US Army Corps of Engineers

Lower Missouri Jefferson City L-142 Flood Risk Management Study

Final Integrated Feasibility Report and Environmental Assessment

Appendix E Economics and Social Considerations

July 2026

MISSOURI DEPARTMENT OF NATURAL RESOURCES

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1 INTRODUCTION

1.1 Purpose

This feasibility-level economic analysis provides a benefit-cost analysis of the proposed Jefferson City flood-risk management project. Demographic data and economic development background pertaining to the community are presented, and the development of a complete structure inventory is discussed. The inventory serves as the basis for a risk-based analysis which evaluates flood damages in the study area on an annualized equivalent basis and calculates damage reduction project performance by simulating a large number of possible flood events, considering all pertinent economic and engineering data including uncertainty factors. This analysis results in several outputs:

- Description and quantification of economic analysis of flood damage impacts to properties within the study area in the existing condition.
- Statistical estimates of project engineering performance or reliability under existing conditions in the context of a range of possible flood events.
- Estimated economic performance of alternatives formulated to improve project performance, in terms of annualized benefits and costs.
- Economic optimization of alternatives and identification of the most economically efficient alternative.
- Characterization of the selected plan in terms of economic performance (annual costs and benefits), enhancement of environmental justice, and engineering performance (or assurance).

1.2 Study Guidance

Pertinent guidance governing economic analysis procedures includes:

- Economic and Environmental Principles and Guidelines for Water and Related Resources Implementation Studies (P&G), dated March 1983
- Engineering Regulation (ER) 1105-2-100, “Planning Guidance Notebook,” dated 22 April 2000 (partially updated subsequently)
- Engineering Regulation (ER) 1105-2-101, Risk-Based Analysis for Flood Damage Reduction Studies, dated 3 January 2006
- Engineering Regulation (ER) 1105-2-103
- Engineer Manual (EM) 1110-2-1619, Risk-Based Analysis for Flood Damage Reduction Studies, dated 29 Sep 2025
- Engineer Regulation (ER) 1165-217, Civil Works Review Policy, 19 Aug 2025
- Economic Guidance Memorandum (EGM) 01-03, Generic Depth-Damage Relationships, 4 Dec 2000
- Economic Guidance Memorandum (EGM) 04-01, Generic Depth-Damage Relationships for Residential Structures with Basements, dated 10 October 2003
- EGM 09-04, Generic Depth-Damage Relationships for Vehicles, dated 22 Jun 2009

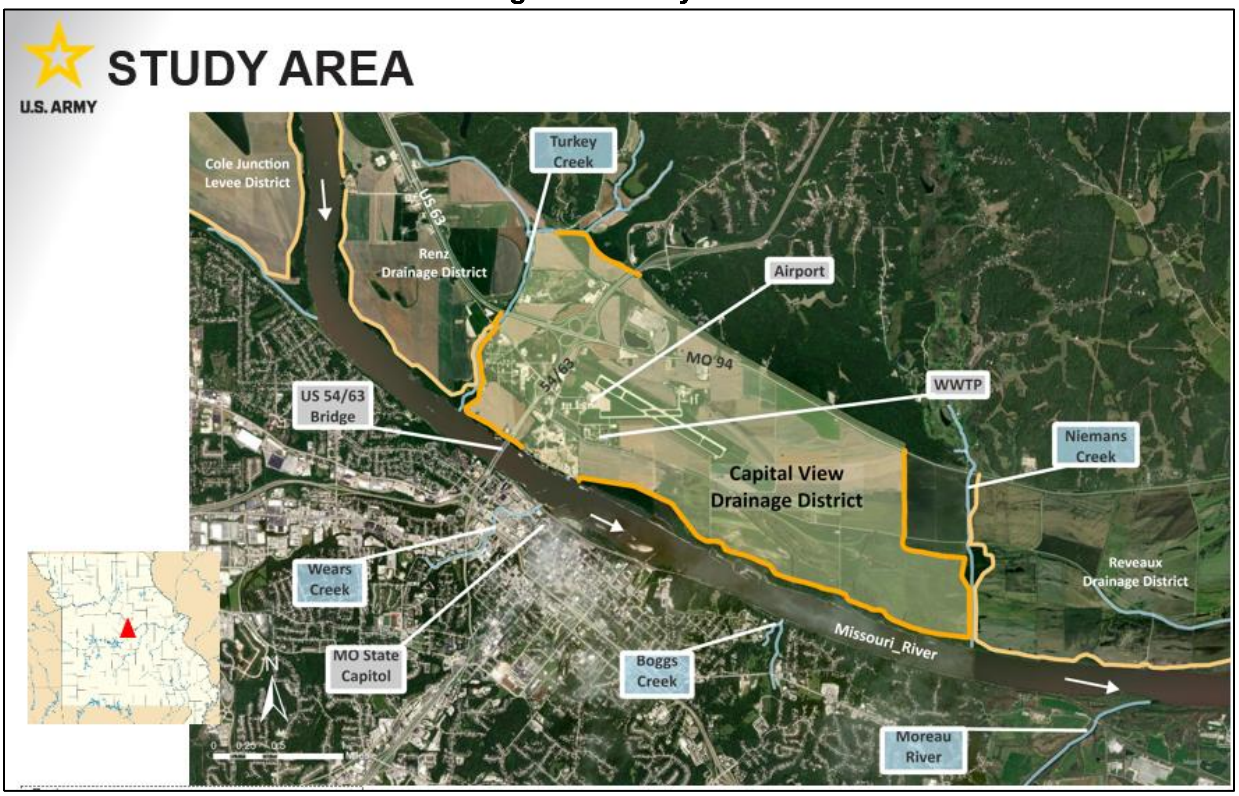
- Institute for Water Resources (IWR) Report 96-R-12, Analysis of Nonresidential Content Value and Depth-Damage Data for Flood Damage Reduction Studies, May 1996
- Engineer Regulation (ER) 1165-2-26, Implementation of Executive Order 11988 on Flood Plain Management, 30 Mar 84
- Planning Bulletin (PB) 2019-04, Incorporating Life Safety into Flood and Coastal Storm Risk Management Studies
- Secretary of the Army (Civil Works) (SACW) POLICY DIRECTIVE – Comprehensive Documentation of Benefits in Decision Document, 5 Jan 2021
- Water Resources Development Act (WRDA) of 1990, Sec. 308 Flood Plain Management, 28 Nov 1990

2 Study Area Setting

2.1 Location

The proposed project is located in Jefferson City, Missouri, on the north side of the Missouri River. The portion of Jefferson City the project is located in is part of Callaway County. That is where the vast majority of this analysis is focused, although additional socioeconomic analysis was done for the Cole County portion of Jefferson City (south of the Missouri River) to assess all potential project impacts. While the project area has a small population, it is important to analyze the entirety of the surrounding area as the effects of inundation reach beyond the project area. The closing of the regional airport and the US 54/ 63 bridge significantly affects travel for the region. Inundation would also potentially close important employers and infrastructure that people outside the project area rely on. **Figure 1** below shows the location of the proposed project area.

Figure 1. Study Area



2.2 Socioeconomics

According to the Census Bureau, the total population of Jefferson City is 42,564 and the population of Callaway County is 45,126 as of 2024. The percentages of dependent population (children, teenagers, and the elderly) are similar to the state and national average. Both Jefferson City and Callaway County have slightly higher percentages of male population than the state and country. Callaway County has a higher White population than Missouri and the United States. Jefferson City has a slightly smaller percentage of White population than the United States. Jefferson City has higher levels of high school graduates and people with bachelor’s degrees than in the US. Callaway County has a high level of high school graduates but a lower percentage of people with bachelor’s degrees. Refer to **Table** 1 for details.

Table 1. Demographic Data

Indicator	Jefferson City (2024 Data[1])	Callaway County (2024 Data[1])	Missouri (2024 Data[1])	U.S. (2024 Data[1])
Total Population	42,564	45,126	6,245,466	340,110,988
Age				
% under 5 years	5.9	5.4	5.6	5.5
% under 18 years	19.9	20.5	22.0	21.5
% 65 and older	17.5	19.0	18.7	18.0
Sex				
% Male	51.1	51.4	49.3	49.5
% Female	48.9	48.6	50.7	50.5
Race (percentage)				
White	72.3	90.4	82.1	74.8
Black or African American	16.1	5.1	11.7	13.7
American Indian and Alaska Native	0.4	0.7	0.7	1.4
Asian	2.4	0.9	2.5	6.7
Native Hawaiian and Other Pacific Islander	0.0	0.1	0.2	0.3
Two or more races	6.8	2.8	2.8	3.1
Hispanic or Latino (of any race)	4.0	2.7	5.6	20.0
Education				
% High School or higher	92.8	91.1	91.9	89.6
% Bachelor’s Degree or higher	38.7	24.6	32.4	35.7

Sources: American Community Survey 2024 5-Year Estimates Data Profiles, Census Bureau QuickFacts

[1]*Most recent data available*

As seen in **Table 2**, the per capita income for Jefferson City and Callaway County are both lower than the state and country per capita income. While lower than the state of Missouri, both Jefferson City and Callaway County have higher poverty rates than the United States. Compared to the US, Jefferson City has a higher percentage of people employed in the following industries: retail trade; finance, insurance, real estate, and rental and leasing; and public administration. Jefferson City has a lower percentage of population employed in the following industries: agriculture, forestry, fishing and hunting, and mining; construction; wholesale trade; transportation and warehousing, and utilities; information; professional, scientific, management, administrative, and waste management services; educational, health and social services; arts, entertainment, recreation, accommodation and food services; and other services. Compared to the US, Callaway County has a higher percentage of population working in the following industries: agriculture, forestry, fishing and hunting, and mining; construction; retail trade; transportation and warehousing, and utilities; other services; and public administration. Callaway County has a lower percentage of population working in the following industries: wholesale trade; information; finance, insurance, real estate, and rental and leasing; professional, scientific, management, administrative, and waste management services; educational, health and social services; and arts, entertainment, recreation, accommodation and food services.

Table 2. Economic Data

Indicators	Jefferson City (2024 Data[1])	Callaway County (2024 Data[1])	Missouri (2024 Data[1])	U.S. (2024 Data[1])
Economics				
Per Capita Income	$37,220	$33,886	$39,695	$44,673
Household Income	$66,371	$74,176	$70,702	$80,734
Unemployment Rate	2.0%	3.0%	2.1%	2.9%
Persons In Poverty	12.0%	11.8%	12.3%	10.6%
Industry (percentage of workers)				
Agriculture, forestry, fishing and hunting, and mining	0.3	2.3	1.6	1.6
Construction	6.7	7.1	6.8	6.9
Manufacturing	6.8	10.1	11.3	9.9
Wholesale Trade	1.6	1.6	2.3	2.2
Retail Trade	11.9	12.3	11.3	10.8
Transportation and warehousing, and utilities	3.7	7.9	5.9	5.9
Information	1.8	.09	1.5	1.9
Finance, insurance, real estate, rental and leasing	7.6	6.0	7.2	6.7
Professional, scientific, management, administrative, and waste management services	9.9	7.5	10.4	12.6
Educational, health and social services	22.9	23.1	24.3	23.5
Arts, entertainment, recreation, accommodation and food services	6.6	5.5	8.1	8.7
Other services (except public administration)	4.0	5.5	4.8	4.7
Public administration	16.0	10.2	4.3	4.7

Sources: American Community Survey 2024 5-Year Estimates Data Profiles, Census Bureau QuickFacts

[1]*Most recent data available*

At this time, the USACE does not anticipate any substantial changes to these existing socioeconomic FWOP conditions within the period of analysis.

2.3 Local Economy

Jefferson City is the capital of Missouri. Most of the economic and political activity that takes place in Jefferson City does so on the south side of the river, outside of the project area. That is where the vast majority of businesses and homes reside as well. After the 1993 flood, most residences in the study area (over 100) were bought out by the government and today, only six functioning homes remain (with an additional dilapidated home bringing the total to seven). Most of the structures in the project area are commercial, industrial, or public. The main businesses in the study area are Capital Sand & Gravel, Jefferson City Memorial Airport, and Hitachi Energy. Major public structures include the Jefferson City Regional Wastewater Treatment Plant and the National Guard Armory. The study area also contains vital transportation arteries that handle a combined nearly 80,000 vehicles per day, and 2,100 acres of agricultural land.

2.4 Historical Flooding in Project Area

In the past 35 years alone, north Jefferson City has seen three major flood events, all caused by flooding from the Missouri River. Those occurred in 1993, 1995, and 2019. Each of these floods overtopped and breached Capital View levee.

In the summer of 1993, north Jefferson City was hit with flooding equivalent to approximately a 0.2% annual exceedance probability (AEP) flood. Capital View levee breached when it was overtopped, but not before. Everything in the project area was inundated with at least some water. In the aftermath of the flood, hundreds of residences were bought out or relocated, leaving only six functioning homes remaining today in the study area. During the 1993 flood, the Capital View levee was overtopped and subsequently breached in 13 locations. Capital View also overtopped and breached in 13 locations in 1995 and in seven locations in 2019. In 1998, 2001 and 2013 the levee was fully loaded but did not breach.

3 Database Development

3.1 Economic Analysis Parameters

3.1.1 Index Years, Price Level, and Interest Rates

The base year for the analysis is Fiscal Year (FY) 2035. Engineering data, water surface profiles, and economic development assumptions are considered constant in all respects for the 50-year period of analysis.

No firm plans for future economic development in north Jefferson City have been discovered. The hydrology and hydraulic (H&H) engineers did not identify anything that would drastically change conditions in the future. Consequently, both the economic and the hydrologic/hydraulic engineering data are identical for the base and future conditions.

The economic analysis in this report is based on an October 2025 price level. The FY 2026 federal interest rate for water resource projects of 3.25 percent is used in annualized cost calculations. The economic period of analysis is 50 years, the maximum allowed by guidance and the maximum amount of time that would be reasonable for attempting to project either economic or hydrologic and hydraulic conditions in the future.

3.1.2 Economic Reaches

The study area was divided into three study reaches. The East Reach is in the most downstream reach of the project. This area spans from the east edge of the project area to the middle of the Jefferson City Memorial Airport runway. The Central Reach spans from the middle of the airport runway to the U.S. Highway 54/63 bridge that crosses the Missouri River. The middle reach has most of the infrastructure in the study area and includes critical infrastructure such as Hitachi Energy, Jefferson City Memorial Airport, and Capital Sand & Gravel. The West Reach is the most upstream reach of the project. It spans from the U.S. Highway 54/63 bridge that crosses the Missouri River to the west edge of the project. See **Figure 2** below for a map of the study reaches. There is a faint white line representing the current Capital View levee. This levee, along with the limestone bluff to the north form the study area boundaries. Notably, the right (south) bank of the Missouri River is not included in the economic analysis. The reaches are separated by orange lines. From left to right are the West Reach, the Central Reach, and the East Reach. The red dots on the map represent the structures in the study area.

Figure 2. Economic Study Reaches

3.2 Data Development

3.2.1 Initial Database Development

The economic database for the study area was developed via complete structure-by-structure survey of all buildings in the 0.2% AEP floodplain by the Kansas City District (NWK) economic staff.

Note that Section 308 of the Water Resources Development Act (WRDA) of 1990 has been considered in this analysis. Section 308 of the Water Resources Development Act of 1990 states “The Secretary shall not include in the benefit base for justifying Federal flood damage reduction projects...any new or substantially improved structure...built in the 100-year flood plain with a first-floor elevation less than the 100-year flood elevation after July 1,1991.” There were no structures that needed to be removed from the inventory due to these conditions. **Table 3** displays the number of structures in the inundation areas by the annual exceedance probability (AEP) event.

Table 3. Number of Structures in the FWOP Condition by Occupancy Type and Event Frequency

	50% AEP Event	20% AEP Event	10% AEP Event	4% AEP Event	2% AEP Event	1% AEP Event	0.50% AEP Event	0.20% AEP Event
Residential	0	0	2	6	7	7	7	7
Commercial	0	0	4	15	18	19	22	22
Public	0	0	3	4	4	6	6	7
Outbuilding	0	0	38	52	59	60	60	60
Vehicles	0	0	2	4	5	5	5	5
Industrial	0	0	24	31	37	37	39	39
TOTAL STRUCTURES	**0**	**0**	**73**	**112**	**130**	**134**	**139**	**140**

3.2.2 Elevations and Stationing

Each property in a flood-risk management economic analysis is assigned a ground, as well as a first-floor elevation. The first-floor elevation of each property, determined from a windshield survey, is aggregated by location and structure type to compute the vertical distribution of damageable property at that location. Ultimately, the first-floor elevations for each type of structure are assigned an uncertainty factor, usually expressed as a standard deviation around a normally distributed variable. According to EM 1110-2-1619, Table 6-5, the uncertainty associated with mapping based on a windshield survey will be characterized by a standard deviation of 0.4 feet. That is the uncertainty used for first-floor elevations in this study.

Elevation data used in this study adopts the North American Vertical Datum of 1988 (NAVD88) in units of feet. The horizontal projection is Albers Equal Are Conic USGS Version (Foot US).

3.2.3 Structure and Content Valuation

Once the structure inventory was completed, the Marshall & Swift Valuation Service was used to generate the value of the structure inventory in January 2024 price levels. The value of the inventory was updated to October 2024 price levels using the Civil Works Construction Cost Index System (CWCCIS) composite average of all accounts. Going from January 2024 to October 2024, this index factor is 1.0198. This was the starting price level of the inventory in the HEC-FDA model. Using FDA’s price updating tool, the inventory was then indexed to current October 2025 price levels using the CWCCIS composite average of accounts factor. Going from October 2024 to October 2025, this index factor is 1.0829. Since structures are the largest benefit category, it is assumed that an increase in the other categories should be proportional.

The Marshall & Swift Valuation Service method takes many structure characteristics such as quality of construction, building material, structure condition, square footage, number of stories, garages, and basements into account. It also incorporates multipliers for location and dates.

Even when using this method to develop structure valuations, there is still a degree of uncertainty present in the result. This uncertainty is captured by using a structure value standard deviation applied to all structure occupancy types.

Content values were developed using content to structure value ratios (CSVRs) which relate the value of a structure's contents to the value of the structure itself. All CSVRs and their associated standard deviations come from existing USACE studies, particularly the 2006 *Final Report, Depth-Damage Relationships for Structures, Contents, and Vehicles and Content-to-Structure Value Ratios (CSVR) in Support of the Donaldsonville to the Gulf, Louisiana, Feasibility Study*, and the 2015 *American River Watershed General Reevaluation Report* by the Sacramento District. As part of the report, the Sacramento District completed an expert elicitation to develop CSVRs. Upon review of these CSVRs, it was determined that they were an appropriate fit for this study as it was reasonably assumed that contents would be similar nationwide, and they match up well with the PDTs existing knowledge of the study area and what they might expect contents to be.

The structure value uncertainty, CSVR, and CSVR uncertainty for each occupancy type is shown in **Table 4** below.

Table 4. Structure Value Uncertainty and Content Valuation

Occ Type	Struc Value Uncertainty Distribution Type	Struc Value Std Dev (%)	CSVR	CSVR Distribution Type	CSVR Std Dev (% increment)
C1 – 1 story no basement high value R&D tech contents	Normal	12	244.04	Normal	55.1
C11 – 1 story no basement masonry motel/office/church/etc… contents	Normal	12	45	Normal	9.2
C13 – commercial mobile structure	Normal	12	45	Normal	15
C14 – 1 story no basement metal structure motel/office/church/etc… contents	Normal	12	45	Normal	9.2
C16 – 1 story no basement retail	Normal	12	367	Normal	14.4
C2 – 2 story no basement motel/office/church/etc… contents	Normal	12	9.2	Normal	4.14
C23 – steel tank	Normal	12	150	Normal	5
C5 – car care	Normal	12	83	None	-
C7 – 2 story no basement airport terminal	Normal	12	10	Normal	35
CLN – cleanup	Normal	5	-	None	-
D1 – displacement 1 story no basement	Normal	10	-	None	-
D2 – displacement 2 story no basement	Normal	10	-	None	-
D5 – displacement 2 story with basement	Normal	10	-	None	-
I1 – generic industrial	Normal	12	256	Normal	55.1
I2 – hangar	Normal	14	10	Normal	4.63
I3 – industrial warehouse	Normal	14	256	Normal	25.3
I4 – grain bin	Normal	14	100	Triangular	82 – 200

Occ Type	Struc Value Uncertainty Distribution Type	Struc Value Std Dev (%)	CSVR	CSVR Distribution Type	CSVR Std Dev (% increment)
I5 – Industrial generic wet floodproofed	Normal	12	256	Normal	55.1
O1 – 1 story outbuilding; residential-type contents	Normal	15	100	Normal	5
O11 – empty shed	Normal	15	0	None	-
O13 – greenhouse	Normal	15	114	Normal	15
O2 – utility outbuilding	Normal	15	14	Normal	12.6
O3 – restroom	Normal	15	14	Normal	5
O4 – outbuilding; electronic contents	Normal	15	66.8	Normal	12.6
O5 – metal 1 story outbuilding; motel/office/church/etc… contents	Normal	15	88	Normal	15
O6 – outbuilding for commercial equipment/barn	Normal	15	256	Normal	25.3
O7 – metal outbuilding wet floodproofed	Normal	15	88	Normal	15
P1 – 1 story no basement; motel/office/church/etc… contents	Normal	14	79	Normal	9.2
P2 – 2 story no basement; motel/office/church/etc… contents	Normal	14	84	Normal	15
P3 – Public structure 1 story no basement; motel/office/church/etc… contents; dry floodproofed	Normal	14	79	Normal	9.2
P13 – wastewater treatment	Normal	14	3.65	Triangular	0.7 – 6.6
P14 – metal 1 story no basement; armory/public safety/etc… contents	Normal	14	256	Normal	9.2
P19 – public playground	Normal	10	-	None	-
P26 – unimproved road	Normal	15	-	None	-
P27 – paved 2-lane road	Normal	15	-	None	-
P28 – paved 4-lane road	Normal	15	-	None	-
P29 – interstate highway	Normal	15	-	None	-
R1 – residential 1 story no basement	Normal	15	100	Normal	5
R2 – residential 2 story no basement	Normal	15	100	Normal	5
R5 – residential 2 story with basement	Normal	17	100	Normal	5
V1 – sedan vehicle	Normal	15	-	None	-

3.2.4 Vehicle Valuation

Vehicles were assigned to each household based on the average number of vehicles per household in the county. In Callaway County, there are on average two vehicles per household.[1] From this number, one vehicle per household is expected to be used to evacuate in the event of a flood, leaving the other vehicles, in this case one vehicle, behind. Therefore, in this study, one vehicle was added to the structure inventory for each residential structure. The

[1] https://datausa.io/profile/geo/callaway-county-mo

vehicle is given a valuation based on the average price of a used car in Missouri and a foundation height of zero.

3.2.5 Road Valuation

To get a valuation for roads, the road network for the study area was pulled into ArcGIS from the OpenStreetMap data source found in LifeSim 2.1.3. Then the road length in miles was calculated for each road segment and the road segments were sorted by which reach it is in and what type of road (unimproved, paved 2-lane, paved 4-lane, or interstate highway) it is. Then each road segment's mileage is multiplied by the valuation factors generated in conjunction with Missouri Department of Transportation for the 2006 St. Joseph, Missouri Flood Risk Management feasibility study. The valuation factors differ based on characteristics of the road (number of lanes, design capacity, location, additional features, etc.). The PDT is unable to gage the condition of roads using available data sources, so depreciation is extremely hard to estimate. However, the road valuations used in the 2006 St. Joseph Missouri feasibility study are about 50% of current road valuation estimates. This was determined to be a reasonable proxy for estimating depreciation given the absence of better data. Road valuation was done outside of FDA, and the work has not been reviewed and therefore not ultimately included in this analysis, but damage to roads could potentially be a significant amount.

3.2.6 Cleanup and Displacement Costs

During a flood, residents of homes can be displaced and must evacuate when they can't stay in their home because the water level is too high. Each residential structure was duplicated to make a "displacement structure" that would receive hydraulic data that feeds into a displacement damage function. The characteristics of the residential structure and this new "displacement structure" are the same except for the structure valuation. The structure value for each "displacement structure" was set to $8,000. These costs are associated with evacuation, reoccupation, and other similar expenses, and only include expenses that would not otherwise be incurred. These costs do not include the costs for lodging, which would be considered a redistribution of resources.

After a flood, all buildings that have been substantially damaged must be cleaned up. Flood waters leave debris, sediment, salts, and the dangers of diseases throughout flooded structures, making the cleaning of these structures a necessary post-flood activity. Clean-up costs for the extraction of flood waters, dry-out, and decontamination vary significantly based upon various factors, including depth of flooding. Studies conducted by both Sacramento and New Orleans Districts, respectively, indicate a maximum value of $\$10/ft^2$ for such clean-up costs. The costs associated with this action are NED costs and are captured as a part of this study. Similar to calculating displacement costs, for each building that would need to be cleaned up, an identical "cleanup structure" was created that would receive the same hydraulic data which feeds into a cleanup damage function. The characteristics of the "cleanup structure" remain the same as the original structure except for the structure value, which is changed to 10 times the building's square footage.

3.2.7 Damage Functions: Residential

Residential damages for homes in this analysis are based on depth-damage functions released in Economic Guidance Memorandum (EGM) 04-01, "Generic Depth-Damage Relationships for

Residential Structures with Basements," dated 10 October 2003. This EGM summarized data developed by the Institute for Water Resources (IWR) using post-flood residential damage claim records provided by the Federal Emergency Management Agency (FEMA). The functions account for both structural and content damage to homes with and without basements. For both residential and nonresidential structures, beginning damage in the model is set to -2 feet for structures without basements and to -10 feet for structures with basements. This does not actually set the depth at which a structure will start receiving damages, that value is set by the stages of the water surface profiles in conjunction with the depth damage curve. The function of the beginning damage value is just to ensure that no damage occurs at stages below the specified value.

3.2.8 Depth-Damage Functions: Nonresidential

The depth-damage functions used for nonresidential structures and contents come from multiple sources and were selected based on how well they fit the structures in the project's study area. Most depth-damage functions for commercial, industrial, and public structures come from 2008 URS Group draft report *Solicitation of Expert Opinion Depth-Damage Function Calculations for the Benefit-Cost Analysis Tool*. Twenty-one core nonresidential structure types were evaluated by a panel of experts from across the United States. The resulting data from the panel included nationally relevant depth-damage functions for use in estimating the value of damages from flooding to commercial, industrial, and public structures nationwide. These curves have been used in numerous studies including the Papillion Creek GI study, Mill Creek GI study, and Tar Pamlico GI study. Other depth-damage functions used for commercial, industrial, and public structures come from the 2006 GEC Donaldsonville to the Gulf Feasibility Study.

The cleanup and displacement depth-damage functions come from the 2015 American River Watershed GRR report.

Vehicle depth-damage functions come from EGM 09-04, Generic Depth-Damage Relationships for Vehicles, dated 22 Jun 2009, using sedan as the vehicle type.

3.3 Final Economic Database

3.3.1 Structure Inventory and Depreciated Replacement Values

The structure inventory and associated depreciated replacement values for the Jefferson City study area are summarized below by event and occupancy type in **Table 5**, and by reach below in **Table 6**. Within the study area, there are 144 structures with an estimated total value of $546,300,000 (FY26 $).

Table 5. Value of Damageable Property by Occupancy Type and AEP Event ($000s)

Damage Category	50% AEP Event	20% AEP Event	10% AEP Event	4% AEP Event	2% AEP Event	1% AEP Event	0.40% AEP Event	0.20% AEP Event
$ / Residential Structure	-	-	$132	$129	$158	$158	$158	$158
Residential Structure Value	-	-	$263	$772	$1,103	$1,103	$1,103	$1,103
Residential Content Value	-	-	$263	$772	$1,103	$1,103	$1,103	$1,103

Damage Category	50% AEP Event	20% AEP Event	10% AEP Event	4% AEP Event	2% AEP Event	1% AEP Event	0.40% AEP Event	0.20% AEP Event
$ / Commercial Structure	-	-	$338	$9,133	$7,624	$7,229	$6,481	$6,481
Commercial Structure Value	-	-	$1,350	$137,002	$137,234	$137,342	$142,584	$142,584
Commercial Content Value	-	-	$484	$324,618	$324,967	$325,365	$327,033	$327,033
$ / Public Structure	-	-	$93	$155	$155	$446	$446	$460
Public Structure Value	-	-	$280	$619	$619	$2,674	$2,674	$3,222
Public Content Value	-	-	$213	$451	$451	$4,821	$4,821	$5,204
$ / Outbuilding	-	-	$48	$42	$45	$45	$45	$45
Outbuilding Structure Value	-	-	$1,825	$2,181	$2,681	$2,696	$2,696	$2,696
Outbuilding Content Value	-	-	$278	$521	$769	$771	$771	$771
$ / Industrial Structure	-	-	$467	$436	$411	$411	$416	$416
Industrial Structure Value	-	-	$11,196	$13,071	$15,214	$15,214	$15,795	$15,795
Industrial Content Value	-	-	$7,423	$12,222	$17,617	$17,617	$19,104	$19,104
$ / Vehicle	-	-	$30	$30	$30	$30	$30	$30
Vehicle Value	-	-	$60	$121	$151	$151	$151	$151
Unit costs	-	-	$54	$123	$105	$105	$107	$106
Clean Up	-	-	$3,479	$11,071	$11,816	$11,816	$12,632	$13,061
Unit costs	-	-	$4	$6	$8	$8	$8	$8
Emergency Costs	-	-	$9	$35	$53	$53	$53	$53
Total	**-**	**-**	**$27,123**	**$503,456**	**$513,778**	**$520,726**	**$530,520**	**$531,880**

October 2025 price level.

Table 6. Structure Inventory and Replacement Values by Reach ($000s)

Property Type	East Reach	Central Reach	West Reach	Total
Number	20	78	46	144
Value – Structures	$4,596	$167,934	$12,213	$184,743
Value – Contents	$5,617	$343,508	$12,433	$361,557
Value – Total	**$10,213**	**$511,442**	**$24,646**	**$546,300**

October 2025 price level. Prices shown in $000s.

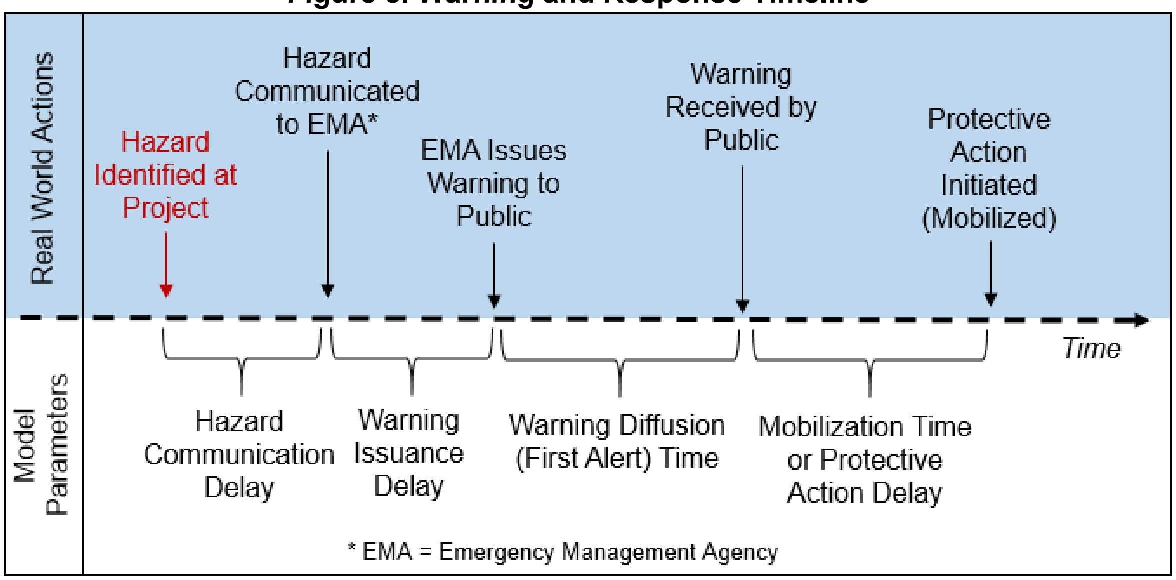
These investment totals are assumed to remain constant under existing and future conditions. Table 6 represents investment in the entire study area for the future without-project (FWOP) condition as well as for existing conditions. Most of the floodplain value resides in the Central

Reach. This reach includes structures such as Hitachi Energy, Jefferson City Memorial Airport, Jefferson City Regional Wastewater Treatment Plant, Capital Sand & Gravel, the National Guard Armory, and more. The "Value – Structures" row also includes the value of "pseudo-structures" such as vehicles, cleanup, and displacement structures. These "structures" do not have content values. The discrepancies in the totals of the above tables is due to three structures in the study area that are not in the 0.002 AEP Event floodplain. Thus, their value is counted in **Table 6,** but not in **Table 5**.

3.3.2 Life Loss Methodology/Inputs and Parameters

This consequence modeling was performed using the USACE's life loss and direct property damage estimation software LifeSim 2.1.3. To determine the percentage of population at risk (PAR) within a structure that is warned and mobilized over time, several parameters are used within LifeSim to estimate the probable values of warning and mobilization percentages at each time step. These include when hazards are identified and warnings will be issued (hazard identification and delays), how long they will take to become effective (warning diffusion), and the rate at which PAR will mobilize in response (mobilization). **Figure 3** below is an example breach warning and response timeline.

Figure 3. Warning and Response Timeline



3.3.2.1 Structure Inventory

The structure inventory was developed using the USACE National Structure Inventory (NSI) version 2 as the base dataset. The NSI is developed from estimated information regarding the locations, building types, population, values, and other relevant information for all residential, commercial, industrial, agricultural, public, and private structures across the nation. Data sources for this information include national level parcel data, Census data, building footprints, and other sources for employment and school information. The value of structures, contents, and vehicles were indexed to FY 2026 price levels. Additional calibration on the structure point placement was accomplished using aerial imagery and inundation maps for both high and low flow scenarios.

3.3.2.2 Emergency Preparedness

Callaway County has an “All-Hazard Mitigation Plan” that was developed by the county’s Office of Emergency Management. Included in the plan is a section dedicated to Flood Hazards. The section on Flood Hazards discusses historic flood events in Callaway County. The Flood Hazards section provides information about flooding and potential sources of flood risk and may be useful for citizens of Callaway County to review to help them understand their risk of being exposed to flooding.

The county’s Office of Emergency Management does maintain a public website. It has links on it for Disaster Information that redirect to FEMAs website. When verifying the link for flooding, the link is to a page that no longer exists at FEMA and returns a 404 page not found error.

The area has experienced significant flooding from the Missouri River in recent times (2013 and 2019) but except for four or five structures, the others in the area are commercial and the employees commute into the area for work. This lack of knowledge about people’s familiarity with flooding since they do not live in the immediate area and with turnover in the work environment increases the uncertainty around warning and evacuation outcomes.

Because of uncertainty associated with emergency operations and response during a flood event, it was necessary to account for a wide range of possible warning and evacuation outcomes. A series of preset curves are included in LifeSim. These curves were developed using research from Mileti and Sorensen (2014). For this study, the “Preparedness Unknown” curves were chosen for the warning parameters (Warning Issuance Delay and Warning Diffusion). The Emergency Preparedness parameters are described in the sections below.

3.3.2.3 Relative Hazard Identification

The Hazard Identification time is the time at which a hazard is identified (a dam breach) relative to when it occurs (the actual breach initiation time). Two different warning scenarios were simulated with different ranges of hazard identification time: minimal warning and ample warning.

For overtopping scenarios, warning is relative to the time that overtopping begins, not breach time. The Relative Hazard Identification Times used for this study are summarized below in **Table 7**.

Table 7. Relative Hazard Identification Times

Warning Scenario	Distribution Type	Minimum (hours)	Maximum (hours)
Minimal	Uniform	-3	0.5
Ample	None	-24	-24

3.3.2.4 Hazard Communication Delay

The Hazard Communication Delay is the time that it would take from when the hazard is identified to when the emergency planning zone (EPZ) representatives would be notified. For example, if a breach occurs when no one is observing the project then the emergency managers could be notified after the hazard is identified. The hazard communication delay was set as a uniform distribution between 0.1 hours and 0.5 hours in this analysis.

3.3.2.5 Warning Issuance Delay

The Warning Issuance Delay is the time it takes from when the emergency managers receive the notification of the imminent hazard to when they issue the first evacuation order to the public. The preset “Preparedness Unknown” warning issuance delay curve was used in this analysis. Although the range of possible warning issuance delay possibilities is between 0 minutes and 300 minutes, the most likely outcome is warning issuance 30 minutes after officials are notified of the flood hazard.

3.3.2.6 Warning Diffusion

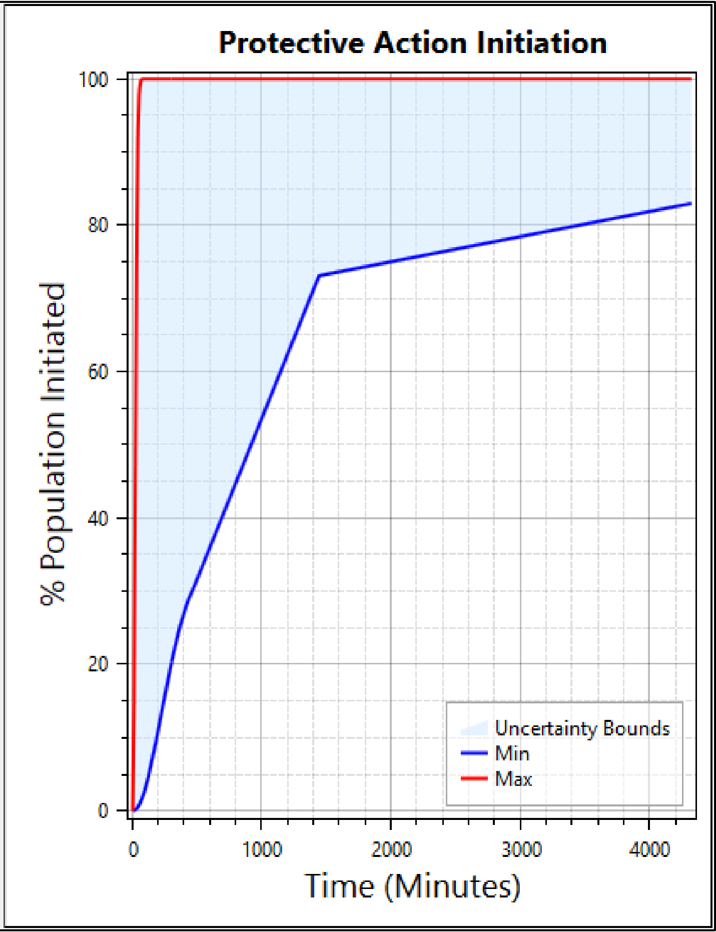
The preset “Preparedness Unknown” warning diffusion curves were used in this analysis. The curves utilize a uniform distribution, and the warning diffusion curves are sampled during each Monte Carlo iteration in LifeSim. The upper bound of the curve reaches 100% diffusion after 100 minutes, and the lower bound reaches 100% diffusion after 360 minutes.

3.3.2.7 Protection Action Initiation

Protective Action Initiation (PAI) is the rate at which PAR takes action after receiving an evacuation order (warning). Unlike the warning diffusion curves, the PAI “Preparedness Unknown” curve includes a perception element as well. The perception element describes a PAR as being aware of their flood risk (Perception = Likely to Impact) or generally unaware that they are at risk of being flooded (Perception = Unlikely to Impact). The “Preparedness Unknown, Perception Unknown” curve was used in this analysis for downstream areas, while the “Preparedness Unknown, Perception Likely to Impact” curve was used for areas upstream of the levee.

Figure 4. PAI Curve: Preparedness Unknown, Perception Unknown

Time (Minutes)	Minimum % Mobilized	Maximum % Mobilized
0	0	0
10	0.07	14.79
20	0.14	47.27
30	0.31	76.309998
40	0.54	92.269997
50	0.85	98.169998
60	1.21	99.68
70	1.64	99.949997
80	2.12	99.949997
90	2.66	99.949997
100	3.26	99.949997
110	3.9	99.949997
120	4.59	99.949997
180	9.48	99.949997
240	14.99	99.949997
300	20.32	99.949997
360	24.870001	99.949997
420	28.379999	99.949997
480	30.83	99.949997
1440	73.07	99.949997
4320	82.949997	99.949997



3.3.2.8 Direct Life Loss

Estimates of direct life loss were generated using LifeSim inundation scenarios. LifeSim utilizes Monte Carlo uncertainty analysis, and 1,000 Monte Carlo iterations were performed for each scenario. **Table 8Table 8** below shows the PAR and median life loss for each scenario under the FWOP condition.

Table 8. FWOP PAR and Life Loss

Event	Minimal Warning	Minimal Warning	Minimal Warning	Minimal Warning	Ample Warning	Ample Warning	Ample Warning	Ample Warning
	Day PAR	Night PAR	Day Median Life Loss	Night Median Life Loss	Day PAR	Night PAR	Day Median Life Loss	Night Median Life Loss
0.5 AEP	0	0	0	0	0	0	0	0
0.2 AEP	0	0	0	0	0	0	0	0
0.1 AEP	77	12	0	0	76	21	0	0
0.04 AEP	124	22	0	0	122	35	0	0
0.02 AEP	134	24	0	0	132	39	0	0
0.01 AEP	809	112	0	0	796	206	0	0
0.005 AEP	809	112	1	0	796	206	1	0
0.002 AEP	809	112	1	0	796	206	1	0

4 DAMAGE ANALYSIS MODELING

4.1 The HEC-FDA Risk Analysis Program

The basic assumption underlying use of a risk analysis program is that data in flood-risk studies are based on imperfect knowledge and unpredictable future developments, so that key variables for which median or most likely values are specified could, in reality, take on a range of values above and below the specified values. A program with advanced mathematical capabilities is needed to perform an analysis that reflects risk and uncertainty, and the Jefferson City FRM economic analysis uses the HEC-FDA program to compute damages and benefits. HEC-FDA is the USACE's certified Flood Damage Analysis program produced by the Hydrologic Engineering Center. This program is standard in USACE economic risk analyses for flood-risk studies. FDA 2.0 is used in this analysis.

In HEC-FDA, key economic input data are first loaded into the program, such as a structure inventory file compiling data for all damageable property in the study area, including structure values, ground and first-floor elevations, and stream stationing, and an occupancies file that compiles information for each major occupancy type, including CSVRs, depth-damage functions, and uncertainty factors for all economic variables. Together, these data files shape the three main economic variables critical to estimating flood damages at each location: elevation, value, and damage susceptibility. Along with the economic data, the hydrologic/hydraulic data for the stream are also entered into the program in the form of water surface profiles for up to eight identified flood events at locations throughout the study area. All engineering and economic data are entered into the program in terms of median or most likely values and are accompanied by appropriate uncertainty parameters specifying the range of possible values for each variable.

The first phase of the risk analysis produces an economic stage-damage function. Stage-damage functions were computed by reach with uncertainty. This computation was made iteratively in HEC-FDA utilizing a minimum of 10,000 Monte-Carlo simulations, each combining various possible values for each economic input (elevation, value, and depth-damage) by sampling the uncertainty distributions provided for those variables. Flood damages for each foot of flooding are computed based on the level of investment subject to flooding, the beginning damage elevation, and the estimated damage to those investments with various depths of flooding. The HEC-FDA program references each structure's first floor elevation or beginning damage elevation to the corresponding frequency event elevation. Individual stage-damage relationships at each structure for each investment category are then computed with risk and aggregated to the reach index location specified for integration with the engineering data.

The ultimate goal is to express damages in an annualized equivalent form, and this is the purpose of the second phase of the risk analysis, which integrates the economic stage-damage function with the available engineering data. The HEC-FDA program utilizes a Monte Carlo process to randomly sample multiple probability distribution functions to produce tens of thousands of possible flood events of varying magnitudes instead of a few discrete scenarios. For each event, the program samples the range of possible values for each variable and determines (a) whether the flood event results in damage, and (b) how much damage occurs.

The calculation of annual damages conceptually involves a weighted average in which damages computed for each event are multiplied by the incremental probability of that event and the product is summed. This total, referred to as equivalent annual damages (EAD), represents an estimate of the average damages that would be expected in any given year over the period of analysis, which is 50 years in this study. The outcome of the Monte Carlo simulations is an expected value for damages that represents an evaluation of the thousands of synthetic events, which could incorporate more damage due to floodplain growth or hydrologic or hydraulic changes to the study area during the period of analysis (none of which is applicable here). The average annual damage total can then be compared on an equivalent basis to an annualized cost for the planned project to obtain a benefit-cost ratio. Computations are made for expected annual damages under each condition, existing (or base, since both conditions are equivalent in this analysis) and future. The goal of the economic screening of alternatives is to identify the National Economic Development (NED) plan. The NED plan is the plan with the highest net benefits, consistent with protecting the environment, and which follows all applicable federal rules and regulations.

4.2 Preliminary Alternatives

The PDT determined that 11 alternatives could not be screened out due to not meeting project objectives and would thus need to be evaluated for their efficiency. These alternatives make up the preliminary array of alternatives and can be seen below in **Table 9**Table 9.

Table 9. Preliminary Alternatives

Alternative	Description
CA0	No Action
CA1	Existing Capital View levee raised to 34-foot stage
CA2	Capital View levee raised to 34-foot stage and setback 1,000 feet at Turkey Creek and Riverside
CA4	Optimization levee alignment at 37-foot stage; Capital View levee removed
CA5	Optimization levee alignment at 37-foot stage; Capital View levee not removed
CA6	Historic L-142 levee alignment and profile at 45-ft stage; Capital View levee removed
CA7	Historic L-142 levee alignment and profile at 45-ft stage; Capital View levee not removed
CA8	Highway levee alignment and profile at 37-ft stage; Capital View removed
CA9	Highway levee alignment and profile at 37-ft stage; Capital View not removed
CA11	Non-Structural
CA13	Hybrid levee alignment at 41-foot (0.01 AEP) stage, partial Capital View removal

See the Main Report for more detail on the composition of the alternatives and how the preliminary array of alternatives was developed. CA11 is the nonstructural plan carried forward for consideration which includes elevating, dry floodproofing, wet floodproofing, and buyouts/relocations. The PDT logically aggregated the nonstructural measures by floodplain and occupancy type. Multiple iterations of a nonstructural plan were made but ultimately the PDT decided to formulate a nonstructural plan based on commercial and public service cohesion, identity, and resilience. This plan entails nonresidential structures remaining in place and receiving elevation or floodproofing where applicable. Residential structures will be elevated or bought out/relocated to reduce damages and life safety risk. It should be noted that a significant effort was made after the historic flood of 1993 to implement nonstructural measures within the FEMA-mapped floodplain. This was undertaken by the City of Jefferson City and resulted in hundreds of buyouts and relocations as well as the elevation of critical infrastructure.

Therefore, the PDT was limited in structures left in the leveed area that would be eligible for nonstructural measures.

4.3 HEC-FDA Modeling

The comprehensive structure inventory for the study area discussed above in Section 3, including elevations, values, and depth-damage functions for each property, accompanied by uncertainty factors, and the set of water surface profiles (WSPs) and frequency distributions were entered into the HEC-FDA risk analysis program for damage computations. Damages in this analysis consist of physical inundation damages (structure and content) to commercial buildings, industrial buildings, residential buildings, public buildings, outbuildings, and roads. Without-project and with-project water surface profiles were prepared for eight annual exceedance probability (AEP) flood events: 50%, 20%, 10%, 4%, 2%, 1%, 0.5%, and 0.2%. This analysis uses one set of WSPs for all without-project conditions. Additional water surface profiles were prepared for each of the nine preliminary structural alternatives. The nonstructural alternative uses the same water surface profiles as the Future Without Project (FWOP) condition since none of the measures affect hydrology or hydraulics.

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. A standard operating procedure for the effective use of HEC-FDA is the extension of the exceedance probabilities with uncertainty to the 99.9% AEP event, and this procedure was followed for this study, with the exceedance frequency functions modified to include the estimated stage for the 99.9% AEP event. The same procedures were followed for the with-project water surface profiles prepared for each of the structural alternatives.

The reliability of frequency-discharge estimates is directly linked to the historical record of stream gage data available. In cases where records are small or incomplete, the associated uncertainty is greater than in circumstances where lengthy records of observed data are available. For the exceedance probabilities with uncertainty, an equivalent record length of 81 years was used. The choice to use an equivalent record length of 81 years for each of the three impact areas (all within three miles of each other) comes from Chapter 4, Table 4-5, “Equivalent Record Length Guidelines” in *Engineering Manual (EM) 1110-2-1619*. For additional detail, see the Hydrology and Hydraulics (H&H) sections of **Appendix A**.

Each alternative with a levee, including the FWOP alternative (CA0), had the top of elevation of the levee at each reach entered into FDA, along with the levee’s associated geotechnical failure analysis. The existing Capital View levee was assumed to not fail until overtopping occurs.

To help understand existing flooding conditions, FWOP damages by AEP and reach, calculated without the incorporation of risk, are presented below in **Table 10**Table 10. FWOP damages by AEP and occupancy type, also calculated without the incorporation of risk by reading the FDA 2.0 StructureStageDamageDetails file, are presented below in **Table 11**Table 11.

Table 10. CA0 Damage by AEP and Reach

AEP	East Reach Damages	Central Reach Damages	West Reach Damages	Total Damages
0.5	$0	$0	$0	$0
0.2	$0	$0	$0	$0
0.1	$245,100	$5,570,800	$3,479,400	$9,295,300
0.04	$545,900	$222,240,800	$5,521,600	$228,308,300
0.02	$1,304,800	$359,185,800	$10,494,800	$370,985,400
0.01	$1,507,800	$378,722,400	$11,500,600	$391,730,800
0.005	$4,283,600	$391,246,900	$13,227,200	$408,757,700
0.002	$5,497,600	$398,357,700	$14,201,100	$418,056,400

Oct 2025 price level. Discrepancies in totals due to rounding.

Table 11. CA0 Damage by AEP Event and Occupancy Type ($000s)

	50% AEP Event	20% AEP Event	10% AEP Event	4% AEP Event	2% AEP Event	1% AEP Event	0.50% AEP Event	0.2% AEP Event
Residential	0	0	$87	$231	$385	$424	$495	$538
Residential Content	0	0	$48	$127	$215	$237	$273	$292
Commercial	0	0	$271	$23,730	$43,659	$50,944	$62,184	$68,553
Commercial Content	0	0	$358	$185,738	$296,046	$307,365	$307,544	$307,940
Public	0	0	$32	$122	$238	$292	$651	$884
Public Content	0	0	$61	$191	$202	$203	$2,187	$3,095
Outbuilding	0	0	$241	$539	$851	$949	$1,111	$1,193
Outbuilding Content	0	0	$128	$247	$382	$418	$491	$515
Industrial	0	0	$1,965	$3,763	$5,722	$6,123	$6,547	$6,814
Industrial Content	0	0	$4,509	$7,378	$12,747	$14,055	$15,947	$16,654
Subtotal - Structures	**0**	**0**	**$2,596**	**$28,386**	**$50,857**	**$58,732**	**$70,988**	**$77,942**
Subtotal - Contents	**0**	**0**	**$5,104**	**$193,682**	**$309,591**	**$322,277**	**$326,442**	**$328,496**
Subtotal - Structures and Contents	**0**	**0**	**$7,701**	**$222,067**	**$360,448**	**$381,009**	**$397,430**	**$406,438**
Vehicles	0	0	$29	$73	$120	$128	$138	$139
Clean Up	0	0	$1,561	$6,102	$10,383	$10,556	$11,147	$11,397
Emergency Costs	0	0	$5	$18	$35	$37	$40	$42
Total	**0**	**0**	**$9,295**	**$228,260**	**$370,985**	**$391,731**	**$408,755**	**$418,016**

Oct 2025 price level. Discrepancies in totals due to rounding.

The physical expected annual damages (EADs) by damage category for the proposed preliminary array of alternatives calculated by the HEC-FDA model are summarized below in **Table 12.** Physical EADs for the FWOP condition total $19,120,500. To help understand risk and assist in decision making, probabilistic benefits are summarized below in **Table** 13**13**.

Table 12. Alternative Physical Expected Annual Damages by Category

Alt	Clean	Com	Dis	Ind	Out	Pub	Res	Veh	Total
CA0	$639.8	$16,766.5	$2.1	$1,499.0	$98.5	$62.2	$43.7	$8.6	$19,120.5
CA1	$455.5	$15,719.9	$1.6	$843.4	$59.6	$51.9	$28.6	$5.5	$17,166.0
CA2	$527.6	$16,842.9	$1.8	$1,064.6	$86.4	$54.2	$35.6	$7.4	$18,620.4
CA4	$341.8	$11,193.8	$1.2	$727.4	$43.5	$45.5	$22.7	$4.3	$12,380.2
CA5	$350.3	$11,238.3	$1.2	$709.0	$60.5	$45.8	$22.0	$4.2	$12,431.3
CA6	$47.5	$22.8	$1.5	$126.1	$65.2	$0.0	$37.1	$6.6	$306.9
CA7	$45.8	$21.3	$1.6	$118.3	$63.7	$0.0	$38.3	$6.9	$295.8
CA8	$382.1	$10,601.9	$2.0	$984.6	$66.5	$58.5	$42.3	$8.1	$12,146.0
CA9	$383.6	$10,568.3	$2.0	$993.6	$67.7	$59.0	$42.9	$8.3	$12,125.5
CA11	$623.5	$16,497.3	$0.7	$1,486.9	$68.5	$36.6	$7.5	$2.3	$18,723.3
CA13	$138.4	$3,868.0	$0.7	$320.2	$44.5	$10.9	$12.9	$3.5	$4,399.0

Clean = cleanup. Com = commercial. Dis = displacement or evacuation and relocation. Ind = industrial. Out = outbuildings. Pub = public. Res = residential. Veh = vehicles.
Oct 2025 $. Values shown in $000s. Discrepancies in totals due to rounding.

Table 13. Preliminary Array of Alternatives Probabilistic Benefits

Alt	Mean Expected Annual Damages	Mean Expected Annual Damages Reduced	75% Chance Annual Damages Reduced Exceeds…	50% Chance Annual Damages Reduced Exceeds…	25% Chance Annual Damages Reduced Exceeds…
CA0	$19,120.5	$0.0	$0.0	$0.0	$0.0
CA1	$17,166.0	$1,954.5	$1,206.2	$1,937.1	$2,663.5
CA2	$18,620.4	$500.1	$329.5	$534.8	$709,1
CA4	$12,380.2	$6,740.3	$3,830.7	$5,916.4	$8,786.7
CA5	$12,431.3	$6,689.2	$3,791.5	$5,876.4	$8,733.1
CA6	$306.9	$18,813.6	$10,314.5	$16,563.8	$24,882.1
CA7	$295.8	$18,824.7	$10,324.1	$16,575.1	$24,895.0
CA8	$12,146.0	$6,974.5	$3,906.6	$6,117.2	$9,044.7
CA9	$12,125.5	$6,995.1	$3,851.7	$6,110.1	$9,094.1
CA11	$18,723.3	$397.2	$217.0	$374.9	$525.6
CA13	$4,399.0	$14,721.5	$9,163.1	$13,615.8	$19,743.9

Oct 2025 $. Values shown in $000s. Discrepancies in totals due to rounding.

4.4 Detour/Delay Cost Modeling

As the study progressed, it became clear to the PDT that based on the geography of the region, the inundation of several transportation arteries would result in significant detour mileage and time. Thus, it was determined to calculate the costs (extra mileage plus extra time spent) of these detours that are direct results of flooding in the project area. Costs of detour were calculated for three transportation arteries under the FWOP and each alternative. These arteries are the North/South U.S. Highway 54/63, East/West U.S. Highway 63/94, and the Jefferson City Memorial Airport. The costs of each artery's detour are then summed together to get a total detour cost for each alternative. Equation 1 below shows the annual detour mileage costs for a given alternative.

Equation 1: ***Annual Detour Mileage Cost = [(commercial vehicles per day) * (commercial vehicle operating cost per mile) + (passenger vehicles per day) * (passenger vehicle operating cost per mile)] * (marginal detour route mileage) * (annual days of detour)***

The first step is to determine the length in mileage of the initial route that will be unusable due to flooding and the length of its shortest detour. This detour route is provided by the Missouri Department of Transportation (MoDOT) and is what would be the official route broadcasted by the state if the original route is to be unusable. **Figure 5**, **Figure 6**, and **Figure 7** show the detour routes for the three transportation arteries. In each map, except for the map detailing the Jefferson City Memorial Airport detour route for which there is no original route, the original route is shown with a blue line, and the detour route is shown with a red line.

Figure 5. North/South U.S. Highway 54/63 Detour Route

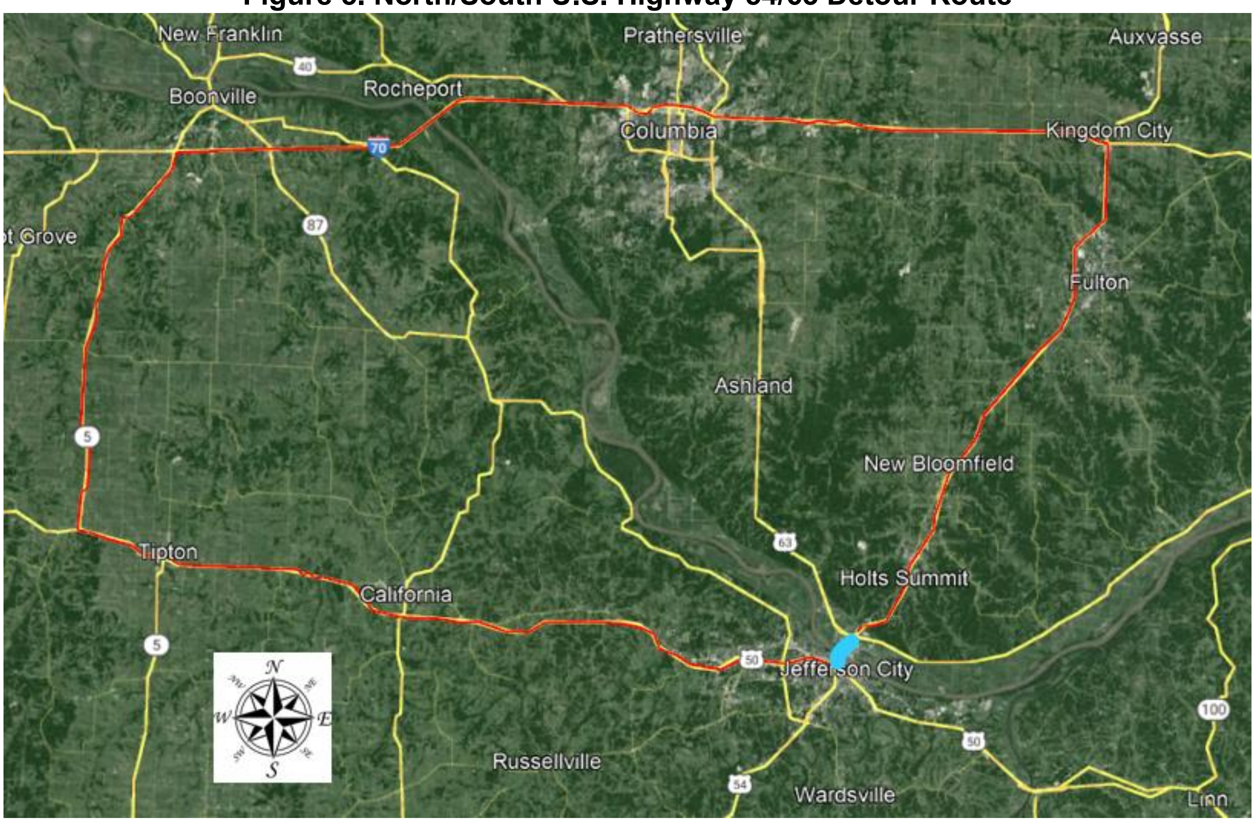
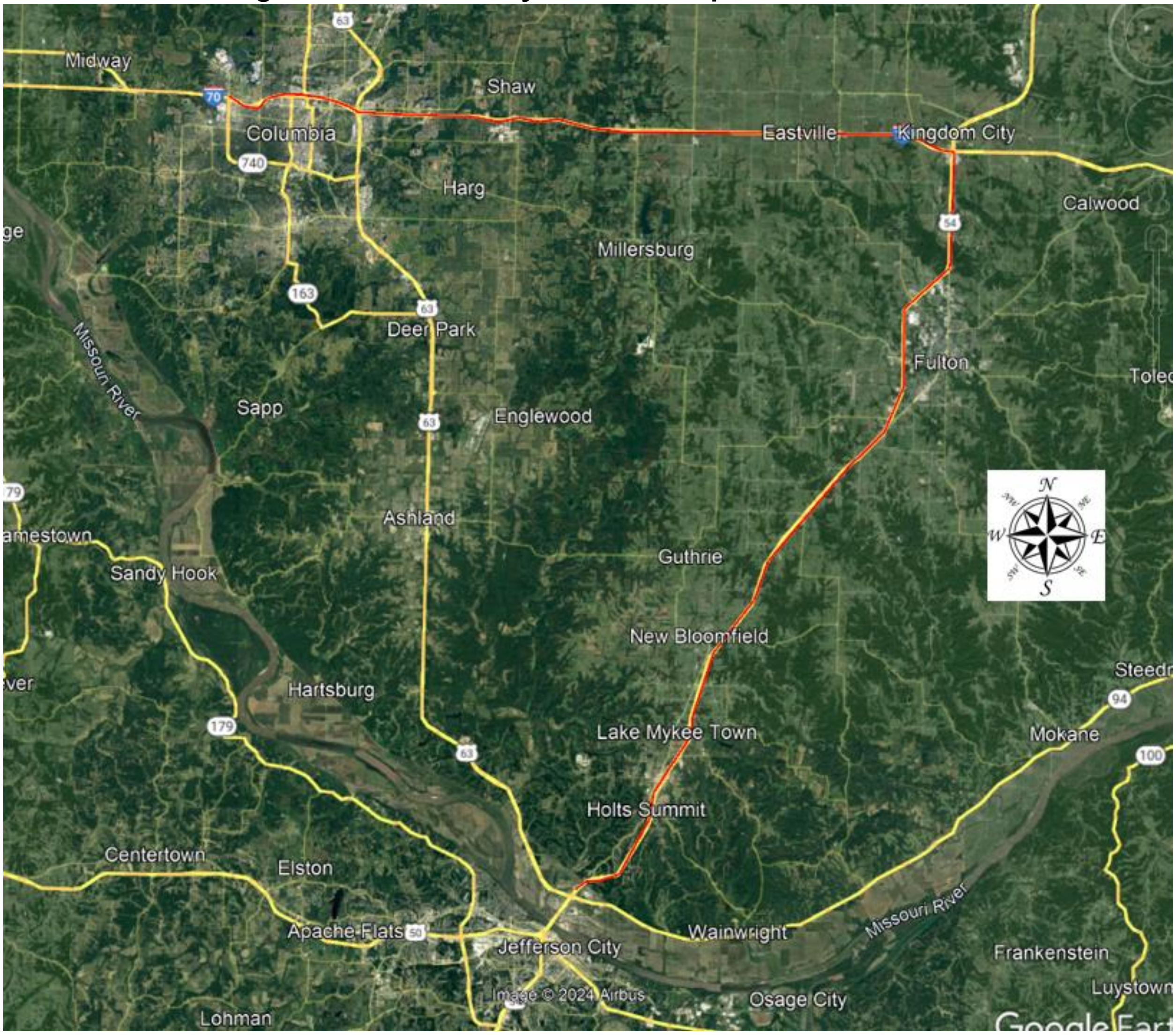


Figure 6. East/West U.S. Highway 63/94 Detour Route

Figure 7. Jefferson City Memorial Airport Detour Route



It is important to remember that while there may appear to be shorter detour routes, for a variety of reasons those routes would not be the most effective or efficient. This may be due to these routes being inundated with water themselves during the same type of event that inundates the original route, the type of road not being able to handle the volume of traffic required, or the type of road not being able to handle the type of vehicle required, among other possible reasons. The mileage difference between the original route and the detour route is the mileage travelers are forced to travel that they otherwise would not have, also called the marginal detour route. In addition to the mileage of the marginal detour route, the average time spent traveling the marginal detour route is calculated by using the speed limit of the proposed detour route. For the airport detour calculation, if the airport is inundated, it is assumed travelers would have to fly into the next-closest airport in Columbia, MO, then drive the distance between the airports. The marginal detour mileage and marginal time spent on the detour is shown below for each transportation artery in **Table 14**Table 14. It is also important to note that the model does not account for the possibility that the rerouted traffic will lead to congestion on the detour route. It is entirely possible that the rerouted traffic would cause enough congestion that all traffic on the reroute would incur additional delays from reduced speeds. While not quantified, the potential reduced speed of traffic due to congestion would increase detour and delay costs. Subsequently, increasing the benefits of any alternative that would shorten the time the detour route needs to be used.

Table 14. Marginal Detour Route Mileage and Time

Transportation Artery	Marginal Detour Mileage	Marginal Detour Hours
North/South U.S. Highway 54/63	131.9	2.2
East/West U.S. Highway 63/94	35.7	0.5
Jefferson City Memorial Airport	51.8	0.8

Next, the average annual days the detour would be required to be used was calculated. This was done with assistance from H&H. H&H provided the duration of inundation, beginning as soon as a part of the road became inundated that made it impassable, and continuing until the water receded, for each of the eight AEP events. An integral calculation was made on the duration curve produced by the eight events to get an average annual number of days each detour would be in effect, for each alternative. These results are shown below in **Table** 15**15**.

Table 15. Average Annual Days of Detour for Each Transportation Artery by Alternative

	Avg. Annual Days of Detour	Avg. Annual Days of Detour	Avg. Annual Days of Detour
Alternative	North/South U.S. Highway 54/63 Artery	East/West U.S. Highway 63/94 Artery	Jefferson City Memorial Airport Artery
CA0/CA11	0.06	0.44	0.45
CA1	0.04	0.13	0.14
CA2	0.07	0.12	0.13
CA4	0.06	0.06	0.03
CA5	0.06	0.03	0.03
CA6	0.06	0.45	0.00
CA7	0.06	0.56	0.00
CA8	0.07	0.03	0.58
CA9	0.06	0.03	0.57
CA13	0.07	0.01	0.01

Next, the daily traffic count data was pulled from MoDOT (https://www.modot.org/traffic-volume-maps). Their most recent data is from 2023. This traffic data is further broken down into whether the vehicles are commercial or passenger. The passenger vehicles are broken down even further by distinguishing if their purpose is work, social, or other. Airport passenger data is taken from FAA and is from 2023. Daily traffic count details are shown below in **Table** 16**16**.

Table 16. Daily Traffic Count Detail by Transportation Artery

Transportation Artery	# of Commercial Vehicles	# of Work Passenger Vehicles (26% of Total Passenger Vehicles)	# of Social Passenger Vehicles (37% of Total Passenger Vehicles)	# of Other Passenger Vehicles (37% of Total Passenger Vehicles)	# of Total Passenger Vehicles
North/South U.S. Highway 54/63	22,017	9,073	12,912	12,912	34,896
East/West U.S. Highway 63/94	8,725	4,188	5,960	5,960	16,109
Jefferson City Memorial Airport	0	31	45	45	121

Note: Discrepancies in totals due to rounding.

Finally, operating costs for both passenger and commercial vehicles were pulled from AAA's, *Your Driving Costs Fact Sheet*, dated 2025[2] and ATRI's *Operational Costs of Trucking*, dated 2025[3], respectively. Costs were escalated to October 2025 dollars using the Consumer Price Index.

Together, these four elements make up Equation 1 which calculated the annual detour mileage costs. This is one part of the total detour costs. The other part is the value of time lost due to the detour and is shown below in Equation 2.

Equation 2: ***Annual Detour Time Delay Cost = (vehicles per day by trip purpose) * (value of time by trip purpose) * (median hourly income) * (marginal detour time in hours) * (annual days of detour)***

Value of time saved by trip purpose comes from the Delay Factors table (Table D-4) listed in ER 1105-2-100, Appendix D, Amendment 1, page D-20. The estimates of trip purpose for passenger vehicles comes from *Summary of Travel Trends, 2009 National Household Travel Survey* by the United States Department of Transportation and Bureau of Transportation Statistics, page 24-25, Table 12 (*http://nhts.ornl.gov/2009/pub/stt.pdf*). Median hourly income for the Jefferson City Metro Area comes from the United States Census Bureau and is indexed to October 2025 price levels using Bureau of Labor Statistics data.

Adding the results of Equation 1 and Equation 2 give the total cost of the detour route by alternative. The detour costs for each transportation artery for each alternative are shown below in **Table 17**. Summing the detour cost for each transportation artery gives an average annual detour cost under each alternative. CA11, the nonstructural alternative, has the same results as

[2] *https://www.aaa.com/autorepair/drivingcosts/MO-U-2020/Honda/Accord/EX%204D%20Sedan%201.5L%20at/near-prime/at-10000-miles/on-55-city*

[3] Leslie, Alex & Murray, Dan. "An Analysis of the Operational Costs of Trucking: 2025 Update". American Transportation Research Institute, July 2025, https://truckingresearch.org/about-atri/atri-research/operational-costs-of-trucking/.

the FWOP given that the alternative doesn't affect the hydraulics or the roads in the project area. Additionally, the end of inundation does not necessarily coincide with the end of detour, as sometimes significant effort in debris removal and road repair must first take place following recession of floodwater, lengthening detours for potentially weeks more. If bridges are damaged, detour durations may be significantly lengthened. This is not considered in this model because of a lack of data. Therefore, the method for computing duration of detour assumed here may significantly underestimate the duration of detour and underestimate the benefit of the project in reducing detours.

Table 17. Average Annual Detour Costs by Alternative

Alt	Average Annual N/S Artery Detour Cost	Average Annual E/W Artery Detour Cost	Average Annual Jefferson City Memorial Airport Detour Cost	Average Annual Total Cost
FWOP/CA11	$511,000	$373,000	$3,000	$887,000
CA1	$303,000	$112,000	$1,000	$416,000
CA2	$530,000	$103,000	$0	$633,000
CA4	$512,000	$48,000	$0	$560,000
CA5	$490,000	$23,000	$0	$513,000
CA6	$512,000	$384,000	$0	$896,000
CA7	$505,000	$479,000	$0	$984,000
CA8	$532,000	$21,000	$0	$553,000
CA9	$521,000	$23,000	$0	$544,000
CA13	$539,000	$11,000	$0	$550,000

Note: Oct 2025 $. Discrepancies in totals due to rounding.

5 ALTERNATIVES SCREENING

5.1 Overview of Evaluation Procedures

Economic costs and benefits resulting from a project are evaluated in terms of their impacts on national benefits, without regard to where in the United States the impacts may occur. National Economic Development (NED) benefits must result directly from a project and must represent net increases in the economic value of goods and services to the national economy, not simply to a locality.

NED costs represent the costs of diverting resources from other uses in implementing the project, as well as the costs of uncompensated economic losses resulting from detrimental effects of the project. The costs for each project are presented below in

Table 18Error! Reference source not found..

Table 18. Cost of Preliminary Array of Alternatives ($000s)

	CA0	CA1	CA2	CA4	CA5	CA6	CA7	CA8	CA9	CA11*	CA13
Construction + Relocation		$85,497	$128,573	$153,134	$152,276	$215,505	$213,113	$116,828	$119,153	$8,352	$112,686
PED		$10,260	$15,429	$18,376	$18,273	$25,861	$25,574	$14,019	$14,298	$1,002	$21,782
S&A		$11,115	$16,715	$19,907	$19,796	$28,016	$27,705	$15,188	$15,490	$1,086	$8,430
Contingency		$45,664	$74,158	$83,168	$88,786	$120,537	$127,720	$66,411	$73,557	$0	$66,317
Real Estate		$4,205	$15,202	$16,405	$16,405	$26,401	$26,401	$20,877	$20,877	$1,896	$6,335
Fixed Mitigation		$7,290	$20,157	$6,602	$21,051	$10,938	$30,631	$8,409	$26,194	$0	$1,345
Capital Costs	0	$164,030	$270,233	$297,593	$316,587	$427,257	$451,143	$241,732	$269,569	$12,336	$237,957
IDC		$23,028	$38,423	$44,132	$45,113	$63,724	$64,781	$36,806	$36,618	$278	$35,053
Investment Costs	0	$187,058	$308,657	$341,725	$361,701	$490,981	$515,925	$278,538	$306,187	$14,330	$273,010
Annual OMRR&R		$247	$217	$228	$228	$221	$221	$200	$200	$0	$200
Annual Mitigation		$96	$56	$74	$74	$71	$71	$55	$55	$0	$0
Total Annual Costs	**0**	**$7,962**	**$12,844**	**$14,221**	**$15,034**	**$20,290**	**$21,306**	**$11,599**	**$12,725**	**$514**	**$11,320**

Oct 2025 price level, 3.25% discount rate. Discrepancies in totals due to rounding.
PED = Planning, Engineering, and Design; S&A = Construction Management; IDC = Interest During Construction; OMRR&R = Operation, Maintenance, Repair, Rehabilitation, and Replacement
**CA11 contingency already included in construction and real estate costs due to how nonstructural costs are generated.*

NED benefits, the benefit-cost ratio, and the net NED benefits are calculated during the evaluation process. Net benefits represent the amount by which the NED benefits exceed NED costs, thereby defining the plan's contribution to the nation's economic output. The NED plan is the alternative plan that reasonably maximizes net NED benefits consistent with protecting the Nation's environment. Note that the plan with highest net benefits is not necessarily the plan with the highest benefit-cost ratio. The benefit-cost ratio helps identify which plans have likely economic feasibility and can be carried forward for further analysis but is not decisive in identifying the NED plan from among those plans that are economically feasible.

To determine the economic justification of the array of alternatives, each alternative was entered into the HEC-FDA risk analysis model. The Monte Carlo analysis in HEC-FDA was then employed to determine residual damages – i.e., damages that would continue to occur in the with-project condition even with implementation of that alternative. The residual damages that would continue to occur in the with-project condition were expressed as equivalent annual damages that account for both the base year condition and the discounted present-worth of the future year condition. The difference between the without condition EAD and the residual EAD for each alternative represents the damages reduced or benefits for the respective alternative. The potential for a "sole beneficiary issue" – where a single property owner receives over 25 percent of a project's benefits – was flagged as a possibility and was raised to the vertical team for coordination in March 2024. The vertical team along with the PDT evaluated this and determined that it would not be an issue and to continue moving forward with the study.

The economic results of the preliminary array of alternatives are shown below in **Table 19**Error! Reference source not found..

Table 19. Economics of Preliminary Array of Alternatives

Alt	Description	Annual Cost	Annual Detour/Delay Benefits*	Annual Flood Damage Reduction Benefits	Mean Annual Benefits	Mean BCR	Mean Annual Net Benefits
CA0	No Action	$0	$0	$0	$0	0	$0
CA1	Current Capital View to 34' Flood Stage	$7,962,200	$471,000	$1,954,500	**$2,425,500**	0.3	**($5,536,700)**
CA2	Capital View @ 34-ft stage, Turkey Creek/Riverside setbacks of 1,000 ft	$12,844,100	$254,000	$500,100	**$754,100**	0.1	**($12,090,000)**
CA4	Optimization Alignment 37-ft stage, Capital View Remains	$14,220,500	$327,000	$6,740,300	**$7,067,300**	0.5	**($7,153,200)**
CA5	Optimization Alignment 37-ft	$15,034,100	$374,000	$6,689,200	**$7,063,200**	0.5	**($7,970,900)**

Alt	Description	Annual Cost	Annual Detour/Delay Benefits*	Annual Flood Damage Reduction Benefits	Mean Annual Benefits	Mean BCR	Mean Annual Net Benefits
	stage, Capital View Removed						
CA6	L-142 historic alignment and profile, Capital View remains	$20,290,200	($9,000)	$18,813,600	**$18,804,600**	0.93	**($1,485,600)**
CA7	L-142 historic alignment and profile, Capital View removed	$21,306,100	($97,000)	$18,824,700	**$18,727,700**	0.88	**($2,578,400)**
CA8	Highway alignment, Capital View remains	$11,599,100	$334,000	$6,974,500	**$7,308,500**	0.6	**($4,290,600)**
CA9	Highway alignment, Capital View removed	$12,725,300	$343,000	$6,995,100	**$7,338,100**	0.6	**($5,387,200)**
CA11	Non-Structural	$513,800	$0	$397,200	**$397,200**	0.8	**($116,600)**
CA13	Hybrid Alignment, Profile at 1% AEP	$11,319,500	$337,000	$14,721,500	**$15,058,500**	1.3	**$3,739,000**

**Negative Annual Detour/Delay Benefits indicate the alternative increases annual detour/delay costs.*
Oct 2025 price level, 3.25% discount rate. Discrepancies in totals due to rounding.

All alternatives except for CA0, CA11, and CA13 were eliminated from the final array of alternatives. The reason for all these plans being removed is the lack of federal interest due to negative net NED benefits (see **Table 19**Error! Reference source not found. above), and low total (comprehensive) benefits. See the Main Report for more detail on initial plan formulation and evaluation. CA11 is kept in the final array of alternatives because it is required by policy, although for many reasons that are outlined in the plan formulation section of the main report, including negative net NED benefits, it is not a good fit for the study area because many structures have already been bought out after the 1993 Flood. The final array of alternatives and their economics are shown below in **Table 20** and **Table 21**.

Table 20. Economics of Final Array of Alternatives

Alt	Total Investment Cost	Annual Cost	Annual Detour/Delay Benefits	Annual Flood Damage Reduction Benefits	Total Annual Benefits	Annual Net Benefits	BCR
CA0	$0	$0	$0	$0	$0	0	0
CA11	$12,614,200	$513,800	$0	$397,200	$397,200	$-116,600	0.8
CA13	$273,009,700	$11,319,500	$337,000	$14,721,500	$15,058,500	$3,739,000	1.3

Oct 2025, 3.25%, $. Discrepancies in totals due to rounding.

Table 21. Probabilistic Net Benefits and BCR of Final Array

Alt	Mean Annual Net Benefits	75% Chance Annual Net Benefits Exceed…	50% Chance Annual Net Benefits Exceed …	25% Chance Annual Net Benefits Exceed …	Mean BCR	75% Chance BCR Exceeds…	50% Chance BCR Exceeds …	25% Chance BCR Exceeds …
CA0	$0	$0	$0	$0	0	0	0	0
CA11	$-116,600	$-296,800	$-138,900	$11,800	0.8	0.5	0.7	1.02
CA13	$3,739,000	$-1,899,100	$2,553,700	$8,681,800	1.3	0.8	1.2	1.7

Oct 2025, 3.25%, $. Discrepancies in totals due to rounding.

6 PLAN SELECTION

6.1 Total (Comprehensive) Benefits

Plan total benefits, also known as comprehensive benefits, attempt to detail all the monetary and non-monetary benefits delivered by a particular plan. It is made up of four accounts, the National Economic Development (NED) account, the Regional Economic Development (RED) account, the Environmental Quality (EQ) account, and the Other Social Effects (OSE) account. The four accounts are detailed below in the following subsections.

6.1.1 National Economic Development Account

The NED plan that emerged from the screening analysis was CA13, which involves constructing a levee designed to a 41-foot stage around much of the project area but set back further from both the Missouri River and Turkey Creek than the current Capital View levee. The current Capital View Levee will be partially removed, only remaining in the study area's eastern portion. It has the highest NED benefits of all alternatives. A map of CA13, the NED Plan, is below in **Figure 8**.

Figure 8. CA13 Map

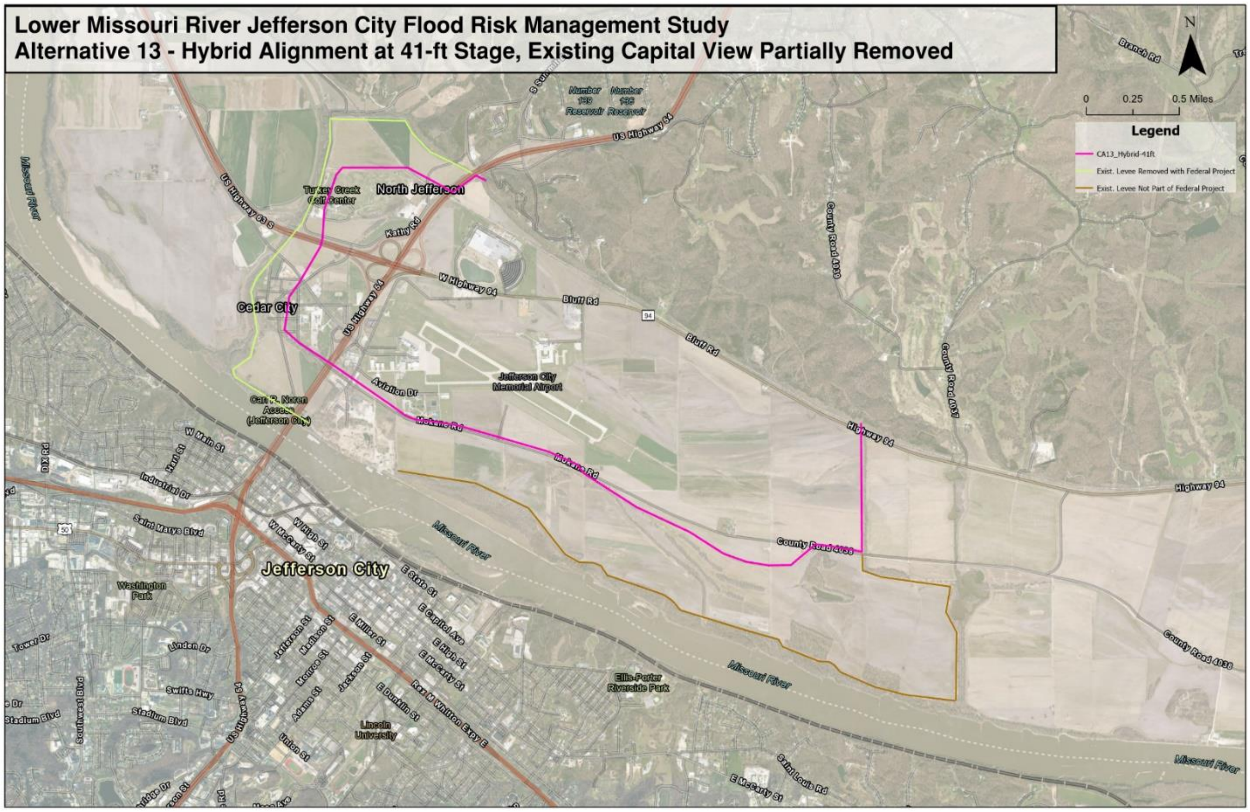


Table 22 below shows how CA13 stacks up against CA0 in terms of expected damages by AEP and reach under each condition.

Table 22. CA0 and CA13 Damage by AEP and Reach ($000s)

AEP Event	CA0 East Reach Damages	CA13 East Reach Damages	CA0 Central Reach Damages	CA13 Central Reach Damages	CA0 West Reach Damages	CA13 West Reach Damages	CA0 Total Damages	CA13 Total Damages
0.5	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
0.2	$0.0	$0.0	$0	$1.8	$0.0	$35.3	$0.0	$37.1
0.1	$245.1	$0.0	5,570.8	$290.5	$3,479.4	$254.9	$9,295.3	$545.4
0.04	$545.9	$0.0	$222,240.8	$925.3	$5,521.6	$456.6	$228,308.3	$1,381.9
0.02	$1,304.8	$0.0	$359,185.8	$2,167.4	$10,494.8	$567.4	$370,985.4	$2,734.8
0.01	$1,507.8	$0.0	$378,722.4	$2,488.6	$11,500.6	$663.6	$391,730.8	$3,152.2
0.005	$4,283.6	$4,418.1	$391,246.9	$390,800.4	$13,227.2	$13,519.1	$408,757.7	$408,737.6
0.002	$5,497.6	$5,759.8	$398,357.7	$399,058.1	$14,201.1	$14,831.8	$418,056.4	$419,649.7

Oct 2025 $. Values shown in $000s. Discrepancies in totals due to rounding.

The current estimated total project first cost in FY 2026 dollars, summarized below in **Table 23**, is $242,639,300. Annual cost calculations for the NED plan, totaling $11,510,200, are summarized in **Table 24**. Annual costs were calculated at the FY 2026 discount rate of 3.25% over the 50-year period of analysis using an interest and amortization factor (I&A) of 0.0407. A 50-year period of analysis is assumed. Interest during construction (IDC) computations, for which the Corps' Institute for Water Resources (IWR) Planning Suite was used, assume real estate costs expended in year 1, PED costs expended years 1-3, construction, relocations, and S&A costs expended in years 4-8, and mitigation costs expended in years 4-9. The contingency cost was spread over the nine years of implementation. The only alternative that does not follow this construction window is CA11, the nonstructural alternative. That alternative is projected to expend Real Estate and PED costs in year 1, and Construction and S&A costs in year 2. IDC was calculated at the end of the period of construction. The information stated above about IDC calculations is also the same for all other alternatives.

Table 23. Estimated NED Plan Costs

Cost Category	Cost ($000s)
Construction	112,686
Planning, Engineering, & Design (PED)	21,782
Construction Management (S&A)	8,430
Contingency	66,317
Real Estate	6,335
Mitigation	1,345
Estimated Project First Cost	**237,957**

Oct 2025 Price Level. Discrepancies in totals due to rounding.

Table 24. NED Plan Annual Costs

Cost Category	Cost ($000s)
Estimated Project First Cost	237,957
IDC	35,053
Total Investment Cost	273,010
I&A Factor	0.0407
Annual Cost Subtotal	11,120
Annual OMRR&R Cost	200
Total Annual Cost	**11,320**

Oct 2025 Price Level. Discrepancies in totals due to rounding.

6.1.2 Regional Economic Development Account

For the RED account, three factors were analyzed. Those factors were:

a. How much stimulus and how many jobs will be brought to the local economy from construction spending via a Regional Economic System (RECONS) analysis (Software developed by USACE).
b. How major commercial public and commercial businesses in the study area are impacted by flooding, and how those impacts affect the larger local economy and community as a whole.
c. How regional agricultural production is affected by flooding.

6.1.2.1 Regional Economic Analysis (RECONS)

As defined in the Planning Guidance Notebook, ER-1105-2-103, the RED account measures changes in the distribution of regional economic activity that result from a proposed alternative. This distribution of economic activity can be captured using the Corps' IWR Regional Economic System (RECONS) software. RECONS was run for the final array of alternatives. The local impact area is defined by the Callaway County boundaries, and the duration of the RED effects is the construction period, 2029 to 2033. The results are shown in **Table 25** below. CA13 distributes the most economic activity to the study area region of the final array alternatives.

Table 25. RECONS Results for Final Array of Alternatives

	CA0	CA11	CA13
Local Capture	$0	$5,017,100	$120,614,900
Jobs (in Full-Time Equivalence)	0	70	1,690
Labor Income	$0	$4,208,000	$101,164,200
Local Capture (US)	$0	$7,969,600	$191,597,600
Jobs (in Full-Time Equivalence) (US)	0	138	3,317
Labor Income (US)	$0	$10,228,200	$245,895,700

**FY2030 dollars*

6.1.2.2 Regional Employers

There are many commercial and public businesses in the study area that are critical to the region in terms of production and employment. Included among these businesses are Hitachi Energy, Capital Sand & Gravel, and Jefferson City Memorial Airport, to name a few. These operations are all at risk of becoming inoperable for extended periods of time due to flooding. Hitachi Energy is a major industrial producer of electrical transformers and other energy sector components. They employ 1,200 employees at the building in Jefferson City. If they were to close for one day, each employee would lose at a minimum $160/day in income (Hitachi Energy's starting wage is $20/hour). Many would lose more. Most employees at the warehouse are paid hourly and will not receive pay if the business is not operating. Additionally, the critical facilities in the region that Hitachi Energy serves with its products such as hospitals, data centers, and power plants, will be strained. Capital Sand & Gravel is the largest producer of sand and gravel on the Missouri River, serving communities as far south as Springfield, MO. They sell approximately 1.2 million tons of product annually. Thirty-two of Capital Sand & Gravel's employees are paid hourly, and most live in the Jefferson City area, similar to the employees of Hitachi Energy. Jefferson City Memorial Airport is very important to the regional economy as well. A 2013 MoDOT study concluded that the airport was responsible for 250 direct and indirect jobs, as well as $21,849,000 in economic output (FY13 $)[4]. The airport is used for corporate flying, law enforcement operations, flight training, military exercises, air cargo, recreational flying, government flights, aerial inspections, prisoner transport, emergency

[4] https://safe.menlosecurity.com/doc/docview/viewer/docN5F39D828A875a30051f9b8a5fc24528d49a838c363495e3674ff012b70f1dc01e08d428ad06b

medical evacuation/transportation, and more. In 2023, Jefferson City Memorial Airport had 44,000 flights (takeoffs and landings) recorded. These are the biggest businesses in the study area, but not the only. The details of these businesses serve to give an idea of what happens to the regional economy when the entire study area is flooded. Without any changes to flood risk management in the study area, existing businesses may be forced to relocate or reduce operations. This will impact jobs, the local economy, and the local tax base. Businesses may avoid investing in this area. The goods and services produced by this economy, servicing not just the local economy, but the economies of the state and nation as well, will cease to be produced or be substantially reduced. The alternatives in the final array of alternatives were ranked on a scale of -3 to 3 according to how well they protect regional employers and allow them to stay open and operational. A ranking of -3 means the alternative would have significant negative effects. A ranking of 0 means the alternative would have no negligible effects. A ranking of 3 means the alternative would have significant positive effects. CA0 receives a ranking of 0 as it would have no negligible effects on the existing conditions. However, as discussed above, the existing flooding conditions are a severe detriment to the regional economy. CA11 receives a ranking of 1 as it would have some positive effects for the businesses it protects through floodproofing and elevation. This protection is not thorough, and it does not protect most of the study area, however, so a qualitative ranking of 1 was deemed appropriate. CA13 receives a ranking of 2. CA13 reduces flood damage to businesses in the study area the most out of all the alternatives. It is by far the friendliest alternative in terms of how it protects regional economic development in all facets.

6.1.2.3 Regional Agricultural

Approximately 2,000 of the 3,300 study area acres are used for agricultural production. A geospatial analysis was undertaken to determine how many acres of agricultural production would be inundated by any amount of water under the FWOP conditions and the conditions of each of alternatives in the final array of alternatives. 2023 USDA crop data polygons were overlaid in ArcGIS Pro with H&H inundation data to calculate the average annual crop acreage inundated for each type of crop being produced in the study area. Crops in the study area consist of corn, winter wheat, soybean, and sorghum. Oats were spotted in the field during a site visit, but they are not in the 2023 USDA crop data. Either this is the first year they are being planted, or they were not reported to/captured by USDA. Either way, oats are not in this analysis. The results of this analysis are below in **Table 26**. The damages associated with increased or decreased crop acreage inundation could be counted in the NED account but are not due to the lack of a certified model and the difficulty in monetizing the loss of agricultural production using a program like HEC-FDA. CA13 does protect slightly less agricultural land on an annual basis than the existing condition due to it being setback from the river, allowing that riverward agricultural land to inundate more frequently. However, the agricultural land landward of the proposed levee will receive significantly better protection from flooding.

Table 26. Average Annual Crop Acreage Inundated for Final Array

Alternative	CA0	CA11	CA13
Corn Acreage Inundated by 1% AEP Event	518	518	163
Soybean Acreage Inundated by 1% AEP Event	1,389	1,389	743

Alternative	CA0	CA11	CA13
Other Crop Acreage Inundated by 1% AEP Event	18	18	9
Corn Acreage Inundated by 0.2% AEP Event	518	518	518
Soybean Acreage Inundated by 0.2% AEP Event	1,389	1,389	1,389
Other Crop Acreage Inundated by 0.2% AEP Event	18	18	18
Total Crop Acreage Inundated by 1% AEP Event	1,925	1,925	915
Total Crop Acreage Inundated by 0.2% AEP Event	1,925	1,925	1,925
Average Total Annual Crop Acreage Inundated	287	287	359

Based on 2023 planting data; Discrepancies in totals due to rounding

6.1.3 Environmental Quality Account

The EQ account is intended to indicate the long-term effects that the alternative plans may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural, and aesthetic environments which, if affected by the alternative plans, could have a material bearing on the decision-making process. Significance is derived from institutional, public, or technical recognition that a resource or an effect is significant. All alternatives were formulated to first avoid impacts to significant resources, particularly those resources protected on the Endangered Species Act and critical habitat. If avoidance was not possible then minimization was utilized in order to have the least possible impact on regulated resources occurring in the system. Impacts to resources will continue to be considered, evaluated, and avoided or minimized to the extent possible.

In this study, the EQ benefits are greatly impacted by the land use that falls outside of the new leveed area. Much of this land is in private ownership and is currently in agricultural production. This is a significant issue for local stakeholders and general project support as well. Therefore, the PDT sought to maximize the EQ benefits that could be gained through publicly owned lands outside of the new leveed area. When looking at the final array of alternatives, the PDT determined that benefits to the environment are only gained through CA13. CA0 (No Action) and CA11 (Non-Structural) result in 0 restored acres. CA13 would allow for a portion of the land outside of the new leveed area to return to natural habitat, also increasing hydraulic connectivity. The area of this restored habitat also has benefits of flood risk reduction, as it allows for conveyance of the Turkey Creek Tributary, which is an issue during high water on the Missouri River. Additional habitat benefits are created through the rehabilitation of the borrow site located upstream in the Church Farm area. Once borrow is removed, restoration will occur. The total acreage of restorable, publicly owned land in the Jefferson City area and Church Farm area exceeds the estimated acreage necessary for mitigating impacts. The PDT used the FACWet model, which is a general ecological model for wetlands and riparian habitat, to determine the benefits in the EQ account. There would be an additional 98.4 average annual habitat units (AAHUs) gained with the implementation of CA13. This approach is detailed in **Appendix C**.

6.1.4 Other Social Effects Account

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

6.1.4.1 Life Safety

OSE considered life safety implications for all the alternatives in the final array. Non-breach overtopping LifeSim results were completed for all alternatives. Alternatives assume USACE design criteria would be utilized to design and construct the levee with negligible probability of a breach. Breaches were not modeled in these scenarios as they are an attempt to gage direct life loss induced by a given alternative. LifeSim results for all alternatives are within the same order of magnitude. They all have maximum life loss results (extreme event, minimum warning) between one and three. **Table 27** below shows the output results from LifeSim 2.1.3.

Table 27. Median Life Loss by Alternative and AEP Event

Alt	50% AEP Median Life Loss	20% AEP Median Life Loss	10% AEP Median Life Loss	4% AEP Median Life Loss	2% AEP Median Life Loss	1% AEP Median Life Loss	0.5% AEP Median Life Loss	0.2% AEP Median Life Loss
CA0	0	0	0	0	0	0	1	1
CA1	0	0	0	0	0	0	0	0
CA2	0	0	0	0	1	1	1	1
CA4	0	0	0	1	2	2	2	3
CA5	0	0	0	0	2	2	3	3
CA6	0	0	0	0	0	0	0	1
CA7	0	0	0	0	0	0	0	1
CA8	0	0	0	0	2	2	2	3
CA9	0	0	0	0	1	2	2	2
CA11	0	0	0	0	0	0	1	1
CA13	0	0	0	0	0	2	2	2

The results were discussed with a member of the Modeling, Mapping, and Consequence (MMC) team who surmised that the difference between life loss results of one and three is within model error, and that there is no discernable difference in life loss reduction between the alternatives. The Incremental risk of breach and non-breach analysis has been run for CA13 as part of a risk assessment. Implementing CA13 (the only structural option in the final array) introduces no significant incremental risk to life loss. The screening level risk assessment (SLRA) resulted in a Levee Safety Action Classification (LSAC) of 4/Low. Because the AEP of overtopping is at the

0.01 AEP event, overtopping is the primary risk driver. The average life loss prior to over topping is 0.1 and the overtopping average life loss is 0.08, resulting in an incremental life loss of less than one. Additionally, CA13 meets the Tolerable Risk Guidelines per Planning Bulletin 2019-04. For additional details about the risk assessment, see **Appendix G**.

The other OSE criteria compare connectivity, community cohesion, and Lower Missouri River Flood Risk and Resiliency Study (LoMO System Plan) adherence.

6.1.4.2 Community Connectivity and Cohesion

One area of community connectivity and cohesion that is greatly impacted by flood events is the traffic network in the area. Major highways (U.S. Highway 54, U.S. Highway 63/94) in the area have very large detours when they are inundated. Traffic counts on these roadways are an estimated ~82,000 vehicles per day total. Failure of these systems, the inability to use them during the flood event, and the recovery and repair lengthening the time these roadways are closed causes additional, non-monetary impacts in the day-to-day lives of citizens not captured in the NED account. The economically disadvantaged community south of the river is not in the project area but also uses this critical infrastructure daily. The primary source of commuting and accessing public services such as healthcare, groceries, and other essential services in this area is by private vehicle. Employers in the area report that most of their employees utilize these transportation corridors to commute to work daily. A loss of these corridors would cease economic activity in the area. Flood damage to the transportation network alone in the area is estimated to be ~$887,000 annually with no action. CA13 reduces this damage to ~$550,000 annually.

6.1.4.3 LoMO System Plan (Implementing Recommendations)

One of the goals of the Lower Missouri River System Plan, of which this study is a spinoff, is to approach flood risk in a more holistic, sustainable, and resilient manner. One of the major ways to execute this approach is with levee setbacks. Levee setbacks increase the conveyance of a river system. Conveyance will significantly improve the efficiency, effectiveness, and resiliency of a river system. By setting back the levee and increasing conveyance, we reduce the risk of flooding by spreading out and therefore slowing down the floodwater. CA13 increases conveyance the most of any final array alternative. CA13 also performs the best in other metrics that reflect a holistic, sustainable, and resilient river system, such as upstream, downstream, and adjacent positive changes in water surface elevation. Additionally, a levee setback will allow for the restoration of natural floodplains that provide invaluable ecosystem restoration services such as water filtration, wildlife habitat, and recreational opportunities.

This community has also found a sense of identity in some of the businesses and services that are offered in the study area. The golf course and event center and the airport restaurant are locations that add to the quality of life in the broader community. They serve as gathering places, contribute to the local economy, provide recreational opportunities, and serve a low-income community.

6.1.5 Synopsis

Table 28 below shows how the alternatives in the final array stack up in the four total benefits accounts. Information is monetized, when possible, then quantified if not able to be monetized, and then qualitatively described.

Table 28. Final Array of Total Benefits Comparison

Alt.	NED			RED			OSE			EQ	
	Total Investment Cost	Mean Annual BCR	Mean Net Annual Benefits (flood damages reduced + detour/delay costs reduced)	RED 1: Local Capture (RECONS)	RED 2: Allows major regional employers to stay open and provide goods and services to the region, along w/ employment	RED3: Agricultural Protection (average annual crop acreage inundated)	OSE 1: Life Safety (0.002 AEP Event Median Life Loss)	OSE 2: Adhering to LoMO System Plan Goals	OSE 3: Providing FRM benefits to communities by maintaining access to goods, services, transportation networks	EQ 1: Net AAHUs from restored acres	EQ 2: Cultural Resources
CA0	$0	0	-	$0	Businesses will still be prone to closures during flood events	287 acres inundated	0.3 – 3 life loss	No Change	0	0	No Impact
CA13	$273 mil	1.3	$3.7 mil	$120.6 mil	Allows business to remain open during more frequent events	359 acres inundated (due to levee setback)	0.3 – 3 life loss	Implements one recommendation: Increases conveyance	Allows all residents, including two economically disadvantaged communities, access to major transportation arteries	13.5	No Impact
CA11	$14.3 mil	0.7	-$186,400	$5 mil	Businesses will still be prone to closures during flood events	287 acres inundated	0.3 – 3 life loss	May alleviate some damage to structures, but not cost effective	No improvements to transportation arteries	0	No Impact

Oct 2025 Price Level.

CA13 is the Maximum Total Net Benefits Plan. It provides the most net benefits to the NED, RED, OSE, and EQ accounts. The net benefits in the NED account are positive, and the benefits realized in the other three accounts are gained at no additional cost, giving much more than any other plan. Specifically,

- CA13 results in $15.1 million damages reduced per year, significantly reducing burden on the community.
- Two low-income communities (both within the study area and across the river in Jefferson City) gain income stability when access to places of employment and goods and services are protected to a higher level.
- Access to jobs, transportation, and emergency care during flood events remains for a much longer period than previous levee performance.
- Community businesses which employ thousands are all currently at risk of becoming inoperable for extended periods of time due to flooding, putting employees at risk of losing jobs and/or income. These businesses and/or their access are included in the new federal levee area:
    - Hitachi Energy employs over 1,200 people.
    - Capital Sand & Gravel is largest producer of sand and gravel on the MO River, serving communities as far south as Springfield, MO.
    - 44,000 flights (takeoffs and landings) annually at Jefferson City Memorial Airport with 250 jobs either directly or indirectly supported.
- Other vital facilities, including the Missouri Army Guard Base containing a Civil Support Team and a Flight Facility, and MFA AgriServices, an important resource for getting critical agricultural products to market, gain significant benefits in flood risk reduction.
- CA13 contributes to community identity and cohesion by ensuring vital economic and communal centers remain accessible, including a restaurant, golf course and events center, and access to the nationally known Katy Trail. These are all important community gathering locations.
- The plan provides better opportunities to maintain infrastructure and quality of life during flood events and in the aftermath.
- CA13 provides an increased level of performance for critical infrastructure such as the Jefferson City Regional Wastewater Treatment Plant that will result in less clean-up costs for local governments.
- A higher level of levee performance will produce positive impacts to economic growth as concerns of flooding is lessened.
- CA13 provides lift to natural habitat in the study area and is the only final array alternative to enhance hydrologic connectivity with the Missouri River.

7 POST FEDERAL INTEREST PLAN DETERMINATION MILESTONE (TSP) ANALYSIS

After the Federal Interest Plan was identified, slight changes were made to move the project toward 35% design maturity. The changes are related to engineering by nature but have a slight effect on the economics of the project. The changes are not substantial enough to change the Federal Interest Plan, and any other alternative selected would go through a similar process.

7.1 Post Federal Interest Plan Determination Milestone Alternative Changes to CA13

The hydraulic model was refined based on information gained from further surveying. These refinements include earthwork estimates, utility impacts, closure structure development, interior drainage, and more. See **Appendix A1** for more detail on how the hydraulic model was refined.

The changes to the hydraulic model changed the hydraulic files that are imported into FDA, as well as the flow-frequency functions and stage-discharge functions. The changes are minimal.

The top of the recommended levee elevation was also refined. To ensure the levee will overtop at the downstream end first, the design levee top elevation at the transition of the mainstem levee to the upstream tieback is designed to be approximately two feet higher than the calculated stage of the 0.01 AEP event. The top of levee elevation then decreases slightly as it continues downstream until ultimately the downstream tieback is reached, where the top of levee elevation will be approximately 0.5 feet higher than the calculated stage of the 0.01 AEP event. See **Appendix A1.4** for more detail on the refinement.

7.1.1 Refined Costs and Benefits for the Federal Interest Plan

The changes discussed above in **Section 7.1** slightly change the economic benefits of the project. FDA was rerun with the updated refinements to hydraulics and the proposed levee. The updated benefit results for CA13 are shown below in **Table 29**. Keep in mind these modeled damages and benefits only represent the outputs of FDA. They do not take into account the detour/delay modeling. That has not changed since selecting the Federal Interest Plan.

Table 29. Updated CA13 FDA-Modeled Benefits

	CA13
Mean Expected Annual Damages	$4,322,000
Mean Expected Annual Damages Reduced	$14,799,000
75% Chance Annual Damages Reduced Exceeds…	$9,185,000
50% Chance Annual Damages Reduced Exceeds…	$13,637,000
25% Chance Annual Damages Reduced Exceeds…	$19,818,000

Oct 2025 Price Level

The benefits of the project are not the only facet that changed after the Tentatively Selected Plan milestone. The costs also changed due to the way that induced flooding impacts from the project are currently being calculated. The way that this is being done for this project is relatively new and unprecedented. The method was not in place prior to the selection of the Tentatively Selected Plan and thus was not able to be done until after the Tentatively Selected Plan milestone. The calculation is done by Real Estate and Office of Counsel and is a separate process from the process that Economics uses to calculate damages due to flooding. The costs associated with induced impacts are approximately $20,000,000 and are added to the Real Estate account and contribute to the Total Project Cost. These are presented below along with the benefits, showing the post-Federal Interest Plan Determination net benefits and BCR of the project. **Table 30** displays the refined and final costs and benefits.

Table 30. Updated CA13 Net Benefits ($000s)

	CA13
Construction Cost	$123,090
Construction Contingency	$73,998
PED Cost	$21,774
S&A Cost	$8,772
Relocations Cost	$22,346
Real Estate (incl. induced impacts) Costs	$39,856
Mitigation Costs	$1,099
Total Project First (Capital) Costs	$290,935
IDC	$46,297
Total Investment Costs	$337,232
I&A Factor	0.040730275
Annualized Costs	$13,736
Annual AM&M Costs	$36
Annual OMRR&R Costs	$156
Total Annual Costs	$13,928
Mean Expected Annual Damages	$4,322
Mean Expected Annual Damages Reduced	$15,136
Mean BCR	1.09
Mean Annual Net Benefits	$1,208

Oct 2025 Price Level; Discrepancies in totals due to rounding.

7.2 Residual Risk and Project Performance

Although it might be desirable if a flood-risk management project could eliminate the consequences of flooding to property and people, the simple fact is that no project that conceivably could be constructed would successfully contain every possible flood. Significant flood risk will continue after the Jefferson City project is implemented.

Table 31 below details the performance statistics for CA0 and Discrepancies due *to rounding*

Table 32 below details the performance statistics for CA13. Three key statistics are indicators of project performance. These three statistics are long-term exceedance probability (LTEP), AEP (mean and median), and assurance of AEP. These statistics are described below. For more information, visit the HEC-FDA technical reference page.[5]

a) LTEP is defined as the probability that one or more flood events (AEP) will occur within a specified time period (t), or the likelihood that a target stage (associated with said flood event) will be exceeded in a specified time period (t). A lower number indicates better project performance. It is calculated with the following equation:

Equation 3. $\mathbf{LTEP = 1 - (1 - AEP)^t}$

b) AEP, mean and median, refers to the mean and median AEP, respectively, that is realized across *i* Monte Carlo iterations (usually 500,000 or when convergence occurs) for a given stage.
c) Assurance of AEP, sometimes referred to as conditional non-exceedance or simply "assurance", is the percent chance that a specific threshold or target stage is not exceeded by a given AEP event. A higher number indicates better project performance. In the absence of a levee or otherwise identified target stage, the threshold value will be defined as the stage at which five percent of the damage of the 0.01 AEP flood occurs. The AEP that has a 90% assurance for a given threshold means that 90% of the time, the stated AEP will not exceed the threshold.

Table 31. CA0 Project Performance

	East Reach	Central Reach	West Reach
Threshold Value	550.1	551.8	552.2
LTEP – 10 Years	76.6%	78.8%	79.0%
LTEP – 30 Years	98.1%	99.0%	99.1%
LTEP – 50 Years	99.9%	100%	100%
Mean AEP	0.135	0.144	0.145
Median AEP	0.133	0.142	0.143
Assurance for 0.1 AEP Event	31.3%	25.0%	24.4%
Assurance for 0.02 AEP Event	0.1%	0.1%	0.1%
Assurance for 0.01 AEP Event	0.1%	0.1%	0.1%
Assurance for 0.004 AEP Event	0%	0%	0%
Assurance for 0.002 AEP Event	0%	0%	0%
AEP With 90% Assurance	0.196	0.207	0.208

Discrepancies due to rounding

[5] https://www.hec.usace.army.mil/confluence/fdadocs/techref/system-performance-with-uncertainty-metrics-167248988.html

Table 32. CA13 Project Performance

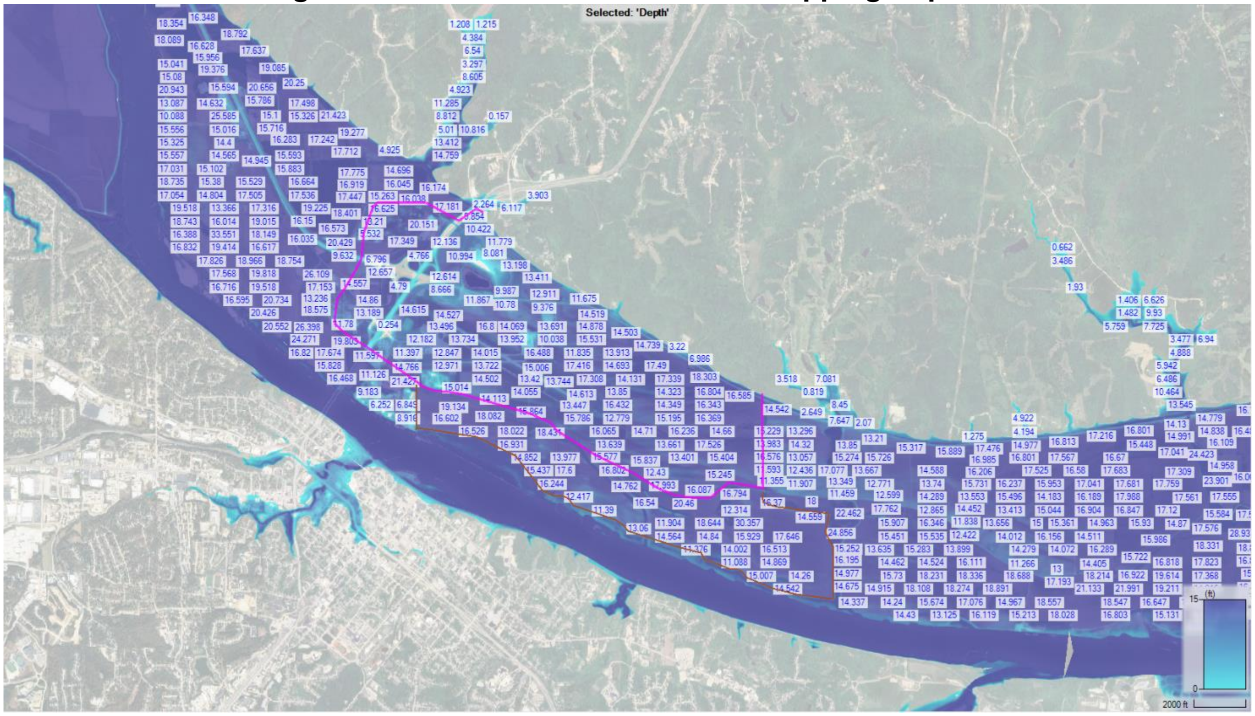
	East Reach	Central Reach	West Reach
Threshold Value	556.3	560.4	561.2
LTEP – 10 Years	12.4%	4.8%	4.8%
LTEP – 30 Years	32.8%	13.6%	13.6%
LTEP – 50 Years	48.4%	21.7%	21.6%
Mean AEP	0.013	0.005	0.005
Median AEP	0.009	0.003	0.003
Assurance for 0.1 AEP Event	100%	100%	100%
Assurance for 0.02 AEP Event	80.3%	98.9%	99.0%
Assurance for 0.01 AEP Event	53.9%	82.9%	86.7%
Assurance for 0.004 AEP Event	20.6%	53.0%	53.8%
Assurance for 0.002 AEP Event	12.5%	42.9%	42.7%
AEP With 90% Assurance	0.034	0.010	0.010

Discrepancies due to rounding

It is important to note that in the FWOP condition, the western-most reach is the most vulnerable. This is also the most upstream reach. A failure at the West Reach will cascade downstream through the Central and East reaches. Under the FWP condition, when the river stage is high enough that a levee breach is inevitable, the levee is designed to breach from the downstream East Reach. This mitigates risk as much as possible by preventing that cascading effect that is currently present in the FWOP condition.

The continuing likelihood that damaging flood events will occur in the project area does not mean that the project is ineffective. As can be seen in the two tables above, CA13 significantly reduces the chance of a flood over the next 50 years and significantly reduces the chance of flooding in the project area for all flood events. As can be seen in the discussion of project benefits, the project very substantially reduces potential economic damage over the long term. This is not accomplished by completely preventing floods from occurring, but by alleviating depths of flooding to much less dangerous and harmful levels when floods do occur. There will be a continuing need, even after project implementation, to monitor potential flood events diligently and take appropriate precautions. In particular, the levee has a high likelihood of being exceeded by events less frequent than the 0.005 AEP event. If an event such as this is to occur, risk to structures behind the levee is very high. It is important that the City, residents, and employees within the study area are aware of these risks. When the levee is eventually overtopped, the water has the potential to rush in very fast at very high depths, although the design of the levee is intended to make this event as safe as possible by ensuring that is breaches from the downstream East Reach. See **Figure 9** below for what this residual risk looks like.

Figure 9. FWP 0.005 AEP Event Overtopping Depths



8 CONCLUSION

The socioeconomics analysis of the Jefferson City federal flood-risk management project in Jefferson City, Missouri has found that a strong federal interest exists in CA13. **Table 33** below displays the final benefit to cost analysis for CA13.

CA13 is also the total net benefits plan, as shown below in **Table 34**. Hence, CA13 is the district's Federal Interest plan. Due to factors discussed in the Main Report, the Recommended Plan will be CA0, the No Action Plan. This is not due to economic factors.

Table 33. Final CA13 Benefit-Cost Analysis ($000s)

	Value
Project First (Capital) Costs	$290,935
Annual Costs	$13,928
Annual Benefits	$15,136
Benefit-Cost ratio	1.09
Net Annual Benefits	**$1,208**

**Oct 2025 Price Level; FY26 Federal Interest Rate of 3.25%*

Table 34. Final CA13 Comprehensive Benefits (Oct 2025 Price Level)

Alt.	NED			RED			OSE			EQ	
	Total Investment Cost	Mean Annual BCR	Mean Net Annual Benefits (flood damages reduced + detour/delay costs reduced)	RED 1: Local Capture (RECONS)	RED 2: Allows major regional employers to stay open and provide goods and services to the region, along w/ employment	RED3: Agricultural Protection (average annual crop acreage inundated)	OSE 1: Life Safety (0.002 AEP Event Median Life Loss)	OSE 2: Adhering to LoMO System Plan Goals	OSE 3: Providing FRM benefits to communities by maintaining access to goods, services, transportation networks	EQ 1: Net AAHUs from restored acres	EQ 2: Cultural Resources
CA0	$0	0	-	$0	Businesses will still be prone to closures during flood events	287 acres inundated	0.3 – 3 life loss	No Change	0	0	No Impact
CA13	$337.2 mil	1.09	$1.2 mil	$120.6 mil	Allows business to remain open during more frequent events	359 acres inundated (due to levee setback)	0.3 – 3 life loss	Implements one recommendation: Increases conveyance	Allows all residents, including two economically disadvantaged communities, access to major transportation arteries	13.5	No Impact
CA11	$14.3 mil	0.7	-$186,400	$5 mil	Businesses will still be prone to closures during flood events	287 acres inundated	0.3 – 3 life loss	May alleviate some damage to structures, but not cost effective	No improvements to transportation arteries	0	No Impact

Oct 2025 Price Level; FY26 Federal Interest Rate of 3.25%