US Army Corps
of Engineers
Los Angeles District

Little Colorado River at Winslow, Navajo County, Arizona

Flood Risk Management Feasibility Study

APPENDIX C

Economic Appendix

October 2018

US Army Corps
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EXECUTIVE SUMMARY

This feasibility report presents the benefits and costs of flood risk-management alternatives for the Little Colorado River at Winslow, Navajo County, Arizona study area. Benefits for each alternative are calculated as the difference in expected flood damages with the alternative in place relative to damages expected to occur without any federal implementation project. This report evaluates the without project condition, also known as the no-action plan or base condition, as well as the benefits and costs of proposed alternatives.

The initial evaluation of without project damages and benefits for alternatives was conducted in fiscal year (FY) 2014 at FY 2014 price levels and a discount rate of 3.5%. These results are summarized below.

Without project condition analysis results are shown in Table 1 below. The table shows the without project condition Expected Annual Damages (EAD) from flooding in the Winslow area. Total EAD are approximately $10 million. Of the $10 million, 75% is attributed to structure and content damages.

Table 1: Without Project Expected Annual Damages ($1,000)
FY 2014 Price Levels

CATEGORY	EAD	PERCENTAGE
Structure & Content	7,693	75%
Automobile Damages	579	6%
Clean-Up	1,066	10%
Displacement Costs	728	7%
Land	163	2%
Total	10,230	100%

Table 2 summarizes the National Economic Development (NED) benefits and costs of proposed flood risk management alternatives.

Table 2: NED Benefits and Costs of Proposed Flood Risk Management 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

The benefit/cost analysis results showed that Alternative 10 has the greatest net NED benefits. Note that Alternatives 1.1, 3.1, 8, and 10 are all based upon the same design standard to achieve an approximately 90% level of assurance of containing the 1% (100-year) event[1]. This was done for comparability purposes to identify the optimal levee alignment/plan. Table 3 below displays the results of the incremental analysis of separable features of Alternative 10. The table illustrates that the structural improvements in Reach 1 are well justified from an economic perspective, with net benefits exceeding $5.35 million. However, the second increment featuring the non-structural measure of elevating floodplain

[1] Alternatives 7 is a nonstructural alternative comprised of elevating floodplain structures north of Interstate 40 above the 1% ACE (100 year) water surface elevation. This alternative does not include levee improvements which would reduce the probability of flooding to downtown Winslow. Alternative 9 also includes these structure raises, as well as rebuilding the eastern end of the Ruby Wash Division levee, which would reduce the risk of flooding to downtown Winslow up to approximately the 2.8% ACE (36-year) event. Levee improvements under Alternatives 1.1, 3.1, 8 and 10 were based upon a levee height corresponding to an approximately 90% assurance of containing the 1% ACE event.

structures in Reach 2 produces a negative net benefit of $132,000 and a benefit cost ratio of only 0.29. Therefore, the Recommended Plan does not include improvements for Reach 2.

Table 3: Incremental Analysis of Alternative 10
FY 2014 Price Levels

Category	Structural (Reach 1)	Non-Structural (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 Cost	$2,901,000	$187,000
Average Annual Benefits	$8,250,000	$55,000
Net Benefits	$5,349,000	-$132,000
Benefit/Cost Ratio	2.84	0.29

An optimization analysis was conducted to determine the scale of Alternative 10 which maximizes net benefits (see Table 4). This analysis showed increasing net benefits for successively larger scales, with Alternative 10.4 having the greatest net benefits (note that the scale of Alternative 10.1 is between Alternatives 10.3 and 10.4). However, it is possible that an even larger scale plan could be the NED Plan.

The non-Federal Sponsor 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 in accordance with USACE regulations and policies. 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 were not formulated to identify the NED Plan, and Alternative 10.1 was identified as the Recommended Plan. Net benefits for the Recommended Plan were estimated at $5.35 million while the benefit to cost ratio was estimated at 2.84.

Table 4: Optimization of Alternative 10
FY 2014 Price Levels

Category	Alt 10.1 1% ACE	Alt 10.2 4% ACE	Alt 10.3 2% ACE	Alt 10.4 0.5% ACE
First Cost	$59,905,000	$39,260,000	$59,356,000	$68,576,000
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

Updated Benefit/Cost Analysis Results for Recommended Plan

Benefits for the Recommended Plan were updated to reflect FY 2018 (October 2017) price levels and the current Federal discount rate of 2.75%. The results of the updated analysis are shown in Table 5 below. Note that the benefits shown in Table 5 do not include the category of reduced displacement costs, which are included in Tables 1-4 above and account for the reduction in the costs floodplain residents incur for temporary relocation and housing after flooding events. These impacts are more appropriately categorized as Other Social Effects (OSE), and should not be included in the NED

benefit/cost analysis as they result in a double counting of NED benefits if they are included. These benefits did not impact plan selection.

Table 5: Expected Annual Damages & Benefits – Recommended Plan ($1,000s)
October 2017 Price Levels

	Without Project	With Project	Benefits
STRUCTURE &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 below.

Table 6: Average Annual Costs – Recommended Plan ($1,000s)
October 2017 Price Levels

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 7 below shows the results of the benefit/cost analysis for the Recommended Plan. As shown below, the Recommended Plan is economically justified with a benefit/cost ratio of 2.70.

Table 7: Benefit/Cost Analysis Results – Recommended Plan ($1,000s)
October 2017 Price Levels

Category	$1,000s)
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.

1.0 BACKGROUND

The City of Winslow, located in northeastern Arizona, has a long history of flooding along the Little Colorado River (LCR) and its tributaries. As shown on Figure 1, (page 6), the LCR is located on the eastern border of the City. In 1979, Navajo County requested assistance from the Arizona Department of Water Resources (ADWR) to build the Winslow Levee. After completing the necessary engineering and securing needed funding and right of way, the 7.2 mile Winslow Levee was constructed along the west side of the LCR between 1986 and 1989. The Winslow Levee was designed to contain the "100-year flood", or the flood which has 1% Annual Chance of Exceedance (ACE) in any given year. At the time of the levee's construction this equated to a design discharge of 65,000 cubic feet per second (cfs). However, hydrologic analysis completed by the US Army Corps of Engineers in 2010 shows the 100-year discharge near the City of Winslow to be approximately 69,200 cfs. The levee's alignment begins at the confluence of Ruby Wash Diversion Levee and flows north to the end of the study area which is approximately one mile past the Winslow Waste Water Treatment Plant.

Four years after completion of the levee, on January 8, 1993, it was overtopped by a flood event with an estimated peak discharge between 57,000 cfs and 75,000 cfs. As a result, a 3,000 foot section of levee was damaged, including a 400 foot section that was washed out entirely. Properties in the Ames Acres and Bushman Acres housing developments, as well as other areas behind the levee were flooded. Of the 204 structures inundated by this event, 140 of them sustained substantial damages. By 1994, temporary repairs were completed using Federal Emergency Management Agency (FEMA), state, and county funds. Current FEMA estimates suggest that this levee provides protection from storms with a 1 in 50 chance of occurring in any given year (2% ACE). A levee failure similar to the one experienced in 1993 would be more damaging today, as it would threaten additional structures. The Winslow Levee does not meet FEMA certification requirements.

On December 31, 2003, the levee experienced a piping failure at well below the 1% ACE water surface elevation. Fortunately, an alert citizen reported the impending levee failure and Navajo County responded immediately. Catastrophic failure was avoided by depositing material on the river side of the levee. Permanent repairs matching the original design were completed in 2005.

In addition to the Winslow Levee, several other levee structures located along Ruby Wash further contribute to the current level of flood damage reduction in the City of Winslow. They consist of the Ruby Wash Diversion Levee (RWDL) and the Ruby Wash Levee (RWL). The US Army Corps of Engineers (USACE) designed and constructed the RWDL. This levee is a rock and earth structure extending 5.3 miles from the high ground near the southwest corner of the Winslow airport to the LCR south of the Burlington Northern Santa Fe Railway Bridge east of Winslow. The construction of the levee was completed in 1970. Flows from Ruby Wash are diverted east to the LCR, reducing flood hazards along RWDL. The RWDL provides flood damage reduction benefits to the Winslow Airport and approximately 500 residents. The RWL was constructed by the Arizona Department of Transportation in 1980 as part of the Interstate 40 at Winslow Project. The RWL channel extends from 3rd Street to Interstate 40. Due to the flat terrain along the channel alignment, the channel was constructed using a small amount of excavation below the existing ground surface. The majority of the levee construction was accomplished by creating embankments of compacted earth above the natural ground elevation to form the channel banks.

The history of flooding along the LCR at Winslow led 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 under seepage that occurred during events with a greater than 1% chance of occurrence in any given year. The levee does not meet FEMA requirements of containing the 1% ACE event because of its insufficient capacity and levee fragility. Navajo County and the USACE have worked together to address problems and opportunities associated with existing flood risks in the Winslow area for this Feasibility Study.

2.0 PURPOSE

This appendix provides an economic evaluation of alternatives formulated to reduce flooding problems associated with the LCR and its tributaries. The benefits associated with each alternative analyzed in the appendix are computed by comparing the flood damages that would be expected to occur with and without federal involvement in a flood risk mitigation project. The condition without federal involvement in a flood risk management plan that each alternative is compared against is known as the without project, or no federal action plan. The benefits associated with each alternative are further compared against its costs. The alternative that reasonably maximizes net benefits is identified as the National Economic Development (NED) plan. Generally the NED Plan is the plan recommended for implementation, unless there is a Locally Preferred Plan desired by the non-Federal sponsor, or (as applies for this Feasibility Study) because the non-Federal sponsor desires a plan with lower net NED benefits than larger scale plans which were evaluated and criteria are met for a Categorical Exemption from identifying the NED plan (as will be discussed later in this appendix). The purpose of this appendix it to present this analysis and identification of the benefits and costs of the Recommended Plan.

3.0 METHODOLOGY

This economic analysis has been completed in accordance with standards, procedures and guidance of the US Army Corps of Engineers (USACE). The Planning Guidance Notebook—ER 1105-2-100, April 2000—serves as the primary source of evaluation methods of flood damage reduction studies and is used extensively for the purpose of this analysis. Additional guidance for risk-based analysis is obtained from EM 1110-2-1619, Engineering and Design—Risk Based Analysis for Flood Damage Reduction Studies, August 1996, and ER 1105-2-101, Planning Risk Based Analysis of Hydrology/Hydraulics, Geotechnical Stability and Economics in Flood Damage Reduction Studies, January 2006. The analysis is performed using a base year of 2026 and 50 year period of analysis. For the evaluation and comparison of plans which supported identification of the Recommended Plan, damages, benefits and costs are presented at fiscal year (FY) 2014 price levels and the FY 14 discount rate of 3.5 percent. Detailed evaluation of the Recommended Plan is presented at FY 2018 (October 2017) price levels and the FY 18 federal discount rate of 2.75%.

4.0 STUDY AREA

The City (most of which is susceptible to flooding from significant flood events) is located on the western border of Navajo County, Arizona about 58 miles east of Flagstaff. It is a typical railroad town that developed along major transportation corridors as a stopping point for travelers and the shipment of goods. The main transportation corridors are Interstate 40 and the Burlington Northern Santa Fe Railway. Today these transportation corridors continue to provide goods and access to those who come to visit the attractions found within Navajo and other nearby counties. Appendix A lists the attractions within a day's drive from the City of Winslow. Appendix B lists local attractions found within the City of Winslow boundary.

Figure 1: The City of Winslow Study Area Map

4.1 City of Winslow

The City of Winslow is located in Navajo County along the Interstate 40 corridor. It encompasses a municipal area of about 12.5 square miles, spanning both sides of the Interstate 40. Along the eastern border of the city lies the LCR which flows generally to the north through the study area. The tributaries of Ruby Wash, Clear Creek, and Cottonwood Wash join the LCR mainstem at the southern end of the study area. As noted in Section 1.0 Background, several levees have been constructed within the study area to reduce flood risk. They include the Winslow Levee, RWDL, and the RWL. The overall terrain is generally flat with a gradual downward slope from the east and west toward the LCR. The LCR flows through the study area in a northerly direction. Vistas, hills and mesas exist to the north and south of the city. All of the local roads follow this general terrain and form a grid pattern throughout the city. These roads also mark differences in zoned land uses in the area.

4.2 Land Use

Major zoned land uses are categorized and described in detail below. In the City of Winslow General Plan adopted in 2002, the document breaks downs the City into the four-zoned land use types and describes the notable structures within each category. These details provide local planning organizations with the information needed to address the community's current and future needs. It also serves as a base framework for future development opportunities.

4.2.1 Residential

The City of Winslow's residential development is primarily single-family homes. A few apartments and condominiums, all of which are less than three stories, are among the multi-family residential structures located near the historic downtown area of Winslow. Most of the single family residences are basic ranch style homes with a single floor and wood construction.

Although there is relatively little variation in residential structure construction characteristics, described in the paragraph above, there is a high amount of variation in residential lot sizes found throughout the floodplain. Larger lots and low density residential land uses are generally located in the municipal edge of town outside the city limits. Low density residential land use accommodates complementary development such as schools, public facilities, churches, and some commercial establishments. Medium density residential land uses are usually smaller single-family detached and/or attached dwelling units. They are built as cluster developments that could include larger open spaces with potential recreation opportunities. This category occurs in close proximity to commercial uses and major streets or highways.

4.2.2 Commercial

Business establishments in Winslow can be found in historic downtown Winslow or the North Park Commercial Plaza located along the North Park Drive Interchange. In historic downtown Winslow, located in the gridded area near Highway 87 in Figure 1 above, smaller business such as quaint shops, restaurants, hotels, and offices are found. Some of the key establishments include: La Posada, Seattle Grind, Whistle Stop, and a newly renovated Rialto Theater. The North Park Commercial Plaza has grocery stores, a Super Walmart, lodging, an auto/truck service center, restaurants, and retail establishments. These facilities serve the newer subdivisions in Winslow and travelers passing through the town.

4.2.3 Industrial

Winslow's industrial area is oriented around the Municipal Airport Industrial Park, located south of Winslow between the railroad line and RWDL. There are smaller industrial areas between Route 66 and the railroad line west of downtown and north of Interstate 40 bounded by the city limits on the east and a drainage channel in rough alignment with Oak Road on the north. A wastewater treatment plant is also located north of the City of Winslow halfway between North Park Commercial Plaza and Ames Acres.

4.2.4 Transportation

The Burlington Northern Santa Fe (BNSF) and Amtrak railway runs though the southern end of the City of Winslow. The BNSF railway is a major transportation corridor for cargo transported from Los Angeles and Long Beach, California ports to the mid-west. Amtrak is also major source of transportation for visitors to Winslow and for those passing through.

The Interstate 40 highway spans the Study Area and runs along northern side of downtown Winslow. It serves as major transportation corridor for those living in the City of Winslow and for those traveling through the City to destinations to the east and west.

4.2.5 Public Facilities

The City of Winslow public facilities include picnic areas and parks, cultural, educational, medical, and library facilities. The picnic areas and parks listed in Table 8 are all located either in or near Winslow. While they do not include significant structures included in flood damage calculations they are an important part of the community because they enhance the quality of life, help promote tourism, and provide recreational opportunities for residents and visitors.

Table 8: Local Picnic Areas and Parks

NAME	LOCATION
9/11 Memorial	East Route 66/ Transcon Lane
Bulldog Plaza	North Park Drive/Cherry Street
Clear Creek Reservoir	Highway 99 Add (4.3 miles SSE)
East End Park	East Route 66
Father Seramur Park	Central Street/Francis Avenue
First Street Linear Park and Pedestrian/Bicycle Path	First Street/Kinsley Avenue to Hicks Avenue
Hubbell Trading Post Ground and Performance Area	Second Street/ Campbell Avenue
Little Painted Desert County Park	15 Miles East of Winslow
McHood Park	Highway 99, AZ (4.3 miles SSE)
Ruby Channel—Multipurpose Ball Field	Oak Street/Interstate–40
Southside Park	Jefferson Street/ Virginia Avenue
Standin' on the Corner Park/ Route 66 Plaza	Second Street/ Kinsley Avenue
Triangle Park	Fleming Street/Elm Street
Winslow City Park	Cherry Street/ Colorado Avenue

Winslow's cultural facilities include two museums, the Rialto Theater and the Arizona State Park in close proximity to the city. The Old Trails Museum and the Hubbell Trading Post building serve as resources regarding the history of settlement activity and Native American history and crafts. The Rialto Theater is a newly restored theater used for cinema and theatrical productions. Also, an historic home is being restored. It will become the Canyon Rose Quilt Company. Finally, Homolovi State Park on North Highway 87 is a culturally significant historical and archaeological resource.

Educational facilities in Winslow include Northland Pioneer College at the post-secondary level. The city population is served by Winslow High School and Winslow Junior High School. There are three elementary schools for area students (Washington School, Jefferson School, Bonnie Brennan School). In addition, Northern Arizona Academy of Career Development, a charter school for grades nine through twelve, has a campus in Winslow and is accredited by the Northern Central Association.

The medical needs of Winslow residents are provided for by Winslow Memorial Hospital, and five medical clinics: North Community Health Care, Winslow Medical Clinic, Winslow Memorial Hospital Physician's Clinic, Winslow Indian Health Services and Lee Medical Clinic.

A new Winslow Public Library is planned to expand the City's services and collections of more than 30,000 volumes and have outgrown the 9,500 square foot library building. Winslow public facilities also include police, fire, emergency, and medical services as well as a municipal airport.

Of all the land uses listed, key critical infrastructure includes: police, fire, emergency, and medical facilities, the municipal airport, Interstate Highway 40, the BNSF and Amtrak rail corridor, the WWTP, and Homolovi State Park.

4.3 Demographics

The population of Winslow has only grown by about 4.4% since 1990. The socioeconomic demographics of this population and the Navajo County as a whole are discussed in the section below.

4.3.1 Population

The City of Winslow is the second most populous incorporated community in Navajo County, Arizona. In 1990, the City of Winslow population was 9,343. This population figure increased 2.2% to 9,544 by 2000, and another 1.2% to 9,655 by 2010. Based upon projections from the Arizona Office of Economic Opportunity, population is not projected to increase in Winslow over the period of analysis. A summary of the population figures and projections are shown in Table 9.

Table 9: Population of Incorporated Communities in Navajo County

CITY/TOWN POPULATION	1990	2000	2010	2016	2050
Holbrook	4,770	4,974	5,053	5,074	5,579
Pinetop Lakeside	2,480	3,561	4,282	4,378	5,338
Show Low	5,093	8,021	10,660	11,096	15,632
Snowflake	3,737	4,462	5,590	5,764	7,509
Taylor	2,409	3,242	4,112	4,217	5,703
Winslow	9,343	9,544	9,655	9,754	8,981
Total	27,832	33,804	39,352	40,283	48,742

Population within incorporated cities and towns make up approximately 34% of the entire Navajo County population. Unincorporated communities make up another approximately 20% and Native American reservations make up another 46% of the county's total population.

Table 10: Navajo County Population Distribution, 2000

Category	Percent
Incorporated Cities and Towns	34
Unincorporated Area	20
Indian Reservations	46
Total	100

See Table 11 for Navajo County population figures and projections.

Table 11: Navajo County Population

County Population	1990	2000	2010	2050
Navajo County	77,658	97,470	107,449	119,505

Tables 9 and 11 illustrate that the City of Winslow population growth has been minimal and significantly lower than the county as whole. Between 1990 and 2000 the Navajo County population grew by more than 25%. Between 2000 and 2010 county population growth slowed, with an increase of about 10.2%. Looking forward, county population is only projected to increase by about 11.2% from the 2010 level by 2050, while Winslow population is not anticipated to grow based upon State of Arizona projections.

4.3.2 Employment

Four primary areas of employment in the City of Winslow are 1) government, 2) trade and transportation, 3) professional and business services, and 4) educational and health services. Winslow is also impacted by the influx of visitors traveling to or through Winslow seasonally, which bolsters employment demand during these periods. Sources of employment in the governmental sector include Arizona Department of Transportation, Arizona State Department of Corrections, City of Winslow, Leupp School, Navajo County Government, Northland Pioneer College, and Winslow Unified School District. Trade and transportation sector employers include, the Burlington Northern Santa Fe Railway, Apache Railway, and AMTRAK. Professional and business services include Bashas' Cake, Chevrolet, Chrysler, Dodge, Jeep Nissan, Denny's, Flying J Truck Stop, McDonalds, Safeway, Taco Bell/Long John Silver, Walmart, and Winslow Ford. Educational and health services employees include: the Northern Arizona Academy for Career Development, Tolani Lake Elementary School, Bonnie Brennan School, Jefferson Elementary School, Washington School, Winslow High School, Winslow Junior High School, and Northland Pioneer College. Medical services are provided by Action Medical Service, the Little Colorado Medical Center and Winslow Indian Healthcare Center.

4.3.3 Employment and Income

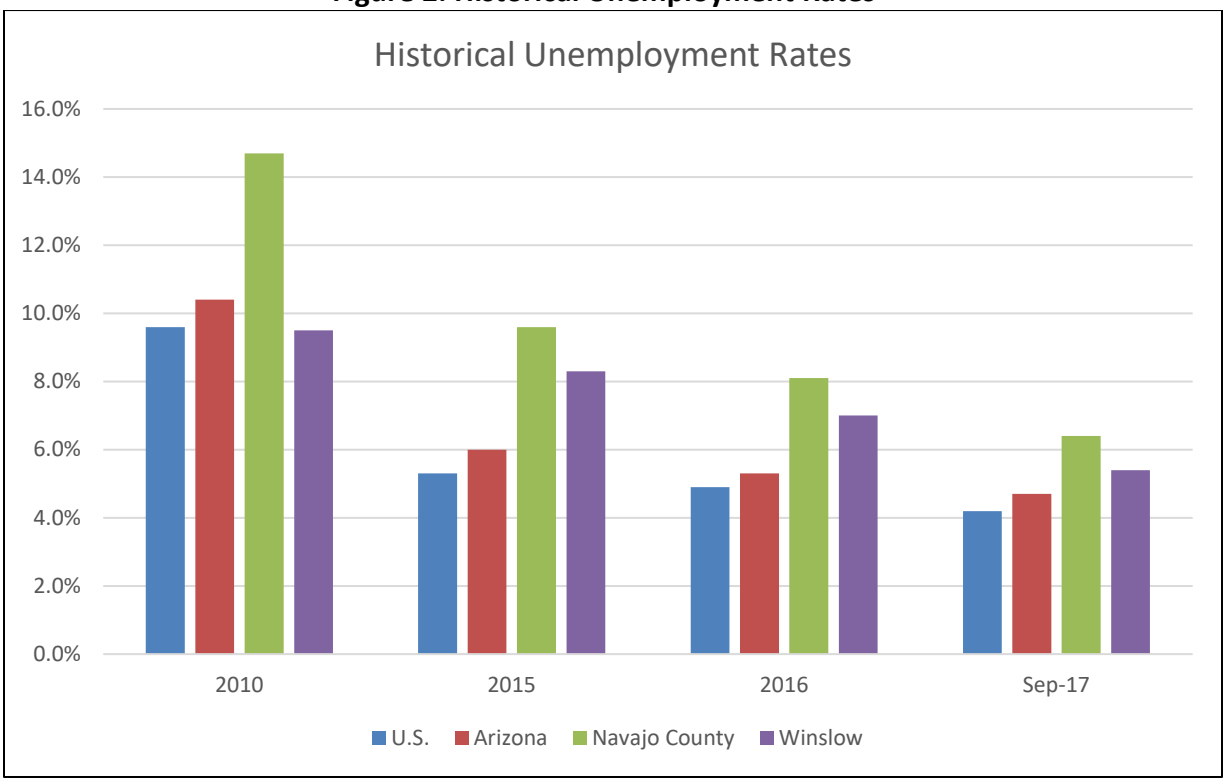
Table 12 and Figure 2 display labor force and employment data for the Study Area. As shown, unemployment rates have been steadily declining in Navajo County and Winslow, tracking the national decline since the Great Recession. Winslow's unemployment rate has remained below county averages, but has been somewhat higher than state and national rates.

Table 12: City of Winslow and Navajo County Labor Force Data (2016)

AREA NAME	LABOR FORCE	EMPLOYMENT	UNEMPLOYMENT	
			Number	Rate (%)
Winslow	3,506	3,262	244	7.0
Navajo County	41,331	37,967	3,364	8.1

Sources: Arizona Commerce Authority & U.S. Bureau of Labor Statistics

Figure 2: Historical Unemployment Rates



Sources: State of Arizona, Office of Economic Opportunity & Office of Employment and Population Statistics

Table 13 below summarizes income data for the City of Winslow, Navajo County and the State of Arizona. As shown below, Winslow's median family income is significantly lower than levels for the county and state, while the percentage of the population living below the poverty level is much higher at nearly one-third.

Table 13: City of Winslow and Navajo County Annual Income Data

	Arizona	Navajo County	Winslow
Median Family Income	$59,480	$42,673	$34,231
Less than $10,000	6%	12%	21%
$10,000-$25,000	12%	18%	20%
$25,000-$50,000	24%	26%	22%
$50,000-$75,000	20%	20%	13%
$75,000-$100,000	14%	10%	12%
Greater than $100,000	25%	13%	13%
Below Poverty Level	13%	25%	32%

Source: U.S. Census (2015)

4.3.4 Race/Ethnicity

Table 14 provides a summary of race and ethnicity for Navajo County and the City of Winslow. Racial composition in the study area is primarily white and American Indian. The Hispanic population in Winslow

is substantial at 39%, and represents a significantly greater proportion of total population than for Navajo County.

Table 14: Race/Ethnic Composition

Race	Navajo County	Winslow
2 or More Races	3%	6%
White	48%	43%
Black or African American	1%	5%
American Indian	44%	28%
Asian	1%	0%
Other Race	3%	19%
Total	100%	100%
Hispanic	11%	39%
Non-Hispanic	89%	61%

Source: U.S. Census (2015)

5.0 WITHOUT-PROJECT CONDITION

The economic analysis for this feasibility study evaluates the benefits and costs of flood risk management alternatives for the LCR at Winslow study area. Benefits for each alternative are calculated as the difference in expected flood damages with the alternative in place relative to damages expected to occur without any federal implementation project. The without project condition, also known as the no action plan or base condition, is the plan against which all alternatives are compared. Because the potential benefits for alternatives can vary significantly based upon changes in without project results, it is imperative that the necessary time and effort be devoted to develop the without project condition assumptions that are reasonable, supportable, and reflective of the best available information.

The process of estimating the without project condition starts with an examination of the project objectives, constraints, problems, and opportunities. The following describes the overall objectives of the study while the problems and opportunities are described as solutions that can be addressed through water and related land resource management.

5.1 National Federal Objective

The Federal objective in water resources planning is to contribute to the National Economic Development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders and other planning requirements.

Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units.

5.2 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.

In addition to the above, the non-federal sponsor's goal is to provide a levee system that is capable of being accredited by FEMA for the 1% annual chance of exceedance (ACE), or 100-year, flood event.

5.3 Problems and Opportunities

Problems and opportunities identified in the main report are categorized below.

5.3.1 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 are subject 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 under-seepage 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.

5.3.2 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.

Passive recreation opportunities were considered, but were not carried forward as a planning objective because the existing/proposed levee alignments cross private property and are more than a mile from the central core of Winslow.

5.4 Flood Risk Analysis

A Risk-Based Analysis (RBA) procedure was used to evaluate without-project flood damages in the study area. Guidance for conducting RBA is included in Corps Engineering Regulation 1105-2-101, *Risk-Based Analysis for Flood Damage Reduction Studies (3 January 2006)* and Engineering Manual EM 1110-2-1619 *Engineering & Design – Risk Based Analysis for Flood Damage Reduction Studies (1 August 1996)*.

The guidance specifies that the derivation of expected annual flood damage must take into account the uncertainty in hydrologic, hydraulic and economic factors. Risk and uncertainty are intrinsic in water resource planning and design. They arise from measurement errors and the inherent variability of complex physical, social, and economic situations. Best estimates of key variables, factors, parameters and data components are developed, but are often based on short periods of record, small sample sizes, measurements subject to error, and innate residual variability in estimating methods. RBA explicitly analytically incorporates these uncertainties by defining key variables in terms of probability distributions, rather than single-point estimates. The focus of RBA is to concentrate on the uncertainties of variables having the largest impact on study conclusions.

The Corps of Engineers Hydrologic Engineering Center has developed software specifically designed for conducting RBA. This software is referred to as the HEC-FDA Program (Version 1.2.5), which was certified by the Flood Risk Management Planning Center of Expertise[2]. This program applies a Monte Carlo simulation process, whereby the expected value of damages is determined explicitly through a numerical integration technique accounting for uncertainty in basic parameters. Data requirements for the program include:

1. Configuration Information: This information is input directly into the program and includes streams, damage reaches, analysis years, and plan definition. Damage reaches are defined by upstream and downstream cross-section. The reaches for this study were identified to represent homogeneous hydraulic and economic characteristics. Analysis years apply when future development is taken into account and is represented as a future year of build out. Finally plan definition identifies whether the plan is under the without-project condition or a plan or plans represented by the analysis of alternatives.
2. Hydrology and Hydraulic Engineering: Hydrologic and Hydraulic data include water surface profiles, exceedance probability functions or probability-discharge relationships, stage discharge relationships, and levee failure parameters. For this study, water surface profiles were developed using the HEC-RAS program. The

2 The current certified version of HEC-FDA is 1.4.2. This study meets the requirements for an exemption from transitioning to the current version since the Tentatively Selected Plan milestone for the study was held prior to 30 November 2015.

profiles are imported into the HEC-FDA program. Uncertainty in exceedance probability functions, stage discharge functions and geotechnical functions are also input into the program. These engineering uncertainties will be described in more detail later in this section.

3. Economics: An economic database is typically prepared in Microsoft Excel according to specific guidelines outlined in the HEC-FDA manual and imported as a text (tab delimited file). Included in the Excel file are a number of attributes about structures including the Assessor's Parcel Number (APN), structure category, stream location, ground and/or first floor elevation, and structure and content values. This data was collected through assessor's data, field surveys, and GIS-based analyses, entered into Excel spreadsheets and imported into the HEC-FDA program. Other parameters specified in the importable Excel file are the depth damage functions. Functions for residential structures were obtained from the Institute of Water Resources. Non-residential functions were obtained from USACE's Sacramento District Report: *Analysis of Nonresidential Content to Structure Ratios and Depth Damage Functions for Flood Damage Reduction Studies (Oct 2009).*

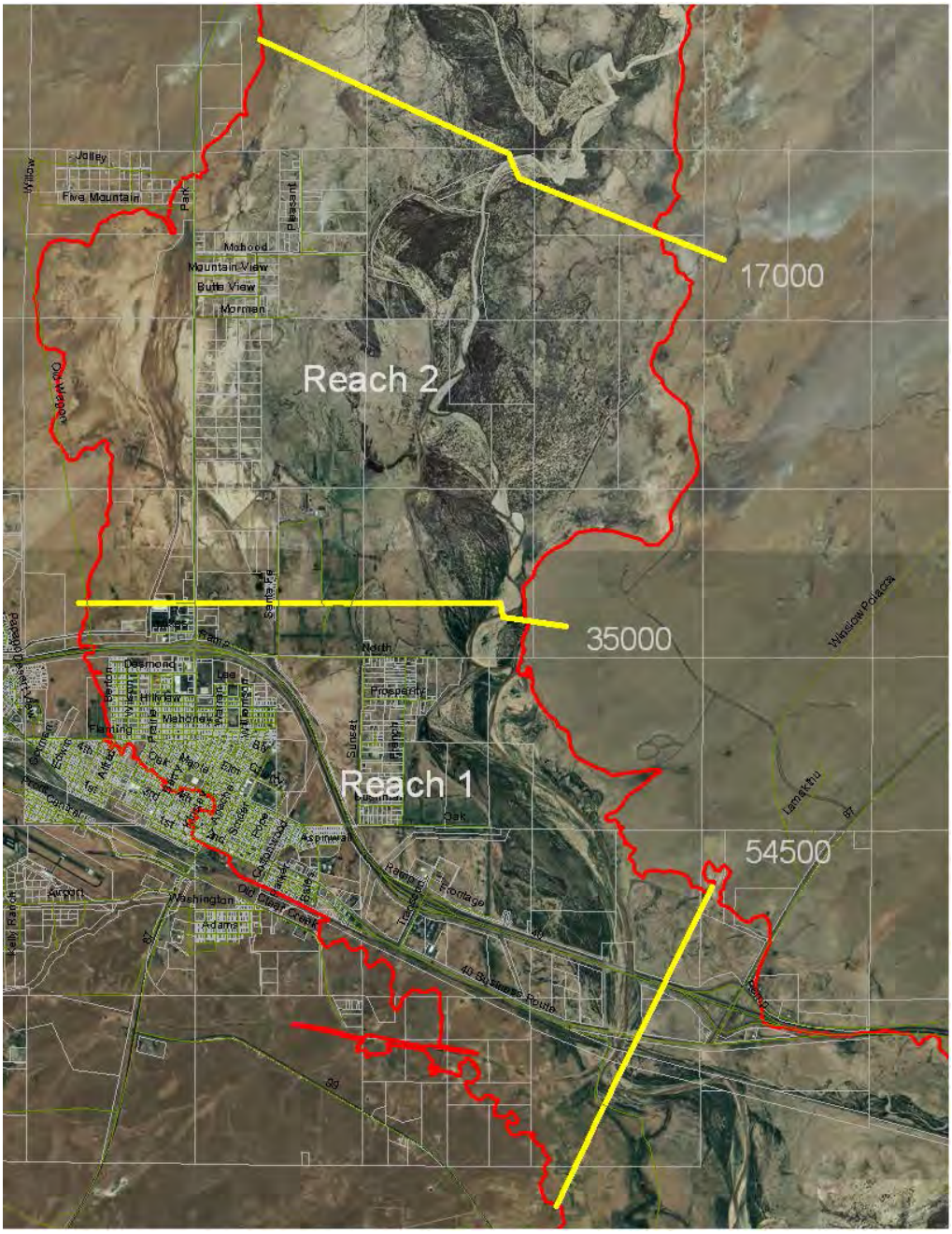
5.4.1 Configuration Information

The stream identified for this study is the LCR located along the eastern side of the City of Winslow, in Navajo County, Arizona. Damages and costs are presented at FY 2014 price levels, with a base year of 2026. Future population growth and changes in existing land uses were evaluated to determine if these changes will significantly impact hydrologic and hydraulic flooding characteristic/risks in the study area. This evaluation concluded that future population growth and development within the watershed is minimal and would have an insignificant impact on flooding characteristics since size of the area that would be developed is very small in comparison to the Winslow drainage basin (16,192 square miles). As a result future conditions are assumed to be the same as base year conditions for this analysis. Economics, hydrology, and hydraulics study team members participated in the segmenting of the Winslow study area into distinct reaches of homogenous land based flooding characteristics. Critical factors for differentiation included: discharge/frequency characteristics, overflow topographic characteristics, and economic activity. From an economic standpoint, the delimitation between Reach 1 and Reach 2 was a natural separation. Reach 1 includes the majority of the City of Winslow located south of Interstate 40. Reach 2, the next reach increment, includes the rest of the structures north of Interstate 40. These structures north of Interstate 40 are less densely developed and separate from downtown Winslow. Of the two reaches, Reach 1 is more susceptible to flooding from RW, RWDL, and LCR and therefore the damage potential is greater than Reach 2. Table 15 provides a summary of reach delineations, including index points and beginning, ending and representative cross sections. Figure 3 shows the location of these reaches on a map. The red line in Figure 3 represents the delimitation of the 0.2% ACE (e.g. 500 year) floodplain.

Table 15: Reach Location & Index Points

REACH	LOCATION	CROSS-SECTIONS	INDEX POINT
Reach 1	Lower Floodplain	35000-54500	53500
Reach 2	Upper Floodplain	17000-35000	29000

Figure 3: Map of 500 Floodplain and Reach Delineations



5.4.2 Hydrology and Hydraulic Engineering

The following are the primary sources of hydrologic and hydraulic uncertainty for flood damage analysis studies:

1. Exceedance Probability Function (Discharge/Probability Relationship): For a flood or storm event with a given probability of occurrence, there is uncertainty regarding what the resulting discharge will be at a specific location along the stream or river. The reliability of discharge/probability estimates is directly linked to the historical record of stream gauge data available. In cases where records are small or incomplete, the associated uncertainty increases. To address this uncertainty, an analytical or graphical method is typically used to determine statistical distributions of discharge for a range of probabilities at locations throughout the floodplain.

   For this study, discharge/probability uncertainty has been estimated for each reach using the graphical method, based upon an equivalent record length of 61 years.

2. Stage/Discharge: For a given discharge, there is uncertainty regarding what the resulting water surface elevation will be at a given location. Factors contributing to this uncertainty include bed forms, water temperatures, debris or other obstructions, unsteady flow effects, variation in hydraulic roughness with season, sediment transport, channel scour or deposition, changes in channel shape during or as a result of flood events, as well as other factors. To address this uncertainty, standard deviation estimates are developed for stages associated with a range of discharges at locations throughout the floodplain.

   For this study, the standard deviations of error for stages associated with a range of discharges were provided for each reach by Engineering Division. The error values generally increase in value from about .10 feet for the 99% ACE event up to about .95 feet for the 1% to .2% ACE events.

Table 16: Stage Discharge Function (Reach 1)

PROBABILITY	Q (CFS)	STAGE	UTILIZED STANDARD DEVIATION (ft)
99%	0	4848.31	.10
50%	8,070	4856.93	.11
20%	16,360	4859.98	.22
10%	24,400	4862.00	.33
4%	38,310	4864.49	.53
2%	52,020	4867.88	.71
1%	69,200	4871.66	.95
.5%	90,660	4872.65	.95
.2%	127,250	4873.18	.95

Table 17: Stage Discharge Function (Reach 2)

PROBABILITY	Q (CFS)	STAGE	UTILIZED STANDARD DEVIATION (FT)
99%	0	4832.06	.12
50%	8,070	4840.57	.13
20%	16,360	4842.41	.26
10%	24,400	4843.47	.38
4%	38,310	4844.90	.60
2%	52,020	4846.07	.82
1%	69,200	4847.33	1.09
.5%	90,660	4848.71	1.09
.2%	127,250	4850.57	1.09
~.1%	168,700	4852.60	1.09

3. Levee Exterior-Interior Relationship: The exterior-interior relationship establishes the differences between water surface stages on the river or exterior side of the levee versus stages in the floodplain or interior side of the levee. This relationship must be defined if the stage in the interior will not reach the same stage that overtops the levee. This may be due to floods that result in stages near the top of the levee overtopping as designed in a safe, controlled manner, or a flood hydrograph volume not sufficient to fill the floodplain to the stage equal to the top of the levee. In either case the relationship must be developed from hydrologic or hydraulic analysis external to the FDA program. If the relationship is not specified, the assumption is that the floodplain fills to the stage in the river (represented by the exterior stage-discharge function for the reach) for all events that result in stages that cause levee failure or are above the top of levee.

Table 18: Exterior/Interior Function (Reach 1)

ACE	EXTERIOR STAGE	INTERIOR STAGE
50.0%	4856.93	4855.46
20.0%	4859.98	4855.56
10.0%	4862.00	4861.97
4.0%	4864.49	4863.43
2.5%	4866.54	4866.30
1.0%	4871.66	4867.75
.5%	4872.65	4869.18
.2%	4873.18	4870.39

Table 19: Exterior/Interior Function (Reach 2)

ACE	EXTERIOR STAGE	INTERIOR STAGE
50.0%	4840.57	4831.57
20.0%	4842.41	4836.28
10.0%	4843.47	4836.92
4.0%	4844.90	4837.77
2.0%	4846.07	4838.48
1.0%	4847.33	4839.26
.5%	4848.71	4840.13
.2%	4850.57	4841.12
~.1%	4852.60	4842.05

5.4.3 Geotechnical Engineering

1. Levee Geotechnical Features: When there are improvements such as levees along a river or stream, there is uncertainty regarding how effective they will be in containing a given flood event. Specifically, there is uncertainty regarding what combination of discharge and stage will result in levee failure. To address this uncertainty, the probabilities of levee failure for a series of stages are determined at two locations along the levee's length. These points describe the stochastic uncertainty of a structural levee failure at a given location for various river stages. Tables 20 &21 below presents the functions relating probability of levee failure to river stage at the index locations of Reach 1 and Reach 2.

Table 20: Geotechnical Function (Reach 1)

ACE	EXTERIOR STAGE	PROBABILITY OR FAILURE
50.0%	4856.46	0.00
25.0%	4859.17	0.00
15.0%	4860.96	0.00
12.5%	4861.20	0.00
4.0%	4864.30	0.16
3.0%	4865.93	0.31
2.5%	4866.70	1.00

Table 21: Geotechnical Function (Reach 2)

ACE	EXTERIOR STAGE	PROBABILITY OF FAILURE
50.0%	4840.60	0.00
3.3%	4845.60	0.24
1.0%	4847.60	0.52
0.4%	4849.60	0.83
0.1%	4852.60	1.00

5.4.4 Economics

The following are the primary sources of economic uncertainty for flood risk management studies:

1. Structure Elevation: A structure's susceptibility to being inundated is a function of its location within the floodplain and its elevation. There are two sources of potential error in determining elevation. The first is the topographic ground elevation of the structure. This uncertainty is a function of the data source used to derive the elevation estimate. For example, there is greater potential error associated with elevation estimates derived from examining a 5-foot contour topographic map than a two-foot aerial survey contour map. The other source of uncertainty is associated with estimates of first floor elevations above ground level (or foundation height). This variable is key, as a structure built on fill or with a large crawl space, for example, may sustain only minor or no damages, even though the surrounding ground is underwater. First floor elevation estimate errors also vary with the methods used to derive them, ranging from best-guess estimates from windshield surveys to professional surveys. Statistical uncertainty in elevation is typically determined by referencing the standard deviation estimates contained in Corps Engineering Manual 1110-2-1619. This publication presents standard deviation estimates for a wide range of measurement methods.

For this study, ground elevations for each structure were derived from a two-foot interval digital elevation model in GIS format. First floor elevations above ground level were estimated during a field survey. Based upon the Engineering Manual cited above, the error associated with first floor elevation estimates is assumed to be normal, with a mean of zero and a standard deviation of .59 feet. This number was added to a first floor elevation uncertainty of .50 feet and input into the FDA program.

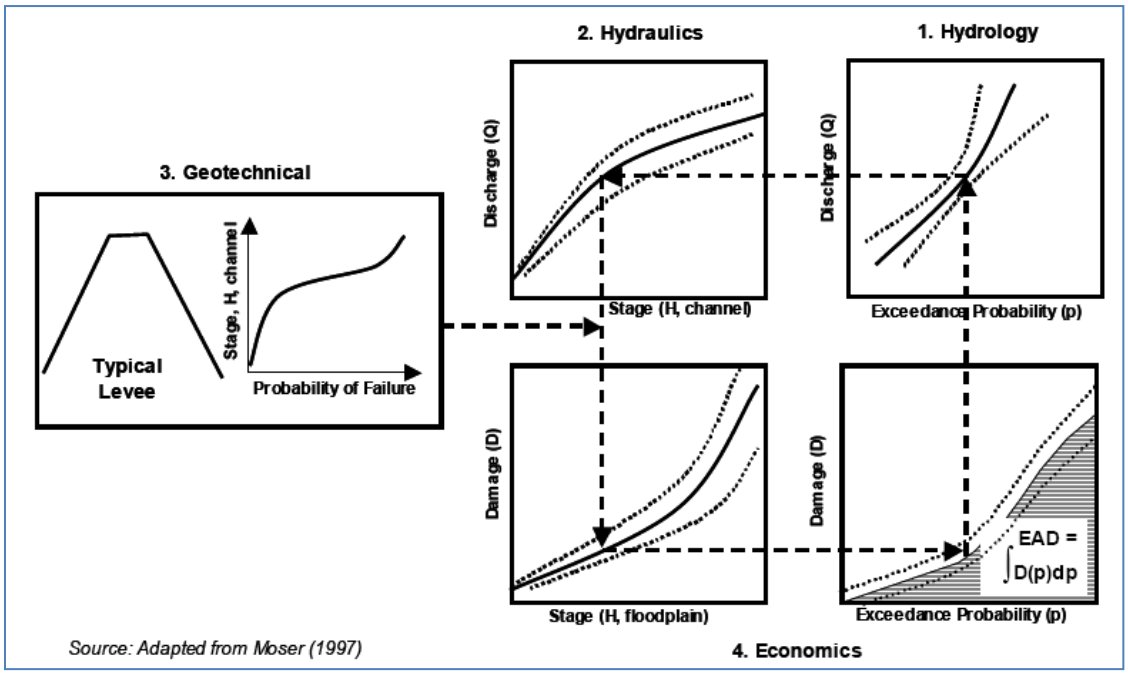
2. Structure Values: Structure values have been determined based upon Marshall & Swift (M&S) valuation factors applied to square footage estimates. Square footage estimates were primarily obtained from real estate assessor's data and were determined to be accurate. The primary source of potential error results from misclassification of a given structure in terms of its construction quality and condition. The errors associated with structure value estimates are assumed to be normal, with a mean of 0 and standard deviations ranging from 13% to 39% (depending on structure type), based upon distributions in M&S multiplier values and potential uncertainties regarding structure condition and corresponding functional depreciation percentages.

3. Inundation Depth/Percent Damage: There is considerable uncertainty regarding the percentage of damage to structures and contents given a certain level of flooding. The Institute for Water Resources collects damage data following flood disasters and publishes depth/damage functions. These functions and associated standard error estimates were used to derive estimates of damages to residential structures. For non-residential structures functions were obtained from USACE's Sacramento District Report: *Analysis of Nonresidential Content to Structure Ratios and Depth Damage Functions for Flood Damage Reduction Studies* (OCT 2009).

5.4.5 Expected Annual Damages

In many respects the entirety of the flood risk analysis culminates in the economic model described in this sub-section. Figure 4 illustrates the conceptual risk approach for Corps' flood damage analyses. To find the damage for any given flood probability, first the discharge for a given annual exceedance probability event is located in the exceedance–probability-discharge panel (Panel 1). Next, the river channel stage associated with the discharge value is determined in the stage-discharge panel (Panel 2). For the study, there are existing levees in the study area so levee heights and geotechnical functions were also entered into the HEC-FDA model. When the stream banks are overtopped or levees fail, water enters the floodplain inundating properties and causing damages. By plotting the resulting stage-damage and exceedance probability-damage relationships developed in the iteration within a Monte Carlo simulation, the damage frequency curve is determined (Panel 4, right side). Expected Annual Damages represent probability weighted average damages computed through by numerical integrating of the damage-frequency curve. In cases where base and future year conditions differ base and future year expected annual damages also differ. When this is the case the present value of base and future year expected annual damages are annuitized to produce equivalent annual damages. Equivalent annual damages represent the present value of flood damages that can be expected to occur in any given year, without prior knowledge of if any damaging flood event will occur. As a result it simultaneously: (1) overestimates the flood damages that can be expected in many years, since many years will produce no damaging event; and (2) underestimates the flood damages that can be expected to result for many damaging flood events. In case where base and future year damages are equal equivalent annual damages and expected annual damages match.

Figure 4: Determination of Expected Annual Damages



5.5 Without Project Flood Damages

The sections below describe the methodology and results of the without project flood damage analysis. Subsequent sub-sections describe flood damages to: (1) structure and structure contents; (2) a few unique considered infrastructure items including the Winslow Waste Water Treatment Plant, Burlington Northern Santa Fe Railroad's railways and the Homolovi I Pueblo; and (3) other damage categories including automobiles, structure clean-up, emergency relocation and landscape clean-up.

5.5.1 Structure and Structure Contents

A structural inventory for import into HEC-FDA 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 .2% ACE (500 year) floodplain boundary with the spatially referenced assessor parcels. Information from the assessor's parcel database such as land use, building square footage, address) was supplemented during field visitation for each parcel within the floodplain by adding fields for foundation height, specific business activity (non-residential) building condition, type of construction, and number of units for example. Where square footage data was not available, the Google Earth measuring tool was used to estimate square footage. The accuracy of square foot data in the Tax Assessor's records was also checked via ortho-rectified aerial photographs in GIS. Parcels with structures were categorized by land use and grouped into the following structural damage categories.

1. Single Family Residence (SFR)—includes all parcels represented by a single unit such as detached single family homes, individually owned condominiums and townhouses.

2. Mobile Homes (MH)—includes all parcels represented by a manufactured unit used for single family living.

3. Multiple Family Residence (MFR)—includes residential parcels with more than one unit such as apartment complexes, duplexes, and quadplex units. Each parcel may have multiple structures.

4. Commercial (COM)—includes retail, office buildings and restaurants.

5. Industrial (IND)—includes warehouses, light and heavy manufacturing facilities.

6. Public (PUB)—includes both public and semi-public uses such as post office, fire department, government buildings, schools and churches.

All parcels within each of the above listed categories were visited and inventoried during the field survey with the exception of single family residences which were sampled and not subject to a 100% in-field survey. All residences were subject to the following protocol. Additional steps were added to include the sampling measures used for single family residences.

1. Parcels in the data set were assigned a numerical identifier denoting the parcel's land use (i.e. SFR, MFR, COM, IND, or PUB) and the existence of square footage data in tax assessor records. In the case of SFRs this identifier was used to sort structures into one of two sampling strata (SFRs with and without a square footage value recorded in the tax assessor data). Parcels in the data set were also assigned a uniformly distributed random number.

2. Within the sampling strata, parcels were sorted in ascending order according to the value of the uniform random number assigned to them. A portion of the structures in each of the two SFR strata were selected for field survey based on the rank of their uniformly distributed random number.

3. A 100% field survey was performed on all structures fitting the following categories: multiple family residences, mobile homes, commercial, industrial, and public while only a sample of the single family residences were inventoried.

4. After the field survey of the sampled structures, a classification matrix was derived counting the proportion of land use categories assigned to structures in the tax assessors data that were determined to be misclassified, based on visual inspections during field surveys of sampled SFRs.

5. The proportions identified in misclassification matrix were used, in conjunction with the Palisades @Risk discrete random number generator, to reclassify a portion of the single family residences not visited during field surveys.

6. Single family residences that were not visited during field surveys were valued using data collected during field surveys. The mean per square foot depreciated structure value of surveyed single family residences with square footage was applied to non-surveyed SFRs square footage values in the tax assessor data. Similarly, the mean depreciated structure value of surveyed single family residences without square footage was applied to non-surveyed single family residential structures without square footage.

7. To assure compliance with Section 308 of WRDA 1990, the PDT completed a review/analysis of historical FEMA floodplain mapping and determined there were only a few structures within the Feasibility Study structure inventory that were constructed within the FEMA floodplain in effect at the time of construction. No adjustments were made to the inventory, since given the small number of structures, damages/benefits relating to these structures would be negligible and would not impact economic justification or the results/conclusions of the analysis.

8. Depreciated structure and content replacement values are a function of the current depreciated replacement value of the structures and its contents. The depreciated structure values are uncertain for several reasons. Per square foot structure values are

calculated by estimating the construction type, quality and condition of structures during field surveys. These estimates are subject to human error associated with incorrectly classifying a structure within each category. Furthermore the type, construction quality and condition classifications themselves may further induce error if they do not adequately account for the proper range of possible per square foot values.

9. Flooding damages to structures and structure contents would have considerable uncertainty given a particular level of flooding. The value of damage to non-residential structures' contents was estimated using a method developed during the expert opinion elicitation process conducted by the Sacramento District USACE and published in Technical Report: *Content Valuation and Depth Damage Curves for Non-residential Structure*, May 2007. Using this methodology, the structure's use (retail, agricultural, residential etc.) and depreciation is correlated with the value of its contents. Damages to these contents during a hypothetical flooding event are then estimated using depth-damage functions published in the report. These depth/damage functions are applicable to the structures in the Study Area, since the construction types for non-residential structures in the Study Area are similar to the Sacramento area. Specifically, structures are generally constructed on slab foundations with wood frame construction. Smaller residential and non-residential structures are generally wood frame with stucco exteriors. The types commercial, public and industrial structures within the Study Area fall within the categories covered by the SPK expert elicitation study, and the contents for such establishments would therefore be similar. The SPK study included both short duration and long duration depth damage functions, with the short duration curves applied for the LCR study as more comparable.

   Residential structures' content values and damage were evaluated using depth damage functions and associated standard error estimates developed by the IWR. Hypothetical damages to residential and non-residential structures during various flood events were also evaluated using IWR depth damage curves. These depth damage functions and standard error estimates are based upon the damages that actually occurred during previous flood events in the United States.

Table 22: Depreciation Percentages

CONDITION	SFR	MH	MFR	COM	REST	OFFICE	IND	PUB
New	0	0	0	0	0	0	0	0
Excellent	4	4	4	3	5	2	3	5
Good	15	15	12	11	15	8	11	20
Average	28	28	24	25	27	19	25	47
Fair	45	45	39	46	48	36	46	69
Poor	63	63	64	59	64	58	59	75
Dilapidated	80	80	80	80	80	80	80	80

In addition to structures, building contents can also be at risk of flood damages. As noted, for this study, non-residential contents values were derived using the results of the Sacramento District SPK expert Elicitation Panel (the Panel) of 2007. The Economic Risk Analysis Section in the Planning Division of the Sacramento District of the USACE documented content to structure ratios and depth damage functions collected during the American River Economic Reevaluation Report's (ERR) structure inventory and expert elicitation. These structure and content ratios and depth damage curves account for the heterogeneity of contents stored in non-residential structures of similar types (such as warehouses). Accordingly, a distribution of possible content to value ratios rather than deterministic point values is entered for each non-residential category.

Table 23 shows a list of structure content ratios for non-residential structures by occupancy type.

Table 23: Structure Content Percentages

USE CATEGORY	CATEGORY NAME	CONTENT/STRUCTURE RATIO
1-LT1	Light Manufacturing 1 Story	188%
1-WH1	Warehouse 1 Story	89%
1-WH2	Warehouse 2 Story	85%
C-AUTO 2	Auto Dealership 2 Story	62%
C-DEAL1	Auto Dealership 1 Story	69%
C-FOOD1	Grocery Store 1 Story	42%
C-HOS1	Hospital 1 Story	92%
C-HOTEL1	Hotel 1 Story	69%
C-HOTEL2	Hotel 2 Story	69%
C-OFF1	Office 1 Story	34%
C-OFF2	Office 2 Story	28%
C-REST1	Restaurant 1 Story	134%
C-RESTFF1	Fast Food 1 Story	42%
C-RET1	Retail 1 Story	51%
C-RET2	Retail 2 Story	47%
C-SERV1	Service Station 1 Story	193%
MFR1[3]	Multiple Family Residence 1Story	100%
MFR2	Multiple Family Residence 2 Story	100%
MH1	Mobile Home 1 Story	50%
P-CH1	Church 1 Story	20%
P-GOV1	Government Building 1 Story	35%
P-GOV2	Government Building 2 Story	26%
SFR1[1]	Single Family Residence 1Story	100%
SFR2[1]	Single Family Residence 2 Story	100%

Table 24 displays the total number of structures within the 0.2 % ACE (500 year) floodplain by category.

[3] IWR depth damage curves were applied for these residential categories (MFR1, MFR2, SFR1, and SFR2). Application of these curves requires content values be set at 100% of structure value for purposes of estimating content damages.

Table 24: Number of Structures in the 0.2% ACE (500 Year) Floodplain

REACH	SFR	MFR	MH	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

As shown on Table 24, there are approximately 1,690 structures in the 0.2% ACE (500 year) floodplain. Out of this total, about 1,487 are residential (sfr, mfr, mh). These categories account for approximately 88% of the structures in the structure inventory. Meanwhile, 118 structures are commercial (office, retail, restaurant, service), 35 are public, and 50 are industrial. These non-residential categories combined account for approximately 12% of the structures in the structure inventory. Over 96% of the structures are located in Reach 1, within which the City of Winslow is nearly entirely contained.

The total value of damageable property sums the depreciated replacement value of all structures and structure contents found within the 0.2% ACE floodplain. Tables 25-28 show the total depreciated structure values, average depreciated structure values, structure content values, and total structure and structure content values by structure category and economic reach. In total, the 0.2% ACE floodplain has just over $461 million in damageable property. Over 94% of which is located in Reach 1.

Table 25: Depreciated Structure Replacement Value ($1,000) (FY 14 Price Levels)

REACH	SFR	MFR	MH	COMMERCIAL	INDUSTRIAL	PUBLIC	TOTAL
1	107,742	16,789	5,550	107,820	3,924	39,607	281,432
2	5,060	N/A	444	10,440	186	767	16,897
Total	112,802	16,789	5,994	118,260	4,110	40,374	298,329

Table 26: Average Depreciated Structure Value ($1,000) (FY 14 Price Levels)

REACH	SFR	MFR	MH	COMMERCIAL	INDUSTRIAL	PUBLIC	TOTAL
1	89	266	35	937	80	1,164	172
2	105	N/A	44	3,480	186	767	268
Total	89	226	35	1,002	82	1,153	176

As shown on Table 25, the total depreciated structure replacement value of structures in the 0.2% ACE floodplain is $298 million. Out of this total about $135 million are residential (sfr, mfr, mh). These categories are approximately 45% of the total structure value in the structure inventory. Meanwhile, of the other categories shown, $118 million are commercial (office, retail, restaurant, service), $4 million are industrial, and $40 million are public. These structures comprise approximately 55% of the structures value in the structure inventory. Average values for each reach and category are also shown in Table 26. While average commercial and industrial values are higher in Reach 2 than Reach 1, it is worth noting that only a few structures in each of those categories are located in Reach 2.

Table 27: Structure Content Value ($1,000) (FY 14 Price Levels)

REACH	SFR	MFR	MH	COMMERCIAL	INDUSTRIAL	PUBLIC	TOTAL
1	53,785	8,394	2,775	73,613	4,533	11,197	154,297
2	2,530	N/A	222	5,300	165	268	8,485
Total	56,315	8,394	2,997	78,913	4,698	11,465	162,782

Table 27 above shows the value of structural contents in the floodplain. Total content values are approximately $163 million. Out of this total about $68 million (or 42%) are residential (sfr, mfr, mh) content values. Meanwhile, for the other categories shown in Table 27, $79 million are commercial (office, retail,

restaurant, service), $4 million are industrial and $11 million are public content values. These categories represent approximately 58% of the structural content value in the structure inventory.

Table 28: Total Value of Structures and Contents ($1,000) (FY 14 Price Levels)

Reach	SFR	MFR	MH	COMMERCIAL	INDUSTRIAL	PUBLIC	TOTAL
Total	169,117	25,183	8,991	197,173	8,808	51,839	461,111

Table 28 shows the total depreciated structure value and structure content value in the 0.2% ACE floodplain is about $461 million. Residential structures account for $203 million, or 44% of this total, while commercial, industrial and public comprise 56% of the total. Commercial, industrial, and public structures combined are only 12% of the structure count, but account for 56% of the value. Figure 5 illustrates the geographic distribution of some of the higher-value properties in the floodplain. While all of the high value properties shown on the map are located in Reach 1 other high values structures such as the Winslow wastewater treatment plant exist in Reach 2.

Figure 5: High Valued Properties

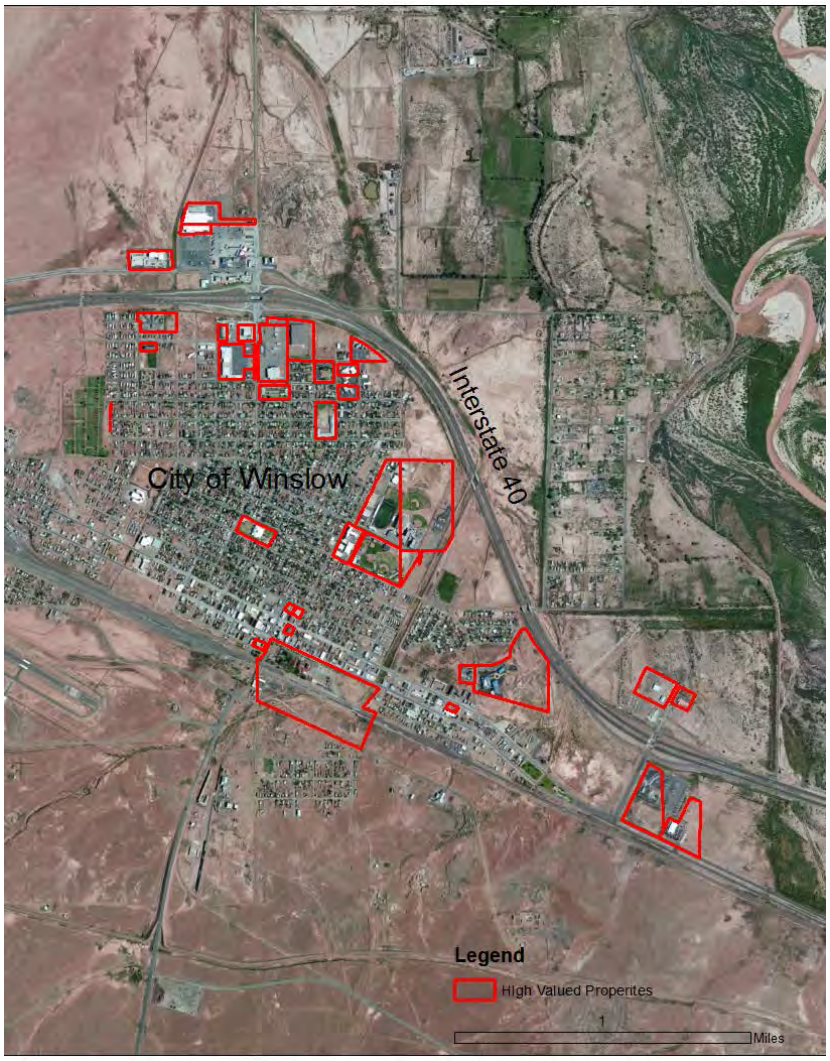


Table 29 presents without project expected annual damages. As is noted in Section 5.4.1 above, base and future year conditions in the study area are not expected to differ during the period of analysis. Accordingly, equivalent and expected annual damage values match, as is described in Section 5.4.5 above.

Table 29: Expected Annual Structure & Content Damages by Reach ($1,000)
(FY 14 Price Levels)

REACH	RESIDENCE	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 expected annual damages to structures and structure contents total approximately $7.7 million, with nearly 99% occurring within Reach 1. Approximately $3.7 million of these damages are attributable to residential structures or 48% of the total value. $3.3 million are attributable to commercial and industrial structures or 43% of the value and $702,000 are attributable to public structures or 9% of the total value.

5.5.2 Damages to the Winslow Waste Water Treatment Plant

Damages to the City of Winslow Waste Water Treatment Plant were evaluated along with the rest of the structures in the structure and content analysis described earlier in this report. Damages were evaluated for the parcel's four structures, including one large main structure and three smaller structures with minimal square footage. The total depreciated replacement values of the structures were estimated at about $722,900 while the content value was estimated at about $252,000. The facility recently completed the work on a ring levee approximately two to three feet high around the plant as a local expense. The enhanced protection provided by the ring levee was incorporated into the analysis under the without project condition; therefore, residual damages to the facility are minor (included under the Commercial category in Table 29).

5.5.3 Damages to the Burlington Northern Santa Fe (BNSF) Railroad

More than $250 million in BNSF freight revenues is generated annually on the transcontinental double track mainline route that runs from Chicago, Illinois to Los Angeles, California through Winslow, Arizona. 120 trains per day (one every 12 minutes), runs through Winslow, or 43,800 trains per year. There is no other rail route to divert BNSF trains west of Albuquerque, so any future flood event that may overtop this crucial railroad freight corridor could significantly delay the 4,800 double containers transported by BNSF that pass through Winslow every day.

East bound trains primarily transport merchandise imported from Asia into the Ports of Los Angeles and Long Beach. West bound trains bring crude oil from Midwest oil producing states to California refineries. Taken together, these comprise one third of all the BNSF's freight service. This freight could not move if the tracks become impassible at Winslow due to flooding. This risk could cost BNSF $685,000 per day in delayed freight revenue. Flooding over the BNSF's Winslow facility could have an impact on Californian energy production and national consumer goods distribution, which would be a direct impact on national consumer markets if the delay from flooding were to last a day or longer.

There is an additional interest in mitigating against impacts to the tracks used by Amtrak's Southwest Chief Passenger Rail Service between Chicago and Los Angeles. In FY 11, the Southwest Chief carried over 350,000 passengers and generated $44,184,060 in revenue. While only ten percent of these annual passengers go through Winslow (which generates $12,105 every day for Amtrak), any disruption through Winslow would upset Amtrak's transcontinental system and impact passenger train travel nationally.

Even though there is a possibility of disruptions lasting a day or longer, which would cause significant damages/costs, it is unlikely. The following table presents flood duration and depths, above the top of tracks, for the 3.3% ACE (30 year), 2% ACE (50 year) and .2% ACE (500 year) events. These estimates were provided by the USACE Los Angeles District Hydrology and Hydraulics Sections. As is shown below, water depths at the rail track are approximately one foot for a 2% ACE event, and seven feet for a .2% ACE event. The disruption during the largest magnitude event shown in Table 30 indicates the .2% ACE event will likely last less than one fifth of a day. Annualized estimates of these potential losses would be minimal, especially considering the likely and immediate remediation actions of BNSF and Amtrak to keep the trains running as quickly as possible after any potential flood event. While the potential impacts to rail traffic during a major flood event could be significant, the low probability of such an event and likely immediate action by the rail operators to reestablish service limits their impact on this damage analysis. Thus, while damages associated with a rare event would be significant, expected annual damages would be minor and were therefore not quantified in this analysis.

Table 30: Duration of Flood Depths by Frequency

FLOOD EVENT	DURATION OF FLOODING ABOVE RAIL TRACKS	DEPTH OF WATER AT RAIL TRACKS
3.3% ACE (30-year)	0.0 hour	0 Feet
2% ACE (50 year)	4.0 hours	1 Foot
.2% ACE (500 year)	4.5 hours	7 Feet

5.5.4 Damages to the Homolovi I Pueblo

The Homolovi I Pueblo State Park is a cluster of four archaeological sites that includes seven separate pueblo sites built between 1260 and 1400 AD. These sites are culturally important to the Hopi people as historical sites and part of their homeland. Many Hopi still make pilgrimages to the sites. Beyond their importance to the Hopi people they are also culturally significant to the nation as a whole.

These sites are located in close proximity to the LCR and are provided some flood risk mitigation by the existing Winslow levee. Currently, the annual chance of flooding (annual exceedance probability) is about 7%. For 10%, 2%, and 1% ACE events, the probabilities of flooding at these sites is about 12%, 33%, and 50%, respectively.

The value of culturally significant resources such as these archaeological sites are, for many reasons, difficult to monetize and evaluate economically. As a result, benefits associated with mitigating flood risks threatening these sites are not monetized and any proposed project would explicitly avoid inducing flooding in this area.

5.5.5 Other Damage Categories

In addition to damages directly related to structures and their contents, losses were also estimated for other categories including damages to automobiles, cleanup costs, and displacement costs. While economic uncertainties for these categories are not specifically identified or required in EM 1110-2-1619, uncertainty parameters for these categories were included in this study.

Automobiles

Damages to automobiles are estimated as a function of the number of vehicles owned per residence, average value per automobile, estimated percentage of autos removed from the area prior to inundation, and depth of flooding above the ground elevation. Depth damage relationships for autos were taken from EGM 09-04 and modified based on weighted average of distributions of car types (SUV, truck, sedan, sports car, etc.) in the study area. Damages for autos begin once flood depths reach 0.5 feet. Vehicle counts were

estimated using an assumption of 2.1 vehicles per residential structure. This number was obtained from CLRSearch.com. Evacuation (autos moved out of the flooded area) was assumed to be 50%, as used on previous studies and based upon EGM 09-04 guidance given potential flood warning times. The assumption is based on the fact that homeowners work most of the day and in a two vehicle household at a minimum one car is typically used for transportation to and from work. Also during non-work hours, some vehicles can be moved prior to being damaged. Depreciated replacement value of autos was based on a figures obtained from the Kelly Blue Book Website. At the website, autos selling within a 75 mile radius around zip code 86047 were obtained and entered into a cumulative distribution function. The cumulative distribution function produced an average auto value of $14,271. The adjusted auto value multiplied $14,271 by average vehicles per household at 2.1 and by vehicles removed from the floodplain (50%). This equals $14,984, the value of vehicles per household at the time of flooding. Estimates of vehicle counts and values for multiple family residences (MFR) were also developed. This was done by dividing the square footage of each MFR structure by an average housing unit size of 1,000 square feet to obtain the estimated number of housing units per structure. An additional 211 vehicles were added to the inventory due to the adjustment for MFR structures. The results from the spreadsheet tabulation indicate 1,698 vehicles in the floodplain for a total vehicle value of $25 million and an average vehicle value of $14,984 dollars per household.

Table 31: Expected Annual Automobile Damages ($1,000) (FY 14 Price Levels)

REACH	EAD
1	570
2	9
Total	579

Structural Clean Up Costs

Flooding not only causes damage to structures and contents but floodwaters present a significant cost in their aftermath. Floodwaters leave debris, sediment, salts and the dangers of diseases and toxins throughout flooded structures. Cleaning these structures is a necessary post-flood activity. Clean-up costs for the extraction of floodwaters, dry-out, and decontamination vary significantly, based upon various factors including depth of flooding. Based upon research and analysis conducted by both Sacramento and New Orleans Districts, a maximum value of $10 per square foot was assumed for such costs. This maximum was conservatively applied to a depth of 5 feet. Zero damage was applied to a depth of 0 feet. For a one foot depth, we assumed damages of $3.70/SF. This was based upon research conducted for and the basis of such damages reported in the Centralia, WA, Chehalis River Feasibility Report, which was completed in 2003. Costs for that study were based upon interviews at the time with firms specializing in such cleanup and also compared with a Bluebook Cost Guide for such costs. The following table summarizes expected and equivalent annual structural cleanup costs.

Table 32: Expected Annual Clean Up Damages ($1,000) (FY 14 Price Levels)

REACH	EAD
1	1,049
2	17
Total	1,066

Displacement Costs

Displacement costs represent those costs incurred by property owners who need to relocate temporarily while repairs are made to their residences. The displacement cost methodology was derived by the Sacramento District (SPK) of the US Army Corps of Engineers for the Yuba County Flood Control Study. SPK used the following assumptions to help derive two points of a depth damage function. The first

point on the curve includes a onetime moving cost of $840 plus one month's rent of $1,200. The total costs utilized in the HEC-FDA analysis as a maximum of the damage function was $15,240. The initial/minimum damage costs are assumed when structure damages reach 10% of structure value and result in the family being displaced for a month. The maximum damage point on the depth damage curve, include a onetime moving cost plus one year's rent. These costs are assumed when structure damages reach 50% of structure value, assuming a family would be displaced for a year. Between these minimum and maximum displacement costs, damage values were interpolated by associating a 1% increase in structure damages with eight day increases in displacement.

Table 33: Expected Annual Displacement Damages ($1,000) (FY 14 Price Levels)

REACH	EAD
1	715
2	13
Total	728

Landscape Cleanup Costs

The landscape costs are for cleanup of the property surrounding residential structures while structural cleanup is for cleanup within the home. The landscape cleanup costs were computed for residential structures by applying a depth-damage function relating such costs to structure value. The source of this function was the publication, *Urban Flood Scenario: Sacramento Area Levee Breach Scenario*, November 23, 2009 developed by David Ford Consulting and Engineering.

Table 34: Expected Annual Landscape Damages ($1,000) (FY 14 Price Levels)

REACH	EAD
1	159
2	4
Total	163

5.5.6 Summary of Damages

Without project damages in the following flood damage categories were evaluated in the HEC-FDA program, as discussed above: 1) structure and structure contents, 2) automobile damages, 3) structural cleanup cost, 4) displacement costs, and 5) landscape cleanup costs. The potential for damages at the BNSF railroad and Homolovi I Pueblo archeological sites were considered but not monetized. Please also see Addendum E which displays the Exceedance Probability/Damage Functions by reach and damage category.

Table 35: Without Project Expected Annual Damage Summary ($1,000)

CATEGORY	EAD	Percentage of Total
Structure & Content	7,693	75%
Automobile Damages	579	6%
Clean-Up	1,066	10%
Displacement Costs	728	7%
Land	163	2%
Total	10,230	100%

The results from the HEC-FDA analysis are summarized in Table 35 (above). Without project expected annual flood damages total over $10 million, with over 96% of the structures located in and approximately 99% of the damages occurring within Reach 1 and the City of Winslow. Damages to structures and structure

contents account for 75% of total without project average annual damages. The remaining 25% is attributable to structure clean-up, landscape clean-up, automobile and temporary displacement costs.

5.6 Without Project Performance

In addition to damage estimates, HEC-FDA reports flood risk in terms of project 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 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.

For example, in Reach 1, the table indicates the following: a) there is a 4.1% chance of having a damaging flood event in any given year, b) there is a 72% chance of a damaging event occurring over any 30 given year period, and c) there is a 7% chance that a 1% ACE flood event will not cause any damages (as defined in this analysis) or equivalently there is a 93% chance that the occurrence of a 1% ACE event would induce flood damages. Reach 2 provides a similar but slightly higher level of performance. However as noted above the consequences associated with any given flooding event are much greater in Reach 1.

Table 36: Project Performance

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	.0380	.0410	.3420	.7150	.8766	.9337	.2629	.0715	.0025
Reach 2	.0692	.0696	.5137	.8850	.9728	.8781	.6728	.5058	.1837

5.7 Recreation

As noted in Section 5.3.2, opportunities for recreation facilities were initially considered, such as the addition of recreational trails along the levees with ancillary features such as, restroom facilities, and a visitor center which would enhance recreation within the area. However, recreation was not carried forward as a planning objective because the existing/proposed levee alignments cross private property and are more than a mile from the central core of Winslow. The following sections summarize recreation supply and demand in the Study Area.

5.7.1 Recreation Supply

For the purposes of this analysis, local parks within the study area were surveyed to better understand existing recreation. The existing LCR levee is not included in the list because current recreation use of the levee system is minimal. There are some pedestrian and equestrian recreation usages but not enough to be considered a functioning park area.

Table 37: Existing 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	.33 acres
Father Seramur Park in Coopertown	Central Street/ Francis Avenue	Pocket Park	.48 acres
Triangle Park	Fleming Street/Elm Street	Pocket Park	.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

Addendum A also shows regional attractions close to the city and Addendum B show other local attractions within the city.

5.7.2 Recreation Demand

The City of Winslow Parks and Recreation Department categorized each park listed in Table 38 by type. These park type categories are explained in Table 39, below. The City of Winslow Parks and Recreation Department also provided the amount of park acres per 1000 residents. This ratio is compared with the national standards developed by the National Recreation and Parks Association (NRPA) in Table 39.

Table 38: Park, Type, Standard Park Size, and Service Radius

PARK TYPE	PARK SIZE	SERVICE RADIUS
Mini/Pocket Park	0-1 acre	¼ mile
Neighborhood Park	1-15 acres	½ mile
Community Park	15-40 acres	1 mile
Metro Park	40-200 acres	1 ½ mile

Table 39: Winslow City and National Park Guidelines

FACILITY TYPE	CURRENT WINSLOW RATIO	NATIONAL GUIDELINES
Mini/Pocket Park	0.22 ac/1000	1.0 ac/1000
Neighborhood Park	0.22 ac/1000	2.5 ac/1,000
Community Park	2.30 ac/1000	3.0 ac/1,000
Metro Park	None in Winslow	3.0 ac/1,000
Total	2.74 ac/1000	9.5 ac/1,000

The above data indicate that the existing recreation facilities within the city do not meet the national guidelines set forth by the NRPA. This indicates a need for parks in each of the four categories (Mini/Pocket Park, Neighborhood Park, Community Park, and Metro Park). Furthermore, of the parks classified, only one bicycle/walking trail exists within the city limits and this trail is only seven blocks long. A recreational linear park would be an asset to the community, one that is generally underserved by recreation resources.

6.0 WITH PROJECT BENEFITS

This section reports the benefits and costs associated with the six proposed flood risk management alternatives carried forward from preliminary screening. In addition, the analysis includes an evaluation of four scales of one of the proposed alternatives, which was necessary to identify the plan and scale that maximizes net benefits (the National Economic Development (NED) Plan). The following: 1) identifies the alternatives evaluated under the with-project condition, 2) analyzes the benefits for each alternative, 3) displays project performance statistics, 4) evaluates the costs of each alternative, 4) computes the benefit cost ratio and net benefits, 5) identifies the plan that maximizes net NED benefits, and 6) concludes the results of the analysis.

6.1 Flood Risk Management Alternatives

ALTERNATIVE 1.1: REBUILD LEVEE SYSTEM ALONG CURRENT ALIGNMENT

Rebuild the Winslow Levee and the eastern end of the Ruby Wash Diversion Levee (RWDL) along their current alignments, construct a new levee parallel to I-40, and improve conveyance under the BNSF Railroad Bridge; project designed to contain the 1% ACE flood with a 90% level of assurance.

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; project designed to contain the 1% ACE flood with an approximately 90% level of assurance.

ALTERNATIVE 7: NONSTRUCTURAL MEASURES ONLY

Employs nonstructural flood risk management measures for residences located north of I-40 only, no levee or conveyance improvements.

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 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; project designed to contain the 1% ACE flood with an approximately 90% level of assurance.

ALTERNATIVE 9: REBUILD RWDL

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

ALTERNATIVE 10: REBUILD RWDL & WINSLOW LEVEE (TO NORTH ROAD)

This alternative includes rebuilding the Winslow Levee from the RWDL downstream to a point 0.8 of a mile 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, 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; project designed to contain the 1% ACE flood with an approximately 90% 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.

Figure 6: Alternative 1.1

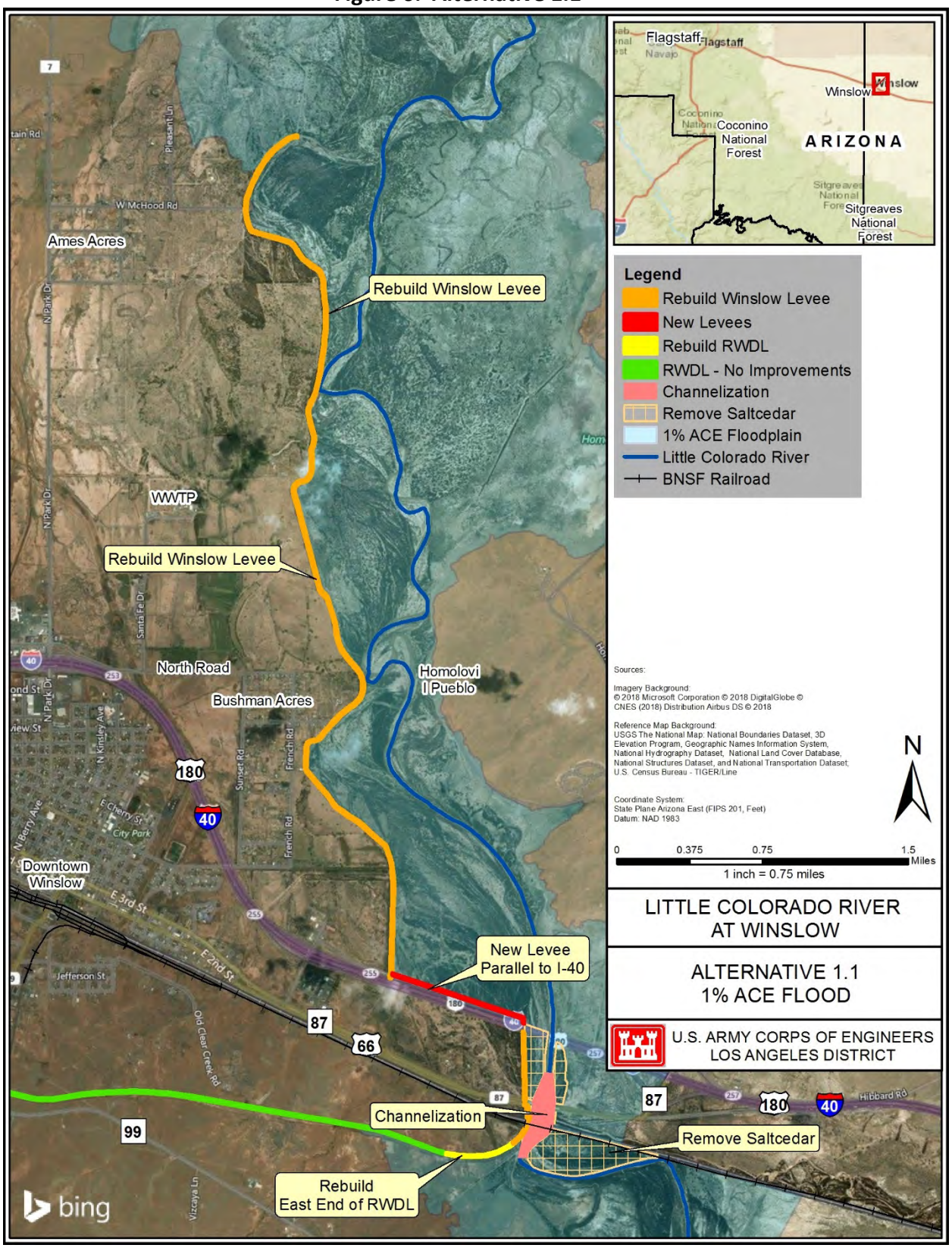


Figure 7: Alternative 3.1

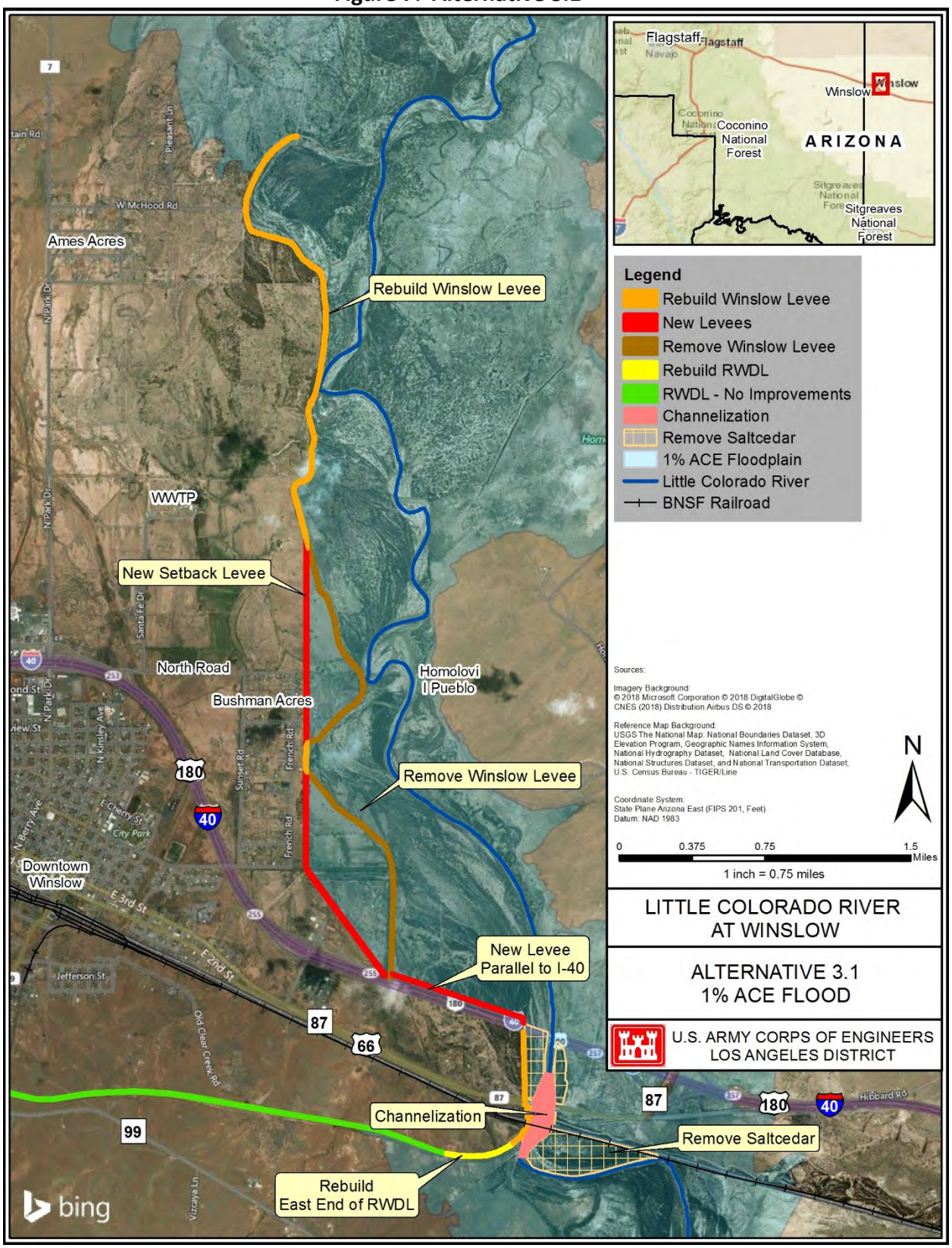


Figure 8: Alternative 7

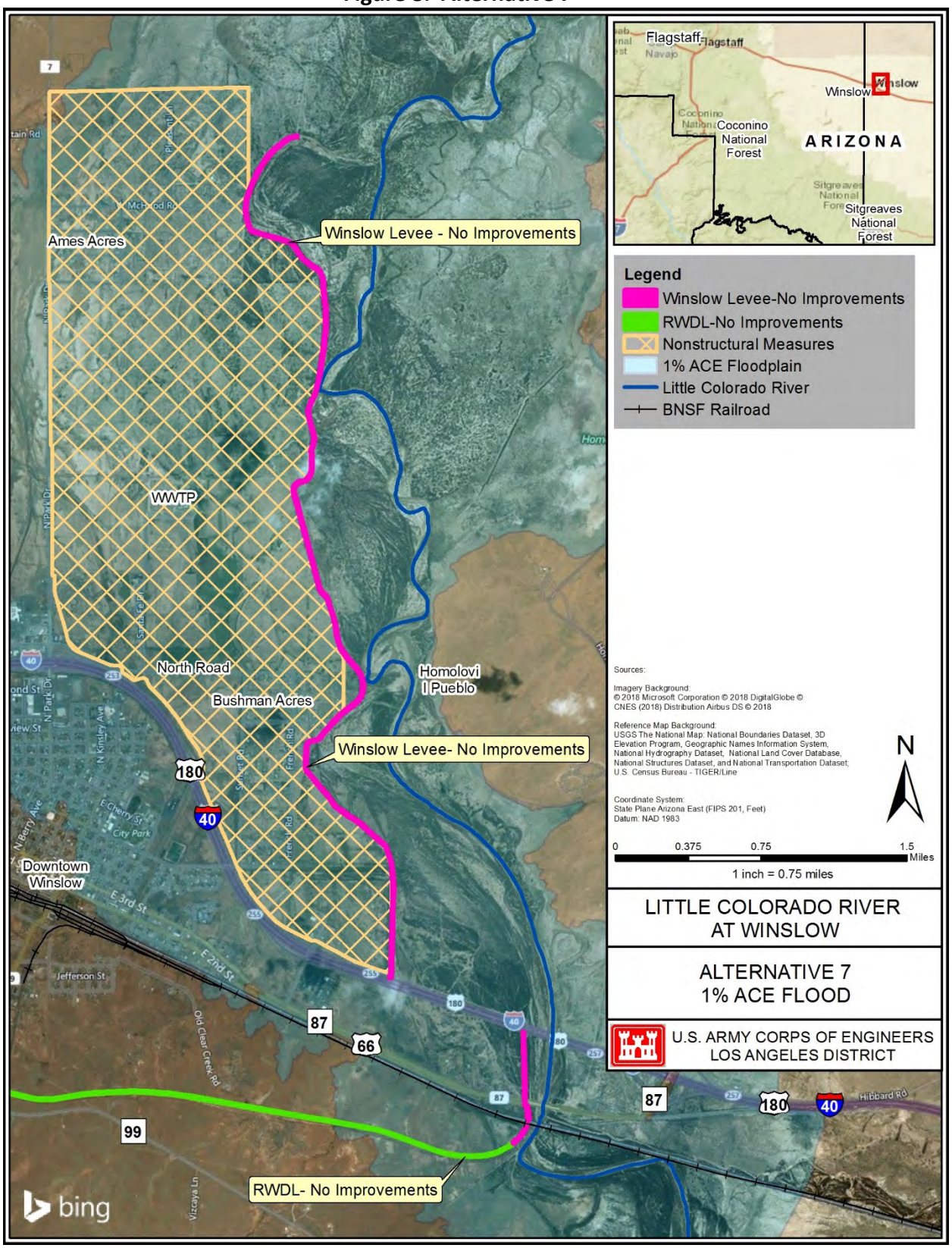


Figure 9: Alternative 8

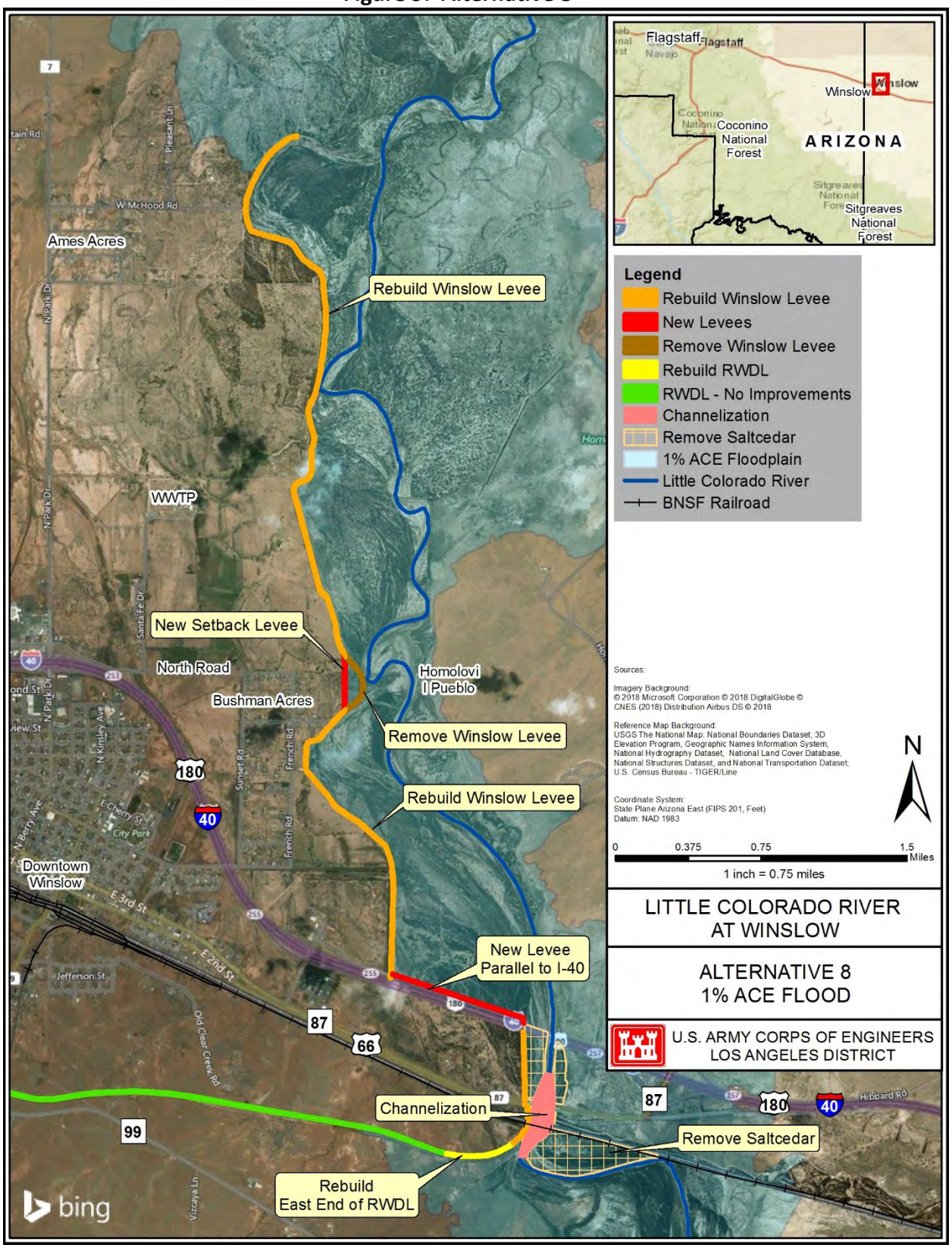


Figure 10: Alternative 9

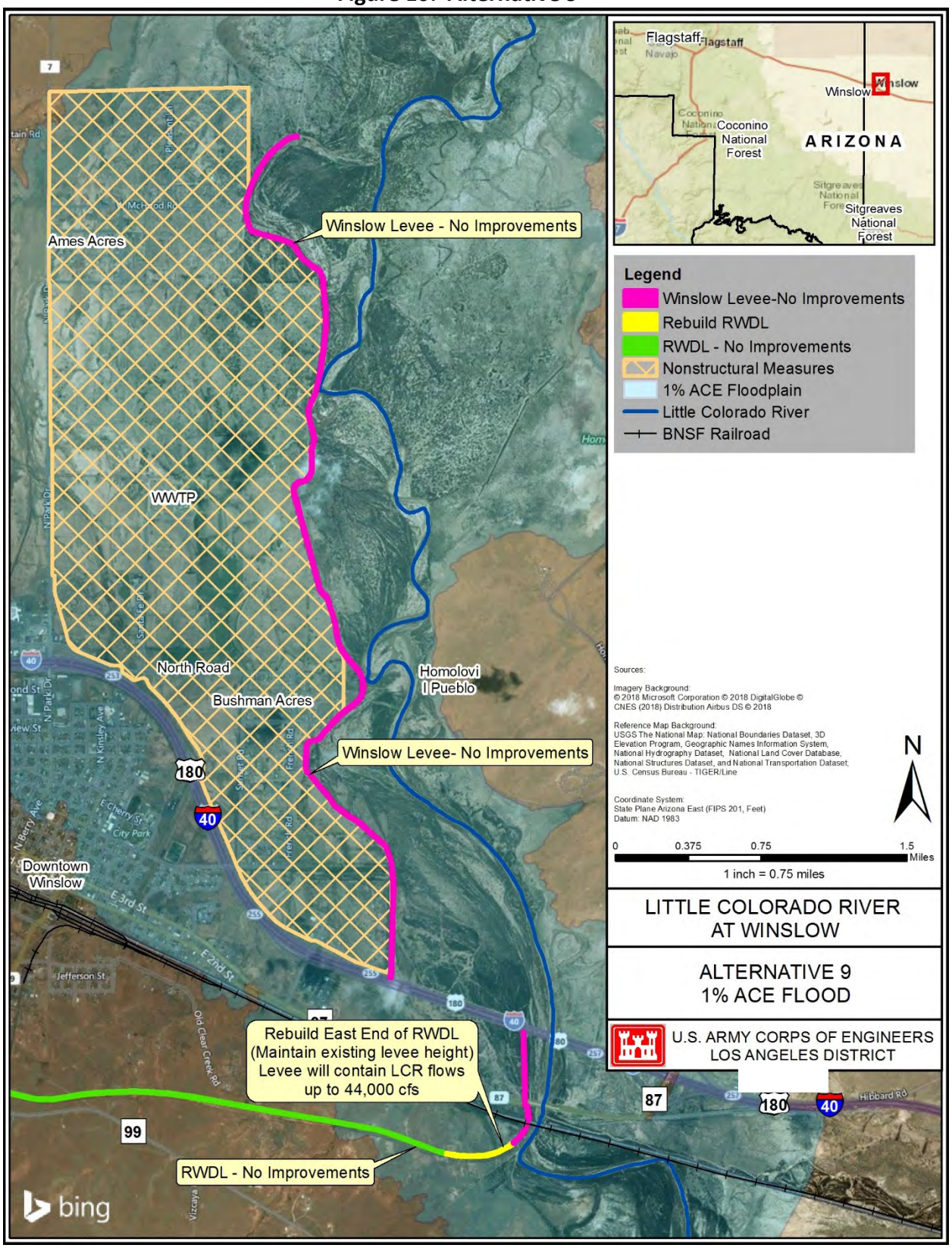
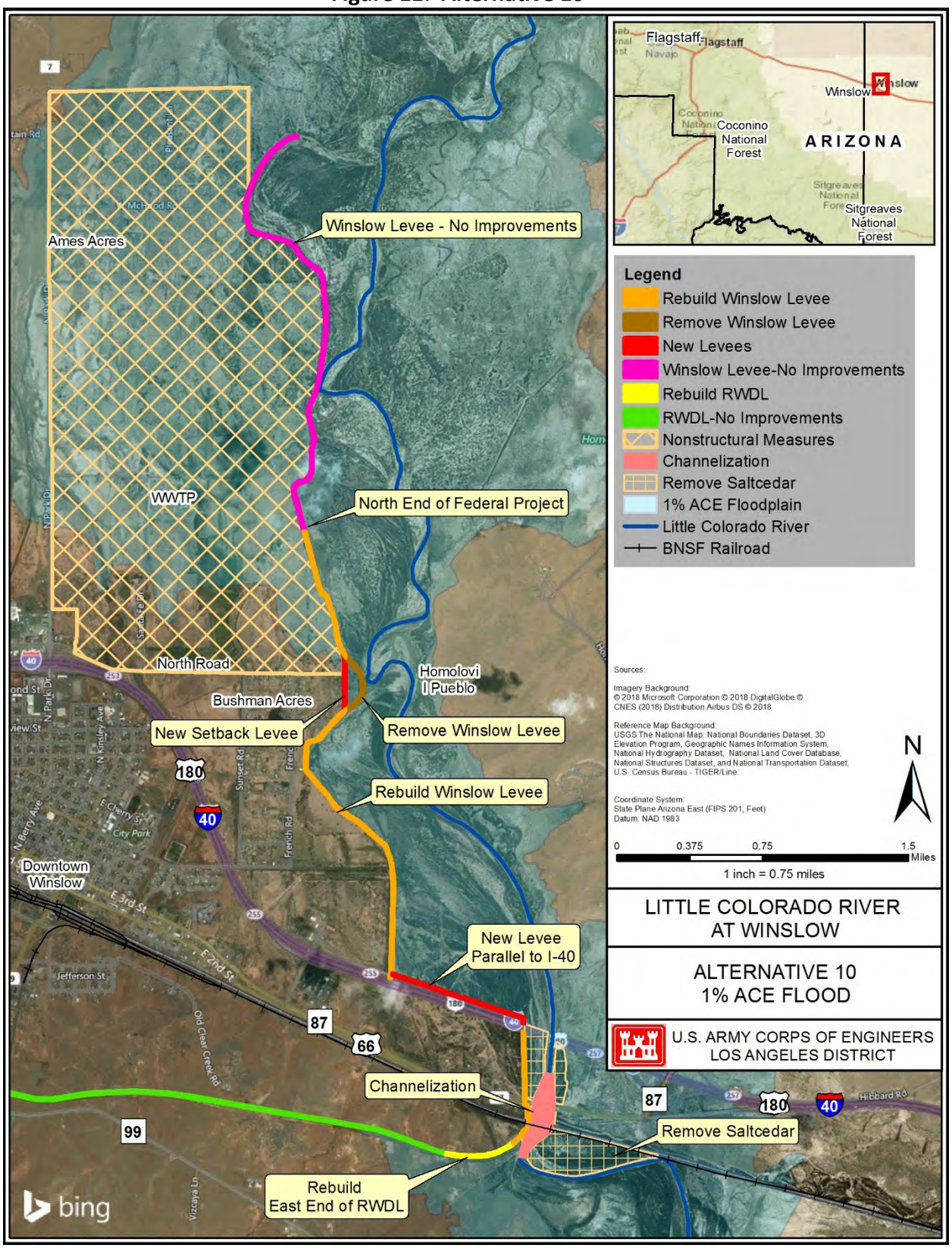


Figure 11: Alternative 10



6.2 Evaluation of Non-Structural Measures (Elevating Structures)

Non-structural flood risk reduction measures evaluated for this analysis include the elevating 117 homes in Reach 1 and 29 in Reach 2 above the 1% ACE water surface elevation. The range of elevations required to elevate these homes above the 1% ACE water surface elevation is between 0 and 4.74 feet.

Alternative 7 includes elevation of residential structures north of Interstate 40 in Reach 1 as well as residential structures in Reach 2. This plan does not include levee improvements. Alternative 9 includes elevating these same residential structures per Alternative 7 in conjunction with improvements to Ruby Wash Diversion Levee. Finally, Alternative 10 includes elevation of residential structures in Reach 2 (only) in conjunction with levee improvements to reduce flood risks in Reach 1.

To evaluate the costs and benefits from elevating structures, parcels within the above-defined geographic limits were identified. Benefits were estimated by modifying the first floor elevations of these structures in a separate HEC-FDA file and re-computing expected annual damages. The benefits were calculated as the difference between simulated damages with the adjusted first floor elevations vs. without these adjustments.

Structure elevation costs were determined based upon size of each structure, the required increase in first floor elevation necessary to raise it above the 1% ACE water surface elevation, and per unit costs. The required raises for each structure were based upon water surface profile data at the location of each structure as provided by the Corps' Los Angeles District Engineering Division. Average per square foot flood-proofing costs were used to estimate the structure elevation costs for each eligible structure. The per-square foot unit costs used for the calculation were obtained from the Fargo Morehead Feasibility Report. This report notes that, "The costs developed for elevating structures were derived through interviews with managers of three structure-raising firms in Louisiana. The cost per square foot includes mobilization and cleanup." A range of costs were provided to account for type of structure (one or two story SFR or MH) and height of elevation.

6.3 Residual Damages

Under with project conditions flood risks are reduced but not eliminated. Accordingly, residual flood risks and expected annual with project damages remain. Table 40 displays residual expected annual damages for each alternative. Larger residual damages imply less flood risk reduction, while smaller residual damages imply more flood risk reduction.

The results show that without project damages are reduced by approximately $8.4 million or 82 percent under Alternatives 1.1, 3.1 and 8. Each of these plans include levee improvements intended to provide approximately 90% assurance of containing the 1% ACE event. The configuration of the levee, not conveyance capacity, north of I-40 distinguishes between these plans. Alternative 10 has slightly lower benefits and higher residual damages since this plan includes non-structural measures rather than levee improvements in Reach 2. The non-structural only plan, Alternative 7, results in the highest residual damages and lowest flood risk reduction.

Table 40: Expected Annual Residual Damages ($1,000s) (FY 14 Price Levels)

PLAN	STRUCTURE AND CONTENTS	AUTO	CLEAN UP	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

6.4 Flood Damage Reduction Benefits

Table 41 below shows the flood damage reduction benefits associated with each alternative. Alternatives 1.1, 3.1 and 8, each of which proposes levees designed to convey flows associated with the 1% ACE event throughout Reaches 1 and 2, produce similar benefits. Over 98 percent of these benefits are produced in Reach 1. Alternative 10 produces slightly lower benefits by combining the non-structural measure of elevating structures in Reach 2 (rather than levee improvements) with the levee improvements for Reach 1 as included in Alternatives 1.1, 3.1 and 8. Meanwhile the non-structural plan, Alternative 7 produces the lowest benefits. A much lower portion of Alternative 7's benefits is produced in Reach 1. It should also be noted that although transportation related damages/costs and damages to the WWTP were determined to be minor under without project conditions, the project alternatives would nonetheless still provide flood risk reduction benefits to these facilities.

Table 41: Expected Annual Damages Reduced ($1,000s) (FY 14 Price Levels)

	W/O PROJ. Without Project	DAMAGES REDUCED by ALTERNATIVE					
		1.1	3.1	7	8	9	10
Reach 1	10,079	8,249	8,248	209	8,249	1,851	8,250
Reach 2	151	132	133	55	132	55	55
Total	10,230	8,381	8,381	264	8,381	1,906	8,305

As previously noted, uncertainty is inherent in water resources planning. Accordingly, a risk based analysis was used in this analysis. As a result, a range of expected annual damages figures are produced by the HEC-FDA model. Table 42 below displays confidence intervals around the expected annual benefit values presented in Table 41 above. The three right-hand columns can be read as the probability that expected annual benefits are at least as high as the values shown in the table.

Table 42: Probability Damages Reduced Exceed Indicated Values ($1,000s) (FY 14 PL)

PLAN	PROBABILITY DAMAGES REDUCED EXCEED INDICATED VALUES		
	0.75	0.50	0.25
1.1	5,506	7,948	10,765
3.1	5,499	7,944	10,763
7[4]	264	264	264
8	5,506	7,948	10,765
9 (Reach 1)	1362	1745	2079
9 (Reach 2)[2]	55	55	55
10	5,475	7,882	10,662

6.5 With Project Performance

Table 43 below presents with project risk-based project performance statistics. This tabular data can be compared to the without project performance statistics presented in the without project performance section presented earlier in this report. Since hydrologic and hydraulic conditions are assumed to stay constant over the period of analysis, this data can also be assessed as the best possible representation of the project's long-term performance.

The tables show that Alternative 1.1, 3.1, and 8 are expected to have a high level of assurance of conveying flows associated with the 1% ACE event for both Reaches 1 and 2. Alternative 9 provides a relatively small increase in project performance in Reach 1. Alternative 10 has similar project performance as Alternatives 1.1, 3.1 and 8 in Reach 1, but does not improve project performance in Reach 2.

Since the non-structural measure of elevating structures on fill (per Alternatives 7 and 9 and for Reach 2 under Alternative 10) do not improve the condition or conveyance capacity of the channels and levees, they are not associated with any increase in project performance. The project performance statistics also show the probability of flooding over 10, 30 and 50 year periods (long term risk). Finally, the project performance statistics show the assurance statistics for the 10% to .2% ACE events. Note that the benefits and project performance statistics (as well as costs) for alternatives are based upon the actual top of levee elevations (e.g., additional elevation for "freeboard" was not added to levee heights that was not reflected in benefit/cost estimates).

[4] Probability damages reduced exceeds indicated values are not computed for Alternatives 7 and Alternative 9 (Reach 2).

Table 43: Project Performance

PLAN	REACH	TARGET ANNUAL EXCEEDANCE PROBABILITY		LONG_TERM RISK (YEARS)			CONDITIONAL NON_EXCEEDANCE PROBABILITY By EVENT			
		MEDIAN	EXPECTED	10	30	50	10%	2%	1%	.2%
Without	1	.0380	.0410	.3420	.7150	.8766	.9337	.2629	.0715	.0025
	2	.0692	.0696	.5137	.8850	.9728	.8781	.6728	.5058	.1837
1.1	1	.0037	.0049	.0482	.1377	.2188	1.000	.9877	.8804	.2702
	2	.0022	.0012	.0122	.0362	.0596	1.000	.9944	.9478	.6059
3.1	1	.0039	.0051	.0498	.1421	.2254	1.000	.9863	.8730	.2593
	2	.0022	.0012	.0122	.0362	.0596	1.000	.9944	.9478	.6059
7	1	.0380	.0410	.3420	.7150	.8766	.9337	.2629	.0715	.0025
	2	.0692	.0696	.5143	.8854	.9730	.8780	.6717	.5043	.1821
8	1	.0037	.0049	.0482	.1377	.2188	1.000	.9877	.8804	.2702
	2	.0022	.0012	.0122	.0362	.0596	1.000	.9944	.9478	.6059
9	1	.0290	.0323	.2799	.6265	.8063	.9952	.2954	.0808	.0029
	2	.0692	.0697	.5143	.8854	.9730	.8780	.6717	.5043	.1821
10	1	.0037	.0049	.0482	.1161	.2187	1.000	.9879	.8808	.2696
	2	.0692	.0695	.5137	.8850	.9728	.8780	.6716	.5051	.2120

7.0 Project Costs and Benefit to Cost Analysis

Project benefits and costs are expressed in average annual terms to facilitate comparison. In order for alternative costs to be compared to benefits, the proposed alternatives costs were amortized over the 50 year period of analysis using the FY 14 federal discount rate of 3.5%. Interest during construction, which represents the opportunity cost of economic capital tied up during the construction period, is based on the following construction periods: 8 years for Alternatives 1.1, 3.1 and 8, 4 years for Alternatives 7 and 9, and 6 years for Alternative 10, assuming uniform expenditure over each construction period. Operation and Maintenance, Rehabilitation, Remediation and Repair (OMRR&R) were also added for all the proposed alternatives. Detailed and itemized costs for the alternatives can be found in the Cost Appendix.

With benefit and cost calculations complete, two key economic indicators - the benefit cost ratio and net benefits - can be computed. These indicators measure the economic feasibility and efficiency of each alternative. For an alternative or increment thereof to be economically feasible, its benefits must exceed costs (the benefit/cost ratio must be greater than one). The economically optimal plan is the one that maximizes net benefits – this plan is referred to as the National Economic Development (NED) Plan. Table 44 displays the project costs and benefits for the array of alternatives.

Table 44 also calculates the net benefits and benefit cost ratio for each alternative. Of the alternatives listed in Table 44, Alternative 10 clearly shows the highest net benefits and benefit cost ratio and has therefore been identified as the NED levee alignment.

Table 44: Little Colorado at Winslow Average Annual Costs by Alternative (FY 14 Price Levels)

Category	Alternative 1.1	Alternative 3.1	Alternative 7	Alternative 8	Alternative 9	Alternative 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 Cost	$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
Benefit/Cost Ratio	1.91	1.83	0.30	2.04	1.96	2.68

8.0 NATIONAL ECONOMIC DEVELOPMENT PLAN

As shown on Table 44, Alternative 10 is the levee alignment that maximizes net NED benefits. This alternative includes two major components – levee improvements in the upstream reach, which provide risk reduction throughout Reach 1, and a non-structural plan which features raising floodplain structures above the 1% 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.

8.1 Incremental Justification

Table 45 displays the results of the incremental analysis. The table illustrates that the structural improvements in Reach 1 are well justified from an economic perspective, with net benefits exceeding $5.3 million. However, the second increment featuring elevating structures in Reach 2 produces a negative net benefit of $132,000 and a benefit cost ratio of only .29. Without the second increment, the benefit to cost ratio of Alternative 10 is increased from 2.68 to 2.84. Therefore, the non-structural improvements (elevation of structures) for Reach 2 are not economically justified from an NED perspective.

Note that due to the low number of structures, the low depreciation replacement cost of the structures and contents, the small amount of without project damages, and the high costs of any alternatives which would protect the structures in Reach 2, there are not any other alternatives which would be economically justified for this reach.

Table 45: Incremental Analysis of Alternative 10 (FY 14 Price Levels)

Category	Structural Reach 1	Non-Structural 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 Cost	$2,901,000	$187,000
Average Annual Benefits	$8,250,000	$55,000
Net Benefits	$5,349,000	-$132,000
Benefit/Cost Ratio	2.84	0.29

8.2 Optimization

The benefits and costs for the Alternative Levee Plans 1.1, 3.1, 8 and 10 were based upon an engineering design which set levee heights to achieve an approximately 90% assurance of containing the 1% ACE flood. This design standard is intended to meet requirements established by FEMA to remove the areas protected by the levee from the designated “100-year” floodplain (and therefore also eliminate the requirement for owners of structures within these areas to purchase flood insurance). This initial evaluation was used to identify the NED levee alignment, i.e., the alignment which maximizes net national economic development benefits. However, additional analyses is necessary to determine the levee height that maximizes net benefits, as it is possible either a smaller or larger levee may maximize net benefits.

Benefits for smaller and larger scale levees were evaluated for Alternative 10, Reach 1 (See maps below). The scales evaluated were designs to achieve an approximately 90% assurance of containing the 4%, 2%, and 0.5% ACE floods (in addition to the results presented in Table 45, which are for the 1% ACE). The scales are identified as Alternatives 10.1, 10.2, 10.3, and 10.4.

Figure 12: Alternative 10.1

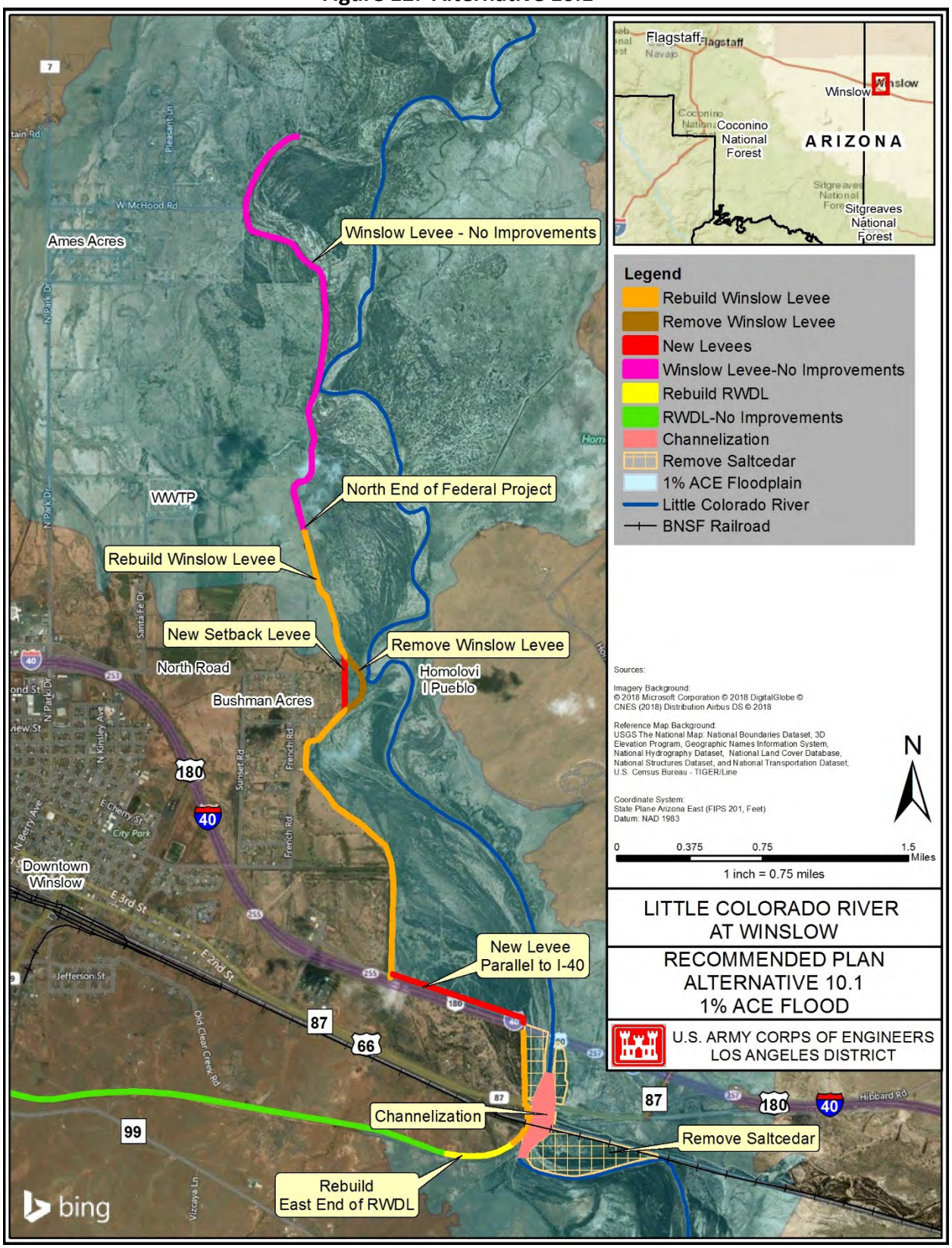


Figure 13: Alternative 10.2

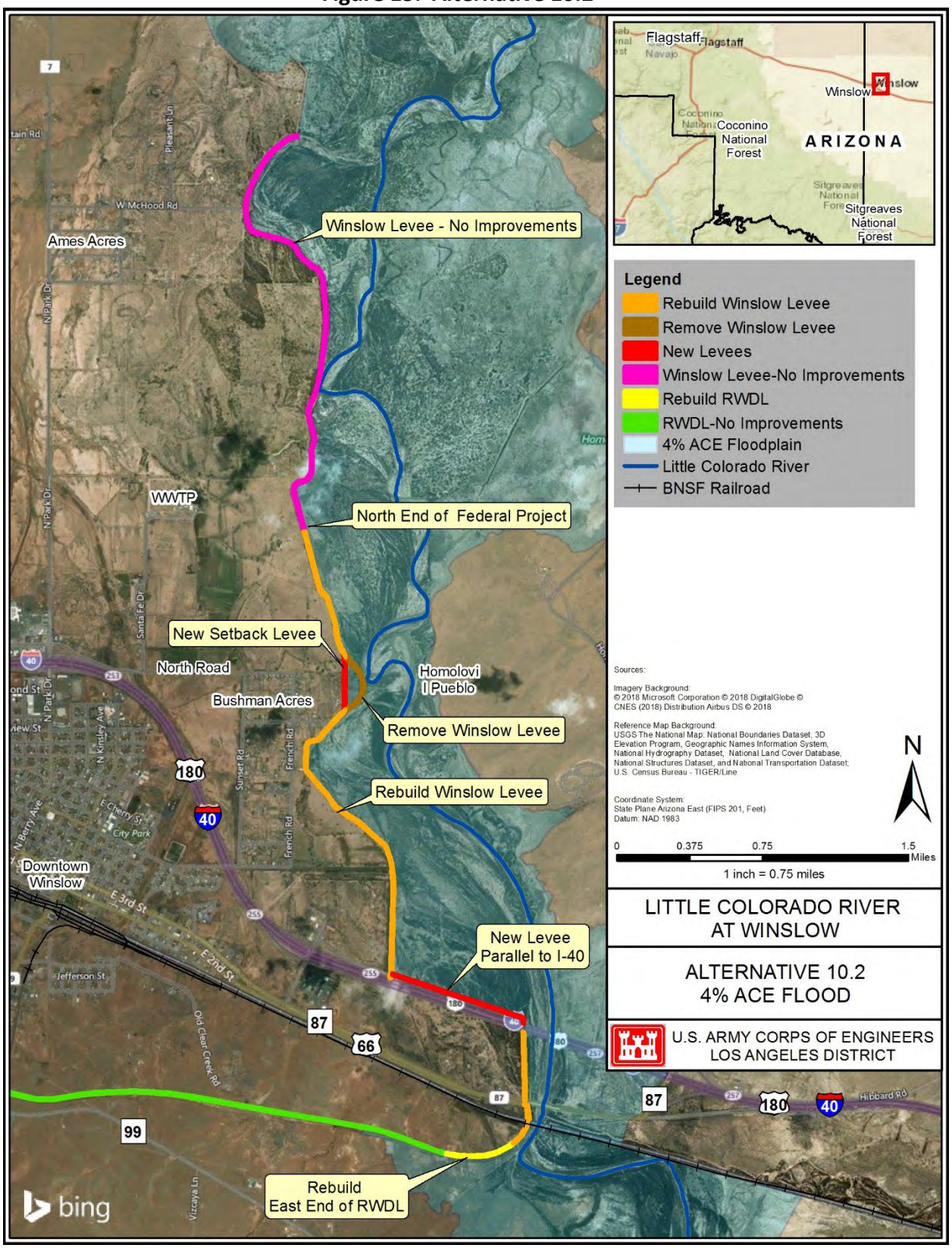


Figure 14: Alternative 10.3

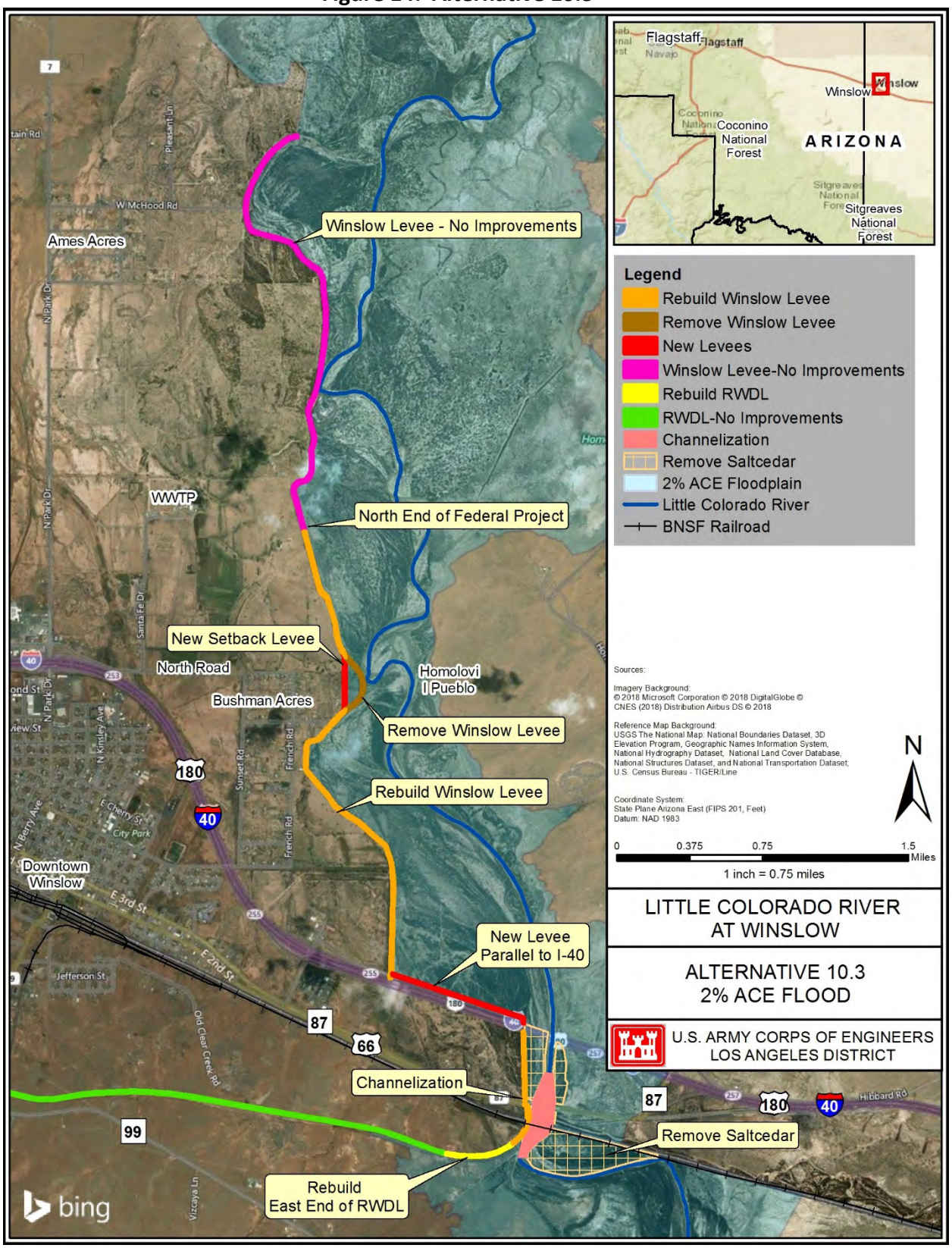
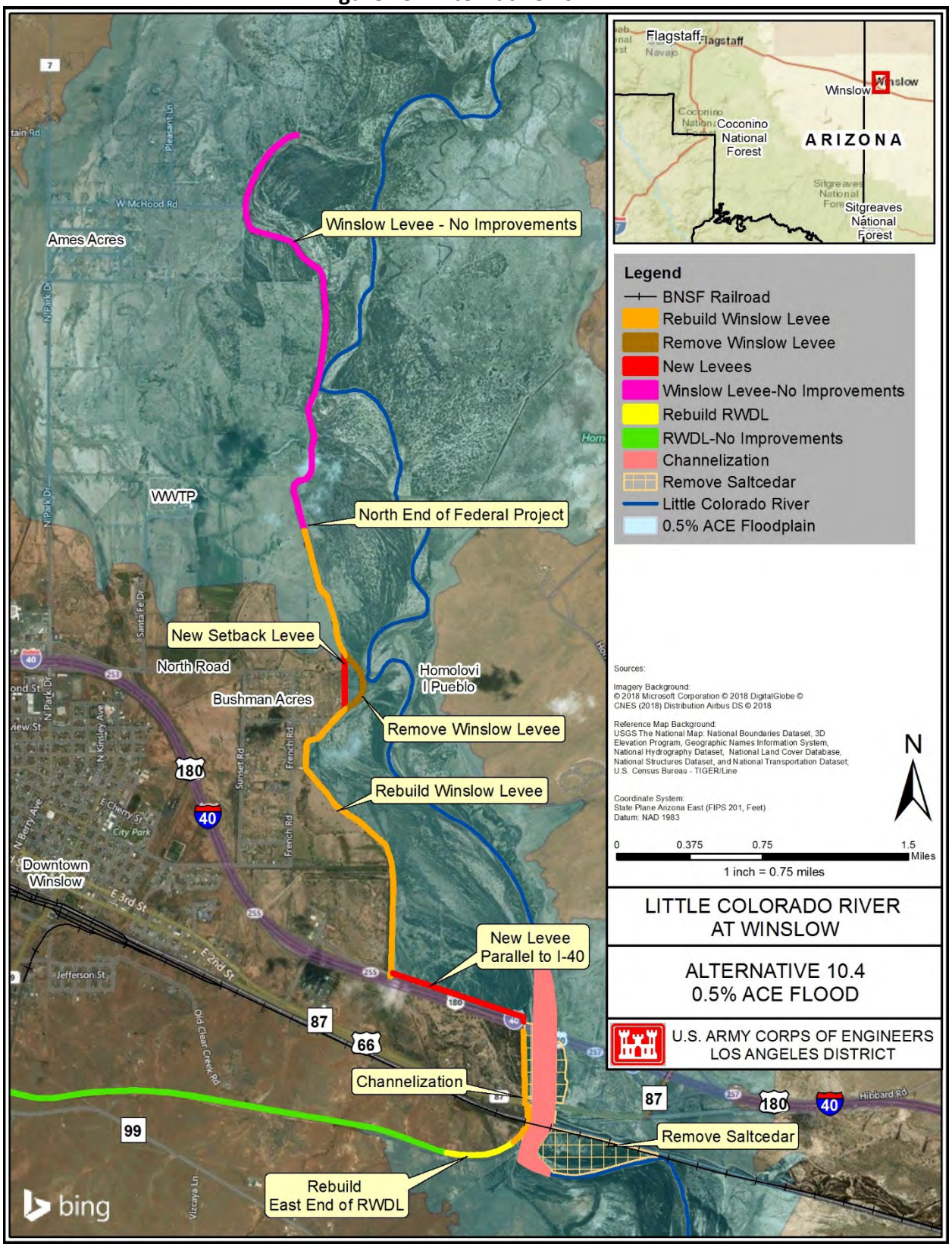


Figure 15: Alternative 10.4



The average annual benefits and costs for the different scales for Alternative 10 are shown below. Note that these benefits and costs are for Reach 1 only, since the non-structural improvements for Reach 2 are not economically justified.

Table 46: Average Annual Benefits & Costs for Alternative 10 Scales (FY 14 Price Levels)

Category	Alternative 10.1 1% ACE	Alternative 10.2 4% ACE	Alternative 10.3 2% ACE	Alternative 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

As shown in Table 46 above, the plan and scale that maximizes net NED benefits is Alternative 10.4, which is designed to convey the 0.5% ACE discharge. This alternative has net benefits of about $5.8 million, a benefit/cost ratio of 2.74, and is expected to reduce without project damages by approximately 90% 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/cost ratio than Alternative 10.4, it does have slightly lower net benefits. The Planning Guidance Notebook (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 with 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, formulation of larger scale plans than Alternative 10.4 to identify the NED Plan is not required, and Alternative 10.1 is identified as the Recommended Plan.

Tables 47 and 48 present: 1) probability of damages reduced exceeds indicated values, and 2) a comparison of project performance statistics for the four levee scales evaluated in the optimization analysis.

Table 47 shows the probability of damages reduced exceeds the indicated values. These numbers reflect the uncertainty inherent in risk based analysis; therefore, a range of expected annual damage figures are produced by the HEC-FDA model. Table 47 below displays confidence intervals around the expected annual benefit values presented in Table 46 above. The three right-hand columns can be read as the probability that expected annual benefits are at least as high as the values shown in the table.

Table 47: Probability of Damages Reduced Exceeds Indicated Values for the Optimization Analysis of Alternative 10 ($1,000s) (FY 14 Price Levels)

PLAN	PROBABILITY DAMAGES REDUCED EXCEED INDICATED VALUES		
	0.75	0.50	0.25
10.1	5,475	7,882	10,662
10.2	3,780	5,090	6,401
10.3	4,914	6,917	9,091
10.4	5,990	8,608	11,665

Table 48 below presents the without and with project risk-based performance statistics. These statistics are broken down into the median and expected annual exceedance probabilities, the long term risk, and the conditional non-exceedance probabilities (assurance) by event. The target annual exceedance probability is broken into a median and expected probability that the levee will be over topped in a given year. The long term risk is the probability that a target stage will be exceeded over a 10, 30 and 50 year period. Finally, when discussing the project performance statistics, we should point out that Alternative 10.1 was formulated assuming that it would provide at least 90% assurance of containing the 1% ACE event. However, as shown on these results, this plan scale only provides an 88% assurance level. Additional analysis has been conducted indicating that just 0.3 feet of additional height will increase the assurance to a 90% level for the 1% ACE event. The costs for the Recommended Plan were refined based upon this slightly higher levee height which will meet FEMA certification criteria, and these results are presented in the Recommended Plan section of this report.

Table 48: Project Performance Statistics for the Optimization Analysis of Alternative 10

PLAN	REACH	TARGET ANNUAL EXCEEDANCE PROBABILITY		LONG_TERM RISK (YEARS)			CONDITIONAL NON_EXCEEDANCE PROBABILITY (ASSURANCE) By EVENT			
		MEDIAN	EXPECTED	10	30	50	10%	2%	1%	.2%
Without	1	.0380	.0410	.3420	.7150	.8766	.9337	.2629	.0715	.0025
	2	.0692	.0696	.5137	.8850	.9728	.8781	.6728	.5058	.1837
10.1	1	.0037	.0049	.0482	.1161	.2187	1.000	.9879	.8808	.2696
	2	.0692	.0695	.5137	.8850	.9728	.8780	.6716	.5051	.2120
10.2	1	.0137	.0163	.1516	.3894	.5605	1.000	.7092	.3523	.0261
	2	.0692	.0695	.5131	.8846	.9726	.8782	.6732	.5060	.2125
10.3	1	.0065	.0085	.0815	.2251	.3462	1.000	.9323	.6944	.1201
	2	.0692	.0695	.5132	.8847	.9727	.8781	.6725	.5064	.2130
10.4	1	.0024	.0018	.0813	.0539	.0882	1.000	.9980	.9619	.5366
	2	.0692	.0695	.5132	.8847	.9727	.8781	.6726	.5066	.2133

9.0 RECOMMENDED PLAN

Alternative 10.1 has been identified as the Recommended Plan. Plan features include rebuilding the Winslow Levee from the RWDL downstream to a point 0.8 of a mile north of North Road, setting back a short segment of the Winslow Levee across the LCR from the Homolovi I Pueblo, removing the original Winslow Levee in the setback area, rebuilding the eastern end of the RWDL, constructing a new levee parallel to I-40 and improving conveyance under the BNSF Railroad Bridge. Alternative 10.1 would significantly reduce flood risk for the most densely developed portions of Winslow.

Benefits and costs for the Recommended Plan have been updated and refined, and are presented in the following sections.

9.1 Benefits

Benefits for the Recommended Plan have been refined as follows:

- Updated price levels to FY 2018 (October 2017)
  - Structure values updated based upon Marshall & Swift October 2017 indices.
  - Content values updated (values are a percent of structure value).
  - No structures added to the structure inventory, per review of updated aerials of the floodplain showing minimal new development.
  - Auto values updated per Kelly Blue Book on line used vehicle search in Winslow area.
  - The benefit category of reduced displacement costs, which accounts for the reduction in the costs floodplain residents incur for temporary relocation and housing after flooding events, has been removed. The Corps of Engineers made a determination that these impacts result in a double counting of NED benefits and are more appropriately categorized as Other Social Effects (OSE).
  - Landscaping damages (exterior cleanup costs) are a function of structure values, so these damages reflect the adjustment of structure values.
  - Interior cleanup costs/square foot not updated (assumed still valid).
- Updated discount rate to FY 2018 (2.75%)
- Based benefits on levee height corresponding with 90% assurance of containing the 1% ACE event.
- Reran HEC-FDA to generate updated without project damages, with project residual damages and benefits.

The following tables summarizes the results of the updated analysis.

Table 49: Updated Value of Structures & Contents ($1,000s)
October 2017 Price Levels[5]

	Number	Structure	Content	Total
SFR	1248	$119,292	$59,646	$178,938
MFR	59	$17,800	$8,900	$26,701
MH	161	$6,232	$3,116	$9,347
COM	117	$125,381	$83,665	$209,046
IND	50	$4,359	$4,982	$9,341
PUB	35	$42,806	$12,157	$54,963
Total	1670	$315,869	172466	$488,335

5 Note that the number of structures in the floodplain shown on this table is slightly reduced from the number shown on Table 24. This is due to the elimination of structures which were identified as outside the floodplain based upon the HEC-FDA Stage/Damage function generation for without project conditions.

As shown on Table 49, the updated estimated value of structure and contents in the 0.2% ACE floodplain is approximately $488.3 million, which is a $27.2 million increase (or about 6%) over the FY 2014 estimate of $461.1 million.

Table 50 below shows the updated without project expected annual damages and with project expected annual benefits for the Recommended Plan. Please also refer to Addendum E for the with-project Exceedance Probability/Damage Functions for the Recommended Plan.

Table 50: Expected Annual Damages & Benefits – Recommended Plan ($1,000s)
October 2017 Price Levels

	Without Project	With Project	Benefits
STRUCTURE &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**

As shown above, without project EAD is estimated at approximately $10.1 million, and expected annual benefits for the Recommended Plan total $8.3 million. These figures are similar to the FY 14 price level estimates presented earlier in this report..

Table 51 presents a comparison of project performance statistics between without project conditions and for the Recommended Plan.

Table 51: Project Performance Statistics

		Long Term Risk			Assurance		
Plan	**AEP**	**10 yrs**	**30 yrs**	**50 yrs**	**2.0%**	**1.0%**	**0.2%**
Without Project							
Reach 1	4.1%	34%	72%	88%	26%	7%	0.3%
Reach 2	7.0%	51%	89%	97%	67%	51%	18%
Recommended Plan							
Reach 1	0.4%	4%	13%	20%	99%	90%	30%
Reach 2	7.0%	51%	89%	97%	67%	51%	18%

The table above shows that the Recommended Plan significantly reduces risk in Reach 1 (there is not a change in project performance statistics in Reach 2). The annual exceedance probability is reduced from 4.1% to 0.4%, indicating that with the project in place, there is only estimated to be about a 0.4% chance of flooding in Reach 1 on an annual basis. The chance of flooding over time is also cut substantially. For example, over a 30-year period, the chance of flooding for Reach 1 is estimated to drop from about 72% under without project conditions to about 13% with the Recommended Plan. Finally, the probability that a given flood event will result in flooding in the study area is also dramatically reduced by the Recommended Plan. For example, for the 1% ACE (100-year) event the probability that the project will be able to contain that event (and thereby prevent damages) in Reach 1 is 90% with the project in place, relative to only 7% under without project conditions.

The level of risk reduction can also be seen in Figure 12 (p. 48), which displays the residual 1% ACE floodplain. As shown, most of the developed area of the floodplain is no longer within the 1% ACE floodplain. Expected annual damages within the Study Area are reduced by about 82%. Although the Recommended Plan improvements are focused on Reach 1, most of the residual risk in the study area corresponds with low probability flood events that exceed the design capacity of the Recommended Plan in this reach.

9.2 Costs

Table 52 below presents the updated costs for the Recommended Plan. The total first cost is $77.2 million. This is a significant increase over the estimated costs used for the evaluation and comparison of costs presented in Sections 7 and 8, which were developed at a much lower level of detail. The costs below are based upon the certified Total Project Cost Summary, and incorporate the results of detailed evaluations of the Recommended Plan, including refined design, quantities, unit costs and a cost and schedule risk analysis.

Table 52: Total First Cost and Average Annual Cost –Recommended Plan ($1,000s)
October 2017 Price Levels, 2.75% Discount Rate

Category	Cost $1,000s)
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**

Interest during construction (IDC) was computed based upon a detailed construction schedule provided by USACE Cost Engineering. The period of construction, from the initiation of PED through completion of construction, is about 5.5 years, although most of the project expenditures occur in the latter half of the period of construction. Total Investment Cost, including the Total First cost and IDC, is estimated at $81.2 million. Incremental OMRR&R costs were computed at $50,000 ($275,000 under the Recommended Plan less $225,000 for the existing levee system under Without Project Conditions)

Total annual costs are estimated at $3.1 million, including annualized investment cost plus annual OMRR&R costs.

9.2 Benefit/Cost Analysis

The following table summarizes the results of the benefit/cost analysis. As shown below, the Recommended Plan is economically justified, with net average annual benefits of about $5.2 million and a benefit/cost ratio of 2.70. Per Executive Order 12893, the benefit/cost ratio is also evaluated at a 7% discount rate. The benefit/cost ratio at 7% is 1.29.

Table 53: Benefit/Cost Analysis Results – Recommended Plan ($1,000s)
October 2017 Price Levels, 2.75% Discount Rate

Category	$1,000s)
Average Annual Benefits	**$8,259**
Average Annual Costs	**$3,058**
Net Benefits	**$5,200**
Benefit/Cost Ratio	**2.70**
Benefit/Cost Ratio @ 7% Discount Rate	**1.29**

In accordance with ER 1105-2-101, an evaluation was conducted of the probability that the project is economically justified. HEC-FDA generates estimates of expected annual damages reduced (i.e., annual benefits) that are exceeded with given probabilities. As shown in the table below, although the mean value of annual benefits is $8.3 million, there is a 75% chance that annual benefits exceed $5.4 million, and a 25% chance that annual benefits exceed $10.6 million. Cost estimates furnished by Cost Engineering are based upon an 80% confidence level for base costs and contingencies. These costs are incorporated into the Total Project Cost Summary that is the basis for benefit/cost computations. Therefore, average annual costs as presented in Table 52 are applied to estimate net benefits and benefit/cost ratios for all probabilities. The following table shows that even with the annual benefits corresponding with the 75% probability, the Recommended Plan is economically justified with a benefit/cost ratio of about 1.77. Hence, there is a greater than 75% probability that the Recommended Plan is economically justified (at the current Federal discount rate).

Table 54: Probability Recommended Plan is Economically Justified
October 2017 Price Levels ($1,000s), 2.75% Discount Rate

	Mean	75%	50%	25%
Average Annual Benefits	$8,259	$5,412	$7,819	$10,612
Average Annual Costs	$3,058	$3,058	$3,058	$3,058
Net Benefits	$5,201	$2,354	$4,761	$7,554
Benefit/Cost Ratio	2.70	1.77	2.56	3.47

10.0 REGIONAL ECONOMIC DEVELOPMENT & OTHER SOCIAL EFFECTS

Addendums C and D present the results of the Regional Economic Development (RED) and Other Social Effects (OSE) analyses, respectively. Please refer to these addendums for a detailed discussion of methodology and results. The following summarizes the results.

10.1 RED Analysis Summary

As noted earlier, the local Sponsor has indicated a preference for Alternative 10.1, and this plan has been identified as the Recommended Plan. Based on the estimated direct impacts associated with project expenditures it is expected that about 1,795 jobs would be created within the Winslow, Arizona region from the implementation of the Recommended Plan. These impacts are anticipated to occur over a span of about 5.5 years. Overall there would be an additional 1,966 jobs supported (direct, indirect, and induced) by the Recommended Plan within the region during the construction period, primarily in labor, commercial and industrial machinery and equipment rental and leasing, and wholesale trade businesses sectors. Overall, the construction of the Recommended Plan is expected to lead to about $58 million in value added in goods and services to the region and increased labor income of over $50 million. There would also be some minor additional RED benefits relating to annual O&M expenditures for the plan.

Table 55: Overall RED Impacts from Alt 10.1 (Recommended Plan)

		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	1,795	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

10.2 OSE Analysis Summary

This OSE analysis describes adverse effects from flooding for the No Action Plan (NAP), or Without Project Condition, as well as the beneficial social effects from the Recommended Plan. Impacts are categorized by OSE dimensions of interest. Public health and safety have a strong/adverse effect from flood risks under the NAP. The Winslow area has had a long history of flooding - one that has the potential to impact and harm its citizenry. The NED Plan would reduce this impact in a strong/moderate way by reducing the chance of harm and decreasing the inundation of key protective and health services. Economic vitality will have a moderate adverse effect from flooding under the NAP. Of the two key economic areas the one impacted most is the North Park area. This area has a key anchor store that provides much of the needs of the individuals living in Winslow. The beneficial effect from the Recommended Plan would counter this adverse impact by removing the North Park Commercial District from the 1% ACE floodplain. Community cohesion will have a moderate/small adverse effect under the NAP. Even though roads will be inundated they will be inundated for a relatively short period of time, making the effect more an inconvenience to most. However, the generally small adverse effect is more significant for those using the transportation network for public health and safety. Under the NAP and Recommended Plan, community and cultural identity will have a small adverse effect from flooding because the Homolovi I Pueblo and the Bingham settlement do not have a significant probability of flooding and the probability will not be reduced under the Recommended Plan. However, impacts to the downtown area

under the NAP are more significant, especially if the historic downtown and La Posada structures are damaged. The Recommended Plan would reduce such impacts. Finally social vulnerability will be affected strongly/moderately under the NAP. Much of the current population is considered to be those in the marginalized demographic. Also, individuals vulnerable to economic loss will be affected moderately. Under the Recommended Plan Individuals will be less likely to lose employment, income, feel stress from flooding and be impacted by the possibility of raised prices for goods and services. Businesses will be impacted less by flooding, temporary business disruptions, transportation impacts and lost business/income.

Table 56: OSE Dimensions of Interest Summary (Recommended Plan)

Category	The Adverse Effect from Flooding for the Without Project Condition	The Beneficial Effect from the Recommended Plan
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

11.0 CONCLUSION

The following summarizes the results of the economic analysis:

1. The City of Winslow, Arizona experiences periodic flood damages due to inundation resulting from overtopping of study area levees. Alternatives were evaluated that include a combination of levee improvements such as rebuilding the levees and constructing setback levees, as well as non-structural measures, including the elevation of structures on fill. For Alternative 10, three scales or flood risk reduction levels were analyzed in addition to the plan designed to meet FEMA levee accreditation requirements (90% assurance of containing the 1% ACE event).
2. Although the City of Winslow, Arizona has experienced steady growth in the past several decades, it makes up a very small portion of the Little Colorado River watershed. Population and development both within the city and the watershed is expected to be limited. Thus future development is not expected to significantly change current hydrologic conditions during the period of analysis. As a result, future and base year flooding conditions are assumed to be the same.
3. There are 1,670 structures in the 0.2% ACE floodplain. About 88% of these structures are devoted to residential purposes. The remaining 12% of the structures have commercial, industrial and public uses. Residential structures account for $143 million in structure value or approximately 45% of the floodplain total structure value. Commercial, industrial and public structures are valued at just over $173 million. The total value of structures and contents in the floodplain is about $488 million.
4. Flood damages to structures, structure contents and automobiles were considered along with flood costs associated temporary housing and land clean-up and structure clean-up following a flood event. Total without project expected annual flood damages are estimated to be $10,091,000. 81% of these damages, approximately $8,162,000, are attributable to structure and structure content damages.
5. There is very minimal difference in benefits for Alternatives 1.1, 3.1 and 8, as all essentially reduce risk to the same area and are scaled to provide the same level of project performance. Alternative 10 focused levee improvements on protecting property in Reach 1. Four scales of Alternative 10 were evaluated to identify the plan which maximizes net benefits. Non-structural improvements (elevation of structures) were also evaluated separately and in conjunction with levee improvements.

6. Total annual costs are computed by first taking the total first cost and adding interest during construction to derive the investment cost. The investment cost is then annualized over 50 years using the current Federal discount rate of 2.75%. The annualized investment costs are added to the OMRR&R costs to compute total annual costs.
7. The results of the benefit cost analysis include estimates of net benefits and benefit cost ratios for each alternative. The alternative with the highest net benefits and benefit cost ratio was Alternative 10.
8. Alternative 10 was analyzed according to its separable elements in an incremental analysis. Increment 1 includes the structural measures in Reach 1 while increment 2 includes the non-structural measure of structure elevations in the downstream reach. The analysis shows that while increment 1 is economically justified, increment 2 is not. Therefore, the Recommended Plan only includes the upstream (Reach 1) structural improvements of Alternative 10.
9. An optimization analysis was conducted to determine the scale of Alternative 10 which would maximize net benefits. This analysis showed increasing net benefits for successively larger scales, with Alternative 10.4 having the greatest net benefits. However, it is possible that a larger scale plan could be the NED Plan.
10. 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. 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 were not formulated to identify the NED Plan, and Alternative 10.1 is identified as the Recommended Plan. Net benefits for the Recommended Plan are estimated at $5.2 million while the benefit to cost ratio is 2.70.
11. RED and OSE analyses were conducted to evaluate the additional beneficial effects of the Recommended Plan. The RED analysis shows that the Recommended Plan would generate about 1,966 jobs, over $50 million in labor income, and about $58 million in value added to the regional economy during the construction period. OSE analyses show that the Recommended Plan would generate moderate to strong positive social impacts across most of the key categories evaluated most notably life, health and safety.

Addendum A: Regional Attractions Close to the City of Winslow

List of Regional Attractions Close to the City of Winslow

1. Homolovi State Park: Arizona's first archaeological state park, with six excavation sites in the works. (5 miles).

2. Little Painted Desert: An exotic combination of colors and natural road formations Hiking and picnic tables are available. (15 miles).

3. McHood Park/Clear Creek: This creek was once an important water source for Winslow. The deep canyon is a great place for boating, fishing, swimming, and picnicking. Campsites and picnic area on site. (5 miles).

4. Meteor Crater: The Meteor Crater has a circumference of three miles and a depth of 570 feet. The visitors' center has a space museum (25 miles, privately owned).

5. Cholla Lake Park: The largest body of water in northeast Arizona. Activities are camping, swimming, boating, fishing, picnicking, and wind surfing. (22 miles).

6. Petrified Forest & Painted Desert National Park: Two great parks in one. With the Petrified Forest at the south end and the Painted Desert to the north. The parks have a visitors' center, museum and hiking trails. (50 miles).

7. Hubbel Trading Post: This National Historic Site will give the visitor a very interesting taste of the past as it is still in operation. (120 miles).

8. Canyon De Chelly National Monument: You can take jeep tours, horseback rides, hike, or drive into rugged back country to see the ancient Indian Cliff Dwellings. (150 miles).

9. Hopi Indian Villages and Cultural Center: This is the location of Old Oraibi, the longest continually occupied village on the North American Continent. The cultural center is a collection of Hopi owned shops and a tribal museum.

10. Mongolian Rim: The scenic high country is the world's largest Ponderosa Pine Forest.

11. Walnut Canyon: The National Park provides the opportunity to explore the prehistoric cliff dwellings left by the Sinagua Indians. (50 miles).

12. Sunset Crater & Wupatki National Monument: Sunset Crater is the remains of an ancient volcano. Wupatki is an ancient Indian ruin 80 miles).

13. Grand Canyon: The earth's greatest canyon is one of the seven natural wonders of the world. Camping, hiking, mule rides and visitors center are all there. (140 miles)

14. Oak Creek Canyon: A scenic ride through some of Arizona's most spectacular red canyon country is especially beautiful in the fall. (74 miles).

15. Montezuma's Castle National Monument and Montezuma's Well: an ancient culture built dwellings under the overhang of a cliff, today they are known as Montezuma's Castle. Not far from there is a large fresh water spring know as Montezuma's Well. (100 miles).

16. Fort Verde State Historic Park: Built in the1870s, this old Fort played a key role in the conflict between the US Military and Apache Indians. (100 miles).

Addendum B: Local Attractions within the City of Winslow

List of Local Attractions within the City of Winslow

1. The Standin' on the Corner Park: Located in historic downtown Winslow is "The Corner", made famous by the song "Take it Easy", written by Glenn Frey and Jackson Browne, Take it easy became The Eagles first hit single in the 70's and peaked peoples interest in Winslow. The verse Standin' on the corner in Winslow Arizona" draws visitors from far and wide to stand on the famous corner. The Standin' on the Corner Park features a life sized bronze statue and a two story mural depicting the story behind the famous song. Be sure to read the inscribed bricks that pave the park.

2. Historic La Posada Hotel: The magnificent property, designed by renowned architect Mary Colter, is the last of the great Harvey Houses of the 1930's. Mary Colter was the premier southwest architect of the early 1900's. She herself referred to the La Posada Hotel in Winslow as her masterpiece. As the showplace of the entire Santa Fe Railroad system all passenger trains running between Los Angeles and Chicago stopped at the La Posada. The hotel has been beautifully restored and is in full operation. Enjoy strolling the beautiful gardens of the hotel while viewing this outstanding example of southwestern architecture.

3. Winslow's Remembrance Garden: This memorial is dedicated to the tragic event of that September day, in 2001 and Northern Arizona's promise that we will never forget. Our remembrance Garden is located on the corner of East 3rd Street and Transcon Lane (from I-40, exit 255). There you will find, as the centerpiece of the garden, the touching display of actual wreckage from the World Trade Center. The 14 and 15 foot beams were entrusted to the citizens of Winslow by the City of New York. They are the largest pieces given to the community in the nation.

4. The First Street Pathway: The First Street Pathway links two important historical sites in downtown Winslow: The Hubbell Trading Post (also the Winslow Visitor Center) and the La Posada Hotel. The landscaped pathway is six blocks long and has exhibits represent Winslow's driver's history (railroad, Route 66, etc.) Of particular interest to many visitors is the Peter Toth Monument, a hand carved totem pole. Renowned wood carver, Peter Toth, presented every state in the country with one of his fantastic totems. Winslow was the lucky city to receive the display his gift to the state of Arizona, when you visit Winslow be sure to check out the pathway.

5. Burlington Northern Santa Fe Railroad: Route 66 buffs enjoy Winslow's historic downtown district, where shops offer Route 66 and railroad memorabilia. As one of the major hubs of the BNSF Railroad, train enthusiasts can watch the engines roar into town on the patio behind the newly restored La Posada Hotel.

6. Old Trails Historical Museum: Winslow's Old Trails Museum opened in 1985 in an old bank building located in the heart of the downtown business district. The building, constructed in 1920, still contains its original tile floor, marble counters, and a vault, adding to the historic ambiance of the museum.

Addendum C: Regional Economic Development Analysis

Purpose

The Regional Economic Development (RED) account is a product of the difference in perspectives between the Federal government and local communities directly impacted by water resource planning. The Federal objective in water resource planning is contributing to national economic development and the Federal perspective is the nation as a whole. Local communities and regions directly impacted by water resource planning may consider impacts at the state, regional, or local level a more relevant measure. From the Federal perspective, transferring employment opportunities and resources from one region of the nation to another to construct a water resource project does not in itself constitute national economic development and therefore regional economic impacts may not be fully captured in the national economic development (NED) account. However, from a regional or local perspective, the transfer of employment opportunities and resources to construct a project in that region, as opposed to some other region of the United States, can be a significant benefit to the local economy in terms of more local employment, more local spending, and more local production. This is why the different perspectives between the Federal government and local communities impacted by water resource projects are addressed in different accounts. The Federal perspective is addressed principally in the NED account while the regional or local perspective is addressed principally in the RED account.

Process

To perform an economic analysis from the regional perspective (RED account), several different impacts from constructing the water resource project have to be analyzed. These impacts are termed direct, indirect, and induced effects.

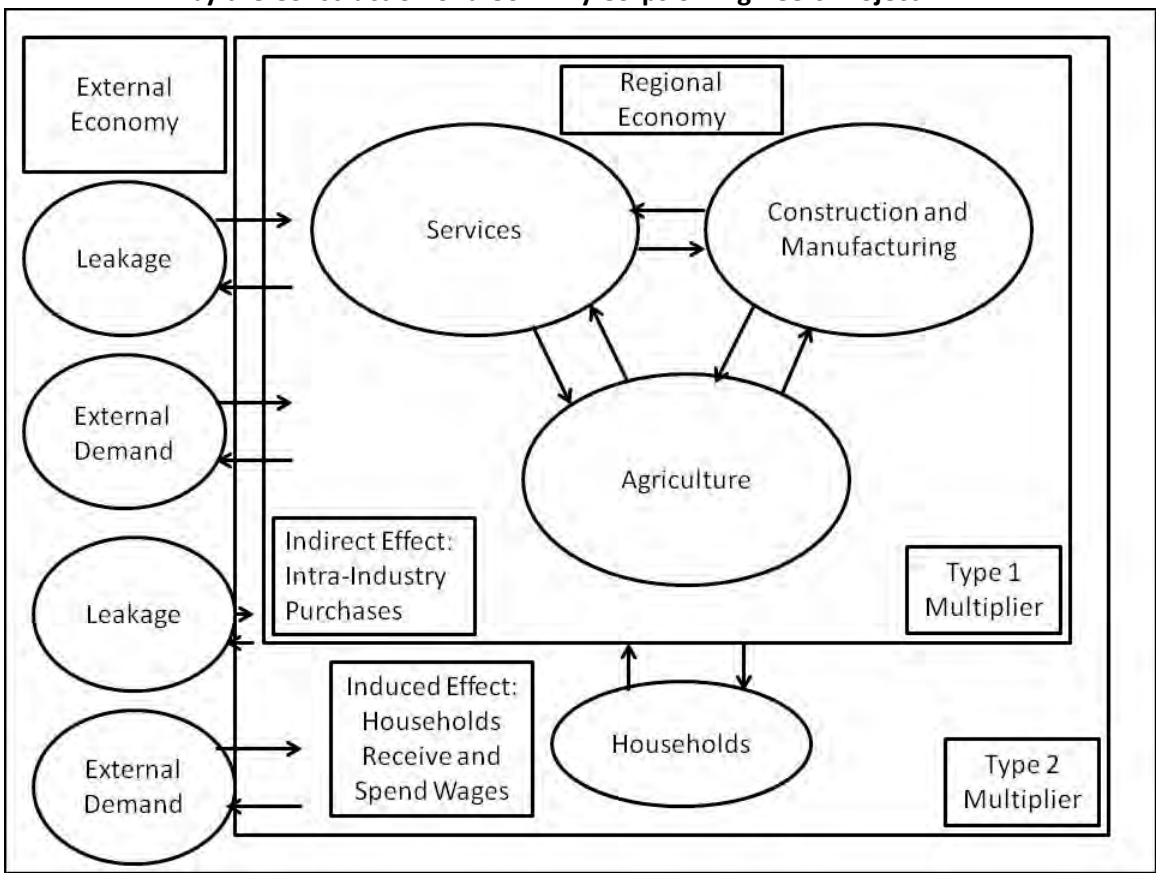
i) *Direct effects* are immediate effects associated with the change in total sales for a particular industry. In other words the proportion of the expenditure in each industry that flows to material and service providers in that region. Stated simply, these are the direct impacts to employment and income due to the demand for goods and services to complete construction (e.g. construction equipment and labor). The region is typically defined by political rather than economic or geographic boundaries. Political boundaries are broken down to state and county or metropolitan area for analysis.

ii) *Indirect Effects* are changes in inter-industry purchases in response to new demand from the directly affected industries. In other words the supply of materials and services to meet the needs of the companies or individuals directly engaged in constructing the project (e.g. concrete suppliers).

iii) *Induced effects* are changes in spending patterns from increases in income to directly and indirectly affected industries. Stated simply, this is the increased spending on local goods and services such as restaurants, grocery stores, hotels, and gas stations due to the direct and indirect effects of the project.

Figure 1 illustrates conceptually how the regional economic can experience changes in demand from the construction of a US Army Corps of Engineers Project. During construction, Federal project funds enter into the local economy. Funds entering into the regional economy directly affect the construction sector as individuals buy and sell construction goods, services and agriculture products. These funds have an indirect effect on the regional economy through linkages to the construction sectors such as construction suppliers and manufacturers. Meanwhile, direct and indirect construction and manufacturing activity impacts the regional economy by inducing spending on local good and services such as restaurants, grocery stores, hotels and gas stations. These are induced effects. Both indirect and induced effects affect the external economy through positive and negative changes to external demand and leakages to and from the economy. Finally, both indirect and induced effects are estimated through multipliers which can be thought of figuratively as money multiplying throughout the regional economy.

Figure 1: Illustration of how the Regional Economy can Experience Change in Demand Brought on by the Construction of a US Army Corps of Engineers Project



To estimate these regional effects the RECONS model was utilized. 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 US Army Corps of Engineers projects. The RECONS model was used to estimate the direct, indirect, and induced effects of the Recommended Plan. The Recommended Plan has been identified as Alternative 10.1.

The RECONS model generates regional construction multipliers based on the USACE business lines (navigation, flood mitigation, water storage & supply, etc.). Each business line is subdivided into numerous work activities, which improves the accuracy of the estimates for regional and national job creation, and retention and other economic measures such as income, value added, and sales. For this analysis the business line is Flood Damage Control/Flood Management Risk and the work activity is Construction and Repair of Levees. Table 1 below shows the first costs for the Recommended Plan. These costs include contingency and costs associated with planning engineering and design and construction management. These costs do not include operations and maintenance (projected ongoing costs that will be incurred subsequent to project construction) or interest during construction (an economic rather than financial cost). It is assumed that the project construction costs shown below will be incurred over approximately 5.5 years.

Table 1: Project First Costs – Recommended Plan

Plan	Costs
Alternative 10.1	$77,202,000

Analysis Results

Results are presented for the region, state, and nation. The region consists of 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.

Direct impacts (effects) to employment and income due to the demand for goods and services to build a levee include labor, equipment, and metals and steel materials. These contribute to additional output, additional demand for jobs, and increased value-added to goods and services within rural areas like Winslow, Arizona, the State of Arizona, and the nation.

Recommended Plan

Table 2 shows the regional economic impacts for the Recommended Plan (Alternative 10.1). In Table 2 the indirect and induced effects (the difference between the values for direct and total impact) are small for the regional economy when compared to the state and nation. This can be attributed to the fact that much of the goods and services that are needed for project construction will need to be acquired from outside the region.

Based on the estimated direct impacts we can expect about 1,795 jobs to be supported within the Winslow, Arizona region from the implementation of the Recommended Plan. These impacts are anticipated to occur over the project implementation period of about 5.5 years. Overall there would be an additional 1,966 jobs supported (direct, indirect, and induced) within the region by the Recommended Plan during the implementation period, 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 less than one additional full time equivalent job within the local economy throughout the study period. Overall, the Recommended Plan is expected to lead to about $58.4 million in value added in goods and services to the region and increased labor income of over $50.1 million.

Table 2: RED Impacts from Alt 10.1 (Recommended Plan)

		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	1,795	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

As mentioned previously, O&M expenses will increase output, jobs, labor income, and added value of the local economy annually (as shown below in table 3). These increases are in addition to the increases displayed in Table 2 for Alternative 10.1 (the Recommended Plan). The incremental annual O&M costs for maintaining the levee system under the Recommended Plan relative to O&M costs for the existing levee system are estimated at $50,000.

Table 3 RED from Operation & Maintenance Expenditures (Annual) – Recommended Plan

		Regional	State	National
Total Spending		$50,000	$50,000	$50,000
Direct Impact	**Output**	$18,342	$42,036	$49,986
	Jobs	0.17	0.38	0.45
	Labor Income	$5,766	$15,062	$19,010
	Value Added	$7,741	$20,495	$24,773
Total Impact	**Output**	$24,413	$78,961	$141,149
	Jobs	0.22	0.65	0.98
	Labor Income	$7,612	$28,541	$48,434
	Value Added	$11,215	$43,347	$75,078

Addendum D: Other Social Effects Analysis

Purpose

A water resource development project's potential beneficial or adverse effects on social well-being are reported under the Other Social Effects (OSE) account and reflect a highly complex set of relationships and interactions between inputs and outputs of a plan and the social cultural setting in which these are received and acted upon. The OSE account also integrates information into the planning process that is not reflected in the other three "accounts" used by the Corps of Engineers to evaluate projects and alternative plans. These other accounts include the: (1) National Economic Development (NED) account, which measures benefits and costs of a project or alternative, from a national perspective; (2) the Environmental Quality (EQ) of the impacted area; and (3) Regional Economic Development (RED) account which measures benefits and costs realized by the region but not the nation, as a whole.

This OSE analysis focuses on the social impacts induced by the Recommended Plan relative to the No-Action Plan (NAP) in the city of Winslow.

Dimensions of Interest and Analysis

The remainder of this report addresses the impact of the Recommended Plan on various "dimensions of interest" in the OSE account. These dimensions of interest were taken from a report entitled: *Applying Other Social Effects in Alternative Analy*sis published by the Institute of Water Resources for the US Army Corps of Engineers. They are: public health and safety, economic vitality and community cohesion, identity, and social vulnerability and resiliency. They are listed in tables below. Following each table is a discussion of how the dimensions highlighted in the tables apply to the NAP. All of the dimensions of interest compare the NAP with the Recommended Plan. The primary purpose of the project is the reduction of flood risk. Accordingly, it is generally through reduced flood risks that the Recommended Plan impacts each of these dimensions of interest.

Recommended Plan

The Recommended Plan includes levee improvements which would significantly reduce flood risks throughout Reach 1 of the study area. The plan is designed to convey the 1% annual chance of exceedance (ACE) flood (or "100-year") event with a 90% level of assurance. This project scale also corresponds with FEMA criteria necessary to support flood insurance rate map revisions and the need for residents to purchaser flood insurance. A non-structural plan was evaluated, which would raise floodplain structures in Reach 2 to reduce flood risks to those properties. However, this plan was not economically justified, and is not incorporated in the Recommended Plan.

The following analysis is focused on the Recommended Plan. Key features of the plan are to rebuild the east end of the Ruby Wash Diversion Levee (RWDL), improve conveyance under the Burlington Northern/Santa Fe Railroad Bridge, add a new levee parallel to Highway 40, rebuild Winslow levee and remove and replace a small portion of the levee by creating a levee setback. Levee improvements would extend partially into Reach 2 thus protecting the North Park commercial area. Reach 2 will retain some flood risk protection from the existing levee. None of the areas in Reach 2 are expected to reach flood depths of greater than 5 feet. No improvements would be made to this portion of the levee.

Table 1: Dimension of Interest One: Public Health and Safety

Social Factor	Metric	Description
Public Health and Safety	Mental Health	Issues affecting the overall mental health of a person, such as anxiety and stress
	Physical Health	Issues affecting a person's physical health
	Physical Safety	Safety issues that could cause bodily harm to a person

Without Project Condition: Public Health and Safety

As noted in Section 1.0 of this Economic Appendix, the City of Winslow has had a long history of flooding. Significant flood events have occurred in 1923, 1978, 1993, and 2003. In the 1993 event several hundred homes were inundated in the Ames Acres and Bushman Acres subdivisions. Major flood damages were fortunately avoided due to emergency response efforts in the 2003 event when a section of levee in the Study Area began failing. Engineering analysis has verified the issues with the existing levees, which led to the decertification of the levees by FEMA in 2008. This Appendix has documented that in the absence of improvements to the levee, thousands of residents would be at risk from a levee failure. Such a failure could occur with very little warning time, making it difficult to notify and evacuate residents. Many areas would be quickly inundated with several feet of water, leading to significant public health and safety risks. Some of these risks may include the potential for the injuries or even drowning of individuals. Water depths would reach six feet in a few areas for a 1% ACE flood. The velocity of water also makes flooding a significant life safety risk. The elderly and children are particularly vulnerable to drowning. Another potential life and safety issue may relate to the Winslow waste water treatment plant. A flood my cause a potential release of sewage and waste water. This may cause potential sickness for those who come in contact. However, the Winslow Waste Water Treatment Plant has recently constructed a ring levee to prevent significant impact from a sewage or wastewater release. So, the probability of this occurring under the future without project condition has been reduced, although if a flood event is significant enough, a release of sewage and wastewater is still possible.

Analysis of the Recommended Plan: Public Health and Safety

The construction of levee improvements would result in less flood related risk to the Winslow public in terms of health and safety. A majority of the population as well as the City's downtown would be afforded significant reduction of levee failures or overtopping. There would a substantial reduction in the risk of injuries, deaths, and impacts from water borne diseases from standing flood waters. Also, negative impacts to mental health from flood events would be reduced, such as stress of needing to find living accommodations, cleaning up flood debris, and finding nourishment. The Recommended Plan would allow for improved safety to residents in the area by protecting public safety infrastructure such as the Winslow fire department. The Sheriff's office and police department are outside the floodplain and therefore may be susceptible to flooding for very large events. Although flood risk for these facilities are low, the ability of the Police Department and Sheriff's office to respond to emergencies during a major flood event would be severely limited given the large portion of the town that would be inundated.. Flood threats to public health facilities, such as the dialysis center and general hospital would also be reduced. The plan would further reduce impacts to emergency response that occur when floodplain transportation infrastructure is inundated. The plan provides a reduction in risks to public health and safety and provides 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. However, the risk in this area will not be any worse than under the NAP.

Table 2: Dimension of Interest Two & Three: Economic Vitality and Community Cohesion

Social Factor	Metric	Description
Economic Vitality	Business Climate	Issues affecting the ability of a community to retain and attract businesses
	Employment Opportunities	Issues affecting the availability to provide employment opportunities for residents
	Financial Impacts	Issues affecting a person or group's standard of living
	Municipal Services	Issues affecting the local tax base and ability to provide municipal services
Community Cohesion	Social Connectedness	Issue affection local social networks, including personal networks
	Community Facilities	Issues affecting access to local community related facilities

Without Project Condition: Economic Vitality and Community Cohesion

The economic vitality within Winslow would be negatively impacted by major flood events. The two significant enterprise areas in the floodplain are Old Town/Downtown Winslow and the North Park Commercial District. Old Town/Downtown Winslow is located in Reach 1 along 2nd and 3rd Avenues while the North Park Commercial District is located in Reach 2 just north of highway 40 on North Park Drive. Of the two areas, Old Town Winslow has more quaint shops such as restaurants, antiques shops, coffee shops, souvenir shops, gas stations, barber shops and other small commercial and business enterprises. Most of the buildings in this area were built before 1935 and are an active part of a revitalization effort that began in 1990. This area has an active tourist base. In the North Park area there are also shops. These are more modern and suit the daily needs of the Winslow citizenry. This area includes restaurants, gas stations, grocery stores, and a Super Walmart. Any major flood event inundating these commercial areas would result in not only damages to the buildings and their contents, but also increased operating costs and temporary business losses. The viability of some businesses could be threatened, resulting in potential closures, reductions in employment/layoffs, etc. Further, negative impacts to the City's economic base would also harm the local tax base. During a post-flood period, local tourism would also be negatively impacted. These losses would only be partially offset by temporary regional economic activity that ensues during post flood recovery and reconstruction efforts.

Furthermore, any disruption of the intermodal transportation system is likely to decrease levels of economic vitality and community cohesion. A well-functioning system provides access to suppliers, distributors, wholesalers and retailers in the local market. During a major flood event Highway 87, the Burlington Northern and Santa Fe Railway, and major streets may be inundated; increasing travel times and uncertainty surrounding arrival times for goods travel to, from and through the region. This is especially true along major railroad junctions and intermodal facilities discussed elsewhere in the report. Traffic delays and disruptions are important in time sensitive supply shipments. If products are not delivered on time or if products perish in transport, this could cause price markups in local stores. Furthermore, when businesses in Winslow rely on their supply being delivered consistently and on time, this means they can operate with fewer inventories. If during a flood event these inventories are depleted, individuals will have to face undue hardship by living without basic necessities.

During a 1% ACE or larger scale event, Highway 87, the Burlington Northern/Santa Fe Railway, and streets within the main City of Winslow are expected to be inundated for up to two to three days at depths approaching four to five feet for Highway 87 and the railway and four to five feet in downtown Winslow. This amount of inundation could provide inconveniences in employment, income, the lack of store inventory, and the potential markups of goods and services. Individuals could also be affected by changes in arrival and departure times of train services which will ultimately affect transportation of individuals and commercial

goods to the Winslow area. Highway 40 is another main transportation thoroughfare but it is at a reduced risk of being inundated because it is elevated above the 0.5% ACE water surface elevation.

Other flood threats to community cohesion are from the potential inundation of the Amtrak's Southwest Chief passenger rail service between Chicago and Los Angeles. In FY 2013, the Southwest Chief, which runs through the Study Area, carried over 350,000 passengers and generated $44 million in revenue. 10% of these annual passengers go through Winslow (generating over $12,000 every day for Amtrak). Any disruption through Winslow would upset Winslow's role as a stopover location for those traveling Amtrak's transcontinental system. The impact locally may be to potential tourism income and to other local commercial enterprises such as the La Posada Hotel located at the Winslow train stop. Also, individuals who use the train for travel to and from their Winslow home will also be affected.

Other impacts to community cohesion not related to economic vitality are to social connectedness through the loss of roadways, telecommunication and medical care. Social connectedness would also be affected in a major flood event as local roadways, highways, and telecommunication lines could be impacted, individuals may feel stranded and need to rely on cell phones which use cell towers to maintain social and personal networks.

Also, connections to major medical care would be cut or interrupted during a flood event further impacting the social connectedness of the community. Winslow is a regional medical center for northern Arizona. It is especially crucial for 60,000 members of the Navajo and Hopi tribes who live within the 3,300 square mile service area of the Winslow Indian Health Center. Individual social connectedness in Winslow would also be affected if the dialysis center and general hospital were inundated.

Analysis of the Recommended Plan: Economic Vitality

If a "100-year" or greater flood were to occur, commerce in the North Park Commercial District and the approximate eastern one-third of old town/downtown area would be interrupted, thereby impacting the profitability of these businesses. In the immediate aftermath of a flood, individuals would also be inconvenienced as they search for consumer goods such as water and food thus affecting for at least several days the standard of living for those living in the City of Winslow. Subsequently, there would be substantial negative impacts to the local economy as described under the Without Project Condition paragraph above. The Recommended Plan would substantially reduce these negative impacts as they would offer risk reduction to the major commercial sectors of the City. Although the project would reduce short term negative impacts to economic vitality, the longer term impacts are not expected to be as substantial given the limited duration of flooding and subsequent post flood recovery/reconstruction that would occur.

As noted above, transportation networks including Highway 87, the Burlington Northern/Santa Fe Railway, and other streets are expected to be inundated during major flood events. The Recommended Plan would significantly reduce threats to the public transportation network which would improve the impact on economic vitality and community cohesion. The plans would also reduce flood risks to medical facilities. Many seek treatment for chronic medical conditions such as diabetes, heart disease, and liver and kidney failure. Reductions in flood events that may inundate the general hospital, dialysis center and local clinics and transportation providing access to these facilities for several days would represent a major social benefit to the community.

Community cohesion would also be improved in terms of normal communication and interactions among residents. In the aftermath of flood events, such interaction is lost, as residents must focus on addressing their own health and safety, in some instances finding temporary housing and subsequently addressing their own property damages. The risks of flooding, and therefore such impacts to community cohesion are substantially reduced by the plan.

Table 3: Dimension of Interest Four: Identity

Social Factors	Metric	Description
Identity	Cultural Identity	Issues affecting sense of cultural identity within the community
	Community Identity	Issues affecting sense of community identity

Without Project Condition: Identity

The City of Winslow's identity can be seen in its social environment and local architecture. On a social level the City of Winslow holds numerous community gatherings which help to bolster not only city identity but also the sense of community. Some of the more popular gatherings that occur at Winslow are: the Day of the Dead celebration inside the Snowdrift Art Space main exhibition hall, the Winslow Christmas parade, the local hot rod car show located at the famous Standin' on the Corner Intersection of Old Route 66 in the center of downtown Winslow, and the annual material girls quilt show held at Snowdrift Art Space. These events bring together the community by helping it build social connections. These social connections can also help the community when faced with a flood hazard event. A close knit community may also lead individuals to inner strength and resiliency within the community during the aftermath of a hazard event.

Identity of a community can also be defined by the historical structures that have been built over time. These structures give the community character and identity. In this case, the structures in Winslow tell a story of the city evolving from a train town and a city with significant American Indian and pioneer heritage. These structures can be categorized as commercial, residential and archeological. The commercial structures include the La Posada Historic District, the Lorenzo Hubbell Trading Post and Warehouse and the Winslow commercial historic district. The La Posada Historic District's main feature is the historic 1929 hotel. It was built by renowned architect Mary Colter and is considered the finest example of Spanish colonial architecture in Arizona. It is also one of the last great railroad hotels in America. It was restored to its former glory in the mid 1990's. The La Posada features museums, gardens, and a railroad passenger station in addition to the hotel. Another commercial building is the Lorenzo Hubbell Trading Post and Warehouse (Winslow's Visitors Center). It was built in 1917 and served as a Navajo/Hopi trading post and wholesale store by the Hubbell family. It is a Pueblo revival style example of southwest architecture. Finally, the Winslow commercial historic district or old town area has approximately two thirds of its buildings on the National Register of Historic Places due to their intact 19th and early 20th century street scape that reflects Victorian and indigenous red sandstone. These architectural buildings were popular between 1883 and 1935. The residential structures that have formed Winslow's identity comprise Winslow residential historical district. Winslow's residential historic district includes eleven homes built between 1890 and 1910. The architectural styles of these homes are typical of Winslow during its original settlement. Finally, the archeological sites within Winslow have helped form the City's identity though its rich heritage. The two sites are Brigham City and Homolovi State Park. Brigham City, established in 1876, was a fortified Mormon settlement on the Little Colorado River. Thirty-seven of the community's buildings remained well preserved. The site is perhaps one of the last examples of the self-sufficient American pioneers who settled in the territory. Another archeological site, the Homolovi State Park, is a cluster of four archaeological sites that include seven separate pueblos built between 1260 and 1400 AD. The Homolovi I Pueblo, located on the east bank of the LCR across from Winslow, is the most culturally significant of these sites. This site are culturally important to the Hopi people as historical sites and part of their homeland. Many Hopi still make pilgrimages to the site. All of these help comprise the identity of Winslow, and to the extent that flooding may cause damages to these important structures and landmarks, there would be corresponding negative impacts to the community's identify.

Analysis of the Recommended Plan: Identity

Of the sites listed above, the La Posada Hotel and about one third of the Old/Downtown Winslow are at risk from flooding during a 1% ACE event in Reach 1. The Recommended Plan would reduce the detrimental impacts to the Victorian structures and pueblo styled hotel, La Posada. These structures are made of sandstone and mud based building materials that are likely to not withstand the velocities of even a moderate flood event.

Two sites, Brigham City and the Homolovi I Pueblo in Reach 2 are at risk of flooding during a 1% ACE event. Expected durations and inundation of flooding for the two sites are 17 hours at up to 3 feet of water. These sites are located in close proximity to the LCR and are provided some flood risk mitigation by the existing Winslow Levee. Currently, the annual chance of flooding (annual exceedance probability) is about 7%. For the 10%, 2%, 1% and 0.5% ACE events, the probabilities of flooding at these sites are about 12%, 33% 50% and 69%, respectively. These conditions would remain even with the construction of the Recommended Plan because the Recommended Plan improvements do not protect these areas. However, while improvements are not planned in the Reach 2 area, these archeological sites are considered a valued cultural resource, one that is difficult to monetized and evaluate economically. The project is designed to avoid inducing flooding in this area.

The other commercial and residential sites listed in the previous section are primarily located in the middle to west side of the City of Winslow and are not expected to be inundated from a 1% ACE flood event.

Table 4: Dimension of Interest Five: Social Vulnerability and Resiliency

Social Factors	Metric	Description
Social Vulnerability and Resiliency	Residents of Study Area	Issues affecting the overall vulnerability to the population within the study area.
	Social Vulnerability Groups	Issues Affecting Socially Vulnerable Groups

Without Project Condition: The Theory of Social Vulnerability and Resiliency

"Social vulnerability is the stress felt by individuals who face challenges in their ability to respond, cope with, and recover from environmental hazards such as flooding" -- this definition is concise but tells only a part of the social vulnerability story. Social vulnerability is not simply a measure of personal stress, it is also measures the susceptibility of individuals to tangible economic losses and their resiliency in responding to those losses. Vulnerability to stress, as defined above, and vulnerability to economic loss are often negatively correlated. Those who feel more vulnerable to stress are often marginalized by society. Those who are vulnerable to large tangible economic losses are less marginalized. In the short run, the marginalized and less marginalized are impacted significantly. But, in the long run, it is ultimately the individuals marginalized by society that are less capable to respond, cope and recover from stress and loss. Meanwhile, those who face greater economic loss due to ownership of higher valued homes and cars are monetarily worse off in the short run; but in the long run they are better able to respond, cope and recover due to higher levels of educational attainment and access to socio-economic resources. Accordingly, these individuals exhibit higher levels of resiliency. The ability to reduce the impact of future crises, through planning, social interaction and access to aid are also important components of resiliency and social vulnerability.

Within Winslow, a segment of the population is considered highly marginalized. This can be seen from local population, economics and housing demographics of the area. Of the 9,655 residents in Winslow as of 2010, 65% were minorities, 33% were single mothers, 22% were single mothers with children under 5, 26% of the population are children under 18 and 10% were elderly over 65. Another vulnerable population

is those who are sick and ailing. 16,500 Navajo/Hopi patients regularly travel from their home reservations to seek medical care at the Winslow Indian Health Center.

On an economic level, 27% of all residents live in poverty compared to 13% nationally. The per capita income within Winslow is $14,482 compared to the national average of $29,829. Winslow's median household income is $34,239, compared to $55,322 nationally. For 2016, Winslow's unemployment rate was about 7%, which was substantially higher than the national average of 4.9%. Finally, 153 individuals or 1.6% of the population are either disabled and/or rely on supplemental security income. Economic loss can be assessed for the occupied units that lay in the Winslow floodplain. The median value of owner-occupied housing units in Winslow from 2012-2016 was $81,500 compared to the US median value of $184,700.

To improve resiliency, individuals working at the local flood control district have implemented a hazard warning system, there have also been improvements to the building code. After previous flood events inundating the Bushman Acres area of the floodplain, individuals have applied for insurance and sought disaster relief. All of these behaviors promote resiliency during and after a flood event. But, there are still socially and economically vulnerable segments of the population whose ability to respond and recover from flood related impacts is more challenging. This makes them less resilient to recovery.

Analysis of the Recommended Plan: Social Vulnerability and Resilience

Social vulnerability measures in Winslow, such as percentage of minorities, single mothers, young children, elderly, sick and ailing, impoverishment and unemployment in the population suggest a high degree of social vulnerability, when compared national averages. The Recommended Plan would result in a moderate reduction in an individual's vulnerability to stress and economic loss. They will benefit from reduced fear of flooding in the area and the need to face post-flood economic and social consequences. Even moderate flooding can affect an individual's ability to achieve a pre-flood level of recovery.

Social vulnerability is almost never driven by a single factor, such as flooding. Instead it is often the result of a variety of socio-economic factors and the individual is vulnerable to a variety of adverse events. However, the Recommended Plan would provide significant benefits to the socially vulnerable in Winslow.

Summary of No Action Plan and Recommended Plan

This OSE analysis describes adverse effects from flooding for the NAP as well as the beneficial social effects from the Recommended Plan. Impacts are categorized by OSE dimensions of interest. Public health and safety have a strong/adverse effect from flood risks under the NAP. The Winslow area has had a long history of flooding - one that has the potential to impact and harm its citizenry. The Recommended Plan would reduce this impact in a strong/moderate way by reducing the chance of harm and decreasing the inundation of key protective and health services. Economic vitality will have a moderate adverse effect from flooding under the NAP. Of the two key economic areas, the one that is impacted more is the North Park area. This area has a key anchor store that provides much of the needs of the individuals living in Winslow. The beneficial effect from the Recommended Plan would counter this adverse impact by removing the North Park Commercial District from the 1% ACE floodplain. Community cohesion will have a moderate/small adverse effect under the NAP. Even though roads will be inundated they will be inundated for a relatively short period of time, making the effect more an inconvenience to most. However, the generally small adverse effect is more significant for those using the transportation network for public health and safety. Under the NAP and the Recommended Plan, there would be small adverse effects from flooding to identity because although the Homolovi I Pueblo and the Brigham City settlement do not have a significant probability of flooding, the probability will not be reduced under the Recommended Plan. However, impacts to the downtown area under the NAP are more significant especially if the historic downtown and La Posada structures are damaged. The Recommended Plan significantly reduces such impacts. Finally social vulnerability will be affected strongly/moderately under the NAP. Much of the current population is considered to be those in the marginalized demographic. Also, individuals vulnerable to economic loss will be affected moderately. Under the Recommended Plan, individuals will be less likely to

lose employment, income, feel stress from flooding and be impacted by the possibility of raised prices for goods and services. Businesses will be impacted less by flooding, temporary business disruptions, transportation impacts and lost business/income.

Table 5: Dimensions of Interest Summary

Category	The Adverse Effect from Flooding for the Without Project Condition	The Beneficial Effects from the Recommended Plan
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

Addendum E: Exceedance Probability Damage Functions

Without Project – Reach 1

Exceedance Probability	Damage by Damage Categories										Total Damage
	AUTO	CLEAN	COM	IND	LAND	MFR	MH	PUB	SFR	TEHRA	
0.0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0250	17018.94	26279.14	83710.13	3655.14	4206.90	10612.68	4978.92	18594.83	79808.05	14330.36	263195.09
0.0200	17526.28	27062.54	86205.56	3764.10	4332.31	10929.05	5127.34	19149.14	82187.16	14757.56	271041.03
0.0150	17992.99	27783.20	88501.17	3864.34	4447.67	11220.08	5263.88	19659.08	84375.76	15150.54	278258.72
0.0100	18608.03	28732.88	91526.32	3996.43	4599.71	11603.61	5443.81	20331.06	87259.89	15668.42	287770.16
0.0090	18778.40	28995.95	92364.30	4033.02	4641.82	11709.85	5493.65	20517.21	88058.81	15811.87	290404.88
0.0080	18971.40	29293.96	93313.59	4074.47	4689.53	11830.20	5550.11	20728.08	88963.85	15974.38	293389.56
0.0070	19185.77	29624.98	94368.02	4120.51	4742.52	11963.88	5612.83	20962.30	89969.13	16154.89	296704.81
0.0060	19408.24	29968.50	95462.27	4168.29	4797.51	12102.61	5677.91	21205.37	91012.38	16342.22	300145.28
0.0050	19630.27	30311.34	96554.36	4215.98	4852.39	12241.06	5742.87	21447.96	92053.55	16529.17	303578.94
0.0040	19861.36	30668.16	97691.00	4265.61	4909.51	12385.16	5810.47	21700.45	93137.21	16723.75	307152.69
0.0020	21799.79	33661.31	107225.44	4681.92	5388.67	13593.93	6377.56	23818.37	102227.21	18355.96	337130.16
0.0010	25156.88	38845.04	123737.80	5402.92	6218.51	15687.35	7359.69	27486.31	117969.87	21182.71	389047.09

Without Project – Reach 2

Exceedance Probability	Damage by Damage Categories										Total Damage
	AUTO	CLEAN	COM	IND	LAND	MFR	MH	PUB	SFR	TEHRA	
0.0750	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0400	42.65	69.97	83.43	0.00	18.61	0.00	23.61	32.19	357.24	44.51	672.21
0.0250	111.60	183.10	218.33	0.00	48.71	0.00	61.77	84.23	934.81	116.48	1759.04
0.0200	141.15	231.59	276.14	0.00	61.60	0.00	78.13	106.54	1182.35	147.33	2224.84
0.0150	185.92	305.04	363.72	0.00	81.14	0.00	102.91	140.33	1557.35	194.06	2930.47
0.0100	256.84	421.39	502.46	0.00	112.09	0.00	142.17	193.85	2151.36	268.08	4048.23
0.0090	275.37	451.81	538.73	0.00	120.18	0.00	152.43	207.85	2306.65	287.43	4340.44
0.0080	296.19	485.96	579.44	0.00	129.27	0.00	163.95	223.56	2480.99	309.15	4668.51
0.0070	320.48	525.82	626.97	0.00	139.87	0.00	177.40	241.89	2684.50	334.51	5051.45
0.0060	349.23	572.99	683.21	0.00	152.42	0.00	193.31	263.59	2925.30	364.51	5504.57
0.0050	382.05	626.83	747.41	0.00	166.74	0.00	211.47	288.36	3200.18	398.77	6021.82
0.0040	423.63	695.06	828.77	0.00	184.89	0.00	234.49	319.75	3548.53	442.17	6677.30
0.0020	548.40	899.77	1072.86	0.00	239.34	0.00	303.55	413.92	4593.64	572.40	8643.90
0.0010	753.51	1236.28	1474.11	0.00	328.86	0.00	417.08	568.73	6311.66	786.48	11876.70

With Project (Recommended Plan) – Reach 1

Exceedance Probability	Damage by Damage Categories										Total Damage
	AUTO	CLEAN	COM	IND	LAND	MFR	MH	PUB	SFR	TEHRA	
0.1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0750	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0400	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0250	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0200	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0090	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0080	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0070	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0060	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0050	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.0040	25112.84	35704.41	115037.36	6165.18	5750.06	16509.59	6341.39	26027.69	116429.91	17946.19	371024.63
0.0020	26010.75	36981.04	119150.55	6385.62	5955.65	17099.89	6568.13	26958.31	120592.89	18587.86	384290.69
0.0010	27388.03	38939.20	125459.63	6723.74	6271.01	18005.34	6915.92	28385.77	126978.34	19572.09	404639.06

With Project (Recommended Plan) – Reach 2

With Project Exceedance Probability/Damage Function for Reach 2 for the Recommended Plan is the same as for Without Project conditions (no improvements included in Reach 2).