Investigation and Analysis Report for the

Cottonwood Creek Flood Prevention Project

Appendix D

Upper Cottonwood Creek HUC 12

Idaho County, Idaho

The purpose of the Investigation and Analysis Appendix is to present information that supports the evaluation and conclusions of the Watershed Plan and Environmental Assessment (Plan-EA). Refer to the Administrative Record for the copies of the studies referred to in this Appendix.

December 2025

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D.1.0 Introduction

The Cottonwood Creek Flood Prevention and Water Quality Project (Proposed Project) is located within the Cottonwood Creek Watershed, in and nearby the City of Cottonwood, Idaho County, Idaho. The Proposed Project provides flood protection. See **Appendix C1, Figure C1-1** for an overview of the plan area and **Appendix C1, Figure C1-4** for identification of the Proposed Project.

Flood Protection: Existing flood protection infrastructure within the City does not have the capacity to carry flood flows from 5- and 10-year storms, causing frequent flooding of buildings and property. The existing system was constructed in a piecemeal fashion driven by minimum necessity as budget allowed and is not the result of a methodical design approach.

The existing flood protection system is shown in **Appendix C1, Figure C1-2** and shows an assortment of pipe-sizes that increase and decrease through the system**.** The Proposed Project will replace and increase the size of infrastructure to carry Cottonwood Creek flows, as well as an unnamed tributary on the north side of the city, referred to as the King Street drainage. Project components include:

- Main Street Alignment—Realign the main channel beneath Main Street. Work would include a new reinforced concrete box conduit and new inlet structures. The new alignment would re-route the main channel flow from the west end of the city to the existing Cottonwood Creek channel near U.S. Highway 95.
- King Street Improvements—Upgrade flood conveyance to pass floodwaters from the northwest boundary of the city through the fairgrounds and along King Street to Cottonwood Creek.
- Creek Crossings and Channel Enhancement—Replace two culverts at creek crossings and conduct creek improvements along East Road between the crossings. The Highway District has observed flooding in these areas and channel enhancement would improve safety and access during high water events. Replace one culvert at Maple Street, where flooding has been observed upstream of this culvert due to inadequate capacity.
- Channel Enhancements—Remove select Cottonwood trees, stumps, and flood debris within the Cottonwood Creek channel along East Road to improve safety and access during high water events. Add vegetation along the Cottonwood Creek channel to restabilize the bank and improve fish and wildlife habitat.
- Lagoon Protection—Armor existing lagoon treatment facilities to mitigate erosion of the stream into the facility embankments, reducing potential for discharge of raw sewage into the stream.

Photos showing the impact of flooding in recent years are provided in **Appendix E1**.

D.2.0 Design Criteria

The basis for the planning engineering investigations and analysis are the current Idaho Department of Transportation Standards, National Resources Conservation Service (NRCS), and IDEQ criteria and standards. Additional information relevant to each of the sections provided in this report is available as part of the administrative record for the Proposed Project. The City is a participating member in the National Flood Insurance Program (NFIP) (City Ordinance #254).

The City of Cottonwood requires building permits and has land use zoning to regulate building construction. Idaho County (outside City Limits) does not require building permits and there is no formal review process outside of federal and state requirements. Idaho County no longer participates in Federal Emergency Management Agency (FEMA) NFIP (outside City Limits). Design criteria is established for the project purpose as follows:

- The City of Cottonwood and Cottonwood Highway District have Development Standards for proposed developments, which address road design and drainage design for new residential and commercial developments.
- The U.S. Highway 95 Business Loop within the city is part of the Idaho Transportation Department (ITD) right-of-way and design criteria for flood protection will utilize the ITD Roadway Design Manual policies/guidance as a basis for improvements.
- The City of Cottonwood Ordinance #254 Flood Ordinance assists the city in regulating development within and alterations of floodplains.

D.3.0 Hydrologic and Hydrology Analysis

The City of Cottonwood was established along Cottonwood Creek in the mid-1800's. The drainage area contributing to Cottonwood Creek at the City is approximately 6,500 acres, the watershed boundary is shown in **Appendix C3, Figure C3.1-1**. In the early 1900’s naturally flowing portions of Cottonwood Creek within the city were diverted to accommodate growth of the downtown business area along Main Street and Front Street. This resulted in sections of the creek channel being located immediately adjacent to the foundations of homes and businesses. Portions of the creek were also routed under businesses through a network of the City’s flood conveyance system. As the City of Cottonwood expanded north of Main Street a flood protection system was installed that collects flood water and carries it down King Street to Cottonwood Creek. Additional detailed project information about hydrology is in **Technical Memorandum 001 Hydraulics and Hydrology** prepared by J-U-B Engineers located in **Appendix E7**.

D.4.0 Flood Protection Analysis

The existing system and proposed design alternative were analyzed using a computer aided modeling system, InfoSWMM Suite 14.7. The analysis utilized a Soil Conservation Service (SCS) Unit Hydrograph model and dynamic wave routing to calculate peak flood rates and flood volumes for each storm event. Flood rates were then loaded into a Surface-water Modeling System (SMS) model to determine the impacts of out of bank flows of Cottonwood Creek for both the existing system and the proposed design alternative. The SMS model was used to identify the number of structures and agricultural land that would be flooded under each storm event, creating a matrix of analysis under various storms in existing and proposed conditions.

The existing flood conveyance system is identified in **Appendix C1, Figure C1-2**. The existing system is hydraulically insufficient to handle storm events with a return period of 5- to 10-years with larger storms causing extensive flooding to Main Street businesses, residences and other structures throughout the city. **Appendix C3, Figures C3.2-1** through **C3.2-4** show the existing impact of flooding under 10-, 50-, 100-, and 500-year storm events.

The Proposed Project includes upgrades for protection and mitigation of flood damage within the city. The design criteria are based on passage of the 50-year storm while limiting damage to structures and roadways at a 100-year storm. An overview of the Project is shown in **Appendix C2, Sheet G-101** and consists of a new alignment along Main Street and King Street. The proposed alignments utilize existing channels that will require cleaning.

- **The Main Street Alignment** starts east of the railroad trestle conveying flows from the natural Cottonwood Creek channel to the east along the north side of Front Street until the intersection of Main Street. The alignment then continues beneath Main Street right of way and outlets into the existing stream channel west of Highway 95 near the Main Street-Highway 95 intersection. A low flow diversion will be installed from Main Street to the existing Cottonwood Creek channel at Idaho Street to provide environmental benefits and maintain service to the localized area.
- **The King Street Alignment** starts behind the storage units on the north end of town and connects to the Main Street Alignment near the intersection of Main Street and King Street. The alignment serves drainages northwest of the city that pass through two low lying areas of agricultural land near Sunset Drive and Cottonwood Butte Road. The city reports that periodic flooding is observed in these areas, and as agricultural in nature, flooding is allowed to remain as part of the design criteria. The Sunset Drive flood area will require outlet modifications.

General flood protection improvements east of Highway 95 along East Road are identified in **Appendix C1, Figure C1-4**. General flood protection improvements include:

- **Channel Culvert Improvements:** Cottonwood Creek crosses a Cottonwood Highway District Road in two locations on East Road and Airport Road east of U.S. Highway 95. The existing concrete box culverts do not have capacity to carry the design storm, and the Highway District reports periodic flooding and resultant damage to the existing roadway. The project will replace these structures with larger structures of sufficient capacity to pass the design storm.
- **Channel Improvements & Embankment Protection:** In addition, the Cottonwood Creek channel between these crossings is overgrown with cottonwood trees, which impede flows and forces the channel to erode creek banks. Trees obstructing the flows will be removed with the project. A portion of the channel flows past the city's wastewater lagoons, and erosion protection of the embankment is required to prevent unintended and untreated drainage of the treatment facilities to the stream. The existing City wastewater lagoons embankment along the Creek will be armored with riprap to protect their embankments, which are currently experiencing erosion during flood events. The channel geometry will remain relatively unchanged after the obstruction removal and erosion protection work. The channel improvement area and embankment protection area is identified in **Appendix C1, Figure C1-4**. Table 1 lists the Structural Table 3b – Channel Work.

Additional details about the analysis and model of the flood protection project can be found in **Technical Memorandum 002 Flood Protection Design** prepared by J-U-B Engineers located in **Appendix E7**.

Table 1. Structural Table 3b – Channel Work – Cottonwood Creek

						CHANNEL DIMENSIONS			
Channel Name (Reach)	**Location**	**Drain Area (mi^2)**	**Year freq design dischg (cfs) (100-yr)**	**Water Surface Depth (ft)**	**Hydraulic Gradient (ft/ft)**	**Gradient (ft/ft)**	**Bottom Width (ft)**	**Elev. (ft/msl)**	**Side Slope (Left/Right)**
Cottonwood Creek	East Road	9.2	380	5.33	1.5/100	1.5%	3.65	3407.4	1.77H:1V / 3.34H:1V

	n Value		**Velocities**					
Channel Name (Reach)	aged	as built	aged	as built	Excavation vol (cy)	Type of work	Existing channel type	Present flow cond.
Cottonwood Creek	0.05	0.05	3.7	3.7	None	Vegetation removal and riprap placement on eroded slopes.	Natural	Perennial

D.5.0 Dam Breach Analysis

The Project does not include the construction of any new detention or storage facilities; therefore, a breach analysis was not conducted, reference **Appendix E7**, **Technical Memorandum 003** for additional discussion.

D.6.0 Flood Protection Inundation Analysis

Inundation analysis was completed to understand the impact of floodwater under varied storm frequencies within the project area. A two-dimensional model was utilized to simulate flood conditions through natural and constructed channels together with terrain elevations under the identified storm conditions. Additional details regarding model development and inundation analysis is contained in **Technical Memorandum 002, Flood Protection Design** prepared by JUB located in **Appendix E7**.

Flood inundation maps of the Proposed Project were generated to compare inundation areas of the existing system against the proposed. Inundation maps of the existing system are provided in **Appendix C3, Figure C3.2-1 through C3.2-4**. Inundation maps of the Proposed Project are provided in **Appendix C3, Figure C3.2-5 through C3.2-8.**

D.7.0 Geotechnical Analysis

A geotechnical investigation of the project area was completed in July of 2021. Refer to the Geotechnical Evaluation Cottonwood Stormwater and Wastewater System Improvements, Various Streets, Cottonwood, Idaho found in **Appendix E3**. The preliminary investigation included four borings and five test pits.

Main Street and King Street each had two borings completed along their length. Borings ranged in depth from 6.5 feet to 16.5 feet from the existing ground surface. Soil layers were identified and classified using the Unified Soil Classification System for each boring. Basalt was encountered in three out of the four borings. Blow counts for a 2 inch outside diameter Split Spoon Standard Penetration are reported on the boring logs. Soil samples were also obtained from the Split Spoon Standard Penetration Test.

Five test pits were excavated. One test pit is located within city limits on Butler Street and four are located outside city limits on East Road. Test pits range in depth from 7 feet to 10 feet from the existing ground surface. Soil layers were identified and classified using the Unified Soil Classification System for each test pit. Basalt was encountered in four out of the five test pits. Soil layers encountered were recorded on the test pit log for each test pit. Soil samples were taken from the test pits.

Ground water was observed in two out of the four boring and three out of the five test pits. Ground water varied from 2.5 feet to 7 feet in depth from the surface. It is anticipated that ground water elevation will fluctuate depending on the season, snow melt, and other environmental factors.

Soil samples obtained from the Split Spoon Standard Penetration Test and the test pits were taken and analyzed in the lab. Moisture content, gradation, fines content, Atterberg limits, pH, and resistivity testing were conducted on representative samples. It was determined that the native soils with the proposed project area are corrosive to very corrosive to metal conduits based on the resistivity testing. Resistivity values range from 200 to 1800 ohm-cm.

The geotechnical report contains guidelines for the materials and construction methods for the Proposed Project. The full geotechnical report can be reviewed in **Appendix E3**.

D.8.0 Seismic Analysis

A seismic study was completed as part of the geotechnical report provided in **Appendix E3**. For the seismic design, the soils were classified as Site Class C. Table 2 lists the seismic design considerations for the proposed project from the geotechnical report. The embankment needs to be designed to meet these loadings and the NRCS and Idaho Department of Water Resources Dam Safety design requirements.

Table 2. Seismic Considerations

DESCRIPTION	VALUE
2012 International Building Code Site Classification (IBC)	C
Site Latitude	46.041597
Site Longitude	-116.335883
So PGA	0.13 g
Ss Spectral Acceleration for a Short Period	0.291 g
Ss Spectral Acceleration for a 1-Second Period	0.102 g
Fa Site Coefficient for a Short Period	1.3
Fv Site Coefficient for a 1-Second Period	1.5

The property is not located within an identified seismic belt. Based upon published geologic maps, no active faults travers through or are immediately adjacent to the site. The site is not located within local fault study zones. The nearest mapped fault system is the Salmon River Fault System located about 12 miles south of the site.

D.9.0 Coordination with Other Projects

The ITD maintains the U.S. Highway 95 Business Loop through the City of Cottonwood along portions of King Street and Main Street. ITD recognizes that underground installation of pipe and conduits on similar projects often requires a hot mix asphalt overlay across the roadway to seal pavement cut lines and repair surface damage. ITD is partnering with the city to complete the pavement repairs and thin lift overlay (anticipated two inches thick) within the project limits as part of the project. ITD intends to enter into an agreement with the city to complete the work. In addition, the ITD project will improve some of the non-compliant Americans with Disabilities Act (ADA) sidewalk ramps. The estimated costs for this work are included in the project cost estimate.

D.10.0 Alternatives

Alternatives that were investigated as part of the study include the analysis of No Action alternative and multiple Flood Protection alignments.

D.10.1 Flood Protection Alternatives

The no action and three flood protection alternatives, as shown in **Appendix C1, Figure C1-3,** were analyzed based on design criteria following discussions with City staff, and project sponsors. Inflow hydrographs for the 500-, 100-, 50-, 25-, 10-, 5-, and 2-year storms were utilized to assess performance of each flood protection alternative. Each flood protection alternative other than the no action alternative analyzed the storage areas, conduits, sizes and depths required to convey the storm event. The location of the storm comparison hydrograph for the selected flood protection alternatives is shown in **Appendix C3, Figure C3.2-9**. The storm comparison hydrographs for the 500-, 100-, 50-, and 25-year storms are shown in **Appendix C3, Figure C3.2-10** are for a duration longer than 24 hours to ensure that they are capturing the entire watershed runoff event since there is delay from the time the storm ends to when the floodwater runoff is routed to the location represented by the storm comparison hydrographs. Sizing of the existing system results in periodic flooding of agricultural areas near City limits.

D.10.1.1 No Action Flood Protection Alternative (Existing Condition)

The existing system currently does not have capacity to pass flow greater than those generated by the 5- to 10-year storms, resulting in a high risk of flooding in the City. Based on an ITD Special Inspection report of a portion of conduit near the Main Street alignment provided in **Appendix E1**, the existing Cottonwood Creek conduit is structurally deficient and needs to be replaced soon. The report identified severe scour and material piping of the backfill at the inlet of the existing Cottonwood Creek alignment as well as distortion, deflection, corrosion, misalignment of splices, and deep abrasion of the conduits that run beneath streets and buildings.

The pipe/box conduit reviewed within the Special Inspection report is located under an existing grocery store and is undersized to handle flood flows, resulting in the inlet structure overtopping and flooding several Main Street businesses. The No Action alternative will result in continuing flooding, on a nearly annual basis. The northern “King Street” drainage also has undersized conveyance systems, which will result in continued flooding through this northern drainage. Inundation maps were not developed to assess the impacts of conduit failure but could be catastrophic to the downtown area.

D.10.1.2 Flood Protection Alternative 1

Flood protection alternative 1 consists of a new alignment for Cottonwood Creek along Main Street with the King Street drainage using the existing connection point to Cottonwood Creek. In concept, the alternative facilitates use of smaller piping along the Cottonwood Creek alignment and the existing natural channel to pass King Street flow. The systems converge at the open channel section of Cottonwood Creek just west of Highway 95 and Main Street. This alternative is the most similar to the existing system since the King Street drainage will utilize the existing channel behind Main Street businesses.

Analysis shows that the timing of peak events from the King Street and Cottonwood Creek drainage (which is generally higher in elevation) are staggered such that the construction of parallel conduits along the creek section does not provide a significant project benefit. The peak flow of King Street occurs prior to the peak flow of Cottonwood Creek while the Main Street alignment has additional capacity.

D.10.1.3 Flood Protection Alternative 2

Flood protection alternative 2 consists of a new alignment along Main Street and King Street. The King Street drainage connects to the Cottonwood Creek alignment near the intersection of Main Street and King Street. The new Main Street alignment starts east of the railroad trestle conveying flows from the natural channel to the east along the north side of Front Street to the intersection of Main Street. The alignment then continues beneath Main Street right of way and outlets into the existing stream channel west of Highway 95. This route reduces the need to resize existing undersized conduits in that area and protects the businesses from flood water. This alternative eliminates under building conveyance piping and open channels near building foundations.

The alternative was assessed with and without upstream flooding to determine the impact of flood areas on conduit sizing. Existing flood areas were included in the model for Cottonwood Creek near the creek crossing with Maple Street and at the railroad trestle. For King Street, existing flood areas were included on the west side of the railroad embankment off the extension of Sunset Drive and west of Lewiston Street just south of the intersection with Cottonwood Butte Road.

Use of existing flood areas while limiting the flood areas to no larger than the existing condition impacts conduit size by about one standard conduit size along King Street. Main Street existing flood areas were confined by available open space and could not feasibly achieve storage capacities that reduced peak flows significantly and therefore did not reduce conduit sizes downstream of the existing flood areas. See **Appendix C1, Figure C1-3** for the location of the existing flood areas utilized for the Alternative assessment.

Without utilizing the existing flood areas, the King Street flows combined with the Main Street flows and caused conduit sizes after the junction to be larger than when the flooded areas are utilized. Preliminary cost estimates and space constraints indicate the use of smaller dimension conduit is preferred.

D.10.1.4 Flood Protection Alternative 3

Flood protection alternative 3 consists of an alternate alignment of Cottonwood Creek along Front and Junction Streets. The King Street drainage connects to the Cottonwood Creek alignment near the intersection of Front and King Street. This alignment also removes the flow from the natural channel between King and Idaho Street. The flow is returned to the existing channel at the downstream end of Idaho Street. This Alternative reduces the number of conduits that need to be replaced. However, Junction Street has narrow right of way and multiple existing utilities including water, sewer, and major communication lines. Utility relocates will likely make this alternative costly. See **Appendix C1, Figure C1-3** for the map layout of Alternative 3.

D.10.1.5 Preferred Flood Protection Alternative

After completing the analysis, the preliminary results were discussed with city staff. The city chose Alternative 2 as the preferred alternative. This alternative provides the best protection of property, simplifies the routing, and provides a low maintenance system. As the Main Street existing flood areas do not reduce conduit sizes downstream, use of the Main Street flood areas are not included as part of the preferred alternative. The King Street existing flood areas will be utilized in the preferred alternative due to impacts on conduit size and project cost. Both are existing features with only the one located off Sunset Drive requiring modification as part of the proposed project. See A**ppendix C1, Figure C1-4** for the map layout of the preferred alternative.

D.11.0 Economic Evaluations

D.11.1 NEPA Analysis

NRCS, as the lead federal agency, is conducting National Environmental Policy Act (NEPA) analysis in the form of a Watershed Plan Environmental Assessment (Plan-EA) to analyze impacts to the natural and human environment from this Project. The Plan-EA will comply with the Council on Environmental Quality's (CEQ) regulations at 40 CFR Parts 1500-1508, which require an evaluation of potential environmental impacts associated with federal projects and actions.

The National Watershed Program Manual (NWPM) (NRCS, 2015a) was used as a reference for the economic analysis, along with the PR&G (NRCS, 2018) and the Water Resources Handbook for Economics (NRCS, 1998, Part 611). The basic objective of principles, requirements and guidelines (PR&G) is to determine whether benefits from proposed actions exceed project costs for federally funded projects. The PR&G also requires that the National Economic Efficiency (NEE) Alternative, which maximizes economic, environmental, and social benefits, be selected for implementation.

The benefits and costs of the Preferred Alternative are compared to a baseline No Action Alternative within the following Benefit Cost Analysis (BCA).

D.11.2 Benefit-Cost Analysis Data and Methodology

Damage reduction economic benefits were calculated for reduced flooding in Cottonwood, Idaho. Benefits were assessed based on the equivalent annual damage reduction expected through implementation of the With Project Alternative (Preferred Alternative) as compared with the Without Project Alternative (No Action Alternative) baseline. The With Project Alternative is based on the costs for engineering, permitting, administration and construction. Costs for operations and maintenance were estimated based on input from city staff on typical maintenance, operations and repairs, based on staff experience. These costs were compared against benefits received by reducing damages and avoiding expenses associated with the Without Project Alternative. Assumptions and calculations of flood and watershed protection damage reduction benefits are discussed below.

The Without Project Alternative does not include flood protection measures. The With Project Alternative includes flood control protection measures that will reduce flood impacts.

The useful life of the flood control protection measures is estimated to be 100 years, thus the term of the agreement for the Preferred Alternative is 103 years, accounting for a 100-year project life, and a 3-year installation period. Replacement costs were not included due to the 100-year design life.

Projected benefits and costs are based on full employment economy and assume no change in the relative prices over the 103-year period of analysis. Benefits are expected to begin accruing the year after improvements are completed and continue to accrue to the end of the 103-year analysis horizon. All costs and benefits were discounted to a net present value, then annualized over the 100-year evaluation period using the FY2023 Federal Water Resources Discount Rate of 2.5%. Costs and benefits are estimated jointly for all works under the With Project Alternative.

D.12.0 Economic Benefits

D.12.1 Reduced Property and Property Related Damages

Average annual flood damages were calculated using the cumulative probability method as specified in the URB1 manual (SCS, 1990). The 2-, 5-, 10-, 25-, 50-, 100-, and 500-year storm events for the With Project alternative and Without Project alternative were modeled. Mapping of the flood extents, and inundation to structures, transportation infrastructure, and lands was calculated through the hydraulic model and GIS analysis. Avoided property damages, including building and contents, were estimated.

Inundated buildings were classified into one of three categories: inundated less than 1 foot, inundated 1 to 3 feet, or inundated 3 feet or more, for each storm event. These types of structures include permanent homes, commercial buildings, and “other” (which includes civic buildings, City/County buildings, schools, and churches). On-site review, aerial imagery, and input from city staff determined the use of each structure impacted.

Average values for the buildings impacted were calculated from data collected from the Idaho County Assessor’s office parcel database. Structures without Assessor office valuations (non-profits, government buildings, churches) were identified and City staff personally interviewed the respective building officials to determine building values. In addition, several commercial and residential property owners were interviewed to determine current building values and screen interviews against assessed values. These interviews were documented on NRCS-ECN-003 NRCS-ECN-2 forms included in the administrative record. In all cases, the building owners listed their building valuations higher than the available Assessor office values.

Apart from structures without assessed values, the analysis used the Assessor values, which results in damage calculations likely less than actual, which is a conservative approach for the Economic Analysis. Only the values of the specific buildings affected by each storm event were used for each scenario. For example, only the 74 structures affected by the 25-year storm was used to determine the average structure value for that scenario. Building values were discounted by 15 percent of the assessed or interviewed value for each structure to reflect older buildings that have been updated and in good to excellent condition. The depreciated values were applied to the depth-damage functions subsequently described below. Contents values were estimated at 50 percent of the structure value for permanent homes, and 100 percent for commercial/businesses and “other” which comprises of government, education and religious uses.

Depth-damage functions were collected from the NRCS Flood Damage Assessment Tools, generated by U.S. Army Corps of Engineers, to use for each type of building (Table 5). Most of the structures damaged were commercial or "other" buildings. One-story homes without a basement were used as a proxy for all homes inundated, although there are some residential buildings with basements. For the commercial buildings and "other" category, separate applicable damage functions were used. The average of Damage factors for the actual types of uses were applied. Commercial uses include auto repair, bank, general business/office, a construction company, drug store, grocery store, convenience store, hardware, hotel, liquor store, lumber yard, newspaper, restaurant, tavern and warehouse. Other category uses include a church, city hall, and fire station.

Table 5. Building and Contents Depth Damage Functions used in NEE BCA

BUILDING TYPE		PERCENT REDUCTION IN BUILDING/CONTENT VALUE		
		Flood Depth		
		<1	1 – 3	>3
Residential	Structure	15%	27%	33%
	Content	22%	68%	85%
Commercial	Structure	3%	7%	8%
	Content	35%	58%	66%
Other	Structure	2%	5%	6%
	Content	14%	48%	66%

D.12.2 Relocation Costs

Relocation expenses were not calculated for the BCA. Relocations damages begin when content damage is greater than 10%, which is the case for several buildings. This is a real cost which homeowners and businesses may realize, but due to lack of available building square feet from the County Assessor, these expenses could not be quantified in the BCA. Incorporation of relocation expenses would increase the estimated benefits provided by the project, thereby making the analysis conservative.

D.12.3 Reduced Road Damages and Critical Services Impacts

The With Project Alternative will reduce the frequency and extent of flooding on public roads in the study area. Table 6 summarizes the change in road lengths impacted by flood flows for the flood frequencies studied. The reduction of impacted roadways was not calculated for economic benefits due to lack of more detailed information but is a non-monetized benefit of the project. The reduction of roadway impacts is of great value to motorists as well as emergency responders due to the increased travel times and potential road damages. Of significant benefit is the response time of the City Fire Department and Police Department. The City's Fire Station is on Main Street and is directly impacted by building flooding. The Police Department office is in the basement of City Hall on King Street, which can also be flooded. The With Project Alternative will enable emergency responders to concentrate on serving other public emergencies, rather than dealing with their own building emergency.

Table 6. Length in Roadway Flooding (Feet)

Storm Event	5-year		10-year		25-year		50-year		100-year		500-year	
	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
Local Roads												
	526	0	697	0	2,498	0	3,435	0	5,590	1,540	7,172	3,127
Change		526		697		2,498		3,435		4,050		4,045
US Highway 95 Business Loop												
	0	0	0	0	1,372	0	1,758	0	2,359	939	2,904	2,095
Change		0		0		1,372		1,758		1,420		809

D.12.4 Building Structures Impacted and Reduction in Costs

Table 7 identifies the number of structures impacted by flooding under present conditions (Without Project Alternative) by storm frequency. Table 8 provides the number of structures impacted by flooding under the Preferred Alternative (With Project Alternative) by storm frequency and by depth of floodwater. Table 7 shows that there are 83 buildings damaged under the 500 year storm, including 20 residential structures, 44 commercial structures, and 19 other structures. Table 8 shows the total number of structures damaged after project completion is significantly reduced by number and depth of floodwater. Also note that flood damage calculations were completed using building values for residential, commercial, and other properties in the specific flood area and included an estimate of both building and content damages.

Table 7. Without Project Flood Damage Structure Count

STORM	HOMES				COMMERCIAL				OTHER			
	<1 ft	1-3 ft	>3 ft	Total	<1 ft	1-3 ft	1-3 ft	Total	<1 ft	1-3 ft	1-3 ft	Total
2-YR	-	-	-	0	1	-	-	1	9	-	-	9
5-YR	-	-	-	0	1	-	-	1	11	-	-	11
10-YR	3	-	-	3	6	-	-	6	12	-	-	12
25-YR	14	2	-	16	36	4	-	40	17	1	-	18
50-YR	12	5	-	17	35	9	-	44	14	4	-	18
100-YR	13	5	-	18	30	14	-	44	12	5	1	18
500-YR	13	6	1	20	21	23	-	44	11	6	1	19

Table 8. With Project Flood Damage Structure Count

STORM	HOMES				COMMERCIAL				OTHER			
	<1 ft	1-3 ft	>3 ft	Total	<1 ft	1-3 ft	1-3 ft	Total	<1 ft	1-3 ft	1-3 ft	Total
2-YR	-	-	-	0	-	-	-	0	-	-	-	0
5-YR	-	-	-	0	-	-	-	0	-	-	-	0
10-YR	-	-	-	0	-	-	-	0	-	-	-	0
25-YR	-	-	-	0	-	-	-	0	-	-	-	0
50-YR	-	-	-	0	-	-	-	0	-	-	-	0
100-YR	1	-	-	1	20	3	-	23	3	-	-	3
500-YR	13	2	-	15	21	15	-	36	5	3	-	8

Table 9 summarizes calculated building related losses (structures and contents) for storm events 2 year through 500-year under existing conditions. Table 10 summarizes calculated building related losses under the condition of the project completed.

Table 9. Flood Damages in the Project Area Without Project

STORM	CALCULATED BUILDING DAMAGES[1]
2-YR	$461,341
5-YR	$564,963
10-YR	$911,166
25-YR	$3,366,184
50-YR	$4,196,159
100-YR	$4,794,527
500-YR	$5,377,222

1. Price Base: 2023, Prepared October, 2025

Table 10. Flood Damages in the Project Area With Project

STORM	CALCULATED BUILDING DAMAGES[1]
2-YR	$0
5-YR	$0
10-YR	$0
25-YR	$0
50-YR	$0
100-YR	$1,176,768
500-YR	$3,309,833

1. Price Base: 2023, Prepared October, 2025

The damages for each storm event are annualized to standardize the damages for a typical year as shown in Tables 11 and 12. Expected average annual damages under the Without Project are estimated at $528,091. Under the Preferred Alternative, expected annual damages are estimated at $30,450, a reduction of about $497,641, or approximately 94%.

Table 11. Average Annual Flood Damage for Without Project[1]

STORM FREQUENCY	PROBABILITY (AEP)	DAMAGES	AVERAGE DAMAGES	CHANGE IN AEP	AVERAGE ANNUAL DAMAGES
2-YR	0.5	$461,341	$513,152	0.3	$153,946
5-YR	0.2	$564,963	$738,064	0.1	$73,806
10-YR	0.1	$911,166	$2,138,675	0.06	$128,320
25-YR	0.04	$3,366,184	$3,781,171	0.02	$75,623
50-YR	0.02	$4,196,159	$4,196,159	0.01	$44,953
100-YR	0.01	$4,794,527	$5,085,875	0.008	$40,687
500-YR	0.002	$5,377,222	$5,377,222	0.001	$10,754
				Average Annual Damages	**$528,091**

1. Price Base: 2023. Prepared October 2025

Table 12. Average Annual Flood Damage for With Project[1]

STORM FREQUENCY	PROBABILITY (AEP)	DAMAGES	AVERAGE DAMAGES	CHANGE IN AEP	AVERAGE ANNUAL DAMAGES
2-YR	0.5	$0	$0	0.3	$0
5-YR	0.2	$0	$0	0.1	$0
10-YR	0.1	$0	$0	0.06	$0
25-YR	0.04	$0	$0	0.02	$0
50-YR	0.02	$0	$588,384	0.01	$5,884
100-YR	0.01	$1,176,768	$2,243,300	0.008	$17,946
500-YR	0.002	$3,309,833	$3,309,833	0.001	$6,620
				Average Annual Damages	**$30,450**

1. Price Base: 2023, Prepared October, 2025

Table 13 identifies calculated floodwater damage reduction benefits for the With Project and Without Project Alternatives, and the resulting damage reduction with implementation of the project. Table 14 shows the Annualized Benefits based on 100 year period at a discount rate of 2.5%.

Table 13. Floodwater Damage Reduction Benefits

ITEM	ESTIMATED AVERAGE ANNUAL OF DAMAGE					
	Without Project (No Action Alternative)		With Project (Preferred Alternative)		Damage Reduction	
	Average Annual	Annualized [1]	Average Annual	Annualized[1]	Average Annual	Annualized[1]
Residential	$58,159	$53,652	$3,503	$3,232	$54,656	$50,420
Commercial	$163,543	$150,869	$20,481	$18,894	$143,062	$131,976
Other	$306,389	$282,647	$6,466	$5,965	$299,923	$276,682
Total	**$528,091**	**$487,168**	**$30,450**	**$28,090**	**$497,641**	**$459,078**

1. Price Base: 2023 dollars amortized over 103 years at a discount rate of 2.5%. Prepared October, 2025

Table 14. Floodwater Damage Reduction Annualized Benefits

ITEM	Average Annual Reduction of Damages	Annualized Damage Reduction[1]
Flood Damage Reduction	$497,641	$459,100

2. Price Base: 2023 dollars amortized over 103 years at a discount rate of 2.5%. Prepared October, 2025

The flood control protection measures in the Preferred Alternative provide a high level of flood control. For example, it is estimated that 80 structures are inundated by the 100-year event under existing conditions, while 27 structures are inundated under the same storm with the Preferred Alternative implemented. Many of the buildings flooded without the project are commercial and governmental properties of relatively high value, and are flooded frequently in existing conditions.

D.13.0 Preferred Alternative Cost Estimate

Unit costs were determined utilizing local experience, historic project bid pricing, and input from local and regional suppliers. There is high unpredictability in pricing due to supply chain issues as well as possible changes between the draft and final plans, therefore a contingency amount of 15% was utilized to obtain the total probable cost.

As per Idaho State Code for public works projects, the project will be publicly bid and require bidders to have the proper Public Works License in order to submit a bid. The project will also require a bid bond. Once the project is awarded to the apparent low bidder, the Contractor will be required to submit payment and performance bonds as well as meet minimum insurance requirements. The project will be funded with federal funds, and it is assumed that Davis Bacon wages will be paid to contractor employees working on the project. Provisions of 2021 Build America Buy America (BABA) Act will likely apply to the project. Lastly, the lowest responsive bidder will have overhead and profit incorporated into the bid price of the project items. All the above conditions factor into the cost of the project leading to increased unit costs compared to private project construction. Costs have been developed within the context of similar projects and funding constraints completed within the project area.

Culverts and water/sewer relocations that are listed with an * in Table 16, are not eligible for PL-566 funding. These costs are included in the total project cost, and engineering costs for those items are prorated and broken out as well in the summary in Table 15. An engineer's opinion of probable cost was determined and summarized in Table 15.

Table 15. Summary Project Costs [1]

DESCRIPTION	PL-566	OTHER FUNDS (Non Federal)	TOTAL
Construction	$11,530,414	$1,631,036	$13,161,449
Engineering	$1,604,231	$226,927	$1,831,158
Right-of-Way/Easements		$53,000	$53,000
Administration	$228,895	$4,000	$232,895
Permits		$10,000	$10,000
Project Total	**$13,363,540**	**$1,924,963**	**$15,288,502**

[1] Project costs are presented in year 2023 dollars and should be inflated accordingly based on the construction index for the anticipated year of construction.

The cost estimate is broken out in Table 16 Flood Protection Project Cost.

Table 16. Flood Protection Project Cost

		SCHEDULE OF VALUES			
ITEM NO.	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL COST
FP-1	Manhole (4' I.D.)	12	EA	$6,500	$78,000
FP-2	Manhole (6' I.D.)	24	EA	$9,500	$228,000

ITEM NO.	DESCRIPTION	SCHEDULE OF VALUES			
		QNTY	UNIT	UNIT PRICE	TOTAL COST
FP-3	Box Conduit Manhole Access	15	EA	$7,000	$105,000
FP-4	Catch Basin (Includes concrete work around it and removal of existing)	77	EA	$4,000	$308,000
FP-5	Trash Rack 84"x48"	1	EA	$35,000	$35,000
FP-6	Rock Excavation	3,700	CY	$100	$370,000
FP-7	Conduit Inlet 36" Pipe (3 Headwalls)	8	CY	$2,000	$16,000
FP-8	Culvert Inlet 36" Pipe (2 Headwalls) *	5	CY	$2,000	$10,000
FP-9	Culvert Inlet 84" Pipe (1 Headwall) *	14	CY	$2,000	$28,000
FP-10	Conduit Inlet 84" x 48" (1 Headwall)	18	CY	$2,000	$36,000
FP-11	Culvert Inlet 144" x 72" (1 Headwall) *	50	CY	$2,000	$100,000
FP-12	Culvert Inlet 144" x 96" (1 Headwall) *	52	CY	$2,000	$104,000
FP-13	Outlet Headwall 36" Pipe (2 Headwalls) *	2	CY	$2,000	$4,191
FP-14	Outlet Headwall 84" Pipe (1 Headwall) *	5	CY	$2,000	$9,334
FP-15	Conduit Headwall 108"x48" (1 Outlet)	9	CY	$2,000	$18,000
FP-16	Outlet Headwall 144" x 72" (1 Outlet) *	9	CY	$2,000	$18,667
FP-17	Outlet Headwall 144" x 96" (1 Outlet) *	12	CY	$2,000	$24,000
FP-18	Water Main Line Crossing *	30	EA	$3,500	$105,000
FP-19	Water Service Crossing *	39	EA	$1,500	$58,500
FP-20	Sewer Crossing *	38	EA	$2,000	$76,000
FP-21	Sewer Service Connection *	1	EA	$2,000	$2,000
FP-22	Sewer Pipe 12" dia. *	910	LF	$120	$109,200
FP-23	Sewer Pipe 15" dia. *	550	LF	$150	$82,500
FP-24	Sewer Manhole 48" dia. *	9	EA	$7,500	$67,500
FP-25	Sewer Pipe 4" dia. *	120	LF	$50	$6,000
FP-26	Sewer Pipe 8" dia. *	1,030	LF	$70	$72,100
FP-27	HDPE Pipe Conduit 12" dia.	3,340	LF	$80	$267,200
FP-28	HDPE Pipe Conduit 15" dia.	511	LF	$100	$51,100
FP-29	HDPE Pipe Conduit 18" dia.	40	LF	$150	$6,000
FP-30	HDPE Pipe Conduit 36" dia.	4,810	LF	$200	$962,000
FP-31	Concrete Pipe Culvert 84" dia. *	90	LF	$700	$63,000
FP-32	Concrete Box Conduit 48" x 36"	1,565	LF	$1,200	$1,878,000

ITEM NO.	DESCRIPTION	SCHEDULE OF VALUES			
		QNTY	UNIT	UNIT PRICE	TOTAL COST
FP-33	Concrete Box Conduit 84" x 48"	950	LF	$1,300	$1,235,000
FP-34	Concrete Box Conduit 96" x 48"	1,170	LF	$1,400	$1,638,000
FP-35	Concrete Box Conduit 108" x 48"	300	LF	$1,600	$480,000
FP-36	Concrete Box Culvert 144" x 72" *	40	LF	$3,000	$120,000
FP-37	Concrete Box Culvert 144" x 96" *	40	LF	$4,020	$160,800
FP-38	Channel Riprap Along East Road *	750	LF	$170	$127,500
FP-39	Channel Tree Removal *	1	LS	$50,000	$50,000
FP-40	Guardrail *	280	LF	$50	$14,000
FP-41	Surface Repair - Grass Hydroseed Trench Patch Back	4	AC	$3,000	$12,000
FP-42	Surface Repair - Gravel Trench Patch Back	560	SY	$15	$8,400
FP-43	Surface Repair - Asphalt Trench Patch Back	8,530	SY	$45	$383,850
FP-44	Site Improvements	1,835	CY	$30	$55,050
FP-45	Debris Basin Metered Outflow	1	LS	$15,000	$15,000
FP-46	U.S. 95 Business Route Pavement Repair	3,000	Ton	$125	$375,000
FP-47	Traffic Control	1	LS	$245,308	$245,308
FP-48	QC Testing	1	LS	$245,308	$245,308
FP-49	Survey	1	LS	$163,539	$163,539
FP-50	Mobilization	1	LS	$817,693	$817,693
	Construction Subtotal				$11,444,738
	Construction Contingency (15%)			15%	$1,716,711
	Construction Total				$13,161,449
	Engineering (8% Design, 8% Construction)**			16%	$1,831,158
	Project Administration (NRCS)			2%	$228,895
	Project Administration (Sponsor)	1	LS	$4,000	$4,000
	Permits	1	LS	$10,000	$10,000
	Total Flood Protection				$15,235,502

* Items to be funded by others (Non-Eligible for PL-566 Funding).

** A portion of Engineering to be prorated between PL-566 and others (Non-Eligible for PL-566 Funding) based on % of construction costs for each.

D.13.1.1 Operations, Maintenance and Replacement Costs

Operation, Maintenance and Replacement (OM&R) costs are included in the economic analysis. These costs include City staff labor and equipment, along with necessary material purchases, to keep the system operational. OM&R costs include routine trash rack inlet checks/cleaning, pipe repairs and cleaning, street inlet cleaning, and open channel clearing. The conveyance system materials have a 100-year life, so replacement was not included in the costs. City staff estimated the annual OM&R expenses for both the No Action Alternative and the Preferred Action Alternative based on historical expenses and expected savings that would result if the improvements were completed under the Preferred Action Alternative. These costs are summarized in Table 17 and 18 below.

Table 17. Flood Prevention Operation, Maintenance & Replacement Cost Assumptions

DESCRIPTION	ASSUMPTION
Labor Rate	Labor Rate plus fringe cost of $50/hr.
Creek Inlet Checks	Cottonwood Creek Inlets. Check weekly during high flow periods, and for both No Action and Preferred Alternative.
Pipe/Structure Repairs	No Action: 40 hours / year for 4-person crew, equipment, and material replacement. Assume 50 feet of pipe and 1 street inlet structures replaced per year. Preferred Alternative: 8 hours / year for 2-person crew, equipment, and material replacement. Assume 50 feet of pipe or 1 damaged structure replaced every 5 years.
Cottonwood Creek Inlet Debris Removal	No Action: 50 hours / year for crew and equipment. Preferred Alternative: 10 hours / year for crew and equipment.
Pipe Jetting, Cleaning, Street Inlet Cleaning	Pipe jetting/cleaning 40 hours / year for crew of 2 – 4 people, same for both No Action and Preferred Alternative
Open Channel Clearing	No Action: 8 hours / year for 2-person crew and equipment. Preferred Alternative: 4 hours / year for 2-person crew and equipment.

Table 18. Flood Prevention Operation, Maintenance and Replacement Costs (2023 $)

DESCRIPTION	OM&R COST NO ACTION	OM&R COST PREFERRED ALT.
Creek Inlet Checks	$1,000	$500
Conduit/Structure Repairs	$15,000	$3,800
Creek Inlet Debris Removal	$5,000	$1,000
Conduit and Inlet Jetting & Cleaning	$11,400	$8,900
Open Channel Clearing	$800	$400
Total OM&R (Annual)	**$33,200**	**$14,600**

The Preferred Alternative is anticipated to significantly reduce the OM&R costs, estimated $18,600 annually, for the duration of the project life. This is primarily attributed to reduced need to repair infrastructure due to age, existing flow capacity and existing flood routing. This reduction in costs is a local benefit, and the saving is not included in the Benefit/Cost Analysis.

D.14.0 Economic and Structural Tables

Economic Table 1 – Estimated Installation Cost of the Preferred Alternative[1]

Preferred Alt.	Unit	Number			Est. Project Cost		Total Cost
		Federal Land	Non-Federal Land	Total	PL 83-566 Funds (Non Federal Land)	Other Funds (Non-Federal Land)	
Flood Control Conduit	**Linear Feet**	**0**	**12,900**	**12,900**	**$13,363,540**	**$1,924,963**	**$15,288,502**

1. Price Base 2023

Economic Table 4 – Estimated Average Annual Costs of Preferred Alternative.[1]

Project Measure	Project Outlays (Amortization of Installation Costs)[1]	Other Direct Costs[2]	Total Cost
Flood Control	$414,800	$14,600	$429,400
Total	$414,800	$14,600	$429,400

1. Price base is 2023 dollars amortized over 103 years at a discount rate of 2.5%. 2. Other costs are for operations and maintenance of the preferred alternative. Prepared October, 2025.

Economic Table 5a – Estimated Average Annual Benefits of the Preferred Alternative[1]

Benefit/Avoided Damage	Agricultural Related	Non-Agricultural Related
On-Site		
Reduced Property Related Damages	459,100	
Subtotal	$459,100	
Off-Site		
N/A	-	
Subtotal	$459,100	
Total Quantified Benefits	**$459,100**	

1. Price Base: 2023 dollars amortized over 103 years at a discount rate of 2.5%. Prepared October, 2025

The total project net average annual economic benefit is approximately $29,700 for the Flood Control Project with a total benefit cost ratio of 1.07. Economic Table 6 provides the calculated annual benefits, costs, benefit cost ratios, and net annual benefits for each of the project measures.

Economic Table 6. Benefit Cost Ratios [1]

PROJECT MEASURE	TOTAL ANNUAL BENEFITS	TOTAL ANNUAL COSTS (INSTALLATION & O&M)	BENEFIT COST RATIO	NET ANNUAL ECONOMIC BENEFIT
Flood Control	$459,100	$429,400	1.07	$29,700

1 Source: Price base 2023. Calculated using FY 2023 Water Resources Discount Rate (2.5%), annualized over 103-year period of analysis.
2. All costs and benefits were discounted to a net present value, then annualized over the 103-year evaluation period using the FY2023 Federal Water Resources Discount Rate of 2.5%.

Prepared October, 2025

D.15.0 Sources

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