, 2015) for Navajo County that historically may have been present within the proposed project area, are listed in Table 4-4 and discussed below. Special status species include Flannelmouth Sucker, Bullhead Sucker, Zuni Bluehead Sucker, Little Colorado River Spinedace, Southwestern Willow Flycatcher, Yellow-billed Cuckoo, Peebles Navajo Cactus, and Northern Mexican Gartersnake. The entire list of special status species for Navajo County can be found in Appendix I - Environmental of this report.

From May 6-29, 2014, AZGFD conducted formal fish protocol surveys for the spinedace, flannelmouth, Zuni bluehead sucker, and the bluehead sucker along the LCR within the proposed project area. There are two fish species of concern (flannelmouth sucker (flannelmouth) and the bluehead sucker), one federally-listed endangered fish (Zuni bluehead sucker), one federally-listed threatened fish (Little Colorado River spinedace (spinedace)), one federally-listed endangered bird (southwestern willow flycatcher (flycatcher)), and one federally-listed threatened bird (yellow-billed cuckoo) that historically may have inhabited the section of the LCR within the Winslow Levee proposed project area.

Formal protocol surveys were also conducted by the AZGFD in 2014 for the presence of the southwestern willow flycatcher within the proposed project area using standardized survey methodology. A total of 67 points were surveyed across the proposed project area. Surveys to detect flycatcher presence were conducted from May 28-July 17, 2014 using the 2010 revised survey protocol developed by the USFWS and USGS as modified by Sogge et al. (2010). Call points were spaced approximately 30-50 minutes apart. To detect flycatchers, male flycatcher territorial calls were broadcast using a MP3 player with power-horn. The 2014 surveys were completed within three established survey periods: 15-31 May, 1-24 June, and 25 June-17 July with each field survey period at least five days apart (Sogge et al. 2010). For project-related surveys, a minimum of five visits were mandatory. The five visits consisted of one survey pass during 15-31 May, two survey passes during 1-24 June, and two survey passes during 25 June-17 July. Surveys were performed when birds were most active (from 30 minutes prior to sunrise to 0900 hours). AZDGF reported that the LCR Winslow project area site is unoccupied by breeding southwestern willow flycatchers due to the limited availability of nesting habitat (Clark, 2014). Formal surveys were not conducted for the yellow-billed cuckoo, as it was first listed as threatened in October 2014, after all surveys occurred. However, the yellow-billed cuckoo does have a distinct call that would be easily identifiable during a formal species survey. While conducting formal species surveys, the AZGFD did not detect yellow-billed cuckoos. Based on what is known about the yellow-billed cuckoo, the preferred habitat and the composition of the vegetated areas within the project footprint, additional surveys for the cuckoo are not warranted at this time. Additionally, the December 20, 2017 signed Coordination Act Report (CAR) from the USFWS states there are no species listed or proposed to be listed as threatened or endangered, or their designated or proposed critical habitats known within the proposed project area. Based on the above, there are no listed species present or anticipated to be present within the project area. The USFWS further notes in the CAR that the portion of the LCR within the action area and the adjacent riparian area do not provide suitable or potential habitat for listed or proposed listed species.

a. Flannelmouth Sucker

The flannelmouth sucker, a USFWS species of special concern, is typically found in the mainstem of moderate to large slow and warm rivers. The flannelmouth has been extirpated from the Gila River basin and Colorado River below Lake Mead. In addition, populations have been reduced in numbers and distribution primarily due to water diversion and channelization, flow alteration, habitat loss and introduction of nonnative fishes.

During formal fish protocol surveys conducted by the AZGFD in May 2014, this species of special concern was detected in the upper reaches of the survey site (Figure 4-9). A total of three individual flannelmouths were detected including two individuals under the SR-87 Bridge and the BNSF Railroad Bridge, and the third near the southern end of the survey area among old remnant bridge structures. As was detected from the surveys, adult flannelmouth suckers use slow water velocity areas with significant amounts of vertical cover (Gorman, 1994).

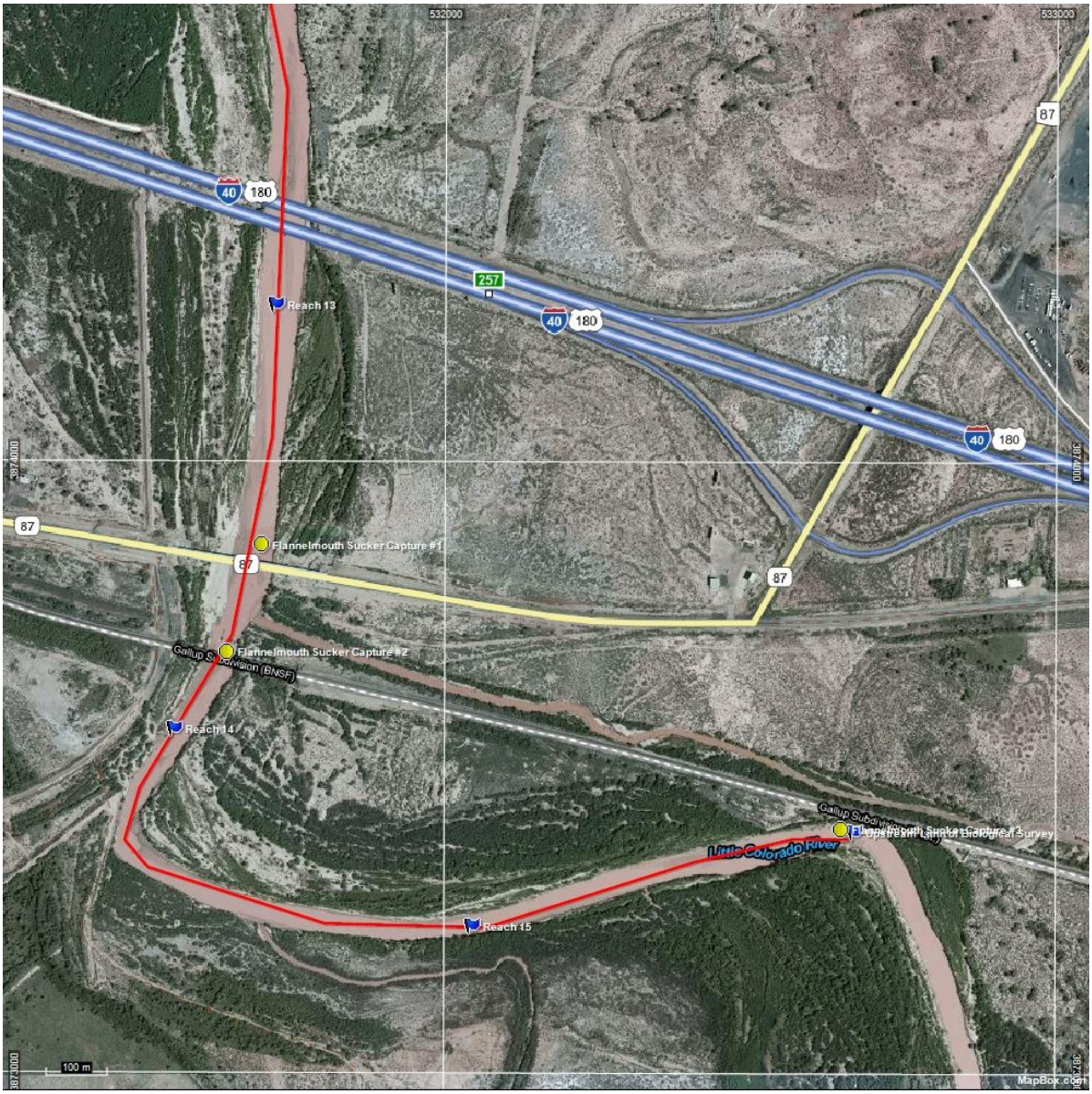


Figure 4-9 Location of Flannelmouth Sucker Captures

b. Bluehead Sucker

The bluehead sucker, a USFWS species of special concern, faces similar threats as the flannelmouth sucker, but can tolerate a wider range of temperature and inhabit smaller headwater streams. During the surveys conducted in May, this species of special concern was not detected in any reaches within the proposed project area. Due to its absence along the LCR within the proposed project area, this fish species will not be included in the impact analysis of alternatives.

c. Zuni Bluehead Sucker

The Zuni bluehead sucker (*Catostomus discobolus yarrowi*), a subspecies of the bluehead sucker, occurs in the upper LCR watershed in east-central Arizona and west-central New Mexico. It was recently listed as endangered by the USFWS in 2014. The Zuni bluehead sucker faces similar threats as the flannelmouth sucker. During the surveys conducted in May 2014, this federally-listed endangered species was not detected in any reaches within the proposed project area. Due to its absence along the LCR within the proposed project area, this fish species will not be included in the impact analysis of alternatives.

d. Little Colorado River Spinedace

The Little Colorado River spinedace is a federally-listed threatened species with critical habitat designated upstream of the proposed project area. The spinedace was listed as threatened with critical habitat in 1987 by the USFWS due to habitat destruction and alteration, use of fish toxicants, and the introduction of exotic predatory and competitive fish species.

Historically, the spinedace have been known to occur along the LCR within the proposed project area. This area includes the City of Winslow and the mainstream of the LCR from the confluence with Clear Creek downstream to the northern end of the Winslow Levee. This area totals approximately 7.2 miles (11.5 km) of the mainstem of the LCR. Miller (1963) reported the fish occurred in flowing stream sections where substrates consisted of sand, gravel, rocks, boulders, some silt and bedrock. However, due to the threats affecting the spinedace, which are mentioned above, the spinedace is currently restricted to north-flowing tributaries of the LCR in Apache, Coconino and Navajo counties of eastern Arizona. Designated critical habitat is approximately 12 miles (19 km) upstream of the proposed project area.

Although spinedace were once known to have occurred within the proposed project area, this federally-listed threatened species was not detected in any reaches within the proposed project area during the surveys conducted in May 2014. Due to its absence along the LCR within the proposed project area, this fish species will not be included in the impact analysis of alternatives.

e. Southwestern Willow Flycatcher

The southwestern willow flycatcher was listed as endangered in 1995 by the USFWS due to significant loss of riparian ecosystems across their range (including Arizona) and the continued threat of habitat destruction. Designated critical habitat for the flycatcher is not present within the proposed project area. The flycatcher breeds in dense riparian habitats along rivers, streams, or other wetlands. The vegetation can be dominated by dense growths of willow, seepwillow, or

other shrubs and medium-sized trees. There may be an overstory of cottonwood, saltcedar, or other large trees, but this is not always the case. In some areas, the flycatcher will nest in habitats dominated by saltcedar and Russian olive. One of the most important characteristics of the habitat appears to be the presence of dense vegetation, usually throughout all vegetation layers present. Almost all flycatcher breeding habitats are within close proximity (less than 20 yards) of water or very saturated soil. This water may be in the form of large rivers, smaller streams, springs, or marshes. At some sites, surface water is present early in the nesting season, but gradually dries up as the season progresses. Ultimately, the breeding site must have a water table high enough to support riparian vegetation.

Formal protocol surveys were also conducted by the AZGFD in 2014 for the presence of the southwestern willow flycatcher within the proposed project area using standardized survey methodology. A total of 67 points were surveyed across the proposed project area. Surveys to detect flycatcher presence were conducted from May 28-July 17, 2014 using the 2010 revised survey protocol developed by the USFWS and USGS as modified by Sogge et al. (2010). Call points were spaced approximately 30-50 minutes apart. To detect flycatchers, male flycatcher territorial calls were broadcast using a MP3 player with power-horn. Surveys were completed within three established survey periods: 15-31 May, 1-24 June, and 25 June-17 July with each field survey period at least five days apart (Sogge et al. 2010). For project-related surveys, a minimum of five visits were mandatory. The five visits consisted of one survey pass during 15-31 May, two survey passes during 1-24 June, and two survey passes during 25 June-17 July. Surveys were performed when birds were most active (from 30 minutes prior to sunrise to 0900 hours). AZDGF reported that the LCR Winslow project area site is unoccupied by breeding southwestern willow flycatchers due to the limited availability of nesting habitat (Clark, 2014). Formal surveys were not conducted for the yellow-billed cuckoo, as it was first listed as threatened in October 2014, after all surveys occurred. However, the yellow-billed cuckoo does have a distinct call that would be easily identifiable during a formal species survey. While conducting formal species surveys, the AZGFD did not detect yellow-billed cuckoos. Based on what is known about the yellow-billed cuckoo, the preferred habitat and the composition of the vegetated areas within the project footprint, additional surveys for the cuckoo are not warranted at this time. Additionally, the December 20, 2017 signed CAR from the USFWS states there are no species listed or proposed to be listed as threatened or endangered, or their designated or proposed critical habitats known within the proposed project area. Based on the above, the species is not known to be present or anticipated to be present within the project area. Due to the absence of suitable habitat within the project footprint, and the lack of observations of southwestern willow flycatcher within the study area, the Corps has determined that the project would not affect the flycatcher. Due to the absence of the southwestern willow flycatcher within the proposed project area, impacts to the flycatcher were not included in the impacts analysis of alternatives in the EIS. As a precautionary measure, presence/absence surveys will be conducted in riparian areas prior to any construction activities.

f. Yellow-billed Cuckoo (western distinct population segment)

The western distinct population segment of the yellow-billed cuckoo (hereafter referred to as the western yellow-billed cuckoo) was listed as threatened in October 2014 by the USFWS. This listing occurred after the AZGFD surveys were completed. Therefore, AZGFD did not conduct surveys for this species in the proposed project area. Although the yellow-billed cuckoo has the

potential to utilize habitat within the project area, it is very unlikely. Although the yellow-billed cuckoo is known to occupy habitat that contains saltcedar, occupancy rates decline rapidly when saltcedar cover is greater than 75 percent (Johnson et al. 2010), which is the case within the project area. Occupancy rates in Arizona were highest in habitat that contained a high percentage of cottonwood with a low percentage in saltcedar. Also in Arizona, on the lower Colorado River, yellow-billed cuckoos use large patches of habitat and areas with dense canopy closure for nesting (McNeil et al. 2013), and habitat modeling identified several important features associated with cuckoo breeding habitat: (1) an 11.1-acre core area of dense cottonwood-willow vegetation and (2) a large (178-acre) native forest surrounding the core (Johnson et al 2012). The odds of cuckoo occurrence decreased rapidly as the amount of saltcedar cover increased or when cottonwood-willow vegetation was scarce (Johnson et al. 2012). The western yellow-billed cuckoo is most commonly associated with cottonwood-willow-dominated vegetation cover, but the composition of dominant riparian vegetation can vary across its range. In Arizona, habitat may also contain box elder, Arizona alder, Arizona walnut, Arizona sycamore, oak, netleaf hackberry, velvet ash, Mexican elderberry, saltcedar, and *Baccharis* ssp. (Corman and Magill, 2000; Corman, 2005; Johnson et. al., 2010). Critical habitat has been proposed for this species, but not within the project area. Because saltcedar is the dominant species throughout most of the proposed project area, with little to no cottonwood/willow presence, the likelihood of the yellow-billed cuckoo being present is greatly decreased due to the absence of habitat known to be associated with cuckoo occupation within the LCR at Winslow project area including all borrow and disposal areas, as well as all staging, stockpiling, and access areas. In addition, the yellow-billed cuckoo has a distinct call that is easily detected and identifiable, but neither the AZGFD biologists' 2014 formal species survey nor the Corps biologists 2014 observational species survey heard the yellow-billed cuckoo. Based on the above, the species is not known to be present or anticipated to be present within the project area. Additionally, the USFWS states in the CAR there are no species listed or proposed to be listed as threatened or endangered, or their designated or proposed critical habitats known within the proposed project area, and the portion of the LCR within the action area and the adjacent riparian area do not provide suitable or potential habitat for listed or proposed listed species. Due to the absence of suitable habitat within the project footprint, and the lack of observations of yellow billed cuckoo within the study area, the Corps has determined that the project would not affect the cuckoo. Due to the absence of the yellow billed cuckoo within the proposed project area, impacts to the cuckoo were not included in the impact analysis of the alternatives in the EIS. As a precautionary measure surveys would be conducted to determine the presence/absence of this species within the proposed project area prior to any construction activities.

g. Peebles Navajo Cactus

The Peebles Navajo Cactus (*Pediocactus peeblesianus var. peeblesianus)* is a federally-listed endangered plant species located in portions of Arizona. From searches performed in the USFWS' Information for Planning and Consultation (IPAC) database of the LCR at Winslow project area including borrow and disposal areas and all project features, the Peebles Navajo cactus does not occur in the LCR at Winslow proposed project area. Based on the above, the Corps has determined the Peebles Navajo cactus would not be found in the LCR at Winslow project area, and therefore, will not be included in the impact analysis of the alternatives in the EIS.

h. Northern Mexican Gartersnake

The Northern Mexican Gartersnake *(Thamnophis eques megalops)* is a federally-listed threatened species since 2014. A 2018 search and review in the USFWS IPAC on the gartersnake revealed it could potentially be present in Navajo County, Arizona, it is not known to occur in the LCR project area, and the preferred habitat for the gartersnake is not within the LCR at Winslow project area. Additionally, the proposed designated critical habitat for the Northern Mexican Gartersnake is not in LCR at Winslow project area. Based on the above, the Corps has determined the Northern Mexican Gartersnake or its habitat would not be found in the LCR at Winslow proposed project area, and therefore, will not be included in the impact analysis of the alternatives in the EIS.

Table 4-4 Special Status Species for Navajo County, Arizona that Historically may have been Present within the Proposed Project Area

Common Name	Scientific Name	Federal (USFWS Status[a])	State of Arizona Status (AZGFD[b])	Potential for Occurrence
Animals				
Flannelmouth Sucker	*Catostomus latipinnis*	SC	SGCN, Tier 1A	Yes
Bluehead Sucker	*Catostomus discobolus*	SC	SGCN, Tier 1A	None
Zuni Bluehead Sucker	*Catostomus discobolus yarrowi*	E	SGCN, Tier 1A*	None
Little Colorado River Spinedace	*Lepidomeda vittata*	T	SGCN, Tier 1A	None
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E	SGCN, Tier 1A	None
Yellow-billed Cuckoo	*Coccyzus americanus*	T	SGCN, Tier 1A	None
Peebles Navajo Cactus	*Pediocactus peeblesianus*	E	SGCN, Tier 1A	None
Northern Mexican Gartersnake	*Thamnophis eques megalops*	T	SGCN, Tier 1A	None

[a] **Endangered Species Act (ESA)** (as prepared by U.S. Fish and Wildlife Services) **status:** Only Endangered and Threatened species are protected by the ESA.

E= Endangered: any species that is in danger of extinction throughout all or a significant portion of its range.

T= Threatened: any species that is likely to become and endangered species within the foreseeable future throughout all or a significant portion of its range.

SC= Species of Concern: taxa for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possible appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules.

[b] **State of Arizona status:**

SGCN= Species of Greatest Conservation Need.

Tier 1A= Scored "1" for Vulnerability in at least one of the eight categories and matches at least one of the following: Federally listed as endangered or threatened under the Endangered Species Act (ESA); Candidate species under ESA; Is specifically covered under a signed conservation agreement (CCA) or a signed conservation agreement with assurances (CCAA); Recently removed from ESA and currently requires post-delisting monitoring; Closed season species (i.e., no take permitted) as identified in Arizona Game and Fish Commission Orders 40, 41, 42 or 43.

*=In preparation

4.6. Cultural Resources

Cultural resources are locations of past human activity, occupation or use on the landscape. The term denotes a wide range of heritage assets including, but not limited to: archaeological sites such as lithic scatters, villages, procurement areas, resource extraction sites, rock shelters, rock art, and shell middens; and historic era sites such as trash scatters, homesteads, railroads, ranches, logging camps, and buildings or structures that are over 50 years old. Cultural resources also include aspects of the physical environment that are associated with cultural practices or beliefs of a living community that are both rooted in that community's history and are important in maintaining its cultural identity (Parker and King 1998). Commonly referred to as Traditional Cultural Properties (TCP), these areas are afforded the same consideration as other cultural resources.

While the NEPA requires analysis of the full spectrum of aesthetic, historic and cultural resources, the National Historic Preservation Act (NHPA) is concerned with a subset of cultural resources known as historic properties. A historic property is defined as a cultural resource that has met certain standards of age, integrity, and significance (as defined in the call-out box) that qualify it as eligible for listing on the National Register of Historic Places (NRHP or National Register). Cultural resources that are not eligible for the National Register are still considered as part of the NEPA review. The NHPA is the major piece of legislation that mandates that Federal agencies take into account the effects of their undertakings on historic properties.

Regulations at 36 CFR 800 outline the process through which Section 106 of the NHPA is administered. In general, the process can be broken into four steps. These are (1) defining the undertaking and assessing whether it has the potential to affect historic properties included on, or eligible for inclusion on, the National Register; (2) making a good faith effort to identify those properties within the area of potential effect; (3) assessing the undertaking's effects on those resources; and (4) taking steps to avoid or mitigate adverse effects if present.

There are three main standards that a resource must meet to qualify for listing on the NRHP (36 CFR 60): age, integrity, and significance. To meet the age criteria, a resource generally must be at least 50 years old. Properties under 50 years of age can be found eligible when the resource is of exceptional significance (36CFR60.4). To meet the integrity criteria, a resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association. Finally, a resource must be significant according to one or more of the following criteria:

(a) be associated with events that have made a significant contribution to the broad patterns of our history; or

(b) be associated with the lives of persons significant in our past; or

(c) embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) have yielded, or may be likely to yield, information important in prehistory or history

4.6.1. Affected Environment

The following cultural-historical narrative outlines the history of human occupation of the middle Little Colorado River valley for the last 10,000 years. The following is adapted from a report prepared for the Corps entitled *Search Results and Planning Recommendations for the Winslow Flood Control Project, Navajo County, Arizona* (2009*) prepared by* Statistical Research Inc. (SRI).

a. Cultural Background

Paleoindian and Archaic Periods

The evidence for occupation and land use by early big game hunting and gathering peoples in this portion of the Colorado Plateau is meager. The material remains of this cultural tradition take the form of lanceolate projectile points with either short (Clovis) or long (Folsom) flutes removed from one or both faces of bifacially flaked implements. No structural or faunal remains found in association with these points have yet been positively identified. Clovis and Folsom fluted points, presumably representing tools from the Paleoindian period (ca. 9500–7500 B.C.), have been recovered from surface contexts at two sites near Winslow and in the Petrified Forest area. At the present time, it is hard to know whether the paucity of reports of Paleoindian points reflects marginal use of this portion of the Colorado Plateau during the late Pleistocene and early Holocene, or whether this is a result of differential preservation, erosional and depositional processes, and/or sampling bias in archaeological research.

Better represented in the middle Little Colorado River area and surrounding regions are the Archaic traditions (ca. 6000–500 B.C.) of hunting and gathering populations that preceded and seemingly transformed into the formative traditions of the Ancestral Pueblo and Mogollon. Material evidence for this economic adaptation comes in the form of a variety of bifacial tools, which includes an array of morphologically distinct projectile point styles, oval or round manos, basin-shaped metates, and the diagnostic lack of ceramic containers. Remains of structures and activity areas dating to the Archaic have been identified, and the evidence of broadly based subsistence economies that focused on the procurement of modern game species and wild plants with the incorporation of maize agriculture into a largely wild-foods diet at the end of the sequence is widespread throughout the Colorado Plateau.

Basketmaker II

The period ca. 500 B.C.–A.D. 450/500 represents the first use of the middle Little Colorado River area by peoples whose subsistence was derived primarily from domesticated crops, with a secondary emphasis on the gathering of wild foods and hunting small to medium-sized game. Cultivation of crops such as maize and squash requires a commitment to field preparation and crop tending and protection, as well as food and seed storage, which often result in the construction of more permanent residences and field houses than had been built previously; a more restricted pattern of seasonal movement over the course of a year; and a return to locations that proved productive, all of which create a more visible archaeological “signature.” Therefore, it is not surprising that small hamlets are recognized for the first time during this period, and minimally represent the locus of farming and residence during the growing and harvesting portion of the year. Sites attributed to this period of cultural development are found in the form of small habitation sites located in the open and within rockshelters and as campsites used for hunting and gathering activities. Distinctive material items and traits associated with this period include sophisticated coiled and plaited basketry (but generally no pottery, with the possible exception of Adamana Brown ceramics), atlatls, large corner- or side-notched projectile points, basin metates and one-handed manos, rabbit-fur blankets, and characteristic rock art motifs depicting large anthropomorphic figures associated with shamanistic experiences. Domesticated dogs lived with Basketmaker II populations.

Basketmaker III

The Basketmaker III period (ca. A.D. 450/500–700/750) is better represented than its predecessor in the middle Little Colorado region. Sites dating to the later Basketmaker period of cultural development continue to show a dependence on maize agriculture, with the addition of beans to the suite of grown or gathered food resources. Changes in architecture and material remains, particularly in pottery types and technological traditions, as well as the addition of the bow and arrow and its associated small projectile point and turkey domestication, are characteristic of the period. Basketmaker III ceramics are generally plain gray ware jars and bowls usually associated with the Ancestral Puebloan tradition (although a few have simple decorations) or plain brown ware jars and bowls manufactured by either the Sinagua tradition people of the Flagstaff area or the Mogollon tradition people of the White Mountains. Habitation sites are characterized by a number of pithouses, outdoor work areas, and artifact scatters that can represent more-specialized activities such as agricultural field houses, campsites, or procurement loci. The growing of cultivated crops is presumed to have been accomplished largely by dry-farming methods on sand dunes and possibly alongside drainages to the Little Colorado River rather than along the master stream itself. Houses tend to be larger and deeper and exhibit a new assemblage of architectural traits that typically can include antechambers or early ventilator systems, deflectors, wing-walls, hearths, ash pits, and sipapus (i.e., floor pits thought to represent places of emergence from the underworld). A greater dependence on agriculture and the increased likelihood of year-round settlement at habitation sites is inferred for this period from the increased number, size, and form of storage features; a greater range of material items; more efficient grinding equipment; the presence of inhumations; and the extensive accumulation of materials in trash middens. Population is presumed to have increased in this period and become more widely dispersed.

Pueblo I

This period dates from about A.D. 700/750 to 900. The earlier portion of the Pueblo I period (A.D. 750–850) is well represented in the middle Little Colorado River area, and generally is characterized by a continuum of occupation and adaptations from Basketmaker III times. The later part of the period, however, is not well documented, and most archaeologists who have worked in the middle Little Colorado River area remark on the paucity of remains (or perhaps more correctly, excavated sites) clearly dating to this period. Pueblo I deposits are characterized by the presence of neck-banded jars and diagnostic styles of decorated bowls and jars. The period is typified by the Kana'a style of decoration on black-on-white decorated vessels. Sites are found as both habitation sites (most of which were not year-round residences) and artifact scatters.

Pueblo II

In other regions of Ancestral Puebloan culture in the northern Southwest, the time period between A.D. 900/950 and 1100/1150 is most commonly referenced in the terminology of the Pecos Classification as Pueblo II. In the middle Little Colorado River region, however, occupation attributed to the early years of this period (ca. A.D. 900–1050/1075) has been very scarce or unrecognizable from surface remains. Where found, it is characterized by Kayenta

Branch tradition or Tusayan White Ware ceramics (e.g., Black Mesa Black-on-white) and an absence of locally produced white wares and gray wares.

Pueblo III

In the middle Little Colorado River region, the Pueblo III period dates from approximately A.D. 1100 to 1275 in the area west and north of the confluence of the Puerco and the Little Colorado River. It is generally referred to as the McDonald phase. The assignment of this phase to archaeological remains is made primarily on the presence of Walnut Black-on-white, a Winslow Branch Little Colorado White Ware ceramic type. During Pueblo III, sites increase in number in all areas of the middle Little Colorado River region, and new architectural expressions of social integration appear in the form of ceremonial sites with notable public architecture. Most habitation sites are small, containing only a few surface rooms, associated pit structures, and an occasional kiva.

Although changes in material culture are noted for this period (e.g., the appearance of stone hoes in the arable side drainages to the Little Colorado River near the Homolovi sites, new ceramic types, changes in architectural details, the appearance of side-notched projectile points, and the predominance of slab-type metates), the most important changes are noted in the diversity of site locations used by Pueblo III populations, perhaps indicating a more diversified economic base. Sand dune and floodwater agriculture are presumed to continue on the basis that habitation sites are located near small arroyos and sand dune clusters

Pueblo IV

The Pueblo IV period traditionally is dated by the Pecos Classification between A.D. 1300 and 1600, although in recent years it is more common to see this period as it is expressed in the middle Little Colorado region dated from A.D. 1250/1275 to 1600 or 1630. It represents the last of the prehistoric puebloan periods for the region. After this time, the term Historic Pueblo or Early Hopi is more appropriate than the original Pecos Classification of Pueblo V.

This period is noted for its large, aggregated villages and significant changes in material culture, including the manufacture of orange ware (e.g., Homolovi and Winslow orange ware), yellow ware (e.g., Jeddito and Sikyatki yellow ware), and other polychrome pottery (e.g., White Mountain red wares like Pinedale and Fourmile Polychrome), piki stones, and the first clear evidence of the presence of the katsina (kachina) cult as seen in ceramic designs, rock art, kiva murals, and associated public and private ceremonial architecture. Pueblo IV habitation sites can be very large, often containing more than 100 rooms. Of the largest early Pueblo IV sites (e.g., Homolovi II, Huckovi), some have been noted to contain 76–501+ rooms; of the late Pueblo IV sites (e.g., Awatovi, Sikyatki), some have been noted to contain 250–1,000+ rooms (Adams et al. 1993). A recent data search for Pueblo IV sites in northeastern Arizona reveals, however, that many sites with Pueblo IV ceramic assemblages are small and contain fewer than three rooms. In the large habitation sites, the rooms are usually organized as massed roomblocks enclosing open spaces that create plazas or as parallel rows of rooms separated by open spaces that probably functioned as public-use places.

Although data from the Homolovi State Park Survey indicate that population in the middle Little Colorado River valley likely peaked in the late 1300s, it is clear that this large population was distributed in only a few large settlements, most of them along the larger drainages of the Little Colorado or Puerco rivers or at reliable springs. Homolovi I, a highly significant pueblo complex and a National Register listed site, is located on the east side of the river opposite the existing Winslow Levee. Homolovi I was occupied by the Hopi Tribe from approximately 1285-1390.

Historical Period

Military expeditions, Mormon settlement, the construction of the Atlantic and Pacific Railroad, cattle ranching, and tourism represent the events and activities in the Winslow area historically. In 1540, the Coronado expedition assigned Lt. Garcia Lopez de Cardenas to investigate the area. In the seventeenth and eighteenth centuries, small parties of Spanish explorers or missionaries traversed the region; however, extensive recorded exploration of the area did not occur until the middle of the nineteenth century, during the American period of occupation.

The region defined by the middle Little Colorado River valley was never colonized by the Spaniards or Mexicans. Mormons were among the first Anglo-Americans to establish permanent settlements in the area. The Mormons extended their colonizing efforts to Arizona in the 1870s.

In February 1876, Brigham Young sent four missionary parties to the Little Colorado River valley for the purpose of establishing permanent colonies. The four companies, comprising a total of some 300 Mormons, arrived at their destinations in the spring of 1876. Two of the companies settled on opposite sides of the river northeast of present-day Winslow. Jesse O. Ballenger, captain of one of the four companies, established Ballenger Camp on the west bank of the Little Colorado River. Residents of the colony changed the name to Brigham City, after Mormon leader Brigham Young, in September 1878. On the east bank of the river, a company under the leadership of Lot Smith and Lorenzo Roundy established the community of Sunset. Both communities constructed fortresses to guard against Indian attacks. The fort at Brigham City contained a gristmill, tannery, blacksmith shop, pottery kiln, and schoolroom. The residents of Brigham City and Sunset dammed the river and excavated a network of ditches to convey water from the river to agricultural plots on the large floodplain. Crops consisted mostly of wheat, and the communities raised dairy cows. By 1878, Sunset had over 100 residents, and the population of Brigham City numbered around 300. Although the settlements initially flourished, repeated crop failures and devastating floods led to the abandonment of Brigham City and Sunset by the early 1880s.

Transportation is a theme that is central to the development of Winslow and the surrounding area. The development of wagon roads, the railroad, and all-weather automobile roads had profound impacts on the region. By the late 1830s, there was widespread interest within the U.S. government and in the private sector in creating a transcontinental railroad. After the acquisition of California in 1848, the federal government commissioned a series of surveys of the West in search of the most suitable route for a transcontinental line. In June 1853, Lt. Amiel W. Whipple led a party of federal surveyors from Fort Smith, Arkansas, to Los Angeles, California, along the 35th parallel for the purpose of locating a transcontinental rail route to the Pacific Ocean.

Whipple reported the feasibility of constructing a railroad along the route; however, sectional disputes delayed the construction of a transcontinental line. Meanwhile, Congress authorized the construction of several wagon roads to temporarily meet the demand for improved and regular communication with the West Coast. U.S. Army Lt. Edward F. Beale was ordered to survey and build a practical wagon road along the 35th parallel from Fort Defiance (located near the present Arizona-New Mexico border) to the Colorado River. Beale and his team surveyed the route in 1857 and completed construction the following year. The wagon road followed the north side of the Puerco and Little Colorado Rivers along the general route of the modern U.S. Highway 66 and Interstate 40. Beale's Wagon Road negotiated the Little Colorado River at Sunset Crossing. . Although the precise location is not known, Sunset Crossing is believed to be located southeast of present-day Winslow. Sunset Crossing, with its high bedrock, was one of the few places where one could ford the treacherous, sandy-bottomed Little Colorado River. Beale, like his Anglo-American and Spanish predecessors who traversed the region, crossed the channel at this point. Beale's Wagon Road served as the main route across northern Arizona for more than 20 years until the arrival of the railroad (Stein 1993:12, 14).

In 1866, Congress chartered the Atlantic and Pacific Railroad Company (APRR) to construct a rail line from Springfield, Missouri, to San Diego, California, along a course that roughly followed the 35th parallel route surveyed by Whipple. Congress granted the APRR 40 alternate sections of public land for every mile of track laid through the Arizona Territory. This amounted to a 10-million-acre corridor across northern Arizona. Construction of the line across the Arizona Territory began in 1880 and was completed in 1883. The APRR (later Santa Fe Pacific Railroad Company; Atchison, Topeka & Santa Fe Railway; and Burlington Northern Santa Fe Railway) was part of the transcontinental rail system that provided access to points on the east and west coasts of the United States. Winslow was established in 1882 as a division terminal on the APRR. The town is named for E. F. Winslow, who served as general manager of the APRR. In 1897, the Atchison, Topeka & Santa Fe Railway (successor to the APRR) transferred the division headquarters from Gallup, New Mexico, to Winslow. The subsequent construction of a shop and repair facility made Winslow the largest rail center between Albuquerque, New Mexico, and Needles, California.

The arrival of the railroad launched a new era of economic development in the region by providing relatively easy and inexpensive access to national markets. Farms and ranches had outlets for their products and could receive necessary supplies. In 1884, the Aztec Land and Cattle Company, a consortium of eastern businessmen and Texas ranchers, purchased one million acres of land from the APRR at $0.50 per acre, making it the largest cattle-ranching operation in the region. The land claimed by the Aztec Land and Cattle Company consisted of alternating 640-acre sections that extended 90 miles from Flagstaff to Holbrook south of the APRR. Winslow served as a major shipping point for livestock and had a large stockyard facility near the siding. As the stock-raising industry developed, Winslow grew in population.

The Fred Harvey Company was closely associated with the APRR and Santa Fe lines in the southwest. Fred Harvey, an English immigrant and entrepreneur, brokered a deal with the Atchison, Topeka & Santa Fe Railway and its subsidiaries to operate restaurants along the line where travelers and railroad employees could purchase meals during a station stop. Harvey establishments were known for good food at reasonable prices, clean facilities, and top-notch

service. A Harvey restaurant opened in Winslow in the mid-1880s. In the early twentieth century, as railroad tourism boomed, the Harvey Company expanded its services by building luxury hotels at major stations on the line. Noted architect Mary Colter designed the La Posada Hotel in Winslow, a Spanish Colonial Revival–style complex that was completed in 1930. Through advertising, the Harvey Company painted an exotic picture of the West and promoted railroad tourism in Arizona by providing visitors with a variety of Native American handicrafts for purchase at its hotels and restaurants.

Increases in automobile ownership in Arizona and across the nation precipitated a rise in automobile tourism as families had the means to travel to distant points of interest. With its open spaces, favorable climate, scenic beauty, and rich history, Arizona became a popular tourist destination. Winslow was situated on the National Old Trails Highway, an east–west transportation corridor that roughly paralleled the railroad across Arizona and later became part of historic U.S. Highway 66, popularly known as Route 66. Stretching from Chicago, Illinois, to Los Angeles, California, Route 66 brought tourists to the state in record numbers, which in turn led to a proliferation of roadside services that included motor courts (motels), gas stations, diners, and general stores. In 1978, Interstate 40 replaced Route 66 and the new highway skirted the Winslow commercial district. Today, transportation, tourism, manufacturing, and trade represent the principal economic activities in the Winslow area.

b. Cultural Resources within the Study Area

In order to determine the likely presence of cultural resources within the proposed project area the Corps contracted SRI in 2009 to conduct an archaeological records search using site and past project information from the Arizona State Museum's (ASM) AZSITE system, General Land Office records, and literature available from the University of Arizona Library's Special Collections (SRI 2009). The archaeological record search covered an area that extended out from the Little Colorado River for about two to three miles to the east and four to five miles to the west and includes the town of Winslow AZ. It includes over 20,000 acres.

The archaeological record in the middle Little Colorado River valley is substantial. A total of 27 archaeological survey projects have been conducted within the study area. These investigations have resulted in the identification of 240 cultural resources and 35 components of three historic districts, the Winslow Residential Historic District, the La Posada Historic District, and the Winslow Commercial Historic District. All three are located in modern-day Winslow.

Of the 240 sites within the record search area, five are identified as listed in the NRHP, 17 have been determined eligible for inclusion on the NRHP, 214 have not been evaluated for eligibility for inclusion on the NRHP, and four are not eligible for inclusion on the NRHP. It is important to note that the bulk of the survey coverage is located within Homolovi State Park, and that 173 of the 240 sites have been recorded in this area. Many of these Homolovi State Park sites are associated with the Homolovi settlement cluster, and they consist of limited-activity locales associated with the larger pueblos. Site density outside of Homolovi State Park appear to be much lower, but the lack of survey outside of the Park skews this data. The site density outside of the park could be much higher if additional survey was conducted.

Many of the sites are located along the margin of or outside of the area that the Corps has estimated as being within the 100-year floodplain (one percent ACE). Therefore, it seems clear that prehistoric people avoided significant construction within the active floodplain of the Little Colorado River. Alternatively, site visibility is likely poor within the floodplain, and many buried sites lacking a surface expression may be preserved in pockets of floodplain sediment.

c. Area of Potential Effect

Compliance with regulations affecting cultural resources requires the definition of an area of potential effect (APE). The APE is the geographical area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties (36CFR 800.16). In accordance with 36 CFR 800.4, the Corps initiated consultation with the Arizona State Historic Preservation Office (SHPO) regarding the APE and scope of the identification efforts via letter on May 7, 2015. The Corps concurrently notified the following Tribes about the project and sought information regarding properties of religious or cultural importance: the Fort Mojave Indian Tribe, the Havasupai Tribe, the Hopi Tribe, the Navajo Nation, and the Pueblo of Zuni. The Corps originally defined the APE for the recommended plan as the 142 acre levee construction corridor, the 12 acre setback area, the 94.5 acre saltcedar removal area, and all associated borrow and disposal areas, access roads, and staging areas (Appendix I – Environmental). The Hopi Indian Tribe contacted the Corps in a letter dated May 18, 2015 and stated their concerns with the APE. Specifically, the Tribe was concerned that the proposed project might alter the River's flow and impact the ancestral village site known as Homolovi I which is located on the east side of the River outside of the construction footprint. Shortly thereafter, the Arizona State Historic Preservation Office (SHPO) contacted the Corps and requested that they consult with all applicable consulting parties on the APE citing the importance of the Little Colorado River and Homolovi to the Hopi Tribe. In response, the Corps has expanded the APE to include an additional 114-acre parcel that extends across the river from the setback and includes Homolovi I in order to address any changes in hydraulics that may occur as a result of the project (Figure 4-10). On April 15, 2016, the Hopi Tribe thanked the Corps for expanding the APE and noted their continued interest in consulting on the project. Copies of all correspondence can be found in Appendix I - Environmental.

d. Cultural Resources within the APE

The Corps completed an archaeological reconnaissance survey of 4.25 miles of the proposed levee alignment that is common to Alternatives 1.1, 8, 10, 10.1, 10.2, 10.3, 10.4, and portions of 3.1. The survey covered a 500-foot- (150-meter) wide corridor, 330 feet (100 meters) on the landward side and 170 feet (50 meters) on the riverward side. The survey also included the 12-acre setback area, the 94.5-acre saltcedar removal area and approximately 60 acres that are adjacent to the levee and that are likely to be used as borrow and disposal areas. Two archaeological sites were discovered during the survey: a large but diffuse prehistoric site with intrasite patterning and a historic period rock foundation and associated debris. In addition to the two archaeological sites, a large concentration of modern and marginally historic-era trash, building materials, concrete, rock, and chucks of asphalt was located between the river and the levee. The dumping episode is outside of the levee corridor but portions overlap with the APE.

Figure 4-10 Area of Potential Effects

The results of the investigation are preliminary. Additional identification efforts would occur in the next phase of the study, including additional work to evaluate the sites located during the reconnaissance survey. These future identification and evaluation efforts are laid out in the Programmatic Agreement executed by the Corps and the Arizona SHPO (Appendix I - Environmental). While the two archaeological sites have not been formally evaluated, the Corps believes that additional testing will reveal that they are eligible and has assumed that they are both eligible for the National Register under Criterion D for the purposes of this analysis. It is unlikely that the dumping episode is eligible for the National Register. The Corps also took the SHPO and Hopi Tribe to the prehistoric site on September 6, 2017 as part of ongoing consultation for the project. Both parties verbally agreed with the Corps that the prehistoric site is likely eligible for the National Register.

Beyond the survey and background search, the Corps also contacted the following Tribes: the Fort Mojave Indian Tribe, the Havasupai Tribe, the Hopi Tribe, the Navajo Nation, and the Pueblo of Zuni. The Corps requested their assistance in identifying properties that are of religious or cultural significance to the Tribes and requested their general input on the proposed project. The Hopi Tribe has identified the Homolovi I pueblo complex as a significant site located within the APE. While the SHPO letter identified the Little Colorado River as a potential TCP of the Hopi Tribe, the Tribe has not identified the river as such during the Corps' consultation with them. To date, no input has been received from the other Tribes. In addition to the Affected Tribes, the Corps has also identified the ASM and Arizona State Parks and Trails as consulting parties in the Section 106 process.

Section 304 of the NHPA prohibits Federal agencies from publicly disclosing specific information about cultural resources that could lead to their harm through vandalism or looting regardless of their eligibility. Therefore, specific site locations are not discussed in this analysis unless it is a well-known property whose location is already on publically available maps such as Homolovi State Park.

Table 4-5 Archaeological Sites and Traditional Cultural Properties known to Exist within the APE

Site Number/Name	Description	Eligibility Status
Homolovi I	Ancestral Pueblo Complex. Both an archaeological site and likely TCP of the Hopi Tribe	Listed on the NRHP
Temp # 1	Lithic and Ceramic Scatter	Corps assumed Eligible (D); no formal determination made (SHPO has not reviewed this determination)
Temp # 2	Homestead remains	Corps assumed Eligible (D); no formal determination made (SHPO has not reviewed this determination)
Dump Site	Several acre dump with mixture of historic and modern debris	Unevaluated.

In addition to the archaeological survey, the Corps reviewed Navajo County appraiser data in order to identify any structures that had met the 50 year threshold to be considered for listing on the NRHP. Any parcel that contains a structure that was over 50 years old is listed in the table below.

Table 4-6 Parcels with Structures that met the 50-Year Threshold

Property ID	Structure	Construction Dates	Discussion
A-1	House and 4 outbuildings	House constructed in 1950. Unknown date on outbuildings	The alternatives are unlikely to require the home to be moved but may affect a historic era barn and corral (date of construction unknown). The barn and corral may be eligible for listing on the NRHP.
A-2	House and 5 outbuildings	House =1937 Shed=1986 Quonset Hut =1995 Shed=1954 A fifth structure was counted during the real estate reconnaissance but does not appear in the appraisal records	The House may be eligible but it is highly unlikely that the outbuildings would be eligible.
A-3	2 houses and 1 outbuilding/yard improvements	House #1=1910 House # 2= 1910 Outbuilding/yard improvements=1945	A search of the Navajo County Assessors website and Google Earth reveals that all of the structures are located well outside the construction footprint. The structures were not examined during the reconnaissance survey. Based on age, the structures may be eligible
B-2	House and 3 outbuildings	House constructed in 1956. Unknown date of construction for outbuildings	Outbuildings appear to date to the same period as the house (unlikely to be eligible).
B-3	House	House constructed in 1965	Single level ranch style home. (Unlikely to be eligible for the NRHP).
B-5	House and 1 outbuilding	House constructed in 1922. Unknown date of construction for outbuilding	The outbuilding appears to be a greenhouse. House may be eligible but it is highly unlikely that the greenhouse would be eligible.

4.7. Air Quality

4.7.1. National Ambient Air Quality Standards

To protect the public health and welfare, the Federal government identified a number of criteria air pollutants and established ambient air quality standards for each through the Federal Clean Air Act (42 U.S.C. 7401, et seq.). The air pollutants for which Federal standards have been promulgated via the National Ambient Air Quality Standards (NAAQS) include ozone (O_3), carbon monoxide (CO), suspended particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb). PM emissions are regulated in two size classes: Particulates up to 10 microns in diameter (PM_{10}) and particulates up to 2.5 microns in diameter ($PM_{2.5}$).

An area is given the status of “attainment” if NAAQS have not been exceeded. Areas where insufficient data are available to make an “attainment” status designation are listed as “unclassified” and are treated as being in attainment for regulatory purposes. A status of “nonattainment” for particular criteria pollutants is assigned if the NAAQS for that pollutant has been exceeded. Once designated as nonattainment, attainment status may be achieved after three

years of data showing non-exceedance of the standard. When an area is reclassified from "nonattainment" to "attainment", it is designated as a "maintenance area," indicating the requirement to establish and enforce a plan to maintain attainment of the standard.

Air quality within the Winslow area is currently within attainment status for all criteria pollutants (ADEQ, 2015). Table 4-7 below summarizes the Federal attainment status of the criteria pollutants for the project area pursuant to the NAAQS.

Table 4-7 NAAQS Attainment Status for Winslow, Arizona

Pollutant	Attainment Status
Ozone (O_3)	Attainment
Carbon monoxide (CO)	Attainment
Nitrogen dioxide (NO_2)	Attainment
Sulfur dioxide (SO_2)	Attainment
Particulate matter less than 10 microns (PM_{10})	Attainment
Particulate matter less than 2.5 microns ($PM_{2.5}$)	Attainment
Lead (Pb)	Attainment

Source: USEPA, 2015.

4.7.2. General Conformity Rule

Section 176(c) of the federal Clean Air Act (42 U.S.C. 7506(c)) states that a Federal agency cannot issue a permit for, or support an activity within, a nonattainment or maintenance area unless the agency determines it will conform to the most recent USEPA-approved State Implementation Plan. Thus, a Federal action must not:

- Cause or contribute to any new violation of a NAAQS.
- Increase the frequency or severity of any existing violation.
- Delay the timely attainment of any standard, interim emission reduction, or other milestone.

A conformity determination is required for each criteria pollutant or precursor where the total of direct and indirect emissions of the criteria pollutant or precursor in a nonattainment or maintenance area caused by the Federal action would equal or exceed rates specified in 40 C.F.R. 93.153, known as *de minimis* levels. Since air quality within the Winslow area is in attainment for all criteria pollutants, a conformity determination is not required for this project.

4.7.3. Greenhouse Gases

Gases that trap heat in the atmosphere are often called greenhouse gases (GHGs). GHGs are emitted by natural processes and human activities. Examples of GHGs that are produced both by natural processes and industry include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Examples of GHGs created and emitted primarily through human activities include fluorinated gases (hydrofluorocarbons [HFCs] and perfluorocarbons [PFCs]) and sulfur hexafluoride (SF_6).

There appears to be a close relationship between the increased concentration of GHGs in the atmosphere and global temperatures. Scientific evidence indicates a trend of increasing global temperatures near the earth's surface over the past century due to increased human-induced levels of GHGs. GHGs differ from criteria pollutants in that GHG emissions do not cause direct adverse human health effects. Rather, the direct environmental effect of GHG emissions is the increase and/or change in global temperatures, which in turn has numerous indirect effects on the human environment.

On, August 1, 2016, the Council on Environmental Quality (CEQ) released Final Guidance for Federal Departments and Agencies on the Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews (CEQ, 2016). The final guidance recommended that agencies consider the direct and indirect effects of all actions for the CO2 equivalent emissions. It is important to note that the CEQ guidance did not propose this emissions reference point as an indicator of a threshold of significant effects. Pursuant to Executive Order 13783, Promoting Energy Independence and Economic Growth, signed on March 28, 2017, the CEQ withdrew its Final Guidance on April 5, 2017 (Executive Order 13783, 2017; (CEQ, 2017)). .

There are currently no Federal GHG emission thresholds, but the anticipated emissions will be disclosed for each alternative without expressing a judgment as to their significance.

4.7.4. Sensitive Receptors

The impact of air emissions on sensitive members of the population is a special concern. Sensitive members of the population include those that may be more negatively affected by poor air quality than other members of the population, such as children, the elderly, or the infirm. Schools, hospitals, and convalescent homes are considered sensitive receptors because children, the elderly, and the infirm are more susceptible to respiratory distress and other air-quality-related health problems than the general public. There are no sensitive receptors immediately adjacent to the Winslow Levee or the RWDL. Most sensitive receptors located in the City of Winslow (two hospitals, eight schools, and one convalescent home) are located approximately a half mile to three miles west of the Winslow Levee. Sensitive receptors close to the Winslow Levee are Winslow High School and Seba Dalkai Boarding School. Both are located a half mile west of the Winslow Levee.

Bushman Acres, an unincorporated rural residential community, is approximately a quarter mile from the Winslow Levee and across the west bank of the LCR. Homolovi State Park is approximately a quarter mile from the Winslow Levee and across the east bank of the LCR. No established trails or recreation operations are within the levees' construction corridor. There are no established recreational facilities within the conveyance improvement area at the BSNF Railroad Bridge.

4.8. Traffic

Traffic routes in the vicinity of the study area that could be affected are described below and depicted on Figure 4-11.

- Interstate 40 is a four lane, east-west limited access highway that transects the study area and provides access to Winslow Levee. I-40, also known as SR-180, is classified as an urban interstate (ADOT, 2012). As part of the Eisenhower Interstate Highway System, I-40 is the third longest east-west Interstate Highway in the United States. I-40 spans from Barstow, California, in the west, to Wilmington, North Carolina, in the east. I-40 provides access to the Winslow Levee (via a frontage road), and disposal areas owned by a private landowner (via SR-87).
- North Park Drive is a major north-south roadway which bisects the northern half of Winslow (ADOT, 2012). North Park Drive is classified as an urban collector roadway. North Park Drive is four-lanes wide with dual left turn lanes at the I-40 interchange. Elsewhere, this road narrows to two lanes. North Park Drive provides access between central Winslow and the North Park Commercial Center at the I-40 interchange. Access is also provided to the Navajo Reservation via unpaved Indian Routes north of Winslow.
- Williamson Avenue is a two-lane, north-south roadway that runs adjacent to and intersects portions of the study area. Williamson Avenue is classified as an urban collector roadway (ADOT, 2012).
- Mike's Pike is a four-lane, east-west roadway between North Park Drive and its western terminus at Hipkoe Drive. Mike's Pike is classified as an urban collector street (ADOT, 2012). Mike's Pike provides access to a Walmart Supercenter and other businesses in the commercial center north of I-40 at Park Drive.
- SR-87 (also known as Route 66 in this area) is a two-lane, north-south state highway that runs adjacent to and intersects portions of the study area. SR-87 is classified as an urban minor arterial roadway (ADOT, 2012). This highway connects Winslow to Payson and the Phoenix-Mesa metropolitan area to the south. It is also a primary route between I-40 and the Navajo and Hopi Reservations to the north. SR-87 provides access to the Winslow Levee, the RWDL, and disposal areas owned by McCauley.
- Transcon Lane is a two-lane road with a center two-way left turn lane that provides access to Winslow's easternmost I-40 traffic interchange (ADOT, 2012). Transcon Lane is classified as an urban arterial roadway. Transcon Lane connects between the Frontage Road north of I-40 to the 2nd Street and 3rd Street couplet south of I-40. It serves the Flying J Travel Plaza. Transcon Lane connects I-40 and SR-87.
- Oak Road Maple Street is a two-lane, east-west, urban collector residential road that passes under I-40 (ADOT, 2012). No access to I-40 is provided via Maple Street. Maple Street becomes Oak Road east of its intersection with Sunset Road. Oak Road provides access to Winslow Levee and a proposed disposal area owned by the City of Winslow (currently the French Farm and a pasture).
- Sunset Road is a two-lane, north-south, urban collector residential road (ADOT, 2012). The north end of Sunset Road intersects with North Road.

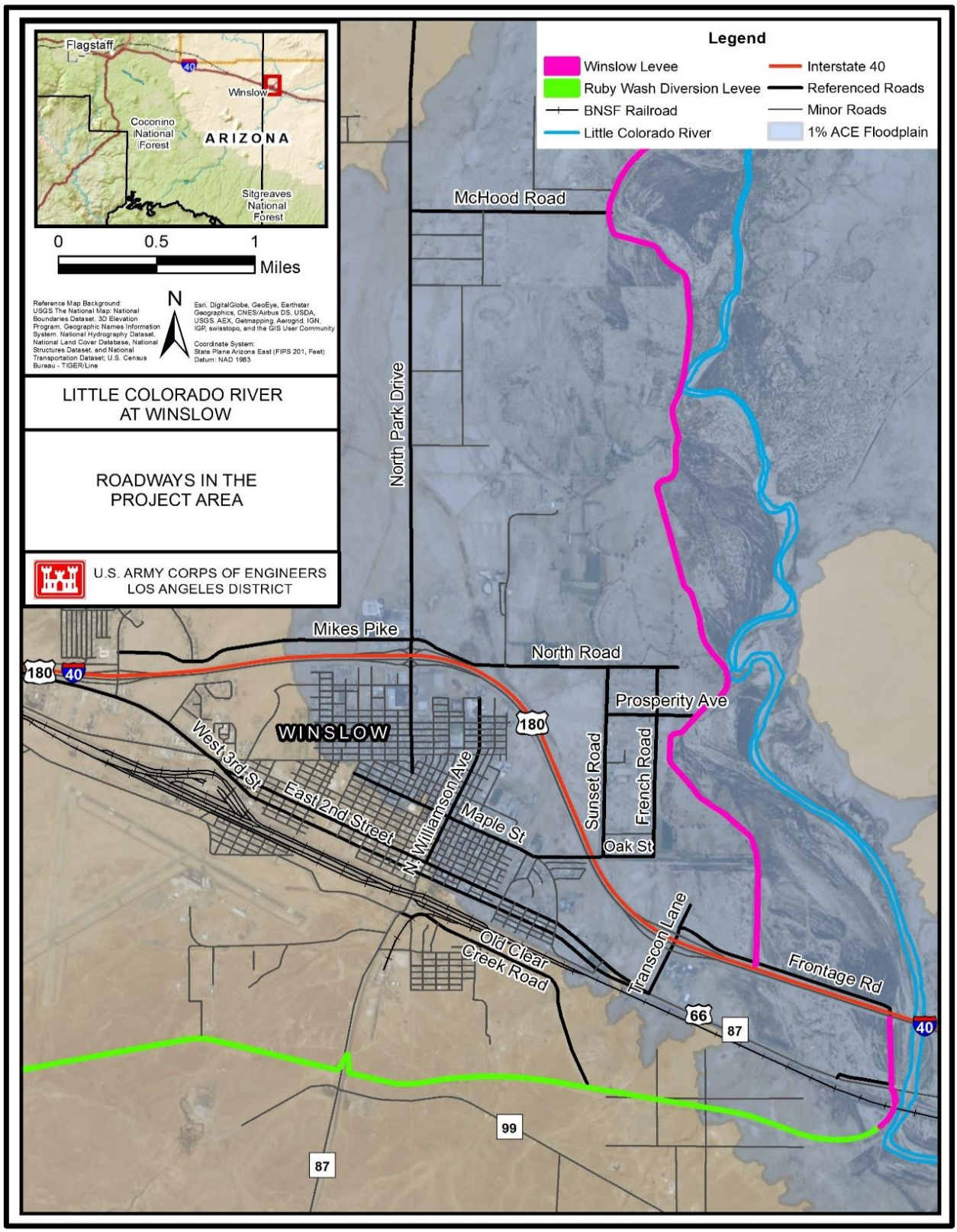


Figure 4-11 Roadways in the Study Area

- North Road is a two-lane, east-west, urban collector, residential road (ADOT, 2012). North Road connects to the north end of Sunset Road and Mike's Pike to the east, and provides access to Winslow Levee.
- Frontage Road is an east-west road that provides access to the Winslow Levee and connects to Transcon Lane and I-40 to the north.
- Prosperity Avenue is a two-lane, east-west road. Prosperity Avenue provides access to residential areas and to the Winslow levee.
- McHood Road is a two-lane, east-west road. McHood Road provides access to residential areas, the Winslow levee, and proposed disposal areas owned by a private landowner.
- Indian Route 15 is a roadway that connects to SR-87 between Winslow and Indian Wells, Arizona.
- Indian Route 154 is a roadway in Indian Wells that connects to Indian Route 15.

Annual Average Daily Traffic (AADT) capacities represent the general level of daily traffic that each roadway type can carry. Table 4-8 below shows the current (baseline) traffic volumes for roadways in the vicinity of the study area (ADOT, 2013; 2012). No AADT counts were available for Frontage Road, Prosperity Avenue, or McHood Road and it is assumed their AADT to be similar to Oak Road (approximately 500 AADT) due to the type of roadway service and pattern in the City of Winslow, in the unincorporated portions of City of Winslow, and in Navajo County. Launching stone would come from a potential source is located at Indian Wells, Arizona, approximately 43 miles northeast of Winslow levee, a 55-mile one-way haul distance along existing roads, which include all of the roadways listed below.

Table 4-8 Current Traffic Volumes

Roadway Name	AADT
I-40 (at Exit 253 – between Hipkoe Dr. and North Park Dr.)	16,517[e]
I-40 (at Exit 255) – between North Park Dr, and Oak Rd.)	17,407[e]
North Park Drive (between Hillview and Henderson St.)	9,880[b]
Williamson Avenue, between 2nd and 3rd St.	9,037[c]
Mike's Pike (between Hipkoe Ave. and North Park Dr.)	2,100[b]
SR-87 (at I-40)	1,632[a]
Transcon Lane (at I-40)	9,011[c]
Oak Road	500[b]
Sunset Road	700[b]
North Road	1,200[b]
Frontage Road	500[d]
Prosperity Avenue	500[d]
McHood Road	500[d]
SR-87 (at Indian Route 15)	1,716[f]
Indian Route 15 to Indian Route 154	1,700[d]
Reference: ADOT, 2013[a]; 2012[b], City of Winslow, 2011[c], estimate[d], 2014[e], 2017[f].	

Ingress-Egress

Six ingress-egress routes for access to the construction corridor have been identified. From upstream to downstream, these are summarized below in Table 4-9. Ingress-egress routes are anticipated to be ±30 feet in width to allow safe passage of heavy construction equipment.

Table 4-9 Ingress-Egress Routes

Location	Required Improvements	Permanence
South side of SR87 west of the Winslow Levee	Present and in use – road safety, load and widening improvements needed	Permanent project feature
North side of SR87 west of the Winslow Levee	Present and in use – road safety, load and widening improvements needed	Permanent project feature
Westbound I-40 frontage road east from Transcon Lane	Present and in use – load and widening improvements needed	Permanent project feature
North end of Transcon Lane via unpaved road along south side of ADOT drainage easement	Widening of existing unpaved roads and new unpaved road construction needed for 2,800 feet	Temporary access; restored to original condition upon project completion
East from intersection between French Road and Oak Road, then north across the French Farm	1,500 feet of new unpaved road construction needed	Temporary access; restored to original condition upon project completion
East from the east end of North Road	1,500 feet of new unpaved road construction needed	Temporary access; restored to original condition upon project completion

4.9. Noise

4.9.1. Noise Levels and Ranges

In general, noise is defined as unwanted sound. The effects of noise on people range from annoyance to inconvenience to temporary or permanent hearing loss. Level of annoyance or impact produced by a sound depends on its loudness, duration, time of day, and land use. Sound measurements are usually expressed as decibels (dB) which equally weights all frequencies. However, the human ear is not equally sensitive to sounds at all frequencies. Therefore, the dBA (A-weighted decibels) scale which primarily weighs frequencies within the human range of hearing is used to assess the impact of noise on human hearing (USEPA, 1972). A range of noise levels in dBA are shown in Table 4-10 below.

Table 4-10 Range of Noises

Noise level (dBA)	Examples	Human Response
0	Recording studio	hearing threshold
20	Rustling leaves	
40	Conversational speech	quiet
60	Freeway at 50 feet	
70	Freight train at 100 feet	moderately loud
90	Heavy truck at 50 feet	
110	Ambulance siren at 100 feet	very loud
120	Jet engine at 200 feet	threshold of pain

Reference: USEPA, 1972

4.9.2. Existing Noise

Noise level measurements that characterize the study area are not available. However, a range of ambient noise levels could be characterized based on consideration of existing land uses. The study area was segmented into three sections in order to characterize ambient noise levels. Figure 4-12 shows the noise ranges for the three sections described below.

a. Transportation Corridor Segment

The Transportation Corridor Segment is approximately 2.25 miles long, and encompasses the study area from the terminus of RWDL to the segment of Winslow Levee extending north approximately 2,700 feet from the I-40, including borrow, disposal, and staging sites and access routes. The land use is open space, but the noise within this segment is influenced by three major transportation corridors that traverse the area: I-40, BNSF Railroad, and SR-87. I-40 is a major east-west U.S. interstate for truck transport of supplies. The average annual daily trips on I-40 at Winslow is approximately 15,000. Based on Table 4-10, noise level for a freeway at 50 feet is approximately 60 dBA. The BNSF freight trains are another source of noise as approximately 120 trains per day (one every 12 minutes), runs through Winslow (Corps, 2014). Based on Table 4-10 noise level for a freight train at 100 feet is approximately 70 dBA. Due to the presence of highly utilized transportation corridors through this segment, ambient noise levels likely ranges from 60 to 70 dBA.

b. Rural Residential Segment

The Rural Residential Segment encompasses an approximately 1.3-mile long segment of Winslow Levee from Oak Road to North Road, including borrow, disposal, and staging sites and access routes. The segment is adjacent to an unincorporated area of Navajo County on the landward side of the levee where the land use is rural residential with lot sizes ranging from 0.5 to one acre. Also present are equestrian facilities to stable and train horses. Sensitive receptors in this segment include residential homes. Within this segment, Homolovi State Park lies to the east of the Winslow Levee and extends north into the Open Space Segment. Noise levels within this reach most likely range from 50 to 60 dBA.

c. Open Space Segment

The Open Space Segment encompasses an approximately 3.25-mile long segment of Winslow Levee from North Road to the terminus of the study area, including borrow, disposal, and staging sites and access routes. The segment is surrounded by open space. As a result, it is likely that ambient noise levels within the study area are within the vicinity of the 45-50 dBA range.

4.9.3. Local Ordinances

The City of Winslow has a general noise statement in their Municipal Code Noise 9.08.020 stating the creation of any unreasonably loud, disturbing, and unnecessary noise in the City of Winslow is prohibited. The code further specifies excessive noise on any street adjacent to any church, school, institution of learning, or court while the same are in session, or adjacent to any hospital, which unreasonably interferes with the workings of such institutions, provided, that conspicuous signs are displayed in such streets indicating that the same is a church, school, hospital or court street, is a violation of this section of the code (City of Winslow, 2016). No churches, schools, institutions of learning, or courthouse are located within the vicinity of the study area. There are no known noise ordinance restrictions applied to exterior, construction work in Navajo County from the Navajo County's Zoning Ordinance (Navajo County, 2012).

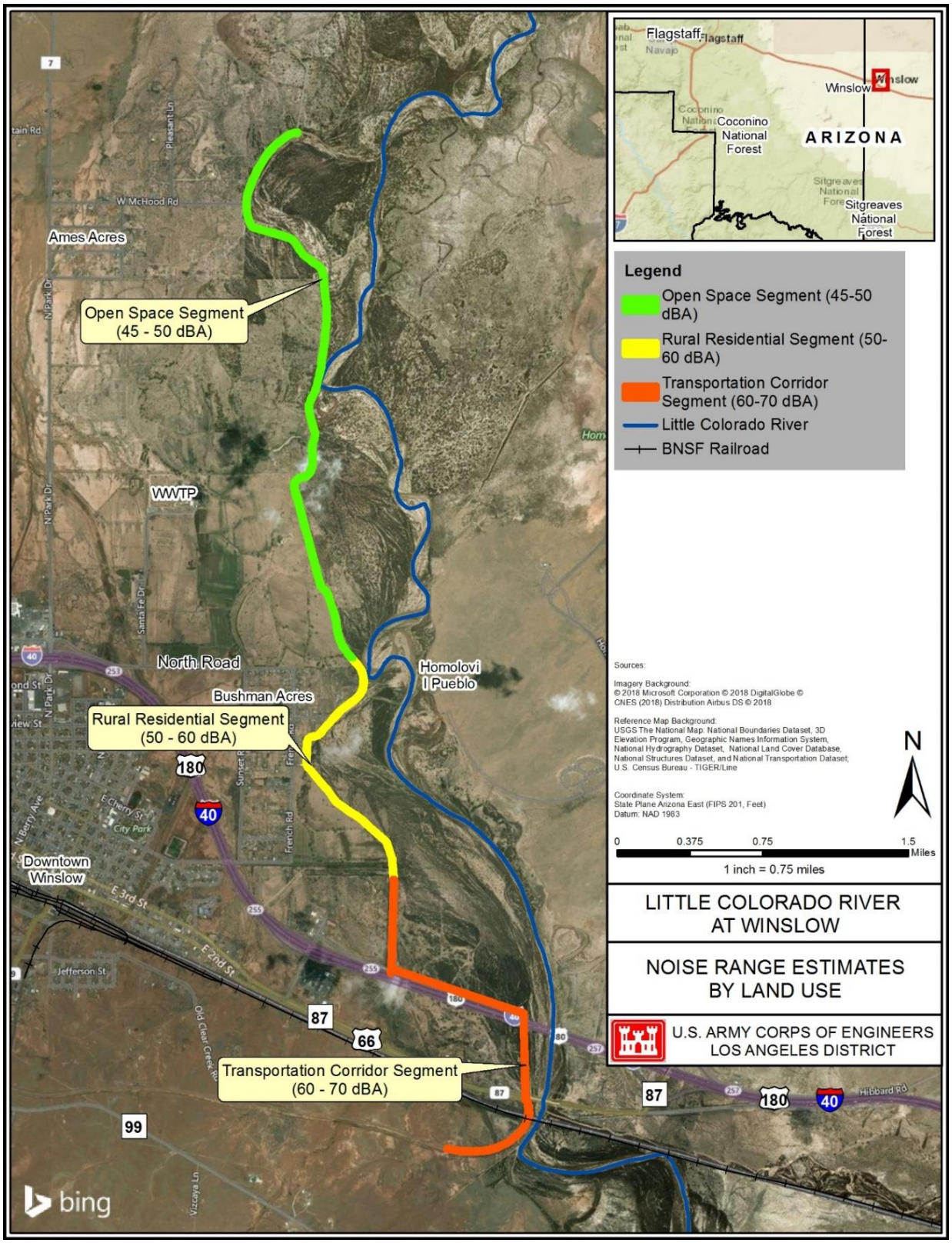


Figure 4-12 Noise Range Estimates by Land Use

4.10. Aesthetics

Visual aesthetics that characterize the proposed project area are characterized by three segments:

a. Transportation Corridor Segment

The Transportation Corridor Segment is as described in Section 4.9.2. The land use is open space but three major transportation corridors traverse the area: I-40, BNSF Railroad, and SR-87. As a result, the existing vista consists of expansive views of an earthen environment with distinct barren sand bars interspersed with patches of saltcedar as well as open water in the foreground. Raised roadway embankments and bridges form continuous lines in the background. Vehicle and rail traffic as well as appurtenant elements such as traffic lights, billboards, utility poles, overpasses, and nearby structures such as gas stations and truck stops also comprise the midground and background. Borrow and disposal sites in this segment include the McCauley Properties site and riverine borrow site under the BNSF Railroad Bridge. Existing vegetation at the McCauley Properties site is sparse and consists mostly of weedy species, while the riverine borrow site is dominated with weeds and saltcedar. Staging would occur on two sites landside of RWDL and Winslow Levee, and one site riverside of the Winslow Levee. Existing vegetation within the staging and access sites are generally sparse with saltcedar and weedy species.

b. Rural Residential Segment

The Rural Residential Segment is as described in Section 4.9.2. From the landside, the visual character consists of rural residential with lot sizes ranging from 0.5 to one acre that are part of the unincorporated area of Navajo County. Also present are equestrian facilities to stable and train horses, and other facilities in the foreground with the Winslow Levee, forming a continuous line in the background. The levee slope on the landside is composed of compacted earth and vegetated with non-native shrubs and weedy species. Although the levee forms a distinct protrusion, the presence of residential and other facilities in the foreground attenuate its visual presence. From the riverside, the visual character consists of expansive views of an open arid environment populated with desert shrubs in the foreground with muddy open waters and the levee in the background. Within this segment, Homolovi State Park lies to the east of the Winslow Levee and extends north into the Open Space Segment. The levee slope on the riverside is armored with gray basalt boulders (riprap). As a result, the levee forms a distinct continuous line protruding from the natural vista. Furthermore, the height of the existing levee ranges from eight to 15 feet. This segment also includes a riverine borrow site that is characterized as a dust dune. Borrow, disposal, and staging would be located on the City of Winslow site landside of the Winslow Levee. Staging would also occur at the east end of North Road. Existing vegetation at these sites are generally sparse with saltcedar and weedy species.

c. Open Space Segment

The Open Space Segment is as described in Section 4.9.2. From the landside, the visual character of the Open Space Segment consists of expansive views of an open arid environment populated with desert shrubs. Though the existing Winslow Levee forms a continuous line protruding from the natural vista, the levee slope on the landside is composed of compacted earth and vegetated with non-native shrubs and weedy species. As a result, the colors and textures of the levee are

consistent with the surrounding landscape, masking the structure without disrupting the continuity of form. Furthermore, the height of the existing levee ranges from eight to 15 feet. As a result, the distinct protrusions are resolved with the natural vista at sufficient distances.

From the riverside, the visual character of the Open Space Segment consists of expansive views of an open arid environment populated with desert shrubs in the foreground with muddy open waters and the levee in the background. The levee slope on the riverside is armored with gray basalt riprap. As a result, the levee forms a distinct continuous line protruding from the natural vista. Furthermore, the height of the existing levee ranges from eight to 15 feet. As a result, the distinct protrusions are only resolved at farther distances relative to the landside perspective.

4.11. Land Use

Most of Winslow Levee is located within an unincorporated area of Navajo County. The segment of Winslow Levee between the southern border of Bushman Acres and the BNSF Railroad is located within the city of Winslow. RWDL is located within an unincorporated area of Navajo County. Land uses along Winslow Levee generally consists of open space and rural residences. The segment of Winslow Levee on city lands traverse areas zoned for commercial and industrial uses. A map describing the current zoning of the Winslow area is shown in Figure 4-13. Since the levees are located sufficiently distant from the developed city center and capital projects on the outer perimeter of the city are not anticipated, future land uses are unlikely to change substantially from current land uses.

The Navajo County Comprehensive Plan addresses planning for growth as “important for Navajo County to ensure economical expansion of infrastructure, improve transportation circulation, conserve significant natural resources and open spaces, and provide a rational pattern of land development” (Navajo County, 2011). However, the Comprehensive Plan would not change the zoning of any parcel of land.

4.11.1. Levee Alignment

The RWDL and Winslow Levee are located adjacent to the City of Winslow. For the most part, they are located outside city limits within an unincorporated area of Navajo County. The Winslow Levee lies within the Character Areas of Community Village, Rural Ranch, and Range Land as designated by Navajo County. Character Area dictates how an area may develop over time using general guidelines appropriate to the designated land use.

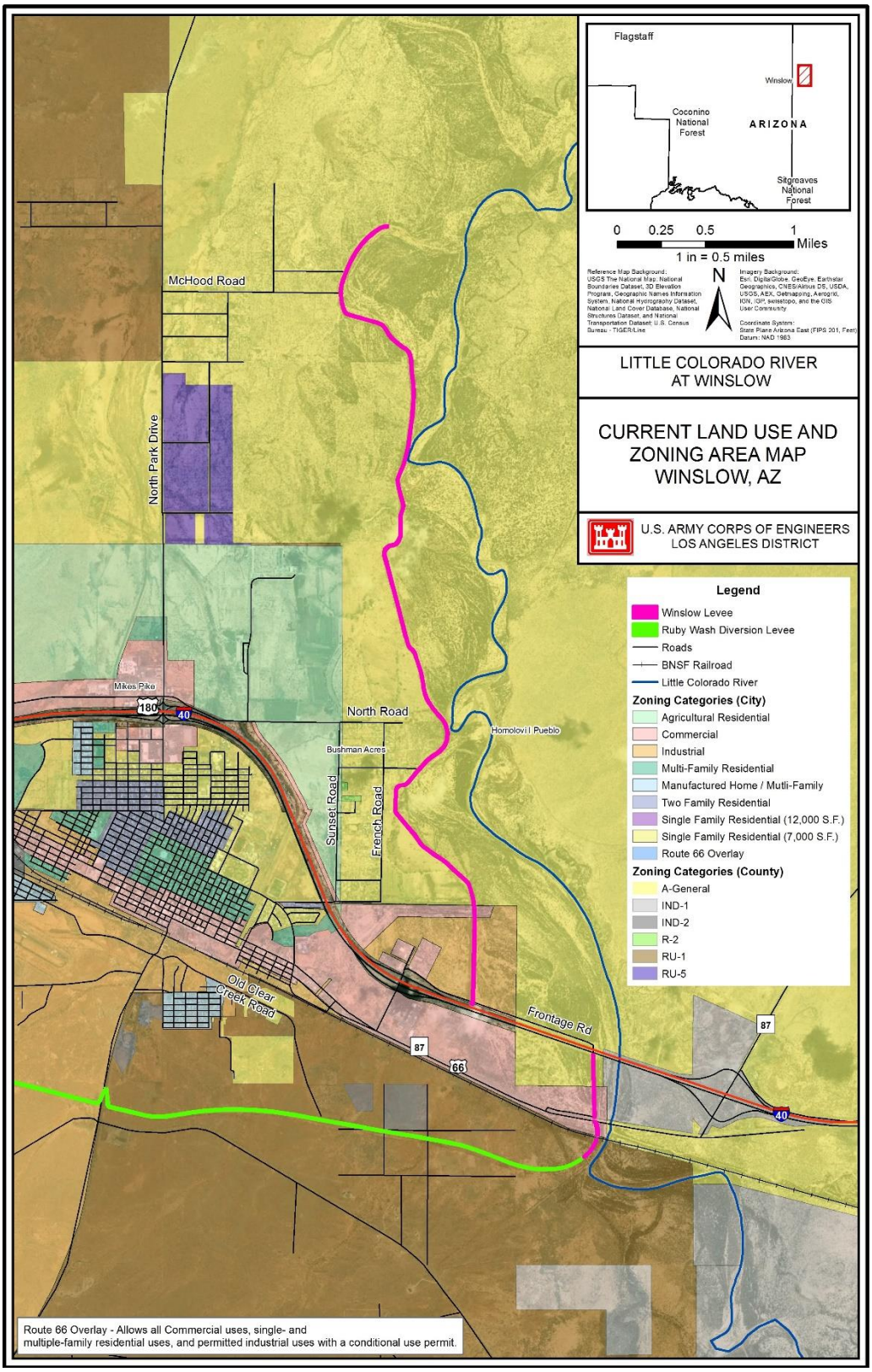


Figure 4-13 Current Land Use and Zoning Map

The RWDL reach is located between SR-87 to the north, SR-99 to the south, and east of Solana Lane within lands designated by Navajo County as low-density residential. The upstream reach from the RWDL to the Winslow Levee at Oak Road is within the vicinity of the city's commercial and industrial zones. The floodplain of LCR between the Winslow Levee and the active channel is zoned as open space/recreational area. Immediately adjacent to this reach are Navajo County lands zoned as low-density residential and open space. The Winslow Levee from Oak Street to North Road is immediately adjacent to Bushman Acres, an unincorporated area of Navajo County where the land use is rural residential with lot sizes ranging from 0.5 to one acre. Also adjacent are lands zoned for open space. The remaining segment of the project area from North Road to the downstream terminus is adjacent to lands zoned as rural residential and open space.

4.11.2. BNSF Railroad Bridge, Interstate 40, and State Route 87

The area surrounding the BNSF Railroad Bridge, I-40, and SR-87 consists of open space and saltcedar.

4.11.3. Riverine Borrow Sites

Both potential borrow sites are open riverine spaces populated with saltcedar. The dust dune site and the borrow sites from the existing levee embankments, trench drain excavation, and channelization area are zoned as open space/recreational area.

4.11.4. Upland Borrow Sites

Upland borrow sites are located within unincorporated Navajo County in areas zoned for general open space and industrial.

4.11.5. Disposal Sites

Five disposal sites are proposed for use. All five sites are located immediately landward of Winslow Levee. Thus, all sites are located within unincorporated Navajo County in areas zoned for general open space.

4.12. Socioeconomics

Socioeconomic data including population, housing, and employment are shown in Table 4-11 below.

Table 4-11 Population, Housing, and Employment

Population; Housing; Employment	City of Winslow	Navajo County
Total Population	9,754	107,449
Total Households	2,914	35,658
Total Housing Units	3,362	56,938
Total Employment	3,717	34,928
Unemployment Rate	7.2%	15.3%
Annual Median Household Income	$36,829	$ 34,855
Per Capita Income	$16,264	$16,282

Reference(s): U.S. Army Corps of Engineers (Corps). 2014a.

The per capita income and median household incomes between the city and county are approximately the same. However, unemployment rate for the city is approximately half of Navajo County.

4.13. Environmental Justice

The 1994 Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires all Federal agencies to conduct "programs, policies, and activities that substantially affect human health or the environment, in a manner that ensures that such programs, policies, and activities do not have the effect of excluding persons (including populations) from participation in, denying persons (including populations) the benefits of, or subjecting persons (including populations) to discrimination under, such programs, policies, and activities, because of their race, color, or national origin." Section 1-101 of the Order requires Federal agencies to identify and address "disproportionately high and adverse human health or environmental effects" of programs on minority and low-income populations (EO, 1994).

The Federal Council on Environmental Quality (CEQ) identifies minority groups as Asian, American Indian and Alaskan Native, Native Hawaiian and Pacific Islander, Black or African American, and Latino (CEQ, 1997). CEQ further notes that a minority population may be present if minorities exceed 50 percent of the existing population within an area or if a minority group comprises a meaningfully greater percentage of the local population than in the general population (CEQ, 1997). A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds (CEQ, 1997). Both the EO and the CEQ definitions of environmental justice and minority groups assist in describing the existing without project demographic condition within the City of Winslow study area.

The City of Winslow, the City of Holbrook, and Navajo County serve as the environmental justice demographics reference. Holbrook, located 35 miles east of Winslow on I-40, is the governmental center for Navajo County. Ethnicity and low-income data are shown in Table 4-12 below.

Table 4-12 Ethnicity, Low Income

Ethnicity; Low Income	City of Winslow	City of Holbrook	Navajo County
Total Population	9,655	5,053	107,449
Poverty Data			
Percentage Below Poverty Threshold	17.0%	19.6%	26.2%
Ethnicity Data			
White	34.5%	35.3%	43.5%
Black	5.7%	3.6%	1.3%
Hispanic/Latino	32.9%	25.4%	11.1%
Asian	1.0%	1.8%	0.6%
American Indian/Native Alaskan	25.8%	30.0%	43.4%
Native Hawaiian/Pacific Islander	0.1%	0.2%	0.1%

Table 4-12 compares the City of Winslow poverty and ethnicity with the City of Holbrook and Navajo County. The table summarizes poverty rates for the City of Winslow, the City of Holbrook, and Navajo County that are all above the national average of approximately 14.3 percent. In terms of ethnicity, the City of Winslow and the City of Holbrook have very similar demographics. Winslow has a slightly higher percentage of Black and Hispanic/Latino populations when compared to the City of Holbrook. Holbrook has a slightly higher population of Asians and American Indians compared to the City of Winslow. Navajo County has lower population figures for the Hispanic, Black, and Asian populations and higher population figures for the American Indian populations when compared to the two cities. In general, low-income or minority populations for Winslow are typically located north of the RWDL, south of I-40, and west of North Park Drive.

As described above and in Table 4-12, these ethnicity groups combined (American Indian/Native Alaskan; Asian; Black; Hispanic/Latino) comprise a minority population as defined by CEQ. Of the 9,655 residents in Winslow, approximately 65 percent, or approximately 6,276 residents, are minorities. Approximately 17 percent are substantially low income.

4.14. Recreation

The City of Winslow has 10 city-owned parks (See Table 4-13) within the boundaries of the city. The 9/11 Memorial, Hubbell Trading Post Grounds and Performance Area, and the Standin' on the Corner Park/Route 66 Plaza are considered miscellaneous parks. The Bulldog Plaza, the Father Seramur Park in Coppertown, Triangle Park, and First Street Linear Park and Pedestrian/Bicycle Path and Walkway are considered pocket parks. The Southside Park is considered a neighborhood park. The Ruby Channel Multi-purpose Ball Field and Winslow City Park are considered community parks. All are scattered throughout the city. The nearest city of Winslow parks to the proposed project area are in the vicinity of the State Route 87-Interstate 40: 9/11 Memorial; Winslow City Park; and Ruby Channel Multi-purpose Ball Field.

There is also a state park adjacent to the City of Winslow boundaries. Homolovi State Park is located on the east side of the LCR. The Homolovi State Park is considered a cluster of four archaeological sites that include seven separate pueblo sites built between 1260 and 1400 AD. The sites are culturally important to the Hopi people as historical sites and part of their homeland. Many Hopi still make pilgrimages to the site.

The LCR floodplain between the Winslow Levee and the active channel is zoned as open space/recreational area of the City of Winslow (City of Winslow, 2002). The Winslow levee is located on lands owned by various private and government/public entities. Navajo County Flood Control District owns lands or holds easements for flood risk management purposes, and these areas are not available for public recreation use. "No trespassing" signs are posted in this area to discourage unauthorized recreational use, however, unauthorized recreation does occur on the levees and access roads.

Table 4-13 City Owned Parks within the City of Winslow

Name	Location	Park Type	Size of Park
9/11 Memorial	East Route 66/Transcon Lane	Miscellaneous Park	In City Right of Way; Small Area Dedicated to Memorial
Hubbell Trading Post Grounds and Performance Area	Second Street Campbell Avenue	Miscellaneous Park Visitors Center and Performance Area	4.3 Acres
Standin' on the Corner Park/Route 66 Plaza	Second Street/Kinsley Avenue	Miscellaneous	1.76 acres
Bulldog Plaza	North Park Drive/Cherry Street	Pocket Park	0.33 acres
Father Seramur Park in Coopertown	Central Street/Francis Avenue	Pocket Park	0.48 acres
Triangle Park	Fleming Street/Elm Street	Pocket Park	0.41 acres
First Street Linear Park and Pedestrian/Bicycle Path and Walkway	First Street/Kinsley Avenue to Hicks Avenue	Pocket Park Walkway	7 City Blocks approximately
Southside Park	Jefferson Street/Virginia Avenue	Neighborhood Park	2.14 acres
Ruby Channel-Multi-purpose Ball Field	Oak Street/Interstate-40	Community Park	7.3 acres
Winslow City Park	Cherry Street/ Colorado Avenue	Community Park	14.94 acres

4.15. Utilities and Public Safety Services

The proposed project area encompasses the following utilities (listed from upstream to downstream), which could be impacted by the proposed project:

- Inverted Siphons: Twin siphons pass irrigation water under the RWDL at the upstream end of the proposed construction area. These siphons are constructed of 30-inch reinforced concrete pipe with concrete headwalls. The Winslow Irrigation District owns and maintains the siphons.
- Utility line on Wooden Poles: An overhead utility of unknown ownership suspended from wooden poles crosses over the RWDL approximately 200 feet downstream of the inverted siphons.
- Buried Telephone Cable (abandoned): There is an abandoned buried telephone cable located at approximately STA 6+10 along the Winslow Levee. This buried telephone cable is no longer active.
- 4.5 inch High Pressure Gas Lines Crossing No. 1: A 4.5-inch (outside diameter) underground high-pressure natural gas line crosses Winslow Levee just off the north toe of the State Route 87 embankment west of the LCR. This gas line services Winslow and the surrounding areas. This utility is owned, operated, and maintained by Kinder Morgan.
- Century Link Fiber Optic Line: A major trunk line and local service line run together in a 4-inch conduit. The fiber optic line is located immediately north of the State Route 87 road embankment.

- Arizona Public Services (APS) High Tension Powerlines: These powerlines cross the Winslow Levee approximately 300 feet north of and approximately parallel to State Route 87.
- ADOT K-3 Channel: This is an eight-barrel concrete box culvert with lift gates that passes under I-40.
- 4.5-inch High Pressure Gas Line Crossing No. 2: A 4.5-inch (outside diameter) underground high-pressure natural gas line crosses Winslow Levee approximately 1,600 feet north of the I-40 Frontage Road. This gas line services Winslow and the surrounding areas. This utility is owned, operated, and maintained by Kinder Morgan.
- I-4 Hydraulic Gate: This is a four-barrel, 4-foot-by-10-foot concrete box culvert with lift gates constructed as part of the Winslow Levee. The I-4 hydraulic gate is located approximately 2,800 feet north of the I-40 Frontage Road.
- Arena Lights: This utility consists of four livestock arena light poles located on private property. These are located approximately 1,200 feet south southeast of the intersection between French Road and Prosperity Avenue, just off the landside toe of the Winslow Levee.
- Homolovi Water Line: The Homolovi State Park is served potable water from the City of Winslow's municipal system. Potable water is provided from a water main that runs to the east end of Prosperity Avenue. The water main terminates at a gate-valve box and an air release/vacuum valve box located at the landside toe of the Winslow Levee. From the gate-valve box, a six-inch polyvinyl chloride water line runs northeast within the levee right of way for 1,000 feet. At this point, the water line crosses under the levee and continues across the LCR floodplain in an east-southeasterly direction to Homolovi State Park. The water supply line is owned and maintained by the City of Winslow.
- Winslow Wastewater Outfall: An underground wastewater effluent outlet from the Winslow Wastewater Treatment Plant crosses Winslow Levee approximately 1.5 miles east of North Park Drive. Treated water is discharged through a 12-inch diameter ductile iron pipe with the outlet located on the riverside approximately 100 feet off the toe of the levee. The outlet of this pipe is covered by a 12-inch flap valve and reinforced by a concrete headwall. The waste water pipeline is owned, operated, and maintained by the City of Winslow, and services Winslow and the surrounding community.
- APS Electrical Line: There are nine utility poles within the vicinity of the proposed project area construction corridor; six are wooden poles and the remaining three are metal poles. These utility poles are located approximately between STA 223+00 and STA 242+00. These utility poles provide electrical service to the locals via overhead power lines. Overhead local electrical service that approaches the landside toe of the Winslow Levee, then runs north for a distance of approximately 1,600 feet before terminating at a private electrical riser. The electrical riser has been de-energized and can be removed per conversation with APS.

The proposed project area provides the following public safety services:

- City of Winslow Police: Winslow Police offices are located at 708 W. 3rd Street in Winslow. Winslow Police is a full-service department operating with 22 sworn officers and nine civilians (City of Winslow, 2015). The Winslow Police Department participates in Drug and Gang Task Force and the School Resource Officer programs.
- City of Winslow Fire Department: Winslow Fire Department is located at 215 N. Taylor Avenue in Winslow. The department provides fire protection for the City of Winslow, population 9,500, covering approximately 900 square miles (City of Winslow, 2015). The Department will respond to calls thirty minutes out of the City limits in any direction. The Department also has mutual aid agreements with other cities in the area. The Department is staffed twenty-four hours a day, seven days a week. The Winslow Fire Department has six full-time paid crossed-trained Fire/EMS personnel and twenty-three on-call positions, some of which are EMS personnel as well.
- Little Colorado Medical Center: Little Colorado Medical Center (LCMC) is located at 1501 N. Williamson Avenue in Winslow. LCMC is a 25-bed, not-for-profit, critical-access hospital and offers primary inpatient and outpatient services to more than 32,000 residents in northeast Arizona.
- Winslow Indian Health Care Center: Winslow Indian Health Care Center (WIHCC) is located at 500 North Indiana Avenue along I-40 in Winslow. WIHCC is a state of the art Ambulatory Health Care Center. WIHCC serves the healthcare needs of the Native American Indians in the southwestern portion of the Navajo Nation. On a regional level, approximately 16,500 Navajo/Hopi patients, or approximately 35 percent of the American Indian/Native Alaskan population residing in Navajo County, annually travel from their home reservation to seek medical care at the Center.
- Action Medical Services, Inc. (Ambulance Service): Action Medical Services, Inc. is located at 1200 E. 2nd Street in Winslow. Action Medical Services is a Certified Ground Ambulance Provider through the state of Arizona's Department Health Service, Bureau of Emergency Medical Service and Trauma System.
- Navajo County Sheriff Department: Navajo County Sheriff's Department is located at 100 E. Carter Drive in Holbrook, approximately 40 miles east of Winslow. The Sheriff's Office is comprised of many units: Patrol, Communications, Criminal Investigations, Evidence, Administration, Adult Detention (Jail), Training, and Search and Rescue. The Sheriff's Department Jail is a 444 bed facility and also houses state of Arizona Department of Corrections and federal Bureau of Prison inmates. Navajo County Sheriff's Department has a substation in Winslow located at 115 E. 2nd Street, known as District 1 Winslow – Joseph City, that provides services to Winslow, Joseph City, and Navajo & Hopi Reservations.
- Navajo County Emergency Management: Navajo County Emergency Management (NCEM) is located at 100 East Code Talkers Drive along South Highway 77 in Holbrook, approximately 40 miles east of Winslow. NCEM provides services in emergency (manmade and natural) events that occur with both tribal and non-tribal lands and oversees the coordination of response and mitigation activity in the event of an emergency. NCEM interacts with Federal, state, tribal and local jurisdictions along with volunteer organizations and the public to minimize the impacts and resume normal activities.

- Burlington Northern Santa Fe Police. BNSF police office is located at 1417 W. 2nd Street in Winslow. The BNSF police office provides patrol and policing services on BNSF railroad property in the Winslow area.
- Arizona Department of Public Safety (Arizona Highway Patrol): Arizona Department of Public Safety includes highway patrol services. An Arizona Highway Patrol District 3 office located at 2411 East Navajo Boulevard in Holbrook, approximately 40 miles east of Winslow, provides state highway patrol services to Winslow.
- Navajo Nation Division of Public Safety (Navajo Nation Police Department): Navajo Nation Division of Public Safety includes Navajo Nation police services. Navajo Nation Police Department provides law enforcement on the Navajo Nation in the southwestern United States including Navajo County. A Navajo Nation jurisdictional Dilcon District police office is located in Winslow at 15 Navajo Drive.

4.16. Hazardous Materials

The Corps Los Angeles District Geotechnical Branch performed a Phase I Environmental Site Assessment (ESA) to identify and provide information on Recognized Environmental Conditions (RECs) that may impact levee improvements currently under consideration for Winslow Levee, the easternmost 2,000 feet of the RWDL, or areas where some existing residential structures might be elevated to achieve flood damage risk reduction (U.S. Army Engineer District, Los Angeles, 2013, rv2017). Database searches for known and potential sources of hazardous materials within the study area were conducted by the Corps and included the following Federal and state pubic-accessible, internet-posted databases:

- US Environmental Protection Agency (USEPA) National Priorities List (NPL) of Superfund sites database (historical and current data to 2013).
- USEPA Resource Recovery and Conservation Act (RCRA) cleanup sites database (historical and current data to 2013). A RCRA cleanup site is a business or former business that used, stored, or produced RCRA-monitored commodities, and that had issues with some type of RCRA-regulated substance.
- Solid Waste Landfills (SWLs) in the vicinity of LCR at Winslow (historical and current data to 2013).
- Arizona Department of Environmental Quality (ADEQ) Leaking Underground Storage Tanks (LUST) database (historical and current data to 2013).
- ADEQ brownfields sites status database (historical and current data to 2013).
- ADEQ Declaration of Environmental Use Restriction (DEUR) and Voluntary Environmental Mitigation - Use Restriction (VEMUR) sites database (historical and current data to 2013).
- ADEQ Underground Storage Tank (UST) and database (historical and current data to 2013 including data on completed, documented UST tank pulls ('tank closure') and Above Ground Storage Tanks (AST) searches (historical and current data to 2013).
- ADEQ hazardous materials incident database (historical and current data through 2001 only)

In addition to searching the above databases, the following additional work was performed:

- Drive-by windshield survey was conducted of the LCR Winslow study area in a search for visible indications of RECs not listed in regulatory databases, and to obtain additional information on known and potentially pertinent REC properties (U.S. Army Engineer District, Los Angeles, 2013 rv 2017)
- Historical and current aerial photographs were reviewed (U.S. Army Engineer District, Los Angeles, 2013 rv 2017)
- City of Winslow map of active LUSTs dated December 2011 was reviewed and compared to existing databases (U.S. Army Engineer District, Los Angeles, 2013 rv 2017)
- Internet-posted information was searched for locations of landfills and waste water treatment plants, for historical background information on former lumber milling locations in Winslow, and to discern the details regarding a reported ADEQ VEMUR site at or near the La Posada hotel in Winslow (U.S. Army Engineer District, Los Angeles, 2013 rv 2017).

The Phase I ESA is attached to this integrated feasibility report as Appendix G – Hazardous, Toxic, and Radioactive Waste.

4.16.1. Findings

a. NPL Sites

The USEPA's Superfund site list/NPL indicates no NPL sites in Winslow, AZ and in the vicinity of Winslow that includes Navajo County (U.S. Army Engineer District, Los Angeles, 2013 rv 2017).

b. RCRA Cleanup Sites

The USEPA's RCRA cleanup site list indicates there are no current RCRA sites in Winslow, AZ and in the vicinity of Winslow that includes Navajo County (U.S. Army Engineer District, Los Angeles, 2013 rv 2017).

c. Solid Waste Landfills

A search was made on internet databases to determine if a solid waste landfill (SWL) exists in Winslow and in the vicinity of Winslow that includes Navajo County (U.S. Army Engineer District, Los Angeles, 2013 rv 2017). No evidence was found suggesting that the community has a solid waste landfill. The City of Winslow operates a Transfer Station that is a temporary storage facility where waste is unloaded from collection vehicles before being transferred to larger trucks for shipment to landfills (Navajo County, 2011).

d. Leaking Underground Storage Tanks (LUSTs)

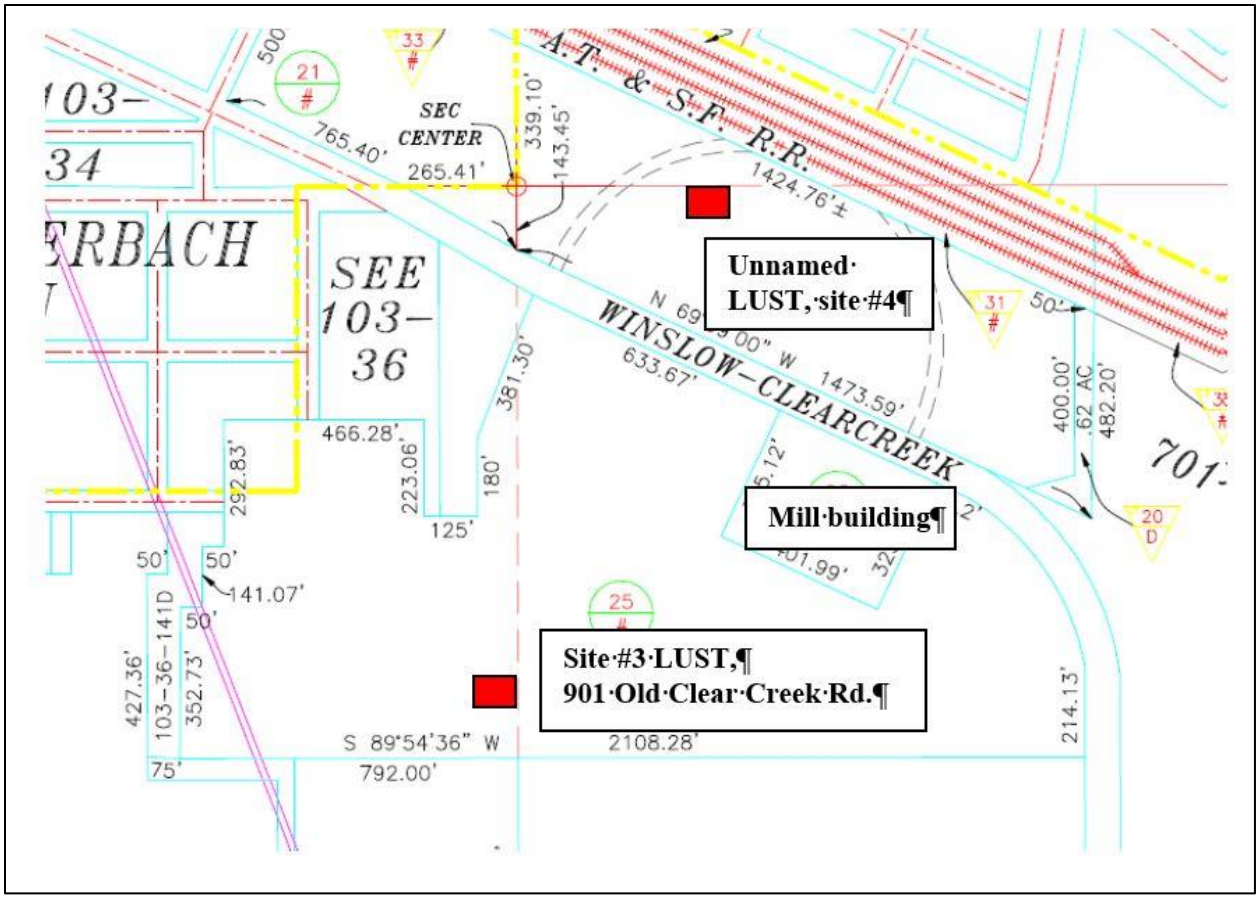
Three "active"/not remediated soil- and groundwater-impacting LUST sites (Whiting Station #23, Phil Bruchman Trading, and Duke City Lumber) received particular consideration in the Phase I ESA as potential RECs (U.S. Army Engineer District, Los Angeles, 2013). The interest

is based on the groundwater impacting characteristics of the sites, coupled with certain unknowns, as explained below. The interest is not based on their soil-impacting characteristics, considering the distances of these sites from this Corps study area. Specifically, the sites are of interest because they:

- are not remediated (Whiting, Bruchman) or are not remediated to completion (Duke City Lumber);
- impact groundwater;
- have free-floating product on the groundwater (suggestive both of increased contaminant mobility and concentration);
- are upgradient of the Corps study with regard to anticipated groundwater flow direction;
- do not have contaminant(s) identified in the databases accessible to this point in time;
- do not have contaminant plume map(s) present in the databases accessible to this point in time;
- are moderately close to the area of interest (0.6 to 0.9 mi west from potential levee realignments and a mile or more west from the existing Winslow Levee), and are close enough that it is conceivable, although unlikely, that the groundwater contaminant plumes could have migrated sufficiently to reach the Corps area of interest.

The Duke City Lumber mill site identified as site #3, which is an inactive sawmill at 901 Old Cedar Creek Rd, has the additional concerns that remediation has been ongoing for 20 years, which is a long time, and involves complex remediation processes, further implying possibly extensive or concentrated contamination (see Figure 4-14 for Lumber Mill LUST site #3). Considering the former use of the site, multiple contaminants may be present and they may include non-petroleum-fuel contaminants, such as chemicals related to the wood processing industry, which may be more of a concern than the petroleum hydrocarbon fuels anticipated to be the sole contaminants at the Whiting and Bruchman sites.

At this point, all three sites are classified as likely non-RECs with regard to this Corps feasibility study, considering the distance their groundwater contaminants plumes would have to travel to reach the Corps proposed project area. Nevertheless, each has some remaining potential to ultimately be classified as RECs with regard to this study. To resolve this, specific additional information on each site is being sought (identity of contaminant(s) and contaminant plume maps), and if the information can be obtained, each site will be reevaluated. It is possible that after access to additional information, all three sites could be dropped from consideration as potential RECs, or they could be elevated to Controlled Recognized Environmental Consideration (CREC) or REC status. Distance and direction that the groundwater contaminant plumes have or have not traveled, and that they may travel, will be major factors in the decision.



Source: Navajo County, 2013.

Figure 4-14 Navajo County Property Plat Map (2013) showing Duke City Lumber Mill LUST Site #3 and Unnamed LUST Site #4

An unnamed LUST site known as site #4 is reported to exist 0.9 mi west from levee realignments (see Figure 4-14 for unnamed LUST site #4), but its existence cannot be verified and it is not on any regulatory database, leading to the conclusion that it may be an erroneous listing of a LUST location. Its potential relevance to this Corps study, if any, would be determined using the same criteria listed above for the Duke City Lumber site, should any other information on this unnamed site ever be encountered.

Ten remediated LUST sites, all in case-closed status, are within one mile of the Winslow Levee, with the closest being 0.5+ miles to the west. None are in the proposed project site on the west (landside) of the levee where existing structures exist. It is concluded that, at such distances, coupled with the fact that they are remediated, all are non RECs with regard to this Corps study, and do not warrant further consideration.

e. ADEQ UST and AST Sites

Documented USTs and ASTs all are sufficiently distant from the levees and related areas of interest that none represent an REC of any type for this feasibility study (this is in regard to non-leaking tanks). No active USTs or ASTs are within the proposed project site. The closest active USTs are the group of 10 petroleum fuel USTs at a trucking plaza ¼ miles to the west of the Winslow Levee.

f. ADEQ Hazardous Material Incidents

Documented hazardous materials incidents (i.e., "spills") all are sufficiently distant from the Winslow Levee and the rest of the proposed project site, that none represent an REC of any type for this feasibility study. Although there was a McHood Oil Co. diesel fuel release at 1115 E. 1st St., it is exceedingly unlikely that the spill could have reached the area of interest, based on the distance involved (one mile from the Winslow Levee) (U.S. Army Engineer District, Los Angeles, 2013 rv 2017). The fact that the incident was reported and presumably included a response to a fire is indicative that 'cleanup' of some manner occurred after the event, further reducing the possibility that migration to the levee could have occurred. The same general conclusions and reasoning are applied to the two diesel fuel spills at the Flying J trucking plaza, even though it is much closer to the levee (0.3 miles). The fuel quantities released at Flying J were considered when drawing this conclusion. The La Posada site is another hazardous materials incident location (two sizeable diesel fuel releases from non-LUST sources) but is not relevant to this Corps study, due to distance (more than a mile).

g. Other Potential RECs

A former railroad track alignment over the Winslow Levee is presumed to be untested, since the Corps could obtain no information to the contrary, and may contain small quantities of leaked petroleum hydrocarbons in the form of journal box oil, and even related trace PCBs, chemicals that may exist as components of journal box oil. Such occurrence is common enough along former rail track alignments that such release is anticipated to possibly be present here, unless or until proven otherwise through soils testing along the alignment. No such soils testing is planned or anticipated to be done as a part of this feasibility study, although further testing would be needed to determine whether the site would be considered a Hazardous, Toxic, and Radioactive Waste site. The site is considered an REC with regard to the levee, as long as there is an absence of favorable soil testing.

Kachina Auto Salvage Yard, a vehicle salvage site with over 500 junk vehicles is less than 600 feet from the levee. It is not considered a REC at this time with regard to this study, because the business has no known 'violations' or other negative environmental records, including no record of any substance releases, or RCRA infractions, or LUSTs, and it has no known USTs or ASTs. The current planning concepts for this area do not include elevating any of the nearby residences.

Buried automobiles used as Winslow Levee fill, 150 feet south of McHood Road, apparently have been in the fill since original attempts to build a levee, more than 40 years ago. It is not known if they contain fluids, such as oil and gasoline, and it must be presumed they do contain at least some such fluids. Therefore, they are RECs. Those fluids may have leaked and caused small areas of petroleum hydrocarbon soil contamination in the levee fill. If present, such release(s) readily should be containable, given the apparent small numbers of vehicles present, and probable age and amount of the potential releases. There was also at one point a vehicle lost in the LCR, 200 feet north of the I-40 Bridge. This vehicle is not considered a REC because there was no evidence of any fluid leaks when the vehicle was observed in 2013, and any fluids remaining are expected to be diluted.

Neither the Winslow wastewater treatment plant nor the prison complex wastewater treatment plant are potential RECs with regard to this feasibility study due to distance from the Levees. Winslow wastewater treatment plant is in the proposed project site on the landside (west) of the Winslow Levee, but is not close to any other structures.

h. ADEQ Brownfields

There are no current brownfield sites in the vicinity of LCR Winslow proposed project site (U.S. Army Engineer District, Los Angeles, 2013 rv 2017). Four previous brownfield sites in the City of Winslow have been cleaned up.

i. ADEQ DEUR and VEMUR Sites

There are no current DEUR or VEMUR sites in the vicinity of LCR Winslow proposed project site.

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5.0 ENVIRONMENTAL CONSEQUENCES

Table 5-1, Summary of Environmental Impacts, provides a summary comparison of environmental impacts by resource category. General environmental impacts and areas of stakeholder interest are summarized below.

As described in Chapter 3.0, certain refinements were made to the Recommended Plan, Alternative 10.1, with proportional adjustments assumed for the other action alternatives. These plan refinements could result in minor adjustments in impacts associated with each action alternative compared to descriptions in the Draft IFR. For most resources, there would be no change in the impacts analyses. For resources for which the refinements would result in minor adjustments, these changes are disclosed in the respective resource sections. The refinements would not change any conclusions about the significance of impacts compared to those in the Draft IFR.

Construction Equipment

Typical equipment to be used during the construction period include loaders, scrapers, dozers, trucks, blades, roller compactors, a soil-cement batch plant, concrete mixers, water trucks, and backhoes.

Construction equipment would generally be operated 10 hours a day, six days a week. If acceleration of work is required to ensure flood control the daily work schedule may be extended.

These refinements have been incorporated into the EIS, as part of the alternatives impact analysis.

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Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
Geology & Soils	***Construction Impacts*:** Potential temporary loss of topsoil. Impacts would be less than significant. ***O&M Impacts*:** Potential for erosion and loss of topsoil would be low. Impacts would be less than significant.	***Construction Impacts*:** Impacts would be similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts*:** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts*:** No impact. ***Operational Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts*:** Impacts would be similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts*:** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts*:** Impacts would be similar to Alternative 1.1 for rebuild of the RWDL. Impacts would be less than significant. ***O&M Impacts*:** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts*:** Impacts would be similar in character to Alternative 1.1 but less overall compared to Alternative 1.1. Alternative 10.4 includes additional channelization, the impacts would be similar overall and insignificant. Impacts would be less than significant. Since Alternative 10.2 would not include any channelization improvements under the BNSF Railroad Bridge, no impacts would occur in that area. Impacts would be less than significant. ***O&M Impacts*:** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Temporary impacts from ongoing maintenance and repair performed by the NCFCD and City of Winslow.
Hydrology, Hydraulics, and Public Safety	***Construction Impacts*:** Levee system would be constructed at a scale that provides a 90% assurance of containing the 1% ACE flood (69,200 cfs), reducing the risk of levee failure and flooding to the city of Winslow and surrounding communities, which would be a benefit to public safety. When compared to the first most likely baseline condition where existing levees would not fail prior to overtopping, average water surface elevation (WSE) is expected to decrease at the upstream end and slightly decrease to no change at the downstream end of proposed project area. A portion of the Homol'ovi I Pueblo footprint is currently within the existing baseline 1% ACE floodplain; Alternative 1.1 would not result in an increase of flooding. Average flow velocity is expected to increase at the upstream end to minimal change at downstream end. Compared to a second less likely baseline condition scenario assuming the probability of unsatisfactory levee performance, average WSE is expected to decrease at the upstream end and slightly increase at the downstream end. Average flow velocity is expected to increase at the upstream end and slightly increase at the downstream end. Base flow characteristics would not substantially change in a manner that would result in substantial erosion or sediment deposition on or off-site compared to baseline conditions. Exposure of people or structures to risk of loss, injury, or death involving flooding would be decreased. Impacts would be less than significant. ***O&M Impacts*:** Temporary impacts from operational and repair activities. Impacts would be less than significant.	***Construction Impacts*:** Impacts would be similar to Alternative 1.1. Levee system would convey flows of up to the 1% ACE flood (69,200 cfs) with 90% assurance, reducing the risk of levee failure and flooding to the city of Winslow and surrounding communities, which would be a benefit to public safety. When compared to the first baseline condition scenario, average WSE is expected to decrease through the proposed project area. The floodplain for the 1% ACE flood does inundate the Homol'ovi I Pueblo area; however, average water surface elevations in this area is expected to decrease by about 0.7 feet. Average flow velocity is expected to increase at the upstream end, slightly decrease from the BNSF Railroad Bridge to the I-40 Bridge, and change little downstream of this point to the end of the project reach. Compared to the second baseline condition scenario, average WSE is expected to decrease at the upstream end and slightly decrease in the downstream portion of the proposed project area. Average flow velocity is expected to increase at the upstream end with minimal to no change through the rest of the proposed project area. At the Homol'ovi I Pueblo, average water surface elevation would decrease by about 1.5 feet, which corresponds to about a 15 foot decrease in floodplain extent compared to this baseline condition scenario. Base flow	***Construction Impacts*:** No change within the LCR channel, and thus, no change to base flow characteristics. Implementation of nonstructural measures would reduce the risk of flood damages up to the 1% ACE. Impacts to public safety would be beneficial. Base flow characteristics would not substantially change in a manner that would result in substantial erosion or sediment deposition on or off-site compared to baseline conditions. Exposure of people or structures to risk of loss, injury, or death involving flooding would be decreased. Impacts would be less than significant. ***O&M Impacts*:** Temporary impacts from operational and repair activities. Impacts would be less than significant.	***Construction Impacts:*** Impacts would be similar to Alternative 1.1. Levee system would convey flows of up to the 1% ACE flood (69,200 cfs) with 90% assurance, reducing the risk of levee failure and flooding to the city of Winslow and surrounding communities, which would be a benefit. Comparison to baseline condition scenarios would be the same as Alternative 1.1. Approximately 12 acres of additional floodplain area would be returned to the riverside of the levee as a result of the single levee setback. Impacts would be less than significant. ***O&M Impacts:*** Temporary impacts from operational and repair activities. Impacts would be less than significant.	***Construction Impacts:*** Impacts would be similar to Alternative 1.1 for rebuild of the RWDL. Implementation of nonstructural measures would reduce the risk of flood damages up to the 1% ACE. Impacts to public safety would be beneficial. Base flow characteristics would not substantially change in a manner that would result in substantial erosion or sediment deposition on or off-site compared to baseline conditions. Exposure of people or structures to risk of loss, injury, or death involving flooding would be decreased. Impacts would be less than significant. ***O&M Impacts:*** Temporary impacts from operational and repair activities. Impacts would be less than significant.	***Construction Impacts*:** Impacts would be similar to Alternative 1.1 except that improvements would not occur to the 12,890 northernmost feet of the Winslow Levee. **Alternative 10.2** would not include conveyance improvements under the BNSF Railroad Bridge, while **Alternative 10.4** would include additional conveyance improvements. For all alternatives, approximately 12 acres of additional floodplain area would be returned to the riverside of the levee as a result of the single levee setback. **Alternatives 10** and **10.1** would convey flows of up to the 1% ACE flood (approx. 69,200 cfs) with 90% assurance. When compared to the first and second baseline condition scenario, average WSE and velocity would be the same as Alternative 8. **Alternatives 10.2** would convey flows of up to the 4% ACE flood (approx. 38,310 cfs) with 90% assurance. When comparing to the first baseline condition scenario, WSE would not change except for a slight decrease at the Homolovi I Pueblo. When comparing to the second baseline condition scenario, would result in no change in average WSE through the proposed project area, with a slight increase at the Homolovi I Pueblo. **Alternative 10.3** would convey the 2% ACE flood (approx. 52,020 cfs) with 90% assurance. When compared to the first baseline condition scenario, average WSE would	***Construction Impacts:*** None. ***O&M Impacts*:** The levee system would remain at a higher risk of failure due to levee slope failure, impingement, or piping failure. Temporary impacts from ongoing maintenance and repair performed by the NCFCD and City of Winslow.

Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
		characteristics would not substantially change in a manner that would result in substantial erosion or sediment deposition on or off-site compared to baseline conditions. Exposure of people or structures to risk of loss, injury, or death involving flooding would be decreased. Large levee setbacks along two segments of the Winslow Levee would return approximately 261 acres of floodplain area to the riverside of the levee, which would be a benefit. Impacts would be less than significant. ***O&M Impacts*:** Temporary impacts from operational and repair activities. Impacts would be less than significant.				decrease through the proposed project area; average flow velocity would increase in the upstream reach, then decrease slightly in the downstream reaches. When compared to the second baseline condition scenario, average WSE would decrease with a slight increase at the Homolovi I Pueblo. Average flow velocities would increase at the upstream portion and minimal to no change through the downstream proposed project area. **Alternative 10.4** would convey the 0.5% ACE flood (approx. 90,660 cfs) with 90% assurance, reducing the risk of levee failure. When compared to the first baseline condition scenario, average WSE would decrease through the proposed project area; average flow velocities would increase at the upstream area, with little change from the BNSF Railroad Bridge to the I-40 Bridge, and decrease slightly at the Homol'ovi I Pueblo downstream to end of the project. When compared to the second baseline condition scenario, average WSE would decrease at the upstream portion with a slight increase at the Homolovi I Pueblo. Average flow velocities would increase at the upstream end with minimal to no change in the downstream end of the proposed project area. For **Alternatives 10, 10.1, 10.2, 10.3, and 10.4,** base flow characteristics would not substantially change in a manner that would result in substantial erosion or sediment deposition on or off-site compared to baseline conditions. Exposure of people or structures to risk of loss, injury, or death involving flooding would be decreased. These alternatives would reduce the risk of levee failure, reducing the risk of flooding to the city of Winslow and surrounding communities, which would be a benefit to public safety. Impacts would be less than significant. ***O&M Impacts*:** Temporary impacts from operational and repair activities. Impacts would be less than significant.	
Water Quality	***Construction Impacts***: No impacts to water quality or waters of the U.S. (WoUS) anticipated from construction of nonstructural measures. Localized, temporary turbidity impacts could occur during	***Construction Impacts:*** No impacts to water quality or WoUS anticipated from	***Construction Impacts:*** No impacts to water quality or WoUS anticipated from	***Construction Impacts:*** No impacts to water quality or WoUS anticipated from	***Construction Impacts:*** No impacts to water quality or WoUS anticipated from	***Construction Impacts:*** No impacts to water quality or WoUS anticipated from	***Construction Impacts:*** None. ***O&M Impacts:*** Temporary

Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
	placement and removal of dewatering structures as the substrate and riverbanks are disturbed, following high flows or rain events during and after each construction season. Approximately 300,000 cy of material would be excavated from the floodplain at the BNSF Railroad Bridge, and saltcedar would be cleared from an approximately 96 acre area in the floodplain. Channelization of the river beneath the BNSF Railroad Bridge would require discharge of approximately 10,992 cy of soil cement within WoUS permanently impacting approximately 1.2 acres of WoUS, approximately 0.37% of the WoUS within the study area. There would be no permanent loss of native substrate within the aquatic environment. BMPs and other environmental commitments would be implemented including an erosion control plan to minimize impacts. Impacts would be less than significant. ***O&M Impacts:*** Localized, temporary turbidity impacts from O&M and repair activities. Impacts would be less than significant.	construction of nonstructural measures. Same as Alternative 1.1, except that two levee segments of the Winslow Levee would be setback resulting in the return of approximately 261 acres to the riverside of the LCR flood plain, which would be a benefit. The setback levee segment would be constructed immediately landward with the existing Winslow Levee left temporarily in place to minimize impacts to surface waters. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	construction of nonstructural measures. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	construction of nonstructural measures. Impacts would be similar to Alternative 1.1, except that the setback of a 2,000 foot segment of the Winslow Levee across from Homolovi I would return approximately 12 acres to the LCR floodplain. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	construction of nonstructural measures. Temporary impacts would be the same as Alternative 1.1 for channel work, although overall impacts would be less since rebuild of levee would be limited to the RWDL and no impacts from conveyance improvements would occur. There would be no permanent impacts to WoUS. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	construction of nonstructural measures. Impacts would be similar to Alternative 1.1, except that channel work would not occur at the northernmost 12,890 feet of the Winslow Levee and a setback of a 2,000 foot segment of the Winslow Levee across from Homolovi I would return approximately 12 acres to the LCR floodplain. **Alternative 10.2** would not include conveyance improvements under the BNSF Railroad Bridge, thus less impacts to water quality and WoUS compared to other alternatives. **Alternative 10.4** would include additional conveyance improvements of approximately 345,000 cy of material excavation and 14,000 cy of soil cement discharged into the WoUS, resulting in an approximate 2.9 acres of permanent impacts within WoUS, about 0.88% of WoUS within the study area. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	impacts from ongoing maintenance and repair performed by the NCFCD and City of Winslow.
Groundwater	***Construction Impacts:*** No impacts to groundwater from construction of nonstructural measures. Depending on the location, groundwater could be encountered during channel work, therefore, dewatering activities may be required. During dewatering activities, groundwater encountered would be pumped outside of the work limits and would be likely released back into the LCR downstream, avoiding depletion of groundwater levels. Alternative 1.1 would not substantially reduce the ability to recharge the underlying aquifer, or cause substantial groundwater contamination or substantial groundwater depletion. Groundwater levels would return to pre-project conditions after project completion. Impacts would be less than significant. ***O&M Impacts:*** Impacts associated with O&M and repair activities would be short term and temporary. Impacts would be less than significant.	***Construction Impacts:*** Same as Alternative 1.1, except that two levee segments of the Winslow Levee would be setback resulting in the return of approximately 261 acres to the riverside of the LCR flood plain, which would be a benefit. Impacts to groundwater would be short-term and localized. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** No impacts to groundwater anticipated from construction of nonstructural measures. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Same as Alternative 1.1, except that the setback of a 2,000 foot segment of the Winslow Levee across from Homolovi I would return approximately 12 acres to the LCR floodplain. Impacts to groundwater would be short-term and localized. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** No impacts to groundwater anticipated from construction of nonstructural measures. Temporary impacts would be the same as Alternative 1.1 for channel work, although overall impacts would be less since rebuild of levee would be limited to the RWDL and no impacts from conveyance improvements would occur. Impacts to groundwater would be short-term and localized. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** No impacts to groundwater anticipated from construction of nonstructural measures. Impacts would be similar to Alternative 1.1, except that channel work would not occur at the northernmost 12,890 feet of the Winslow Levee and a setback of a 2,000 foot segment of the Winslow Levee across from Homolovi I would return approximately 12 acres to the LCR floodplain. **Alternative 10.2** would not include conveyance improvements under the BNSF Railroad Bridge, thus less impacts to groundwater compared to other alternatives. **Alternative 10.4** would include additional conveyance improvements, thus dewatering may be required over a larger area compared to other alternatives. Impacts to groundwater would be short-term and localized. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Temporary impacts from ongoing maintenance and repair performed by the NCFCD and City of Winslow.

Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
Biological Resources	***Construction Impacts:*** **Vegetation -** No impacts to vegetation from construction of nonstructural measures. Temporary and permanent impacts to low quality vegetation. A total of 221 acres of vegetation (mostly non-native vegetation and some native weed species) would be impacted or removed during construction. Of this, about 96 acres would be removed from new levee construction, the widened levee base on the landside of the reconstructed levees, and maintenance of the 15-foot corridor adjacent to the levee toe to comply with Corps policy. About 26 acres of uplands and channel area would be impacted by conveyance improvements at the BNSF Railroad Bridge and 96 acres of saltcedar would be removed. Flexible and/or low growing vegetation would be allowed to reestablish within the conveyance improvement area underneath the BNSF Railroad Bridge. Up to about 263.8 acres could be temporarily impacted at the proposed borrow and disposal sites. All other impacts, including use of the staging, stockpiling, and access areas would be temporary. Impacts would not result in a substantial loss to native riparian vegetation or change in native habitat structure because the vast majority of the vegetation currently existing are non-native or weedy species. Temporary impacted areas would be reseeded and/or revegetated with native plantings. Impacts would be less than significant. **Wildlife -** No impacts to wildlife from construction of nonstructural measures. Brief disturbance during the reconstruction of the levees. These effects would be temporary and mobile wildlife would leave the area upon initiation of construction activities. Vegetation is very abundant within the study area, wildlife would be able to find other areas of similar habitat. Turbidity impacts to fish would be minimal. BMPs would be implemented to minimize impacts. Impacts would be less than significant. **Special Status Species -** No impacts to special status species from construction of nonstructural measures. Potential turbidity impacts to the flannelmouth sucker, a federally-listed species of special concern, would be minimal and temporary. BMPs would be implemented to minimize impacts. After completion of conveyance improvements, channel bottom would be replaced with native material that is characteristic for the LCR. The federally-listed yellow-billed cuckoo and southwestern willow flycatcher is not known to be present within the proposed project area; however, surveys would be conducted in suitable habitat prior to construction to confirm the presence/absence of these species. If either species is detected within the project area, measures would be applied to avoid effects to the species. Impacts would be less than significant. ***O&M Impacts:*** Vegetation and wildlife impacts would be short term and temporary. BMPs would be implemented during any type of O&M channel work to reduce negative impacts to the flannelmouth sucker. Surveys for the yellow-billed cuckoo and southwestern willow flycatcher would be conducted in suitable habitat prior to any activity to determine their presence within the O&M work areas. Although unlikely, if yellow-billed cuckoo or southwestern willow flycatcher are detected within the project area, BMPs would be applied to avoid effects to the species. Impacts would be less than significant.	***Construction Impacts:*** **Vegetation -** Impacts would be similar to Alternative 1.1, except that setback levees would permanently remove about 26.9 acres of vegetation and the removal of the existing segments would restore approx. 221.6 acres to the active LCR floodplain, which would be a benefit. Impacts would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts would be less than significant. **Wildlife -** Impacts would be similar to Alternative 1.1. Impacts would be less than significant. **Special Status Species -** Impacts would be similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** **Vegetation -** No impacts to vegetation anticipated from construction of nonstructural measures. **Wildlife -** No impacts to wildlife anticipated from construction of nonstructural measures. **Special Status Species -** No impacts to special status species anticipated from construction of nonstructural measures. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** **Vegetation -** Impacts would be similar to Alternative 1.1, except that setback levees would permanently remove about 3.3 acres of vegetation and the removal of the existing segments would restore approx. 12 acres to the active LCR floodplain, which would be a benefit. Impacts would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts would be less than significant. **Wildlife -** Impacts would be similar to Alternative 1.1. Impacts would be less than significant. **Special Status Species -** Impacts would be similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** **Vegetation -** No impacts to vegetation anticipated from construction of nonstructural measures. Impacts associated with rebuild of RWDL would be the same as Alternative 1.1, although overall impacts would be less since rebuild of levee would be limited to the RWDL and no impacts from conveyance improvements would occur. Impacts would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts would be less than significant. **Wildlife -** No impacts to wildlife anticipated from construction of nonstructural measures. Impacts associated with rebuilt of RWDL would be similar to Alternative 1.1, although overall impacts would be less since rebuild of levee would be limited to the RWDL and no impacts from conveyance improvements would occur. Impacts would be less than significant. **Special Status Species -** No impacts to special status species anticipated from construction of nonstructural measures. Impacts associated with rebuilt of RWDL would be similar to Alternative 1.1, although overall impacts would be less since rebuild of levee would be limited to the RWDL and no impacts from conveyance improvements would occur. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** **Vegetation -** For all alternatives, no impacts to vegetation anticipated from construction of nonstructural measures. Impacts would be similar to Alternative 1.1, except that setback levees would permanently remove about 3.3 acres of vegetation and the removal of the existing segments would restore approx. 12 acres to the active LCR floodplain, which would be a benefit. Additionally, channel work would not occur at the northernmost 12,890 feet of the Winslow Levee, thus less vegetation would be impacted compared to Alternative 1.1. **Alternative 10.2** would result in less impacts due to no conveyance improvements. **Alternative 10.4** would result in additional impacts due to additional conveyance improvements. Impacts would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts would be less than significant. **Wildlife -** Impacts would be similar to Alternative 1.1, except that Alternative 10.4 could result in additional turbidity impacts due to the additional conveyance improvements. Implementation of BMPs would minimize impacts. Impacts would be less than significant. **Special Status Species -** Impacts would be similar to Alternative 1.1 except that Alternative 10.4 could result in additional turbidity impacts due to the additional conveyance improvements, which could affect the flannelmouth sucker. Implementation of BMPs would minimize impacts. Impacts would be less than significant. ***O&M Impacts:*** Impacts would be similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Temporary impacts from ongoing maintenance and repair performed by the NCFCD and City of Winslow.

Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
Cultural Resources	***Construction Impacts:*** May result in an adverse effect to historic properties due to the impacts to the potentially eligible historic era barn and corral; however, full demolition of these structures is not anticipated. If one or more structures are determined to be eligible for the NRHP and if impacts cannot be avoided or minimized, then this alternative would result in an adverse effect under NHPA and a significant impact under NEPA. However, impacts are expected to be avoided through design refinements. Hydraulic analysis of potential flooding impacts to Homolovi I Pueblo indicated that when compared to the first most likely baseline condition scenario where the existing levees would not fail prior to overtopping, WSE would not be significantly altered and flooding would not be increased. When compared the second, less likely baseline condition scenario, WSE and flooding extent would slightly increase. However, this scenario is highly unlikely, therefore it is not reasonably foreseeable there would be an adverse effect or significant impact to Homolovi I Pueblo. ***O&M Impacts:*** O&M and repair activities would not result in an adverse effect under NHPA or a significant impact under NEPA. A Programmatic Agreement was executed in consultation with the SHPO and Affected Tribes that lays out the process for determining the long term management for those properties. Such protections may include conservation easements or the designation of avoidance areas for future O&M activities.	***Construction Impacts:*** Impacts would be similar to Alternative 1.1. Construction of the setback levees would result in an adverse effect to at least one prehistoric archaeological site. Would require removal of several structures. If one or more structures are determined to be eligible for the NRHP and if they cannot be avoided then the project would result in an adverse effect under NHPA and a significant impact under NEPA. Hydraulic analysis of potential flooding impacts to Homolovi I Pueblo indicated that when compared to the first most likely baseline condition scenario, WSE is expected to decrease by about 2.2 feet. When compared the second less likely baseline condition scenario, WSE would decrease by about 1.5 feet, which corresponds to about a 15-foot decrease in floodplain extent. Impacts to Homolovi I Pueblo would be less than significant. ***O&M Impacts***: Same as Alternative 1.1.	***Construction Impacts:*** No adverse effect to historic properties; impacts would be less than significant. ***O&M Impacts:*** Same as Alternative 1.1.	***Construction Impacts***: Impacts would be similar to Alternative 1.1. May require the removal of structures located within the levee alignment and setback area. If these structures are determined to be eligible for the NRHP and if they cannot be avoided then the project would result in an adverse effect under NHPA and a significant impact under NEPA. Potential flooding impacts at Homolovi I Pueblo would be the same as Alternative 1.1. ***O&M Impacts:*** Same as Alternative 1.1.	***Construction Impacts:*** No adverse effect to historic properties; impacts would be less than significant. ***O&M Impacts:*** Same as Alternative 1.1.	***Construction Impacts***: Impacts would be similar to Alternative 1.1. May require the removal of one or more structures located within the levee alignment and setback area. If these structures are determined to be eligible for the NRHP and if they cannot be avoided then the alternative would result in an adverse effect under NHPA and a significant impact under NEPA. For **Alternatives 10 and 10.1**, hydraulic analysis indicated that when compared to the first and second baseline condition scenario, average WSE and velocity would be the same as Alternative 8 at Homolovi I Pueblo. For **Alternatives 10.2,** when comparing to the first baseline condition scenario, there would be a slight decrease in WSE at the Homolovi I Pueblo. When comparing to the second baseline condition scenario, there would be a slight increase at the Homolovi I Pueblo. For **Alternative 10.3**, when compared to the first baseline condition scenario, average WSE would decrease at the Homolovi I Pueblo. When compared to the second baseline condition scenario, average WSE would slightly increase at the Homolovi I Pueblo. For **Alternative 10.4**, when compared to the first baseline condition scenario, average WSE would slightly decrease at the Homolovi I Pueblo. When compared to the second baseline condition scenario, average WSE would slightly increase at the Homolovi I Pueblo. None of the alternatives are expected to result in an adverse effect or significant impact to Homolovi I Pueblo. ***O&M Impacts:*** Same as Alternative 1.1.	***Construction Impacts:*** None. ***O&M Impacts:*** No change.

Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
Air Quality	***Construction Impacts:*** Annual emissions for all criteria air pollutants would be less than the General Conformity de minimis rates. Impacts to air quality would be temporary and less than significant. ***O&M Impacts:*** The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity de minimis rates. Impacts to air quality would be less than significant.	***Construction Impacts:*** Annual emissions for all criteria air pollutants would be less than the General Conformity de minimis rates. Impacts to air quality would be temporary and less than significant. ***O&M Impacts:*** The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity de minimis rates. Impacts to air quality would be less than significant.	***Construction Impacts:*** Annual emissions for all criteria air pollutants would be less than the General Conformity de minimis rates. Impacts to air quality would be temporary and less than significant. ***O&M Impacts:*** The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity de minimis rates. Impacts to air quality would be less than significant.	***Construction Impacts:*** Annual emissions for all criteria air pollutants would be less than the General Conformity de minimis rates. Impacts to air quality would be temporary and less than significant. ***O&M Impacts:*** The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity de minimis rates. Impacts to air quality would be less than significant.	***Construction Impacts:*** Annual emissions for all criteria air pollutants would be less than the General Conformity de minimis rates. Impacts to air quality would be temporary and less than significant. ***O&M Impacts:*** The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity de minimis rates. Impacts to air quality would be less than significant.	***Construction Impacts:*** Annual emissions for all criteria air pollutants would be less than the General Conformity de minimis rates. Impacts to air quality would be temporary and less than significant. ***O&M Impacts:*** The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity de minimis rates. Impacts to air quality would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** The extent and intensity of O&M and repair activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity de minimis rates. Impacts to air quality would be less than significant.
Traffic	***Construction Impacts:*** Localized, temporary increase in AADTs for affected roadways from on and off-road vehicles and equipment. Impacts would be less than significant. ***O&M Impacts:*** Truck trips generated during implementation of O&M and repair activities would not permanently increase AADTs. The number of equipment and vehicles would be limited and less compared to those identified for construction. Traffic related impacts due to O&M and repair activities would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.
Noise	***Construction Impacts:*** Short-term, temporary adverse noise impacts from construction. Noise source would be mobile, not remaining within a particular area for extensive periods of time. Environmental commitment to install temporary sound walls next to residential areas, where necessary, for noise protection purposes, would reduce noise impacts from construction related activities. Would not contribute to long term, permanent impacts to sensitive receptors. Noise levels would return to pre-project levels upon completion of construction. Impacts would be less than significant. ***O&M Impacts:*** May temporarily elevate noise levels due to equipment and vehicle use. Potential noise impacts would be short-term and localized to repair sites. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.
Aesthetics	***Construction Impacts:*** Localized, temporary impacts to aesthetics from construction. Would not substantially change the vista. Environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, impacts would be further reduced. Impacts would be less than significant. ***O&M Impacts:*** Temporary and insignificant impacts to the vista. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1, except that setback levees would change the views for residents of the open desert environment to a closer view of the Winslow Levee. However, the setback levee would not result in a substantial change in the character of the open space viewshed remaining to the north and east since views to these areas would remain unaltered by Alternative 3.1. Environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, impacts would be further reduced.	**Construction Impacts:** Localized, temporary impacts to aesthetics from construction of nonstructural measures. Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.	**Construction Impacts:** Similar to Alternative 1.1, except that setback levee would change views slightly for residences, similar to Alternative 3.1, but to a lesser degree. The setback levee would not result in a substantial change in the character of the open space viewshed remaining to the north and east since views to these areas would remain unaltered by Alternative 8. Environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, impacts would be further reduced. Impacts would be less than	***Construction Impacts:*** Similar to Alternative 7. Impacts associated with rebuild of the RWDL would be similar to Alternative 1.1, but to a lesser degree. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.

Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
		Impacts would be less than significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.		significant. **O&M Impacts:** Similar to Alternative 1.1. Impacts would be less than significant.			
Land Use	***Construction Impacts:*** The rebuilt and newly built Winslow Levee and rebuild of the RWDL would occupy the same general footprint as the existing levee. Additional easements would be obtained by Navajo County to accommodate the additional area needed for the widened levee base along most of the alignment. The new levee parallel to I-40 would permanently remove approximately 11 acres of county lands designated as open space. Conveyance improvements would also entail removal and long term management of approximately 96 acres of saltcedar. The improved flood risk management system would be a benefit to land use as it would effectively remove approximately 2,700 properties and 1,600 structures from the FEMA 100-year floodplain (1% ACE flood event), and support the existing and planned uses within the community. There would be no substantial change or substantial incompatibilities with land uses; impacts to land uses would be less than significant. ***O&M Impacts:*** Short-term, temporary, and limited to specific sites. Would not result in changes in land use designations or existing uses once complete. Therefore, impacts to land use resulting from O&M and repair activities would be less than significant.	***Construction Impacts:*** Alternative 3.1 would substantially conflict with existing and planned uses because it would convert such a substantial percentage of rural residential and commercial land to other uses, resulting in substantial incompatibilities with planned uses. Approximately 8 residences on the riverside of the levee would require relocation. The improved flood risk management system would be a benefit to land use as it would effectively remove approximately 2,700 properties and 1,600 structures from the FEMA 100-year floodplain (1% ACE flood event), and support the existing and planned uses within the community. Property acquisitions required for the new setback levees would be conducted in compliance with Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Impacts to land use would be significant. ***O&M Impacts:*** Short-term, temporary, and limited to specific sites. Would not result in changes in land use designations or existing uses once complete. Therefore, impacts to land use resulting from O&M and repair activities would be less than significant.	***Construction Impacts:*** Designated land uses would remain unchanged. There would be no permanent loss of developed land or substantial changes or incompatibilities to the existing or planned land uses. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Impacts would be similar to Alternative 1.1, except that the setback component of Alternative 8 would impact 2 properties, totaling 12 acres, which would return to the active LCR flood plain. Although not anticipated, one permanent, physical residential relocation may be required as a result of the setback levee alignment. Would not result in a substantial change or cause substantial incompatibilities with lands uses; impacts to land uses would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Impacts from construction of nonstructural measures would be the same as Alternative 7. Impacts associated with rebuild of the RWDL would be similar to Alternative 1.1. Would not result in a substantial change or cause substantial incompatibilities with existing or planned uses. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Impacts would be similar to Alternative 1.1, except that channel work would not occur at the northernmost 12,890 feet of the Winslow Levee, and the levee setback would impact 2 properties, totaling 12 acres, which would return to the active LCR flood plain. Although not anticipated, one permanent, physical residential relocation may be required as a result of the setback levee alignment. There are no additional land use impacts anticipated from the additional excavation under **Alternative 10.4**. **Alternative 10.2** does not include any conveyance improvements under the BNSF Railroad Bridge, so no impacts would occur in that area. **Alternative 10** impacts from nonstructural measures would be similar to Alternative 7. Would not result in a substantial change or cause substantial incompatibilities with lands uses; impacts to land uses would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.
Socioeconomics	***Construction Impacts:*** Seasonal employment within the construction industry over the construction period. Would not likely require new permanent housing. Temporary benefit to local and regional supplies from purchase and delivery of construction materials. Long term beneficial effects due to the reduced risk of flooding and flood damages. Overall, impacts to socioeconomics would be beneficial; impacts would be less than significant. ***O&M Impacts:*** O&M activities would not have the potential to result in substantial shifts in population, housing, or employment. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Overall, impacts to socioeconomics would be beneficial; impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Overall, impacts to socioeconomics would be beneficial; impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Overall, impacts to socioeconomics would be beneficial; impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Overall, impacts to socioeconomics would be beneficial; impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Overall, impacts to socioeconomics would be beneficial; impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None.***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.

Table 5-1 Summary of Environmental Impacts

Resource Area	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternatives 10, 10.1, 10.2, 10.3, 10.4	Alternative 11 No Action Alternative
Environmental Justice	***Construction Impacts:*** Potential temporary impacts from traffic increases during construction. Long term beneficial effect from reduced risk of flooding and flood damages. Impacts would be less than significant. **O&M Impacts:** O&M would not impact recreation, traffic, utilities or public services and would provide equal protection to everyone who uses these resources adjacent to the levees. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.
Recreation	***Construction Impacts:*** Impacts are not anticipated; however, upon project completion, any impacts to recreation would be short-term, less than significant, localized, and return to pre-project conditions. ***O&M Impacts:*** Although impacts are not anticipated, any impacts to recreation would be short-term, localized, and return to pre-project conditions.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.
Utilities and Public Safety Service	***Construction Impacts:*** A small number of utilities may require relocation or replacement. Potential impacts to utilities and public safety services would be minimal and temporary, or beneficial. Impacts would be less than significant. ***O&M Impacts:*** Potential impacts would be temporary and relatively minor; impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Potential temporary impacts from construction of nonstructural measures. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 7. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1, but less since reconstruction of the Winslow Levee would not include the northmost 12,890 feet. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.
Hazardous Materials	***Construction Impacts:*** Possibility for long-term exposure of humans, wildlife, wildlife habitat or the general environment to hazardous materials or acute or public health hazard through the release of hazardous materials into the environment of the LCR at Winslow proposed project site is low. Impacts would be avoided and/or minimized by implementing safety standards and BMPs. Impacts due to hazardous materials would be less than significant. ***O&M Impacts:*** Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1 for rebuild of the RWDL. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.	***Construction Impacts:*** None. ***O&M Impacts:*** Similar to Alternative 1.1. Impacts would be less than significant.

5.1. Geology and Soils

5.1.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative results in:

- Substantial discharge of non-native material into the Little Colorado River
- Substantial erosion of soils from the project area

5.1.2. Alternatives 1.1 and 8

Nonstructural Measures
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system, which would consist of two distinct parts: a flood detection network (including a communication system) and an emergency response/evacuation plan. Installation of a flood warning system would not result in impacts to geology or soils since nonstructural measures would not entail discharge of materials nor actions that could result in erosion.

Channel Work
The rebuild of the levees would not widen the footprint of the existing structure riverward (only landward, if needed). Levee segments located away from the active channel would be removed and rebuilt in place. In contrast, under Alternatives 8, sections of the existing Winslow Levee where the LCR forms impingement points would be temporarily left in place while a new segment is constructed immediately landward. Upon completion of the new segment, the existing segment would be removed via excavators. Although the construction of the new levee and reconstruction of the existing levees would not widen the footprint of the existing structure riverward, there would be a 75-foot-wide zone used as a construction corridor. The levees would be rebuilt at a scale that provides a 90 percent assurance of containing the one percent ACE flood event.. The total length of the new and reconstructed levees would be 35,694 feet.

Pre-construction activities would include tasks such as clearing and grubbing, cutting vegetation, and grading. Clearing activities may require the use of a loader or bulldozer or other equipment to scrape the top soil. However, the loss of topsoil would be temporary, since future flows through the project area would replace topsoil removed during the clearing and grubbing operations. Subsequent to clearing activities, construction would require excavation at a maximum depth of approximately 20 feet deep below existing ground elevation, an approximate maximum 75-foot-wide trench, and a maximum total width of approximately 270 feet along the length of the levee. The excavated material would be temporarily stored in staging area(s) and/or disposal area(s) during construction. Upon completion of construction, the trench would be backfilled with previously excavated native material.

These alternatives include channelization and saltcedar removal to improve conveyance under the BNSF Railroad Bridge. Material would be excavated from the channel through the area of the BNSF Railroad Bridge. The channel slopes would be armored with soil cement and the channel bottom would remain earthened with native soils. Areas removed of saltcedar would be replanted with native species.

There could be some loss of unconsolidated substrate during initial storm flows following construction. This impact would lessen as vegetation is reestablished throughout the project reach through planting and natural recruitment. The establishment of root structures in the topsoil would minimize erosion. Therefore, there would not be a long-term change to the native substrate. After project completion, the substrate would return to pre-project conditions. Based on the above, impacts to geology and soils from channel work would be less than significant.

Borrow and Disposal Work

Alternatives 1.1 and 8 would recycle material from the existing levees for new construction. The existing levees were built with native substrate excavated from the LCR floodplain. Additional materials would come from riverine or upland borrow areas, described in Chapter 3.0, that are similar in nature and composition to the native substrate of the existing levees material. However, existing vegetation at the riverine borrow sites are dominated with weeds and saltcedar. The McCauley Properties upland borrow site is located on an active site currently mined for materials and is sparsely populated with mostly weeds. The other potential upland borrow site is the O'Haco Northwest pit site, located on a former borrow site that was previously mined for borrow materials and is sparsely populated with mostly weeds. The City of Winslow borrow site would be located on an area used for grazing and row crop irrigation. Vegetation here is sparse and consists mostly of weedy species.

Stone for riprap and launch stone would come from the nearest source of suitable quality stone located at Indian Wells, Arizona, approximately 43 miles northwest of Winslow levee (a 55-mile one-way haul distance along existing roads).

Under Alternative 1.1 and 8, approximately 263.8 acres (259.9 acres under Alternative 8) at a maximum to 105.6 acres (103.9 acres under Alternative 8) at a minimum of excavated material (depending on fill depth), totaling approximately 266,977 cy (approximately 265,388 cy under Alternative 8) would permanently raise the elevation of a portion of the disposal sites by approximately 30 inches at a maximum to approximately 12 inches at a minimum.

The rebuild would reuse the existing substrate to the maximum extent practicable. Approximately 50 percent of the excavated material under BNSF Bridge would be reused for the rebuild. Based on field observations of the levee surface, the Corps anticipates that approximately 80 percent of the material moved for the project (river excavation and levee demolition) could be reused for new levee construction. The remaining material needed would come from sediment excavated from the LCR around the BNSF Railroad Bridge traversing the LCR or from borrow areas in the LCR floodplain, including the riverine dust dune. Upland borrow areas are also available, as needed, and borrow material would be native substrate. Therefore, Alternatives 1.1 and 8 would utilize native substrate that is expected to be free of contaminants and suitable for reuse. Use of these borrow sites would not lead to substantial

erosion above natural conditions. Flows from the LCR would be expected to regularly transport and deposit sediment within the floodplain areas including the riverine borrow sites. Disturbed areas would be reseeded and/or revegetated to minimize exposed soil. The establishment of root structures in the topsoil would minimize erosion. Any excess excavated materials could be placed at McCauley, Winslow, or the O'Haco sites. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Therefore, based on the above, impacts to geology and soils from borrow and disposal work would be less than significant.

Staging, Stockpiling, and Access

Construction equipment is proposed to be staged at specified locations along the project construction corridor. Four of these sites are located on the same properties used as disposal areas (O'Haco North, O'Haco Middle, O'Haco South, and City of Winslow). A batch plant would be located at the City of Winslow staging area. This plant would provide the concrete and grout needed for installation of soil cement and grouted stone, respectively. The other four sites are vacant with disturbed vegetation. The Pugh staging area is located on the riverside of the levee. The substrate within the staging areas are similar to the native substrate of the existing levee material. Some of staging areas have saltcedar and weeds.

Typical equipment to be used during the construction period include loaders, scrapers, dozers, trucks, blades, roller compactors, a soil-cement batch plant, concrete mixers, water trucks, and backhoes. Construction equipment would generally be operated 10 hours a day, six days a week. If acceleration of work is required to ensure flood control the daily work schedule may be extended.

The staging, stockpiling, and access areas would temporarily impact substrate but impacts would be short-term and minor. Existing floodplain soils may not support the weight of construction equipment or vehicles. Soil enhancements may be required in addition to dewatering to provide access for equipment and vehicles. Soil enhancements would entail mixing soil with gravel, soil cement, clay, or silt as appropriate to better harden or bind the soil. Any soil enhancements required for removal would be removed after completion of construction. Based on the above, impacts to substrate from staging, stockpiling and access would be less than significant.

Operations and Maintenance

The Navajo County Flood Control District is responsible for maintenance of the proposed project. In order to determine the need for specific maintenance items, routine inspections should be conducted twice each year and after any significant flooding. The inspection crew would consist of two laborers with a pickup truck. It is estimated that these inspections would require a maximum of four days per year. Each inspection would include a written report summarizing findings and recommending repairs that would correct any problems. As described in Chapter 4.0, maintenance would include vegetation control, rodent control, levee and interior drainage structures repair, sediment removal under the BNSF Railroad Bridge, and survey river cross sections.

The O&M repair work discussed above would require use of relatively small amounts of native materials and would typically occur for a short period of time, when needed. Work would also include removal of vegetation and debris that exists on and around the levees and the BNSF Railroad Bridge, and the removal of small mammal burrows from the earthen levee embankment. Herbicides or rodenticides may be applied as needed in a manner that avoids impacts to non-target species. Substrate material needs for O&M repairs would come from sediment excavated from the LCR, around the BNSF Railroad Bridge traversing the LCR, or from borrow area in the LCR floodplain. Upland borrow areas are also available. The substrate is expected to be free of contaminants and suitable for reuse. Potential for erosion and loss of topsoil would be low. Therefore, based on the above, impacts to geology and soils would be less than significant.

Effects Determinations Summary

For all activities, substrate levels would return to pre-project levels upon completion of project, and there would not be a significant discharge of non-native material into the LCR. Based on the above, impacts to geology and soils would be less than significant.

5.1.3. Alternative 3.1

Nonstructural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work

Conveyance improvements at the BNSF Railroad Bridge and saltcedar removal would result in impacts similar to those characterized under Alternative 1.1 and 8. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternative 1.1 and 8. Unlike Alternative 1.1 and 8, the footprint of the two setback levees would permanently remove 26.9 acres of vegetation including removal of a minimal amount of native substrate. Existing vegetation in this area is primarily weeds. By removing some of the Winslow Levee segments, approximately 221.6 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area following construction. The levees would be rebuilt at a scale that provides a 90 percent assurance of containing the one percent ACE flood event. Under Alternative 3.1, a total of 6.46 miles (34,440 feet) of new or rebuilt levee would occur. The 75-foot construction corridor equals approximately 58.8 acres of existing vegetation removal and a minimal amount of native substrate removal.

Reconstruction of the Winslow Levee and RWDL, setback work, and the conveyance improvements at the BNSF Railroad Bridge would result in substrate impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Borrow and Disposal Work

Borrow and disposal levee construction work and locations would by similar to Alternatives 1.1 and 8, except that the City of Winslow disposal site would not be used.

Stone for riprap and launch stone would come from the nearest source of suitable quality stone located at Indian Wells, Arizona, approximately 43 miles northwest of Winslow levee (a 55-mile one-way haul distance along existing roads).

Potential impacts from borrow material excavation and placement would be similar to Alternatives 1.1 and 8.
Approximately 226 acres at a maximum to 90.4 acres at a minimum of excavated material (depending on fill depth), totaling approximately 255,027 cy would permanently raise the elevation of a portion of the disposal sites by approximately 30 inches at a maximum to approximately 12 inches at a minimum. The excavated sediment would be placed in open spaces or grazing areas similar to the existing native substrate in disposal areas, avoiding agricultural or aggregate processing areas. Based on the above, impacts would be less than significant.

Staging, Stockpiling, and Access
Staging areas would be similar as described for Alternative 1.1 and 8, except that the City of Winslow staging area would not be used. The batch plant proposed for the City of Winslow site would be relocated to property adjacent to the ADOT I-4 hydraulic gate right-of-way. Therefore, based on the above, impacts would be less than significant.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Based on the above, impacts would be less than significant.

Effects Determinations Summary
For all activities, substrate levels would return to pre-project levels upon completion of project, and there would not be a significant discharge of non-native material into the LCR. Based on the above, impacts to geology and soils would be less than significant.

5.1.4. Alternatives 7 and 9

Nonstructural Measures
Elevating residences would not require use of substrate from the LCR floodplain or the BNFS Railroad Bridge. Installation of a flood warning system would not require additional substrate. Therefore, there would be no impacts to the substrate from implementation of nonstructural measures.

Channel Work
Alternative 7 does not include any channel work. Under Alternative 9, a total of 0.44 miles (2,000 feet) of rebuilt levee would occur. The 25-foot construction corridor on the riverward side of the levee equals approximately 3.9 acres of existing vegetation removal that would include removal of a minimal amount of native substrate. Reconstruction of the RWDL for Alternative 9 would result in geology and soils impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Borrow and Disposal Work
Alternative 7 does not include any borrow or disposal work. For Alternative 9, borrow and disposal and levee construction work would be similar to Alternatives 1.1 and 8, except that it would only include the McCauley Properties.

Stone for riprap and launch stone would come from the nearest source of suitable quality stone located at Indian Wells, Arizona, approximately 43 miles northwest of Winslow levee (a 55-mile one-way haul distance along existing roads).

Potential impacts from borrow material excavation and placement also would be similar to Alternatives 1.1 and 8.

Approximately 0.30 acres at a maximum to 0.12 acres at a minimum of excavated material (depending on fill depth), totaling approximately 6,022 cy would permanently raise the elevation of a portion of the disposal sites by approximately 30 inches at a maximum to approximately 12 inches at a minimum. The sediment would be placed in open spaces or grazing areas similar to the existing native substrate in disposal areas, avoiding agricultural or aggregate processing areas. Based on the above, impacts would be less than significant.

Staging, Stockpiling, and Access
Alternative 7 does not include any work in staging, stockpiling, or access areas. Due to smaller levee reconstruction footprint, Alternative 9 would require only two staging areas. These consist of the sites on the Bolle Klaus Jurgen Rainer Trustee site and the nearby property owned by the Navajo Tribe. Potential impacts would be as described for Alternatives 1.1 and 8. Impacts would be temporary and less than significant.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Based on the above, impacts would be less than significant.

Effects Determinations Summary
For all activities, substrate conditions would return to pre-project conditions upon completion of project, and there would not be a significant discharge of non-native material into the LCR. Based on the above, impacts to geology and soils would be less than significant.

5.1.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures
Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8. Alternative 10 would also include elevation of residences, and impacts would be similar to those described for Alternatives 7 and 9.

Channel Work
Conveyance improvements at the BNSF Railroad Bridge would result in impacts similar to those characterized under Alternatives 1.1 and 8. Although Alternative 10.4 includes additional channelization, the impacts would be similar overall and insignificant. Since Alternative 10.2 would not include any channelization improvements under the BNSF Railroad Bridge, no

impacts would occur in that area. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternatives 1.1 and 8, but since under Alternative 10, 10.1, 10.2, 10.3, and 10.4, a total of 4.46 miles (22,552 ft.) of new or rebuilt levee would occur, impacts would be even less than Alternatives 1.1 and 8. The 25-foot construction corridor on the riverward side of the levee equals approximately 13.6 acres of existing vegetation removal. Unlike Alternative 1.1 and similar to Alternative 8, the footprint of the single setback levee would permanently remove 3.3 acres of vegetation that would include minimal removal of substrate. Existing vegetation in this area is primarily weeds. By removing some of the existing Winslow Levee segments (approximately 0.3 miles), approximately 9.9 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area following construction. Therefore, impacts to substrate would be short-term and localized. Substrate conditions would return to pre-project levels upon completion of project, and there would not be a significant discharge of non-native material into the LCR. Based on the above, impacts to substrate would be less than significant.

Borrow and Disposal Work

Borrow and disposal and levee construction work would be similar to Alternatives 1.1 and 8.

Stone for riprap and launch stone would come from the nearest source of suitable quality stone located at Indian Wells, Arizona, approximately 43 miles northwest of Winslow levee (a 55-mile one-way haul distance along existing roads).

Potential impacts from borrow material excavation and placement also would be similar to Alternatives 1.1 and 8. See Table 5-2 for area needed for excavated material under each alternative.

Table 5-2 Area Needed for Disposal

Alternative	Maximum Area Needed for Disposal (acres)	Minimum Area Needed for Disposal (acres)	Excavated Material (cy)
10	205.5	82.2	223,959
10.1	205.5	82.2	223,959
10.2	93.4	37.3	67,713
10.3	248.9	99.6	223,959
10.4	191.4	76.6	442,703

Under Alternatives 10, 10.1, 10.2, 10.3, and 10.4 project area footprints would generally remain unchanged. The excavated sediment would be placed in open spaces or grazing areas similar to native substrate in disposal areas, avoiding agricultural or aggregate processing areas. Based on the above, impacts would be less than significant.

Staging, Stockpiling, and Access

Locations for staging, stockpiling, and access areas, and the batch plant would be as described for Alternatives 1.1 and 8, except that the O'Haco North and O'Haco Middle sites would not be used. Potential impacts would be as described for Alternatives 1.1 and 8. Impacts would be temporary and insignificant.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Based on the above, impacts would be less than significant.

Effects Determinations Summary
For all activities, substrate conditions would return to pre-project conditions upon completion of project, and there would not be a significant discharge of non-native material into the LCR. Based on the above, impacts to geology and soils would be less than significant.

5.1.6. Alternative 11: No Federal Action Alternative

The Navajo County Flood Control District and the City of Winslow will continue operation and maintenance activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Periodic emergency repairs of the existing bank protection would likely be required. Emergency repairs may include stabilizing weakened sections of the levees during storm events and floods, would be limited in scope and duration, and would likely entail the discharge of rocks and native earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders. Potential impacts to geology and soils would be temporary. The No Federal Action Alternative would have less than significant impact on geology and soils.

5.2. Hydrology and Hydraulics and Public Safety

5.2.1. Significance Threshold

Based on the existing conditions discussed above, impacts to hydrology, hydraulics, and public safety would be considered significant if the alternative results in:

- Substantial change to base flow characteristics such as flow velocity, channel capacity, or channel configuration, in a manner that would result in substantial erosion or sediment deposition on or off-site.
- Greater exposure of people or structures to a significant risk of loss, injury, or death involving flooding.

5.2.2. Alternatives 1.1 and 8

Nonstructural Measures
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system and would not result in impacts to hydrology or hydraulics. Impacts to public safety would be beneficial and less than significant.

Channel Work
Alternatives 1.1 and 8 would entail rebuild of the existing levees by recycling native substrate from the LCR floodplain. In general, rebuilds would retain the approximate configuration and dimension of the existing levees, except the levees would be slightly higher and wider in certain areas. Additionally, material utilized from the floodplain to rebuild the levees would not substantially alter the floodplain. As the active LCR floodplain width varies between 6,000 feet

to 20,500 feet, rebuilds would only convert approximately three percent of the floodplain material to levee material. Relatively little new levee material would be used. Thus, levee rebuilds would not affect runoff rates.

The capacity of the LCR would be expected to change in terms of channel flow conveyance (percent ACE or cfs). As described in Section 4.2, the existing Winslow Levee was designed and built to convey flows up to approximately 65,000 cfs, which was estimated to be the one percent ACE in the 1980s. However, based on an evaluation completed by the Corps in 2010, the one percent ACE was determined to be 69,200 cfs, and based on current levee conditions, the existing levee would overtop at the same location as the 1993 flood at a discharge rate of 55,000 cfs (about a two percent ACE storm event) (see Appendix B - Hydraulics). Further, based on geotechnical analysis conducted for this study, the existing levee system is susceptible to potential failure before overtopping at certain locations for certain levels of flood events. At the most likely failure point with the greatest risk of flooding to the City of Winslow, there is approximately a 16 percent chance of failure at a water surface elevation that corresponds with about the four percent ACE event. This probability of failure increases with increases in water surface elevations or lower probability flood events.

Hydraulic analyses conducted for the study evaluated impacts to flow characteristics of each alternative compared to the without-project baseline conditions which included two evaluations: a baseline condition where the existing levees would not fail prior to overtopping and a baseline condition where the existing levees could fail based on the probability of unsatisfactory performance due to levee slope failure, impingement, or piping failure prior to waters overtopping the levee. Construction of Alternative 1.1 or 8 would provide a 90 percent assurance of conveying the one percent ACE flood (about 69,200 cfs), reducing both the risk of levee failure, and the flood risk to the communities in the City of Winslow. However, at the end of the rebuilt Winslow Levee, flows flank the landside of the levee before moving downstream. There are no structures within the affected area, but the floodplain boundary is very close to a few residents and outbuildings. However, a cutoff levee could potentially minimize the flooding in the overbank area upstream from the end of improvements. The need for a cutoff levee or other structure would be evaluated in more detail during the PED phase and included into the detailed design, if needed, to minimize the risk of flooding at this location.

When compared to the baseline condition where the existing levees would not fail prior to overtopping, Alternatives 1.1 and 8 would result in decreased average water surface elevation and increased velocities upstream and through the BNSF Railroad Bridge segment under the design flood (one percent ACE). Downstream of the BNSF Railroad Bridge to the downstream end of the proposed project area, there would be a slight decrease to no change in water surface elevation, and flow velocities would not change significantly. A portion of the Homolovi I Pueblo footprint is currently within the existing baseline one percent ACE floodplain. With Alternatives 1.1 and 8 in place, the floodplain for the one percent ACE flood does inundate the Homolovi I Pueblo area; however, this does not result in an increase of flooding compared to this baseline condition scenario.

In comparison to the baseline condition scenario assuming the probability of unsatisfactory levee performance (i.e., levee failure prior to water overtopping the levee), Alternatives 1.1 and 8

would result in decreased average water surface elevations and increased velocities upstream and through the BNSF Railroad Bridge segment under the design flood (one percent ACE), similar to the first scenario described. Average water surface elevations and velocities downstream of the BNSF Railroad Bridge to the downstream end of the proposed project area would increase slightly. At the Homolovi I Pueblo, average water surface elevation is estimated to increase by less than a foot.

As discussed above, the LCR has adjusted to the effects of extreme floods including a flood event in 1923, and a subsequent decline in peak discharge and mean annual flow by channel narrowing: the channel width and area of the river have decreased by approximately 90 percent (USGS, 2014). Although deposition historically exceeds erosion, lateral migration exacerbates localized erosion, particularly near hydraulic controls (levees). Despite repeated cutoff and avulsion, the LCR has steadily increased in length and sinuosity over a period of 74 years (1936-2010). Changes in temperature and precipitation are likely affecting the discharge of the LCR near and downstream of Winslow. Therefore, in general, natural conditions, such as floods, lateral migration, temperature and precipitation, are primary factors influencing the hydrology and hydraulics of the LCR. The rebuild of the levees would have an impact on hydrology and hydraulics to the effect of containing the median water surface elevation of the one percent ACE plus an additional three feet (69,200 cfs).

Removal of approximately 96 acres of saltcedar near the BNSF Railroad Bridge would reduce channel roughness and increase hydraulic capacity through the study area. Given the LCR channel alignment and configuration upstream and downstream of the BNSF Railroad Bridge, the reduction in channel roughness would be expected to increase localized erosion and sediment deposition in the vicinity of the BNSF Railroad Bridge during each storm event. The existing baseline sediment trends through this area is of an overall accretion of sediment. However, Alternative 1.1 and 8 would not increase sediment deposition compared to existing conditions.

Riverward vegetation would also be removed within the construction corridor. There could be some loss of unconsolidated substrate during initial storm flows following construction. This impact of substrate loss would lessen as vegetation is reestablished within the temporary disturbed areas throughout the project reach through natural recruitment of native species. Additionally, the area of saltcedar removal would be reseeded or replanted with flexible and/or low-growing native plants. Use of flexible and/or low-growing native plants would not reduce conveyance through this area. The establishment of root structures in the topsoil would minimize erosion.

There would be an overall beneficial impact to hydrology and hydraulics in the project area. The channel work would not substantially change base flow characteristics such as flow velocity, channel capacity, or channel configuration in a manner that would result in substantial erosion or sediment deposition on- or off-site compared to baseline conditions. In general, Alternatives 1.1 and 8 are not expected to result in any changes to hydrology or hydraulics baseline conditions downstream of where the improvements would be implemented. The channel work would not result in an increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding. Therefore, impacts to hydrology and hydraulics from the channel work would be less than significant.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement and disposal would result in impacts similar to those characterized under Alternatives 1.1 and 8, Channel Work, described above. Borrow and disposal work would include excavation and widening of the thalweg beneath the BNSF Railroad Bridge to accommodate the conveyance improvements. Material excavated would be used as borrow material for rebuilding of the levees. Conveyance improvements would result in conveyance of flows within the LCR of up to the one percent ACE or about 69,200 cfs.

Approximately 263.8 acres for Alternative 1.1 and 259.9 acres for Alternative 8 at a maximum to 105.6 acres for Alternative 1.1 and 103.9 acres for Alternative 8 at a minimum of excavated material (depending on fill depth), totaling approximately 266,977 cy for Alternative 1.1 and approximately 265,388 cy for Alternative 8 would permanently raise the elevation of a portion of the disposal site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. The excavated sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. This would have a temporary and short-term impact on hydrology and hydraulics.

Borrow and disposal work would not result in substantial change in flow characteristics of the LCR in a manner that would result in substantial erosion or sediment deposition on- or off-site. Borrow and disposal work would not induce flooding or result in an increased exposure of people or structures to a significant risk of loss, injury, or death involving flooding. Impacts to hydrology and hydraulics and public safety would be beneficial overall.

Staging, Stockpiling, and Access

Use of the staging, stockpiling, and access areas may temporarily impact hydrology and hydraulics but impacts would be short-term and localized. Existing floodplain soils may not support the weight of construction equipment or vehicles. Soil enhancements may be required in addition to dewatering to provide access for equipment and vehicles. Soil enhancements entail mixing soil with gravel, soil cement, clay, or silt as appropriate to better harden or bind the soil. Any soil enhancements required for removal would be removed after completion of construction. Impacts would be temporary and less than significant.

Operation and Maintenance

The O&M repair work would include routine inspections and minor repairs of the levees that would require relatively small amounts of native materials that typically would occur over a short period of time, when needed. Additionally, periodic sediment and vegetation management may be required within the conveyance channel underneath the BNSF Railroad Bridge to maintain flow conveyance capacity. The primary substrate utilized for construction of the existing levees is similar to sediment material excavated around the BNSF Railroad Bridge and the borrow area in the LCR. The substrate is expected to be free of contaminants and suitable for reuse. Upland borrow areas are also available. If the structural repairs require work within the LCR, the work area would be dewatered with portable dewatering structures without substantial interference to channel capacity, water surface elevation, or velocity. Upon completion of work, the dewatering structures would be removed, and the area would be allowed to revegetate via natural recruitment or replanted without substantial interference to flows in the LCR. Nonstructural repairs would entail some removal of vegetation and debris but would not

substantially interfere with channel capacity, water surface elevation, or velocity in the LCR, or impact hydrology or hydraulics. Therefore, the impacts related to O&M would be temporary and less than significant.

Effects Determinations Summary

As discussed above, Alternatives 1.1 and 8 would not result in a substantial change to base flow characteristics such as flow velocity, channel capacity, or channel configuration, in a manner that would result in substantial erosion or sediment deposition on- or off-site compared to baseline conditions. Alternatives 1.1 and 8 would result in an overall decrease in exposure of people or structures to risk of loss, injury, or death involving flooding. The levee system would contain the median water surface elevation for the one percent ACE plus an additional three feet and reduce the risk of levee failure, thereby reducing the risk of flooding to the residents of Winslow. Overall, impacts associated with Alternatives 1.1 and 8 would be less than significant.

5.2.3. Alternative 3.1

Nonstructural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work

Conveyance improvements at the BNSF Railroad Bridge and saltcedar removal would result in impacts similar to those characterized under Alternative 1.1 and 8. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternative 1.1 and 8. The levees would be rebuilt to a height sufficient to contain the median water surface elevation of the one percent ACE flood event plus an additional three feet. Under Alternative 3.1, a total of 6.46 miles (34,440 feet) of new or rebuilt levee would occur.

With Alternative 3.1 in place, the levee system would contain the median water surface elevation of the one percent ACE plus an additional three feet (about 69,200 cfs) through the project area and reduce the risk of levee failure, resulting in a reduction of flood risk to the communities in the city of Winslow. At the end of the rebuilt Winslow Levee, flows travel around the end of the levee and travel upstream (south) approximately 1,500 feet. There are no major structures within the affected area, but the floodplain boundary is very close to a few residents and outbuildings. However, a cutoff levee could potentially minimize the flooding in the overbank area upstream from the end of improvements. The need for a cutoff levee or other structure would be evaluated in more detail during the PED phase and included into the detailed design, if needed, to minimize the risk of flooding at this location.

Due to the setback of the Winslow Levee, some properties are affected by the floodplain for this alternative. Alternative 3.1 includes two setback locations. Unlike Alternative 1.1 and 8, the footprint of the two setback levees would permanently remove 26.9 acres of vegetation including removal of a minimal amount of native substrate that would increase hydrologic flows. The southern setback results in an increase of flow width in this reach by as much as approximately 2,300 feet to the west. The northern setback is directly west from the Homolovi I Pueblo and would result in an increase in flow width by as much as about 1,500 feet to the west. By

removing some of the Winslow Levee segments, approximately 261 acres of floodplain area would be returned to the riverside of the levee. This would result in a net increase to the floodway area following construction.

When comparing Alternative 3.1 to the baseline condition scenario where the existing levees would not fail prior to overtopping, hydraulic analyses show that average water surface elevations are generally decreased under Alternative 3.1 compared to existing conditions. The floodplain for the one percent ACE flood does inundate the Homolovi I Pueblo area; however, average water surface elevations in this area is expected to decrease by about 0.7 feet. Conveyance improvements at the BNSF Railroad Bridge would result in an increase in flow velocities upstream of the BNSF Railroad Bridge, slight decrease from the BNSF Railroad Bridge to the I-40 Bridge, and very little change downstream of this point to the end of the project reach.

When comparing Alternative 3.1 to the baseline condition scenario of the probability of unsatisfactory levee performance (i.e., levee failure prior to water overtopping the levee), hydraulic analyses show that average water surface elevation would decrease in the upstream area in the vicinity of the BNSF Railroad Bridge with a slight decrease in the downstream portion of the proposed project area. Average flow velocities would increase in the upstream area in the vicinity of the BNSF Railroad Bridge with minimal to no change from the I-40 Bridge to the downstream end of the proposed project area. At the Homolovi I Pueblo, average water surface elevation would decrease by about 1.5 feet, which corresponds to about a 15-foot decrease in floodplain extent compared to this baseline condition scenario.

As described under Alternatives 1.1 and 8, given the LCR channel alignment and configuration upstream and downstream of the BNSF Railroad Bridge, the reduction in channel roughness would be expected to increase localized erosion and sediment deposition in the vicinity of the BNSF Railroad Bridge during each storm event; however, Alternative 3.1 would not increase sediment deposition compared to baseline conditions.

Overall, Alternative 3.1 would not result in substantial changes to the overall flow characteristics of the LCR, and would not result in substantial erosion or sediment deposition on- or off-site. In general, Alternative 3.1 and 8 are not expected to result in any changes to hydrology or hydraulics baseline conditions downstream of where the improvements would be implemented.

<u>Borrow and Disposal Work</u>
Borrow and disposal levee construction work would be similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement would be similar to Alternatives 1.1 and 8.

Approximately 226 acres at a maximum to 90.4 acres at a minimum of excavated material (depending on fill depth), totaling approximately 255,027 cy would permanently raise the elevation of a portion of the disposal site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. The excavated sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. This would have a temporary, short-term, and insignificant impact on hydrology and hydraulics.

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling and access areas work would result in impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be temporary and insignificant.
Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be temporary and insignificant.

Effects Determinations Summary
Alternative 3.1 would result in hydrology and hydraulic impacts similar to those characterized under Alternatives 1.1 and 8. Alternative 3.1 would result in limited change in channel configuration and flow velocities and would not result in substantial erosion or sediment deposition on- or off-site. Alternative 3.1 would result in an overall decrease in exposure of people or structures to risk of loss, injury, or death involving flooding. Alternative 3.1 would contain the one percent ACE, thereby reducing the risk of flooding to the residents of Winslow. These changes are not considered substantial changes to the overall flow characteristics of the LCR. Impacts associated with Alternative 3.1 would be less than significant.

5.2.4. Alternatives 7 and 9

Nonstructural Measures
Under Alternatives 7 and 9, a combination of nonstructural measures would be implemented within the 100-year floodplain of Winslow Levee: elevating residences and installation of a flood warning system. Elevating residences for flood protection and installation of a flood warning system would not require use of substrate from the LCR. Implementation of nonstructural measures would not impact hydrology or hydraulics. Impacts to public safety would be beneficial.

Channel Work
Proposed channel work includes rebuilding the east end of the RWDL under Alternative 9 at its existing height. No channel work is proposed under Alternative 7, thus there would be no change to base flow characteristics such as flow velocity, channel capacity, or channel configuration, or induce flooding. Alternative 7 is not expected to result in any changes to hydrology and hydraulics baseline conditions downstream of the proposed project. Conveyance improvements at the BNSF Railroad Bridge would not be implemented. Reconstruction of the RWDL for Alternative 9 would result in impacts to hydrology and hydraulics similar to those characterized under Alternatives 1.1 and 8 for that area with respect to materials used. Under Alternative 9, a total of 0.44 miles (2,300 feet) of rebuilt levee would occur. The current RWDL height is sufficient to convey the median water surface elevation of the 36-year flood (about the 2.8 percent ACE flow event). Under Alternative 9, the rebuild of RWDL would reduce the risk of levee failure due to levee slope failure, impingement or piping from flows up to about the 2.8 percent ACE flow event. This would result in a decrease of flood risk to the Winslow area compared to existing conditions. There would be no change in water surface elevation, flow velocities, or channel configuration. There would be little to no change with respect to impacts from the one percent ACE flow event compared to baseline conditions. Under the one percent ACE flow event, levee failure could occur at three downstream locations in the vicinity of the Bushman Acres community. This alternative would not result in substantial changes to flow

characteristics of the LCR and would not result in substantial erosion or sediment deposition on or off-site compared to baseline conditions. In general, Alternative 9 is not expected to result in any changes to hydrology or hydraulics baseline conditions downstream of where the improvements would be implemented.
Removal of approximately 3.9 acres of existing vegetation to accommodate the 75-foot construction corridor would include removal of a minimal amount of native substrate, minimally affecting hydrology or hydraulics. Impacts from vegetation removal would be temporary.

Borrow and Disposal Work
Borrow and disposal levee construction work would be similar to Alternatives 1.1 and 8, only much less due to the limited amount of material needed. Potential impacts from borrow material excavation and placement would be similar to Alternatives 1.1 and 8. For Alternative 9, approximately 0.30 acres at a maximum to 0.12 acres at a minimum of excavated material (depending on fill depth), totaling approximately , 6,022 cy would permanently raise the elevation of a portion of the disposal site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. The excavated sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. This would have a temporary, short-term, and insignificant impact on hydrology and hydraulics.

Staging, Stockpiling, and Access Areas
Alternative 7 does not include any work in staging, stockpiling, or access areas. For Alternative 9, use of staging, stockpiling and access areas work would result in impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be temporary.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be temporary and insignificant.

Effects Determinations Summary
Alternative 7 would not result in a change to base flow characteristics such as flow velocity, channel capacity, or channel configuration. Based on the above, impacts to hydrology and hydraulics would be less than significant for Alternative 7, and would be beneficial, but less than significant with respect to public safety. Alternative 9 would increase flow conveyance capacity compared to baseline conditions by addressing levee deficiencies. There would be no change in water surface elevation, flow velocities, or channel configuration, and the alternative would not result in substantial erosion or sediment deposition on or off-site compared to baseline conditions. Alternative 9 would result in an overall decrease in exposure of people or structures to risk of loss, injury, or death involving flooding. Impacts under Alternative 9 would not be significant and would be beneficial with respect to public safety.

5.2.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Implementation of nonstructural measures under Alternative 10 would result in impacts similar to those characterized under Alternatives 7 and 9. For the other alternatives, impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work

Under Alternatives 10, 10.1, 10.2, 10.3, and 10.4, conveyance improvements at the BNSF Railroad Bridge would result in impacts similar to those characterized under Alternatives 1.1 and 8. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternatives 1.1 and 8, except that improvements would not occur to the 12,890 northernmost feet of the Winslow Levee. Unlike Alternative 1.1, the footprint of the single setback levee would permanently remove 3.3 acres of vegetation that would include minimal removal of sediment causing a minimal impact on hydrology and hydraulics. By removing a portion of the Winslow Levee segments, approximately 12 acres of additional floodplain area would be returned to the riverside of the levee. This would result in a net increase to floodway area following construction. This would be a beneficial effect to floodplain values.

Alternatives 10 and 10.1 would convey the median water surface elevation for the one percent ACE flow event plus an additional three feet, reducing the risk of levee failure by slope failure, impingement, or piping issues. As detailed in Appendix B - Hydraulics, the one percent ACE floodplain for Alternative 10 and 10.1 shows flows overtopping the Winslow Levee approximately 5,000 feet downstream from the southern river impingement (downstream of the levee improvements; hydraulic river station 320+00). The breakout overflow travels southward towards Winslow for approximately 3,000 feet. The maximum flow depth in the backwater area (upstream from hydraulic river station 320+00) is approximately 10 feet. Downstream (north) from hydraulic river station 320+00, the flows in the overbank reach a maximum flow depth of five feet near Ames Acres. This would not result in an increase of the flooding area compared to baseline conditions.

When comparing Alternatives 10 and 10.1 to the more likely baseline condition scenario where the existing levees would not fail prior to overtopping, Alternatives 10 and 10.1 would have the same water surface elevation and velocities as Alternative 8, including at the Homolovi I Pueblo. Under the design flood (one percent ACE flow event), average water surface elevation would decrease and average flow velocities would increase upstream and through the BNSF Railroad Bridge segment. Downstream of the BNSF Railroad Bridge to the downstream end of the proposed project area, there would be a slight decrease to no change in water surface elevation, and velocities would not change significantly.

A portion of the Homolovi I Pueblo footprint is currently within the one percent ACE floodplain for this baseline condition. Under Alternative 10 and 10.1, the floodplain for the one percent ACE flood does inundate the Homolovi I Pueblo area, but would not increase flooding at the Homolovi I Pueblo compared to the baseline (existing) condition one percent ACE flood. Alternatives 10 and 10.1 result in decreased water surface elevation and a slight decrease in flow velocities at Homolovi I Pueblo compared to the first baseline condition. Alternatives 10 and

10.1 have the same flood duration as the first baseline condition. Implementation of Alternative 10 and 10.1 would slightly decrease the footprint of the floodplain at the Homolovi I Pueblo compared to this baseline condition due to the decrease in water surface elevation.

When comparing Alternative 10 and 10.1 to the baseline condition scenario assuming the probability of unsatisfactory levee performance (i.e., levee failure prior to water overtopping the levee), Alternatives 10 and 10.1 would result in decreased average water surface elevations and increased flow velocities upstream and through the BNSF Railroad Bridge segment under the design flood (one percent ACE flow event), similar to the non-levee failure scenario described above. Average water surface elevations downstream of the BNSF Railroad Bridge to the downstream end of the proposed project area, including at the Homolovi I Pueblo would increase slightly by about 0.5 feet. This equates to an increase of about 10 feet in the floodplain extent at the Homolovi I Pueblo. Alternative 10 and 10.1 would result in little to no change in average flow velocities. Under a second less likely baseline scenario, the existing levee system was modeled taking into account the potential failure before overtopping. Consequently, the Corps also modeled a scenario in which there are a series of four levee failures (three upstream and one downstream) from Homolovi I during a one percent ACE event and compared that scenario to Alternative 10.1. In this second baseline scenario, water would leave the system prior to reaching Homolovi I; the water surface elevation could be up to 0.5 feet higher at Homolovi I under Alternative 10.1 versus a baseline condition where the levees failed. This increase in water surface elevation equates to an average of 10 feet of aerial extent. The second baseline condition in which the levees fail is much less likely to occur than the baseline condition in which the levees do not fail but are overtopped. The four levee cross sections were evaluated for their probability to perform unsatisfactorily in a series of given flood events. At the most likely failure point for locations where improvements would be made under Alternatives 10 to 10.4, there is approximately a 16 percent chance of failure at a water surface elevation that corresponds with about the four percent ACE event. At the levee failure point closest to Homolovi I there is a one percent chance of failure at a water surface elevation that corresponds to the four percent ACE event. This probability of levee failure increases with larger (and lower) probability flood events. In summary, the levee would need to simultaneously fail at all four locations in order to see less water at Homolovi I which brings the likelihood that this second baseline condition would occur to a less than five percent chance in any given flood event.

Alternative 10.2 would not include conveyance improvements under the BNSF Railroad Bridge and would convey the median water surface elevation for the four percent ACE (approximately 38,310 cfs) plus an additional three feet, and reduce the risk of levee failure by slope failure, impingement, or piping issues. The four percent ACE flood event for Alternative 10.2 does not show flooding caused by overtopping or failure of the Winslow Levee. When comparing Alternative 10.2 to the baseline condition scenario where the existing levees would not fail prior to overtopping, results of hydraulic analysis show that average water surface elevations would not change through the proposed project area with a slight decrease at the Homolovi I Pueblo. The floodplain for the four percent ACE flood does inundate a portion of the Homolovi I Pueblo area, however, this would not result in an increase of the flood plain compared to baseline conditions under this scenario. Average flow velocities are not expected to change significantly.

When comparing Alternative 10.2 to the baseline condition scenario assuming the probability of unsatisfactory levee performance (i.e., levee failure prior to water overtopping the levee), under the design flood (four percent ACE flow event), Alternatives 10.2 would result in no change in average water surface elevations through the proposed project area, with a slight increase at the Homolovi I Pueblo (estimated to be less than a foot), which would equate to an increase in floodplain extent by about eight feet. Additionally, Alternative 10.2 would result in minimal to no change in average flow velocities through the proposed project area.

Alternative 10.3 would include additional conveyance improvements under the BNSF Railroad Bridge and would convey the median water surface elevation for the two percent ACE (approximately 52,020 cfs) storm event plus an additional three feet, and reduce the risk of levee failure by slope failure, impingement, or piping issues. The two percent ACE flood for Alternative 10.3 does not show flooding caused by overtopping or failure of the Winslow Levee. When comparing Alternative 10.3 to the baseline condition scenario where the existing levees would not fail prior to overtopping for the design flood (two percent ACE flow event), results of the hydraulic analysis, average water surface elevations would decrease upstream of the BNSF Railroad Bridge due to the conveyance measure. The average flow velocity would increase in this reach, then decrease slightly in the downstream reaches. Additionally, the floodplain for the two percent ACE flood does inundate a portion of the Homolovi I Pueblo area, however average water surface elevations decrease by about 0.1 feet, and would not result in an increase in the floodplain.

When comparing Alternative 10.3 to the baseline condition scenario assuming the probability of unsatisfactory levee performance (i.e., levee failure prior to water overtopping the levee), under the design flood (two percent ACE flow event) Alternative 10.3 would result in a decrease in average water surface elevations and an increase in average flow velocities at the upstream portion of the proposed project area through the BNSF Railroad Bridge. Through the downstream portion of the project area, Alternative 10.3 would result in a slight increase at the Homolovi I Pueblo (estimated to be less than a foot), which would equate to an increase in floodplain extent by about eight feet, similar to Alternative 10.2 under this baseline condition scenario. Additionally, Alternative 10.3 would result in minimal to no change in average flow velocities through the proposed project area.

Alternative 10.4 would convey the median water surface elevation for the 0.5 percent ACE (approximately 90,660 cfs) storm event plus an additional three feet, and reduce the risk of levee failure by slope failure, impingement, or piping issues. When comparing Alternative 10.4 to the baseline condition scenario where the existing levees would not fail prior to overtopping under the design flood (two percent ACE flow event), results of the hydraulic analysis shows that Alternative 10.4 would decrease average water surface elevations through the proposed project area with the conveyance improvement measures and levee improvements in place. Average flow velocity would increase upstream of the BNSF Railroad Bridge, with little change from the BNSF Railroad Bridge to the I-40 Bridge. A portion of the Homolovi I Pueblo footprint is currently within the 0.5 percent ACE floodplain for the baseline condition. Average flow velocity would decrease slightly at the Homolovi I Pueblo downstream to end of the project compared to the baseline condition 0.5 percent ACE flood event for this scenario. Alternative 10.4 has the same flood duration as the baseline condition.

When comparing Alternative 10.4 to the baseline condition scenario assuming the probability of unsatisfactory levee performance (i.e., levee failure prior to water overtopping the levee), under the design flood (0.5 percent ACE flow event), Alternative 10.4 would result in a decrease in average water surface elevations and an increase in average flow velocities at the upstream portion of the proposed project area through the BNSF Railroad Bridge. Through the downstream portion of the project area, Alternative 10.4 would result in a slight increase at the Homolovi I Pueblo (estimated to be less than a foot), which would equate to an increase in floodplain extent by about 10 feet. Additionally, Alternative 10.4 would result in minimal to no change in average flow velocities through the proposed project area.

Under Alternatives 10, 10.1, 10.2, 10.3, and 10.4, at the end of the rebuilt Winslow Levee, the overbank river flow travels around and over the levee and travels upstream (south) approximately 3,000 feet. This assumes that the unimproved levee segment downstream from the proposed Federal project fails. There are some structures affected in this area, however, this impact would be similar to existing conditions.

As described under Alternatives 1.1 and 8, given the LCR channel alignment and configuration upstream and downstream of the BNSF Railroad Bridge, the reduction in channel roughness would be expected to increase localized erosion and sediment deposition in the vicinity of the BNSF Railroad Bridge during each storm event; however, Alternative 10, 10.1, 10.2, 10.3, and 10.4 would not increase sediment deposition compared to baseline conditions. Overall, Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would not result in substantial changes to the overall flow characteristics of the LCR, and would not result in substantial erosion or sediment deposition on- or off-site. In general, Alternatives 10, 10.1, 10.2, 10.3, and 10.4 are not expected to result in any changes to hydrology or hydraulics baseline conditions downstream of where the improvements would be implemented. Impacts to public safety would be beneficial.

Borrow and Disposal Work

Borrow and disposal levee construction work would be similar to Alternatives 1.1 and 8, though slightly less due to less material. Potential impacts from borrow material excavation and placement would be similar to Alternatives 1.1 and 8. The maximum and minimum area needed for disposals (and total cubic yards) for each alternative are described in Table 5-3 below. The excavated sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. This would have a temporary, short-term, and insignificant impact on hydrology and hydraulics.

Table 5-3 Disposal Quantities Associated with Alternatives

Alternative	Maximum Area Needed for Disposal (acres)	Minimum Area Needed for Disposal (acres)	Excavated Material (Cubic Yards)
10	205.5	82.2	223,959
10.1	205.5	82.2	223,959
10.2	93.4	37.3	67,713
10.3	248.9	99.6	223,959
10.4	191.4	76.6	223,959

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling and access areas work would result in impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be temporary and less than significant.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be temporary and less than significant.

Effects Determinations Summary
In summary, Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would not result in a substantial change to base flow characteristics such as flow velocity, channel capacity, or channel configuration, and would not result in substantial erosion or sediment deposition on- or off-site compared to baseline conditions. Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would result in an overall decrease in exposure of people or structures to risk of loss, injury, or death involving flooding. Implementation of Alternatives 10 and 10.1 would convey flows of up to the median water surface elevation for the one percent ACE flood event plus an additional three feet. Alternative 10.2 would convey flows of up to the median water surface elevation for the four percent ACE flood event plus an additional three feet. Alternative 10.3 would convey flows of up to the median water surface elevation for the two percent ACE flood event plus an additional three feet. Alternative 10.4 would convey flows of up to the median water surface elevation for the 0.5 percent ACE flood event plus an additional three feet. This would result in a reduction of levee failure risk, thereby reducing the risk of flooding to the residents of Winslow. Overall, impacts associated with Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would be less than significant and beneficial.

5.2.6. Alternative 11: No Federal Action Alternative

The Navajo County Flood Control District and the City of Winslow will continue O&M activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows.

There would be no Federal reconstruction of the existing levees to provide additional reduction of flood risk against high flows and scour. Therefore, the hydrology and hydraulics through the project area would remain unchanged.

As described in Section 4.2, the existing Winslow Levee was designed and built to convey flows up to approximately 65,000 cfs, which was estimated to be the one percent ACE in the 1980s. However, based on an evaluation completed by the Corps in 2010, the one percent ACE was determined to be 69,200 cfs, and based on current levee conditions, the existing levee would overtop at the same location as the 1993 flood at a discharge rate of 55,000 cfs (about a two percent ACE storm event) (see Appendix B - Hydraulics). Further, based on geotechnical analysis conducted for this study, the existing levee system is susceptible to potential failure before overtopping at certain locations for certain levels of flood events. At the most likely failure point with the greatest risk to the City of Winslow, there is approximately a 16 percent chance of failure at a water surface elevation that corresponds with about the four percent ACE event. This probability of failure increases with increases in water surface elevations or lower

probability flood events. As described above, two without-project baseline conditions were evaluated for comparison with the action alternatives: a baseline condition where the existing levees would not fail prior to overtopping, and a baseline condition, less likely, where the existing levees could fail based on the probability of unsatisfactory performance due to levee slope failure, impingement, or piping failure prior to waters overtopping the levee. Further detail is included in Appendix B - Hydraulics.

Future high flow conditions through the project reach could undermine the existing levees and threaten residents and properties adjacent to the project reach. Emergency repairs may be required to stabilize weakened sections of the levee during floods. Such repairs would be limited in scope and duration, and would likely entail the discharge of rocks and earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel. Given that the LCR floodplain transecting the study area varies between approximately 6,000 feet to 20,500 feet in width, it is unlikely that periodic discharge of rocks to stabilize portions of the existing embankment would affect the channel capacity, water surface elevation, or velocity or the alignment of the active channel. Therefore, the No Federal Action Alternative would have less than significant impact on hydrology and hydraulics and public safety.

5.3. Water Quality

Since the levees for the most part are located outside of waters of the U.S., discharges of dredged or fill material would only occur at points where the LCR or Ruby Wash impinge against the levees. For this reason, the minor plan refinements would not result in substantively greater discharges beyond those originally characterized below.

5.3.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative:

- Creates long-term impacts to water quality.

5.3.2. Alternatives 1.1 and 8

<u>Nonstructural Measures</u>
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system and would not result in impacts to water quality, since activities would occur outside of the active channel of LCR and waters of the U.S.

<u>Channel Work</u>
In general, the estimated construction time assumes year-round construction with allowance for adverse weather delays, the monsoon season, and national holidays. Construction would generally stop on the months of July, August, and September. Construction phasing would be accomplished in a manner that assures a functioning levee system during each winter-spring rain and snowmelt season. Since freezing winter temperatures and high summer temperatures occur at Winslow, placing of materials should be planned for periods of mild weather. Most levee

construction would be located approximately 500 to 2,850 feet outside of the active channel of LCR and waters of the U.S. (WoUS) with the exception of conveyance improvements at the BNSF Railroad Bridge and at two locations where the LCR forms impingement points with the existing levee and at three points where Ruby Wash impinges against RWDL. Levee segments located away from the active channel would be removed and reconstructed in place. There would be no direct impacts to water quality during construction in these areas. Where the LCR or Ruby Wash impinges against LCR or RWDL, placement of dewatering structures such as berms, cofferdams or other structures or methods may be necessary if water is present to avoid working in open water. Localized, temporary turbidity impacts could occur during placement and removal of dewatering structures as the substrate and riverbanks are disturbed. However, this would minimize or avoid larger scale and potentially erosive impacts caused by construction equipment working in the active flow channel. Moreover, existing turbidity/suspended sediment levels are high in this area, so any construction related increases related to placement or removal of dewatering structures would be negligible. Regarding pH, neither grouted stone nor soil cement will be placed in water or immediately adjacent to water bodies. Rip rap grouting (grouted stone) and soil cement are never constructed "in-the-wet" as it would be impossible to get proper grout penetration for grouted stone or proper compaction for soil cement if they were under water during construction. As discussed above in Chapter 3.5, the project includes a provision for water diversion and/or control of water to include dewatering. When the water table may be above proposed construction depths, temporary construction dewatering would be used, and where the river channel may direct flows close to the proposed construction area, the active water flow would be diverted by dikes as needed for the period of construction. With the implementation of this provision, impacts to pH would be less than significant. Under Alternative 8, the setback levee segment would be constructed immediately landward with the existing Winslow Levee left temporarily in place to minimize impacts to surface waters. This construction method at the impingement points on the Winslow Levee may reduce the need for water diversion structures, reduce the need to use additional earthmoving equipment within the active channel, and reduce the construction period so that any diversion work can be accomplished during periods of minimal flow. Upon completion of the new segment, the existing segment would be removed via excavators. Additionally, all dewatering structures would be removed. For Alternative 8, setback of a 2,000 foot segment of the Winslow Levee across from Homolovi I would return approximately 12 acres to the LCR floodplain.

Conveyance improvements at the BNSF Railroad Bridge would require removal of approximately 96 acres of saltcedar and approximately 300,000 cy of sediment from an approximately 26-acre footprint. The estimated construction time assumes year-round construction with allowance for adverse weather delays, the monsoon season and national holidays. Construction would generally stop on the months of July, August, and September. Construction phasing would be accomplished in a manner that assures a functioning levee system during each winter-spring rain and snowmelt season. Since freezing winter temperatures and high summer temperatures occur at Winslow, placing of materials should be planned for periods of mild weather. Where water is present or encountered, dewatering structures such as earthen berms or cofferdams, or other structures or methods would be utilized to dewater the work area. The dewatering structures would be removed upon completion of construction. The work would require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel.

The RWDL segments would be removed and reconstructed in place. There would be minimal impacts to water quality during construction. Initial storm flows in Ruby Wash subsequent to construction would flush unconsolidated substrate downstream into the LCR. Potential for erosion would be minimized with the implementation of BMPs including an erosion control plan as a water quality environmental commitment. The structure would be armored with grouted riprap. The materials are chemically inert and would not leach contaminants into surface waters.

Indirect effects could occur in the form of potential increases in turbidity in the event of high flows or rain events during construction and after each construction season. Potential erosion of unconsolidated substrate during initial storm flows following construction of the levee segments could cause increased turbidity levels in the LCR. Furthermore, the LCR is already turbid due to excessive sediment from natural and anthropogenic sources from the upper watershed. Thus, increases in turbidity would not result in notable changes in turbidity overall. Disturbed areas would be reseeded and/or revegetated to minimize exposed soil. The establishment of root structures in the topsoil would minimize erosion and therefore reduce turbidity impacts. Turbidity impacts would be temporary and return to pre-project conditions following completion of construction.

Use of earthmoving equipment riverside of the levee and within the LCR channel could entail the release of *de minimis* amounts of lubricants, solvents, and hydraulic fluids. Potential for their release would be minimized with implementation of best management practices (BMPs) including a Pollution Protection Plan as a water quality environmental commitment. Construction material consists of rocks, soil and cement that are inert and stable materials, and therefore, the structure or materials would not leach or introduce contaminants into surface waters. Overall, there would be no long-term effects to water quality.

Waters of the U.S. (WoUS)

Alternatives 1.1 and 8 would require the discharge of dewatering structures such as earthen berms or cofferdams at the Winslow Levee and RWDL associated with construction near the impingement points. Dewatering structures will also be required for reconstruction of the RWDL. The dewatering structures would be removed from WoUS upon completion of construction.

Conveyance improvements would require excavation and earthmoving activities associated with the removal of sediment and saltcedar. Approximately 300,000 cy of material would be excavated from the floodplain at the BNSF Railroad Bridge, and saltcedar would be cleared from an approximately 96-acre area in the floodplain. These activities would require temporary stockpiling of native substrate or vegetation. All stockpiled material would be hauled to the uplands for disposal. Channelization of the river beneath the BNSF Railroad Bridge would require discharge of approximately 10,992 cy of soil cement within WoUS permanently impacting approximately 1.2 acres of WoUS. The total acreage of WoUS in the study area is approximately 326.5 acres. Thus, permanent impacts would be limited to approximately 0.37 percent of the WoUS within the study area. Furthermore, the structure would not impede sediment transport processes. Thus, there will be no permanent loss of native substrate within the aquatic environment.

Borrow and Disposal Work

Impacts associated with borrow and disposal work, including material excavation, placement and disposal would be similar to those characterized under Alternatives 1.1 and 8, Channel Work, described above. Alternatives 1.1 and 8 would recycle material from the existing levees for new construction. The existing levees were built with native substrate excavated from the LCR floodplain. Borrow materials would come from riverine or upland borrow areas, described in Chapter 4.0, that are similar in nature and composition to the native substrate of the existing levees material. Construction material consists of rocks, soil and cement that are inert and stable materials, and therefore, the structure or materials would not leach or introduce contaminants into surface waters. Areas where surface water is present, dewatering structures such as earthen berms or cofferdams, or other structures or methods would be utilized to dewater the work area. The dewatering structures would be removed upon completion of construction. As described above, turbidity impacts would be temporary and return to pre-project conditions following completion of construction. Potential impacts to surface water quality would be temporary.

Staging, Stockpiling, and Access Areas

Use of the staging, stockpiling, and access areas may temporarily impact water quality but impacts would be short-term and localized. Existing floodplain soils may not support the weight of construction equipment or vehicles. Soil enhancements may be required in addition to dewatering to provide access for equipment and vehicles. Soil enhancements entail mixing soil with gravel, soil cement, clay, or silt as appropriate to better harden or bind the soil. Any soil enhancements required would be removed after completion of construction. As described above, turbidity impacts would be temporary and return to pre-project conditions following completion of construction. Implementation of BMPs would reduce the potential for accidental spills of equipment fluid and fuels.

Operation and Maintenance

Depending on the nature of the O&M and repair activities, turbidity may be temporarily increased. However, given the normally high background turbidity levels in the LCR, O&M impacts would be minimal. Turbidity would return to pre-project conditions upon completion of maintenance activities. Potential repairs would require relatively small amounts of native materials, which are expected to be free of contaminants and suitable for reuse. If the structural repairs require work within the LCR, the work area would be dewatered with portable dewatering structures, as needed. Use of earthmoving equipment within the channel could entail the release of *de minimis* amounts of lubricants, solvents, and hydraulic fluids. Potential for their release would be minimized with implementation of BMPs. Impacts would be less than significant.

Effects Determinations Summary

For all activities, potential impacts to water quality would be temporary, and water quality would return to pre-project conditions upon completion of the work. With the implementation of BMPs and commitment for dewatering areas where water is present, potential impacts would be reduced. A Clean Water Act (CWA) Section 401 water quality certification was issued on August 6, 2018 (Appendix I - Environmental). All conditions would be implemented to further reduce impacts to water quality. There would be no permanent impacts to water quality during

the operational life of the constructed structures. In the long term, the levee and conveyance improvements would reduce the risk of levee failure, thus reducing the potential contaminants to be released to the LCR from flood events. Therefore, there would be no long term impacts to water quality. Impacts would be less than significant.

5.3.3. Alternative 3.1

Nonstructural Measures
Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work
Reconstruction of the Winslow Levee and RWDL, setback work, and the conveyance improvements at the BNSF Railroad Bridge, would result in water quality impacts similar to those characterized under Alternatives 1.1 and 8. With the removal of levee segments riverward of the new setback levees, approximately 261 acres would return to the LCR floodplain, resulting in a net increase to the floodway area following construction. The native substrate used for construction would be expected to be free of contaminants and suitable for reuse. Environmental commitments to implement BMPs and dewater areas where surface water is present would reduce impacts to water quality. Potential impacts to water quality would be temporary. Water quality would return to pre-project conditions upon completion of project.

Waters of the U.S.
Alternative 3.1 would result in impacts similar to Alternative 1.1 and 8.

Borrow and Disposal Work
Borrow and disposal work, including material excavation, placement, and disposal, would result in impacts to water quality similar to those characterized under Alternatives 1.1 and 8. Impacts would be temporary.

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling and access areas work would result in impacts to water quality similar to those characterized under Alternatives 1.1 and 8. Impacts would be temporary.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be temporary, and water quality levels would return to pre-project levels upon completion of maintenance activities.

Effects Determinations Summary
With the implementation of BMPs and a commitment for dewatering areas where water is present, potential impacts would be reduced. As with Alternatives 1.1 and 8, a CWA Section 401 water quality certification was issued on August 6, 2018 (Appendix I - Environmental). All conditions would be implemented to further reduce impacts to water quality. Based on the above, impacts to water quality would be less than significant.

5.3.4. Alternatives 7 and 9

Nonstructural Measures

In general, nonstructural work would occur over an approximate four-year construction duration. Since structures to be elevated and location for the flood warning system are outside of the active channel of LCR and WoUS as part of the non-structural work, there would be no impacts to water quality.

Channel Work

Alternative 7 does not include any channel work. For Alternative 9, reconstruction of the RWDL would result in water quality impacts similar to those characterized under Alternatives 1.1 and 8 for that area.

Waters of the U.S.

Nonstructural measures associated with Alternative 7 would affected areas outside WoUS. There would be no temporary or permanent impacts. Alternative 9 would result in temporary impacts similar to those characterized under Alternatives 1.1 and 8 for the relevant segment. There would be no permanent impacts since conveyance improvements at the BNSF Railroad Bridge would not be implemented.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal, would result in impacts to water quality similar to those characterized under Alternatives 1.1 and 8, except much less due to significantly less material being needed. Impacts would be temporary.

Staging, Stockpiling, and Access Areas

Alternative 7 does not include any work in staging, stockpiling, or access areas. For Alternative 9, use of staging, stockpiling and access areas work would result in impacts to water quality similar to those characterized under Alternatives 1.1 and 8 for the RWDL area. Impacts would be temporary.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be temporary, and water quality levels would return to pre-project levels upon completion of maintenance activities.

Effects Determinations Summary

With the implementation of BMPs and commitment for dewatering areas where water is present, potential impacts would be reduced. As with Alternatives 1.1 and 8, a CWA Section 401 water quality certification was issued on August 6, 2018 (Appendix I – Environmental). All conditions would be implemented to further reduce impacts to water quality. Based on the above, impacts to water quality would be less than significant.

5.3.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Implementation of nonstructural measures would result in water quality impacts similar to those characterized under Alternatives 7 and 9 for Alternative 10 and those for Alternatives 1.1 and 8 for the other alternatives.

Channel Work

Water quality impacts associated with implementation of structural management measures for Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would be similar to those characterized under Alternative 1.1 and Alternative 8.

Water quality impacts associated with implementation of conveyance improvement work at the BNSF railroad bridge for Alternatives 10, 10.1, 10.3, 10.4 would be similar to those characterized under Alternative 1.1 and Alternative 8, except that channel work would not occur at the northernmost 12,890 feet of the Winslow Levee. Alternative 10.2 does not include any channelization improvements under the BNSF Railroad Bridge, so impacts would not occur in that area. Under Alternative 10.4, conveyance improvements at the BNSF Railroad Bridge would require removal of approximately 96 acres of saltcedar and approximately 345,000 cy of sediment from an approximately 81 acre footprint, a larger area compared to Alternatives 10, 10.1, 10.2, and 10.3. The larger excavation area could lead to turbidity increases above the other alternatives. As explained under Alternatives 1.1 and 8, turbidity impacts would be temporary and return to pre-project conditions following completion of construction. With the implementation of environmental commitments, impacts would be reduced.

Waters of the U.S.

Alternatives 10, 10.1, 10.2, and 10.3 would result in impacts similar to Alternative 1.1. There would be a slight decrease in temporary impacts since reconstruction at Winslow Levee would avoid one impingement point where construction would not occur for these alternatives. Permanent impacts would remain unchanged from those characterized for Alternative 1.1.

Alternative 10.4 would avoid reconstruction at one impingement point at Winslow Levee compared to Alternative 1.1. Thus, 0.3 acres of temporary impacts associated with placement of dewatering structures would be avoided. The conveyance improvement area would be doubled in length compared to Alternative 1.1. The amount of material to be excavated would increase from 300,000 to 345,000 cy. Likewise, the volume of soil cement discharged into WoUS would increase from 10,992 to 14,000 cy, resulting in approximately 2.9 acres of permanent impacts within WoUS. However, the total acreage of WoUS in the study area is approximately 326.5 acres. Thus, permanent impacts would be limited to approximately 0.88 percent of the WoUS within the study area.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal, would result in impacts to water quality similar to those characterized under Alternatives 1.1 and 8. Impacts would be temporary.

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling and access areas work would result in impacts to water quality similar to those characterized under Alternatives 1.1 and 8. Impacts would be temporary.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be temporary.

Effects Determinations Summary
For all activities, water quality levels would return to pre-project levels upon completion of project. With the implementation of BMPs and commitment for dewatering areas where water is present, potential impacts would be reduced. As with Alternatives 1.1 and 8, a CWA Section 401 water quality certification was issued on August 6, 2018 (Appendix I – Environmental). All conditions would be implemented to further reduce impacts to water quality. Based on the above, impacts to water quality would be less than significant.

5.3.6. Alternative 11: No Federal Action Alternative

Grazing practices and loss of vegetation within the watershed will continue to cause turbidity impairments downstream.

The Navajo County Flood Control District and the City of Winslow will continue operations and maintenance activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Emergency repairs may be required to stabilize weakened sections of the levee during floods. Such repairs would be limited in scope and duration, and would likely entail the discharge of rocks and earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel. Turbidity would be temporarily increased during minimal flow. However, given the normal background turbidity levels in the LCR, impacts would be minimal. Turbidity would return to pre-project conditions upon completion. Use of earthmoving equipment within the channel could entail the release of *de minimis* amounts of lubricants, solvents, and hydraulic fluids. Implementation of BMPs would minimize potential impacts to water quality.

Furthermore, there would be no permanent impacts to water quality associated with emergency repairs. Materials that would most likely be used are rocks and concrete. The materials are chemically inert and would not leach inorganic or organic compounds into surface waters. Therefore, there would be no long term impacts to water quality. Impacts would be less than significant.

5.3.7. Environmental Commitments

The following BMPs are water quality (WQ) environmental commitments that would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to water quality.

WQ 1 The construction contractor shall be required to obtain coverage under the National Pollution Discharge Elimination System (NPDES) construction general permit program, in compliance with the Clean Water Act Section 402, prior to construction. As part of this process the construction contractor shall be required to coordinate with the Arizona Department of Environmental Quality (ADEQ), and obtain and comply with the requirements of applicable permits including providing notifications/reports to the permitting agencies and to the Corps. Prior to initiating construction, the construction contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP), coordinate the SWPPP with the ADEQ for their concurrence and implement the SWPPP, in accordance with the requirements of the NPDES construction general permit program.

WQ 2 The SWPPP prepared by the construction contractor shall include an erosion control plan to control potential sedimentation and turbidity impacts. The erosion control plan shall include temporary measures such as sandbags and/or water bars and may include long-term measures such as re-vegetating access roads and soils borrow areas.

WQ 3 The construction contractor shall also prepare a pollution prevention plan (PPP) to reduce the potential for accidental release of fuels, pesticides, and other materials. The PPP shall include the designation of refueling locations, emergency response procedures, and definition or reporting requirements for any spill that occurs. Equipment for immediate cleanup shall be kept at the staging area for immediate use.

WQ 4 Prior to construction, the Corps shall prepare, obtain, and implement a project specific CWA 401 Water Quality Certification (WQC) from the ADEQ. A Clean Water Act (CWA) 401 Water Quality Certification letter of support from the ADEQ for the proposed project was received on July 13, 2018. A CWA 401 WQC was issued on August 6, 2018 (Appendix I – Environmental).

WQ 5 Areas where surface or groundwater is encountered would be dewatered and pumped outside of the work limits, likely released back into the LCR downstream, thereby minimizing contact with construction activities. Applicable permits for dewatering and/or water releases would be obtained.

5.4. Groundwater

5.4.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative would:

- Substantially reduce the ability to recharge the underlying aquifer, or cause substantial groundwater contamination or substantial groundwater depletion.

5.4.2. Alternatives 1.1 and 8

Nonstructural Measures
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system. This measure would not entail work within active flows, excavation to groundwater depths, groundwater pumping or ponding of water. Thus, there would be no impacts to groundwater.

Channel Work
Alternatives 1.1 and 8 would rebuild the existing levees, with a small setback levee under Alternative 8. Construction would require excavation at a maximum depth of approximately 20 feet deep below existing ground elevation, an approximate maximum 75-foot-wide trench, and a maximum total width of approximately 270-foot-wide levee work area along the length of the levee. Groundwater would not likely be discovered at 20 feet below the existing grade of the levee landward of LCR but may be possible riverward of the Winslow Levee. Depending on the type of levee work, such as at the levee toe, it is likely that groundwater could be encountered if groundwater levels are shallow in certain areas or where the active LCR is close to or impinging upon the levee. Therefore, depending on the location and type of levee work, dewatering activities may be required. Dewatering the levee area would draw from the groundwater table but any groundwater encountered would be pumped outside of the work limits and would be likely released back into the LCR downstream. Thus, potential for groundwater depletion would be avoided. An environmental commitment to dewater areas where groundwater is encountered is included as WQ5. Implementation of an environmental commitment (GW 1 below) during dewatering activities would avoid depletion of groundwater. Regarding RWDL, groundwater would likely be encountered, and similar impacts would be expected. Since construction is a rebuild with a small levee setback under Alternative 8, though slightly wider at certain points, the structure would not increase impermeable barriers to groundwater, and therefore, would not influence or alter groundwater recharge. With implementation of GW 1, impacts to groundwater would be further reduced. Based on the above, impacts would be less than significant.

Conveyance improvements at the BNSF Railroad Bridge and saltcedar removal would result in a widened low-flow channel with terraces protected with riprap. Riprap placement would be limited to the slopes of the terraces and thus would not impact groundwater recharge. Construction material consists of rocks, soil and cement that are inert and stable materials, and therefore, the structure would not leach into the groundwater aquifer, and would not introduce contaminants into the groundwater recharge. Based on the above, impacts to groundwater would be less than significant.

Borrow and Disposal Areas

Alternatives 1.1 and 8 would recycle material from the existing levees for new construction. The existing levees were built with native substrate excavated from the LCR floodplain. Borrow materials would come from riverine or upland borrow areas, described in Chapter 4.0, that are similar in nature and composition to the native substrate of the existing levees material. Alternatives 1.1 and 8 would use substrate expected to be free of contaminants and suitable for reuse. Excess material from excavation and demolition work is anticipated to be disposed of at the McCauley properties east of the LCR or at the other potential disposal sites. Placement of the excess material would not create an impermeable layer, and thus would not affect groundwater recharge. An environmental commitment to dewater areas where groundwater is encountered would reduce impacts to groundwater. Impacts to groundwater would be short-term and localized. Groundwater levels would return to pre-project conditions upon completion of project. Therefore, based on the above, impacts to groundwater would be less than significant.

Staging, Stockpiling, and Access Areas

Use of the staging, stockpiling, and access areas may temporarily impact groundwater but impacts would be short-term and localized. Existing floodplain soils may not support the weight of construction equipment or vehicles. Soil enhancements may be required in addition to dewatering to provide access for equipment and vehicles. Soil enhancements entail mixing soil with gravel, soil cement, clay, or silt as appropriate to better harden or bind the soil. Any soil enhancements required for removal would be removed after completion of construction. Alternatives 1.1 and 8 would use substrate expected to be free of contaminants and suitable for reuse, and impacts to groundwater would be short-term and localized. Based on the above, impacts to groundwater would be less than significant.

Operations and Maintenance

O&M activities would include routine inspection, minor repairs of the levees, and other associated activities and would typically occur for short durations of time, when needed. Potential repairs would require relatively small amounts of native materials, which are expected to be free of contaminants and suitable for reuse. If the structural repairs require work within the LCR, the work area would be dewatered with portable dewatering structures, as needed. Non-structural repairs would entail removal of vegetation and debris. Impacts to groundwater would be short-term and localized. Therefore, impacts would be less than significant.

Effects Determinations Summary

For all activities, impacts would be localized and temporary, and groundwater levels would return to pre-project conditions upon completion of project. The alternatives would not substantially reduce the ability to recharge the underlying aquifer, or cause substantial groundwater contamination or substantial groundwater depletion. Based on the above, impacts to groundwater would be less than significant.

5.4.3. Alternative 3.1

Nonstructural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work

Reconstruction of the Winslow Levee and RWDL, setback work, construction of a new levee parallel to I-40, the conveyance improvements at the BNSF Railroad Bridge, and O&M activities, would result in groundwater impacts that would be similar to those characterized under Alternatives 1.1 and 8. Unlike Alternative 1.1 and 8, the alignment of the two setback levees and removal of the existing Winslow Levee under Alternative 3.1 would return approximately 261 acres of additional floodplain area riverside of the levee. This would result in a net increase to the floodway area following construction. The native substrate used for construction would be expected to be free of contaminants and suitable for reuse. An environmental commitment to dewater areas where groundwater is encountered would reduce impacts to groundwater. Impacts to groundwater would be short-term and localized. Groundwater would return to pre-project conditions upon completion of project. Based on the above, impacts would be less than significant.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal, would result in impacts to groundwater similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas

Staging, stockpiling, and access areas would be similar as described for Alternative 1.1, except that the City of Winslow staging area would not be used. Use of staging, stockpiling and access areas work would result in impacts to groundwater similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Effects Determinations Summary

For all activities, impacts would be localized and temporary, and groundwater levels would return to pre-project condition upon completion of project. Based on the above, impacts to groundwater would be less than significant.

5.4.4. Alternatives 7 and 9

Nonstructural Measures
Raising foundations of structures for flood protection or installing flood warning system would likely not come into contact with groundwater. Therefore, no impacts to groundwater would be expected. Based on the above, potential impacts to groundwater from implementation of nonstructural measures would be less than significant.

Channel Work
Alternative 7 does not include any channel work. For Alternative 9, reconstruction of the RWDL would result in groundwater impacts similar to those characterized under Alternatives 1.1 and 8. An environmental commitment to dewater areas where groundwater is encountered would reduce impacts to groundwater. Therefore, impacts to groundwater would be short-term and localized. Groundwater would return to pre-project conditions upon completion of project. Based on the above, impacts would be less than significant.

Borrow and Disposal Work
Borrow and disposal work, including material excavation, placement, and disposal, would result in impacts to groundwater similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas
Due to the limited levee reconstruction, Alternative 9 would require only two staging areas. These consist of the sites on the Bolle Klaus Jurgen Rainer Trustee site and the nearby property owned by the Navajo Tribe. Use of staging, stockpiling, and access areas may temporarily impact groundwater, but impacts would be short-term and localized. Groundwater would return to pre-project levels upon completion of project.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be localized and temporary and less than significant.

Effects Determinations Summary
For all activities, impacts would be localized and temporary, and groundwater levels would return to pre-project condition upon completion of project. Based on the above, impacts to groundwater would be less than significant.

5.4.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures
Nonstructural measures associated with these alternatives are not likely to encounter groundwater. There would be no temporary or permanent impacts.

Channel Work
Conveyance improvements at the BNSF Railroad Bridge would result in impacts similar to those characterized under Alternatives 1.1 and 8, except that direct impacts would not occur in the downstream area of Winslow Levee where no construction would occur. Likewise,

reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternatives 1.1 and 8. Unlike Alternative 1.1, the footprint of the single setback levee would permanently remove 3.3 acres of vegetation that would include a minimal removal of sediment that would temporarily impact groundwater. By removing some of the Winslow Levee segments, approximately 12 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area following construction. The native substrate used for construction would be expected to be free of contaminants and suitable for reuse. An environmental commitment to dewater areas where groundwater is encountered would reduce impacts to groundwater. Potential impacts to groundwater are expected to be short-term and localized. Groundwater conditions would return to pre-project levels upon completion of project. The additional channelization proposed under Alternative 10.4 would not result in significant impacts because construction methods used for channelization would remain unchanged. There is potential for additional dewatering during construction. However, there would be no notable depletion of additional groundwater since the active channel would recharge drawn groundwater. Alternative 10.2 does not include any channelization improvements under the BNSF Railroad Bridge, so impacts would not occur in that area. With implementation of GW 1, impacts to groundwater would be less than significant.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal, would result in impacts to groundwater similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging Areas and Access

Locations for staging, stockpiling, and access areas, and the batch plant would be as described for Alternative 1.1, except that the O'Haco North and O'Haco Middle sites would not be used. Potential impacts would be similar to those described for Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Effects Determinations Summary

For all activities, groundwater conditions would return to pre-project conditions upon completion of project. Based on the above, impacts to groundwater would be less than significant.

5.4.6. Alternative 11: No Federal Action Alternative

Under the No Federal Action Alternative, the Corps would not implement any structural work on Winslow Levee such as reconstruction of the existing levees, construction of new setback levees, removal of levee sections riverward of new setback levees, or implementation of conveyance improvements upstream of the railway bridge; therefore, there would be no reconstruction of the existing levees to provide additional flood risk management protection against high flows and scour. Furthermore, the east end of RWDL would not be reconstructed. Likewise, the Corps would not implement nonstructural measures such as raising the foundations of structures within

the Winslow Levee 100-year floodplain. Therefore, there would be no impacts to groundwater from construction of structural or nonstructural measures. However, future high flow conditions through the project reach could undermine the existing levee and threaten the residents and properties located adjacent to the project reach. Periodic emergency repairs of the existing levee system may be required. Emergency repairs would likely entail the discharge of rocks to stabilize the embankment. It is possible that emergency repairs would require some amount of excavation to establish a proper toe for rocks. If groundwater is encountered, it is unlikely that emergency repairs would hinder the ability to recharge groundwater or result in groundwater contamination. Based on the above, the No Federal Action would have a less than significant impact on groundwater.

5.4.7. Environmental Commitments

Environmental commitments identified under Section 0 and below would be implemented to further reduce impacts to groundwater.

GW 1 Groundwater extracted during construction would be pumped back into the active river channel or elsewhere in the floodplain to minimize potential for groundwater depletion during construction.

5.5. Biological Resources

5.5.1. Significance Threshold: Vegetation

Based on the existing conditions discussed above, impacts would be considered significant if the alternative results in:

- Substantial reduction to the existing native riparian habitat or substantial changes to the existing native habitat structure.

5.5.2. Alternatives 1.1 and 8

<u>Nonstructural Measures</u>
Alternative 1.1 includes the installation of a flood warning system. This would have no impact on vegetation.

<u>Channel Work</u>
In general, under Alternatives 1.1 and 8, construction and reconstruction of the levees would not widen the footprint of the existing structure riverward. Levee segments located away from the active channel would be removed and reconstructed in place, except for the setback levee portion under Alternative 8. In contrast, sections of the existing Winslow Levee where the LCR forms impingement points would be temporarily left in place while a new segment is constructed immediately landward. Upon completion of the new segment, the existing segment would be removed via excavators.

Under Alternative 1.1, a total of 221 acres of vegetation (mostly non-native vegetation such as saltcedar and camelthorn, and some native weed species) would be impacted or removed during construction. Although the construction and reconstruction of the levees would not significantly widen the footprint of the existing structure riverward, there would be a 25-foot zone used as a construction corridor. In addition Engineer Technical Letter (ETL) 1110-2-583 (dated 30 April 2014) requires that no vegetation (except grasses) be allowed to grow within 15 feet of each side of the levee. This area is included in the 25-foot construction corridor zone. For Alternative 1.1, approximately 6.85 miles (35,929 feet) of new or rebuilt levee would occur. This would require removal of approximately 20.6 acres of existing vegetation. Of the 20.6 acres, approximately 12.4 acres lie within the 15-foot-wide corridor immediately adjacent to the riverside of the levee. Vegetation within the 15-foot-wide corridor is sparse as Navajo County Flood Control District maintains the vegetation immediately adjacent to the levee on an as-needed basis. The vegetation that does exist in this area includes open weedy areas and saltcedar, and is considered low quality. Vegetation would be reestablished within the disturbed areas of the construction corridor. To comply with ETL 1110-2-583, only low growing vegetation such as grasses would be allowed to establish within 15-foot wide corridor on either side of the levees. Alternative 1.1 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts are considered temporary and insignificant.

Due to a widened levee base, there would be additional impacts to vegetation (approximately 75.4 acres) on the landside of the reconstructed levees. However, vegetation within this area is very sparse with mostly weedy species. Impacts to vegetation on the landside of the levees would be permanent in that reconstruction of the levees would prohibit the potential for vegetation to grow in this area in the future. However, this would not result in a substantial loss to native riparian vegetation or change in native habitat structure because the vast majority of the vegetation currently existing are weed species. No native riparian vegetation exists immediately landward of the existing levee throughout the project area.

Alternative 8 would have the same impacts described above for Alternative 1.1, except that under Alternative 8, an additional 3.3 acres of vegetation landside of the existing levee would be permanently removed due to the footprint of the setback levee. Vegetation within this area is sparse with some weedy species. The setback levee and removal of the existing segment would restore approximately 12 acres to the active LCR floodplain, which would be a beneficial effect. Alternative 8 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts are considered temporary and insignificant.

In addition to the construction and reconstruction of the levees, conveyance improvements at the BNSF Railway Bridge would be the same for Alternatives 1.1 and 8, and would entail excavation of approximately 26 acres of uplands and channel area, and removal of approximately 96 acres of saltcedar. Existing vegetation located within the 26-acre excavation area includes saltcedar, greasewood, and an open area with weeds. The removal of this vegetation would be a relatively minor impact as these species are found throughout the project area. Flexible and/or low growing vegetation would be allowed to reestablish within the conveyance improvement area underneath the BNSF Railroad Bridge; however, periodic sediment and vegetation would be managed to maintain conveyance capacity. Impacts are considered insignificant.

The removal of approximately 96 acres of saltcedar would be beneficial to this area. The study area is dominated by saltcedar and the removal of this species may help this area transition to more native riparian habitat. To help facilitate this transition and minimize saltcedar resprouts or invasion of other weeds, this area would be reseeded and/or replanted with flexible and/or low growing native riparian vegetation that is found in other parts of the study area. Impacts to vegetation from conveyance improvements would be beneficial and insignificant.

Borrow and Disposal Work

Borrow materials would come from riverine or upland borrow areas, with the exception of stone for rip-rap and launch stone would come from the nearest source of suitable quality stone located at Indian Wells, Arizona, approximately 43 miles northwest of Winslow levee (a 55-mile one-way haul distance along existing roads). Excavated materials could be placed at McCauley, Winslow, or O'Haco sites. Use of borrow material would disturb/remove the existing vegetation within these sites. However, existing vegetation at the riverine borrow sites are dominated with weeds and saltcedar. The upland borrow site would be located on a former borrow site that was previously mined for borrow materials. Vegetation is sparse within this area and consists mostly of weedy species.

Under Alternative 1.1 and 8, approximately 263.8 acres (259.9 under Alternative 8) at a maximum to 105.6 acres (103.3 acres under Alternative 8) at a minimum of excavated material (depending on fill depth), totaling approximately 266,977 cy (approximately 265,388 cy under Alternative 8) would permanently raise the elevation of a portion of the disposal site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. However, the footprint of the disposal area would generally remain unchanged. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation occurred. Although borrow and disposal activities would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites is dominated by weeds and saltcedar. Although there is some native vegetation, it is sparse. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions through natural reestablishment or replanting, as required by an environmental commitment. Therefore, borrow and disposal activities would not permanently affect vegetation. Impacts would be less than significant.

Staging, Stockpiling, and Access

Construction equipment is proposed to be staged at specified locations along the project construction corridor. Four of these sites are located on the same properties used as disposal areas (O'Haco North, O'Haco Middle, O'Haco South, and City of Winslow). A batch plant would be located at the City of Winslow staging area. This plant would provide the concrete and grout needed for installation of soil cement and grouted stone, respectively. The other four sites are vacant with disturbed vegetation. The Pugh staging area is located on the riverside of the proposed new levee alignment, but would remain behind the existing Winslow Levee until the levee embankment is demolished. The vegetation within this area is mostly saltcedar and weeds.

Although use of the staging, stockpiling, and access areas would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites is dominated by weeds and saltcedar. Although there is some native vegetation, it is sparse. Staging, stockpiling, and access areas currently vegetated would need to be brought back to pre-construction conditions through natural reestablishment or replanting, as required by an environmental commitment. Therefore, staging, stockpiling, and access areas would not permanently affect vegetation. Impacts would be less than significant.

Operation and Maintenance

O&M work would include periodic removal of vegetation that exists on and around the levees and periodic vegetation and sediment removal within the channel under the BNSF Railroad Bridge. The vegetation management along the levees is required per ETL 1110-2-583; however low growing grasses would be allowed to remain. Flexible and/or low growing vegetation would be allowed to reestablish within the conveyance improvement area underneath the BNSF Railroad Bridge following periodic sediment and vegetation removal.

Due to the dominant presence of saltcedar within the project area, growth on the structure (especially access roads) through natural recruitment is likely. Hand removal and herbicide application would be sufficient in most cases. Spot mechanized mowing or mechanized removal could be required on a periodic basis. Mechanized equipment may consist of a mower, dump truck, back hoe, and a loader as well as crew vehicles. Annual vegetation management could require up to 5 laborers for a period of 15 days. Because the majority of vegetation to be removed during O&M work would likely be saltcedar, Alternatives 1.1 and 8 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. O&M work would have less than significant impacts to vegetation.

Effects Determination Summary

Considering all of the measures included in Alternative1.1 and 8, a total of 221 acres (under Alternative 1) and 224.3 acres (under Alternative 8) of vegetation would be impacted or removed during construction. This area may be slightly less depending on the amount of vegetation that exists within the construction corridor zone. Also, under both alternatives, approximately 263.8 acres at a maximum to 103.3 acres at a minimum would be used for disposal. Permanent vegetation impacts would occur due to the widened Winslow Levee base and where there is a proposed setback levee under Alternative 8. All other areas of vegetation removal would be considered temporary since other vegetation would reestablish naturally or with manual revegetation. Therefore, Alternative 8 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Due to the quality of habitat that would be impacted, the proposed measures in Alternative 1.1 and 8 would not cause significant effects to vegetation.

To further reduce impacts, the newly exposed area from the saltcedar removal would be reseeded and/or replanted with native vegetation to minimize erosion, minimize colonization by invasive weed species, and provide wildlife habitat. In addition, any vegetated areas that are temporarily disturbed from disposal, borrow, staging, stockpiling, or access or other construction associated activities would need to be returned to pre-construction conditions. See environmental commitments listed below.

The Endangered Species Act (ESA) protects threatened and endangered species and their designated critical habitat from unauthorized take. A species list was developed based on Little Colorado River, Winslow, Arizona, May 2016 information available on the USFWS Information for Planning and Conservation website (USFWS, http://ecos.fws.gov/ipac) and is provided in Appendix I - Environmental Appendix, of the EIS. The presence of proposed or listed threatened or endangered species or designated critical habitats was coordinated with the USFWS in January 2015 and March 2016. There are no species listed or proposed to be listed as threatened or endangered, or their designated or proposed critical habitats under the Endangered Species Act of 1973 (ESA) as amended (16 U.S.C. 1531 et seq.) known within the proposed project area. The proposed project would not affect any proposed or listed threatened or endangered species or designated critical habitats. Therefore, formal or informal consultation pursuant to this Act is not required. Further, the Coordination Act Report (CAR) received from the USFWS dated December 20, 2017 states the portion of the LCR within the action area and the adjacent riparian area do not provide suitable or potential habitat for listed or proposed listed species. The Corps will continue coordination efforts with the USFWS under the Endangered Species Act. The proposed project complies with this Act.

5.5.3. Alternative 3.1

Channel Work

Conveyance improvements at the BNSF Railroad Bridge and saltcedar removal would result in impacts similar to those characterized under Alternative 1.1 and 8. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternative 1.1 and 8. Under Alternative 3.1, a total of 6.46 miles (34,440 feet) of new or rebuilt levee would occur, and a total of approximately 221 acres of vegetation would be impacted (not including the setback levees construction impacts). Like Alternative 1.1 and 8, approximately 75.4 acres would be permanently impacted due to the widened Winslow Levee base. Existing vegetation in these areas is primarily weeds. Unlike Alternative 1.1 and 8, the footprint of the two setback levees would permanently remove 26.9 acres of vegetation landside of the existing levees. By removing a portion of the Winslow Levee segments (2.4 miles), approximately 221.6 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area and floodplain values following construction. All other impacts to vegetation are considered temporary. Alternative 3.1 would not result in a substantial loss to native riparian vegetation or change in native habitat structure.

Borrow and Disposal Work

The assumptions applicable to borrow and disposal and levee construction work would be similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement also would be similar to Alternatives 1.1 and 8.

Disposal of approximately 226 acres at a maximum to 90.4 acres at a minimum of excavated material (depending on fill depth), totaling approximately 255,027 cy would permanently elevate a portion of the disposal sites by approximately 30 inches at a maximum to approximately 12 inches at a minimum. However, the footprint of the disposal areas would generally remain unchanged. The sediment would be placed in open spaces or grazing areas, avoiding agricultural

or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation.

Although borrow and disposal activities would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites is dominated by weeds and saltcedar. Although there is some native vegetation, it is sparse. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions. Therefore, borrow and disposal activities would not permanently affect vegetation. Impacts would be less than significant.

Staging, Stockpiling, and Access

Staging and stockpiling would be as described for Alternative 1.1, except that the City of Winslow staging area would not be used. The batch plant proposed for the City of Winslow site would be relocated to property adjacent to the ADOT I-4 hydraulic gate right-of-way (on property owned by either the Navajo Tribe or Transcon, LLC).

Although use of the staging, stockpiling, and access areas would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites is dominated by weeds and saltcedar. Although there is some native vegetation, it is sparse. Staging, stockpiling, and access areas currently vegetated would need to be brought back to pre-construction conditions. Therefore, staging and stockpiling areas would not permanently affect vegetation. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Alternative 3.1 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts to vegetation are considered temporary. Vegetation related impacts due to O&M activities would be less than significant.

Effects Determination Summary

Considering all of the measures included in Alternative 3.1, a total of 221 acres of vegetation would be impacted or removed during construction (other than the setback levees). Of this area a total of 102.3 acres of predominately non-native vegetation would be permanently removed due to the widened Winslow Levee footprint and the footprint of the two setback levees. Area of vegetation removal may be slightly less depending on the actual amount of vegetation that exists within the construction corridor zone. The newly exposed area to the east of the new setback levees provides a total of 221.6 acres added to the active LCR. All other impacts to vegetation are considered temporary since other vegetation would reestablish naturally or with manual revegetation. Alternative 3.1 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Due to the quality of habitat that would be impacted or removed, the proposed measures in Alternative 3.1 would not cause significant effects to vegetation.

5.5.4. Alternatives 7 and 9

Nonstructural Measures

Nonstructural measures under Alternative 7 and 9 would not result in impacts to vegetation because the raising of structures would occur only at existing structures, where no vegetation currently exists. Installation of flood warning systems would likewise not include vegetation removal.

Channel Work

No channel work is proposed for Alternative 7. Under Alternative 9, reconstruction of the RWDL would result in impacts similar to those characterized under Alternatives 1.1 and 8. Under Alternative 9, a total of .44 miles (2,000 feet) of rebuilt levee would occur. Due to the 25-foot-wide construction corridor, approximately 1.3 acres of predominately non-native existing vegetation would be impacted. Alternative 9 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts to vegetation are considered temporary, as vegetation would be replanted or would reestablish naturally.

Borrow and Disposal Work

No borrow or disposal work is proposed for Alternative 7. For Alternative 9, the assumptions applicable to borrow and disposal work would by similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement also would be similar to, but less than, Alternatives 1.1 and 8.

Approximately 0.30 acres at a maximum to 0.12 acres at a minimum of excavated material (depending on fill depth) , totaling approximately 6,022 cy would permanently raise the elevation of a portion of the disposal site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation occurred.

Although borrow and disposal activities would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites is dominated by weeds and saltcedar. Although there is some native vegetation, it is sparse. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions. Therefore, borrow and disposal activities would not permanently affect vegetation. Impacts would be less than significant.

Staging, Stockpiling, and Access

No staging, stockpiling, or access activities would be needed for Alternative 7. Due to the limited levee reconstruction, Alternative 9 would require only two staging areas. These consist of the sites on the Bolle Klaus Jurgen Rainer Trustee site, and the nearby property owned by the Navajo Tribe.

Although the staging and stockpiling areas would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites has been disturbed. Although there is some native vegetation, it is sparse. Staging, stockpiling, and access areas currently vegetated would be brought back to pre-construction conditions. Therefore, staging and stockpiling areas would not permanently affect vegetation. Impacts would be less than significant.

Operation and Maintenance

Under Alternative 9, impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Alternatives 7 and 9 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts to vegetation are considered temporary. Vegetation related impacts due to O&M activities would be less than significant.

Effects Determination Summary

Under Alternative 7, only non-structural measures would occur and there would be no disturbance to vegetation from these measures. Under Alternative 9, a total of 1.3 acres of vegetation would be removed. This area may be slightly less depending on the amount of vegetation that exists within the construction zone. Also, under Alternative 9, approximately 0.30 acres at a maximum to 0.12 acres at a minimum would be used for disposal. The newly exposed area from the saltcedar removal would be planted with native vegetation to minimize erosion, to minimize colonization by invasive weed species, and to provide wildlife habitat. In addition, any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions. Alternative 9 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts to vegetation are considered temporary. Vegetation related impacts would be less than significant.

5.5.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Nonstructural measures under Alternative 10 would not result in impacts to vegetation, as described for Alternatives 7 and 9. Nonstructural measures under Alternatives 10.1, 10.2, 10.3, and 10.4 would be the same as identified for Alternatives 1.1 and 8, and would result in similar impacts as those described for Alternatives 1.1 and 8.

Channel Work

Conveyance improvements at the BNSF Railroad Bridge would result in impacts similar to those characterized under Alternatives 1.1 and 8, even though Alternative 10.4 would include slightly more excavation under the bridge. Although there would be an increase in vegetation removal and due to the type of vegetation being removed and its abundance within the study area, impacts would still be minor and similar to those characterized under Alternatives 1.1 and 8. Alternative 10.2 does not include any conveyance improvements or saltcedar removal under the BNSF Railroad Bridge, so no impacts in this area would occur from Alternative 10.2. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternatives 1.1 and 8. Under Alternative 10, 10.1, 10.2, 10.3, and 10.4, a total of 4.46 miles (22,552 feet) of new or rebuilt levee would occur. The 25-foot-wide construction corridor equals approximately 13.6 acres of

existing vegetation removal, though temporary and mostly weed species. Additionally, due to a widened levee base, approximately 49.1 acres of vegetation would be permanently impacted on the landside of the reconstructed levees. Vegetation within this area is sparse with mostly weedy species. Impacts to vegetation on the landside of the levees would be permanent in that reconstruction of the levees would prohibit the potential for vegetation to grow in this area in the future. However, this would not result in a substantial loss to native riparian vegetation or change in native habitat structure because the vast majority of the vegetation currently existing are weed species. No native riparian vegetation exists immediate landward of the existing levee throughout the project area. Approximately, 0.3 miles of existing levee would be removed for the levee set back. Unlike Alternative 1.1, the footprint of the single setback levee would permanently remove 3.3 acres of vegetation. Existing vegetation in this area is primarily weeds. By setting back a portion of the Winslow Levee segments, approximately 12 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area and floodplain values following construction. Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. All other impacts to vegetation are considered temporary. Vegetation related impacts due to Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would be less than significant.

Borrow and Disposal Work

The assumptions applicable to borrow and disposal work would be similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement would also be similar to Alternatives 1.1 and 8. See Table 5-4 for area needed for excavated material under each alternative.

Table 5-4 Area Needed for Disposal

Alternative	Maximum Area Needed for Disposal (acres)	Minimum Area Needed for Disposal (acres)	Excavated Material (Cubic Yards)
10	205.5	82.2	223,959
10.1	205.5	82.2	223,959
10.2	93.4	37.3	67,713
10.3	248.9	99.6	223,959
10.4	191.4	76.6	223,959

Under Alternatives 10, 10.1, 10.2, 10.3, and 10.4 borrow and disposal area footprints would basically remain unchanged. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation occurred.

Although borrow and disposal activities would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites is dominated by weeds and saltcedar. Although there is some native vegetation, it is sparse. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions. Therefore, borrow and disposal activities would not permanently affect vegetation. Impacts would be less than significant.

Staging, Stockpiling, and Access
Locations for staging, stockpiling and the batch plant would be as described for Alternative 1.1, except that the O'Haco North and O'Haco Middle sites would not be used.

Although the staging and stockpiling areas would temporarily impact vegetation, these effects would be short-term and minor. In addition, the vegetation that currently exists within these sites has been disturbed. Although there is some native vegetation, it is sparse. Staging, stockpiling, and access areas currently vegetated would be brought back to pre-construction conditions. Therefore, staging and stockpiling areas would not permanently affect vegetation. Impacts would be less than significant.

Operation and Maintenance
Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Impacts to vegetation are considered temporary. Vegetation related impacts due to O&M activities would be less than significant.

Effects Determination Summary
Considering all of the measures included in Alternatives 10, 10.1, 10.2, 10.3, and 10.4, a total of approximately 187.7 acres of vegetation would be impacted or removed during construction for each alternative. Of this area, a total of 49.1 acres of vegetation would be permanently removed due to the widened Winslow Levee footprint and the footprint of the setback levee. The area of vegetation removal may be slightly less depending on the actual amount of vegetation that exists within the construction corridor zone. The newly exposed area to the east of the new setback levee would provide a total of 12 additional acres. All other impacts would be temporary. The newly exposed area from the saltcedar removal would be reseeded and/or replanted with native vegetation to minimize erosion, minimize colonization by invasive weed species, and provide wildlife habitat. In addition, any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions. Alternatives 10, 10.1, 10.2, 10.3, and 10.4, would not result in a substantial loss to native riparian vegetation or change in native habitat structure. Vegetation related impacts would be less than significant.

5.5.6. Alternative 11: No Federal Action Alternative

The Navajo County Flood Control District and the City of Winslow would continue operations and maintenance activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Emergency repairs may be required to stabilize weakened sections of the levee during floods. Such repairs would be limited in scope and duration, and would likely entail the discharge of rocks and earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel. Depending on the scope of the repairs and improvements, vegetation adjacent to the existing levees may be impacted during these activities. These impacts would be relatively minor, due to type of vegetation being removed and its abundance within the study area. Routine vegetation control would also continue. It is anticipated that unless measures

to combat the spreading of saltcedar are implemented, the population would continue to expand. Impacts would be less than significant.

5.5.7. Environmental Commitments

The following environmental commitments are proposed to further reduce impacts to vegetation resources.

VG 1 In the areas where saltcedar removal is proposed, follow-up treatment (e.g. mechanical and /or herbicide) is required on re-sprouting saltcedar. The approximately ±96-acre area of saltcedar within the floodplain and in vicinity of the BNSF Railroad and State Route 87 bridges would be reseeded and/or revegetated with native, historic vegetation previously found in the LCR Winslow project area.

VG 2 For all considered disposal areas, material should be placed in areas that are upland and are not within riparian areas of the project area. All riparian areas, or where moist soil occurs, should be avoided when placing disposed material. In addition, any vegetated areas that are disturbed from disposal or borrow would need to be returned to pre-construction conditions revegetating with native, historic vegetation previously found in the LCR Winslow project area.

VG 3 Any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions revegetating with native, historic vegetation previously found in the LCR Winslow project area.

VG 4 To reduce potential spread of the invasive saltcedar into borrow/disposal areas, borrow areas will segregate material to reduce the potential spread of saltcedar.

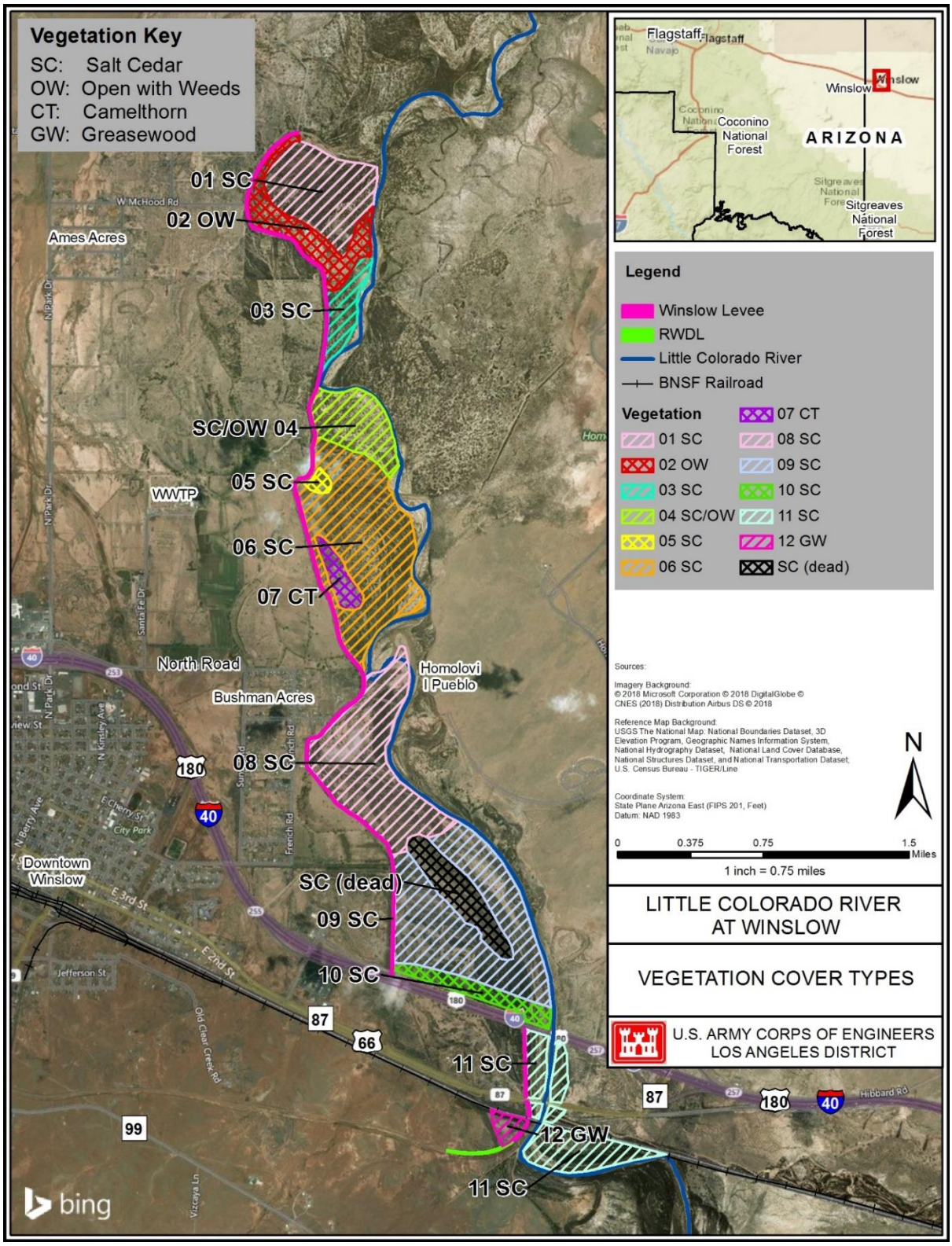

Figure 5-1 Vegetation Map of the Project Area

5.5.8. Significance Threshold: Wildlife

Impacts would be considered significant if the alternative results in:

- A substantial loss in the population or habitat of any native fish or wildlife.

5.5.9. Alternatives 1.1 and 8

Nonstructural Measures
Alternative 1.1 includes the installation of a flood warning system. This would have no impact on wildlife.

Channel Work
Although the construction and reconstruction of the levees would not widen the footprint of the existing structure riverward, there would be a 25-foot-wide zone used as a construction corridor. Therefore, this would require the removal of existing vegetation within the 25-foot construction corridor zone for the entire length of constructed or reconstructed levees. Vegetation that does exist in dense patches near the levee includes saltcedar and other weed species. Also, adjacent to the levee, there are many open areas where little vegetation exists. This is probably due to ongoing maintenance along the levee toe. Because this type of vegetation is very abundant within the study area, wildlife would be able to find other areas of similar habitat. Wildlife in the area would be briefly disturbed during the reconstruction of the levees. These effects would be temporary and mobile wildlife would leave the area upon initiation of construction activities.

Sections of reconstructing the Winslow Levee, where the LCR forms impingement points, may require construction during minimal flow periods. In addition, the structure at the impingement points would be armored with soil cement. The estimated construction time assumes year-round construction with allowance for adverse weather delays, the monsoon season and national holidays. Construction would generally stop on the months of July, August, and September. Construction phasing would be accomplished in a manner that assures a functioning levee system during each winter-spring rain and snowmelt season. Since freezing winter temperatures and high summer temperatures occur at Winslow, placing of materials should be planned for periods of mild weather. The structure at this location would be armored with grouted riprap. Turbidity could be temporarily increased during construction activities. However, given the already turbid waters in the LCR, impacts to fish would be minimal. Turbidity would return to pre-project conditions upon completion.

In addition to the construction and reconstruction of the levees, conveyance improvements at the BNSF Railroad Bridge would entail excavation of approximately 26 acres, and removal of about 96 acres of saltcedar. Removing saltcedar would directly affect about 96 acres of habitat that is used by migratory birds and resident wildlife. Conveyance improvements would include the excavation and widening of the channel bottom from approximately 1,000 feet upstream from the BNSF Railroad Bridge to approximately 1,000 feet downstream from the Route 66 (SR-87) Bridge. Turbidity would be temporarily increased during this time. However, given the already turbid waters in the LCR, impacts to fish would be minimal. Turbidity would return to pre-project conditions upon completion. After the completion of the widening the conveyance

channel, the channel bottom would be replaced with native material that is characteristic for the LCR.

Borrow and Disposal Work

Borrow materials would come from riverine or upland borrow areas. Excavated materials could be placed at McCauley, Winslow, or O'Haco sites. Vegetation is sparse within these areas and mostly consists of weeds. Wildlife in these areas would be briefly disturbed during the use of borrow material. However, these effects would be temporary and mobile wildlife would leave the area upon initiation of activities and return upon completion.

Under Alternative 1.1 and 8, approximately 263.8 acres (259.9 under Alternative 8) at a maximum to 105.6 acres (103.3 under Alternative 8) at a minimum of excavated material (depending on fill depth), totaling approximately 266,927 cy (approximately 266,388 cy under Alternative 8) would permanently raise the elevation of a portion of the placement site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. However, the footprint of the disposal area would generally remain unchanged. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation occurred.

Although borrow and disposal activities would temporarily impact wildlife, these effects would be short-term and minor. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions. Therefore, borrow and disposal activities would not permanently affect wildlife. Impacts would be less than significant.

Staging, Stockpiling, and Access

The vegetation within this area is mostly saltcedar and weeds. Although wildlife in the area would be briefly disturbed during staging and stockpiling activities, and equipment and vehicle access, these effects would be temporary and mobile wildlife would leave the work area upon initiation of the activities listed and return upon completion. Impacts would be less than significant.

Operation and Maintenance (O&M)

The O&M work would typically occur for only a short period of time, when needed. O&M work would take place during times of the year that would cause the least amount of disturbance to wildlife (e.g., outside migratory bird season and periods of minimal to no flow for channel work). Periodic vegetation and sediment removal may disturb wildlife in the area. Although wildlife in the area would be briefly disturbed during O&M work, these effects would be temporary and mobile wildlife would leave the work area upon initiation of the activities listed. BMPs would be implemented to avoid and minimize impacts to wildlife.

Effects Determination Summary

Considering all of the measures included in Alternatives 1.1 and 8, only short-term, minor adverse impacts would occur to wildlife as a result of the proposed project. The newly exposed area from saltcedar removal would be planted with native vegetation that would provide wildlife with a similar habitat structure to current habitat. In addition, any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions. To avoid impacts to migratory birds, work that would disturb or remove woody vegetation would not occur between April 15 and August 30 unless the affected area is first surveyed by a biologist and determined not to have nesting birds. During any in-water construction activity (near impingement points, channel excavation/widening, placing riprap or soil cement protection, etc.) BMPs would be incorporated to avoid and minimize possible negative impacts to fish species. BMPs may include, but would not be limited to silt curtains, wattles, coffer dams, and erosion protection screens. These BMPs would help to prevent fish access to the construction site and insure protection of water quality. BMPs would be inspected daily to maintain the connection to the substrate and would be removed following construction. After the completion of the widening of the conveyance channel, the channel bottom would be replaced with native material that is characteristic for the LCR. Impacts would be less than significant.

5.5.10. Alternative 3.1

Channel Work

Conveyance improvements at the BNSF Railroad Bridge and saltcedar removal would result in impacts similar to those characterized under Alternatives 1.1 and 8. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternatives 1.1 and 8. Unlike Alternative 1.1, the footprint of the two setback levees would permanently remove 26.9 acres of vegetation. Existing vegetation in this area is primarily weeds. By removing a portion the Winslow Levee segments, approximately 221.6 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area following construction. Sections of reconstructing the Winslow Levee, where the LCR forms impingement points, would require in-water construction and would be similar to the impacts characterized under Alternatives 1.1 and 8.

Borrow and Disposal Work

The assumptions applicable to borrow and disposal and levee construction work would be similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement also would be similar to Alternatives 1.1 and 8.

Approximately 226.2 acres at a maximum to 90.4 acres at a minimum of excavated material (depending on fill depth), totaling approximately 255,027 cy would permanently raise the elevation of a portion of the placement site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. However, the footprint of the disposal area would generally remain unchanged. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation occurred.

Although borrow and disposal activities would temporarily impact wildlife, these effects would be short-term and minor. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions. Therefore, borrow and disposal activities would not permanently affect wildlife. Impacts would be less than significant.

Staging, Stockpiling, and Access

Staging, stockpiling, and access would be as described for Alternative 1.1, except that the City of Winslow staging area would not be used. The batch plant proposed for the City of Winslow site would be relocated to property adjacent to the ADOT I-4 hydraulic gate right-of-way (owned by either the Navajo Tribe or Transcon, LLC).

Although wildlife in the area would be briefly disturbed during staging and stockpiling activities, these effects would be temporary and mobile wildlife would leave the work area upon initiation of the activities listed and would return upon completion. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Wildlife related impacts due to O&M activities would be less than significant.

Effects Determination Summary

Considering all of the measures included in Alternative 3.1, only short-term, minor adverse impacts would occur to wildlife as a result of the proposed project. The newly exposed area from saltcedar removal would be planted with native vegetation that would provide wildlife with a similar habitat structure to current habitat. In addition, any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions. To avoid impacts to migratory birds, work that would disturb or remove woody vegetation would not occur between April 15 and August 30 unless the affected area is first surveyed by a biologist and determined not to have nesting birds. During any in-water construction activity (near impingement points, channel excavation/widening, placing riprap or soil cement protection, etc.), BMPs would be incorporated to mitigate possible negative impacts to fish species. BMPs may include, but not limited to silt curtains, wattles, coffer dams, and erosion protection screens. These BMPs would help to prevent fish access to the construction site and insure protection of water quality. BMPs would need to be inspected daily to maintain the connection to the substrate and would be removed following construction. After the completion of the widening the conveyance channel, the channel bottom would be replaced with native material that is characteristic of the LCR. Impacts would be less than significant.

5.5.11. Alternatives 7 and 9

Nonstructural Measures

Nonstructural measures under Alternative 7 and 9 would not result in impacts to wildlife because the raising of structures would occur only at existing structures, where no wildlife is expected to be regularly present. Installation of flood warning systems would likewise not include impacts to wildlife.

Channel Work

No channel work is proposed for Alternative 7. For Alternative 9, reconstruction of the RWDL would result in impacts similar to those characterized under Alternatives 1.1 and 8. Reconstruction of the RWDL would take place during the dry season when there are little to no flows within the waterway. The structure at this location would be armored with grouted riprap. Turbidity would be temporarily increased during this time. However, given the already turbid waters in the LCR, impacts to fish would be minimal. Turbidity would return to pre-project conditions upon completion.

Borrow and Disposal Work

No borrow or disposal work is proposed for Alternative 7. For Alternative 9, the assumptions applicable to borrow and disposal and levee construction work would be similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement also would be similar to Alternatives 1.1 and 8.

Approximately 0.30 acres at a maximum to 0.12 acres at a minimum of excavated material (depending on fill depth), totaling approximately 6,022 cy would permanently raise the elevation of a portion of the disposal site by approximately 30 inches at a maximum to approximately 12 inches at a minimum. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation occurred.

Although borrow and disposal activities would temporarily impact wildlife, these effects would be short-term and minor. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions. Therefore, borrow and disposal activities would not permanently affect wildlife. Impacts would be less than significant.

Staging, Stockpiling, and Access

Due to the limited levee reconstruction, Alternative 9 would require only two staging areas. These consist of the sites on the Bolle Klaus Jurgen Rainer Trustee site, and the nearby property owned by the Navajo Tribe.

Although wildlife in the area would be briefly disturbed during staging and stockpiling activities, these effects would be temporary and mobile wildlife would leave the work area upon initiation of the activities listed and return upon completion. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Wildlife related impacts due to O&M activities would be less than significant.

Effects Determination Summary

Under Alternative 7, only non-structural measures would occur and there would be no effect to wildlife from these measures. Under Alternative 9, a minimal amount of vegetation would be removed. Due to similar vegetative abundance within other sections of the project area, this would not result in a significant impact to wildlife because the wildlife would be able to relocate

to other areas of similar habitat. Any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions. To avoid impacts to migratory birds, work that would disturb or remove woody vegetation would not occur between April 15 and August 30 unless the affected area is first surveyed by a biologist and determined not to have nesting birds. Impacts would be less than significant.

5.5.12. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

The impacts from the nonstructural measures for Alternative 10 would be similar to those for Alternatives 7 and 9. Nonstructural measures under Alternative 10.1, 10.2, 10.3, and 10.4 would be the same as and result in similar impacts as those described for Alternatives 1.1 and 8.

Channel Work

Conveyance improvements at the BNSF Railroad Bridge would result in impacts similar to those characterized under Alternatives 1.1 and 8, except that Alternative 10.4 would entail slightly more excavation. Alternative 10.2 does not include any conveyance improvements or saltcedar removal under the BNSF Railroad Bridge, so no impacts in this area would occur from Alternative 10.2. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternatives 1.1 and 8. Unlike Alternative 1.1, the footprint of the single setback levee would permanently remove 3.3 acres of vegetation. Existing vegetation in this area is primarily weeds. By removing some of the Winslow Levee segments, approximately 12 acres of additional floodplain area riverside of the levee would be available. This would result in a net increase to floodway area following construction. Sections of reconstructing the Winslow Levee, where the LCR forms impingement points, would require in-water construction and would be similar to the impacts characterized under Alternatives 1.1 and 8.

Borrow and Disposal Work

The assumptions applicable to borrow and disposal and levee construction work would be similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement also would be similar to Alternatives 1.1 and 8. See Table 5-5 for area needed for excavated material under each alternative.

Table 5-5 Disposal Quantities Associated with Alternatives

Alternative	Maximum Area Needed for Disposal (acres)	Minimum Area Needed for Disposal (acres)	Excavated Material (Cubic Yards)
10	205.5	82.2	223,959
10.1	205.5	82.2	223,959
10.2	93.4	37.3	67,713
10.3	248.9	99.6	223,959
10.4	191.4	76.6	223,959

Under Alternatives 10.1, 10.2, 10.3, and 10.4 disposal area footprints would basically remain unchanged. The sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment or revegetation occurred.

Although borrow and disposal activities would temporarily impact wildlife, these effects would be short-term and minor. All disposal and borrow areas that are currently vegetated would be brought back to pre-construction conditions. Therefore, borrow and disposal activities would not permanently affect wildlife. Impacts would be less than significant.

Staging, Stockpiling, and Access

Locations for staging, stockpiling and the batch plant would be as described for Alternative 1.1, except that the O'Haco North and O'Haco Middle sites would not be used.

Although wildlife in the area would be briefly disturbed during staging and stockpiling activities, and access of construction equipment and vehicles, these effects would be temporary and mobile wildlife would leave the work area upon initiation of the activities listed and would return upon completion. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Wildlife related impacts due to O&M activities would be less than significant.

Effects Determination Summary

Considering all of the measures included in Alternatives 10, 10.1, 10.2, 10.3, and 10.4, only short-term, minor adverse impacts would occur to wildlife as a result of the proposed project. The newly exposed area from saltcedar removal would need to be planted with native vegetation that would provide wildlife with a similar habitat structure to current habitat. In addition, any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions. To avoid impacts to migratory birds, work that would disturb or remove woody vegetation would not occur between April 15 and August 30 unless the affected area is first surveyed by a biologist and determined not to have nesting birds. During any in-water construction activity (near impingement points, channel excavation/widening, placing riprap or soil cement protection, etc.) BMPs would be incorporated to minimize possible negative impacts to fish species. BMPs may include, but would not be limited to silt curtains, wattles, coffer dams, and erosion protection screens. These BMPs would help to prevent fish access to the construction site and insure protection of water quality. BMPs would be inspected daily to maintain the connection to the substrate and will be removed following construction. After the completion of the widening the conveyance channel, the channel bottom would be replaced with native material that is characteristic for the LCR. Impacts would be less than significant.

5.5.13. Alternative 11: No Federal Action Alternative

The LCR would continue to meander across its floodplain, affecting the Winslow Levee at random locations over time. Within the context of global climate change, existing weather patterns could become more intense. Droughts could be more severe resulting in lower river flows. Rainfall could intensify, further increasing flows during the storm and monsoon seasons. Physical destruction of vegetation from high flow velocities, soil erosion/or sediment deposition will occur over time.

The Navajo County Flood Control District and the City of Winslow would continue operations and maintenance activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Emergency repairs may be required to stabilize weakened sections of the levee during floods. Such repairs would be limited in scope and duration, and would likely entail the discharge of rocks and earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel. Depending on the scope of the repairs and improvements, wildlife may be temporarily disturbed during these activities. These impacts would be relatively minor and mobile wildlife would leave the area upon initiation of construction activities and would return upon completion. Minor vegetation and rodent control would also occur, but impacts to wildlife would be minimal, if any. Impacts would be less than significant.

5.5.14. Environmental Commitments

In addition to the measures identified under Biological Resources – Vegetation, the following environmental commitments applicable to levee structural work would be incorporated into the contract specification or otherwise implemented by the Corps to reduce potential impacts to wildlife (WL):

WL 1 To avoid impacts to migratory birds, work that would disturb or remove woody vegetation would not occur between April 15 and August 30 unless the affected area is first surveyed by a biologist and determined not to have nesting birds.

WL 2 During any construction and O&M activities during minimal flow periods (near impingement points, channel excavation/widening, etc.), BMPs would be incorporated to minimize negative impacts to the sensitive flannelmouth. BMPs may include, but are not limited to the following: silt curtains, wattles, coffer dams, and erosion protection screens. These BMPs would help to prevent fish access to the construction site and insure protection of water quality. BMPs would be inspected daily to maintain the connection to the substrate and would be removed following construction.

WL 3 After the completion of the approximately ±26-acre area widening of the conveyance channel at the BNSF Railroad Bridge, follow-up treatment (e.g. mechanical and / or herbicide) is required on re-sprouting saltcedar. No reseeding and/or revegetation with native plantings would be required in the conveyance channel, as recurring O&M work removing sediment in the conveyance channel would inhibit long-term establishment of natives.

5.5.15. Significant Threshold: Special Status Species

Impacts would be considered significant if the alternative results in:

- Substantial loss of individuals of a federally-listed or special status species or unmitigated adverse modification of designated critical habitat.

5.5.16. Alternatives 1.1 and 8

Nonstructural Measures

Nonstructural measures under Alternative 1.1 and 8 would include a flood warning system and would not result in impacts to special status species, since none are anticipated in the developed area where the system would be installed.

Channel Work

As discussed above, sections of reconstructing the Winslow Levee, where the LCR forms impingement points, would require construction during minimal flows. Reconstruction of the RWDL would take place during the dry season when there are minimal to no flows within the waterway. The potential impact on flannel sucker would be avoided, minimized or reduced by performing channel work during the dry season and/or low flow periods in the LCR project area. Conveyance improvements would include the excavation and widening of the channel bottom from approximately 1,000 feet upstream from the BNSF Railroad Bridge to approximately 1,000 feet downstream from the Route 66 (SR-87) Bridge. An access point is also identified under the BNSF Railroad Bridge. Turbidity could be temporarily increased during construction and associated activities. However, given the normal background turbid waters in the LCR, impacts to fish including a species of special concern, the flannelmouth sucker, would be minimal and temporary. Turbidity would return to pre-project conditions upon completion. BMPs would be implemented during conveyance improvement work to minimize turbidity impacts. After the completion of the widening the conveyance channel, the channel bottom would be replaced with native material that is characteristic for the LCR. Excess material would be disposed of at upland areas and not within the active functional floodplain. Staging and stockpiling would be limited to areas upland and outside of the LCR. Therefore, impacts to the flannelmouth sucker would be less than significant. The determination of less than significant effect for the flannelmouth sucker is carried forward and applied to all Alternatives.

Although the construction and reconstruction of the levees would not widen the footprint of the existing structure riverward, there would be a 25-foot-wide zone used as a construction corridor. Therefore, this would require the removal of existing vegetation within the 25-foot-wide construction corridor zone for the entire length of constructed or reconstructed levees. Vegetation that does exist in dense patches near the levee includes saltcedar and other weed species. Also, adjacent to the levee, there are many open areas that little vegetation exists. In addition to the construction and reconstruction of the levees, conveyance improvements at the BNSF Railroad Bridge would entail excavation of approximately 25 acres, and removal of over 100 acres of saltcedar.

Due to the absence of habitat known to be associated with cuckoo and southwestern willow flycatcher occupation within the project area (including all borrow and disposal areas, as well as all staging, stockpiling, and access areas), the Corps has determined that the project would not affect the cuckoo or the southwestern willow flycatcher. As a precautionary measure, surveys would be conducted in suitable habitat prior to any construction activities to confirm the presence/absence of this species and of southwestern willow flycatcher within the project area. If either species is detected within the project area, BMPs (buffer zones, monitoring by a qualified biologist, removing vegetation outside of bird-nesting season, etc.) would be applied to avoid effects to the species, and consultation or coordination with the USFWS may occur as necessary to ensure compliance with the Endangered Species Act. Significant impacts to special status species are not anticipated. The determination of no effect for the yellow-billed cuckoo and southwestern willow flycatcher is carried forward and applied to all Alternatives.

Operation and Maintenance (O&M)

The O&M repair work discussed above would typically occur for only a short period of time, when needed. It is anticipated that most O&M work would take place during times of the year that would cause the least amount of disturbance to the flannelmouth sucker (ideally during periods of no flow for channel work). BMPs would be implemented during any type of O&M channel work (stream widening, dropping of water levels, placement of block nets to remove sensitive fish species prior to construction, etc.) to reduce negative impacts to the sensitive flannelmouth sucker occurring near bridge structures south of I-40. Surveys for the yellow-billed cuckoo and southwestern willow flycatcher would be conducted in suitable habitat prior to any activity to determine their presence within the O&M work areas. Although unlikely, if yellow-billed cuckoo or southwestern willow flycatcher are detected within the project area, BMPs would be applied to avoid effects to the species.

Effects Determination Summary

Impacts to special status species would be avoided or further reduced with implementation of the environmental commitments.

5.5.17. Alternatives 3.1

Channel Work

Conveyance improvements at the BNSF Railroad Bridge and saltcedar removal would result in impacts similar to those characterized under Alternatives 1.1 and 8. Likewise, reconstruction of Winslow Levee, RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized under Alternative 1.1 and 8. Unlike Alternative 1.1 and 8, the footprint of the two setback levees would permanently remove 26.9 acres of vegetation. Existing vegetation in this area is primarily weeds. By removing and relocating portions of the Winslow Levee segments, approximately 221.6 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area following construction. Sections of reconstructing the Winslow Levee, where the LCR forms impingement points, may require construction during minimal flow and would be similar to the impacts characterized under Alternatives 1.1 and 8. Potential impacts to fish including the flannelmouth sucker would be minimal and temporary. Therefore, impacts to the flannelmouth sucker would be less than significant. The determination of less than significant effect for the flannelmouth sucker is carried forward and applied to all Alternatives.

The assumptions applicable to borrow and disposal and levee construction work would be similar to Alternatives 1.1 and 8. Potential impacts from borrow material excavation and placement, as well use of as staging, stockpiling and access areas, also would be similar to Alternatives 1.1 and 8. Potential impacts to fish including the flannelmouth sucker would be minimal and temporary. Impacts would be less than significant.

Due to the likelihood that the cuckoo is not present within the project area, the Alternative 3.1 would not affect the cuckoo. As with Alternatives 1.1 and 8, no impacts are expected from borrow material excavation and placement, or from use of areas for staging, stockpiling and access. As an avoidance measure, surveys would be conducted in suitable habitat prior to any construction activities to confirm the presence/absence of this species within the proposed project area, as well as the flycatcher. If the either is detected within the project area, BMPs would be applied to avoid effects to these species.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8, and similar avoidance measures would be implemented. Special status species related impacts due to O&M activities would be less than significant.

Effects Determination Summary

With implementation of BMPs identified for Alternative 1.1 and 8, there would be no effect to the yellow-billed cuckoo under Alternative 3.1 and potential impacts to the flannelmouth sucker would be minimized. Therefore, impacts to the flannelmouth sucker would be less than significant. The determination of less than significant effect for the flannelmouth sucker is carried forward and applied to all Alternatives. Impacts would be less than significant to special status species.

5.5.18. Alternatives 7 and 9

Nonstructural Measures

Nonstructural measures under Alternative 7 and 9 would not result in impacts to special status species because none are expected to occur in the developed areas where structures would be raised or a flood warning system installed.

Channel Work

Under Alternative 7, only non-structural measures would occur and thus, there would be no effect to the yellow-billed cuckoo. Under Alternative 9, potential impacts resulting from reconstruction of the RWDL and associated activities would be similar to those characterized under Alternatives 1.1 and 8. However, since Alternative 9 does not include any conveyance improvements or channel work, impacts would be even less than under Alternatives 1.1 and 8. Impacts to fish including the flannelmouth sucker would be minimal and temporary, including those from borrow material excavation and placement, or from use of areas for staging, stockpiling and access. Therefore, impacts to the flannelmouth sucker would be less than significant. The determination of less than significant effect for the flannelmouth sucker is carried forward and applied to all Alternatives. Due to the likelihood that the yellow-billed cuckoo is not present within the project area, the Alternative 9 would not affect the cuckoo. As with Alternatives 1.1 and 8, no impacts are expected from borrow material excavation and

placement, or from use of areas for staging, stockpiling and access. As an avoidance measure, surveys would be conducted in suitable habitat prior to any construction activities to confirm the presence/absence of this species and the flycatcher within the proposed project area. If the yellow-billed cuckoo or flycatcher is detected within the project area, BMPs would be applied to avoid effects to these species.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Special status species related impacts due to O&M activities would be less than significant.

Effects Determination Summary

Under Alternative 7, only non-structural measures would occur and there would be no effect to the yellow-billed cuckoo. With implementation of BMPs identified for Alternative 1.1 and 8, there would be no effect to the yellow-billed cuckoo under Alternative 9 and potential impacts to the flannelmouth sucker would be minimized. Impacts would be less than significant to special status species.

5.5.19. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Nonstructural measures under Alternative 10 would not result in impacts to special status species, as described for Alternatives 7 and 9. Nonstructural measures under Alternative 10.1, 10.2, 10.3, and 10.4 would be the same as identified for Alternatives 1.1 and 8, and would not result in impacts to special status species, since none are anticipated in the developed area where the system would be installed.

Channel Work

Conveyance improvements at the BNSF Railroad Bridge would result in impacts similar to those characterized under Alternatives 1.1 and 8, even though Alternative 10.4 would entail slightly more excavation under the bridge. Alternative 10.2 does not include any conveyance improvements or saltcedar removal under the BNSF Railroad Bridge, so no impacts in this area would occur from Alternative 10.2. Likewise, reconstruction of Winslow Levee, RWDL, the construction of a new levee parallel to I-40, and associated borrow and disposal activities would result in impacts similar to those characterized under Alternatives 1.1 and 8. Unlike Alternative 1.1, the footprint of the single setback levee would permanently remove 3.3 acres of vegetation. Existing vegetation in this area is primarily weeds. By removing some of the Winslow Levee segments, approximately 9.9 acres of additional floodplain area riverside of the levee is available. This would result in a net increase to floodway area following construction. Sections of reconstructing the Winslow Levee, where the LCR forms impingement points, may require construction during minimal flows and would be similar to the impacts characterized under Alternatives 1.1 and 8. Impacts to fish including the flannelmouth sucker would be minimal and temporary, including those from borrow material excavation and placement, or from use of areas for staging, stockpiling and access.

Due to the likelihood that the yellow-billed cuckoo is not present within the project area, the Alternatives 10, 10.2, 10.2, 10.3, and 10.4 would not affect the cuckoo. As with Alternatives 1.1 and 8, no impacts are expected from borrow material excavation and placement, or from use of areas for staging, stockpiling and access. As an avoidance measure, surveys would be conducted in suitable habitat prior to any construction activities to confirm the presence/absence of this species and the flycatcher within the proposed project area. If the yellow-billed cuckoo or flycatcher is detected within the project area, BMPs would be applied to avoid effects to these species.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Special status species related impacts due to O&M activities would be less than significant.

Effects Determination Summary

With implementation of the environmental commitments, any potential impacts would be further reduced, and there would be no effect to the yellow-billed cuckoo under Alternatives 10, 10.1, 10.2, 10.3, and 10.4 and potential impacts to the flannelmouth sucker would be minimized. Impacts would be less than significant to special status species.

5.5.20. Alternative 11: No Federal Action Alternative

The LCR would continue to meander across its floodplain, affecting the Winslow Levee at random locations over time. Within the context of global climate change, existing weather patterns could become more intense. Droughts could be more severe resulting in lower river flows. Rainfall could intensify, further increasing flows during the storm and monsoon seasons. Physical destruction of vegetation from high flow velocities, soil erosion or sediment deposition could occur over time.

The Navajo County Flood Control District and the City of Winslow would continue operations and maintenance activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Emergency repairs may be required to stabilize weakened sections of the levee during floods. Such repairs would be limited in scope and duration, and would likely entail the discharge of rocks and earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel. Depending on the scope of the repairs and improvements, BMPs would be employed to reduce the negative impacts to the flannelmouth sucker during these activities. Due to the likelihood that the yellow-billed cuckoo is not present within the project area, the Alternative 11 would not affect the cuckoo. Impacts would be less than significant.

5.5.21. Environmental Commitments

In addition to the measures identified under Biological Resources – Vegetation and Biological Resources – Wildlife, the following environmental commitment applicable to levee structural work would be incorporated into the contract specification or otherwise implemented by the Corps to reduce potential impacts to special status species:

SP 1 As a precautionary measure, prior to the start of any construction or O&M activities, surveys for the Yellow-billed Cuckoo and southwestern willow flycatcher will be conducted. The following additional BMPs would be applied to avoid or minimize effects to species.

- Follow-up treatments (e.g. mechanical and /or herbicide) of saltcedar would occur within saltcedar removal areas. This area would be reseeded and/or revegetated with native plantings.
- During any construction or O&M activities during minimal flow periods (near impingement points, channel excavation/widening, etc.), BMPs would be incorporated to minimize negative impacts to the sensitive flannelmouth as well as other fish species. BMPs may include, but are not limited to the following: silt curtains, wattles, coffer dams, and erosion protection screens. These BMPs would help to prevent fish access to the construction site and insure protection of water quality. BMPs would be inspected daily to maintain the connection to the substrate and would be removed following construction.
- After the completion of the widening of the conveyance channel, the channel bottom would be replaced with native material that is characteristic for the LCR.
- In addition, any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions.

5.6. Cultural Resources

5.6.1. Significance Threshold

Under NEPA, significance is determined based on ‘context’ and ‘intensity.’ For cultural resources, context is often viewed in terms of how important the resource may or may not be, while intensity is viewed in terms of the severity of the impacts to the resource. While cultural resources that are not eligible for the NRHP are still considered as part of the NEPA review, once that resource fails to meet the criteria for eligibility for inclusion on the NRHP its ‘context’ is found to be lacking. The phrase “adverse effect” (used in the NHPA) and “significant impact” (used in NEPA) are not equivalent terms but are similar in concept. Under the NHPA, impacts to cultural resources are typically examined in terms of how the project would affect the characteristics that make the property eligible for the National Register. The types of characteristics (criteria) are described in the sidebar in section 4. For instance archaeological sites that are eligible under Criterion D may be impacted by ground disturbance. Meanwhile, a property that is eligible under Criterion A, such as a farmhouse or TCP, may be impacted by the introduction of audible or visual intrusions because these intrusions would affect its integrity of location, setting, and feeling. Such impacts are referred to as adverse effects in the NHPA’s implementing regulations (36 CFR 800.5).

For the purposes of this analysis, an adverse effect to an eligible cultural resource would be considered a significant impact under NEPA if after minimization and mitigation, the remaining impacts to the property from implementation of the alternative would be substantial enough that implementation of the alternative would result in the loss of a property's eligibility (intensity). Except in rare cases, the relocation of a property that is eligible under Criteria A or B would result in the loss of that property's eligibility (36 CFR 60.4).

5.6.2. Alternatives 1.1 and 8

Nonstructural Measures

Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system and would not result in impacts to cultural resources. Implementation of a flood warning system would be limited to development of a plan or set of procedures and potential installation of instrumentation to measure rainfall or stream flow. No impacts would occur to cultural resources.

Channel Work

Cultural resources are geospatial resources that are most clearly impacted by ground disturbing activities. Alternatives 1.1 and 8 follow the current levee alignment where prior ground disturbance likely destroyed or damaged any archaeological sites that may have been located within or under the current levee making it unlikely that these sites, if they exist, would be eligible for the NRHP. Alternative 8 also includes a short setback levee across from Homolovi I. The Winslow levee was built in 1989 and the RWDL was built in 1970. Neither feature currently meets the 50-year threshold typically required for evaluation for inclusion on the NRHP. The RWDL will likely reach the 50-year threshold by the time that the project would be constructed. The levee is not of an unusual type, exhibit any unique characteristics, nor did its construction significantly alter development in the Winslow area. It is highly unlikely that the marginally historic era resource would be determined to be eligible for the NRHP. A cultural resources survey was conducted of the southern 4.25 mile levee construction corridor. As described in Table 5-6, a prehistoric site is located within the levee construction corridor (Temp 1), and a historic archaeological site is located in one of the borrow and disposal areas (Temp 2).

The Corps has assumed that both sites are eligible for the NRHP under Criterion D for the purposes of this analysis. Further testing to evaluate the site will be conducted in the next phase of the study in accordance with the PA (Appendix I - Environmental). Due to its location in a borrow and disposal area, the historic archaeological site can easily be avoided during project construction. Approximately 10 to 20 yards of the eastern edge of the prehistoric site would be directly impacted by ground disturbing activities associated with construction of the levee. These impacts would constitute an adverse effect under the NHPA. However, the site is very large and the majority of the site would be preserved thus the impact would not be substantial enough that implementation of the alternative would result in the loss of the property's eligibility, and consequently, the impact would be below the threshold of significance under NEPA. The total number of historic structures that would be removed as part of these alternatives is not known at this time. Preliminary real estate analysis has identified three parcels that contain historic era structures that may be impacted by these alternatives. The remaining parcels either contain no extant structures or the structures are over 0.25 miles away from the construction corridor. This analysis is based on the preliminary real estate plan (Appendix H – Real Estate) and Navajo

County Appraiser data. During the detailed design phase, every effort would be made to avoid impacting historic structures.

Table 5-6 Properties within Alternatives 1.1 and 8

Property ID	Structure	Construction Dates	Discussion
A-1	House and 4 outbuildings	▪ House constructed in 1950. Unknown date on outbuildings	The alternatives are unlikely to require the home to be moved but may affect a historic era barn and corral (date of construction unknown). The barn and corral may be eligible for listing on the NRHP. If eligible this alternative would result in an adverse effect under NHPA but it is anticipated that the effect could be avoided or minimized to below significant under NEPA.
A-2	House and 5 outbuildings	▪ House =1937 ▪ Shed=1986 ▪ Quonset Hut =1995 ▪ Shed=1954 ▪ A fifth structure was counted during the real estate reconnaissance but does not appear in the appraisal records	The house and outbuildings are located within the setback levee alignment (Alt 8). The residence and or some of the outbuildings may need to be relocated. The House may be eligible but it is highly unlikely that the outbuildings would be eligible. If the house is eligible and must be removed then this would constitute an adverse effect under NHPA. Removal of the structure would most likely result in a loss of the property's eligibility and therefore would be a significant impact under NEPA.
A-3	2 houses and 1 outbuilding/yard improvements	▪ House #1=1910 ▪ House # 2= 1910 ▪ Outbuilding/yard improvements=1945	A search of the Navajo County Assessors website and Google Earth reveals that all of the structures are located well outside the construction footprint and are unlikely to be affected. From the aerial photos it appears that the described "yard improvements" are actually 2 separate structures.

None of the structures have been recorded or evaluated for listing on the NRHP. If determined eligible for listing, demolition or relocation of the structures would constitute an adverse effect under NHPA and would constitute a significant impact under NEPA if demolition or removal results in a loss of eligibility.

Approximately 1.25 miles of the levee corridor proposed in Alternatives 1.1 and 8 have not been inventoried for cultural resources. Larger area or extent of ground disturbance typically increases the likelihood of impacting cultural resources. Alternatives 1.1 and 8 follow the current alignment of the levee so the likelihood of encountering intact archaeological sites immediately adjacent to the levee is diminished. If eligible sites are located within the corridor then it is more likely that they will be located outside of the original impact zone, in an area that can be avoided. Alternative 8 also includes a short setback levee. The setback area and levee corridor has been inventoried for cultural resources. No archaeological sites were located within the setback area. One parcel containing historic structures is located within the setback area and is discussed in the table above.

Similarly, the Corps completed a reconnaissance survey of the approximate 94.5 acre saltcedar removal and channelization area. The saltcedar is too dense to allow for full inventory coverage. The river changes course frequently, actively scouring sections of the channel and depositing river silts in others. These two project elements, located in an active river channel, have an extremely low likelihood of containing eligible cultural resources.

At this time, the Corps believes that implementation of Alternatives 1.1 and 8 is likely to result in an adverse effect to historic properties due to impacts to the prehistoric site, as well as impacts to the potentially eligible historic era barn and corral (A-1); however, full demolition of these structures is not anticipated. If the barn and corral are determined to be eligible for the NRHP and if impacts cannot be avoided or minimized, then the alternative would result in an adverse effect under NHPA and a significant impact under NEPA. Alternative 8 may require the removal of a residence located within the setback area (A-2). If the residence is determined to be eligible for the NRHP and if it cannot be avoided then the alternative would result in an adverse effect under NHPA and a significant impact under NEPA. While impacts to the prehistoric site are likely to be adverse under NHPA, the impact would not be substantial enough that implementation of the alternative would result in the loss of a property's eligibility, and consequently, the impact would be below the threshold of significance under NEPA.

The Hopi Tribe contacted the Corps via letter in May of 2015. The Hopi Tribe has stated that they are concerned that the setback levee may alter the LCR's flow and cause adverse impacts to Homolovi State Park on the east side of the LCR. The Corps has entered into formal consultation with the Hopi Tribe about these concerns. The Hopi Tribe's letter was specifically in response to Alternative 10.1 which contains the same setback found in Alternative 8. In order to address these concerns, the Corps completed a variety of hydraulic analyses. The Corps compared hydraulic models of each alternative to two discrete baseline conditions. In the first baseline condition, the Corps assumed that the existing levees would not fail prior to overtopping. In the second baseline condition, the Corps factored in the probability that the existing levees could perform unsatisfactorily either through slope failure, impingement or piping.

A thorough discussion of potential impacts to Homolovi I for Alternatives 1.1 and 8 can be found in Section 5.6.5. Based on conceptual level designs, hydraulic modeling and best professional judgment, Alternatives 1.1 and 8 should not significantly alter the water surface profile at Homolovi or increase the flood frequency compared to the baseline conditions where the existing levee would not fail prior to overtopping. During later planning and design phases, additional hydraulic conditions would be modeled with the recommended plan to ensure that the project would not result in an adverse effect or a significant impact under NEPA.

<u>Borrow and Disposal Work and Staging Stockpiling and Access Areas</u>
Currently, 800 acres have been identified as potential borrow and disposal areas although it is estimated that only about 200 acres will be needed. Only about 60 of these acres have been surveyed for cultural resources. During the next design phase, PED, a cultural resource inventory would occur at borrow and disposal areas as well as any ancillary staging areas or access roads. Since there is anticipated to be sufficient extra space, any eligible cultural resources would be avoided and consequently there would not be a significant impact under NEPA. One area that has been preliminarily identified as a potential borrow area is in the river bed. Based on the

hydraulic analysis and water surface profile related to the setback levee and the fact that the proposed borrow location is upstream from Homolovi I by 2,000 feet, the use of the in-river borrow area is not expected to result in any changes to the calculated water surface at Homolovi.

Operations and Maintenance

Future O&M activities such as vegetation control, levee repair/maintenance and sediment removal under the BNSF Bridge would not result in an adverse effect under NHPA or a significant impact under NEPA. All O&M activities would occur in areas that were inventoried for cultural resources and were disturbed as part of the initial project. If any historic properties are located within O&M areas, then they would have previously been mitigated. As part of the implementation of the PA (Appendix I - Environmental), any treatment plans prepared, where eligible sites are not fully mitigated, shall include provisions for avoidance during future O&M activities.

Effects Determination Summary

Implementation of Alternative 1.1 and 8 are likely to result in an adverse effect to historic properties due to the impacts to the prehistoric site referred to as Temp 1 as well as impacts to the potentially eligible historic era barn and corral; however, full demolition of these structures is not anticipated. While impacts to the prehistoric site are likely to be adverse under NHPA, the impact would not be substantial enough that implementation of the alternative would result in the loss of a property's eligibility, and consequently, the impact would be below the level of significance under NEPA. However, if the barn and corral are determined to be eligible for the NRHP and if impacts cannot be avoided or minimized, then the alternative would result in an adverse effect under NHPA and a significant impact under NEPA. It is anticipated that the effect could be avoided or minimized to below significant under NEPA. Alternative 8 may require the removal of a residence located within the setback area. If the structure is determined to be eligible for the NRHP and if they cannot be avoided then the alternative would result in an adverse effect under NHPA and a significant impact under NEPA.

5.6.3. Alternative 3.1

Nonstructural Measures

Nonstructural impacts would be the same as described for Alternatives 1.1 and 8.

Channel Work

Conveyance improvements at the BNSF Railroad Bridge would result in impacts similar to those characterized under Alternative 1.1. Likewise, reconstruction of the Winslow Levee, east end of the RWDL, and the construction of a new levee parallel to I-40 would result in impacts similar to those characterized with Alternative 1.1.

Construction of new setback levees and removal of existing levees would result in an adverse effect to the prehistoric archaeological site (Temp 1). The site would be mostly destroyed by the construction of the levee and consequently, the adverse effect is considered a significant impact under NEPA. Furthermore, the alignment of the proposed levee is more likely to encounter eligible cultural resources since it is within an undisturbed corridor.

Preliminary real estate analysis has identified nine parcels containing ten residences that may be impacted by this alternative, but only eight of these are residences that may be relocated. The remaining parcels either do not have extant structures or the structures are over 0.25 miles away from the construction corridor. The nine parcels are each described and analyzed in the table below for Alternative 3.1.

If determined eligible, the demolition or relocation of these structures would constitute an adverse effect under NHPA and would constitute a significant impact under NEPA.

Alternative 3.1 features the largest setback of all of the alternatives. In order to ascertain, how Homolovi I would be affected by this alternative, the Corps modeled Alternative 3.1 and compared it to a baseline condition assuming that the existing levees do not fail. Under the no levee failure baseline condition, the average water surface elevations in this area is expected to decrease by about 2.2 feet under Alternative 3.1 compared to this baseline.

The Corps also compared Alternative 3.1 to a baseline condition scenario in which the levee failed prior to water overtopping the levee. Under this second scenario, the average water surface elevation at Homolovi decreased by about 1.5 feet, which corresponds to about a 15 foot decrease in floodplain extent.

Borrow and Disposal and Staging and Access Areas

During the PED phase, a cultural resource inventory would occur of the appropriate borrow and disposal parcels and additional staging areas and access routes. Impacts would be the same as Alternative 1.1 and 8.

Operations and Maintenance

O&M impacts would be the same as Alternative 1.1 and 8.

Effects Determination Summary

Overall implementation of Alternative 3.1 would result in adverse impacts to at least one known archaeological site and is considered a significant impact under NEPA. The proposed alignment is likely to adversely impact additional archaeological sites. The alternative would also require relocating three historic structures. If the structures are determined to be eligible, this relocation of the structures would result in a significant impact under NEPA.

Table 5-7 Properties within Alternative 3.1

Property ID	Structure	Construction Dates	Discussion
B-1	House and 3 outbuildings	▪ House constructed in 1979 ▪ Unknown date on Outbuildings	Does not meet age threshold for NRHP (highly unlikely to be eligible).
A-1	House and 4 outbuildings	▪ House constructed in 1950. ▪ Unknown date on outbuildings	The alternative is unlikely to require the home to be moved but will most likely affect a historic era barn and corral (date of construction unknown). The barn and corral may be eligible. If eligible this alternative would result in an adverse effect under NHPA but it is anticipated that the effect could be avoided or minimized to below significant under NEPA.
B-2	House and 3 outbuildings	▪ House constructed in 1956. Unknown date of construction for outbuildings	Outbuildings appear to date to the same period as the house (unlikely to be eligible).
B-3	House	▪ House constructed in 1965	Single level ranch style home. (Unlikely to be eligible for the NRHP).
B-4	House and 1 outbuilding	▪ House constructed in 1986. Unknown date of construction for outbuilding	Does not meet age threshold for NRHP (highly unlikely to be eligible).
B-5	House and 1 outbuilding	▪ House constructed in 1922. ▪ Unknown date of construction for outbuilding	The outbuilding appears to be a greenhouse. House may be eligible but it is highly unlikely that the greenhouse would be eligible. The house would be relocated. If determined eligible its removal would constitute an adverse effect. Removal of the structure would most likely result in a loss of the property's eligibility and therefore would be a significant impact under NEPA.
A-2	House and 5 outbuildings	▪ House =1937 ▪ Shed=1986 ▪ Quonset Hut =1995 ▪ Shed=1954 ▪ Aerial photos indicate a fifth structure may be present on the property	The house and outbuildings are located within the setback levee alignment. The residence and or some of the outbuildings may be relocated. The House may be eligible but it is highly unlikely that the outbuildings would be eligible. Removal of the structure would most likely result in a loss of the property's eligibility and therefore would be a significant impact under NEPA.
B-6	House	▪ House constructed in 1987	Does not meet age threshold for NRHP (highly unlikely to be eligible).
A-3	2 houses and 1 outbuilding/yard improvements	▪ House #1=1910 ▪ House # 2= 1910 ▪ Outbuilding/yard improvements=1945	A search of the Navajo County Assessors website and Google Earth reveals that all of the structures are located well outside the construction footprint and are unlikely to be affected. From the aerial photos it appears that the described "yard improvements" are actually 2 separate structures.

5.6.4. Alternatives 7 and 9

Nonstructural Measures

Implementation of nonstructural measures under these alternatives could lead to impacts to historic structures in the floodplain. These impacts include historic structure modifications as a result of flood proofing structures. Measures such as a flood warning system are highly unlikely to result in adverse impacts under the NHPA but measures such as elevating a house foundation could lead to adverse effects under the NHPA if those structures are determined to be eligible for the NRHP. It is highly unlikely that these adverse effects would be extensive enough to result in the loss of a property's eligibility for the NRHP. Significant impacts under NEPA are not expected.

Neither alternative would reduce flood risk for the urban core of the City of Winslow. Flooding impacts to the Winslow Residential Historic District, the La Posada Historic District, and the Winslow Commercial Historic District would continue to occur under these alternatives. As no change would occur compared to the existing condition, this would not be a significant impact under NEPA.

Channel Work

Under Alternative 9 an approximately 0.4-mile-long segment of RWDL would be reconstructed at the existing height. This corridor was surveyed for cultural resources and no cultural resources were located in this section. No additional impacts to cultural resources are expected to occur under Alternative 9 versus Alternative 7.

Under either baseline scenario, Alternatives 7 and 9 would have no change to the existing conditions at Homolovi I

Borrow and Disposal Work and Staging and Access Areas

During PED phase, a cultural resource inventory would occur of the appropriate parcels. Impacts would be the same as Alternative 1.1 and 8.

Operations and Maintenance

O&M impacts would be the same as Alternative 1.1 and 8.

Effects Determination Summary

Under these alternatives, minor modifications would occur to historic structures but these modifications are unlikely to be significant under NEPA. No additional impacts to cultural resources are expected to occur under Alternative 9 versus Alternative 7.

5.6.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Implementation of nonstructural measures under Alternative 10 would result in cultural resources impacts similar to those characterized under Alternatives 7 and 9. A flood warning

system was proposed under Alternatives 10.1 thru 10.4. The flood warning system would not impact cultural resources.

Channel Work

For the purposes of cultural resources, there is no real difference between Alternatives 10, 10.1, 10.2, 10.3, and 10.4.

Reconstruction of the RWDL and Winslow Levee, setback work, conveyance improvements at the BNSF Railroad Bridge, and O&M activities would result in cultural impacts that would be similar to those characterized under Alternatives 1.1 and 8, with the exception that no impacts would occur in the northern 2.50 miles of the Winslow Levee.

Preliminary real estate analysis has identified two parcels containing two structures that may be impacted by Alternatives 10, 10.1, 10.2, 10.3, and 10.4. The remaining parcels do not contain extant structures or the structures are over .25 miles away from the construction corridor. The parcels identified in the table below are common to Alternatives 1.1, 8, and 3.1.

As previously discussed under Alternatives 1.1 and 8, the Hopi Tribe contacted the Corps in regards to potential adverse effects to Homolovi I. The letter specifically addressed Alternative 10.1; however, the information is applicable to all alternatives that modify the current levee alignment. The Hopi Tribe is concerned that changes in the levee may modify the River's course and impact the National Register listed site, Homolovi I, located on the east side of the river opposite the proposed setback. As described in Section 0, Homolovi I is a highly significant pueblo complex occupied by the Hopi Tribe from approximately 1285-1390.

Table 5-8 Properties within Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Property ID	Structure	Construction Dates	Discussion
A-1	House and 4 outbuildings	▪ House constructed in 1950. Unknown date on outbuildings	The alternative is unlikely to require the home to be moved but will most likely affect a historic era barn and corral (date of construction unknown). The barn and corral may be eligible. . If eligible this alternative would result in an adverse effect under NHPA but it is anticipated that the effect could be avoided or minimized to below significant under NEPA.
A-2	House and 5 outbuildings	▪ House =1937 ▪ Shed=1986 ▪ Quonset Hut =1995 ▪ Shed=1954 ▪ A fifth structure was counted during the real estate reconnaissance but does not appear in the appraisal records	The house and outbuildings are located within the setback levee alignment. The residence and or some of the outbuildings may need to be relocated. The House may be eligible but it is highly unlikely that the outbuildings would be eligible. If the house is eligible and must be removed then this would constitute an adverse effect under NHPA. Removal of the structure would most likely result in a loss of the property's eligibility and therefore would be a significant impact under NEPA.

In an effort to assess if and how the proposed project would affect Homolovi I, the Corps modeled the baseline conditions of the 1 percent ACE flood event, also known at the 100-year flood, and compared it to the same event but with the constructed Alternative 10.1. Under this model scenario, the water surface elevation at Homolovi I slightly decreased with Alternative 10.1 compared to the most likely baseline condition as a result of the setback levee across from the site. The water surface elevation decreased by approximately 0.2 feet (4,852.4 feet for the baseline condition and 4,852.2 feet for the proposed project) near Homolovi I. The aerial extent of the water would also decrease by about two feet. The average flow velocity in the reach near the Homolovi I Pueblo slightly decreased 0.5 feet per second (ft/s) from 4.2 ft/s from the baseline condition to 3.7 ft/s for the proposed project due to changes in the river's conveyance and the setback levee. Under this model scenario, the decrease in average flow velocity in the reach by Homolovi I is minimal and would not result in an increase in flooding at Homolovi I.

Under the second less likely baseline scenario, the existing levee system was modeled taking into account the potential failure before overtopping. Consequently, the Corps also modeled a scenario in which there are a series of four levee failures (three upstream and one downstream) from Homolovi I during a one percent ACE event and compared that scenario to Alternative 10.1. In this second baseline scenario, water would leave the system prior to reaching Homolovi I and therefore, the water surface elevation could be up to 0.5 feet higher at Homolovi I under Alternative 10.1 versus a baseline condition where the levees failed. This increase in water surface elevation equates to an average of ten feet of aerial extent. (See Figure 5-2).

The second baseline condition in which the levees fail is much less likely to occur than the baseline condition in which the levees do not fail but are overtopped. The four levee cross sections were evaluated for their probability to perform unsatisfactorily in a series of given flood events. At the most likely failure point for locations where improvements would be made under Alternatives 10 to 10.4, there is approximately a 16 percent chance of failure at a water surface elevation that corresponds with about the four percent ACE event. At the levee failure point closest to Homolovi I there is a one percent chance of failure at a water surface elevation that corresponds to the 4 percent ACE event. This probability of levee failure increases with larger (and lower probability) flood events. In summary, the levee would need to simultaneously fail at all four locations in order to see less water at Homolovi I which brings the likelihood that this second baseline condition would occur to a less than five percent chance in any given flood event.

Similar modeling as described above was also performed for Alternative 10.4. For the first baseline condition scenario in which the levees do not fail, a 0.5 percent ACE flood event, also known as a 200-year flood, was used because Alternative 10.4 includes increased conveyance under the BNSF Railroad Bridge designed for the 0.5 percent ACE flood and is based in the water surface profiles for the 0.5 percent ACE flood. Compared to this scenario, the average flow velocity and water surface elevation are anticipated to slightly decrease with implementation of Alternative 10.4. For Alternative 10.4, the average flow velocity decrease is anticipated to be 0.7 ft/s (from 4.8 ft/s from the baseline to 4.1 ft/s) for Alternative 10.4. The water surface elevation near Homolovi I is anticipated to decrease by 0.2 feet (4854 feet for the baseline condition and 4853.8 feet for Alternative 10.4). This equates to a two-foot decrease in aerial extent.

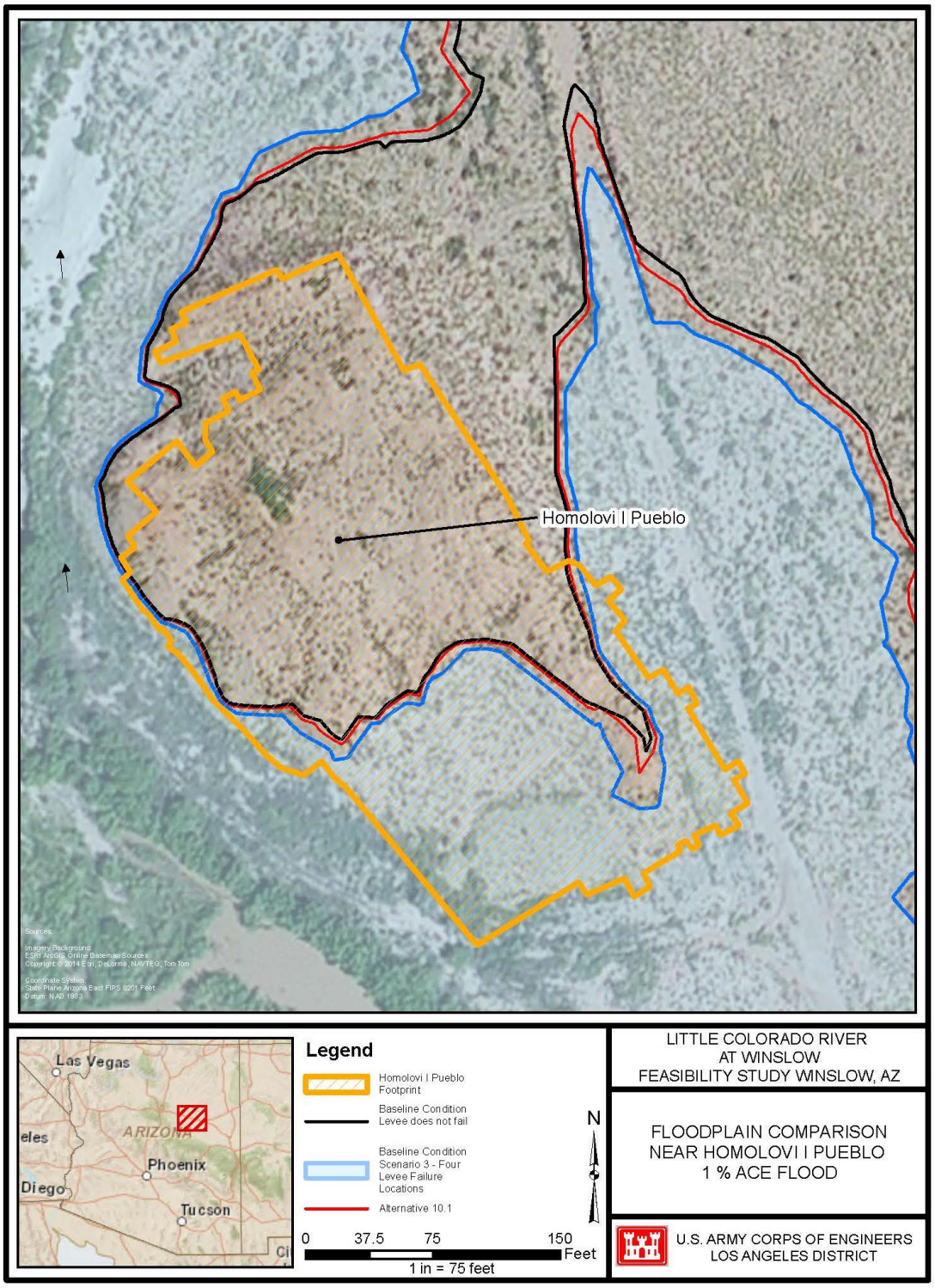

Figure 5-2 Floodplain Comparison near Homolovi I Pueblo 1 percent ACE Flood

A levee failure scenario was not modeled for Alternative 10.4, but the data strongly suggests that the results would be similar to the model run of 10.1. The Corps anticipates that all other alternatives, with the exception of 3.1, 7 and 9, would have similar water surface elevations and aerial extents as Alternatives 10.1 and 10.4. Based on this modeling effort, the Corps has concluded that it is not reasonably foreseeable that the project alternatives would result in an adverse effect to Homolovi I.

The Corps prepared a memo summarizing the results of the first baseline condition model run (levees overtop but do not fail), which was provided to the Hopi Tribe on March 31, 2016, along with an offer to conduct a consultation meeting with the Hopi Tribe, SHPO, ASM, and Arizona State Parks. The Hopi Tribe agreed that a meeting would be useful; however, due to scheduling conflicts the meeting did not occur until September 6,' 2017. The results of both model runs were a primary focus of the consultation meeting, which included representatives from the Hopi Tribe, the SHPO, Arizona State Parks, the Corps, and Navajo County. By the end of the meeting, and reaffirmed by the follow up letter sent by the Hopi Tribe on September 18, 2017, the parties agreed that the modeling demonstrated that adverse effects were unlikely to occur due to implementation of the recommended plan; however, adverse effect to the prehistoric site located in the levee construction corridor were likely

The Corps will continue to work closely with the Hopi Tribe, Arizona State Parks, ASM, and the SHPO to ensure that potential impacts to Homolovi I are addressed throughout each stage of the study. Early in the PED phase, as the recommended plan is further refined, the Corps would model the alternative at different flood events and different scenarios to ensure that impacts to Homolovi I are avoided and minimized or otherwise mitigated.

Borrow and Disposal Work and Staging and Access Areas

Currently, 800 acres have been identified as potential borrow and disposal areas although it is estimated that only about 200 acres will be needed. Only about 60 of these acres have been surveyed for cultural resources. During the PED phase, a cultural resource inventory would occur of the appropriate parcels and any additional staging areas or access routes. Impacts would be the same as Alternative 1.1 and 8.

Operations and Maintenance

O&M impacts would be the same as Alternative 1.1 and 8.

Effects Determination Summary

Similar to Alternatives 1.1 and 8, Alternatives 10 through 10.4 will likely result in an adverse effect to the prehistoric site located in the levee construction corridor and may result in an adverse effect to the historic era barn and corral if they are determined eligible for the NRHP and if they cannot be avoided. While impacts to the prehistoric site are likely to be adverse under NHPA, the impact would not be substantial enough that implementation of the alternative would result in the loss of the property's eligibility, and consequently, the impact would be below the threshold of significance under NEPA. Similarly, it is anticipated that if the barn and corral are determined eligible, appropriate avoidance and/or minimization measures shall be employed in order to lessen the impact so that it would be less than significant under NEPA. These alternatives may also require the removal of structures located within the setback area. If these

structures are determined to be eligible for the NRHP and if they cannot be avoided then the project would result in an adverse effect under NHPA and a significant impact under NEPA. Homolovi I would not be adversely affected by the alternatives.

5.6.6. Alternative 11: No Federal Action Alternative

Under Alternative 11, no Federal action would be undertaken to address the flood risk for the Winslow community. As described in Section 4.2, the existing Winslow Levee was designed and built to convey flows up to approximately 65,000 cfs, which was estimated to be the one percent ACE in the 1980s. However, based on an evaluation completed by the Corps in 2010, the one percent ACE was determined to be 69,200 cfs, and based on current levee conditions, the existing levee would overtop at the same location as the 1993 flood at a discharge rate of 55,000 cfs (about a two percent ACE storm event) (see Appendix B - Hydraulics). Further, based on geotechnical analysis conducted for this study, the existing levee system is susceptible to potential failure before overtopping at certain locations for certain levels of flood events. At the most likely failure point with the greatest risk to the City of Winslow, there is approximately a 16 percent chance of failure at a water surface elevation that corresponds with about the four percent ACE event. This probability of failure increases with increases in water surface elevations or lower probability flood events. As described above, two without-project baseline conditions were evaluated for comparison with the action alternatives: a baseline condition where the existing levees would not fail prior to overtopping, and a baseline condition, less likely, where the existing levees could fail based on the probability of unsatisfactory performance due to levee slope failure, impingement, or piping failure prior to waters overtopping the levee. Further detail is included in Appendix B - Hydraulics.

With the “No Action Alternative,” O&M activities for the Winslow Levee and RWDL would continue. Navajo County would continue repairing and improving the Winslow Levee on a reactionary, post-flood basis. Cultural resources located within the flood plain would continue to be flooded on the same cycle that it currently occurs. No change in impacts to cultural resources would occur.

5.7. Air Quality

5.7.1. Significance Threshold

Impacts would be considered significant if the alternative:

- Exceeds General Conformity Rule *de minimis* rates (specified in 40 C.F.R. 93.153).

5.7.2. Air Quality Calculation Methodology

To calculate anticipated emissions for a project, projected equipment hours were multiplied by composite emission factors for each class of equipment. Emission factors provide a way to convert equipment hours to pounds of pollutants. The AZDEQ Air Quality Division does not publish emission factors for on-road and off-road vehicles. As a result, emissions were estimated using the South Coast Air Basin (SCAB) Fleet Average Emission Factors (diesel) published by the South Coast Air Quality Management District. Due to the regional vicinity of Arizona to

California, the fleet mix was assumed to be similar. Fleet emissions factors for the year 2020 were used in the calculations. The factors were then multiplied by the estimated predicted hours or miles for each unit of equipment to produce an estimated emission. A summation of each equipment emissions per alternative was then created (in tons), as well as a maximum annual air emissions over the expected duration of the project. Assumptions and calculations are documented in Appendix I - Environmental.

Detailed emissions estimates were calculated for Alternative 3.1 only since this alternative entailed the largest scope of construction relative to the other alternatives. Thus, emissions estimates for Alternative 3.1 are expected to exceed emissions estimates associated with the other alternatives. Emissions for other alternatives were prorated to the length of the levee construction relative to Alternative 3.1.

Under Alternative 3.1, equipment usage hours for the entirety of levee construction were multiplied by the appropriate emissions factors to yield total emissions for the entirety of construction. However, the duration of construction is expected to be approximately eight years. The results were divided by eight to yield annual emissions estimates.

Estimates of lead emissions were not calculated. Lead emissions from mobile sources significantly decreased due to the near elimination of lead in fuels. Thus, there are no emission factors available for mobile sources. Lead levels beyond natural background concentrations are associated with areas where buildings containing lead-based paints were demolished and paint chips are mixed with the soil as a result. The past use of the land within the construction footprint does not include the type of activities that would result in lead being found in the soil. Thus, little to no quantifiable and foreseeable lead emissions would be generated by the alternatives.

As noted in Section 4.7, since air quality within the Winslow area is in attainment for all criteria pollutants, a conformity determination is not required for any of the alternatives. Further, since *de minimis* levels are only established by the USEPA for air basins in maintenance or non-attainment status, the threshold *de minimis* levels used for NEPA purposes are the highest levels designated in 40 CFR 93.153 (i.e., maintenance thresholds instead of nonattainment thresholds).

5.7.3. Air Quality Emissions Estimate

Subsequent to the release of the IFR for public review and comment, additional design refinements resulted in changes to the amount of trucking required and compression of the construction schedule from eight to 2.5 years. Air quality calculations were revised accordingly. The revised emissions for the 2.5-year schedule are shown in Table 5-9 immediately below the eight-year construction schedule. Estimated emission for the 2.5-year schedule show a notable increase relative to the eight-year schedule. However, estimated annual emissions for all criteria air pollutants under all action alternatives continue to remain less than the General Conformity de minimis rates. Thus, impacts to air quality for the 2.5-year construction schedule remain less than significant.

Design refinements would not affect the nature and scope of operations and maintenance activities. Thus, emission from operations and maintenance activities would remain unchanged.

5.7.4. Alternatives 1.1 and 8

Alternatives 1.1 and 8 are rebuilds of existing levees with the exception of constructing a new short, levee setback along a portion of the existing Winslow levee, construction of a new levee segment along the I-40, and removal of an original portion of the Winslow levee in the vicinity of Homolovi I under Alternative 8. These alternatives include channelization and saltcedar removal to improve conveyance under the BNSF Railroad Bridge. These alternatives also include a flood warning system. Estimates include borrow, disposal, staging, and access work. Based on the results in Table 5-9, the estimated annual emissions for all criteria air pollutants associated with Alternative 1.1 and Alternative 8 are less than the General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

Operations and Maintenance Activities

Emissions levels would differ depending on the nature of operations and maintenance activities that may be required. Most general repairs could be undertaken with on-road dump trucks and limited number of earthmoving equipment such as backhoes, rubber-tired loaders, mowers, and portable concrete mixers. Most general repairs could be completed within a few months. Excavation of the conveyance improvements area to maintain design depths would require excavators, bulldozers, loaders, and on-road dump trucks. Excavated sediment would likely be placed in suitable areas within a few miles of Winslow Levee. The size of rainstorms as well as rates of some deposition would determine the frequency of excavation. Excavation of the conveyance improvements area would require use of off-road and other equipment for at least a few months. The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

5.7.5. Alternative 3.1

Alternative 3.1 primarily consists of reconstruction of the easternmost segment of the RWDL to its abutment with the Winslow Levee; rebuilding of the Winslow Levee from the RWDL north to I-40; construction of new levee along the north side of and parallel to I-40, set back of approximately 12,795 feet of the Winslow Levee; rebuilding of approximately 12,860 feet of Winslow Levee from I-40 to the north end of the proposed project near McHood Road; and conveyance improvements at the BNSF Railroad. This alternative also includes a flood warning system. Based on the results in Table 5-9, the estimated annual emissions for all criteria air pollutants associated with Alternative 3.1 are less than the General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

Operations and Maintenance Activities

Emission levels would differ depending on the nature of operations and maintenance activities that may be required. Most general repairs could be undertaken with on-road dump trucks and limited number of earthmoving equipment such as backhoes, rubber-tired loaders, mowers, and portable concrete mixers. Most general repairs could be completed within a few months. Excavation of the conveyance improvements area to maintain design depths would require excavators, bulldozers, loaders, and on-road dump trucks. Excavated sediment would likely be placed in suitable areas within a few miles of Winslow Levee. The size of rainstorms as well as rates of some deposition would determine the frequency of excavation. Excavation of the

conveyance improvements area would require use of off-road and on-road equipment for at least a few months. The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

5.7.6. Alternatives 7 and 9

Alternatives 7 and 9 are primarily non-structural in nature with the exception of a rebuild to the east end of the RWDL under Alternative 9.

Emissions were not specifically calculated for Alternative 7 since it is composed of non-structural measures having little to no anticipated impacts to air quality, including, but not limited to: raising foundations of structures and installation of a flood warning system. Alternative 7 would not require use of large earth moving equipment required for levee construction or the use of heavy duty haul trucks. Emissions would likely be limited to those associated with residential construction such as skid-steer loaders, back hoes, and light duty trucks. Thus, emissions are expected to be substantially below General Conformity *de minimis* rates. Impacts would be less than significant.

Under Alternative 9, an approximately 0.4-mile-long segment of RWDL would be reconstructed at the existing height and would include the same nonstructural measures as identified for Alternative 7. Based on the results in Table 5-9, the estimated annual emissions for all criteria air pollutants associated with Alternative 9 are less than the General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

<u>Operations and Maintenance Activities</u>
Operations and maintenance activities would occur along the Winslow Levee and RWDL. Most general repairs could be undertaken with on-road dump trucks and limited number of earthmoving equipment such as backhoes, rubber-tired loaders, mowers, and portable concrete mixers. Most general repairs could be completed within a few months. The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed federal General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

5.7.7. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Alternatives 10, 10.1, 10.2, 10.3, and 10.4 primarily are a combination of structural management measures: reconstruction of the existing levee, construction of new setback levees, construction of a levee parallel to Interstate 40, and channelization improvements under the BNSF Railroad Bridge (except for Alternative 10.2, which does not include channelization improvements). These alternatives include a flood warning system, while Alternative 10 would also include elevation of residences north of North Road and east of North Park Drive. Based on the results in Table 5-9, the estimated annual emissions for all criteria air pollutants associated with Alternative 10 are less than the General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

Emissions were not separately calculated for Alternative 10.1, 10.2, 10.3, and 10.4. Alternatives 10.1, 10.2, 10.3, 10.4 are optimized variants of Alternative 10. Thus, estimated annual emissions for these alternatives are expected to be similar to those characterized for Alternative 10, and at most no more than insignificantly higher. Impacts to air quality would be less than significant.

Operations and Maintenance Activities

Emissions levels would differ depending on the nature of operations and maintenance activities that may be required. Most general repairs could be undertaken with on-road dump trucks and limited number of earthmoving equipment such as backhoes, rubber-tired loaders, mowers, and portable concrete mixers. Most general repairs could be completed within a few months. Excavation of the conveyance improvements area to maintain design depths would require excavators, bulldozers, loaders, and on-road dump trucks. Excavated sediment would likely be placed in suitable areas within a few miles of Winslow Levee. The size of rainstorms as well as rates of some deposition would determine the frequency of excavation. Excavation of the conveyance improvements area would require use of off-road and on-road equipment for at least a few months. The extent and intensity of maintenance activities would be below those required for construction. Thus, emissions would not exceed Federal General Conformity *de minimis* rates. Impacts to air quality would be less than significant.

Based on the minor plan refinements, estimated emissions of criteria pollutants and greenhouse gases were recalculated and are presented below.

Table 5-9 Estimated Annual Emissions of Criteria Pollutants

8 Year Construction Schedule						
Pollutant	***De minimis* levels (tons/year)**	**Alternative 1.1 (tons/year)**	**Alternative 3.1 (tons/year)**	**Alternative 8 (tons/year)**	**Alternative 9 (tons/year)**	**Alternative 10 (tons/year)**
Ozone (VOC)	100	0.802	0.945	0.802	0.162	0.666
Ozone (NOx)/NO_2	100	5.332	6.243	5.332	1.017	4.386
CO	100	3.245	3.826	3.245	0.626	2.687
SO_2	100	0.014	0.016	0.014	0.003	0.011
PM_{10}	100	0.205	0.239	0.205	0.037	0.167
$PM_{2.5}$	100	0.18	0.21	0.18	0.033	0.147
2.5 Year Construction Schedule						
Pollutant	***De minimis* levels (tons/year)**	**Alternative 1.1 (tons/year)**	**Alternative 3.1 (tons/year)**	**Alternative 8 (tons/year)**	**Alternative 9 (tons/year)**	**Alternative 10 (tons/year)**
Ozone (VOC)	100	36.467	35.023	36.213	1.406	29.206
Ozone (NOx)/NO_2	100	54.896	55.669	54.604	4.208	44.470
CO	100	10.473	10.859	10.424	0.974	8.523
SO_2	100	0.161	0.162	0.160	0.012	0.130
PM_{10}	100	4.137	4.050	4.111	0.207	3.326
$PM_{2.5}$	100	3.682	3.604	3.658	0.184	2.960

5.7.8. Alternative 11: No Federal Action Alternative

Under the No Federal Action Alternative, the existing levees would not be removed and replaced with a structure capable of providing additional flood protection. There would be no emissions from earth moving equipment and the on-site batch plant. Furthermore, there would be no emissions from on-road trucks for the import or export of fill or excavated material from the LCR Winslow project area. Therefore, there would be no impact on air quality.

However, future high flow conditions through the LCR Winslow project reach could undermine the existing levee protection and threaten the residential community and transportation services located adjacent to the project reach. Periodic emergency repairs of the existing bank protection may be required. It is likely that any emergency repair would be limited in scope and duration. Emergency repairs would likely entail the placement of rocks to stabilize the levees. It is unlikely that air quality impacts associated with this alternative would exceed federal General Conformity *de minimis* rates.

5.7.9. Greenhouse Gases

Estimated annual GHG emissions for all action alternatives are shown in Table 5-10.

Table 5-10 Estimated Annual Emissions of Greenhouse Gasses

8 Year Construction Schedule				
Alternative 1.1 (MTCO2e)	**Alternative 3.1 (MTCO2e)**	**Alternative 8 (MTCO2e)**	**Alternative 9 (MTCO2e)**	**Alternative 10 (MTCO2e)**
1338	1559	1338	270	1092
2.5 Year Construction Schedule				
Alternative 1.1 (MTCO2e)	**Alternative 3.1 (MTCO2e)**	**Alternative 8 (MTCO2e)**	**Alternative 9 (MTCO2e)**	**Alternative 10 (MTCO2e)**
1530	1821	1530	336	1285

5.8. Traffic

With the minor plan refinements since the circulation of the Draft IFR, the overall number of days of construction is not anticipated to appreciably change for any of the alternatives. Daily truck trips are expected to be similar. While the construction schedule would be compressed, there would be fewer mobilization and demobilization activities, and, since the overall construction would be completed more quickly, the temporary impacts to traffic during construction would also cease more quickly when construction is completed. Therefore, impacts with the refinements would be similar to those discussed below for all alternatives.

5.8.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative:

- Permanently increases the annual average daily traffic (AADT) of major arteries within the study area.

5.8.2. Alternatives 1.1 and 8

Non-Structural Measures

Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system. Installation of a flood warning system would be limited to development of a plan or set of procedures, and potential installation of instrumentation to measure rainfall or stream flow. The flood warning system would not result in increases in vehicle trips and thus would not result in impacts to traffic.

Construction would utilize a variety of earthmoving equipment: excavators, loaders, dozers, cranes, soil stabilizer, graders, rollers, loaders, backhoes, crawlers, tree cutters, brush chippers, dump trucks, water trucks, and off-highway trucks.

Channel Work

Levee construction and reconstruction would proceed at a rate of approximately 100-foot segment per day for 2.5 years. The estimated construction time assumes year-round construction with allowance for adverse weather delays, the monsoon season and national holidays. Construction would generally stop on the months of July, August, and September. Construction phasing would be accomplished in a manner that assures a functioning levee system during each winter-spring rain and snowmelt season. Since freezing winter temperatures and high summer temperatures occur at Winslow, placing of materials should be planned for periods of mild weather. Approximately 15 laborers would commute daily to the project site. The maximum volume of fill required to armor the riverside face of the levee such as riprap and soil cement would be approximately 780 cy per day. Use of 15 cy on-road trucks would yield approximately 52 daily round trip truck trips. Thus, levee construction work would result in approximately 67 daily round trips (trucks and passenger vehicles combined). Depending on where the levees, borrow, disposal, and staging area work are located, roadways that would be used could include I-40, North Park Drive, Williamson's Avenue, Mike's Pike, SR-87, Transcon Lane, Oak Road, Sunset Road, North Road, Frontage Road, Prosperity Avenue, McHood Road. Indian Route 15, and Indian Route 154, as these roadways provide access to different locations of the levees, borrow, disposal and staging areas.

Conveyance improvements at the BNSF Railroad Bridge would require export of approximately 300,000 cy of fill over a 120-day construction period (Corps, 2014). Approximately 2,500 cy of fill is estimated to be exported per day. Use of 15 cy on-road trucks would yield approximately 170 daily round trip truck trips. Approximately 15 laborers would commute daily to the project site. Conveyance improvement work would result in approximately 185 roundtrip daily trips on the I-40, Williamson Avenue, SR-87, and Transcon Lane. The conveyance improvements would not affect I-40 or the BNSF railway operation over the Railroad Bridge, and therefore, no interruptions to transportation would occur.

There would be no significant indirect impacts to transportation. Implementation of Alternatives 1 and 8 would not result in development of additional lands that could generate increased residential or commercial traffic.

The increases in roadways' AADT associated with Alternatives 1.1 and 8 are shown in Table 5-11 and Table 5-12.

Table 5-11 Comparison of Major Arterial Road AADT to Alternative 1.1 Project Traffic Increases

Roadway Name	Baseline AADT	Import Trips (Trips/Day)	Export Trips (Trips/Day)	Commuter Trips (Trips/Day)	Total Trips (Trips/Day)	Percentage Increase from Baseline AADT
I-40 (at Exit 253 - between Hipkoe Dr. and North Park Dr.)	16,517[e]	52	170	30	252	1.53%
I-40 (at Exit 255 – between North Park Dr. and Oak Rd.)	17,407[e]	52	170	30	252	1.45%
North Park Drive (between Hillview and Henderson St.)	9,880[b]	52	n/a	15	67	0.68%
Williamson Avenue, (between 2nd and 3rd St.)	9,037[c]	52	170	30	252	2.79%
Mike's Pike (between Hipkoe Ave. and North Park Dr.)	2,100[b]	52	n/a	15	67	3.19%
SR-87 (at I-40)	1,632[a]	52	170	30	252	15.44%
Transcon Lane (at I-40)	9,011[c]	52	170	30	252	2.80%
Oak Road	500[b]	52	n/a	15	67	13.40%
Sunset Road	700[b]	52	n/a	15	67	9.58%
North Road	1,200[b]	52	n/a	15	67	5.58%
Frontage Road	500[d]	52	n/a	15	67	13.40%
Prosperity Avenue	500[d]	52	n/a	15	67	13.40%
McHood Road	500[d]	52	n/a	15	67	13.40%
SR-87 (at Indian Rte.15)	1,716 [f]	52	170	30	252	14.68%
Indian Rte, 15 to Indian Route 154	1,700 [d]	52	170	30	252	14.82%

Source: ADOT, 2013[a]; 2012[b], City of Winslow, 2011[c], estimate[d], 2014[e], 2017[f].
Note: n/a means not applicable.

Table 5-12 Comparison of Major Arterial Road AADT to Alternative 8 Project Traffic Increases

Roadway Name	Baseline AADT	Import Trips (Trips/Day)	Export Trips (Trips/Day)	Commuter Trips (Trips/Day)	Total Trips (Trips/Day)	Percentage Increase from Baseline AADT
I-40 (at Exit 253 - between Hipkoe Dr. and North Park Dr.)	16,517[e]	52	170	30	252	1.53%
I-40 (at Exit 255 – between North Park Dr. and Oak Rd.)	17,407[e]	52	170	30	252	1.45%
North Park Drive (between Hillview and Henderson St.)	9,880[b]	52	170	30	252	2.55%
Williamson Avenue (between 2nd and 3rd St.)	9,037[c]	52	170	30	252	2.79%
Mike's Pike (between Hipkoe Ave. and North Park Dr.)	2,100[b]	52	n/a	15	67	3.19%
SR-87 (at I-40)	1,632[a]	52	170	30	252	15.44%
Transcon Lane (at I-40)	9,011[c]	52	170	30	252	2.80%
Oak Road	500[b]	52	n/a	15	67	13.40%
Sunset Road	700[b]	52	n/a	15	67	9.58%
North Road	1,200[b]	52	n/a	15	67	5.58%
Frontage Road	500[d]	52	n/a	15	67	13.40%
Prosperity Avenue	500[d]	52	n/a	15	67	13.40%
McHood Road	500[d]	52	n/a	15	67	13.40%
SR-87 (at Indian Rte.15)	1,716 [f]	52	170	30	252	14.68%
Indian Rte, 15 to Indian Route 154	1,700 [d]	52	170	30	252	14.82%

Source: ADOT, 2013[a]; 2012[b], City of Winslow, 2011[c], estimate[d], 2014[e], 2017[f].
Note: n/a means not applicable.

Potential increases in Alternatives 1.1 and 8 AADTs during construction range between 0.68 percent and 15.44 percent, as shown in Table 5-11 and Table 5-12. The increase in AADTs for affected roadways would be localized and temporary, and assumes year-round construction window over an anticipated 2.5-year construction period. Ingress and egress access would be limited to six routes and would be used in conjunction with roadways discussed and analyzed above, and would not be accessed during non-construction time periods. Traffic impacts would not occur during the non-construction window. The implementation of a traffic management plan (TMP) as an environmental commitment would reduce impacts to traffic and to ingress-egress. The increased AADTs would return to pre-project conditions upon completion of construction. Based on the above, and with the implementation of a TMP environmental commitment, impacts to traffic and transportation would be less than significant.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal, would result in traffic impacts similar to those characterized under Alternatives 1.1 and 8 - Channel Work. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas

Activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in traffic impacts similar to those characterized under Alternatives 1.1 and 8 - Channel Work. Impacts would be localized and temporary.

Operations and Maintenance

The NCFCD is responsible for maintenance of the proposed project. In order to determine the need for specific maintenance items, routine inspections should be conducted every six months or twice per year and after any significant flooding. The inspection crew would consist of two laborers with a pickup truck. It is estimated that these inspections would require a maximum of four days per year. Each inspection would include a written report summarizing findings and recommending repairs that would correct any problems. Maintenance would include vegetation control, rodent control, levee and interior drainage structures repair, sediment removal under the BNSF Railroad Bridge, survey river cross section, and surveys for the yellow-billed cuckoo and southwestern willow flycatcher. Truck trips generated during implementation of operation and maintenance activities would not permanently increase AADTs. The number of equipment and vehicles would be limited and less compared to those identified for construction. Based on the above, traffic-related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

For all activities, impacts would be localized and temporary, and traffic levels would return to pre-project levels upon completion of construction. The implementation of a TMP as an environmental commitment would reduce traffic impacts. Based on the above, impacts to transportation would be less than significant.

5.8.3. Alternative 3.1

Non-Structural Measures
Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work
Reconstruction of the RWDL and Winslow Levee, setback work, the conveyance improvements at the BNSF Railroad Bridge would result in traffic impacts similar to those characterized under Alternatives 1.1 and 8. Potential increases in AADTs during construction would be localized and temporary.

Borrow and Disposal Work
Borrow and disposal work, including material excavation, placement, and disposal, would result in traffic impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling and access areas work would result in traffic impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operations and Maintenance
Traffic impacts resulting from O&M activities would be similar to those characterized under Alternatives 1.1 and 8.

Effects Determinations Summary
For all activities, impacts would be localized and temporary, and traffic levels would return to pre-project levels upon completion of construction or O&M work. The implementation of a TMP as an environmental commitment would reduce traffic impacts. Based on the above, impacts to transportation would be less than significant.

5.8.4. Alternatives 7 and 9

Nonstructural Measures
Construction associated with any nonstructural measures would require limited pieces of construction equipment compared to the structural alternatives. The duration of construction of the nonstructural alternatives would be substantially shorter than construction of the structural alternatives. Transportation impacts would be short-term and localized. Traffic levels would return to pre-project levels upon completion of construction. Based on the above, impacts would be less than significant.

Channel Work
Alternative 7 would not include any channel work. For Alternative 9, assumptions related to rate of construction, number of construction laborers, and maximum volume of fill for reconstruction of the RWDL are similar to those identified under Alternative 1.1 and 8, above, except that much less channel work would occur, since only the RWDL would be reconstructed. Use of 15 cy on-road trucks would yield 52 daily round trip truck trips. Levee construction work would result in

approximately 67 daily round trip truck trips on the I-40, Williamson Avenue, SR-87, and Transcon Lane. Alternative 9 is expected to take approximately 4 years to construction with channel work occurring concurrent to implementation of nonstructural measures.

Increases in roadways AADTs' associated with the RWDL reconstruction are shown in Table 5-13.

Table 5-13 Comparison of Major Arterial Road AADT to Project Traffic Increases, Alternative 9

Roadway Name	Baseline AADT	Import Trips (Trips/Day)	Export Trips (Trips/Day)	Commuter Trips (Trips/Day)	Total Trips (Trips/Day)	Percentage Increase from Baseline AADT
I-40	15,606	52	n/a	15	67	0.43%
Williamson Ave.	9,037	52	n/a	15	67	0.74%
SR-87	1,632	52	n/a	15	67	4.11%
Transcon Lane	9,011	52	n/a	15	67	0.74%

Source: ADOT, 2013, 2012, 2011; Corps, 2014.
Note: n/a means not applicable.

Potential increases in AADTs during construction are anticipated to range between 0.43 percent and 4.11 percent as shown above. Alternative 9 would not include conveyance improvements to the BNSF Railroad Bridge. Impacts or interruptions to the 1-40 or the BNSF Railway Bridge operation are not expected. The increase in AADTs for affected roadways would be localized and temporary, and are expected to return to pre-project levels upon completion of construction.

There would be no significant indirect impacts to transportation. Implementation of Alternatives 7 and 9 would be less compared to Alternatives 1.1 and 8, and would not result in development of additional lands that could generate increased residential or commercial traffic. Based on the above, impacts to transportation would be less than significant.

Borrow and Disposal Work

Alternative 7 would not entail any borrow or disposal activities. For Alternative 9, borrow and disposal work, including material excavation, placement, and disposal, would result in traffic impacts less than those characterized under Alternatives 1.1 and 8, since less construction and excavation would occur. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas

Alternative 7 would not require staging, stockpiling, or access areas. Use of staging, stockpiling and access areas under Alternative 9 would result in traffic impacts less than those characterized under Alternatives 1.1 and 8, since less equipment and stockpiling of materials would be required. Impacts would be localized and temporary.

Operations and Maintenance

Traffic impacts resulting from O&M activities would be similar to those characterized under Alternatives 1.1 and 8.

Effects Determinations Summary
For all activities, impacts would be localized and temporary, and affected roadways would return to pre-project levels upon completion of construction or O&M work. The implementation of a TMP as an environmental commitment would reduce traffic impacts. Based on the above, impacts to transportation would be less than significant.

5.8.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures
Impacts under Alternative 10 would be the same as those described for Alternatives 7 and 9. Impacts under Alternative 10.1, 10.2, 10.3 and 10.4 would be the similar to those described for Alternatives 1.1 and 8.

Construction Work
Reconstruction of the RWDL and Winslow Levee, setback work, and conveyance improvements at the BNSF Railroad Bridge would result in transportation impacts similar to those characterized for Alternatives 1.1 and 8. Alternative 10.2 would not include any channelization work under the BNSF Railroad Bridge, so traffic impacts would be even more limited. Although Alternative 10.4 entails additional excavation work under the BNSF Railroad Bridge, the impacts to traffic are not expected to noticeably increase from this minor additional work. There would be no significant indirect impacts to transportation. Implementation of Alternatives 10, 10.1, 10.2, 10.3, or 10.4 would not result in development of additional lands that could generate additional residential or commercial traffic.

Borrow and Disposal Work
Borrow and disposal work, including material excavation, placement, and disposal, would result in traffic impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging and Access Areas
Use of staging, stockpiling and access areas work would result in traffic impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operations and Maintenance
Traffic impacts resulting from O&M activities would be similar to those characterized under Alternatives 1.1 and 8.

Effects Determinations Summary
For all activities, impacts would be localized and temporary, and transportation levels would return to pre-project levels upon completion of construction. The implementation of a TMP as an environmental commitment would reduce traffic impacts. Based on the above, impacts to transportation would be less than significant.

5.8.6. Alternative 11: No Federal Action Alternative

The Navajo County Flood Control District and the City of Winslow would continue O&M activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Emergency repairs may be required to stabilize weakened sections of the levee during floods. Such repairs would be limited in scope and duration, and would likely entail the discharge of rocks and earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel.

Duration and intensity of traffic impacts would be commensurate with the scope and location of work, respectively. In all cases, affected roadways would return to pre-project levels upon completion of construction. Based on the above, impacts to transportation would be less than significant.

5.8.7. Environmental Commitments

TF 1 The construction contractor would be required to prepare and implement a TMP. The TMP would be coordinated with the City of Winslow and Navajo County, as appropriate. The TMP at a minimum would include the identification of ingress and egress points, speed limits, and placement of traffic signage.

5.9. Noise

5.9.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered if the alternative:

- Results in a long-term or permanent elevation of noise levels above ambient noise levels or results in exceedance of established noise ordinances.

5.9.2. Alternatives 1.1 and 8

<u>Non-Structural Measures</u>
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system. Installation of a flood warning system would be limited to development of a plan or set of procedures, and potential installation of instrumentation to measure rainfall or stream flow. The flood warning system would result in minimal noise impacts from potential installation of instrumentation and would not result in exceedance of established noise ordinances. Impacts would be less than significant.

<u>Channel Work</u>
Construction and related activities would utilize a number of earthmoving equipment: excavators, loaders, dozers, cranes, soil stabilizer, graders, roller, loaders, backhoes, crawlers, tree cutters, brush chippers, dump trucks, water trucks, and off-highway trucks. As shown in Table 5-14, potential noise associated with construction equipment at 50 feet ranges from 80 dBA to 90 dBA (USEPA, 1972). Furthermore, noise levels are atmospherically attenuated by a factor of 6 dB per doubling of the distance.

Table 5-14 Potential Noise Levels at Various Distances

Distance from Construction Activities (ft)	Noise Levels (dBA)
50	80 - 90
100	74 – 84
200	68 – 78
400	62 – 72
800	56 – 66
1,600	50 – 60
3,200	44 – 54

References: USEPA, 1971, 1972, 1974.

Use of earth moving equipment within the 2.3-mile-long Transportation Corridor Segment would temporarily elevate noise levels. At a rate of approximately 100 feet per day, approximately 120 days of construction is anticipated within the segment. The land use is open space, but the noise within this segment is influenced by I-40, BNSF rail line, and SR-87. Ambient noise levels likely ranges from 60 to 70 dBA, as discussed in Section 4. At an approximate distance of 400 to 800 feet, the anticipated noise levels associated with construction would range from 56 to 72 dBA and would not be distinguishable from the ambient noise level. Furthermore, since the land use is open space, there would be no impacts to sensitive receptors. Moreover, the progression of construction requires daily relocation of equipment from one segment of the levee to another. Therefore, the noise source would be mobile, not remaining within a particular area for extensive periods of time. Noise levels would return to pre-project levels upon completion of construction.

Use of earth moving equipment within the 1.3-mile-long Rural Residential Segment would temporarily elevate noise levels within rural residential areas above the 50 to 60 dBA ambient noise level. At a rate of approximately 100 feet per day, approximately 70 days of construction is anticipated within the segment. The intensity of noise would be commensurate with distance from the construction site. The distance of residential structures from the Winslow Levee ranges from approximately 75 feet to 0.5 miles (2640 feet). The noise levels at 50 to 150 feet is expected to range from 74 to 90 dBA. At a distance of 0.5 miles, construction noise level would not be distinguishable from the ambient noise. Noise impacts to sensitive receptors could be adverse, but short-term and temporary.

Homolovi State Park is located east of the Winslow Levee, which provide recreation opportunities including hiking, camping, and day use visits. Potential noise impacts to park users would be limited to areas within the immediate vicinity of the Winslow Levee. Homolovi I is approximately 1,400 feet from the nearest point of the Winslow Levee, which would result in noise levels ranging from 60 and 66 dBA. Noise impacts would be short-term and temporary.

The progression of construction requires daily relocation of equipment from one segment of the levee to another. Therefore, the noise source would be mobile, not remaining within a particular area for extensive periods of time. Night time construction is not anticipated. Construction is estimated to last 2.5 years, with work occurring year-round. Therefore, construction impacts would be short-term and localized and would not contribute to long term, permanent impacts to sensitive receptors. The implementation of an environmental commitment to install temporary sound walls next to residential areas, where necessary, for noise protection purposes, would

reduce noise impacts from construction related activities. Noise levels would return to pre-project levels upon completion of construction.

Use of earth moving equipment within the 3.25-mile long Open Space Segment would temporarily elevate noise levels above the 45-50 dBA ambient noise level range. At a rate of approximately 100 feet per day, approximately 170 days of construction is anticipated within the segment. The intensity of noise would be commensurate with distance from the construction site per Table 5-14. However, since the land use is open space, there would be no impacts to sensitive receptors. Moreover, the progression of construction requires daily relocation of equipment from one segment of the levee to another. Therefore, the noise source would be mobile, not remaining within a particular area for extensive periods of time. Noise levels would return to pre-project levels upon completion of construction.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal, would result in noise impacts that would be similar to those characterized under Alternatives 1.1 and 8 Channel Work. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas

Activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling and access areas would result in noise impacts similar to those characterized under Alternatives 1.1 and 8 Channel Work. Impacts would be localized and temporary.

Operations and Maintenance

Depending on the nature of the required O&M and repair, work may temporarily elevate noise levels due to equipment and vehicle use. The number of equipment and vehicles needed for O&M including repairs would be limited and less compared to those identified for construction. Potential noise impacts would be short-term and localized to repair sites. Therefore, noise related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

For all activities, noise impacts from construction and O&M related activities would be short-term and localized. Noise levels would return to pre-project levels upon completion of construction and O&M work. There are no churches, schools, hospitals, institutions of learning or court houses located within the vicinity of the work area, therefore, project activities would not result in excessive noise impacts to these institutions. Alternatives 1.1 and 8 would not result in exceedance of established noise ordinances. With the implementation of an environmental commitment to install temporary sound walls next to residential areas, where necessary, for noise protection purposes, noise impacts would be reduced. Therefore, based on the above, noise impacts would be less than significant.

5.9.3. Alternative 3.1

Non-Structural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work

Reconstruction of the RWDL and Winslow Levee within the Transportation Corridor Segment, as well as the conveyance improvements at the BNSF Railroad Bridge, and other construction related activities would result in noise impacts similar to those characterized for the same segment under Alternatives 1.1 and 8.

Construction of a new setback levee within the Rural Residential Segment would require relocation of about 8 residences and associated outbuildings and entail construction activities located approximately 75 feet to 500 feet away from existing residences. Therefore, construction would temporarily elevate noise levels within rural residential areas above the 50 to 60 dBA ambient noise level. The intensity of noise would be commensurate with distance from the construction site. At approximately 75 feet to 150 feet, noise level range associated with construction would be approximately 74 to 84 dBA. At approximately 500 feet, noise level range associated with construction would be approximately 62 to 72 dBA. Noise impacts to sensitive receptors could be adverse, but short-term and temporary. The progression of construction requires daily relocation of equipment from one segment of the levee to another. Therefore, the noise source would be mobile, not remaining with within a particular area for extensive periods of time. Night time construction is not anticipated. Construction is estimated to last 2.5 years, with work occurring year-round. Therefore, construction impacts would be short-term and localized and would not contribute to long-term, permanent impacts to sensitive receptors. The implementation of an environmental commitment to install temporary sound walls next to residential areas, where necessary, for noise protection purposes, would reduce noise impacts from construction related activities. Noise levels would return to pre-project levels upon completion of construction.

Reconstruction of Winslow Levee; construction of a new setback levee; removal of sections of the Winslow Levee riverward of the setback levee, and other construction related activities within the Open Space Segment would result in noise impacts similar to those characterized for the same segment under Alternatives 1.1 and 8.

For all activities, noise levels would return to pre-project levels upon completion of construction. Based on the above, noise impacts would be less than significant.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal would result in noise impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging and Access Areas
Activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in noise impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operations and Maintenance
O&M activities would be similar to those described under Alternatives 1.1 and 8. Noise related impacts resulting from O&M activities would be short-term and localized to repair sites. Impacts would be less than significant.

Effects Determinations Summary
For all activities, noise impacts from construction and O&M related activities would be short-term and localized. Noise levels would return to pre-project levels upon completion of construction or O&M work. There are no churches, schools, institutions of learning or court houses located within the vicinity of the work area, therefore, project activities would not result in excessive noise impacts to these institutions. Alternative 3.1 would not result in exceedance of established noise ordinances. With the implementation of an environmental commitment to install temporary sound walls next to residential areas, where necessary, for noise protection purposes, noise impacts would be reduced. Therefore, based on the above, noise impacts be less than significant.

5.9.4. Alternatives 7 and 9

Nonstructural Measures
Implementation of nonstructural measures would be located within the Rural Residential Segment and the Open Space Segment. Construction associated with any nonstructural measures would require limited pieces of construction equipment compared to the structural alternatives. The duration of construction of the nonstructural alternatives would be substantially shorter than construction of the structural alternatives. Noise impacts would be short-term and localized. Noise levels would return to pre-project levels upon completion of construction. Based on the above, noise impacts would be less than significant.

Channel Work
Alternative 7 does not include channel work. For Alternative 9, rebuild of the RWDL in the vicinity of the Transportation Corridor Segment would result in noise impacts similar to those characterized for the same segment under Alternatives 1.1 and 8. Winslow Levee improvements are not proposed under Alternative 9, therefore, noise impacts would not occur within the Rural-Residential or Open Space Segments from channel work. Thus, overall noise impacts would be less compared to Alternatives 1.1 and 8.

Borrow and Disposal Work
Alternative 7 does not include borrow and disposal work. For Alternative 9, borrow and disposal work, including material excavation, placement, and disposal would result in noise impacts similar to those characterized under Alternatives 1.1 and 8. Since channel work under Alternative 9 would be limited to the rebuild of the RWDL, overall noise impacts from borrow

and disposal work would be less compared to Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas

Alternative 7 does not include staging, stockpiling, or use of access areas. For Alternative 9, activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in noise impacts similar to those characterized under Alternatives 1.1 and 8. Since channel work under Alternative 9 would be limited to the rebuild of the RWDL, overall noise impacts from use of staging, stockpiling, and access areas would be less compared to Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operations and Maintenance

O&M activities would be similar to those described under Alternatives 1.1 and 8. Noise-related impacts resulting from O&M activities would be short-term and localized. Impacts would be less than significant.

Effects Determinations Summary

For all activities, noise impacts from construction related activities would be short-term and localized. Noise levels would return to pre-project levels upon completion of construction or O&M activities. Construction of Alternatives 7 and 9 are expected to take approximately four years. Alternatives 7 and 9 would not result in exceedance of established noise ordinances. Based on the above, noise impacts would be less than significant.

5.9.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Implementation of nonstructural measures would require limited pieces of construction equipment compared to the structural alternatives. Construction duration would be substantially shorter. Noise impacts would be short-term and localized.

Channel Work

Reconstruction of the RWDL and Winslow Levee within the Transportation Corridor Segment as well as the conveyance improvements at the BNSF Railroad Bridge would result in noise impacts similar to those characterized for the same segment under Alternatives 1.1 and 8. Alternative 10.2 would not include any channelization work under the BNSF Railroad Bridge, so noise impacts would be even more limited. The slightly increased amount of excavation under Alternative 10.4 would not result in an overall change in noise impacts.

Reconstruction of Winslow Levee; construction of the 0.25-mile-long setback levee; and removal of an approximately 0.3-mile-long section of the Winslow Levee riverward of the setback levee within the Rural Residential Segment would result in noise impacts similar to those characterized for the same segment under Alternatives 1.1 and 8.

Reconstruction of Winslow Levee within the Open Space Segment would result in noise impacts similar to those characterized for the same segment under Alternatives 1.1 and 8, except that noise impacts would be limited to a shorter length of the Winslow Levee compared to Alternatives 1.1 and 8.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal would result in noise impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging and Access Areas

Activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in noise impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operations and Maintenance

O&M activities would be similar to those described under Alternatives 1.1 and 8. Noise related impacts resulting from O&M activities would be short-term and localized. Impacts would be less than significant.

Effects Determinations Summary

For all activities, noise impacts from construction and O&M related activities would be short-term and localized. Noise levels would return to pre-project levels upon completion of construction or O&M activities. Construction is expected to take 2.5 years. There are no churches, schools, hospitals, institutions of learning or court houses located within the vicinity of the work area, therefore, project activities would not result in excessive noise impacts to these institutions. Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would not result in exceedance of established noise ordinances. With the implementation of an environmental commitment to install temporary sound walls next to residential areas, where necessary, for noise protection purposes, noise impacts would be reduced. Based on the above, noise impacts would be less than significant.

5.9.6. Alternative 11: No Federal Action Alternative

The ambient noise level along the levee areas would continue to be affected by the traffic noise on I-40, BNSF rail line, and SR-87. Duration and intensity of noise impacts generated by repair work would be commensurate with the scope and location of work, respectively. Work located within the Transportation Corridor Section and the Open Space Section would not result in noise impacts. Work located within the Rural Residential Section would result in temporary noise impacts during repair work. For all activities, noise levels would return to pre-project levels upon completion of construction. Alternative 11 would not result in exceedance of established noise ordinances. There would be no significant impact.

5.9.7. Environmental Commitments

NO 1 Install temporary sound walls next to residential areas, where necessary based on anticipated noise levels at specified distances, for noise protection purposes. Placement locations of sound walls would be dependent upon the detailed engineering designs and would be determined during the PED Phase.

5.10. Aesthetics

5.10.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative:

- Substantially and permanently modifies the existing vista.

5.10.2. Alternatives 1.1 and 8

<u>Nonstructural Measures</u>
Nonstructural measures under Alternatives 1.1 and 8 would include installation of a flood warning system limited to development of a plan or set of procedures, and potential installation of instrumentation to measure rainfall or stream flow. This would not result in a change to the existing vista and thus would not result in impacts to aesthetics.

<u>Channel Work</u>
Reconstruction of the Winslow Levee and RWDL would replace the existing levees on a like-for-like basis. Rebuild levee work and construction of a new short levee setback adjacent to the Rural Residential Segment under Alternative 8 could potentially impact the vista of a few residential homes; however, Alternatives 1.1 and 8 would not substantially change the character of the open space viewshed remaining to the north and east. For residences in the vicinity of the Winslow Levee, the levee setback segment under Alternative 8 would result in slightly closer views of the levee, which would be similar in size to the existing levee. Alternatives 1.1 and 8 would not substantially change the vista from the Homolovi State Park as work would be limited to rebuilding of the Winslow Levee within the existing levee alignment with a small setback levee under Alternative 8. During construction, temporary noise-attenuating sound walls would be constructed, where necessary, and presence of laborers, construction equipment, and vehicles would result in a short term and localized impact to the vista. The temporary sound walls, laborers, construction equipment, and vehicles would move as levee construction progresses. Thus, potential impacts to aesthetics during construction would be localized and temporary. With the implementation of an environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, impacts would be further reduced.

Construction of the levee parallel to I-40 in the Transportation Corridor Segment would add a continuous line within the existing vista. However, the levee embankment would parallel the existing I-40 embankment through the LCR floodplain. Thus, the vista within the Transportation

Corridor Segment would not substantially change. The rebuilt levees would be similar in size to the existing levees, and therefore, would not create a new obstruction to the current vista. As a result, there would be no substantial change in the vista for all three segments (Transportation Corridor, Rural Residential, or Open Space).

Conveyance improvements would also entail removal of approximately 100 acres of saltcedar from the Transportation Corridor Segment upstream of the BNSF Railroad Bridge. However, since the existing vista within the Transportation Corridor Segment is composed of distinctly barren dust dunes that is in the LCR floodplain, presence of an approximate 100-acre sand bar temporarily devoid of vegetation would not result in a new element with the vista. Upon project completion, the area would be revegetated through natural recruitment and/or reseeded/replanted with native grasses and shrubs. Excavation of approximately 26 acres within the conveyance improvement area would convert uplands to open water and terraces with riprap protection, and would not result in a substantial change within the vista. The additional open water area would be a benefit to the vista. The approximate 26 acres of salt cedar removal would not be mechanically reseeded or replanted with native grasses or shrubs due to greater frequency of recurring O&M maintenance within the conveyance improvement area that would prevent long term establishment of native plants. Last, given the fluvial geomorphologic dynamics within LCR and commitment to revegetate the approximate 100 acres with native plants, the approximate 100-acre sand bar and approximate 26 acres of excavation area would return to a pre-project, natural environment in the long term.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement, and disposal would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8 Channel Work. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas

Activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8 Channel Work. Impacts would be localized and temporary.

Operation and Maintenance

Temporary and insignificant impacts to the vista would occur during implementation of O&M activities. O&M related structural levee repairs, vegetation control, rodent control, sediment removal under the BNSF Railroad Bridge, and survey work would be limited in scope and size and less compared to those identified for construction. Based on the above, aesthetics related impacts resulting from O&M activities would be less than significant.

Effects Determinations Summary

For all activities, impacts to aesthetics during construction and O&M activities would be localized. Impacts from the setback levee under Alternative 8 would not result in a substantial permanent change to the viewshed. With implementation of an environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee,

where possible, to retain the natural environment, impacts would be further reduced. Based on the above, impacts to aesthetics would be less than significant.

5.10.3. Alternative 3.1

Nonstructural Measures
Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work
Reconstruction of the RWDL and Winslow Levee, the conveyance improvements at the BNSF Railroad Bridge, and the new setback levee would result in aesthetics impacts similar to those characterized under Alternatives 1.1 and 8, except for the differences described below. Potential increases in aesthetics impacts during construction would be localized.

A portion of the new setback levee would potentially affect a number of residences of the Rural Residential Segment. As a result, the current vista for those residents would change as views of the open desert environment populated with desert shrubs and the Winslow Levee would be modified by a closer view of the Winslow Levee, an approximate 15-foot-tall engineered setback structure. The rebuilt Winslow Levee would be similar in size to the existing Winslow Levee, about 0.5 feet taller on average and slightly wider within this segment. However, the setback levee would not result in a substantial change in the character of the open space viewshed remaining to the north and east since views to these areas would remain unaltered by Alternative 3.1. With the implementation of an environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, impacts would be further reduced.

Borrow and Disposal Work
Borrow and disposal work, including material excavation, placement, and disposal would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas
Activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operation and Maintenance
Temporary and insignificant impacts to the vista would occur during implementation of O&M activities. O&M related structural levee repairs, vegetation control, rodent control, sediment removal under the BNSF Railroad Bridge, and survey work would be limited in scope and size and less compared to those identified for construction. Based on the above, aesthetics related impacts resulting from O&M activities would be less than significant.

Effects Determinations Summary

For all activities, impacts to aesthetics during construction and O&M work would be localized. Impacts from the setback levee would not result in a substantial permanent change to the viewshed because it would not alter the open space character of the area. With implementation of an environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, impacts would be further reduced. Based on the above, impacts to aesthetics would be less than significant.

5.10.4. Alternatives 7 and 9

Nonstructural Measures

Construction associated with any nonstructural measures would require limited pieces of construction equipment compared to the structural alternatives. Duration of construction of the nonstructural alternatives would be substantially shorter than construction of the structural alternatives. Vista impacts would be largely short-term and localized. Aesthetics would substantially return to pre-project levels upon completion of construction, except that any residences elevated would be slightly higher off the ground. Based on the above, impacts from implementation of nonstructural measures on aesthetics would be less than significant.

Channel Work

Alternative 7 does not include any channel work. For Alternative 9, rebuild of the RWDL would result in aesthetic impacts that would be similar to those characterized under Alternatives 1.1 and 8 regarding impacts from the RWDL rebuild. However, impacts overall would be limited to the Transportation Corridor Segment and less compared to Alternatives 1.1 and 8. Impacts would be localized.

Borrow and Disposal Work

Alternative 7 does not include any borrow or disposal work. For Alternative 9, borrow and disposal work, including material excavation, placement, and disposal would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8, except less because only RDWL would be reconstructed. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas

Alternative 7 does not include any work in staging, stockpiling, or access areas. For Alternative 9, activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8 channel work, but even less due to the more limited activities proposed. Impacts would be localized and temporary.

Operation and Maintenance

Temporary and insignificant impacts to the vista would occur during implementation of O&M activities. O&M related structural levee repairs, vegetation control, rodent control, sediment removal under the BNSF Railroad Bridge, and survey work would be limited in scope and size and less compared to those identified for construction. Based on the above, aesthetics related impacts resulting from O&M activities would be less than significant.

Effects Determinations Summary
For all activities, aesthetics would be similar to pre-project levels upon completion of construction or O&M activities. Based on the above, impacts to aesthetic would be less than significant.

5.10.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures
Nonstructural measures would result in aesthetic impacts similar to those characterized for Alternatives 7 and 9 for Alternative 10, and similar to Alternatives 1.1 and 8 for the others.

Channel Work
Reconstruction of the RWDL and Winslow Levee, setback levee work, and conveyance improvements at the BNSF Railroad Bridge would result in aesthetics impacts similar to those characterized for Alternatives 1.1 and 8, except that there would be no aesthetic impacts on the 12,890 northernmost feet of the Winslow Levee, so no work would occur there. The additional excavation proposed under Alternative 10.4 would not have an impact on aesthetics. Alternative 10.2 does not include channelization improvements under the BNSF Railroad Bridge, so no changes to aesthesis would occur in that area.

Borrow and Disposal Work
Borrow and disposal work, including material excavation, placement, and disposal would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8, except even less due to less borrow and disposal material being needed. Impacts would be localized and temporary.

Staging, Stockpiling, and Access Areas
Activities associated with use of staging, stockpiling, and access areas would be performed in conjunction with the channel and borrow and disposal work. Use of staging, stockpiling, and access areas would result in aesthetic impacts similar to those characterized under Alternatives 1.1 and 8. Impacts would be localized and temporary.

Operation and Maintenance
Temporary and insignificant changes to the vista would occur during implementation of O&M activities. O&M related structural levee repairs, vegetation control, rodent control, sediment removal under the BNSF Railroad Bridge, and survey work would be limited in scope and size and less compared to those identified for construction. Based on the above, aesthetics related impacts resulting from O&M activities would be less than significant.

Effects Determinations Summary
For all activities, impacts to aesthetics during construction and O&M activities would be localized and would not result in a substantial permanent change to the vista. With implementation of an environmental commitment to reseed and/or revegetate temporarily disturbed areas, and a commitment to investigate opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, impacts would be further reduced. Based on the above, impacts to aesthetics would be less than significant.

5.10.6. Alternative 11: No Federal Action Alternative

Emergency repairs may be required to stabilize weakened sections of the levee during floods. Emergency repairs would be temporary and limited in scope and duration. They would likely entail the discharge of rock to stabilize the levees and may require limited removal of vegetation growing adjacent to the levees. The Navajo County Flood Control District and the City of Winslow would continue operations and maintenance activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. All repairs would likely entail like-for-like repairs. Elements of the existing vista within the project area would remain unchanged. Due to seasonal surface flows from the LCR and relative abundance of groundwater, potential impacted areas within the LCR would be repopulated with native and also likely invasive non-native vegetation within a few years via natural recruitment. The existing vistas of the vegetation in the LCR would remain unaltered over the long-term. Therefore, the No Federal Action Alternative would have less than significant impacts on aesthetics.

5.10.7. Environmental Commitments

AE 1 Temporarily disturbed areas would be reseeded and/or revegetated with native vegetation. Also, opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, would be investigated.

5.11. Land Use

5.11.1. Significance Threshold

Impacts would be considered significant if the alternative results in:

- The creation of substantial incompatibilities with existing or planned uses.

5.11.2. Alternatives 1.1 and 8

<u>Nonstructural Measures</u>
Implementation of nonstructural measures under these alternatives would not directly impact land use since there is no need for borrow material, no need for placement of excavated material, and no need for construction easements. Furthermore, nonstructural measures such as a flood warning system would not change the use of affected structures for different purposes. Thus, structures would continue to be in compliance with designated land uses. There would be no significant indirect impacts to land use as these alternatives would not induce flooding or alter the risk of flooding over additional lands. Development in previously undeveloped areas is not expected. The designated land uses would remain unchanged. As a result, there would be no permanent loss of developed land or substantial changes to the existing or planned land uses. Impacts would be less than significant.

<u>Channel Work</u>
Under these alternatives, the entire 5.75-mile-long Winslow Levee would be reconstructed; a new 0.7 mile long levee parallel to I-40 would be constructed; conveyance improvements at the BNSF Railroad Bridge; and an approximately 0.4-mile-long segment of the east end of the RWDL would be reconstructed. Construction would require temporary construction easements

and staging areas. The maximum width of the temporary easement would be approximately 35 feet on the landward side of the levee (beyond the 15 foot maintenance road) and 25 feet on the riverward side, for a total of 60 feet on both sides of the levees. The easements would be temporary and would return to their designated land uses upon completion of construction.

Under Alternatives 1.1 and 8, the newly reconstructed Winslow Levee would occupy the same general footprint as the existing levee, except for the setback levee under Alternative 8, described further below, and a likely increase in width and height in order to provide protection against the one percent ACE flood event. However, with the raised levee height, additional area is needed to accommodate a wider levee base along most of the project length. Additional easements would be obtained by Navajo County to accommodate the rebuilt levee. Designated uses adjacent to the existing Winslow Levee is primarily undeveloped rural residential and open space, with limited undeveloped commercial. Reconstruction of the Winslow Levee would not result in incompatibilities with existing uses.

The new levee parallel to I-40 would permanently remove approximately 11 acres of county lands designated as open space on the riverside of the Winslow Levee within the Community Village character area, resulting in an approximately 1.2 percent decrease of county lands zoned as open space. Although there would be minimal losses of areas within designated land uses, the construction levee would not conflict with existing uses. Although the loss of open space would conflict with planned uses as part of the Community Village area, this area is limited to the corridor immediately parallel to I-40 and adjacent to the LCR active channel. The new levee is, and would be consistent with the growth area guidance contained in the Navajo County Comprehensive Plan, and is not considered a substantial incompatibility with planned uses.

The conveyance improvements work would entail excavation of approximately 26 acres of saltcedar within the LCR channel and adjacent floodplain in the vicinity of the BNSF Railroad Bridge. Conveyance improvements would also entail removal and long term management of approximately 96 acres of saltcedar from undeveloped lands zoned for commercial, low residential, and open space within the Range Land character area. Conveyance improvements and associated saltcedar removal would not conflict with existing uses, or be inconsistent with allowable planned uses within this character area.

Reconstruction of the RWDL under these alternatives would be located within undeveloped lands designated by the county as low density residential. Construction would require temporary construction easements and staging areas. The maximum width of the easement would be approximately 35 feet on the landward side (beyond the 15-foot-wide maintenance road) of the levee and 25 feet on the riverward side, for a total of 60 feet on both sides of the levees. The easements would be temporary and would return to their designated land uses upon completion of construction. Reconstruction of the RWDL would not cause incompatibilities with existing or planned uses.

Under Alternative 8, an approximate 0.25-mile-long setback levee would be constructed and an approximate 0.3-mile-long section of the Winslow Levee riverward of the setback levee would be removed. Construction of a new 0.25-mile-long setback levee would convert approximately 12 acres, impacting two properties, of primarily undeveloped lands designated by the county as

rural residential to open space within the Community Village character area, resulting in a 1.18 percent reduction of lands zoned as rural residential located between the Winslow Levee and the city boundary. Although not anticipated, one permanent, physical residential relocation may be required as a result of the setback levee alignment. Due to the largely rural and undeveloped character of the Winslow community and region, there would be adequate opportunities of developed and undeveloped rural residential properties and uses elsewhere in the area that are consistent with the designed uses and growth area guidance contained in the Navajo County Comprehensive Plan. The setback levee alignment would add additional lands to the adjacent floodplain and improve flood flow conveyance through the LCR channel, thereby reducing the risk of flooding in the community of Winslow. Although the setback component of Alternative 8 would impact two properties, totaling 12 acres, the improved flood risk management system would be a benefit to land use as it would effectively remove approximately 2,700 properties and 1,600 structures from the FEMA 100-year floodplain (one percent ACE flood event), and support the existing and planned uses within the community. Property acquisitions required for the new setback levees would be conducted in compliance with applicable Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. The levee setback would not result in a substantial incompatibility with existing or planned uses because of its overall minimal impact to the entire area. Impacts associated with the channel work would be less than significant.

Borrow and Disposal Work

Borrow and disposal work, including material excavation, placement and disposal would not conflict with existing or planned uses. Excess sediment would be placed in open spaces or grazing areas, avoiding agricultural or aggregate processing areas. Placement of earthen substrate atop grazing areas would bury vegetation and temporarily render the area unsuitable for animal grazing until reestablishment of vegetation through natural recruitment. Other grazing areas would be available during the revegetation process. Remaining or unused excavated material would be returned to existing disposal areas and would not alter the land use. Therefore, borrow and disposal activities would not permanently affect or create substantial incompatibilities with existing or planned land uses. Impacts would be less than significant.

Staging, Stockpiling, and Access Areas

Use of staging, stockpiling, and access areas would result in land use impacts that would be similar to those characterized under Alternatives 1.1 and 8 borrow and disposal work. Activities associated with use of staging, stockpiling, and access areas would not permanently affect or create substantial incompatibilities with existing or planned land uses. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be short-term, temporary, and limited to specific sites. O&M activities would not result in changes in land use designations or existing uses once complete. Therefore, impacts to land use resulting from O&M activities would be less than significant.

Effects Determinations Summary

In summary, all project activities associated with Alternatives 1.1 and 8 would not result in a substantial change or cause substantial incompatibilities with lands uses. Property acquisitions required for the new setback levees would be conducted in compliance with applicable Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Alternatives 1.1 and 8 would be consistent with the Navajo County Comprehensive Plan as well as the City of Winslow General Plan (City of Winslow, 2002). Thus, impacts to land uses would be less than significant.

5.11.3. Alternative 3.1

Nonstructural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work

Reconstruction of the Winslow Levee, reconstruction of the RWDL, construction of a new levee parallel to I-40, and conveyance improvements at the BNSF Railroad Bridge and saltcedar removal would result in land use impacts similar to those characterized under Alternative 1.1 and 8.

Construction of new setback levees and removal of exiting levees would convert approximately 158 acres of undeveloped and developed lands designated by the county as rural residential to open space within the Community Village character area, resulting in a 17.3 percent reduction of lands zoned as rural residential located between the Winslow Levee and the city boundary. Likewise, approximately 65 acres of undeveloped and developed lands designated by the city as commercial would be converted to open space resulting in an 8.5 percent decrease of lands zoned as commercial. As a result of the setback levees, there would be an increase of approximately 261 acres of lands that would be designated as open space. The resulting levee realignment would leave approximately eight developed properties on the riverside of the levee, which would require relocation of those residences and structures.

The reductions in undeveloped and developed lands are within the segment between the Winslow Levee and the city boundary. However, the community of Winslow and the rest of the region are largely rural with an ample amount of undeveloped land. There would be adequate opportunities for developed and undeveloped rural residential and commercial properties and uses elsewhere in the area, consistent with the Navajo County Comprehensive Plan (Navajo County, 2011) and City of Winslow Zoning Ordinance. The setback levee alignment would add additional lands to the adjacent floodplain and improve flood flow conveyance through the LCR channel, thereby reducing the risk of flooding in the community of Winslow. Although the setback component could potentially impact approximately eight properties requiring relocation, the improved flood risk management system would be a benefit to land use as it would effectively remove approximately 2,700 properties and 1,600 structures from the FEMA 100-year floodplain (one percent ACE flood event), and support the existing and planned uses within the community.

In summary, activities associated with Alternative 3.1 would affect undeveloped and developed lands. The reconstructed Winslow Levee and RWDL would occupy the same footprint as the existing levees, though slightly wider, and would not permanently result in the loss of more than a minimal amount of adjacent lands. Conveyance improvements would result in a 0.35 percent decrease of lands zoned as low residential; a 0.80 percent decrease of lands zoned as commercial. Construction of a levee parallel to I-40 would result in a 1.2 percent decrease of county lands zoned as open space. However, construction of new setback levees would result in a 17.3 percent reduction of lands zoned as rural residential located between the Winslow Levee and the city boundary, and an 8.5 percent decrease of lands zoned as commercial. Thus, Alternative 3.1 would substantially conflict with existing and planned uses because it would convert a substantial percentage of rural residential and commercial land to other uses, resulting in substantial incompatibilities with planned uses. Property acquisitions required for the new setback levees would be conducted in compliance with Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Impacts to land use would be significant.

Borrow and Disposal Work

Potential impacts from borrow material excavation and placement would be similar to Alternatives 1.1 and 8 borrow and disposal work. Borrow and disposal activities would not permanently affect or create substantial incompatibilities with existing or planned land uses. Impacts would be less than significant.

Staging, Stockpiling, and Access Areas

Use of staging, stockpiling, and access areas would result in land use impacts that would be similar to those characterized under Alternatives 1.1 and 8 borrow and disposal work. Activities associated with use of staging, stockpiling, and access areas would not permanently affect or create substantial incompatibilities with existing or planned land uses. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Land use related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Reconstruction of Winslow Levee would result in a 17.3 percent reduction of lands zoned as rural residential located between the Winslow Levee and the city boundary and a 8.5 percent decrease of lands zoned as commercial. The amount of open space lands would increase correspondingly. The levee realignment would leave approximately eight developed properties on the riverside of the levee, which would require relocation of those residences and structures. Conveyance improvements would result in a 0.35 percent decrease of lands zoned as low residential; a 0.80 percent decrease of lands zoned as commercial. Construction of a levee parallel to I-40 would result in a 1.2 percent decrease of county lands zoned as open space. Alternative 3.1 would substantially conflict with existing and planned uses because it would convert a substantial percentage of rural residential and commercial land to other uses, resulting in substantial incompatibilities with planned uses. Property acquisitions required for the new

setback levees would be conducted in compliance with applicable Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Impacts would be significant.

5.11.4. Alternatives 7 and 9

Nonstructural Measures

Implementation of nonstructural measures under these alternatives would not directly impact land use since there is no need for borrow material, no need for placement of excavated material, and no need for construction easements. There would be no significant indirect impacts to land use as these alternatives would not induce flooding or alter the risk of flooding over additional lands. Development in previously undeveloped areas is not expected. The designated land uses would remain unchanged. As a result, there would be no permanent loss of developed land or substantial changes to the existing or planned land uses. Impacts would be less than significant.

Channel Work

Alternative 7 does not include any channel work. Under Alternative 9, an approximate 0.4-mile-long segment of RWDL would be reconstructed at the existing height. Land use impacts associated with reconstruction of the RWDL would be the same as characterized for Alternatives 1.1 and 8 for that reconstruction. Alternative 7 and 9 would not result in a substantial change or cause substantial incompatibilities with existing or planned uses. Impacts would be less than significant.

Borrow and Disposal Work

Alternative 7 does not include any borrow or disposal work. For Alternative 9, potential impacts from borrow material excavation and placement would be similar to Alternatives 1.1 and 8 borrow and disposal work, except that less borrow and disposal material would be used. Borrow and disposal activities would not permanently affect or create substantial incompatibilities with existing or designated land uses.

Staging, Stockpiling, and Access Areas

Alternative 7 does not include any work in staging, stockpiling, or access areas. For Alternative 9, use of staging, stockpiling, and access areas would result in land use impacts that would be similar to those characterized under Alternatives 1.1 and 8 borrow and disposal work, except that fewer areas would be used due to the reduced scope of activities proposed. Activities associated with use of staging, stockpiling, and access areas would not permanently affect or create substantial incompatibilities with existing or designated land uses. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Land use related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Alternative 7, composed of nonstructural measures, would not directly impact land use since there is no need for borrow material, no need for placement of excavated material, and no need for construction easements. Nonstructural measures under Alternatives 7 and 9, such as flood

proofing structures or a flood warning system, would not change the use of affected structures for different purposes. Thus, structures would continue to be in compliance with designated land uses. There would be no significant indirect impacts to land use as these alternatives would not induce flooding or alter the risk of flooding over additional lands. Development in previously undeveloped areas is not expected. The designated land uses would remain unchanged. As a result, there would be no permanent loss of developed land or substantial changes to the existing or planned land uses. For Alternative 9, use of staging, stockpiling, and access areas would result in land use impacts that would be similar to those characterized under Alternatives 1.1 and 8 borrow and disposal work, except that fewer areas would be used due to the reduced scope of activities proposed. Activities associated with use of staging, stockpiling, and access areas would not permanently affect or create substantial incompatibilities with existing or designated land uses. Impacts would be less than significant.

5.11.5. Alternatives 10. 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8. Alternative 10 would also include flood-proofing of structures, and impacts would be similar to those described for Alternatives 7 and 9.

Channel Work

The levees would be rebuilt to a height sufficient to contain: the one percent ACE flood event for Alternatives 10 and 10.1; the four percent ACE flood event for Alternative 10.2; the two percent ACE flood event for Alternative 10.3, and; the 0.5 percent ACE flood event for Alternative 10.4. Reconstruction of Winslow Levee, construction of a new levee parallel to I-40, reconstruction of the RWDL, and conveyance improvements at the BNSF Railroad Bridge, including saltcedar removal would result in impacts similar to those characterized under Alternative 1.1, except that impacts would be even less because the alternatives do not include the 12,890 northernmost feet of Winslow Levee. There are no additional land use impacts anticipated from the additional excavation under Alternative 10.4. Alternative 10.2 does not include any conveyance improvements under the BNSF Railroad Bridge, so no impacts would occur in that area. Impacts resulting from construction of a new 0.25-mile-long setback levee would be the same as that described under Alternative 8. Although not anticipated, one permanent, physical residential relocation may be required as a result of the setback levee alignment.

In summary, all project activities associated with these alternatives would not result in a substantial change or cause substantial incompatibilities with lands uses. Property acquisitions required for the new setback levee would be conducted in compliance with Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would be consistent with the Navajo County Comprehensive Plan as well as the City of Winslow General Plan (City of Winslow, 2002). Thus, impacts to land uses would be less than significant.

Borrow and Disposal Work

Potential impacts from borrow material excavation and placement would be similar to, and slightly less than, Alternatives 1.1 and 8 borrow and disposal work. Borrow and disposal activities would not permanently affect or create substantial incompatibilities with existing or planned land uses. Impacts would be less than significant.

Staging, Stockpiling, and Access Areas

Use of staging, stockpiling, and access areas would result in land use impacts that would be similar to, and slightly less than, those characterized under Alternatives 1.1 and 8 borrow and disposal work. Activities associated with use of staging, stockpiling, and access areas would not permanently affect or create substantial incompatibilities with existing or planned land uses. Impacts would be less than significant.

Operation and Maintenance

Impacts resulting from O&M activities would be similar to those described under Alternatives 1.1 and 8. Land use related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Nonstructural measures would not directly impact land use since there is no need for borrow material, no need for placement of excavated material, and no need for construction easements. Channel construction impacts would be less that those characterized under Alternatives 1.1, 3.1, and 8 since the 12,890 northernmost feet of Winslow Levee would not be reconstructed. Borrow and disposal activities would not permanently affect or create substantial incompatibilities with existing or planned land uses. Activities associated with use of staging, stockpiling, and access areas would not permanently affect or create substantial incompatibilities with existing or planned land uses. Impacts would be less than significant.

Although not anticipated, property acquisitions required for the new setback levee would be conducted in compliance with Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would be consistent with the Navajo County Comprehensive Plan as well as the City of Winslow General Plan (City of Winslow, 2002).

5.11.6. Alternative 11: No Federal Action Alternative

Under Alternative 11 (No Federal Action Alternative), no Federal action would be undertaken to address the flood risk for the Winslow community. Operation and maintenance activities for the Winslow Levee and RWDL would continue. Navajo County would continue repairing and improving the Winslow Levee on a reactionary, post-flood basis. A potential levee failure could affect more than 2,700 properties and 1,600 residential, commercial, industrial and public structures with a combined value of over $460 million that lie within the “500-year” (0.5 percent ACE) floodplain. Potential damages from a major flood event causing a levee breach could exceed $200 million. Expected annual damages, including structures, contents, autos, cleanup and other emergency costs are estimated at over $10 million. Borrow material and disposal areas, and staging areas, may be needed for the O&M levee work. Land uses under the No Federal

Action Alternative may be temporarily disrupted as a result of flooding events. However, land use is expected to return to existing uses. No significant impacts are anticipated.

5.11.7. Environmental Commitments

LU 1 Property acquisitions required for the new setback levee(s) would be conducted in compliance with applicable Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

5.12. Socioeconomics

5.12.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative results in:

- a substantial shift in population, housing, or employment.

5.12.2. Alternatives 1.1 and 8

Nonstructural Measures
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system. Installation of a flood warning system would not result in impacts to socioeconomics because it would be limited to development of a plan or set of procedures, and potential installation of instrumentation to measure rainfall or stream flow. It would not result in a shift in population, housing, or employment.

Channel Work
Rebuild of the levees would provide seasonal employment within the construction industry over the 2.5-year duration of construction for approximately 15 construction laborers. Work on the levees would be limited to approximately six months a year due to environmental restrictions and the monsoon season. Since the work would require general skills associated with the operation of earthmoving equipment, it is likely that the labor pool could be found within the City of Winslow, the City of Holbrook, and nearby portions of unincorporated Navajo County; or in the City of Flagstaff, in Coconino County, which are within approximately one-hour driving distance of Winslow. As a result, it is unlikely that construction laborers would require new permanent housing for construction work. Purchase and delivery of cement, grout, and stone would temporarily benefit local and regional suppliers.

Though the work would entail improvements in flood risk management infrastructure, it is unlikely that levee rebuilds would foster a substantial long-term shift in population, housing, or employment. Due to the presence of the BNSF rail line and the I-40, transportation/warehousing and tourism/accommodation sectors account for approximately 35 percent of the businesses within Winslow.[3] Furthermore, BNSF and the Arizona Department of Corrections are the major

[3] http://www.city-data.com/city/Winslow-Arizona.html#ixzz34HHradek

employers with 500 employees each.[4] Since the physical infrastructure was constructed with the existing baseline flood risks in mind, the proposed improvements to the flood risk management system would not likely result in a noticeable change to socioeconomics. Also, there are approximately 2,700 properties and 1,600 structures along the Winslow levee that are in the 100-year floodplain requiring flood insurance. Although not anticipated, one permanent, physical residential relocation may be required under Alternative 8 from the setback levee (Corps, 2014b), and as a result approximately 0.04 percent of the total existing properties or 0.06 percent of the total existing structures would be impacted. Thus, the scale of relocation would not be substantial. Relocation of a structure and/or a residence outside the floodplain of Winslow Levee would not substantially alter the socioeconomics of the Winslow area due to the potentially one residence that could be relocated. Moreover, this is a rural area that provides an ample amount of undeveloped land, and a sufficient amount of residential land properties are available to accommodate this relocation. Upon completion of the flood risk management measures, the reduction of flood risk would be a benefit for the City of Winslow and Navajo County. Therefore, impacts to socioeconomics would be less than significant impact.

Borrow and Disposal Work

Borrow and disposal work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work, except no relocations would occur. Impacts would not be significant.

Staging, Stockpiling, and Access Areas

Staging, stockpiling, and access areas work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work, except no relocations would occur. Impacts would not be significant.

Operations and Maintenance

O&M activities would not have the potential to result in substantial shifts in population, housing, or employment. Therefore, impacts to O&M would be less than significant

Effects Determinations Summary

Overall, impacts to socioeconomics would be beneficial due to the reduced risk of flooding and flood damages afforded by implementation of Alternatives 1.1 and 8. Based on the above, impacts to socioeconomics would be less than significant.

5.12.3. Alternative 3.1

Nonstructural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work

Both direct and indirect impacts to socioeconomics would be similar to those characterized for Alternatives 1.1 and 8. Also, there are approximately 2,700 properties and 1,600 structures along the Winslow levee that are in the 100-year floodplain needing flood insurance. Related to the

[4] http://www.wmonline.com/cities/winslow/winlowpro.htm

setback levees, at least eight permanent, physical residential relocations may be required (Corps, 2014b), and as a result approximately 0.30 percent of the total existing properties or 0.50 percent of the total existing structures within the proposed project area would be impacted. Thus, the scale of displacements would not be substantial. Relocation of structures and residences outside the floodplain of Winslow Levee would not substantially alter the socioeconomics of the Winslow area due to the limited number of residences that would be relocated. Moreover, this is a rural area that provides an ample amount of undeveloped land, and a sufficient amount of residential land properties are available to accommodate these relocations. Upon completion of the flood risk management measures, the reduction of flood risk would be a benefit for the City of Winslow and Navajo County. Therefore, impacts to socioeconomics would be less than significant impact.

Borrow and Disposal Work

Borrow and disposal work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work.

Staging and Access Areas

Staging, stockpiling, and access areas work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work.

Operations and Maintenance

O&M activities would be similar to those described under Alternatives 1.1 and 8. Socioeconomic related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Overall, impacts to socioeconomics would be beneficial due to the reduced risk of flooding and flood damages afforded by implementation of Alternative 3.1. Based on the above, impacts to socioeconomics would be less than significant.

5.12.4. Alternatives 7 and 9

Nonstructural Measures

Alternatives 7 and 9 include nonstructural measures. Work implementing non-structural measures would require general skills associated with residential construction, and it is likely the labor pool could be found within the cities of Winslow, Holbrook or Flagstaff, or in unincorporated Navajo County, that are within approximately one-hour driving distance from Winslow. As a result, it is unlikely that construction laborers would require new permanent housing for non-structural work. Purchase and delivery of construction materials would temporarily benefit local and regional suppliers. Non-structural measures work would provide limited small-scale, short-term employment associated with raising foundations or installation of a flood warning system. The number of laborers required for work and duration required for implementation of the non-structural measures work would vary yet would be less than the structural levee work. Also, it has been determined that non-structural measures work would have no permanent, physical residential relocations (Corps, 2014b). Based on the above, Alternative 7 and 9 would have a less than significant impact on socioeconomics.

Channel Work
Alternative 7 does not include any channel work. The RWDL rebuild under Alternative 9 would provide limited short-term employment. Construction would require approximately 15 construction laborers. As the primary work would be a combination of nonstructural measures and some work on a short portion of the RWDL, the construction duration would be substantially shorter, approximately 4 years. Work on the levee would be limited to approximately 6 months a year due to environmental restrictions and the monsoon season. The work would not require additional housing for construction laborers since the proposed project is within commuting distance of Winslow, Holbrook and Flagstaff. Furthermore, the work would not entail the construction of infrastructure or utilities that would result in growth of the surrounding area, nor would the work increase capacity of existing infrastructure that would induce growth. Also, it has been determined that RWDL rebuild would have no permanent, physical residential relocations (Corps, 2014b). Under Alternative 9, the risk of flooding and flood damages would be reduced, which would be a benefit to the city of Winslow and Navajo County. Therefore, impacts would be less than significant impact on socioeconomics.

Borrow and Disposal Work
Alternative 7 does not include any borrow or disposal work. For Alternative 9, borrow and disposal work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work.

Staging, Stockpiling, and Access Areas
Alternative 7 does not include any work in staging, stockpiling, or access areas. For Alternative 9, staging, stockpiling, and access areas work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work.

Operations and Maintenance
O&M activities would be similar to those described under Alternatives 1.1 and 8. Socioeconomic related impacts due to O&M activities would be less than significant.

Effects Determinations Summary
Overall, impacts to socioeconomics would be beneficial due to the reduced risk of flooding and flood damages afforded by implementation of Alternatives 7 and 9. Based on the above, impacts to socioeconomics would be less than significant.

5.12.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures
Implementation of nonstructural measures under Alternative 10 would result in socioeconomic impacts similar to those characterized under Alternatives 7 and 9. Impacts from the other alternatives would be similar to those characterized under Alternatives 1.1 and 8.

Channel Work
Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would provide limited short-term employment. Construction would require approximately 15 construction laborers. As the primary work would be on the levees with some nonstructural measures, the construction duration would be shorter than Alternatives 1.1 and 8, approximately 2.5 years. Work on the levees would be limited to

approximately 6 months a year due to environmental restrictions and the monsoon season. Both direct and indirect impacts to socioeconomic would be similar to those characterized for Alternatives 1.1 and 8, even though these alternatives would not include construction activities for the northernmost 12,890 feet of the Winslow Levee, and even though Alternative 10.4 includes additional excavation under the BNFS Railroad Bridge. Alternative 10.2 does not include channelization improvements under the BNSF Railroad Bridge. Thus, any impact would be even less. Also, there are approximately 2,700 properties and 1,600 structures along the Winslow levee that are in the 100-year floodplain requiring flood insurance, and although not anticipated, one permanent, physical residential relocation may be required (Corps, 2014b), or approximately 0.04 percent of the total existing properties or 0.06 percent of the total existing structures, would be impacted. Thus, relocation of these facilities would not be substantial. Relocation of a structure and/or a residence outside the floodplain would not substantially alter the socioeconomics of the Winslow area due to the potential one residence that could be relocated. Moreover, this is a rural area that provides an ample amount of undeveloped land, and a sufficient amount of residential land properties are available to accommodate this relocation. Upon completion of the flood risk management measures, the reduction of flood risk would be a benefit for the City of Winslow and Navajo County. Therefore, impacts to socioeconomics would be less than significant.

Borrow and Disposal Work

Borrow and disposal work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work.

Staging, Stockpiling, and Access Areas

Staging, stockpiling, and access areas work would result in socioeconomic impacts that would be similar to those characterized under Alternatives 1.1 and 8, Channel Work.

Operations and Maintenance

O&M activities would be similar to those described under Alternatives 1.1 and 8. Socioeconomic related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Overall, impacts to socioeconomics would be beneficial due to the reduced risk of flooding and flood damages afforded by implementation of Alternatives 10, 10.1, 10.2, 10.3, and 10.4. Based on the above, impacts to socioeconomics would be less than significant.

5.12.6. Alternative 11: No Federal Action Alternative

The Navajo County Flood Control District and the City of Winslow would continue O&M on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Therefore, residents and properties would periodically be threatened during high flow conditions, requiring emergency repairs of the levees. It is likely that any emergency repair work would be short-term and construction work would be limited. It would not require additional housing for construction laborers since the construction is within commuting distance from Winslow, Holbrook and Flagstaff. In addition, emergency repair work would not entail the construction of infrastructure or utilities that would result in growth of the surrounding area. Therefore, impacts to socioeconomics would be less than significant.

5.13. Environmental Justice

5.13.1. Significance Threshold

Based on the existing conditions discussed above, impacts would be considered significant if the alternative results in:

- a disproportionately high and adverse human health or environmental effect on minority or low-income populations.

5.13.2. Alternatives 1.1 and 8

Nonstructural Measures

Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system and would not result in impacts regarding environmental justice. Installation of a flood warning system would be limited to development of a plan or set of procedures, and potential installation of instrumentation to measure rainfall or stream flow. No construction or installation would occur in a location where it would have a disproportionally high and adverse environmental effect on minority or low income populations.

Channel Work

Levee rebuilds would not result in a disproportionately high and adverse human health or environmental effect on minority or low-income populations. There are approximately 2,700 properties and 1,600 structures along the Winslow levee that are in the one percent ACE floodplain requiring flood insurance. Although not anticipated, one permanent, physical residential relocation may be required under Alternative 8 for the setback levee, or approximately 0.04 percent of the total existing properties or approximately 0.06 percent of the total existing structures that could potentially be impacted. The potential relocation of one residential owner outside the floodplain of Winslow Levee would not create a disproportionately high and adverse human health or environmental effect on minority and low-income populations in the Winslow area as this is limited to one potential residence. Moreover, this is a rural area that provides an ample amount of undeveloped land, and a sufficient amount of residential land properties are available to accommodate this relocation. Upon completion of the flood risk management measures, the reduction of flood risk would be a benefit for the City of Winslow and Navajo County. Alternatives 1.1 and 8 would not result in a loss of jobs to minority or low-income communities or create new physical barriers separating neighborhoods. Construction operations would require the use of roadways to deliver laborers, materials, and equipment to the work sites. The main transportation haul routes would not include travel on roadways that traverse through low-income or minority communities, particularly south of SR-87.

Borrow and Disposal Work

Borrow and disposal work would not occur within or immediately adjacent to low-income or minority communities. In general, low-income or minority populations for Winslow are typically located north of the RWDL, south of Interstate 40, and west of North Park Drive. The main transportation haul routes would not include travel on roadways that traverse through low-income or minority communities. There would be no impacts to environmental justice communities.

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling, and access areas would not occur within or immediately adjacent to low-income or minority communities. The main transportation haul routes would not include travel on roadways that traverse through low-income or minority communities. There would be no impacts to environmental justice communities.

Operations and Maintenance
O&M could require the import of fill material and possibly discharge of rocks to stabilize the levees. It is likely that the O&M would be limited in scope and duration. O&M work would not result in disproportionately high and adverse human health or environmental effect on minority or low-income populations as the majority of the work would stay within the footprint of levees and existing maintenance access road routes. O&M would not impact recreation, traffic, utilities, or public services and would provide equal protection to everyone who uses these resources adjacent to the levees. The O&M work would not disproportionately affect minority or low-income populations. Therefore, potential environmental justice related impacts due to O&M activities would be less than significant.

Effects Determinations Summary
For all activities, there would be no significant or adverse impacts to environmental justice communities.

5.13.3. Alternative 3.1

Nonstructural Measures
Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work
Alternative 3.1 primarily is reconstruction of the entire 5.75-mile-long Winslow Levee, construction of 2.5 miles of new, long setback levees, removal of sections of the Winslow Levee riverward of the setback levees, construction of a new 0.7-mile-long levee parallel to I-40, reconstruction of an approximately 0.4-mile long segment of the east end of the RWDL, and implementation of conveyance improvements at the BNSF Railroad Bridge. The levees would be rebuilt to a height sufficient to contain the one percent ACE flood event. There are no non-structural measures proposed for Alternative 3.1.

Though the work would entail improvements in flood risk management infrastructure, it is unlikely that levee rebuilds would foster a disproportionately high and adverse human health or environmental effect on minority and low-income populations. It has been determined that eight permanent, physical residential relocations may be required for the setback levees , or approximately 0.30 percent of the total existing properties or approximately 0.50 percent of the total existing structures that could potentially be impacted. Potential relocation of eight residential owners outside the floodplain of Winslow Levee would not create a disproportionately high and adverse human health or environmental effect on minority or low-income populations in the Winslow area as these residences are not part of the low-income or minority populations. Moreover, this is a rural area that provides an ample amount of undeveloped land; a sufficient amount of residential land properties are available to

accommodate these relocations. Upon completion of the flood risk management measures, the reduction of flood risk would be a benefit for the City of Winslow and Navajo County. Alternative 3.1 would not result in a loss of jobs to minority or low-income communities or create new physical barriers separating neighborhoods. Construction operations would require the use of roadways to deliver laborers, materials, and equipment to the work sites. The main transportation haul routes would not include travel on roadways that traverse through low-income or minority communities, particularly south of SR-87.

Borrow and Disposal Work

Borrow and disposal work would result in environmental justice impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Staging, Stockpiling, and Access Areas

Use of staging, stockpiling, and access areas would result in environmental justice impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Operation and Maintenance

O&M activities would be similar to those described under Alternatives 1.1 and 8. Potential environmental justice related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Based on the above, there would be no significant or adverse impacts to environmental justice communities.

5.13.4. Alternatives 7 and 9

Implementation of non-structural measures work would require general skills associated with residential construction, and it is likely the labor pool could be found within the city of Winslow, or from the cities of Holbrook or Flagstaff that are within one-hour driving distance from Winslow. As a result, it is unlikely that construction laborers would require permanent housing for non-structural work that would have a disproportionately high and adverse human health or environmental effect on minority or low-income populations. Purchase and delivery of construction materials would temporarily benefit local and regional suppliers. Non-structural measures work would provide limited small-scale, short-term employment associated with raising foundations or installation of a flood warning system. The number of laborers required for work and duration required for implementation of the non-structural measures work would vary yet would be less than the structural levee work. Also, it has been determined that non-structural measures work would have no permanent, physical residential relocations. Based on the above, potential impacts to environmental justice would be less than significant.

Channel Work

Alternative 7 does not include any channel work. For Alternative 9, the RWDL rebuild would provide limited short-term employment. Construction would require approximately 15 construction laborers. As a result, it is unlikely that construction laborers would generate permanent housing or services, expand utilities or induce growth that would have a disproportionately high and adverse human health or environmental effect on minority or low-income populations. As the primary work would be a combination of nonstructural measures and

some work on a short portion of the RWDL, the construction duration would be substantially shorter, approximately four years. Work on the levee would be limited to approximately six months a year due to environmental restrictions and the monsoon season. The work would not require additional housing for construction laborers since the proposed project area is within commuting distance of Winslow, Holbrook, and Flagstaff. Furthermore, the work would not entail the construction of infrastructure or utilities that would result in growth of the surrounding area, nor would the work increase the capacity of existing infrastructure that would induce growth. Also, it has been determined that RWDL rebuild would have no permanent, physical residential relocations. Therefore, potential impacts would be less than significant regarding environmental justice.

Borrow and Disposal Work

Alternative 7 does not include any borrow or disposal work. For Alternative 9, borrow and disposal work would result in environmental justice impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Staging, Stockpiling, and Access Areas

Alternative 7 does not include any work in staging, stockpiling, or access areas. For Alternative 9, use of staging, stockpiling, and access areas would result in environmental justice impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Operation and Maintenance

O&M activities would be similar to those described under Alternatives 1.1 and 8. Potential environmental justice related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Based on the above, there would be no significant or adverse impacts to environmental justice communities.

5.13.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Implementation of nonstructural measures would result in environmental justice impacts similar to those characterized under Alternatives 7 and 9 for Alternative 10, and similar to Alternatives 1.1 and 8 for the other alternatives.

Channel Work

Impacts resulting from Alternatives 10, 10.1, 10.2, 10.3, and 10.4 would be similar to but less than Alternative 8, since the channel reconstruction would not include the northernmost 12,890 feet of the Winslow Levee, except that Alternative 10.4 would include slightly more excavation, though the impacts would be similar overall. As described under Alternative 8, as there are approximately 2,700 properties and 1,600 structures along the Winslow levee that are in the 100-year floodplain requiring flood insurance. Although not anticipated, one permanent, physical residential relocation may be required. Potential relocation of one residential owner outside the floodplain of Winslow Levee from the setback levee would not create a disproportionately high and adverse human health or environmental effect on minority and low-income populations in the Winslow area as this is limited to one potential residence. Moreover, this is a rural area that

provides an ample amount of undeveloped land, and a sufficient amount of residential land properties are available to accommodate this relocation. Upon completion of the flood risk management measures, the reduction of flood risk would be a benefit for the City of Winslow and Navajo County. These alternatives would not result in a loss of jobs to minority or low-income communities or create new physical barriers separating neighborhoods. Construction operations would require the use of roadways to deliver laborers, materials, and equipment to the work sites. The main transportation haul routes would not include travel on roadways that traverse through low-income or minority communities, particularly south of SR-87.

Borrow and Disposal Work

Borrow and disposal work would result in environmental justice impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Staging, Stockpiling, and Access Areas

Use of staging, stockpiling, and access areas work would result in environmental justice impacts that would be similar to those characterized under Alternatives 1.1 and 8.

Operation and Maintenance (O&M) Work

O&M activities would be similar to those described under Alternatives 1.1 and 8. Potential environmental justice related impacts due to O&M activities would be less than significant.

Effects Determinations Summary

Based on the above, there would be no significant or adverse impacts to environmental justice communities.

5.13.6. Alternative 11: No Federal Action Alternative

The No Federal Action Alternative would not create a disproportionately high and adverse human health or environmental effect on minority or low-income populations as a majority of the work would stay within the footprint of levees and existing maintenance access road routes. O&M activities, including emergency repairs, would not impact recreation, traffic, utilities or public services and would provide equal protection to everyone who uses these resources adjacent to the levees. The No Federal Action Alternative would not disproportionately affect minority or low-income populations. Therefore, potential environmental justice related impacts would be less than significant.

5.14. Recreation

5.14.1. Significance Threshold

Based on the existing conditions discussed above, impacts to recreation would be considered significant if the alternative results in:

- permanent or significant limitation of the use of or access to a recreational area or facility.

5.14.2. Alternatives 1.1 and 8

Nonstructural Measures
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system and would not result in impacts to recreation. Implementation of a flood warning system would be limited to development of a plan or set of procedures, and potential installation of instrumentation to measure rainfall or stream flow. This would not affect the use or access to recreational areas or facilities.

Channel Work
Recreation is not authorized on or immediately adjacent to the levee or in the temporary construction easement areas to be used during channel work. Recreation at the Homolovi State Park would not be impacted by the channel work. Similarly, the setback levee under Alternative 8 would not have impacts on recreation because there are no authorized recreational uses or facilities in this area. Thus, construction would not permanently or significantly limit the use of or access of a recreational area or facility.

There are no established recreational facilities within the conveyance improvement area, and the existing undeveloped lands adjacent to the conveyance improvement area would still be available for passive recreation. Also, the construction of a new levee parallel to I-40 would not impact recreation since it is immediately adjacent to the highway.

In summary, there are no established recreational facilities within the footprint of the proposed project area. Recreation use on the Winslow Levee and access roads would not change and would continue to be prohibited. Recreation within the open space and undeveloped areas east of the levees would not be affected. Overall, impacts to recreation are not anticipated; however, upon project completion, any impacts to recreation would be short-term, localized, and return to pre-project conditions.

Borrow and Disposal Work
Impacts from borrow and disposal activities would not result in impacts to recreation as there are no authorized recreational use or facilities in these areas. However, if any impacts do occur, they would be short-term, localized, and return to pre-project conditions.

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling, and access areas would not result in significant impacts because there are no authorized recreational use or facilities in these areas. However, if any impacts do occur, they would be short-term, localized, and return to pre-project conditions.

Operations and Maintenance (O&M)
O&M activities are not anticipated to result in impacts to recreation. Open space adjacent to the levees (on the riverside outside the temporary construction easements areas) would be available for passive recreation during O&M work. Although impacts to recreation are not anticipated, any impacts to recreation would be short-term, localized, and return to pre-project conditions.

Effects Determination Summary
Overall, impacts to recreation are not anticipated; however, upon project completion, any impacts to recreation would be short-term, localized, and return to pre-project conditions. Any impacts, if occur, would be less than significant.

5.14.3. Alternative 3.1

Nonstructural Measures
There would be no impacts from nonstructural measures. Implementation of a flood warning system would be limited to development of a plan or set of procedures, and potential installation of instrumentation to measure rainfall or stream flow. This would not affect the use or access to recreational areas or facilities.

Channel Work
There would be no impacts from channel work similar to those characterized under Alternatives 1.1 and 8. The additional setback levees proposed under Alternative 3.1 would not result in impacts to recreation as there are no designated recreational facilities in those areas.

Borrow and Disposal Work
There would be no impacts from borrow and disposal work similar to those characterized under Alternatives 1.1 and 8.

Staging, Stockpiling and Access Areas
There would be no impacts from use of staging, stockpiling, and access areas similar to those characterized under Alternatives 1.1 and 8.

Operation and Maintenance (O&M)
There would be no impacts from O&M similar to those characterized under Alternatives 1.1 and 8.
Effects Determination Summary
Overall, impacts to recreation are not anticipated; however, upon project completion, any impacts to recreation would be short-term, localized, and return to pre-project conditions. Any impacts, if occur, would be less than significant.

5.14.4. Alternatives 7 and 9

Nonstructural Measures
Raising foundations of structures for flood protection or installing flood warning system would not substantially interfere with recreation. Impacts to recreation would be short-term and localized, if any. Furthermore, passive recreational activities would continue to take place on undeveloped lands or open spaces adjacent to the levees but outside the construction easement

areas. Thus, nonstructural measures would not permanently limit the use and access of a recreational area or facility. Also, since established recreational facilities such as parks are located near the center of town rather than in the proposed project area, implementation of nonstructural measures would not impact established recreational facilities. No impacts are anticipated, but upon project completion, any impacts to recreation would return to pre-project conditions.

Channel Work
Alternative 7 does not include any channel work. Under Alternative 9, reconstruction of the RWDL recreation impacts are not anticipated; however, if any impacts do occur, they would be short-term, localized, and return to pre-project conditions.

Borrow and Disposal Work
Alternative 7 does not include any borrow or disposal work. Under Alternative 9, there would be no impacts from borrow and disposal work similar to those characterized under Alternatives 1.1 and 8.

Staging, Stockpiling, and Access Areas
Alternative 7 does not include any work in staging, stockpiling, or access areas. Under Alternative 9, there would be no impacts from use of staging, stockpiling, and access areas work similar to those characterized under Alternatives 1.1 and 8.

Operation and Maintenance (O&M)
There would be no impacts from O&M similar to those characterized under Alternatives 1.1 and 8.

Effects Determination Summary
Overall, impacts to recreation are not anticipated; however, upon project completion, any impacts to recreation would be short-term, localized, and return to pre-project conditions. Any impacts, if occur, would be less than significant.

5.14.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures
For Alternative 10, implementation of nonstructural measures are not anticipated to result in impacts to recreation, as discussed under Alternatives 7 and 9. For the other alternatives, impacts to recreation are not anticipated as described for Alternatives 1.1 and 8.

Channel Work
There would be no impacts from channel work similar to those characterized under Alternatives 1.1 and 8. The additional excavation under Alternative 10.4 would not impact recreation.

Borrow and Disposal Work
There would be no impacts from borrow and disposal work similar to those characterized under Alternatives 1.1 and 8.

Staging, Stockpiling, and Access Areas
There would be no impacts from use of staging, stockpiling, and access areas similar to those characterized under Alternatives 1.1 and 8.

Operation and Maintenance (O&M)
There would be no impacts from O&M similar to those characterized under Alternatives 1.1 and 8.

Effects Determination Summary
Overall, impacts to recreation are not anticipated; however, upon project completion, any impacts to recreation would be short-term, localized, and return to pre-project conditions. Any impacts, if occur, would be less than significant.

5.14.6. Alternative 11: No Federal Action Alternative

Periodic O&M work including emergency repairs of the levees would be required. During repair activities, recreational opportunities would be available in the open spaces and undeveloped areas around the levees. Repair activities and other O&M work would retain the existing alignment and would not change designated or existing land uses, as the amount of open space available for passive recreation would remain unchanged. Based on the above, the No Federal Action Alternative would not result in impacts on recreation.

5.15. Utilities and Public Safety Services

5.15.1. Significance Threshold

Based on the existing conditions discussed above, impacts to utilities and public safety services would be considered significant if the alternative results in:

- a modification to an existing utility that would result in substantial disruptions to services provided to the public; and
- a substantial increased, long-term demand for law enforcement, fire protection, and other public safety services.

5.15.2. Alternatives 1.1 and 8

Nonstructural Measures
Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system and would not result in impacts to utilities or public safety services because there would be no change to utilities or no increase in need for public services.

Channel Work
Under Alternatives 1.1 and 8, utilities within the proposed project area would be replaced, relocated, protected in place, removed, or avoided with design refinements, as identified in Table 5-15.

Table 5-15 Alternatives 1.1 and 8 Utilities (Listed in Order from Upstream to Downstream)

Utility	Owner/Operator	Specifications	Action During Construction
Inverted Siphons	Winslow Irrigation District	Two siphons constructed with 30 inch reinforced concrete pipe	Relocate (reconstruct in place)
Utility line on wooden poles	Unknown	Single overhead line with unidentified local utility	Relocation or removal
Fiber Optic Line	CenturyLink	Major trunk line and local service line in 4-inch conduit	Protect in place
High Pressure Gas Line Crossing No. 1	Kinder-Morgan	4.5 inch outside diameter pipe	Relocate
High Tension Electric Lines	Arizona Public Services (APS)	Unknown; possibly 130kV	Within construction access easement; protect in place
High Pressure Gas Line Crossing No. 2	Kinder-Morgan	4.5 inch outside diameter pipe	Relocate
K3 Channel, Under I-40	ADOT	3 barrel 4 feet X 10 feet concrete box culvert with lift gates	Not in construction area; levee design to be refined during PED to avoid impacts, as needed
High Pressure Gas Line Crossing No. 3	Kinder-Morgan	4.5 inch outside diameter pipe	Relocate
I-4 Hydraulic Gate	ADOT	4 barrel 4 feet X 10 feet concrete box culvert with lift gates	Rebuild in place
Arena lights	Hatch, Ben Trustee B & M Hatch Family Trust	Four livestock arena light poles	Protect in place; design to be refined during PED to avoid impacts
Homolovi Water Line	City of Winslow	6 inch PVC line for potable water supply	Relocate

There are nine separate utilities and/or utility crossings within the Alternatives 1.1 and 8 construction corridor. These utilities consist of irrigation infrastructure, local and regional electrical service, a fiber optic line, a high pressure gas line, drainage infrastructure operated by ADOT, private arena lights, and a potable water line. Utilities would be relocated/reconstructed in place, protected in place, or avoided via minor changes to project alignment during PED. Refer to Table 5-15 above for a description of the utilities and impacts associated with Alternatives 1.1 and 8.

To protect the CenturyLink fiber optic conduit in-place, it would be encased in concrete with concrete slope anchors beneath the riverside levee slope (10 feet o/c). The concrete encasement would extend 30 feet out from the landside levee toe and 10 feet out from the riverside toe-down. The landside encasement extension would be to protect the line from construction traffic.

The Kinder-Morgan gas line crosses the construction corridor three times. A total of 1,200 feet of gas line would need to be relocated to a sufficient depth to pass beneath the new construction to avoid levee penetrations. This work would involve excavation and removal of the existing line, trenching and sidecast of excavated material, placement of new line, backfill, and connection of the new line. Use of directional boring for part of the relocation work may be feasible.

The potable water line runs parallel to the landside of the Winslow Levee for a distance of approximately 1,000 feet from the east end of Prosperity Avenue to an access vault at the landside toe of the levee. An estimated 1,600 feet of this line would need to be relocated during project construction.

The ADOT K3 channel is aligned with a normally dry manmade channel that extends under I-40. This gate is normally closed but can be opened by means of lift gates. This canal has no discernable channel north of I-40. The current culvert extends approximately 50 feet from the edge of the road to the north, and the proposed levee alignment goes over the existing culvert. The culvert may need to be extended to accommodate a levee embankment or another design feature could allow the culvert to be protected in-place (e.g. using floodwall over the culvert that ties into the levee). This level of deign will be determined in PED.
If possible, utility line relocations would be accomplished in a manner that does not require service interruptions. However, during relocation of these utilities and final connection of the new lines to the existing lines, temporary disruptions to potable water and natural gas service may be necessary. Potable water service disruptions would be limited to Homolovi State Park. Service outages, if necessary, are anticipated to be short term. Multiple service outages for one or more utilities are also possible. Since the CenturyLink fiber optic line would be protected in-place, no service interruptions are expected.

Relocation or replacement of utilities may temporarily disrupt services to service users such as the waterline to Homolovi State Park, utility line on wooden poles, inverted siphons, and overhead electrical line on poles; however impacts would be short-term and temporary. With the implementation of environmental commitments, potential impacts to utility service would be reduced. Utility service would return to pre-project conditions upon completion of replacement or relocation actions.

Certain utilities, such as fiber optic cable, high tension electric lines, K3 Channel, arena lights, and overhead electrical line on poles, would be protected in place or avoided during construction. Since the utilities would be protected in place or avoidance of the utilities during construction, there would be no impact.

Removal of the buried, abandoned telephone cable that is not active and not in service would occur during construction. Since there is currently no telephone service coming from the abandoned cable, then there would be no disruption of utility service, and therefore, there would be no impact.

The Winslow wastewater outfall would have to be relocated during construction. A temporary outlet would be constructed prior to starting construction near the utility. Water would be conveyed from the existing outlet to the temporary outlet during construction. A new outfall would be constructed and upon completion of construction water would be reconveyed through the new outfall. With the implementation of environmental commitments, potential impacts to utilities would be reduced. Disruption of wastewater services, if any, are expected to be no more than two hours to connect the new line to the existing line.

The hydraulic gate and four-foot-by-ten-foot underground concrete box culvert would be rebuilt in place during construction. The ADOT underground channel would be extended through the new levee parallel to I-40. With the implementation of environmental commitments, potential impacts to utilities would be reduced. Storm flows through the channel are not anticipated to be disrupted during construction. Hydraulic gate and culvert function would return to pre-project conditions upon completion of construction.

Based on the above and with the implementation of environmental commitments (U-1 and U-2), there would be no substantial disruptions to public utilities during construction. Therefore, impacts to utilities would be less than significant.

Alternatives 1.1 and 8 would not involve development of new residential or nonresidential structures that would contribute to a permanent increase in population to the area. There may be a temporary increase in construction workers to the Winslow area, but this temporary increase would not cause a permanent increase in demand for public services. The levels of public safety services would return to pre-project conditions upon completion of construction. Construction of structural measures would represent improvements to the levee system for flood risk management, which would reduce the risk of flooding and flood damages from storm flows. With Alternative 1.1 or 8 in place, the need for emergency services, such as law enforcement, fire protection, or public safety services, during certain storm events would be reduced. Based on the above, there would be no substantial increased, long-term demand for law enforcement, fire protection, or public safety services, and there could be a beneficial impact. Therefore, impacts to public safety services would be less than significant.

Borrow and Disposal Work

The only borrow or disposal site activities that could impact utilities are the use of borrow material from the existing levee embankments, trench drains, or channelization areas. Borrow and disposal work would result in utilities and public safety services impacts that would be similar to those characterized under Alternatives 1.1 and 8 channel work. Potential impacts would be short-term and temporary.

Staging, Stockpiling, and Access Areas

Use of staging, stockpiling, and access areas and work in these areas would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8 channel work.

Operations and Maintenance

O&M activities would include routine inspections and minor repairs of the levee structures, when needed. Future O&M activities would not substantially disrupt existing utilities services and would not interfere with maintenance activity of utility providers. Demands on utilities (water, wastewater treatment facility, storm water drainage facility, and solid waste, electrical power, natural gas, etc.) during maintenance would be temporary and relatively minor. O&M activities would require relatively small amounts of materials, would typically occur for only a short period of time, and would not require a substantial number of new workers for O&M of the levees. Therefore, O&M would not result in an increase in the local population, leading to a substantial increased long-term demand on local public services or exceed capacity of existing

services. O&M activities would not include uses that would require substantial increases to utility or public safety services. Based on the above, impacts to utilities and public safety services from O&M activities would be less than significant.

Effects Determinations Summary
For all activities, potential impacts to utilities and public safety services would be minimal and temporary, or beneficial. Impacts would be less than significant.

5.15.3. Alternative 3.1

Nonstructural Measures
Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work
Reconstruction of the Winslow Levee and RWDL, setback work, and the conveyance improvements at the BNSF Railroad Bridge would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8. The setback areas would not increase any impacts to utilities or public safety services. Potential impacts would be short-term and temporary and potentially beneficial, and not significant.

Borrow and Disposal Work
Borrow and disposal work would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8 channel work. Potential impacts would be short-term and temporary, and not significant.

Staging, Stockpiling, and Access Areas
Use of staging, stockpiling, and access areas would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8. Potential impacts would be short-term and temporary, and not significant.

Operations and Maintenance
O&M activities would result in utilities and public safety services impacts that would be similar to those characterized under Alternatives 1.1 and 8. Potential impacts would be short-term and temporary, and not significant.

Effects Determinations Summary
Potential impacts to utilities and public safety services would be short-term and temporary, and potentially beneficial. Implementation of environmental commitments identified below would reduce impacts further. Based on the above, impacts to utilities and public safety services would be less than significant.

5.15.4. Alternatives 7 and 9

Nonstructural Measures

Raising foundations of structures may result in temporary disruptions of electrical, natural gas, or water and sewer services. However, impacts to utility services would be short-term and localized, and impacts to public safety services would be negligible and potentially beneficial if the need for use of public safety services during flood events is decreased. Construction of flood warning systems would not result in disruptions to utilities or public safety services. Impacts to utilities and public safety services would be short-term and localized. Utility services would return to pre-project conditions upon completion of non-structural work. Based on the above, impacts to utilities and public safety services would be less than significant.

Channel Work

Alternative 7 does not include any channel work. For Alternative 9, reconstruction of the RWDL would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8, except that none of the utilities identified as being impacted by reconstruction of the Winslow Levee would be impacted. Potential impacts would be short-term and temporary, potentially beneficial, and not significant.

Borrow and Disposal Work

Alternative 7 does not include any borrow or disposal work. For Alternative 9, borrow and disposal work would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8 channel work. Potential impacts would be short-term and temporary, and not significant.

Staging, Stockpiling, and Access Areas

Alternative 7 does not include any work in staging, stockpiling, or access areas. For Alternative 9, use of staging, stockpiling, and access areas would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8. Potential impacts would be short-term and temporary, and not significant.

Operations and Maintenance

O&M activities would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8. Potential impacts would be short-term and temporary, and not significant.

Effects Determinations Summary

Potential impacts to utilities and public safety services would be short-term and temporary. Implementation of environmental commitments identified below would reduce impacts further. Based on the above, impacts to utilities and public safety services would be less than significant.

5.15.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Implementation of nonstructural measures would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8. Alternative 10 would also include flood proofing of structures, and impacts would be similar to those described for Alternatives 7 and 9.

Channel Work

Reconstruction of the RWDL and Winslow Levee, setback work, and conveyance improvements at the BNSF Railroad Bridge, would result in utilities and public safety services impacts similar to those characterized for the under Alternatives 1.1 and 8, except that no impact to the Winslow Wastewater Outfall is anticipated for these alternatives, since these alternatives would not include reconstruction of the Winslow Levee in the 12,890 northernmost feet. The increased channelization under Alternative 10.4 would not result in a change in impacts to utilities or public safety services compared to the other alternatives. Impacts would potentially be beneficial, and would not be significant. Alternative 10.2 would have no impact on utilities existing under the BNSF Railroad Bridge, since no channelization improvements are proposed for this alternative.

Borrow and Disposal Work

Borrow and disposal work would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8. Potential impacts would be short-term and temporary, and not significant.

Staging, Stockpiling, and Access Areas

Use of staging, stockpiling, and access areas would result in utilities and public safety services impacts similar to those characterized under Alternatives 1.1 and 8. Potential impacts would be short-term and temporary, and less than significant.

Operations and Maintenance

O&M activities would result in utilities and public safety services impacts that would be similar to those characterized under Alternatives 1.1 and 8 O&M work. Potential impacts would be short-term and temporary, and not significant.

Effects Determinations Summary

Potential impacts to utilities and public safety services would be short-term and temporary and potentially beneficial. Implementation of environmental commitments identified below would reduce impacts further. Based on the above, impacts to utilities and public safety services would be less than significant.

5.15.6. Alternative 11: No Federal Action Alternative

Without flood risk management improvements, residents and properties adjacent to the proposed project reach would be exposed to a higher risk of flooding. Future high flow conditions through the proposed project reach could undermine the existing levee and threaten residents and properties. Utilities may be disrupted and public safety services may be impacted.

The Navajo County Flood Control District and the City of Winslow will continue operations and maintenance activities on both levees. Both jurisdictions may undertake levee repairs and improvements as needs arise and funding allows. Emergency repairs may be required to stabilize weakened sections of the levee during floods. Such repairs would be limited in scope and temporary in duration, and would likely entail the discharge of rocks and earthen fill. Levee repairs and improvements could require use of earthmoving equipment such as excavators, bulldozers, and loaders within the active channel. Impacts and disruptions to utilities and public safety services would be commensurate with the limited scope, temporary duration, and location of work, respectively. Utilities and public safety services would return to prior conditions upon completion of construction.

5.15.7. Environmental Commitments

The following are environmental commitments that would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to utilities (U).

U 1 Prepare and implement a utilities management plan. The plan will identify location of known utilities and their respective owners and points of contacts. Location specific construction methods will be developed in conjunction with affected utility owners to avoid or minimize disruptions to services.

U 2 Permits required to dig, reroute, or construct within the vicinity of utilities will be obtained prior to construction. Terms and conditions of the permits would be implemented.

5.16. Hazardous Materials

5.16.1. Significance Threshold

Based on the existing conditions discussed above, impacts regarding hazards materials would be considered significant if the alternatives results in:

- long-term exposure of humans, wildlife, wildlife habitat or the general environment to hazardous materials; and
- an acute or adverse public health hazard through the release of hazardous materials into the environment.

5.16.2. Alternatives 1.1 and 8

Nonstructural Measures

Nonstructural measures under Alternatives 1.1 and 8 would include a flood warning system and would not result in impacts regarding hazardous materials since no work would be performed near the Recognized Environmental Conditions (RECs) discussed in Section 4.16.

Channel Work (including Borrow and Disposal Work, and Staging, Stockpiling, and Access Areas)

As noted in Section 4.16, there are no CERCLA Superfund sites, RCRA cleanup sites, ADEQ brownfield, DEUR, VEMUR, or hazardous waste sites within the vicinity of Winslow. A number of non-leaking USTs and ASTs are within the vicinity of the LCR Winslow proposed project site and the documented non-leaking USTs and ASTs are all sufficiently distant from the project footprint that a potential discharge or migration of hazardous materials into the proposed project site is low. No channel work would be done near any of these sites. Therefore, impacts due to hazardous materials would be less than significant.

The above mentioned three LUST sites (Whiting Station #23, Phil Bruchman Trading, and Duke City Lumber) do not have contaminants listed or contaminants cited on plume maps in the federal or state databases. The sites are currently being remediated, in the case of Duke City Lumber, for over 20 years. If groundwater plume(s) exist, it would be unlikely that such plume(s) could sufficiently migrate to the LCR at Winslow proposed project site due to anticipated groundwater flow direction. Further, no channel work is proposed near any of the three sites. Therefore, a potential discharge or migration of a hazardous material is low. The three LUST sites would not generate a long-term exposure to humans, wildlife, wildlife habitat, or the general environment and would not generate an acute or adverse public health hazard through a potential release into the environment.

Reconstruction of Winslow Levee and RWDL would involve reuse of suitable soils from the existing levees which are composed of native alluvial substrate from the LCR. Additional fill material required would come from previously used borrow sources, alluvial and dune deposits in the river floodplain or from the conveyance improvement area at the BNSF Railroad Bridge. Construction of the new levee parallel to I-40 would utilize fill material from reuse of suitable soils from the existing levees that are composed of native alluvial substrate from the LCR, alluvial and dune deposits borrow areas on the riverside of Winslow Levee in the LCR floodplain, and from the conveyance improvement area at the BNSF Railroad Bridge. The reconstruction of Winslow Levee south of I-40 would impact the former railroad track alignment, considered a REC in Section 4.16. Although the former railroad track alignment cannot be avoided, soil from that area would not be used as fill for construction. Soil testing would occur as needed, and any contaminants found would be remediated. Some shallow soil removal (three feet or less) may be required. The Kachina Auto Salvage Yard at 637 French Road would be avoided.

For the reconstruction of the Winslow Levee, RWDL, and construction of the new levee parallel to I-40, other imported material for the levees would include rock and cement both of which are inert and stable materials. Due to their inert and stable properties, these imported materials would not leach chemicals into the aquatic environment. Furthermore, most of the two levees are

located away from the active channel such that aquatic transport of materials is not anticipated with the exception of large floods. Any unsuitable material found, such as abandoned vehicles, in the LCR at Winslow would be disposed of at approved landfill facilities. If any abandoned vehicles are removed, the removal would include monitoring for small releases of petroleum hydrocarbons, such as motor oil and gasoline. The visual conditions of the soil around and beneath the vehicles would be recorded, looking for staining and potentially including sampling the soils, so that any releases, though minor, could be documented and remediated. Therefore, impacts due to hazardous materials would be less than significant.

Conveyance improvements at the BNSF Railroad Bridge would involve excavation of existing native soils in the floodplain of the LCR at Winslow. There would also be no discharge of hazardous material into the LCR. Therefore, impacts due to hazardous materials would be less than significant.

The proposed project activities would not require long-term storage, treatment, disposal, or transport of substantial quantities of hazardous materials. However, small quantities of hazardous materials would be stored, used, and handled during the proposed project activities, including petroleum hydrocarbons and their derivatives (e.g., diesel, gasoline, oils, lubricants, and solvents) to operate the construction equipment. The hazardous materials would be contained within vessels engineered for safe storage. Construction vehicles may require on-site fueling, or routine or emergency maintenance that could result in the release of oil, diesel fuel, transmission fluid or other materials; however, the materials would not be used in quantities or stored in a manner that would pose a significant hazard to the public or the workers themselves. The potential for an accidental release of toxic materials from construction vehicles (e.g., oil and diesel fuel) would be minimized by the fueling and servicing of construction vehicles in protected areas so that fluids would be contained within an isolated or impervious area and a safe distance from the active flow path. Spills or leaks would be cleaned up immediately, and any contaminated soil would be disposed of properly.

An environmental commitment to prepare a Pollution Protection Plan would be implemented during construction to reduce the potential for accidental release of hazardous wastes and materials, or fuels. Overall, impacts due to hazardous materials would be less than significant.

Operations and Maintenance

Impacts due to hazardous material from O&M activities would be less than significant.

Effects Determinations Summary

Based on the above, the possibility for long-term exposure of humans, wildlife, wildlife habitat or the general environment to hazardous materials or acute or public health hazard through the release of hazardous materials into the environment of the LCR at Winslow proposed project site is low. Therefore, impacts due to hazardous materials would be less than significant.

5.16.3. Alternative 3.1

Nonstructural Measures
Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8.

Channel Work (including Borrow and Disposal Work; Staging, Stockpiling, and Access Areas; and Operations and Maintenance)
Reconstruction of the Winslow Levee and RWDL, setback work, the conveyance improvements at the BNSF Railroad Bridge, and O&M activities, would result in hazardous material impacts that would be similar to those characterized under Alternatives 1.1 and 8. Although the two setback levee areas are closer to the Kachina Auto Salvage Yard, the site would be avoided, as with Alternatives 1.1 and 8, such that no changes to impacts would occur.

Based on the above, the possibility for long-term exposure of humans, wildlife, wildlife habitat or the general environment to hazardous materials or acute or public health hazard through the release of hazardous materials into the environment is low. Therefore, impacts due to hazardous materials would be less than significant.

5.16.4. Alternatives 7 and 9

Nonstructural Measures
Construction associated with any nonstructural measures would require limited pieces of construction equipment compared to the structural alternatives. Nonstructural alternatives construction work duration for the period of construction would be substantially shorter than the structural alternatives construction work duration. In addition, no RECs are located in the area where structures would be raised. Therefore, hazardous material impacts would be short-term and localized, if any. Based on the above, impacts due to hazardous material would be less than significant.

Channel Work (including Borrow and Disposal Work; Staging, Stockpiling, and Access Areas; and Operations and Maintenance)
Alternative 7 does not include any channel work; borrow and disposal work; or use of staging, stockpiling, or access areas. For Alternative 9, reconstruction of the RWDL and O&M activities would result in hazardous material impacts that would be similar to those characterized under Alternatives 1.1 and 8. Impacts would be even less because under Alternative 9, no conveyance improvements would occur and no reconstruction of the Winslow Levee would occur. Thus, there would be no impacts near the three identified RECs (the former railroad alignment, the vehicle in the LCR, and the buried vehicles in the Winslow Levee). Impacts would be less than significant.

Effects Determinations Summary
Based on the above, the possibility for long-term exposure of humans, wildlife, wildlife habitat and the general environment to hazardous materials or acute or public health hazard through the release of hazardous materials into the environment is low. Therefore, impacts due to hazardous materials would be less than significant.

5.16.5. Alternatives 10, 10.1, 10.2, 10.3, and 10.4

Nonstructural Measures

Impacts from nonstructural measures would be the same as those described for Alternatives 1.1 and 8. Alternative 10 would also include flood proofing of structures, and impacts would be similar to those described for Alternatives 7 and 9.

Channel Work (including Borrow and Disposal Work; Staging, Stockpiling, and Access Areas; and Operations and Maintenance)

Reconstruction of the RWDL and Winslow Levee, setback work, conveyance improvements at the BNSF Railroad Bridge, and O&M activities would result in hazardous materials impacts that would be similar to those characterized for the under Alternatives 1.1 and 8, except smaller because the construction footprint and length of time to implement the alternatives is less. The additional channelization proposed under Alternative 10.4 would not change impacts. Even though a lost vehicle is in or near the area of the additional channelization area of Alternative 10.4, the vehicle likely would have been removed by local agencies by the time any channelization work would occur. Alternative 10.2 would result in even less impacts, since no conveyance improvements would occur. Impacts would be less than significant.

Effects Determinations Summary

Based on the above, the possibility for long-term exposure of humans, wildlife, wildlife habitat and the general environment to hazardous materials or acute or public health hazard through the release of hazardous materials into the environment is low. Therefore, impacts due to hazardous materials would be less than significant.

5.16.6. Alternative 11: No Federal Action Alternative

Under the No Federal Action Alternative, the City of Winslow and Navajo County would periodically be threatened during high flow conditions through the LCR Winslow proposed project site requiring emergency repairs of the existing levees. In the event that high flow conditions lead to break in the levees, the three LUSTs sites (Whiting Station #23, Phil Bruchman Trading, and Duke City Lumber) concentrations could be released into the aquatic environment. However, there are no known contaminants currently listed for the three LUST sites. The Duke City Lumber has undergone remediation for over 20 years. The releases from the three LUST sites would be diluted yet would be considered a release of hazardous material. Impacts due to hazardous materials would be less than significant.

5.16.7. Environmental Commitments

HM 1 Prior to construction, the construction contractor shall prepare a pollution prevention plan (PPP) to reduce the potential for accidental release of fuels, pesticides, and other materials. The PPP shall include the designation of refueling locations, emergency response procedures, application methods, definition and reporting requirements for any spill that occurs. Equipment for immediate cleanup shall be kept at the staging area for immediate use. The contractor shall coordinate the PPP with the required state of Arizona and federal agencies for their concurrence, and provide notifications/reports to the required state of Arizona, federal agencies, and the Corps.

5.17. Environmental Commitments

5.17.1. Water Quality

The following BMPs are water quality (WQ) environmental commitments that would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to water quality.

WQ 1 The construction contractor shall be required to obtain coverage under the National Pollution Discharge Elimination System (NPDES) construction general permit program, in compliance with the Clean Water Act Section 402, prior to construction. As part of this process the construction contractor shall be required to coordinate with the Arizona Department of Environmental Quality (ADEQ), and obtain and comply with the requirements of applicable permits including providing notifications/reports to the permitting agencies and to the Corps. Prior to initiating construction, the construction contractor shall prepare a Storm Water Pollution Prevention Plan (SWPPP), coordinate the SWPPP with the ADEQ for their concurrence, and implement the SWPPP, in accordance with the requirements of the NPDES construction general permit program.

WQ 2 The SWPPP prepared by the construction contractor shall include an erosion control plan to control potential sedimentation and turbidity impacts. The erosion control plan shall include temporary measures such as sandbags and/or water bars and may include long-term measures such as re-vegetating access roads and soils borrow areas.

WQ 3 The construction contractor shall also prepare a pollution prevention plan (PPP) to reduce the potential for accidental release of fuels, pesticides, and other materials. The PPP shall include the designation of refueling locations, emergency response procedures, and definition or reporting requirements for any spill that occurs. Equipment for immediate cleanup shall be kept at the staging area for immediate use.

WQ-4 Prior to construction, the Corps shall prepare, obtain, and implement a project specific CWA 401 Water Quality Certification (WQC) from the ADEQ. A Clean Water Act (CWA) 401 Water Quality Certification letter of support from the ADEQ for the proposed project was received on July 13, 2018. A CWA 401 WQC was issued on August 6, 2018. (Appendix I – Environmental).

WQ 5 Areas where surface or groundwater is encountered would be dewatered and pumped outside of the work limits, likely released back into the LCR downstream, thereby minimizing contact with construction activities. Applicable permits for dewatering and/or water releases would be obtained.

5.17.2. Groundwater

The following groundwater (GW) environmental commitment applicable to levee structural work would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to groundwater.

GW 1 Groundwater extracted during construction would be pumped back into the active river channel or elsewhere in the floodplain to minimize potential for groundwater depletion during construction.

5.17.3. Biological Resources: Vegetation

The following environmental commitments applicable to levee structural work would be incorporated into the contract specification or otherwise implemented by the Corps to reduce potential impacts to vegetation (VG):

VG 1 In the areas where saltcedar removal is proposed, follow-up treatment (e.g. mechanical and /or herbicide) is required on re-sprouting saltcedar. The approximately ±96-acre area of saltcedar within the floodplain and in vicinity of the BNSF Railroad and State Route 87 bridges would be reseeded and/or revegetated with native, historic vegetation previously found in the LCR Winslow project area.

VG 2 For all considered disposal areas, material should be placed in areas that are upland and are not within riparian areas of the project area. All riparian areas, or where moist soil occurs, should be avoided when placing disposed material. In addition, any vegetated areas that are disturbed from disposal or borrow would need to be returned to pre-construction conditions revegetating with native, historic vegetation previously found in the LCR Winslow project area.

VG 3 Any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions revegetating with native, historic vegetation previously found in the LCR Winslow project area.

VG 4 To reduce potential spread of the invasive saltcedar into borrow/disposal areas, borrow areas will segregate material to reduce the potential spread of saltcedar.

5.17.4. Biological Resources: Wildlife

In addition to the measures identified under Biological Resources - Vegetation, the following environmental commitments applicable to levee structural work would be incorporated into the contract specification or otherwise implemented by the Corps to reduce potential impacts to wildlife (WL):

WL 1 To avoid impacts to migratory birds, work that would disturb or remove woody vegetation would not occur between April 15 and August 30 unless the affected area is first surveyed by a biologist and determined not to have nesting birds.

WL 2 During any construction and O&M activities during minimal flow periods (near impingement points, channel excavation/widening, etc.), BMPs would be incorporated to minimize negative impacts to the sensitive flannelmouth. BMPs may include, but are not limited to the following: silt curtains, wattles, coffer dams, and erosion protection screens. These BMPs would help to prevent fish access to the construction site and ensure protection of water quality. BMPs would be inspected daily to maintain the connection to the substrate and would be removed following construction.

WL 3 After the completion of the approximately ±26-acre area widening of the conveyance channel at the BNSF Railroad Bridge, follow-up treatment (e.g. mechanical and /or herbicide) is required on re-sprouting saltcedar. No reseeding and/or revegetation with native plantings would be required in the conveyance channel, as recurring O&M work removing sediment in the conveyance channel would inhibit long-term establishment of natives.

5.17.5. Biological Resources – Special Status Species

In addition to the measures identified under Biological Resources - Vegetation and Biological Resources - Wildlife, the following environmental commitment applicable to levee structural work would be incorporated into the contract specification or otherwise implemented by the Corps to reduce potential impacts to special status species:

SP 1 Prior to the start of any construction or O&M activities, surveys for the Yellow-billed Cuckoo and southwestern willow flycatcher will be conducted. If Yellow-billed Cuckoo or flycatcher is detected within the project area, BMPs would be applied to avoid effects to this species.

- Follow-up treatments (e.g. mechanical and/or herbicide) of saltcedar would occur within saltcedar removal areas. This area would be reseeded and/or revegetated with native plantings.
- During any construction or O&M activities during minimal flow periods (near impingement points, channel excavation/widening, etc.), BMPs would be incorporated to minimize negative impacts to the sensitive flannelmouth as well as other fish species. BMPs may include, but are not limited to the following: silt curtains, wattles, coffer dams, and erosion protection screens. These BMPs would help to prevent fish access to the construction site and insure protection of water quality. BMPs would be inspected daily to maintain the connection to the substrate and would be removed following construction.
- After the completion of the widening of the conveyance channel, the channel bottom would be replaced with native material that is characteristic for the LCR.
- In addition, any vegetated areas that are disturbed from disposal, borrow, staging, stockpiling, or access, or other construction related activities would be returned to pre-construction conditions.

5.17.6. Cultural Resources

The following environmental commitment would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to cultural resources.

CR 1 When construction crews are working within 50 meters of an eligible or unevaluated cultural resource, the edge of the site including a 25-meter site buffer will be fenced off, thus ensuring that no construction equipment inadvertently strays into the culturally sensitive area.

5.17.7. Traffic

The following traffic (TF) environmental commitment applicable to levee structural work would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to traffic.

TF 1 The construction contractor would be required to prepare and implementation of a traffic management plan (TMP). The TMP would be coordinated with the City of Winslow and Navajo County, as appropriate. The TMP, at a minimum, would include the identification of ingress and egress points, speed limits, and placement of traffic signage.

5.17.8. Noise

The following noise (NO) environmental commitment applicable to levee structural work near residential homes would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to noise.

NO 1 Install temporary sound walls next to residential areas, where necessary based on anticipated noise levels at specified distances, for noise protection purposes. Placement locations of sound walls would be dependent upon the detailed engineering designs and would be determined during the Pre-construction Engineering Design Phase.

5.17.9. Aesthetics

The following aesthetics (AE) environmental commitment applicable to levee structural work would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to aesthetics.

AE 1 Temporarily disturbed areas would be reseeded and/or revegetated with native vegetation. Also, opportunities for installation of a vegetative buffer between the residential area and the levee, where possible, to retain the natural environment, would be investigated.

5.17.10. Land Use

The following land use (LU) environmental commitment is applicable to levee setback work:

LU 1 Property acquisitions required for the new setback levee(s) would be conducted in compliance with Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1960.

5.17.11. Utilities

The following are environmental commitments that would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to utilities (U).

U-1 Prepare and implement a utilities management plan. The plan will identify location of known utilities and their respective owners and points of contacts. Location specific construction methods will be developed in conjunction with affected utility owners to avoid or minimize disruptions to services.

U-2 Permits required to dig, reroute, or construct within the vicinity of utilities will be obtained prior to construction. Terms and conditions of the permits would be implemented.

5.17.12. Hazardous Materials

The following is an environmental commitment that would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to hazardous material (HM).

HM 1 Prior to construction, the construction contractor shall prepare a pollution prevention plan (PPP) to reduce the potential for accidental release of fuels, pesticides, and other materials. The PPP shall include the designation of refueling locations, emergency response procedures, application methods, definition, and reporting requirements for any spill that occurs. Equipment for immediate cleanup shall be kept at the staging area for immediate use. The contractor shall coordinate the PPP with the required state of Arizona and federal agencies for their concurrence, and provide notifications/reports to the required state of Arizona, federal agencies, and the Corps.

5.17.13. Air Quality

The following is an environmental commitment that would be incorporated into the contract specifications or otherwise implemented by the Corps to reduce potential impacts to air quality (AQ).

AQ 1 Implement best management measure (BMP), e.g. suppress dust through wetting or use of watering trucks, during construction to reduce fugitive dust, nuisance dust, or particulate matter at levee construction sites, at contractor staging/storage areas, and on equipment haul transportation routes adjacent to and through residential areas.

5.18. Cumulative Impacts

This section presents the requirements for cumulative impact analysis, and also analyzes the potential for impacts from each alternative to combine with impacts of other past, present, and reasonably foreseeable future projects, to result in significant cumulative effects. CEQ regulations implementing NEPA define a "cumulative impact" as follows:

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. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. 40 C.F.R. 1508.7.

For purposes of this analysis, significant cumulative impacts would occur in circumstances where impacts related to implementation of an alternative results in a significant effect when added to the environmental impacts of other past, present, and reasonably foreseeable actions. For an impact to be considered cumulative, these incremental impacts and potential incremental impacts must be related to the types of (resource) impacts caused by the alternative.

The geographic area used for the cumulative impacts analysis encompasses the proposed project area including the Winslow Levee and the RWDL and adjacent areas within approximately 2 miles upstream and downstream of the levees.

5.18.1. Past, Present, and Foreseeable Future Actions

In general, there are three, separate actions that contribute to cumulative impacts, those being past, present, and foreseeable future actions. The timeframe selected for most of the resource topics addressed in this cumulative impact assessment is approximately 40 to 50 years in the past (1970) to approximately 15 years in the future (2030). Given this timeframe, the evaluation of all known past actions could not be based on a list of projects. However, two methods were used to analyze the changes in the study area due to historical land development over the last 40 years, ongoing projects, and reasonably foreseeable future projects. First, the Corps conducted a review of Section 404 of the Clean Water Act permits issued for projects within the study area between approximately 1970 and 2015 to characterize the changes in the study area with respect to the waters of the US. Second, a review of the City of Winslow and Navajo County future projects was assessed. Furthermore, the conditions that exist in the study area at this time, which are reflective of the effects of past actions and with project conditions were fully considered in the evaluation of cumulative impacts.

Previously completed activities, current work, and foreseeable future actions in the LCR at Winslow are summarized in Table 5-16.

Table 5-16 Past, Present, and Foreseeable Future Actions

Agency	Action	Year	Project
U.S. Army Corps of Engineers (Corps)	Construction	1970	Construct RWDL
Navajo County	Construction	1986-1989	Construct Winslow levee
Navajo County	Temporary repairs	1993	Winslow Levee temporary repairs
Navajo County	Permanent repairs	1994	Winslow Levee repairs; riprap placement on both sides of levee
Corps – Regulatory	Section 404 Permit SPL-2002-00927	2002	SR 87 Bridge replacement
Navajo County	Emergency response	2003	Winslow Levee emergency response; placement of material on riverside of levee
Navajo County	Permanent repairs	2005	Winslow Levee repairs; riprap placement on both sides of levee
City of Winslow	Planned development	2007, ongoing	Master Plan establishes a comprehensive plan for development (i.e., mix of low-, medium-density, multi-family residential, commercial, and parks and open space) of over 1,000 acres mostly undeveloped located north of I-40 and the historic downtown area of Winslow
City of Winslow	Construction	2013	Completion of sidewalk, lighting, and streetscaping between Renaissance 1 and 2, First Street - Hubbell to City Hall.
ADOT	Reconstruction	Late 2014	Reconstruct I-40 bridges at Ruby Wash, Maple Street and Transcon Lane in Winslow
City of Winslow	Repair; Rehabilitation	2014 thru 2018	Repair and rehabilitation work on airport runways, and levee relocation construction work at Winslow-Lindbergh Regional Airport
Navajo County	Improvements	2020	Two-lane overpass over the BNSF at Coopertown Road
Navajo County	Construction	2030	BNSF undercrossing, north-south BNSF railroad track underpass connecting to Williamson Avenue
Navajo County	Improvements	2030	SR 87 corridor, passing lanes, additional BNSF crossing and shoulder improvements on SR 87 between Payson and Winslow
Navajo County	Routine maintenance	Ongoing	Routine maintenance of levees including periodic clearing of vegetation and minor levee repairs

Source(s): City of Winslow. 2002, 2008; Navajo County, 2012; U.S. Army Corps of Engineers, 2014.

5.18.2. Cumulative Impacts Analysis

Alternative 11 would not contribute to significant cumulative impacts to the environment, and is therefore not discussed in detail below, as the action alternatives are. Under the No Federal Action Alternative (Alternative 11), the Corps would not implement any structural work on Winslow Levee such as reconstruction of the existing levees, construction of new setback levees, removal of levee sections riverward of new setback levees, or implementation of conveyance improvements upstream of the railway bridge. Furthermore, the east end of Ruby Wash Diversion Levee would not be reconstructed. Likewise, the Corps would not implement nonstructural measures such as raising the foundations of structures within the Winslow Levee 100-year floodplain.

Geology and Soils: Past and present activities primarily entailed like-for-like repairs that were limited in scope and duration, as well as upgrades of existing infrastructure and development consistent with the Master Plan. Existing substrate in the LCR floodplain basically is native and free of contaminants. The construction of the existing levees included native substrate excavated from the LCR floodplain. Potential impact to geology and soils is associated with the construction phase with minor operational work to maintain substrate compaction. The loss of topsoil from past, present and foreseeable future actions in the levee area would be temporary, since future flows through the levee area would replace topsoil removed during the clearing and grubbing operations. The excavated material would be temporarily stored in previously used staging areas and disposal areas. Upon completion of construction, trenches would be backfilled with native material previously excavated. There could be some loss of unconsolidated substrate during initial storm flows following construction. This impact would lessen as vegetation is reestablished through the project reach through natural recruitment. The establishment of root structures in the topsoil would minimize erosion. Furthermore, it is unlikely that past projects reduced the overall amount of soils as the LCR replenishes new substrate during flows. Foreseeable future actions are also expected to include repairs, upgrades, and limited development, and would be site specific. Thus, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative geology or soils impacts.

Hydrology and Hydraulics and Public Safety: Past and present activities primarily entail like-for-like repairs, upgrades of existing facilities throughout the study area, and limited development, though not near the levees, limited in scope and duration that did not have a long term permanent impact to hydrology. It is unlikely that past maintenance reduced the overall hydrology as the LCR has basically maintained its current channelization, flow velocity and capacity over time. The action alternatives would address levee deficiencies and reduce the risk of flooding to the residents of the Winslow area. The Winslow Levee and RWDL would be rebuilt following their existing alignments, with levee setbacks proposed under Alternatives 3.1, 8, 10, 10.1, 10.2, 10.3, and 10.4. Based on the hydraulic analysis completed for this study, the action alternatives would not result in a substantial change to base flow characteristics such as flow velocity, channel capacity, or channel configuration, in a manner that would result in substantial erosion or sediment deposition on or off-site compared to baseline condition scenarios as described in Section 5.2. Vegetation removal and channelization at the BNSF Railroad Bridge proposed under Alternatives 1.1, 3.1, 8, 10, 10.1, 10.3, and 10.4 would not increase long term sediment deposition or erosion compared to baseline conditions. The action alternatives would result in an overall decrease in exposure of people or structures to risk of loss,

injury, or death involving flooding. Foreseeable future actions are expected to be like-for-like repairs, upgrades of existing facilities, and limited development that would be site specific. Potential hydrology and hydraulic and public safety impacts would not singly, or combine cumulatively, with similar impacts of other projects as significant impacts. Thus, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative hydrology and hydraulic and public safety impacts.

Water Quality: The LCR at Winslow along the Winslow Levee and RDWL is in compliance with all water quality standards with the exception of turbidity, in particular, historic and current grazing practices within the watershed has reduced the amount of vegetation cover, especially riparian, resulting in increased runoff, soil erosion, and bank destabilization. Loss of vegetation and increased surface runoff causes down cutting within tributaries, and sedimentation downstream. Past and present activities primarily entail like-for-like repairs limited in scope and duration with no long term impacts to water quality, and some upgrades to existing infrastructure and controlled development, consistent with the Master Plan, throughout the study area. Foreseeable future actions are expected to be similar to past and present actions and would be limited in scope and duration. Thus, all action alternatives, especially with the implementation of environmental commitments to further reduce and potential impacts, would not contribute to significant cumulative water quality impacts.

Groundwater: Past and present work basically is like for like maintenance repairs, upgrades of existing infrastructure, and limited development, limited in scope and duration. Historically and recently, groundwater was most likely not encountered during most past and present maintenance work. When dewatering was required, impacts to groundwater were temporary as the dewatering was pumped outside of the work limits into the active flow channel of the LCR downstream, thereby minimizing contact with construction activities. Past and present work consisted of use of rocks, soil and cement that are inert and stable materials, and therefore, the structure would not leach into the groundwater aquifer or would not be disturbed, and would not introduce contaminants into the groundwater recharge. Past and present maintenance work would not create an impermeable barrier to groundwater, and therefore, did and does not influence or alter groundwater recharge. For the action alternatives (except Alternative 7), dewatering activities would be temporary and short term within the levee footprint. Groundwater would return to pre-project conditions after project completion. Foreseeable future actions are expected to be like-for-like repairs, upgrades, and limited development that would be site specific. Potential groundwater impacts would not singly, or combine cumulatively, with similar impacts of other projects as significant impacts. Thus, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative groundwater impacts.

Biological Resources: The Winslow Levee is an approximately 75-foot-wide, slope, man-made and earthen structure, and is approximately 6 feet to 16 feet in height. The RWDL is a rock and earth structure approximately 65 feet in width levee toe to levee toe and about 6 to 8 feet in height above the invert. Most past and present activities on the levees and within the adjacent river channel primarily entail like-for-like repairs limited in scope and duration that did not have a long term permanent impact to vegetation, wildlife or special status species such as flannelmouth sucker, bluehead sucker, Zuni bluehead sucker, southwestern willow flycatcher, yellow-billed cuckoo, or the Little Colorado River spinedace. Past construction activities most

likely caused wildlife to temporarily abandon the immediate project area during construction. However, wildlife within this area is mobile and highly adapted to the environment. As a result, they most likely reoccupied the abandoned areas upon completion of construction. Other past and present actions include updates of existing infrastructure and controlled development, with likewise little impact to biological resources. Construction activities under the action alternatives except Alternative 7 would include removal of sediment and vegetation within the levee reconstruction area, use of material sources within the borrow areas, placement of disposal material within the disposal areas, and reconstruction of the levees. These activities would entail temporary impacts to existing vegetation that is primarily saltcedar. Where saltcedar is removed in large amounts, follow-up treatment (e.g. mechanical and/or herbicide) will be necessary on re-sprouting saltcedar. In addition, within the larger saltcedar removal area, revegetation of native plants should occur. In the absence of the latter action, erosion would occur, which would result in siltation and degradation of the aquatic wildlife community, and saltcedar would certainly reestablish within a short period of time thus negating the original purpose of the conveyance improvements. Alternative 7 would only entail elevating existing residences and no permanent or significant impacts on biological resources. Future activities within the study area primarily entail repairs and minor upgrades and controlled development, all limited in scope and duration that would not have a long term permanent impact to biological resources. For each of the action alternatives, proposed BMPs would be incorporated to reduce impacts to the aquatic wildlife. With implementation of the measures identified in Section 5.5 to reduce impacts to biological resources, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative impacts to biological resources.

Cultural Resources: The Winslow area is rich in archaeological resources with few impacts due to previous development. Past and present activities are primarily maintenance, upgrades, and limited development consistent with the Master Plan throughout the study area. The original construction of the levees could have impacted cultural resources within the project impact, but the area is now disturbed from that past work. The past building of these levees also could have increased water flows and thus erosion at cultural sites on the riverside of the levees, such as at Homolovi State Park, as further discussed below. Alternatives 1.1, 8, 9, and 10-10.4 mostly follow the current levee corridors. These areas have been previously disturbed by the construction of the original levees and have less potential for containing significant archaeological or historical sites. Two archaeological sites have been recorded just outside of this disturbed zone but within the wider construction footprint needed for this project. If any significant archaeological sites cannot be avoided by the project or other foreseeable federal projects, then the responsible federal agency in consultation with the SHPO and affected Tribes would attempt to avoid, minimize or mitigate those impacts through the preparation and execution of a memorandum of agreement. Through this process, these impacts would ideally be avoided or minimized to below significant. Mitigation efforts such as data recovery both add to society's knowledge of prehistoric and/or historic lifeways within the region but also result in a cumulative loss of a non-renewable resource. Alternatives 1.1, 8, 10, 10.1, 10.2, 10.3, and 10.4 may result in individually significant impacts if structures in the area of the proposed levee alignment and setback cannot be avoided. Taken together with past, present, and reasonably foreseeable actions, the effects of the alternatives could therefore be cumulatively significant.

Alternative 3.1 would require the removal of several historic structures and is likely to impact archaeological resources. Construction of new setback levees and removal of exiting levees would result in an adverse effect to at least one prehistoric archaeological site. Removal of any structures that are found to be eligible for the National Register may be individually significant. Furthermore, the alignment of the proposed levee could encounter eligible cultural resources since it is within an undisturbed corridor. The setback levees, when combined with other development across the valley floor, could contribute to a general loss of the areas' historical character through the continued loss of historic rural structures and alteration of the valley's landscape and would be cumulatively significant.

Changes to the levee configuration under Alternatives 1.1, 3.1, 8, 9, and 10-10.4 may impact water surface elevation, flow directions and water velocity throughout the system. The Corps has evaluated how these changes impact the National Register listed site Homolovi I, located across the river. Archaeological research suggests that Homolovi I has been flooded at the 10 percent ACE since its construction in the late 1200s (Adams 2002 45-58). The Winslow Levee, constructed in 1986-1989, would have created a hard surface on the west side of the river and may have slightly altered the flows through this stretch or prevented the river from migrating away from Homolovi I. With-project hydraulic modeling completed for the proposed project indicates that there could be a slight increase in the water surface elevation and profile under Alternatives 1.1, 8, 10, 10.1, 10.2, 10.3 and 10.4 compared to one of the two baseline conditions analyzed, which may have a minor adverse effect to the Homolovi I Pueblo. However, impacts are unlikely to result in a significant impact under NEPA. Alternative 3.1 would result in a slight decrease in water surface elevation. Action alternatives would result in little to no change in average flow velocities at the Homolovi I Pueblo. These changes are virtually imperceptible. The Corps will continue to work closely with the Hopi Tribe, Arizona State Parks, Arizona State Museum, and the Arizona SHPO to ensure that potential impacts to Homolovi I are addressed. Future foreseeable projects include continued maintenance, upgrades, and limited development. Based on these results, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to cumulatively significant impacts to Homolovi I Pueblo.

Air Quality: Air quality within the Winslow area is currently within attainment or unclassified status for all criteria pollutants [ozone (O_3); carbon monoxide (CO); suspended particulate matter (PM) including particulates up to 10 microns in diameter (PM_{10}) and particulates up to 2.5 microns in diameter ($PM_{2.5}$); sulfur dioxide (SO_2); nitrogen dioxide (NO_2); Reactive Organic Gasses (ROG); Volatile Organic Compounds (VOC), and; lead (Pb)]. Past and present activities primarily entail like-for-like repairs limited in scope and duration, as well as upgrades of existing infrastructure and limited new development consistent with the Master Plan. The original construction of the Winslow Levee and RWDL resulted in impacts to air quality, but impacts likely returned to pre-project conditions upon completion. Impact to air quality for the present project is associated with the construction phase, with little or no operational-related air emissions. Furthermore, it is unlikely that past projects exceeded the General Conformity de minimis thresholds. Work under Alternative 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would entail temporary impacts to air quality during construction. Foreseeable future actions are expected to be like-for-like repairs and continued upgrades of existing infrastructure and controlled development that would be limited in scope and duration regarding air quality

impacts. Thus, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative air quality impacts.

Traffic: Existing transportation levels are influenced by the project reach's adjacency to the I-40 Freeway, State Route 87, and the BNSF rail line. The Winslow levee's characterization includes a vast open space covering an approximately 3.25- mile long open space segment in the northern portion of the existing levee with no transportation corridor, an approximate 1.3- mile long rural residential segment in the center of the proposed project reach that includes residential streets, and an approximate 2.25- mile long transportation corridor in the south portion of the proposed project area that include the above-mentioned, vehicle roadways and rail line. Past and present activities primarily entail maintenance actions and upgrades of existing infrastructure limited in scope and duration. Specifically, many road, bridge, and airport upgrades have occurred in the study area, which all likely provided beneficial impacts to traffic. Work under Alternatives 1.1, 3.1, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would entail temporary impacts to transportation due to construction work for the proposed project. There would be designated staging areas outside normal transportation corridors, and borrow and disposal sites would be located near work areas to the extent possible, which would minimize potential traffic impacts. Work under Alternative 7 would entail temporary impacts to transportation over shorter duration as only non-structural features would be constructed. Transportation levels would return to pre-project levels upon completion of construction. Foreseeable future actions are expected to be like-for-like maintenance and upgrades of additional bridges and roads that would be limited in scope and duration and could have a positive impacts on traffic. Thus, none of the action alternatives would contribute to significant cumulative transportation impacts.

Noise: Existing noise levels are influenced by the project reach's adjacency to the I-40 Freeway, State Route 87, and the BNSF rail line. The noise in the study area includes a vast open space covering an approximately 3.25- mile long open space segment in the northern portion of the existing levee, an approximate 1.3- mile long rural residential segment in the center of the project reach, and an approximate 2.25- mile long segment in the south portion of the project area that include the three, above-mentioned transportation roadways. Past and present activities primarily entail maintenance actions limited in scope and duration. In addition, there have been improvements to existing infrastructure that temporarily increased noise. Work under Alternatives 1.1, 3.1, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would entail temporary impacts to noise during construction activities. This work would only occur approximately six months per year. Work under Alternative 7 would entail temporary impacts to noise over shorter duration as only non-structural features would be required. Noise levels would return to pre-project levels upon completion of construction. Foreseeable future actions are expected to be like-for-like maintenance and upgrades of existing infrastructure that would be limited in scope and duration. Thus, none of the action alternatives would contribute to significant cumulative noise impacts.

Aesthetics: Winslow Levee is an approximately 75-foot-wide, slope, man-made and earthen structure. The levee height varies between 6 to 16 feet and abuts a vast open space that includes desert shrubs covering an approximately 3.25-mile long Open Space Segment in the northern portion of the existing levee. An approximate 1.3- mile long rural residential area (Rural Residential Segment) that primarily contains homes and facilities lie in the center of the study area. The levee slope on the landside consists of compacted earth and vegetated shrubs and

weedy species, while on the riverside the visual character consists of expansive views of an open arid environment populated with desert shrubs in the foreground with muddy open waters. The view of the levee includes the armored levee slope with gray granite rocks. An approximate 2.25- mile long Transportation Corridor Segment in the south portion of the project area includes the I-40 Freeway, State Route 87, and the BNSF rail line. The RWDL lies within the Transportation Corridor Segment. The RWDL is a rock and earth structure approximately 65 feet in width levee toe to levee toe and about 6 to 8 feet in height above the invert. Past and present maintenance activities primarily entail like-for-like repairs limited to work within the LCR channel and on the levees. As a result, the activities most likely had no permanent impacts to the overall aesthetics of the study area. Other past and present work includes upgrades of existing infrastructure and development consistent with the Master Plan, which could have permanently changed aesthetics over a period of time in a planned and controlled manner. Work associated with Alternatives 1.1, 3.1, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would be primarily located along the Winslow Levee and downstream reach of the RWDL, and would not change the overall aesthetics within the Open Space, Rural Residential, or Transportation Corridor Segments. Aesthetic impacts would generally return to pre-project conditions after completion. Alternative 3.1 could result in a permanent change, since the setback levees would result in a more proximate levee than present for nearby residents; however, the setback levee would not change the overall character or viewshed of the area. Foreseeable future actions are expected to be like-for-like repairs with little or no change to aesthetics. Limited upgrades to existing infrastructure throughout the study area, as well as continued managed development, would not significantly alter the surrounding viewshed. Thus, none of the action alternatives would contribute to significant cumulative impacts to aesthetics.

Land Use: The upstream reach of LCR at Winslow from Ruby Diversion Wash Levee to Oak Road is within the vicinity of the city's commercial and industrial zones with adjacency to the I-40 Freeway, State Route 87, and the BNSF rail line. Immediately adjacent to this reach are Navajo County lands zoned as low density residential and open space. The reach from Oak Street to North Road is immediately adjacent to Bushman Acres, an unincorporated area of Navajo County where the land use is rural residential with lot sizes ranging from 0.5 to 1 acre. Also adjacent are lands zoned for open space. The remaining segment of the project reach from North Road to the downstream terminus is adjacent to lands zoned as rural residential and open space. Past and present activities primarily entail like-for-like maintenance actions limited in scope and duration and upgrades of existing facilities. In addition, development consistent with the Master Plan has been implemented and is expected to continue in the future. Other foreseeable future actions are also expected to be maintenance and minor upgrades that would be limited in scope and duration. Alternatives 3.1, 8, 10, 10.1, 10.2, 10.3, and 10.4 would all entail construction of setback levees that would convert land use. Alternative 3.1 would result in a significant impact due to the acreage it would convert from rural residential to floodplain. The others mentioned would not create a significant impact because a much smaller area would be converted. Alternatives 1.1 and 9 would not include setback levees, but the rebuilt levees may be slightly wider than existing levees, of which the difference would not be significant. Thus, Alternatives 1.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative land use impacts, while Alternative 3.1 would contribute to significant cumulative impacts.

Socioeconomics: Past and present activities primarily entail like-for-like repairs limited in scope and duration, plus upgrades to existing facilities and controlled development, consistent with the Master Plan. Development of the area adjacent to the channel most likely ensued after construction of the channel in 1970. Past work likely did not affect the socioeconomic profile of the area adjacent to the Winslow Levee or RWDL. Furthermore, most repair projects were undertaken by Navajo County Public Works Department or City of Winslow Public Works maintenance crews. As a result past repairs most likely did not provide temporary construction work for the private sector. Work contracted to the private sector likely resulted in limited and temporary work opportunities in the construction sector. Construction work for the action alternatives would provide temporary jobs, and is not expected to result in long-term socioeconomic impacts. Future work includes maintenance and additional upgrades and development. Thus, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative socioeconomic impacts.

Environmental Justice: Past and present activities primarily entail like-for-like repairs, upgrades to existing facilities, and limited development consistent with the Master Plan limited in scope and duration. Development of the area adjacent to the channel most likely occurred after construction of the channel in 1970. Past work likely did not create a disproportionately high adverse human health or environmental effect on minority and low-income populations. Under Alternatives 8, 10, 10.1, 10.2, 10.3, and 10.4, although not anticipated, one residential relocation may be required. Under Alternative 3.1, 8 residential relocation may be required. Construction would occur on public- and privately-owned land. Any property acquisitions required would be conducted in compliance with Federal and State relocation law, and relocation services would be accomplished in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Construction would occur primarily in rural areas away from population centers that would have less exposure to construction impacts from noise, air, and traffic. The proposed project would be constructed in phases and would be limited to temporary construction impacts. Foreseeable future actions are expected to be like-for-like repairs, upgrades, and limited development that would be site specific. Thus, Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would not contribute to significant cumulative environmental impacts.

Recreation: The Winslow Levee is an approximately 75-foot-wide sloped, man-made and earthen structure with existing heights ranging from approximately 6 feet to 16 feet. RWDL is a rock and earth structure approximately 65 feet in width levee toe to levee toe and about 6 to 8 feet in height above the invert. There is no recreation allowed on or immediately adjacent to the levees. As the levee abuts open space and rural development, there are active and passive recreational opportunities, such as bicycling, walking, running, hiking, and horse riding) and a number of parks (e.g., First Street Pathway; Standin' on the Corner; East Cherry Avenue; Winslow; Homolovi State) in the LCR at Winslow study area. Past and present actions primarily entail like-for like activities and upgrades of existing infrastructure, most of which did and do not result in temporary or permanent impacts to recreation. Some recreation improvements occurred through the planned development consistent with the Master Plan, and is ongoing. Also, a sidewalk and related work was recently completed. Foreseeable future actions include additional updates to existing infrastructure and also would be like-for-like maintenance of the levees, not

in areas where recreation is allowed, and would not impact recreation. Thus, none of the action alternatives would contribute to significant cumulative impacts to recreation.

Utilities and Public Safety Services: Existing utilities within the study area include an underground electrical conduit, power poles, a waste-water treatment plant, underground high pressure gas lines, and storm drains, among others. Past and present activities primarily entail maintenance actions limited in scope and duration and upgrades of existing infrastructure. Work under Alternatives 1.1, 3.1, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 would entail impacts to utilities due to reconstruction of the levees and associated work. There could be temporary (maximum of a few hours) impacts when access to utility service are interrupted. Some utilities would be permanently relocated, but the access to these services would not be permanently affected. Work under Alternative 7 would entail temporary impacts to utilities over shorter duration as only non-structural features would be constructed. Utilities service would return to pre-project levels upon completion of construction. Under all action alternatives, the need for emergency services, such as law enforcement, fire protection, or public safety services, during certain storm events would be reduced, potentially resulting in a beneficial impact to public safety services. Foreseeable future actions are expected to be maintenance and upgrades of existing infrastructure that would be limited in scope and duration. Thus, none of the action alternatives would contribute to significant cumulative utilities or public safety services impacts.

Hazardous Materials: Per the USEPA's Superfund site /NPL and RCRA cleanup site lists, and a literature search of solid waste landfills, there are no known hazardous waste sites within the study area. The ADEQ's LUST database indicates three active/not remediated soil- and groundwater-impacting LUST sites (Whiting Station #23, Phil Bruchman Trading, and Duke City Lumber) that are moderately close to the LCR at Winslow, (0.6 to 0.9 miles west potential levee realignments and a mile or more west from the existing Winslow levee), and are described in the Phase I ESA as potential Recognized Environmental Conditions (RECs) [U.S. Army Engineer District, Los Angeles, 2013]. An unnamed fourth, LUST site is reported to exist 0.9 miles west from the levee realignments, but its existence cannot be verified and it is not in any regulatory database. All four above- mentioned, LUST sites are classified as likely non-RECs with regard to the LCR at Winslow, considering the distance their groundwater contaminants plumes would have to travel to reach the LCR at Winslow project area. Potential RECs include a former railroad track alignment over the Winslow Levee near the BNSF channelization area, buried automobiles used as fill for the existing Winslow Levee (which would not impact Alternatives 10, 10.1, 10.2, 10.3, and 10.4), and a vehicle abandoned in the LCR north of the BNSF Railroad Bridge (which would only potentially impact Alternative 10.4). Past, present, and future activities primarily entail like-for-like maintenance actions and construction improvements of existing facilities. The original construction of the Winslow Levee could have increased impacts regarding hazardous materials, as automobiles were placed in the levee as fill, potentially causing minor amounts of deposit of fluids in the river. Overall, because the project is not expected to entail work in areas known to have hazardous materials at a level of concern, and measures are proposed to minimize impacts, none of the action alternatives would contribute to significant cumulative impacts regarding hazardous materials.

5.19. Unavoidable Adverse Impacts

Pursuant to NEPA regulations (40 CFR 1502.1) an EIS must consider adverse environmental effects that cannot be avoided. Unavoidable impacts are those that would occur after implementation of all agency's recommended avoidance and minimization measures, environmental commitments, and proposed mitigation measures. Unavoidable impacts do not include temporary or permanent impacts that would be mitigated. These also do not include impacts from speculative events such as hazardous waste spills that are not cleaned up promptly in accordance with accepted mitigating measures.

The alternatives includes measures to avoid and minimize impacts on resources. However, even after these measures are implemented, there could be less-than-significant impacts to some environmental resources. These minor impacts are fully described in Sections 5.2 to 5.16. In addition, potential significant adverse impacts to cultural resources and land use remain. It is not reasonably foreseeable that the project alternatives would result in an adverse effect to Homolovi I. Alternatives 1.1, 3.1, 8, 10, 10.1, 10.2, 10.3, and 10.4 may result in an adverse effect to historic properties due to impacts to the potentially eligible historic era barn and corral; however, full demolition of these structures is not anticipated. Similarly, it is anticipated that if the barn and corral are determined eligible, appropriate avoidance and/or minimization measures shall be employed in order to lessen the impact so that it would be less than significant under NEPA. If the barn and corral are determined to be eligible for the NRHP and if impacts cannot be avoided or minimized, then the alternative would result in an adverse effect under NHPA and a significant impact under NEPA. Although anticipated to be avoided through design adjustments, removal of structures located within the levee setback areas may be required for Alternatives 3.1, 8, 10, 10.1, 10.2, 10.3, and 10.4. If these structures are determined to be eligible for the NRHP, and if they cannot be avoided, then the project would result in an adverse effect under NHPA and an unavoidable significant impact under NEPA. During the PED phase, the levee alignment would be optimized to avoid or minimize impacts to cultural resources to the extent possible. However, avoidance of sites may not be possible due to the levee alignment and engineering design requirements. Also, construction of new setback levees and removal of existing levees under Alternative 3.1 would result in an adverse effect to at least one prehistoric archaeological site. This impact could not be mitigated to a level below significance due to the proposed levee alignment and engineering design requirements.

Alternative 3.1 includes set back of levees along two segments of the Winslow Levee with the purpose of widening the floodplain of the LCR to reduce the possibility of river impingement on the toe of the levee. The set back of levees would convert a substantial percentage of rural residential and commercial land to other uses, resulting in substantial incompatibilities with planned uses. Although the land would be converted to open space as part of the LCR floodplain, and would be a benefit to overall floodplain function, this is considered an unavoidable adverse effect under NEPA. This impact could not be mitigated to less than significant because the location of the proposed setback levee alignment and the land to be converted to the floodplain is necessary to reduce the possibility of river impingement on the toe of the levee.

5.20. Relationship between Short-Term and Long-Term Productivity

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. Within the context of the IFR/EIS "short-term" refers to the construction period, while "long-term" refers to the operational life of the proposed project and beyond. Overall, the proposed project would provide minor and temporary short-term losses, while resulting in significant beneficial impacts to the long-term flood risk management of the affected area.

The relationship between the short-term uses of the environment and the maintenance and enhancement of long-term productivity with regard to the proposed project considers the management of water and the use of the land for flood risk management (FRM). The proposed project would include FRM protection for the residents of Winslow and unincorporated portions of Navajo County.

The proposed project construction would result in short-term, temporary construction-related effects, such as interference with local traffic, ambient noise level, water quality turbidity, and increased air emissions, and is not expected to alter the long-term productivity of the natural environment.

The proposed project implementation would contribute to long-term productivity of the environment by improving the flood risk management system that protects Winslow and unincorporated portions of Navajo County, thereby reducing the overall flood risk to residential, commercial, and infrastructure properties. Hydrology, hydraulics, and public safety would be permanently, positively affected with the proposed project reducing the risk of flooding to the residents of Winslow. Cultural resources and land use could potentially be permanently, adversely affected by the proposed project. However, the action alternatives, except for Alternative 3.1, would result in few changes to existing residential, agricultural practices including grazing, open space, or undeveloped land use practices as these existing land uses are available and would continue in and around the LCR. As a result, there would be minimal effects on the overall residential, grazing, open space, and undeveloped land use capacity of the area. Alternative 3.1 would convert a substantial percentage of rural residential and commercial land to other uses, resulting in substantial incompatibilities with planned uses. However, the land would be converted to open space as part of the LCR floodplain, and would be a benefit to overall floodplain function. The long-term maintenance and enhancement productivity and beneficial effects of the proposed project would outweigh its potentially significant short-term uses and impacts to the environment.

5.21. Irreversible or Irretrievable Commitments of Resources

NEPA regulations (40 CFR 1502.16) dictate that an EIS must consider irreversible or irretrievable commitments of resources. An irreversible commitment of a resource is one that, once committed to the proposed project, would continue to be committed throughout the life of the proposed project (50 years). An irretrievable commitment of resources refers to those resources that, once used, consumed, destroyed, or degraded during construction, operation, or decommissioning of the proposed project, would cause the resource to be unavailable for use by future generations.

For the alternatives that include a rebuild of the Winslow Levee and RWDL, the alternatives would change land use parcels (open space; residential; undeveloped) for the life of the proposed project, for example where the new Winslow Levee would be constructed north of and parallel to I-40, and where the levee would be slightly widened or set back. Use of natural resources that ordinarily occur in the proposed project area would be a limited amount due to the ability to reuse existing structural components of the levee and use of borrow material from sediment in the LCR floodplain and the conveyance area around the BNSF railroad bridge, such that substantial amounts of new material would not be needed; however, there may be a need for native, borrow materials outside of the LCR floodplain for reconstruction. Consequently, some loss of production of certain resources such as forage for livestock and wildlife would occur during the time that those lands are out of production while being used as borrow sites, although lands currently in use for those reasons can likely be largely avoided, given the amount of land available for use. Use of disposal sites could also temporary affect these lands in a similar manner. The commitment of a portion of the land would not result in long-term irreversible or irretrievable commitment of resources. The loss of soil productivity associated with the setback levee structures and any additional land used for widened levees would result in a temporary commitment of resources, as this loss of productivity could be minimized with natural recruitment or replanting of native vegetation. The loss of residential uses (in the case of Alternative 3.1) would not be mitigated, although there is sufficient other residential land available in the immediate area. For the nonstructural measures, the elevation of residences would not require use of material from the LCR floodplain. Materials obtained commercially would be minimal and would not be a substantial commitment of resources. The flood warning system would not result in irreversible or irretrievable commitments of resources.

While many of the components of the existing levee structure for the alternatives that include levee reconstruction would be recycled, as discussed above, there would be an irretrievable commitment of some non-recyclable building materials (gravel and cement) and fuel for construction equipment. An undetermined amount of energy (gasoline; diesel oil) would be spent on rebuild of the levees for the proposed project, and for O&M. The proposed project would not result in offsets from other energy development.

Cultural resources such as prehistoric sites, historic properties, and cultural landscapes are non-renewable resources. Inadvertent or accidental destruction of cultural resources during construction that might occur despite mitigation actions would be an irretrievable commitment of resources. The preferred action is to avoid identified sites, and additional pre-construction surveys would be conducted to implement this measure for any of the action alternatives. The Corps will continue to consult with the SHPO and interested Tribes regarding potential impacts.

Consultation resulted in a Programmatic Agreement (PA), which outlines agreed-upon measures the Corps would take to avoid, minimize, or mitigate adverse effects to historic properties. In some cases, the consulting parties may agree that no such measures are possible, but that the adverse effects must be accepted in the public interest.

Vegetation that would be altered would be irretrievably lost, though the irretrievable loss of non-native and invasive vegetation is a preferred outcome. In other areas, loss of vegetation due to construction will be remedied with revegetation efforts. Biological resources would be protected from irretrievable loss through environmental commitments and BMPs.

Beyond the natural and cultural resource commitments, there have been financial resources already expended by the non-Federal sponsor, the Corps, and other resource agencies, for the planning and review of the proposed project. The expenditure of funds would continue throughout the planning phases, where required, and construction phases of the proposed project should the proposed project be approved. Construction would require expenditure of non-Federal sponsor and Federal funds for the costs of construction and lands necessary for the proposed project. The proposed project would also require funding for O&M of the levees from the non-Federal sponsor. Such financial resources would not be available for other uses. Use of human resources during construction would be an irreversible loss of labor supply for other projects. However, labor opportunities are desired in the proposed project area and this use of human resources represents beneficial employment opportunities.

The proposed project to commit the above mentioned resources is based on the concept that residents in the immediate area, region, and state of Arizona would benefit from the implementation of the proposed action. The benefit of the proposed project is that the integrity of the flood risk management system would be maintained and greatly improved through the application of bank protection structural and/or non-structural measures to remedy existing risks and specifically to improve erosion sites with high failure potential in order to prevent levee failure, catastrophic damage, possible loss of life, and flood insurance costs that residents and businesses are incurring. Implementation of the proposed project would ensure the continued integrity of the Winslow Levee and RWDL while protecting environmental resources, and implementing best management practices (BMPs), minimization measures, and environmental commitments to reduce impacts to environmental resources to the degree feasible. Therefore, these benefits are expected to outweigh the commitment of these resources.

6.0 ENVIRONMENTAL COMPLIANCE

The proposed project has been developed in accordance with the requirements of the environmental statutes, regulations, and other requirements and guidance outlined below.

- **National Environmental Policy Act (NEPA) of 1969,** 42 United States Code (U.S.C.) 4321 et seq.; Council on Environmental Quality Regulations for Implementing NEPA, 40 Code of Federal Regulations (CFR) Parts 1500 et seq., USACE Regulations for Implementing NEPA, 33 CFR Part 230.

NEPA is the nation's primary charter for protection of the environment. It establishes national environmental policy which provides a framework for Federal agencies to minimize environmental damage and requires Federal agencies to evaluate the potential environmental impacts of their proposed actions.

CEQ Regulations for implementing NEPA establish the requirements and procedures by which Federal agencies fulfill their obligations under NEPA. The regulations also define such key terms as “cumulative impact,” “mitigation,” and “significant” (as it relates to impacts) to ensure consistent application of the terms in environmental documents.

Corps guidance for implementing NEPA is provided in Engineer Regulation 200-2-2, March 1988 and at 33 CFR Part 230. This regulation provides guidance for implementation of the procedural provisions of the NEPA for the Civil Works Program of the Corps. It supplements the CEQ regulations.

This IFR has been prepared to comply with the requirements of NEPA and the CEQ and Corps Regulations. In addition, a Notice of Intent to Prepare a Draft Environmental Impact Statement was prepared and published in the Federal Register on February 27, 2009, and a public scoping meeting occurred in Winslow, Arizona on March 24, 2009. The Draft IFR was posted on the Los Angeles District website on May 26, 2016, and in the *Federal Register* on June 3, 2016; the official closing date for receipt of comments was July 18, 2016. Two public meetings were held on June 9, 2016, in Winslow, Arizona, to solicit comments from the public on the draft IFR. The proposed project will be in compliance with this Act upon completion of the NEPA process.

- **Clean Water Act (33 U.S.C. 1251 et seq.)**

Section 401 of the Clean Water Act (CWA) requires every applicant for a Section 404 permit for an action that may result in a discharge of dredged or fill material into “waters of the United States” to obtain a State Water Quality Certification (Certification) or waiver that the proposed activity will comply with established effluent limitations and state water quality standards (i.e. beneficial uses, water quality objectives, and anti-degradation policy). The Arizona Department of Environmental Quality (ADEQ) issues Section 401 Water Quality Certifications for activities within the state of Arizona. A Section 401 Water Quality Certification has been requested from the ADEQ. A Clean Water Act (CWA) 401 Water Quality Certification letter of support from the

ADEQ for the proposed project was received July 13, 2018. A CWA 401 WQC was issued on August 6, 2018 (Appendix I - Environmental).

Section 402 of the CWA prohibits the discharge of pollutants into "waters of the United States" from any point source unless the discharge is in compliance with the National Pollution Discharge Elimination System (NPDES) Permit. Section 402 requires a NPDES Permit for the discharge of stormwater from municipal separate storm sewer systems (MS4) serving urban areas with a population greater than 100,000; construction sites that disturb one acre or more; and industrial facilities. The ADEQ administers these permits with oversight provided by the U.S. Environmental Protection Agency (USEPA), Region IX. Prior to construction, the construction contractor will prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) and obtain coverage under Construction General Permit of the NPDES program.

Section 404 authorizes the Secretary of the Army acting through the Corps to issue permits for the discharge of dredged or fill materials into the waters of the United States, including wetlands at specified disposal sites. The selection and use of disposal sites must be in accordance with guidelines developed by the Administrator of the USEPA in conjunction with the secretary of the Army and published in 40 CFR Part 230 (known as the 404(b) (1) guidelines). Under the Section 404(b) (1) guidelines, the Corps shall examine practicable alternatives to the proposed discharge and permit only the Least Environmentally Damaging Practicable Alternative (LEDPA). Based on the 404(b)(1), Alternative 10.1 is the least environmentally damaging practicable alternative. The Corps does not issue permits to itself, but generally it demonstrates compliance with Section 404 through a Section 404(b)(1) Evaluation. In addition, the requirements and conditions of nation-wide permits and regional general permits may be applied to Corps projects and thus considered when addressing compliance under Section 404. All other entities must obtain a permit before undertaking any discharge of fill materials into waters of the United States. A 404(b)(1) Evaluation has been prepared and is provided in Appendix J.

The following Arizona Department of Environmental Quality (ADEQ) permits could be required on the proposed project: Arizona Pollutant Discharge Elimination System (AZPDES) permit, Aquifer Protection Permit, Type 3 General Permit for Reclaimed Water Agent, and a Construction General Permit to include a stormwater pollution prevention plan (SWPPP).

The proposed project will be in compliance with this Act.

- **Clean Air Act of 1970 (42 U.S.C. 7401 et seq.)**

The 1977 Amendments to the Clean Air Act enacted legislation to control seven toxic air pollutants. The USEPA adopted National Emission Standards for Hazardous Air Pollutants, which have been designed to control Hazardous Air Pollutants and emissions to prevent adverse health effects in humans.

1990 Amendments to the Clean Air Act determine the attainment and maintenance of air basins for National Ambient Air Quality Standards (NAAQS) (Title I), motor vehicles and reformulation (Title II), hazardous air pollutants (Title III), acid deposition (Title IV), operating permits (Titles V), stratospheric ozone protection (Title VI), and enforcement (Title VII).

General Conformity. Under Section 176(c) of the Clean Air Act Amendments (CAAA) of 1990, the Lead Agency is required to make a determination of whether the Proposed Action "conforms" to the State Implementation Plan (SIP). Conformity is defined in Section 176(c) of the CAAA as compliance with the SIP's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards. However, if the total direct and indirect emissions from the Proposed Action are below the General Conformity Rule "de minimis" emission thresholds established at 40 C.F.R. 93.153(b)(1) for all criteria pollutants for which the air basin in in non-attainment or maintenance status, the Proposed Action would be exempt from performing a comprehensive Air Quality General Conformity Analysis, and would be considered to be in conformity with the SIP. The proposed project does not include any stationary sources that would be subject to permitting or recordkeeping requirements of the Clean Air Act.

Based upon the analysis of air quality impacts, a conformity determination for a specific pollutant is not required because the air basin is in attainment status for each criteria pollutant and, further, for each criteria pollutant or precursor the total of direct and indirect emissions of the criteria pollutant or precursor caused by the proposed project would not equal or exceed any of the de minimis thresholds. As a result, the proposed project conforms to the CAA (see Section 5 and Appendix I - Environmental). For any of the action alternatives, the Corps would implement environmental commitment AQ-1 to further ensure that impacts to air quality would not be considered regionally significant, and that construction emissions would not violate NAAQS (see Section 5.7). The proposed project would have no long-term impacts on local or regional air quality.

Based upon a recent U.S. Supreme Court decision (Massachusetts v. EPA 549 U.S. 497 (2007)), the USEPA has been given the authority to regulate CO2 or GHG emissions as an air pollutant under the Federal Clean Air Act (42 U.S.C. §7602(g)). The USEPA has adopted 40 CFR Part 98 – Mandatory Reporting of Greenhouse Gases Rule which requires mandatory reporting of GHG emissions for facilities that emit more than 25,000 metric tons of CO2e emissions per year (USEPA, 2009) and 40 CFR Part 52 – Proposed Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule which mandates Prevention of Significant Deterioration (PSD) permitting to facilities whose stationary source CO2e emissions exceed 75,000 tons per year (USEPA, 2011). Neither of these regulations is applicable to the proposed project because it has no operating stationary emission sources that are subject to these regulations. In addition, the CEQ has published Final Guidance on the Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in NEPA Reviews, dated August 1, 2016. The final guidance recommends agencies consider the direct and indirect effects of all actions for the CO2 equivalent emissions. Annual GHG emissions have been calculated and are shown in Section 5.7 and in Appendix I - Environmental. Pursuant to Executive Order 13783, Promoting Energy Independence and Economic Growth, signed on March 28, 2017, the CEQ guidance withdrew its Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews on April 5, 2017 (Council of Environmental Quality, 2017; Executive Order 13783, 2017). The proposed project is in compliance with this Act.

- **Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 as amended (49 CFR Part 24)**

This Act was enacted to ensure that owners of real property to be acquired for Federal and Federally assisted projects are treated fairly and consistently, to encourage and expedite acquisition by agreements with such owners, to minimize litigation and relieve congestion in the courts, and to promote public confidence in Federal and federally-assisted land acquisition programs. The Act also ensures that persons displaced as a direct result of Federal or federally-assisted projects are treated fairly, consistently, and equitably so they will not suffer disproportionate injuries as a result of projects designed for the benefit of the public as a whole and that agencies implement these regulations in a manner that is efficient and cost effective. Relocation advisory services, moving costs reimbursement, replacement housing, and reimbursement for related expenses and rights of appeal are provided for in the Act.

Any relocations required would following the provisions of this Act, and is identified as an environmental commitment. Therefore, the proposed project is in compliance with this Act.

- **Noise Control Act of 1972, as amended (42 U.S.C. 4901 et seq.)**

Noise generated by any activity, which may affect human health or welfare on Federal, state, county, local, or private lands must comply with noise limits specified in the Noise Control Act of 1972. Major sources of noise include transportation vehicles and equipment, machinery, appliances, and other products in commerce. The Noise Control Act of 1972 establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. Primary responsibility for control of noise rests with state and local governments, although the USEPA is directed by Congress to coordinate the programs of all Federal agencies relating to noise research and noise control.

The proposed project would result in temporary construction-related noise emissions. The Corps would be required to reduce noise impacts through implementation of environmental commitments (N-1 through N-2). Operation and maintenance of the proposed project would not alter the existing noise environment, as operation and maintenance activities would remain unchanged. The proposed project is in compliance with this Act.

- **U.S. Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.)**

This Act requires Federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) and the fish and wildlife agencies of states where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted…or otherwise controlled or modified" by any agency under a Federal permit or license. Consultation is to be undertaken for the purpose of "…preventing loss of and damage to wildlife resources." The intent is to give fish and wildlife conservation equal consideration with other purposes of water resources development projects. Coordination with the USFWS (Phoenix Office) was initiated in 2014 and is ongoing. Based on input received from USFWS, the proposed project area does not contain any sensitive or critical habitats, nor is there any concern for sensitive or endangered or threatened species concerns (M. Martinez, D. Smith, USFWS, pers. comm., 9 March 2016). A

signed CAR dated December 20, 2017, has been provided by the USFWS for circulation with this Final IFR. The CAR states there are no species listed or proposed to be listed as threatened or endangered, or their designated or proposed critical habitats under the Endangered Species Act of 1973 (ESA) as amended (16 U.S.C. 1531 et seq.) known within the proposed project area, and further states the portion of the LCR within the action area and the adjacent riparian area do not provide suitable or potential habitat for listed or proposed listed species. The CAR concludes that "Therefore, the Service has no recommendations for activities to be incorporated into the proposed actions to benefit wildlife and fish or their habitat." Since no recommendations were provided in the CAR, no updates to the project were necessary. The 2014 AZGFD formal species survey, the FWCA timeline and the signed CAR can be found in Appendix I - Environmental of the EIS. The Corps will continue coordination efforts with the USFWS under the U.S. Fish and Wildlife Coordination Act.

- **Endangered Species Act, as amended (16 U.S.C. 1531 et seq.)**

The Endangered Species Act (ESA) protects threatened and endangered species and their designated critical habitat from unauthorized take. Section 9 of the Act prohibits such take, and Section 3 defines take as to harm, harass, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in such conduct. Section 7 of the ESA requires Federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or adversely modify their critical habitat. Consultation with the USFWS or National Marine Fisheries Service is required if the Federal action may affect a Federally-listed species or designated critical habitat. A species list was developed based on information available on the USFWS Information for Planning and Conservation website (USFWS, http://ecos.fws.gov/ipac) and is provided in Appendix I - Environmental. The presence of proposed or listed threatened or endangered species or designated critical habitats was coordinated with the USFWS in January 2015 and March 2016. There are no species listed or proposed to be listed as threatened or endangered, or their designated or proposed critical habitats known within the proposed project area, and further the portion of the LCR within the action area and the adjacent riparian area do not provide suitable or potential habitat for listed or proposed listed species. The Corps will continue coordination efforts with the USFWS under the Endangered Species Act. The proposed project would not affect any proposed or listed threatened or endangered species or designated critical habitats. Therefore, formal or informal consultation pursuant to this Act is not required. The proposed project complies with this Act.

- **Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703 et seq.)**

The Migratory Bird Treaty Act prohibits the taking or harming of any migratory bird, its eggs, nests, or young without an appropriate Federal permit. Almost all native birds are covered by this Act and any bird listed in wildlife treaties between the United States and several countries, including Great Britain, Mexican States, Japan, and countries once part of the former Union of Soviet Socialist Republics. A "migratory bird" includes the living bird, any parts of the bird, its nest, or eggs. Section 704 of the MBTA states that the Secretary of the Interior is authorized and directed to determine if, and by what means, the take of migratory birds should be allowed and to adopt suitable regulations permitting and governing take. Disturbance of the nest of a migratory bird requires a permit issued by the USFWS pursuant to Title 50 of the Code of Federal

Regulations (CFR). With implementation of the environmental commitments, there would be no impacts to migratory birds, breeding, or nesting activities. The proposed project is in compliance with this Act.

- **National Historic Preservation Act (54 U.S.C. 300101 et seq)**

The National Historic Preservation Act (NHPA) and its implementing regulations 36 CFR Part 800 provide a regulatory framework for the identification, documentation, and evaluation of cultural resources that may be affected by Federal undertakings. Under the Act, Federal agencies must take into account the effects of their undertakings on historic properties (cultural resources that have been found to be eligible for listing or which are listed in the National Register of Historic Places) and afford the Advisory Council on Historic Properties a reasonable opportunity to comment on such undertaking.

In accordance with Section 106 of the NHPA, the Corps initiated consultation with the Arizona SHPO regarding the area of potential effects (APE) and proposed identification efforts on May 7, 2015. The Corps, concurrently, notified the following Tribes and solicited information about properties of traditional and religious importance: the Fort Mojave Indian Tribe, the Havasupai Tribe, the Hopi Tribe, the Navajo Nation, and the Pueblo of Zuni.

As part of their identification efforts, the Corps completed an archaeological inventory of the recommended plan (Alternative 10.1). The Corps and Arizona SHPO have executed a Programmatic Agreement (Appendix I - Environmental) that will guide the future identification, evaluation, efforts and the resolution of adverse effects. The proposed project is in compliance with the Act.

- **Farmland Protection Policy Act (7 U.S.C. 4201 et seq.)**

This Act requires a Federal agency to consider the effects of its actions and programs on the Nation's farmland. There are no designated prime or unique farmlands within the study area; therefore, there would be no effects to farmland and the proposed project is in compliance with this Act.

- **Occupational Safety and Health Act**

The Occupational Safety and Health (OSH) Act was enacted to ensure safe and healthful conditions for working men and women. The OSH Act created the Occupational Safety and Health Administration (OSHA) at the Federal level and provided that states could run their own safety and health programs as long as those programs were at least as effective as the Federal program. The OSHA regulations (29 CFR Part 1926) specify requirements for a workplace free from serious recognized hazards, including safeguard the hearing of workers exposed to occupational noise, employee training, availability of safety equipment, accident-prevention programs, and hazardous substance exposure warnings. The proposed project would implement safety and health programs pursuant to the OSH Act and OSHA regulations. Implementation of the proposed project will be in compliance with the Act and these regulations.

- **Resource Conservation and Recovery Act (42 U.S.C. 6901 et seq.)**

The Federal Resource Conservation and Recovery Act directs the EPA to administer a regulatory program that extends from the manufacture of hazardous materials to their disposal, thus regulating the generation, transportation, treatment, storage, and disposal of hazardous waste at all facilities and sites in the nation. No materials classified as hazardous are proposed to be used for the proposed project. Implementation of the proposed project will be in compliance with the Act.

- **Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601 et seq.)**

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (also known as Superfund) was passed to facilitate the cleanup of the nation's toxic waste sites. In 1986, the act was amended by the Superfund Amendment and Reauthorization Act Title III (community right-to-know laws). Title III states that past and present owners of land contaminated with hazardous substances can be held liable for the entire cost of the cleanup, even if the material was dumped illegally when the property was under different ownership.

The CERCLA provided the USEPA with the authority to identify and clean up contaminated hazardous waste sites. Individual states may implement hazardous waste programs under the Resource Conservation and Recovery Act with approval of the USEPA. CERCLA also contains enforcement provisions for the identification of liable or responsible parties. It details the legal claims that arise under the statute, and provides guidance on settlements with the USEPA. Section 120 of CERCLA addresses hazardous waste cleanups at Federal facilities, and requires the creation of a Federal Agency Hazardous Waste Compliance Docket, which lists facilities that have the potential for hazardous waste problems.

During design, implementation (construction and operation/maintenance) of the proposed project, conformance with CERCLA would be engaged by the non-Federal sponsor if HTRW requiring remediation is identified. The proposed project is in compliance with this Act.

- **Executive Order 13175 Consultation and Coordination with Indian Tribal Governments**

Executive Order 13175 reaffirmed the Federal government's commitment to a government-to-government relationship with Indian Tribes, and directed Federal agencies to establish procedures to consult and collaborate with tribal governments when new agency regulations would have tribal implications. USACE has a government-to-government consultation policy to facilitate the interchange between decision makers to strive for mutually acceptable decisions. In accordance with this Executive Order, USACE has engaged in regular and meaningful consultation and collaboration with Indian Tribes. The project is in compliance with the executive order.

- **American Indian Religious Freedoms Act**

The American Indian Religious Freedom Act reiterates the U.S. government's commitment to protecting the freedom of religion for all people as an inherent right, fundamental to the democratic structure of the United States as guaranteed by the First Amendment of the United States Constitution. The proposed project does not prevent access to sacred or religious sites not does it prohibit the use of or possession of sacred objects or the exercise of any Indian religion. The project is in compliance with the Act.

- **Presidential Memo of 1994 on Government to Government Relations**

The United States government has a unique legal relationship with Native American Tribal governments as set forth in the Constitution of the United States, treaties, statutes, and court decisions. The Memorandum requires that as executive departments and agencies undertake activities affecting Native American Tribal rights or trust resources, such activities should be implemented in a knowledgeable, sensitive manner respectful of Tribal sovereignty. The project would not impact Tribal rights or trust resources; however the act further states that the head of each executive department and agency shall be responsible for ensuring that the department or agency operates within a government-to-government relationship with federally-recognized Tribal governments. In response to the 1994 memorandum, the Corps adopted its Tribal Policy Principles on 18 February 1998. The Policy Principles were the result of nationwide listening sessions with Tribes. In accordance with this Presidential Memo and the Corps Tribal Policy guidance, the Corps has engaged in regular and meaningful consultation and collaboration with Federally-recognized Indian Tribes. The project is in compliance with the executive order.

- **National Flood Insurance Program**

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency's (FEMA's) Flood Insurance Administration. The study area is within a Special Flood Hazard Area (FEMA Zone A) within Navajo County. Any development within the floodplain is subject to local, state and federal regulations regarding floodplain management and development. Navajo County and City of Winslow would seek a FEMA Map revision upon the proposed project completion to remove properties behind the new accredited levee segment(s) from the Special Flood Hazard Area.

- **Executive Order (EO) 11514, Protection and Enhancement of Environmental Quality, amended by Executive Order 11991, Relating to Protection and Enhancement of Environmental Quality**

This EO mandates that the Federal government provide leadership in protecting and enhancing the quality of the nation's environment to sustain and enrich human life. Federal agencies must initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals. Corps regulations advocate early NEPA document preparation and require impact statements to be concise, clear, and supported by evidence that agencies have made the necessary analyses. This IFR has been prepared to comply with the EO and the proposed project is consistent with the EO.

- **Executive Order 11988, Floodplain Management**

Executive Order (EO) 11988, Floodplain Management, signed 24 May 1977, revoked and replaced Executive Order 11296 issued 10 August 1966. EO 11988 requires Federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of natural flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities." To comply with EO 11988, projects are formulated and recommended that, to the extent possible, avoid, minimize and/or mitigate adverse effects associated with use of the floodplain, and avoid inducing incompatible development in the floodplain unless there is no practicable alternative. Under the Order, the Corps is required to provide leadership and take action to:

a. Avoid development in the base flood plain unless it is the only practicable alternative;

b. Reduce the hazard and risk associated with floods;

c. Minimize the impact of floods on human safety, health and welfare; and

d. Restore and preserve the natural and beneficial values of the base floodplain.

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, 10 Feb 1978 (43 FR 6030), as referenced in the Engineer Regulation (ER) 1165-2-26, 30 Mar 1984, require an eight-step process that agencies should carry out as part of their decision-making process on projects that have potential impacts to or within the base floodplain. The eight steps reflect the decision-making process required in Section 2(a) of the Order. The evaluation and decision making process described below are consistent with the EO.

1. Determine if the proposed action would be in the base (1 percent ACE or 1/100-year) floodplain.

The proposed action (project) is located within the defined base floodplain. The location of the existing levee system is within the base floodplain.

2. If the proposed action would be in the base floodplain, identify and evaluate practicable alternatives to the action or to locating the action in the base floodplain.

The floodplains for the study area are already established by the existing flood risk management projects. The existing base floodplain encompasses generally the entire City of Winslow and unincorporated rural areas to the north.

As described in ER 1165-2-26, it is the policy of the Corps to formulate projects which, to the extent possible, avoid or minimize adverse impacts associated with use of the base floodplain and avoid inducing development in the base floodplain unless there is no practicable alternative. Practicable alternatives are those capable of being done within existing constraints. The decision on whether a practicable alternative exists is based on weighing the advantages and disadvantages of floodplain sites and non-floodplain sites. The test of practicability applies to both the proposed action and to any induced development likely to be caused by the action.

Practicable structural and nonstructural measures and alternatives were identified and evaluated. These include: alternative sites (carrying out the proposed action outside the flood plain); alternative actions (other means which accomplish the same purpose as the proposed action); and no action.

As described in this document, locations for the proposed action were limited by the need to reduce damages and life, safety, and health risks caused by flooding. The proposed action is the only practicable alternative and there are no practicable alternatives to undertaking an action inside or outside the floodplain which address the identified flood risk management problems and meet the objectives. No development is likely to be induced by the proposed action within the base floodplain.

3. If the action must be in the floodplain, advise the general public in the affected area and obtain their views and comments.

Federal, state and local agencies and the general public were informed of the proposed action, including its location in the base floodplain. A Notice of Intent was published in Federal Register on February 27, 2009 and a public scoping meeting in Winslow, Arizona on March 24, 2009. The Draft IFR was posted on the Los Angeles District website on May 26, 2016, and in the *Federal Register* on June 3, 2016; the official closing date for receipt of comments was July 18, 2016. Two public meetings were held on June 9, 2016, in Winslow, Arizona, to solicit comments from the public on the draft IFR. The non-Federal sponsor, Navajo County Flood Control District, has implemented public outreach opportunities for public participation in this study through various means, such as scoping meetings, public meetings, public notices, websites, direct mailing, and presentations to various agencies and small groups. In addition, this IFR is being circulated for public review and comment.

4. Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial floodplain values. Where actions proposed to be located outside the base floodplain will affect the base floodplain, impacts resulting from these actions should also be identified.

Beneficial and adverse impacts due to the proposed action are identified in Chapter 5.0, for the proposed action. No adverse impacts to the floodplain or losses of natural and beneficial floodplain values are anticipated from the proposed action, as a similar flood risk management system is already in place.

5. If the action is likely to induce development in the base floodplain, determine if a practicable non-floodplain alternative for the development exists.

There are no direct or indirect impacts to the flood plain that are likely to induce development in the flood plain or outside it. The proposed action does not include construction of any new, permanent housing or commercial activities, and is not expected to induce any new residential or commercial growth. The floodplain within the incorporated area of the City of Winslow is approximately 85 percent developed. Land use in the unincorporated area north of Winslow (Reach 2) is primarily dominated by rural, large acre properties. This type of land use and economy does not support rapid, urbanized growth or demand. The necessary public infrastructure (i.e., roadways, water and sewer systems, and utilities) do not exist for urban growth, and would require a substantial investment from the county, local governments, and the development community. This type of future investment is unlikely due to the lack of demand from consumers within and outside the floodplain.

The City of Winslow Land Use General Plan, Environmental Planning Element, adopted June 25, 2002, recommends that flood protection areas be utilized for recreational opportunity and habitat preservation.

6. As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial floodplain values. This should include reevaluation of the "no action" alternative.

During the environmental analysis of the proposed action, wherever there were potential adverse impacts by the proposed action, appropriate Best Management Practices or other environmental commitments were identified. The proposed action would not induce development in the floodplain. The proposed action is site specific and would not aggravate current hazards of the floodplain and would not disrupt the natural and beneficial floodplain values. The Recommended Plan would restore about 12 acres to the active flood plain of the Little Colorado River, and Alternatives 3.1, 8, 10, 10.2, 10.3, and 10.4 would likewise restore areas to the active floodplain. The other action alternatives would not restore areas into the active floodplain. Chapter 4.0 of this report summarizes the alternative identification, screening and selection process. The "no action" alternative was carried through the entire assessment and selection process.

7. If the final determination is made that no practicable alternative exists to locating the action in the floodplain, advise the general public in the affected area of the findings.

The Draft IFR was posted on the Los Angeles District website on May 26, 2016, and in the *Federal Register* on June 3, 2016; the official closing date for receipt of comments was July 18, 2016. Two public meetings were held on June 9, 2016 to receive comments on the Draft IFR. Comments received were considered and responded to and included in the Appendix I - Environmental of this Final IFR, as appropriate.

8. Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order 11988.

Based on the above decision-making process, it has been determined that the Recommended Plan and all action alternatives would be in compliance with EO 11988. The proposed project would have no adverse effects on floodplain function or values, and the Recommended Plan is recommended as the most responsive option to planning objectives and requirements established by EO 11988.

- **Executive Order 11990, Protection of Wetlands**

Under Executive Order 11990, Federal agencies shall take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agencies responsibilities. No wetlands exist in the proposed project area. The proposed project is in compliance with the executive order.

- **Executive Order 12088, Federal Compliance with Pollution Control Standards**

Under Executive Order 12088 of 1978, Federal agencies are required to ensure compliance of agency decisions with all applicable pollution control standards, laws, and regulations, including but not limited to the following: Toxic Substances Control Act; Federal Water Pollution Control Act; Public Health Service Act; Clean Air Act; Noise Control Act of 1972; Solid Waste Disposal Act; Radiation guidance pursuant to Section 274(h) of the Atomic Energy Act of 1954; Marine Protection, Research, and Sanctuaries Act of 1972; and Federal Insecticide, Fungicide, and Rodenticide Act. The head of each Executive agency is responsible for ensuring that all necessary actions are taken for the prevention, control, and abatement of environmental pollution with respect to Federal facilities and activities under control of the agency. The proposed project would implement environmental commitments for the prevention, control, and abatement of environmental pollution. Implementation of the proposed project will be in compliance with this EO.

- **Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations**

Executive Order 12898 was signed on February 11, 1994, directing Federal agencies to "…make achieving environmental justice part of its mission by identifying and addressing... disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the [U.S.]..." Section 5.13 addresses environmental justice. The proposed project is in compliance with this EO.

- **Executive Order 13045 Protection of Children from Environmental Health Risks and Safety Risks**

Executive Order 13045 requires Federal agencies to the extent permitted by law and within their missions to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and to ensure that their policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks. The proposed project would not disproportionately impact children. Potential impacts were identified with regard to biology, air quality, aesthetics, noise, traffic, and recreation. Environmental commitments were identified to reduce these potential impacts. While there was no specific study conducted to assess impacts to children, there is no indication that any impacts would disproportionately affect children. This proposed project is in compliance with this executive order.

- **Executive Order 13112, Invasive Species and Landscaping**

Executive Order 13112 directs Federal agencies to expand and coordinate their efforts to combat the introduction and spread of plants and animals not native to the United States. Requirements are to prevent the introduction of invasive species; provide for their control; and take measures to minimize economic, ecological, and human health effects. In compliance with Executive Order 13112, restoration of disturbed vegetation should be conducted using native plants and efforts to prevent the introduction of invasive plant species must be demonstrated. This proposed project includes removal of invasive species, and is in compliance with this executive order.

- **Arizona Native Plant Law**

The state of Arizona law was enacted to protect rare plant species and to protect some species from being over harvested. There are four Protected Native Plant Categories: Highly Safeguarded; Salvage Restricted; Salvage Assessed; and Harvest Restricted. These protected plants may not be removed from any lands, whether private or public, without the permission of the land owner and a permit from the Arizona Department of Agriculture. While land owners do have the right to remove native plants on their land, there is a process that must be followed. Protected species notification must be given to the Arizona Department of Agriculture and a permit must be issued prior to removal. There are three plants listed for Navajo County (two federally threatened and one federally endangered); however, these plants are not known to occur in the proposed project area or in the type of habitat that exists within the proposed project area. Additionally, these plants were not seen during the vegetation mapping/site visit conducted for this study. The proposed project will comply with this law.

- **Arizona Executive Order 91-6, Protection of Riparian Areas**

Under this executive order, the Governor of Arizona has established state policy:

a. To recognize that the protection and restoration of riparian areas are of critical importance to the State;

b. To actively encourage and develop management practices that will result in maintenance of existing riparian areas and restoration of degraded riparian areas;

c. To promote public awareness through the development of educational programs of the benefits and values of riparian areas and the need for their protection and careful management;

d. To seek and support cooperative efforts and local group and citizen involvement in the protection, maintenance and restoration of riparian areas; to actively encourage the preservation, maintenance, and restoration of instream flows throughout the State; and that any loss or degradation of riparian areas will be balanced by restoration or enhancement of other riparian areas of equal values and functions.

The proposed project is in compliance with this executive order.

7.0 PUBLIC INVOLVEMENT, REVIEW, AND COORDINATION

The Corps is committed to providing information from the public draft IFR and this public final IFR. The following provides a summary of the coordination that has been performed to date on the study.

7.1. Federal Register Notice of Intent (NOI)

A Notice of Intent (NOI) to Prepare a Draft Environmental Impact Statement for the Little Colorado River (LCR) at Winslow was published in the Federal Register on February 27, 2009. No comments were received in response to the NOI.

A mailing distribution list for interested parties was created, which also included required agencies.

7.2. National Environmental Policy Act (NEPA) Public Scoping Meeting

As part of compliance with the National Environmental Policy Act (NEPA), a Public Scoping Meeting on the study occurred on March 24, 2009, in Winslow, Arizona. Notice of the Public Scoping Meeting was published in the NOI as well as the local newspaper. Residents of Winslow and Navajo County, resource agencies, and non-governmental organizations (NGOs) were invited, and copies of the NOI were also mailed to Tribes. Approximately 38 agency representatives and other individuals attended the meeting. There was one oral comment read at the meeting by a representative of the Arizona State Museum. The comment focused on the importance of and potential impacts to the Homolovi I Pueblo, and also asked that as plans were developed, the ancient communities on the east side and farther downriver, including Homolovi III and Creswell Pueblo, would also be considered.

7.3. U.S. Fish and Wildlife Coordination Act, Coordination Act Report (CAR)

As part of compliance with the U.S. Fish and Wildlife Coordination Act, the Corps initiated coordination with the USFWS Phoenix Office in 2014 and such coordination is ongoing. Based on input received from USFWS to date, the project area does not contain any sensitive or critical habitats, nor is there any concern for sensitive or endangered or threatened species (M. Martinez, D. Smith, USFWS, pers. comm., 9 March 2016). A signed Coordination Act Report (CAR) dated December 20, 2017, has been provided by the USFWS for circulation with this Final IFR. The CAR states there are no species listed or proposed to be listed as threatened or endangered, or their designated or proposed critical habitats under the Endangered Species Act of 1973 (ESA) as amended (16 U.S.C. 1531 et seq.) known within the proposed project area, and the signed CAR further states the portion of the LCR within the action area and the adjacent riparian area do not provide suitable or potential habitat for listed or proposed listed species. The 2014 AZGFD formal species surveys, the FWCA timeline, and the signed CAR can be found in Appendix I - Environmental. The USFWS provided no recommendations in the CAR and therefore no changes were made to the proposed project based on the CAR. The Corps will continue coordination efforts with the USFWS under the U.S. Fish and Wildlife Coordination Act.

7.4. National Historic Preservation Act Consultation and Tribal Coordination

As described in Chapter 6.0, the Corps initiated consultation with the Arizona SHPO regarding the area of potential effects (APE) and proposed identification efforts on May 7, 2015. The Corps, concurrently, notified the following Tribes and solicited information about properties of traditional and religious importance: the Fort Mojave Indian Tribe, the Havasupai Tribe, the Hopi Tribe, the Navajo Nation, and the Pueblo of Zuni.

The Hopi Tribe contacted the Corps in a letter dated May 18, 2015, and stated their concerns that the proposed project will alter the River's flow and impact the ancestral village site known as Homolovi I. Shortly thereafter, the Arizona SHPO sent a letter dated June 5, 2015, to the Corps requesting the Corps to consult with all applicable consulting parties on the APE citing the importance of the Little Colorado River and Homolovi to the Hopi Tribe. In response to the concerns of the Hopi Tribe and the SHPO, the Corps has expanded the APE to include Homolovi State Park at Homolovi I Pueblo as detailed in a letter dated March 31, 2016. In a letter dated April 15, 2016, the Hopi Tribe thanked the Corps for the additional information and agreed that a face to face meeting would be appropriate. The Corps attempted to schedule a consultation meeting in June of 2016 to coincide with the NEPA public meeting being held in Winslow on June 9th; however, schedules did not allow for that meeting.

The Corps reached out to the Hopi Tribe, SHPO, ASM, and Arizona State Parks and Trails to give a project update and to try and schedule the consultation meeting in late May or early June on 2017. The SHPO, ASM, and State Parks were available but the Corps was unable to get a response from the Hopi Tribe.

The consultation meeting was ultimately scheduled for September, 6, 2017, at the Homolovi State Park visitor center. Attendees included representatives from the Corps, the SHPO, State Parks, the Hopi Tribe, Navajo County, and the Deputy State Director for Representative Tom O' Hallerran. The representative from ASM was unable to attend the meeting. The group toured the project area with special attention paid to the levee setback across from Homolovi I. The Corps gave a presentation on the modeling results and answered questions from the consulting parties. At the meeting, the group decided that a PA would be appropriate for this undertaking due to the nature of the feasibility study and the many unknowns at this stage of the study.

The Corps worked closely with the consulting parties on the development of a PA. The executed PA can be found in Appendix I - Environmental. As outlined in the PA, the Corps will continue to work with the consulting parties on the identification and evaluation of historic properties throughout the stages of the project.

7.5. Other Public and Agency Involvement

The public and other agencies have multiple opportunities to participate in this study. The non-Federal sponsor developed a public involvement plan that outlines both formal and informal opportunities for public participation in this study.

In addition to seeking input through the NOI and public scoping meeting, the Corps and non-Federal sponsor hosted a three-day planning charrette in Winslow on May 29-31, 2012. The

primary purpose of this charrette was to use a collaborative process to expedite plan formulation for the preliminary array of alternatives. Participants in the charrette workshop included representatives from the U.S. Army Corps of Engineers, Navajo County Flood Control District, City of Winslow, Arizona Game and Fish Department, Arizona Department of Environmental Quality, Arizona Department of Water Resources, Hopi Tribe, Navajo Nation, Pueblo of Zuni, Arizona State Parks, U.S. Geologic Survey, Arizona State Museum, and Burlington Northern Santa Fe Railroad. Forty-five participants attended the workshop for one or more of the three days.

In addition, throughout the study period, many sponsor coordination meetings have been held concurrently with quarterly meetings of the Winslow Levee Advisory Board. These meetings are attended by the Navajo County Board of Supervisors, and are open to the public for comment.

Comments received to date have been minimal. The most significant comments have been provided by the Arizona State Museum, as mentioned above in the NEPA Scoping Meeting section, and Homolovi State Park, which has not provided a formal comment but has coordinated with the Corps during the study period. Their comments pertain to possible impact of the proposed project on flood risk to the Homolovi I Pueblo, located across the LCR from the levee. Their perception is that construction of the existing Winslow Levee along its current alignment has increased the flood risk to the Homolovi I site. Flooding at the Homolovi I Pueblo begins at approximately the 10 percent ACE (10-year) flood under current conditions. See Sections 5.2 and 5.6 for further details on potential impacts of the action alternatives. The potential impacts of the proposed project on the Homolovi I Pueblo may continue to be of public concern through completion of the study. The Corps will continue to work closely with the Hopi Tribe, Arizona State Parks, Arizona State Museum, and the Arizona SHPO to ensure that potential impacts to Homolovi I are addressed.

The Navajo community of Bird Springs has also raised concerns about potential impacts to their community from the proposed project. This community is involved with a floodplain mapping project with the Corps, and informally raised its concerns about the LCR study in this separate coordination with the Corps. Bird Springs is approximately 20 miles downstream of the proposed project area. Based on hydraulic analyses, the proposed project would not result in changes to hydrology or hydraulics and would not increase flooding along the LCR downstream of the proposed project area compared to baseline conditions. Section 5.2 includes a discussion of potential impacts to hydrology and hydraulics from the proposed project.

The U.S. Geological Survey has coordinated with the Corps to request a copy of the report, but no formal written comment has been received from that agency.

In addition, the non-Federal sponsor has shared with the Corps that the public routinely asks whether homeowners still need to continue to purchase flood insurance for mortgages backed by Federal loans.

7.6. Public Comments and Public Meeting on Draft IFR

On May 26, 2016, the Draft IFR was made available to the public through the Corps SPL (Los Angeles District) Public Notice website, through social media (e.g., Corps Facebook), and to pertinent agencies and interested stakeholders through the U.S. Postal Service. The Draft IFR was released for public review and comment via publication of the Notice of Availability in the Federal Register (81 FR 35756) on June 3, 2016. Two public meetings were held in Winslow on June 9, 2016, concurrent with release of the Draft IFR. These meetings occurred in the afternoon from 3 PM to 5 PM, and in the evening from 6:30 PM to 9:30 PM, at The Church of Jesus Christ of Latter-day Saints, located at 205 Lee St., Winslow, Arizona, 86047. The public was invited to provide oral and/or written comments during these meetings. Comments on the Draft IFR were also accepted in writing for a 45-day period extending from June 3, 2016 through July 18, 2016. Sixteen comments (10 agencies, 6 public meeting commenters) were received on the Draft IFR, and can be found in Appendix I – Environmental. None of the comments on the Draft IFR required significant changes to the Alternative 10.1, the Recommended Plan.

The USEPA, Region IX, Environmental Review Section, provided comments on the Draft IFR in a letter dated July 18, 2016. The USEPA has a rating system developed as a means to summarize the USEPA level of concern with a proposed action, and the ratings are a combination of alphabetical categories for evaluation of the environmental impacts of the proposed and numerical categories for evaluation of the adequacy of the EIS. The USEPA rated Alternative 10.1 as *Lack of Objections (LO).* An LO rating is defined as the EPA has not identified any potential environmental impacts requiring substantive changes to the proposal, and the review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal. The USEPA comments have been considered and have been included in the IFR, where appropriate.

The U.S. Department of Interior, Office of the Secretary, Office of Environmental Policy and Compliance, provided a letter dated July 18, 2016, and had no comments on the Draft IFR.

The ADEQ provided comments on the Draft IFR in a letter dated June 1, 2016, in an e-mail dated June 13, 2016, and in a letter dated July 26, 2016. The ADEQ comments have been considered and have been included in the IFR, where appropriate.

The Arizona Department of Transportation (ADOT) provided comments on the Draft IFR in a letter dated July 18, 2016. The ADOT comments have been considered and have been included in the IFR, where appropriate.

The Arizona Game and Fish Department (AZGFD) provided comments on the Draft IFR in a letter dated June 30, 2016. The AZGFD June 30, 2016 comments on the Draft IFR have been considered and included in the IFR, where appropriate. Additionally, the AZGFD provided comments on the 2017 signed CAR in a letter dated April 4, 2018, generally agreeing with the Discussion and Recommendation sections on page 4 of the CAR, but on page 3 of the CAR, the AZGFD did not agree that only non-native fish species are currently found in the LCR in the proposed project area, as the flannelmouth sucker, a native fish species, had been identified in the 2014 AZGFD formal protocol species survey report based on best scientific data. The AZGFD April 4, 2018 letter stated that the flannelmouth sucker was misidentified, and the actual

identification should have been the Little Colorado River sucker (*Catostomus* species) since Grand Falls, along the LCR downstream of Winslow, isolates Little Colorado River sucker within the Little Colorado River basin from flannelmouth sucker, which occur in the watershed further downstream below Grand Falls. The Corps appreciates the discussion on the fish sucker species from the AZGFD April 4, 2018 comment letter on the 2017 signed CAR, but with the AZGFD April 4, 2018 letter identification of the Little Colorado River sucker as *Catostomus species*, the AZGFD is stating that it is a scientifically undescribed species that is similar to flannelmouth sucker, but it is not a known species scientifically. Based on the above, the Corps has considered the comments from the AZGFD April 4, 2018 letter on the 2017 signed CAR, and the Corps determination on the flannelmouth sucker discussed in the Draft IFR/EIS (May 2016) and in the EIS are current and valid, based on the discussion and analyses from the 2014 AZGFD formal protocol species survey report, from the Draft IFR/EIS (May 2016), and from the 2017 signed CAR.

The Arizona State Historic Preservation Office (Arizona SHPO) provided an e-mail dated June 22, 2016, and had no comments on the Draft IFR. The SHPO did state it looked forward to continued Section 106 consultation. The Corps has and will continue its ongoing Section 106 consultation with Arizona SHPO and the Tribes.

The Arizona State Museum provided comments on the Draft IFR in an e-mail dated July 15, 2016. The Arizona State Museum comments have been considered and have been included in the IFR, where appropriate.

The White Mountain Apache Tribe provided comments on the Draft IFR in a letter dated June 29, 2016. The White Mountain Apache Tribe comments have been considered and have been included in the IFR, where appropriate.

Copies of comments on the Draft IFR and responses to the comments on the Draft IFR, and copies of the 2017 signed CAR, and the 2018 AZGFD comments on the 2017 signed CAR, can be found in Appendix I - Environmental.

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8.0 RECOMMENDED PLAN

This chapter describes Alternative 10.1, the Recommended Plan, and provides the economic summary, cost estimate, and cost apportionment for the Recommended Plan. It also identifies the environmentally preferable alternative, addresses the Recommended Plan's consistency with the Corps' environmental operating principles and the Campaign Plan and Strategic Plan, and outlines implementation requirements.

8.1. Description of the Recommended Plan

Alternative 10.1 (Recommended Plan, Figure 8-1) would include the following components (from upstream to downstream):

- Removal and reconstruction of approximately 2,000 feet of the RWDL to its abutment with the Winslow Levee
- Removal and reconstruction of approximately 3,500 feet of the Winslow Levee from its abutment with the RWDL to I-40
- Improvement of conveyance under the BNSF Railroad Bridge through channelization and saltcedar removal
- Construction of a new levee segment parallel to I-40 (approximately 3,700 feet)
- Removal and reconstruction of the Winslow Levee from I-40 to a point 0.8 miles north of North Road, including setback of 1,600 feet
- Flood warning system

The total length of new and reconstructed levees would be approximately 22,570 feet. New levee construction would be designed to provide an approximately 90 percent assurance of containing the one percent ACE event. The non-Federal sponsor specified that their plan of interest was one that would meet FEMA certification criteria. This plan scale was one of the scales analyzed as part of the NED analysis, and was ultimately identified as the Recommended Plan.

No improvements would be made to the Winslow Levee downstream of the proposed Federal project. In addition to the components listed above, a flood warning system would be implemented as part of the Recommended Plan.

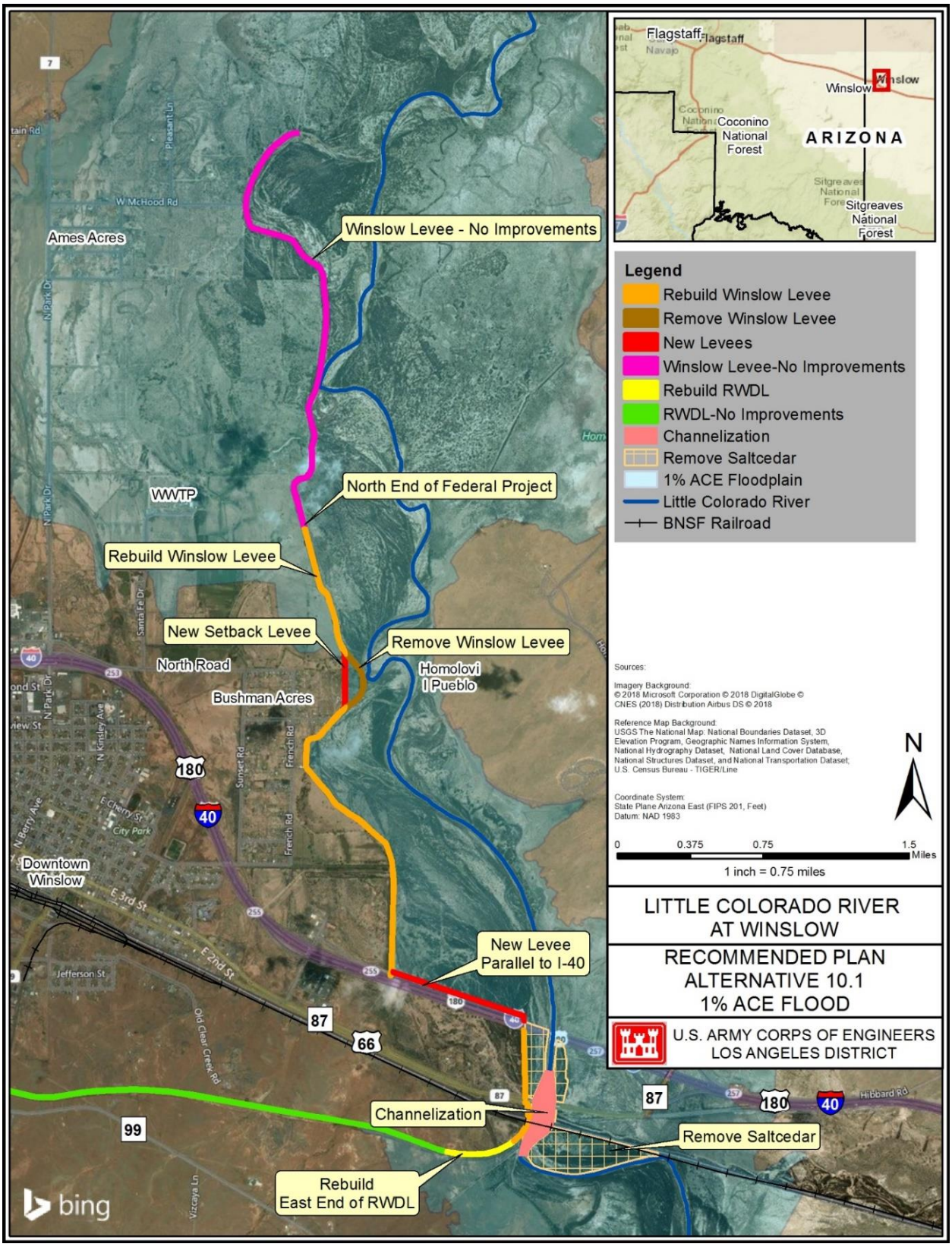

Figure 8-1 Alternative 10.1, Recommended Plan

8.1.1. Levee Construction Features

From upstream to downstream, the levee improvements would consist of the following: rebuild the easternmost 2,000 feet of the RWDL to its abutment with the Winslow Levee; rebuild 3,500 feet of Winslow Levee from the RWDL north to I-40 (distance accounts for alignment under bridges); construct approximately 3,700 feet of new levee along the north side of and parallel to I-40; and rebuild 13,370 feet of Winslow Levee from I-40 to the north end of the proposed project, approximately 0.8 miles north of North Road. The reconstructed levee would include a levee setback across the river from Homolovi I Pueblo that is approximately 1,600 feet long. A 2,000-foot section of the original Winslow Levee would be removed at this location and replaced by the setback levee. The total length of new and reconstructed levee would be 22,570 feet. The typical levee section would consist of a trapezoidal compacted earth fill levee designed to contain the one percent ACE flood with an assurance of approximately 90 percent. This levee scale corresponds with a levee height of approximately 3.3 feet above the one percent ACE water surface elevation. Maximum levee height for the Recommended Plan would be approximately 16.3 feet. The levee would be faced with 2:1 (H:V) basaltic riprap, or 1:1 soil cement on the riverside; scour protection installed to an average depth of 15 feet below grade on the riverside; a 2:1 slope on the landside overlain with four inches of gravel mulch to prevent erosion; a 16-foot-wide access road along the crest of the levee; a 10-foot-wide, 6-foot-deep trench drain with 2:1 side slopes at the toe of the levee on the landside; and a 15-foot-wide gravel mulch maintenance road landward of the trench drain. The typical levee section footprint would be approximately 210 feet in width including the maintenance road and trench drain.

A temporary construction corridor would utilize the 15-foot-wide maintenance road, plus an additional 35 feet, for a total width of 50 feet. An additional 25 feet for construction access would be needed on the riverside of the levee. Adding the temporary construction zones increases the total construction corridor to a width of 270 feet. The total area of the project and temporary construction corridor would be approximately 139 acres.

8.1.2. Channel Construction Features

In addition to levee construction, the Recommended Plan includes saltcedar removal and river channelization to increase conveyance of floodwater under the BNSF Railroad Bridge. Saltcedar would be removed from an approximately 96-acre area in the vicinity of the BNSF Railroad and State Route 87 bridges using land clearing equipment. Removed saltcedar would be disposed of on an upland location outside of the floodplain.

Following saltcedar removal, the river would be channelized for a length of about 2,500 feet at the BNSF Railroad Bridge by excavating an approximately 26-acre area to the current thalweg depth. Excavation depth would range from one to eight feet. The bottom of the newly excavated channel would remain earth-lined. Excavated material would either be recycled for levee construction, or disposed of to an upland area outside of Section 404 jurisdiction. The maximum total width of the channel would be approximately 650 feet.

Dewatering and/or water diversion would be required for the work proposed in the LCR channel and on the riverside of the levee. Existing floodplain soils would not support the weight of construction equipment, or in some areas, even a standard passenger vehicle. Wheeled or tracked transport across the LCR channel or adjacent floodplain would require soil enhancements in addition to dewatering to avoid equipment bog down. Any soil enhancements placed can be removed after the construction ends and the construction/access road alignment is restored.

8.1.3. Nonstructural Measures

The Recommended Plan includes a flood warning system. No other nonstructural measures are included as part of this alternative.

8.1.4. Material Required for Construction

Approximately 156,000 CY of material would be excavated from the LCR floodplain at the BNSF Railroad Bridge. As part of the channelization work, approximately 37,000 CY of soil cement and 26,000 CY of 36-inch riprap would be installed to create a low-flow channel, terrace, and armored side slopes.

Approximately 428,000 CY of material would be obtained from the excavation of the existing levee. No testing of the material in the existing levees could be found, and no investigation sampling and testing was done as part of this feasibility study. Based on field observations of the levee surface, the Corps anticipates that approximately 80 percent of the material moved for the project (river excavation and levee demolition) could be reused for new levee construction. Excavation of the trench drain along the landside toe of the levee would yield approximately 110,000 CY of additional material. Based on the information available, it is assumed that the soils excavated from the trench drain could be reused for new levee construction.

Reconstruction of the levees would require approximately 460,000 CY of fill. This material would be obtained from the LCR channelization, levee demolition, and trench drain excavation to the extent practicable. Unsuitable material will be disposed of at suitable sites. The trench drain filter material would require approximately 40,000 CY of sand and 40,000 CY of gravel. The sand and gravel would either be obtained onsite if appropriate materials are available, or trucked from offsite sources as necessary. The remaining trench volume would be backfilled using an estimated 30,000 CY of material originally excavated from the trench.

The existing levees to be reconstructed are armored by approximately 10,000 CY of large-sized, high-quality, durable basalt riprap with a median rock size (D_{50}) of approximately 10 inches. Poor quality sandstone and broken concrete riprap (approximately 18,000 CY) would either be stockpiled for flood fighting or disposed of at nearby stockpile or borrow sites.

The riverside levee embankment armoring consists of approximately 10,000 linear feet of soil cement south of I-40 and in the vicinity of the upstream impingement point. The remaining 12,546 feet of riverside levee embankment would be armored using a combination of riprap and stone, as appropriate. Installation of the armoring would require approximately 99,000 CY of soil cement and 55,000 CY of 24-inch riprap. Launch-stone (-24-inch to -48-inch) will be placed in the toedown trench. Launch-stone amounts to approximately 34,000 CY. A potential quarry

source is the Brimball Hardluck Quarry at Indian Wells, Arizona, located 43 miles northeast of Winslow Levee (a 55-mile, one-way haul distance along existing but indirect roads).

For landside levee slope protection, a four-inch layer of gravel mulch would be installed on the landside of the levee for slope protection. Approximately 7,400 CY of gravel mulch would be needed for this work. Maintenance roads construction along the length of the project requires an estimated 9,000 CY of ABC gravel.

Construction fines (clay and silt) for levee embankment construction would be obtained, to the extent practicable, from the materials available on site. Possible sources for this material consist of the old river channel on City of Winslow property adjacent to the Winslow Levee, or a dust dune located between the Winslow Levee and the LCR. Any needed fines that are not available locally would need to be trucked in from offsite sources.

8.1.5. Borrow and Excess Material

a. Borrow

The Recommended Plan would entail borrow of construction materials from multiple sites, consisting of the existing levee embankments, trench drain excavation, and the approximately 26-acre LCR channelization area. Additional sources of material may include, as necessary, the commercial Dyna Sand and Rock/Winslow Ready Mix site east of the LCR, the "O'Haco Northwest" pit located 2.5 miles northwest of the north end of the Winslow Levee, the 18-acre old river bend on the City of Winslow property at French Road, and the dust dune located in the floodplain between the Winslow Levee and LCR. Access to the dust dune in the LCR floodplain would require construction of a temporary access road approximately 30 feet wide and 800 feet long within the floodplain. This road would not cross areas within Clean Water Act Section 404 jurisdiction given the current configuration of the floodplain. The Brimball Hardluck Quarry is anticipated to be a source for basaltic riprap and launchable stone. This site is at Indian Wells, Arizona, located 43 miles northeast of Winslow Levee (approximately a 55-mile, one-way haul distance along existing but indirect roads).

b. Excess Material

The cut and fill volumes are very close to balanced, and any excess/unusable material will be distributed to the most cost-effective disposal location at a depth of one to 2.5 feet. Any excess material originating from the LCR channelization area and levee demolition south of I-40 is anticipated to be placed on the McCauley properties east of the LCR. Due to the topography of the McCauley site, material deposition may be deeper than 2.5 feet in some areas. The O'Haco Middle and O'Haco North disposal sites are not anticipated to be used due to their distance from the project area.

8.1.6. Staging/Stockpiling Areas

Six staging/stockpiles areas are identified along the project construction corridor. Two of these areas are located on the same properties used as disposal areas (O'Haco South and City of Winslow). Current land use and area needed at each staging area is provided in Table 8-1.

Table 8-1 Proposed Recommended Plan Staging Areas

	O'Haco South	City of Winslow	Pugh/Gale	Transcon LLC	Klaus Bolle	Navajo Tribe
Area (Acres)	2	5	2	2	2	2
Current Land Use	Rangeland	Pasture	Rangeland	Vacant Floodplain	Vacant	Vacant

A batch plant would be located on the five-acre City of Winslow staging area. This plant would provide the grout needed for installation of soil cement.

The Pugh/Gale staging area is located behind the existing Winslow Levee at the North Road alignment. During construction of the proposed project, this staging area would be on the riverside of the new levee alignment. However, this site would remain behind the existing Winslow Levee until the levee embankment is demolished. The Transcon LLC staging area is located on the riverside of the levee, adjacent to the north side of I-40. Heavy construction equipment would need to pass under the BNSF Railroad Bridge for access to the proposed staging area owned by the Navajo Tribe. Measures required to ensure equipment access without bog down have been addressed in the discussion of channel construction features above. Limited equipment staging and stockpiling would also take place along the 50-foot-wide construction corridor, as appropriate.

8.1.7. Ingress-Egress

Six ingress-egress routes for access to the construction corridor have been identified. From upstream to downstream, these are as follows:

Table 8-2 Alternative 10.1 Ingress-Egress

Location	Required Improvements	Permanence
South side of SR87 west of the Winslow Levee	Present and in use – road safety, load and widening improvements needed	Permanent project feature
North side of SR87 west of the Winslow Levee	Present and in use – road safety, load and widening improvements needed	Permanent project feature
Westbound I-40 frontage road east from Transcon Lane	Present and in use – load and widening improvements needed	Permanent project feature
North end of Transcon Lane via unpaved road along south side of ADOT drainage easement	Widening of existing unpaved roads and new unpaved road construction needed for 2,800 feet	Temporary access; restored to original condition upon project completion
East from intersection between French Road and Oak Road, then north across the French Farm	1,500 feet of new unpaved road construction needed	Temporary access; restored to original condition upon project completion
East from the east end of North Road	1,500 feet of new unpaved road construction needed	Temporary access; restored to original condition upon project completion

Ingress-egress routes are anticipated to be about 30 feet in width to allow safe passage of heavy construction equipment.

8.1.8. Utilities

There are nine separate utilities and/or utility crossings within the Recommended Plan construction corridor. These utilities consist of irrigation infrastructure, local and regional electrical service, a fiber optic line, a high pressure gas line, drainage infrastructure operated by ADOT, private arena lights, and a potable water line. Utilities would be relocated/reconstructed in place, protected in-place, or avoided via minor changes to project alignment during the PED. Table 8-3 provides a description of the utilities and impacts associated with the Recommended Plan.

Table 8-3 Recommended Plan Utilities (Upstream to Downstream)

Utility	Owner/Operator	Specifications	Action During Construction
Inverted Siphons	Winslow Irrigation District	Two siphons constructed with 30 inch reinforced concrete pipe	Relocate (reconstruct in place)
Utility line on wooden poles	Unknown	Single overhead line with unidentified local utility	Relocation or removal
Fiber Optic Line	CenturyLink	Major trunk line and local service line in 4-inch conduit	Protect in place
High Pressure Gas Line Crossing No. 1	Kinder-Morgan	4.5 inch outside diameter pipe	Relocate
High Tension Electric Lines	Arizona Public Services (APS)	Unknown; possibly 130kV	Within construction access easement; protect in place
High Pressure Gas Line Crossing No. 2	Kinder-Morgan	4.5 inch outside diameter pipe	Relocate
K3 Channel, Under I-40	ADOT	3 barrel 4 feet X 10 feet concrete box culvert with lift gates	Not in construction area; levee design to be refined during PED to avoid impacts, as needed
High Pressure Gas Line Crossing No. 3	Kinder-Morgan	4.5 inch outside diameter pipe	Relocate
I-4 Hydraulic Gate	ADOT	4 barrel 4 feet X 10 feet concrete box culvert with lift gates	Rebuild in place
Arena lights	Hatch, Ben Trustee B & M Hatch Family Trust	Four livestock arena light poles	Protect in place; design to be refined during PED to avoid impacts
Homolovi Water Line	City of Winslow	6 inch PVC line for potable water supply	Relocate

To protect the CenturyLink fiber optic conduit in-place, it would be encased in concrete with concrete slope anchors beneath the riverside levee slope (10 feet o/c). The concrete encasement would extend 30 feet out from the landside levee toe and 10 feet out from the riverside toedown. The landside encasement extension would be to protect the line from construction traffic.

The Kinder-Morgan gas line crosses the construction corridor three times. A total of 1,200 feet of gas line would need to be relocated to a sufficient depth to pass beneath the new construction to avoid levee penetrations. This work would involve excavation and removal of the existing line, trenching and sidecast of excavated material, placement of new line, backfill, and

connection of the new line. Use of directional boring for part of the relocation work may be feasible.

The potable water line runs parallel to the landside of the Winslow Levee for a distance of approximately 1,000 feet from the east end of Prosperity Avenue to an access vault at the landside toe of the levee. An estimated 1,600 feet of this line would need to be relocated during project construction.

The ADOT K3 channel is aligned with a normally dry manmade channel that extends under I-40. This gate is normally closed but can be opened by means of lift gates. This canal has no discernable channel north of I-40. The current culvert extends approximately 50 feet from the edge of the road to the north, and the proposed levee alignment goes over the existing culvert. The culvert may need to be extended to accommodate a levee embankment, or another design feature could allow the culvert to be protected in-place (e.g. using floodwall over the culvert that ties into the levee). This level of design will be determined in PED.

If possible, utility line relocations would be accomplished in a manner that does not require service interruptions. However, during relocation of these utilities and final connection of the new lines to the existing lines, temporary disruptions to potable water and natural gas service may be necessary. Potable water service disruptions would be limited to Homolovi State Park. Service outages, if necessary, are anticipated to be short term. Multiple service outages for one or more utilities are also possible. Since the CenturyLink fiber optic line would be protected in-place, no service interruptions are expected.

8.1.9. Construction Equipment

Typical equipment to be used during the construction period include loaders, scrapers, dozers, trucks, blades, roller compactors, a soil cement batch plant, concrete mixers, water trucks, and backhoes.

8.1.10. Duration of Construction

The base schedule for the construction phase is estimated at 2.5 years, which is the most-likely schedule, regardless of schedule contingency. This duration excludes any landscape establishment period, if required.

The proposed construction plan would be implemented in one phase. Construction consists of demolition of the existing levee and construction of a new levee, extension of interior drainage, and associated features including the trench drain and collector channel. The estimated construction time assumes year-round construction with allowance for adverse weather delays, the monsoon season, and national holidays. Construction would generally stop during the months of July, August, and September due to the summer monsoon season. Construction phasing would be accomplished in a manner that assures a functioning levee system during each winter-spring rain and snowmelt season. Since freezing winter temperatures and high summer temperatures occur at Winslow, placing of materials should be planned for periods of mild weather.

As a result of the proximity of the river to the construction site, construction of the levee on areas adjacent to the river should be scheduled to coincide with a time of year when the flooding risk would be minimized. The risk factor could have significant impact on the construction cost of the project. The embankment work would be most susceptible to damage and construction delays during the wet season of the year. Winslow experiences both summer and winter rains; however, the primary rainy season occurs on July, August, and September. The winter months of December through March also have the possibility of high flows in the channel due to winter storms and possible snow melt at higher elevations. Avoidance of these months to the extent possible in scheduling construction would be advantageous.

Construction equipment would generally be operated 10 hours a day, six days a week. If acceleration of work is required to ensure flood control, the daily work schedule may be extended.

8.1.11. Property Ownership

Navajo County currently holds approximately 100- to 340-foot-wide, 113-acre permanent flood control easement along the current alignment of the Winslow Levee. The project width is expected to be as wide as 210 feet where the levee height is greatest. The existing easement is not wide enough to accommodate the proposed new project along most of the project length. Therefore, Navajo County would need to obtain additional easements from property owners to construct and operate the new project.

Temporary construction easements would be required on either side of the 210-foot-wide project area to accommodate the needed 270-foot-wide construction corridor. Temporary construction access is described under levee construction features above.

Approximately 15 properties would be affected with the construction of Alternative 10.1. The affected properties include the BNSF Railroad corridor, two ADOT properties (I-40 and a drainage easement), nine mostly large ranch/vacant properties, a large ranch property having residences and/or outbuildings outside of the construction zone, and two additional properties where residences and/or outbuildings are located within or close to the construction access corridor. Approximately four occupied residences are located within 200 feet of the existing levee, one of which is within 100 feet. Relocations are anticipated to be avoided with minor adjustments to the levee alignment and construction corridor during PED.

Setback of the Winslow Levee across from Homolovi I would restore approximately 12 acres to the active LCR floodplain. No structures are located within the proposed levee setback area. Relocation of occupied structures is not anticipated for the Recommended Plan.

Permanent or temporary permits issued by ADOT and BNSF would be required to construct the LCR channelization measures. Such authorizations would also be needed for portions of the levee reconstruction located within ADOT and BNSF rights-of-way.

8.1.12. Managed Overtopping

The analysis and design of managed overtopping features during PED will follow the guidance contained in Engineering and Construction Bulletin (ECB) 2017-15.

Resiliency, based on ECB 2017-15, refers to the ability of an engineered structure to withstand overtopping flows at a specified location. Configuring a levee system using methods presented in the ECB, includes setting top of levee profile, determining overtopping reach length and depth, considering resiliency measures in the overtopping reach, and managing residual risk. Resiliency measures provided by various forms of surface hardening, armoring, or resistance to overtopping scour, define one of the driving parameters in sizing the overtopping reach and establishing overtopping rates and volumes. Resiliency in the overtopping reach provides a higher degree of confidence in levee performance at the point of overtopping to assist floodplain managers.

Levee superiority would include hardening sections to withstand overtopping to minimize levee reconstruction efforts. Superiority and its accompanying increased resiliency (resistance to erosion from overtopping) at overtopping sections may be used. Identifying a feasible and practical overtopping location includes the requirement that, with reasonable confidence, the location be designated and maintained for the life of the levee system.

The managed overtopping location would be capable of absorbing energy during loading without experiencing permanent deformation, extensive damage, cumulative degradation, or catastrophic failure. Scour protection will be provided on the protected side of the levee for the purpose of minimizing erosion during flood events that exceed the top of levee.

During the PED phase, further investigations will be conducted for this most-likely overtopping location to develop and design features, which would incorporate managed overtopping and resiliency in accordance with Corps design criteria. Based on the water surface profile for the 0.5 percent ACE flood, the managed overtopping reach upstream of the BNSF Railroad Bridge would be approximately 800 feet long. The schedule for PED will account for the time necessary to complete the managed overtopping design, which will be combined with the interior drainage reanalysis.

8.1.13. Induced Flooding

The 1% ACE flood for the Recommended Plan does not show flooding caused by overtopping or failure of the Winslow Levee. However, at the north end of the rebuilt Winslow Levee, flows could flank the landside of the levee before moving downstream if the levee overtops/fails in the unimproved levee segment. There are some structures affected in this area, but since this area is in the baseline conditions floodplain, flooding to this area would not be considered induced flooding when compared to the baseline condition analysis.

Hydraulic analysis at Homolovi I Pueblo shows that the Recommended Plan would not increase flooding compared to the baseline condition 1% ACE flood. A portion of the Homolovi I Pueblo footprint is currently within the 1% ACE floodplain for the baseline condition. The Recommended Plan results in a slightly decreased floodplain extent and a decreased water surface elevation at Homolovi I Pueblo compared to the baseline condition. The Recommended

Plan has the same flood duration as the baseline condition.

Attachment 7 provides more information on the hydraulic analysis at the Homolovi I Pueblo. A detail view comparing 1% ACE floodplain for the baseline condition and the Recommended Plan at Homolovi I is provided in Attachment 7, Enclosure 4 (note that the Recommended Plan, Alternative 10.1, is referred to as the Tentatively Selected Plan on Enclosure 4).

8.2. Economic Summary

The project construction costs and OMRR&R costs were developed using the MII cost estimating system. These costs, along with annualized costs, annualized benefits, net economic benefits and the benefit-to-cost ratios are shown in Table 8-4. These values are based on FY 2018 price levels, a discount rate of 2.75 percent, a 50-year period of analysis, and an assumed 5.5-year design and construction period.

Table 8-4 Total First Cost and Average Annual Cost – Recommended Plan ($1,000s)

October 2017 Price Levels, 2.75% Discount Rate

Category	Cost
Lands & Damages	$193
Relocations	$1,065
Total LERRD	***$1,258***
Construction	$56,540
Preconstruction Engineering and Design (PED)	$15,160
Construction Management (S&A)	$4,043
Cultural Resources	$201
Total Construction	***$75,944***
Total First Cost	**$77,202**
Interest During Construction	$4,012
Total Investment Cost	**$81,214**
Annualized Investment Cost	**$3,008**
OMRR&R	**$50**
Total Average Annual Cost	**$3,058**

The non-Federal Sponsor has requested the selection of Alternative 10.1 as the Recommended Plan. This alternative meets the criteria for a Categorical Exemption from identifying and selecting the NED Plan, as described in the PGN, ER 1105-2-100, paragraph 3-3.b(11).

Specifically, this plan (1) provides the non-Federal Sponsor's desired maximum level of protection; (2) has with-project residual risks that are not unreasonably high; (3) features levee improvements designed to meet FEMA's flood insurance requirements; (4) has greater net benefits than smaller scale plans; and (5) does not contain uneconomical increments. Expected annual benefits and costs for the Recommended Plan are estimated at $8.3 million and $3.1 million, respectively. Net benefits for the Recommended Plan are estimated at $5.2 million, while the benefit-to-cost ratio is 2.70.

8.3. Cost Estimate and Cost Apportionment

Table 8-5 provides the project cost estimate as described in Appendix E - Cost Engineering. This cost includes the contingency from the Cost Schedule Risk Analysis and is in October 2017 Price Levels.

Table 8-5 Recommended Plan First Cost Estimate ($1,000s)

(October 2017 Price Levels)

Account	Description	Cost	Contingency (%)	Contingency	Total
01	Lands and Damages	$138	40%	$55	$193
02	Relocations - Utilities	$761	40%	$304	$1,065
11	Levees & Floodwalls	$42,194	34%	$14,346	$56,540
22	Cultural Resources	$150	34%	$510	$201
30	Planning, Engineering and Design (PED)	$11,312	34%	$3,848	$15,160
31	Construction Management (S&A)	$3,017	34%	$1,026	$4,043
	TOTAL PROJECT COST	$57,572		$19,630	$77,202

Cost sharing for construction of the Recommended Plan would be consistent with the requirements of Section 103 of WRDA 1986, as amended. Table 8-6 shows the cost apportionment for the Federal and non-Federal shares of total project cost. The sponsor is responsible for providing all lands, easements, rights of way, and disposal sites and performing all relocations (together referred to as lands, easements, rights of way, relocations, and disposal sites, or LERRD) required for the project. Items included in the LERRD total include the land to construct the project and the relocation of facilities/utilities. Costs for any Hazardous, Toxic, and Radioactive Waste (HTRW) response/remediation is a non-Federal sponsor responsibility and is not a project cost.

Table 8-6 Recommended Plan Cost Apportionment ($1,000s)

(October 2017 Price Levels)

Item	Federal	Non-Federal	Total
Lands and Damages		$193	$193
Relocations - Utilities		$1,065	$1,065
Levees & Floodwalls	$56,540		$56,540
Cultural Resources	$201		$201
Preconstruction Engineering and Design (PED)	$15,160		$15,160
Construction Management (S&A)	$4,043		$4,043
Subtotal	**$75,944**	**$1,258**	**$77,202**
Adjustments			
5% Minimum Cash Contribution	-$3,860	$3,860	
Additional Cash Contribution	-$21,903	$21,903	
TOTAL	**$50,181**	**$27,021**	**$77,202**
Cost Sharing Percentage	*65%*	*35%*	*100%*

8.4. Environmentally Preferable Alternative (NEPA)

The environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. Ordinarily, this means the alternative that causes the least damage to the biological and physical environment; it also means the alternative that best protects, preserves, and enhances historic, cultural, and natural resources.

Alternatives 1.1, 3.1, 7, 8, 9, 10, 10.1, 10.2, 10.3, and 10.4 are feasible alternatives for purposes of NEPA. Alternative 11 is the No Federal Action Alternative and is included in the final array of alternatives.

Alternatives 1.1, 3.1, 8, 10, 10, 10.1, 10.2, 10.3, and 10.4 are similar as they include rebuilding portions of the Winslow Levee and RWDL, and construction of a new segment of the Winslow Levee along I-40. This would result in similar temporary construction impacts to geology and soils, water quality, groundwater, biological resources, air quality, traffic, utilities, and socioeconomics. Alternatives 8, 10, 10.1, 10.2, 10.3, and 10.4 include a levee setback near the impingement point across from the Homolovi I Pueblo, and Alternative 3.1 includes a larger levee setback at two segment points of the Winslow Levee. Although Alternatives 8, 10, 10.1, 10.2, 10.3, and 10.4 are anticipated to avoid the need for removal of residences through minor adjustments to the levee alignment and construction corridor during the design phase, removal of one residence is possible. There would be a greater potential impact under Alternative 3.1, which would require removal of about eight residences. Alternative 3.1 would also result in greater land use and aesthetics impacts compared to the other alternatives due to the larger levee setback. The impacts of Alternative 3.1 on land use would be significant due to conversion of a substantial percentage of rural residential and commercial land to other uses.

Alternatives may also result in adverse impacts to cultural resources. For Alternatives 1.1, 8, 10, 10.1, 10.2, 10.3, and 10.4, if structures are determined to be eligible for the NRHP, and if impacts cannot be avoided or minimized, then the alternative would result in an adverse effect under NHPA and a significant impact under NEPA; Alternative 3.1 is expected to result in adverse effects to historic properties and significant impacts under NEPA.

Regarding hydraulic impacts to Homolovi I, the Corps compared hydraulic models of each alternative to two discrete baseline conditions. In the first baseline condition, which is the more likely scenario, the Corps assumed that the existing levees would not fail prior to overtopping. In the second baseline condition, the Corps factored in the probability that the existing levees could perform unsatisfactorily (fail) through slope failure, impingement, or piping. Under the first model scenario, in which the levee does not fail, the water surface elevation velocity, and floodplain extent at Homolovi I slightly decreased or did not change compared to the baseline condition for Alternatives 1.1, 3.1, 8, 10, 10.1, 10.2, 10.3, and 10.4. There would be no change at Homolovi I from Alternatives 7 or 9. No increase in flooding at Homolovi I is expected from any of the alternatives compared to the first baseline condition. The second baseline condition, in which the levees fail, is much less likely to occur than the baseline condition in which the levees do not fail but are overtopped. Alternative 3.1 would reduce average water surface elevations and floodplain extent at Homolovi I Pueblo when compared to the same baseline scenario. Alternatives 7 and 9 would result in no change. However, for the second baseline to occur, the levee would need to simultaneously fail at four locations, a less-than-five-percent chance in any

given flood event. Therefore, it is not reasonably foreseeable that the alternatives would result in an adverse effect or a significant impact to Homolovi I. All action alternatives would reduce the risk of flooding to the City of Winslow and surrounding communities, which would be a benefit.

Within the array of alternatives that provide one percent ACE level of flood risk minimization (i.e., Alternatives 1.1, 3.1, 8, 10.1) or greater (i.e., Alternative 10.4), and would therefore meet the non-Federal sponsor's stated goals, Alternative 10.1 would result in the least environmental impacts. Alternative 10.1, the Recommended Plan, entails the shortest length of reconstruction for the Winslow Levee relative to Alternatives 1.1, 3.1, and 8. The rebuild of Winslow Levee under Alternative 1.1, 3.1, and 8 is approximately 34,440 feet long; in contrast, Alternative 10.1 is approximately 22,570 feet long. As a result, Alternative 10.1 avoids the incremental environmental impacts associated with longer levee rebuild length for most environmental resources. Alternative 10.1 also lacks the levee setback elements included in Alternative 3.1 that would result in significant impacts to land use. Relative to Alternative 10.4 which has the same length of reconstruction for the Winslow Levee and greater level of flood risk minimization as Alternative 10.1, Alternative 10.1 would require less fill material due to the lower levee height associated with the one percent ACE level of flood risk minimization. Alternative 10.4 would require approximately 346,000 CY of fill, compared to approximately 332,000 CY for Alternative 10.1. Thus, Alternative 10.1 avoids the incremental impacts to air quality and trucking compared to Alternative 10.4. Furthermore, Alternative 10.1 has less impacts to waters of the United States compared to Alternative 10.4—1.2 acres to 2.9 acres, respectively. Based on the above, Alternative 10.1, the Recommended Plan, is the environmentally preferable alternative.

Alternative 10.1 has been identified as the Environmentally Preferred Alternative as it meets the project objectives while maximizing net benefits compared to smaller scale plans and minimizing impacts to environmental resources.

8.5. Environmental Operating Principles

The Corps has reaffirmed its commitment to the environment by formalizing a set of "Environmental Operating Principles" applicable to all of its decision-making programs. These principles foster unity of purpose on environmental issues, reflect a new tone and direction for dialog on environmental matters, and ensure that employees consider conservation, environmental preservation, and restoration in all Corps activities. The principles are described in Engineer Circular 1105-2-4040 "Planning Civil Work Projects under the Environmental Operating Principles," 1 May 2003. The Environmental Operating Principles were revised and reissued in 2012.

This study addresses the Corps' Environmental Operating Principles as described below:

1. Foster sustainability as a way of life throughout the organization.
    - Environmental sustainability, when applied to a water resource project, must be designed to balance three major elements: environmental health, economic prosperity, and social well-being.

- The proposed project would improve environmental health because alternatives were developed with environmental impacts in mind, and a variety of environmental commitments and best management practices would be implemented to further reduce impacts to the environment.
- The proposed project will contribute to future economic prosperity because it will contribute to future economic development by creating jobs during construction and improving the flood risk management for the community.
- Social well-being would be improved by the proposed project because it would provide flood risk management for the society in the vicinity.
- Overall, the proposed project will foster sustainability as a way of life as it will provide beneficial effects to public safety and health for the adjacent community.

2. Proactively consider environmental consequences of all Corps activities and act accordingly.
   - The Corps has proactively considered environmental consequences of the proposed project. Potential environmental consequences on environmental resources have been analyzed for the final array of alternatives, and numerous measures to avoid and reduce impacts on resources have been identified and would be implemented.
3. Create mutually supporting economic and environmentally sustainable solutions.
   - The project will provide significant national and regional economic development benefits. Construction of the project is anticipated to support additional jobs and provide income for labor.
   - Overall, the proposed project reduces risk of flooding while balancing environmental impacts against levels of residual risk.
4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps which may impact human and natural environments.
   - The values of environmental sustainability are incorporated into the Nation's laws and mandates to governmental and private actors. The statute that provides a basis for evaluation of environmental impacts is the NEPA. The planning framework found in the Water Resources Council's Principles and Guidelines provides a guide for seeking sustainable solutions in civil works projects.
   - The proposed project incorporates a coordinated approach to the need for flood risk management while complying with environmental laws such as NEPA, the Clean Water Act, the Clean Air Act, the Fish and Wildlife Coordination Act, and the Endangered Species Act, among others. All applicable requirements will be met.
5. Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs.
   - The environment was considered in employing a risk management and systems approach. The formulation of alternatives considered designs and specific measures to avoid and minimize impacts on the surrounding environmental resources.
   - The Corps will continue to communicate impacts and residual risk to stakeholders and the public throughout the life cycle of the proposed project.

6. Leverage scientific, economic, and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.
    - The Corps must effectively utilize sources of expertise among other professional organizations, and other Federal, state, and local entities to address problems of regional and national significance. The Corps has utilized the scientific expertise within the agency, for example through coordination with the Corps' Planning Centers of Expertise for Flood Risk Management, and the expertise of numerous resource agencies. The efforts from this coordination was included during the assessment phase and plan formulation phase and will continue into future phases to include the most up-to-date knowledge available in support of a more sustainable project.
7. Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.
    - Throughout the study process, the Corps and the non-Federal sponsor have sought the views of individuals and groups on the best way to improve the flood risk management system. The Corps has actively sought involvement of engineers and other experts, members of the private sector, public interest groups, and Federal, Tribal, state, and local agencies, listening objectively to their input and concerns. For this study, the Corps and non-Federal sponsor incorporated public input through the scoping process and numerous other meetings. The Corps will continue to provide information to keep the public informed on the study. The Corps recognizes its obligation to promote the interests of the Nation by continuously engaging the public and stakeholders throughout the project delivery process. The Corps will continue to actively listen and respond to and incorporate public concerns.

8.6. Corps Campaign Plan and Strategic Plan

The Corps' "Campaign Plan Goal 2 to Transform Civil Works and the Sustainable Solutions to America's Water Resources Needs: Civil Works Strategic Plan 2014-2018" guided this study effort. The team worked diligently with all segments of our partners and stakeholders. By following the Corps' six-step plan formulation process, as well as the extensive review process, the Corps is delivering an enduring and essential solution that meets the Nation's needs under Goal 2, which seeks to "deliver enduring and essential water resources solutions through collaboration with partners and stakeholders." The proposed project was developed with an overarching integrated water resources management strategy, by focusing on water resources challenges and opportunities that reflect development and management of water, land, and related resources.

These Campaign Plan and Strategic Plan priorities are supported by the study and the Recommended Plan as described below:

- Established public involvement early in the study process with regular meetings and updates available for the public.
- Assured engineering, economic, and environmental sustainability of project over a 50-year period of analysis.

- Employed risk-based concepts in planning and conceptual design and will continue to do so during construction and O&M.
- Employed a continuous assessment of study policy issues through coordination with the Corps South Pacific Division and Headquarters, assessing and modifying operational behavior as needed.

8.7. Implementation Requirements

This section describes the future actions for authorization and construction of the recommended plan:

1. This IFR will be reviewed by the Headquarters of the U.S. Army Corps of Engineers (HQUSACE), Washington D.C.
2. The Chief of Engineers will seek formal review and comment on the IFR by the Governor of the State of Arizona and interested Federal agencies. The IFR will be circulated for a 30-day State and Agency review period.
3. Following State and Agency review, HQUSACE will prepare the report of the Chief of Engineers and will submit the report and the IFR to the Assistant Secretary of the Army for Civil Works (ASA[CW]), who will coordinate with the Office of Management and Budget (OMB) to obtain the relationship of the project to programs of the President.
4. The final report of the Chief of Engineers will then be submitted to Congress by the ASA(CW).
5. Congressional review and possible authorization of the project would follow.
6. Prior to authorization for project construction, the Chief of Engineers could include funds, where appropriate, in his budget requests for PED of the project.
7. Following receipt of funds and execution of a design agreement between the Department of the Army and the non-Federal sponsor, PED would be initiated, and surveys and detailed engineering designs would be accomplished.
8. Following Congressional authorization of the project and appropriation of construction funds, the Department of the Army and non-Federal Sponsor would enter into a project partnership agreement.
9. Construction of the project would be performed with Federal and non-Federal funds in accordance with the project partnership agreement.

8.8. Federal Responsibilities

The cost of the plan recommended in this report would be cost shared in accordance with Section 103 of the Water Resources and Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213), with a minimum non-Federal share of 35 percent, not to exceed 50 percent, of total project first costs. Responsibilities of the Federal Government for implementation of the project include:

- Sharing a percentage of the costs for PED, including preparation of the Plans and Specifications, which is cost shared at the same percentage that applies to construction of the project.
- Sharing a percentage of construction costs for the project.
- Administering contracts for construction and supervision of the project after authorization funding, and receipt of non-Federal assurances.

8.9. Non-Federal Responsibilities

Specific items of local cooperation are identified in Chapter 9.0, Recommendations.

8.10. Non-Federal Sponsor's Financial Capability

The non-Federal sponsor has committed to provide its share of total project costs, as well as all LERRD required for the project. The non-Federal sponsor has committed to performing all OMRR&R required for the project. The non-Federal sponsor has also made a commitment to undertake all necessary response and remediation for CERCLA contaminants required for the project, including providing lands free of soil contamination prior to construction of the project features on those lands and handling groundwater contamination during construction activities.

8.11. Project Partnership Agreement

Prior to advertisement for the first construction contract, a Project Partnership Agreement will be required to be signed by the Federal Government and the non-Federal sponsor, requiring formal assurances of local cooperation from non-Federal sponsor. This agreement will be prepared and negotiated during the Plans and Specifications Phase.

9.0 RECOMMENDATIONS

As District Engineer, I recommend that the plan described herein for flood risk management in the vicinity of the City of Winslow, Navajo County, Arizona, be authorized for implementation as a Federal project, with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable. The total first cost of the project is currently estimated at $77,202,000 using October 2017 price levels. The Federal share is currently estimated at $50,181,000.

My recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and State laws and policies, including Section 103 of the Water Resources and Development Act of 1986, as amended (33 U.S.C. § 2213), and in accordance with, and in accordance with the following requirements which the non-Federal sponsor must agree to prior to project implementation.

Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:
    1. Provide 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work;
    2. Provide, during construction, a cash contribution of funds equal to 5 percent of total project costs;
    3. Provide all lands, easements and rights-of-way, including those required for relocations, the borrowing of material and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction and O&M of the project;
    4. Provide, during construction, any additional funds necessary to make its total contribution equal to at least 35 percent of total project costs;
b. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;
c. Not less than once each year, inform affected interests of the extent of protection afforded by the project;
d. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;
e. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management

plan within 1 year after the date of signing a project cooperation agreement, and to implement such plan not later than 1 year after completion of construction of the project;

f. Publicize floodplain information in the area and provide this information to zoning and other regulatory agencies for use in adopting regulations, or taking other actions to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

g. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements and rights-of-way or the addition of facilities that may reduce the level of protection the project affords, hinder O&M of the project, or interfere with the project's proper function;

h. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements and rights-of-way required for construction and O&M of the project, including those necessary for relocations, borrowing of material or disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies and procedures in connection with said Act;

i. For so long as the project remains authorized, OMRR&R the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations, and any specific directions prescribed by the Federal Government;

j. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the NFS owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

k. Hold and save the U.S. free from all damages arising from the construction, OMRR&R of the project and any betterments, except for damages due to the fault or negligence of the U.S. or its contractors;

l. Keep and maintain books, records, documents or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after final accounting;

m. Comply with all applicable Federal and State laws and regulations, including but not limited to: Section 601 of the Civil Rights Act of 1964 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; the Age Discrimination Act of 1975 (42 U.S.C. 6102); the Rehabilitation Act of 1973, as amended (29 U.S.C. 794) and Army Regulation 6007 issued pursuant thereto; and 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (labor standards originally enacted as the Davis-Bacon Act, the Contract Work Hours and Safety Standards Act, and the Copeland Anti-Kickback Act);

n. Perform, or ensure performance of, any investigations that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on or under lands, easements or rights-of-way that the Federal Government determines to be required for construction and O&M of the project. However, for lands that the Federal Government

determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the NFS with prior specific written direction, in which case the NFS shall perform such investigations in accordance with such written direction;

o. Assume, as between the Federal Government and the NFS, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on or under lands, easements or rights-of-way that the Federal Government determines to be required for construction and O&M of the project;

p. Agree, as between the Federal Government and the NFS, that the NFS shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, OMRR&R the project in a manner that will not cause liability to arise under CERCLA; and

q. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99- 662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project , or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

The plans presented herein are recommended with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the non-Federal sponsors, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Kirk E. Gibbs
Colonel, U.S. Army
Commander and District Engineer

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10.0 LIST OF PREPARERS

Table 10-1 Primary PDT Members

Name of Preparer	Position/Discipline
Adam Bier	Civil Engineer (Hydraulics)
Tiffany Bostwick	Supervisory Biologist
Steve Brown	Civil Engineer (Soils & Materials)
William Brown	Realty Specialist
Kirk Brus	Physical Scientist/Environmental Coordinator
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