Attachments: Planning Process & Alt. Documentation

- PR&G Alternative Formulation & Screening Matrix Report
- Ecosystem Services Framework Worksheet Documentation
- Cumulative Effects Analysis Documentation
- Economic Investigations & Analysis Report
- Economic Analysis Spreadsheet (excel)

PR&G ALTERNATIVE FORMULATION AND SCREENING PROCESS FOR THE CORN CREEK WATERSHED PLAN-ENVIRONMENTAL ASSESSMENT LOCATED IN MILLARD COUNTY, UTAH

LEAD AGENCY: USDA NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

SPONSORING LOCAL ORGANIZATION: TOWN OF KANOSH, UTAH

CO-SPONSORING LOCAL ORGANIZATIONS: CORN CREEK IRRIGATION COMPANY (CCIC) AND THE KANOSH BAND OF PAIUTE INDIANS

CONSULTANT: FRANSON CIVIL ENGINEERS (FCE)

PHASE I: PROBLEMS & OPPORTUNITIES, DEFICIENCIES, OBJECTIVES, & PLANNING CONSTRAINTS

TABLE 1: PROBLEMS AND OPPORTUNITIES

Problem Statement(s): **Flood Prevention** **Agricultural Water Management**	The Corn Creek Watershed, located in Millard Couty, Utah, currently experiences problems related to Flood Prevention and Agricultural Water Management. The Town of Kanosh is at risk of significant flooding due to the noncompliance of Corn Creek Dam and Debris Basin with State and NRCS standards and is at risk of imminent failure due to foundation issues. Additionally, the CCIC system experiences significant seepage and evaporation losses. The Kanosh Band of Paiute Indians (Kanosh Band) does not have access to secondary water and currently relies on their culinary system to meet high outdoor demands, preventing their current system from reliably meeting indoor needs.
Opportunity 1 - Improve Public Safety	Improve the Safety of the residents of Kanosh Town through the implementation of project measures.
Opportunity 2 - Resilience to Flooding	Enhance community resilience to flood risks through the implementation of project measures.
Opportunity 3 - Flood Risk Awareness	Increase the level of breach and flood risk awareness in the community.
Opportunity 4 - Water Conservation	Conserve water resources and optimize agricultural water delivery systems in the watershed.
Opportunity 5 - Tribal Culinary System	Improve resilience of the culinary system for the Kanosh Band through project measures.
Opportunity 6 - Reduce Pumping Demands	Reduce community reliance on groundwater for late season irrigation and reduce pumping demands.

IDENTIFIED DEFICIENCIES
Deficiency 1. Corn Creek Dam and Debris Basin
Deficiency 2. Seepage & Evaporation Losses in CCIC System
Deficiency 3. Kanosh Band Secondary Water Access
Deficiency 4. Flooding Issues in Kanosh Town

Federal Objective (Required by PR&G)

The Federal Objective specifies that Federal water resource investments shall reflect national priorities, encourage economic development, and protect the environment by:
1. Seeking to maximize sustainable economic development;
2. Seeking to avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area may be used; and
3. Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

TABLE 2: PROJECT OBJECTIVES

Objective 1 - Dam Safety Compliance	Address dam safety complaince problems with Corn Creek Dam and Debris Basin through the year 2080.
Objective 2 - Breach Hazards	Address recognized breach and flood hazards for infrastructure downstream of Corn Creek Dam through the year 2080.
Objective 3 - Access to Secondary Water	Develop and implement a solution to providee a secondary water source to the Kanosh Band to rimprove the resilience of their culinary system through the year 2080.
Objective 4 - Drought Resilience	Develop and implement a solution that will allow the residents of the watershed to be more resilient to drought conditions, which are forecasted to increase in frequency as a result of long-term climate change.

TABLE 3: CONSTRAINTS AND CONSIDERATIONS

Constraint 1 - Disruptions to Property	Avoid disruptions to existing residential and commercial properties during the implementation of the project in Kanosh Town and on Tribal land.
Constraint 2 - Cultural/Historic Impacts	Avoid adverse impacts to cultural and historic resources in the watershed to the maximum extent possible during project implementation.
Constraint 3 - Transportation Impacts	Avoid impacts to existing transportation infrastructure to ensure continued access for emergency services and residents during implementation.
Constraint 4 - Irrigation Water Access	Avoid disruptions to the ability of farmers to access their water supply during the irrigation season.
Constraint 5 - Environmental Justice	Avoid adverse impacts to the socioeconomic conditions of the Kanosh Band of Paiutes, which constitute an environmental justice population.

PHASE II: FORMULATION OF POTENTIALLY SUITABLE MANAGEMENT MEASURES TO ADDRESS EACH IDENTIFIED DEFICIENCY

DEFICIENCY #1: CORN CREEK DAM AND DEBRIS BASIN

TABLE 4: INITIAL APPROACHES AND MANAGEMENT MEASURES

7 carried forward
11 considered

Initial Approaches & Management Measures	Initial Qualitative Evaluation	Carried Forward?
RECONSTRUCT THE CURRENT DEBRIS BASIN		
Update the Debris Basin to have an updated alignment and a taller embankment.	The current debris basin would be reconstructed. The new debris basin would have an updated alignment farther downstream and a taller embankment. The proposed embankment crest elevation is designed to be 5,208.75 feet and the height of the embankment measured from the lowest downstream toe elevation is approximately 50 feet. Carried Forward.	Y
REPAIRING AND UPGRADING THE EXISTING DAM AND DEBRIS BASIN		
remove much of current dam, add filter and drain system, add material to downstream slope for stability, and install deep seepage cutoff wall.	To bring the existing dam into compliance with current standards, a majority of the dam would need to be removed, a filter and drain system installed to collect high seepage through the current core, and additional material placed on the downstream slope to improve stability. This is in addition to the need to install a deep seepage cutoff wall from the crest and replacement of the spillway and low-level outlet. These factors combine to make rehabilitation and raising of the current dam infeasible when compared to the cost to remove and replace the existing dam. Not Carried Forward.	N
USE THE AG. WATER MANAGEMENT SYSTEM FOR FLOOD CONTROL		
Use the ag. Water management system to convey the floodwater.	During initial scoping it was hoped that the agricultural water management system would be able to convey a significant portion of the floodwater. However, the hydrological study performed found that the100-year design flood event has a peak flow of 1,945 cfs which is far greater than the needs of the agricultural water system of 40 cfs. It is impractical and not cost effective to construct a pipe system that could take even ten percent of the design flood. Utilizing the existing ditch system to convey high water and a portion of the floodwater is a far more cost-effective solution. Not Carried Forward.	N
REMOVAL OF DEBRIS BASIN W/CONNECTION TO EXISTING CHANNELS		
Remove the debris basin divert floodwaters to the flood channel by installing a large diversion.	The removal of the debris basin eliminates the potential flooding from a failed dam, but it increases flooding potential in all cases other than the worst-case condition where the debris basin dam fails. The removal of the debris basin does not meet the purpose and need to protect Kanosh from flooding. Any diversion structures and flood channels constructed to protect Kanosh would be subject to debris blockages and sediment accumulation without a debris basin to remove the debris and sediment. Regardless of what measures are taken downstream, debris and sediment in floodwater will increase the potential for flooding and damage. Removing the debris basin is not a feasible option whether downstream improvements are made or not due to the threat posed by the debris and sediment. Not Carried Forward.	N
DIVERT ALL EXCESS FLOOD WATER TO THE EMERGENCY CHANNEL		
	One of the actions considered routed the 100-year flood out the existing emergency channel utilizing a debris basin or direct diversion by a diversion structure and extension of the flood channel to move the floodwater to the flood channel. During the initial evaluations, it became evident that overtopping I-15, which is considered critical infrastructure, occurs when a peak flow of more than 1,000 cfs is routed through the emergency channel without any other improvements. The largest flood event that could be routed through the emergency channel without any other improvements, that did not overtop I-15, was the 25-year flood event. The flood channel is a critical piece in the effort to provide flood protection but, due to concerns with overtopping I-15, it can only be a part of the solution. Not Carried Forward.	N
RECONSRUCT THE PRIMARY &SECONDARY SPILLWAY		
	The proposed primary spillway/low level outlet is a 42-inch conduit with a crest elevation of 5,177 feet. This conduit would discharge into a box that would dissipate energy, split water between two pipelines, and measure flow. This outlet pipe would have a trash rack and be controlled with a guard gate at the inlet of the pipe. The proposed secondary spillway is a morning glory and	

Reconstruct the primary spillway to be compliant with standards	standpipe type design with a crest elevation of 5,199 feet and effective weir length of 22 feet. The 84-inch standpipe would have a 100-inch trash ring that would keep floating debris from blocking the flow of water into the spillway and blocking downstream culverts. The 84-inch standpipe would transition to a 60-inch conduit that would discharge into the energy dissipation box. Carried Forward.	Y
RECONSTRUCT THE EMERGENCY & AUXILIARY SPILLWAY		
Reconstruct the auxiliary spillway to be compliant with standards	The proposed emergency spillway is a side channel spillway design with a crest elevation of 5,203.8 feet and width of 200 feet. A concrete weir wall would discharge into a concrete side channel that would route the water to the existing emergency channel. The road would be regraded to remove the culverts and create a broad swale that would convey floodwater to the existing flood channel. The proposed auxiliary spillway would be constructed as an armored spillway over the dam with a crest elevation of 5,205.4 feet and width of 200 feet. The proposed armoring is a fabric-formed concrete mattress. . Carried Forward.	Y
FLOODPROOFING OF STRUCTURES (NONSTRUCTURAL)		
Utilized various floodproofing techniques to address problems related to flooding in the watershed.	Various options including demolition, dry floodproofing, wet floodproofing, floodwalls, raising of the structure, and construction of a berm alonf the south and east of Kanosh were considered as nonstructural measures to address the flood prevention option. Carried Forward.	Y
RELOCATION OF STRUCTURES/BUYOUTS (NONSTRUCTURAL)		
Conduct property buyouts as a nonstructural measure to address flood prevention problems in the watershed.	The values for the flooded properties with structures, according to Millard County records, is $89,757,800. Actual relocation and buyouts would also include the cost of moving, demolition of existing buildings, and more. This measure would constitute a nonstructural solution to the flood prevention problem required by the PR&G. Carried Forward.	Y
REMOVE THE DAM EMBANKMENT		
Remove the dam embankment.	This measure would remove the dam embankment and use the emergency channel to route water that exceeded the capacity of the current ditch system. The best way to route water without an embankment is to divert it upstream. This measure would install a diversion structuree to pass the first 575 cfs toward the current ditch system and the next 1,000 cfs toward the emergency channel. The rest of the water would be routed toward the existing channel to prevent damage to I-15, which is critical infrastructure. Without a way to remove debris, the culverts necessary to route the floodwaters would be blocked. The diversion structure would be difficult or impossible to design so that it could handle debris and still function. Carried Forward.	Y
REMOVE THE DEBRIS BASIN		
Remove the Debris Basin of the dam	The removal of the debris basin eliminates the potential flooding from a failed dam, but it increases flooding potential in all cases other than the worst-case scenario where the debris basin dam fails. The removal of the debris basin does not meet the purpose and need to protect Kanosh from flooding. Any diversion structures and flood channels constructed to protect Kanosh would be subject to debris blockages and sediment accumulation without a debris basin to remove the debris and sediment. Regardless of what measures are taken downstream, debris and sediment in floodwater will increase the potential for flooding and damage. Carried Forward.	Y

DEFICIENCY #2: SEEPAGE AND EVAPORATION LOSSES IN THE CCIC SYSTEM

TABLE 4: INITIAL APPROACHES AND MANAGEMENT MEASURES

Initial Approaches & Management Measures	Initial Qualitative Evaluation	Carried Forward?
GRAVITY PIPE NETWORK		
Install gravity pipe network to reduce seepage/evaporation losses in the system.	A gravity pipe system is proposed to greatly reduce seepage and evaporation losses and increase irrigation water deliveries to the farmers in the area. Diversion boxes would be installed at current irrigation turnouts. The proposed pipe system would replace the equivalent of approximately 4.9 miles of open ditches. Up to approximately 14.1 miles of ditches would have pipe installed adjacent to the ditch because the ditch would be needed to convey floodwater. The ends of laterals that are used infrequently or serve a single shareholder may not be piped if funding becomes short. Carried Forward.	Y
SPLITTING STRUCTURES FOR PIPE NETWORK		
Install splitting structures for the proposed pipe network	There are multiple splitting/measurement structures proposed for the piped system. A main splitting/measurement structure is proposed where the 60-inch debris basin outlet would discharge. This main splitting box would dissipate energy and distribute the water into two pipelines. The pipelines would have a combined capacity of about 40 cfs. Other splitting/measurement structures would also divide water downstream where previous ditches have been combined to reduce the amount of pipe needed. A sharp crested weir would be used in the structures to ensure uniform controlled flow and to provide measurement data. Carried Forward.	Y
CANAL LINING WITH A MEMBRANE		
Line canal to reduce seepage losses.	On an average year, it is estimated that 3,148 acre-feet of the total 7,164 acre-feet inflow (44%) in the CCIC system is lost due to seepage. To save the water lost due to seepage, canal lining and piping actions were considered. Canal lining with membrane liners was considered as a method to reduce canal seepage; however, this action has a shorter life and lacked local support. Not Carried Forward.	N
CONCRETE LINED CANALS		
Line canals with concrete to reduce seepage losses.	The potential implementation of concrete lined canals was initially considered to mitigate seepage within the CCIC canal system. Presently, the existing double ditches (low water ditches) are already lined with concrete. CCIC's experience has been unsatisfactory with the lined ditches. To meet current demands, a newly installed concrete-lined canal system would exceed the size of the current concrete-lined ditches. Concrete-lined canals present open water channels and have raised concerns due to risks to public safety and lacking the flexibility of allowing crossings at any point along the alignment. Landowners, in turn, express a preference for buried pipe systems on their property rather than open canals. This choice has both political and safety considerations. Furthermore, the proposed canal lining action falls short in terms of cost-effectiveness and durability when compared to piped systems. Not Carried Forward.	N
PRESSURIZED PIPE NETWORK		
Pipe canal to reduce seepage losses.	To save the water loss due to seepage and to allow better water management, piping alternatives were evaluated. Both gravity flow and pressurized systems were evaluated. For the pressurized systems, the delivering capacities evaluated were 10 cfs, 5 cfs, and a true pressurized irrigation (PI) system. A true PI system delivers the total flow evenly across all acres served. The true PI system would allow shareholders to take water at almost any time, but the flow would be less than the 5 or 10 cfs delivery capacities that assume a form of a turn system. Laterals in a true PI system could be smaller due to the lower flow. In the pressurized actions, both pressure reducing valves (PRVs) and higher pressure rated pipe were modeled to handle the high pressures at the end of the system. Not Carried Forward.	N

2 carried forward
5 considered

DEFICIENCY #3: KANOSH BAND SECONDARY WATER ACCESS

TABLE 4: INITIAL APPROACHES AND MANAGEMENT MEASURES

2 carried forward
3 considered

Initial Approaches & Management Measures	Initial Qualitative Evaluation	Carried Forward?
CONSTRUCT SECONDARY WATER SYSTEM FOR KANOSH BAND		
Install secondary system for Tribe by adding to the existing pipeline.	The Corn Creek Watershed Project aims to improve irrigation systems for the Kanosh Band of Paiute Indian Tribe by adding a secondary system to the existing pipeline between the debris basin and the community. The new regulating pond would be at a higher elevation that would allow it to service both the Town and Kanosh Band. The secondary system for the Kanosh Band would reduce the demand for existing culinary water systems. Water would be diverted from Corn Creek before it reaches the debris basin, stored in a new regulating pond with a partition to separate the Tribe's water from the Town's water. Carried Forward.	Y
RELOCATE THE SECONDARY REGULATING POND TO HIGHER ELEVATION		
Relocate the regulating pond to a higher elevation to provide more pressure.	The pond would be relocated approximately a half mile upstream of the current pond location. The new pond would supply both the Kanosh Town and the Kanosh Band of Paiutes (the Tribe) secondary systems from a higher elevation. This would provide additional pressure for the Kanosh system and adequate pressure in the Tribal system. Carried Forward.	Y
RECREATION MANAGEMENT MEASURES		
Potential measures to increase recreational opportunities in the watershed.	Recreation actions in the project area included creating trails, public lookouts and water access at the debris basin, and better access to Corn Creek for recreation. However, these recreation actions were ruled out because there was a lack of local interest and support. Sponsors felt that they lacked the resources available to fund and maintain a recreation action. Additionally, the project does not have an authorized purpose of Public Recreation. Not Carried Forward.	N

DEFICIENCY #4: FLOODING ISSUES IN KANOSH TOWN

TABLE 4: INITIAL APPROACHES AND MANAGEMENT MEASURES

2 carried forward
4 considered

Initial Approaches & Management Measures	Initial Qualitative Evaluation	Carried Forward?
FLOOD CHANNELS		
conduct various channel improvements to route floodwater to different areas using flood channels	Channel 1 would utilize the existing emergency spillway channel and expand it to the northwest to connect with the Hatton Ditch to the north of Kanosh. Channel 1 was assumed to have a bottom width of 30 feet with side slopes of 1:1. To meet NRCS standards to prevent erosion, the channel would have to be lined. Another related action that was considered was extending Channel 1 to send a portion of the floodwater back to the west. Channel 2 and Channel 3 are alignments that route the water to the west once the flood was downstream of Kanosh. Various factors make this measure infeasible including flood easements and costs. Not Carried Forward.	N
ENLARGING EXISTING CHANNELS TO CONVEY FLOODWATER DOWNSTREAM OF KANOSH		
Obtain easements and enlarge existing channels to convey floodwater downstream of the town.	Although only existing channels would be enlarged, the recorded and prescriptive easements would not be sufficient when enlarging and increasing the capacity of the channels. Additional easements would need to be obtained for nearly all enlarged channels. The existing channels are in more developed areas and, as a result, the needed easements would be more difficult and costly for the sponsors to obtain. There is also the potential for the needed space not being available due to adjacent development. Structures may need to be purchased. By comparison, the financial implications of this measure is too great compared to other measures. Not Carried Forward.	N
BERM FLOOD PREVENTION		
Construct a berm to address flooding in ditches in Kanosh Town	This measure would construct a berm north of a large culvert to prevent the floodwater from flowing north. Shortening the existing emergency channel releases the floodwater farther south and allows more water to reach the larger culvert. This plan routes more water through the large culvert. This plan would also raise 800 feet of an existing dirt road to prevent the water from flowing north as one of the actions that would utilize the large capacity I-15 culvert enough to prevent the overtopping of I-15. Carried Forward.	Y
CHANNEL IMPROVEMENTS		
Implement channel modifications to address flooding in ditches in Kanosh Town	Minimal modifications to the last two blocks of the West Ditch allowed the upstream capacity of the West Ditch to be fully utilized. Another proposed action is to enlarge the West Ditch downstream of the Main Street culvert. The improvements include enlarging the existing channel, extending the channel, lining the ditch with concrete, and replacing the two 65 cfs capacity culverts with bridges over the concrete channel. This would allow the floodwater to be contained within the ditch until it can be safely discharged beyond the homes and structures in Kanosh. Carried Forward.	Y

TABLE 5: MEASURES CONSIDERED AND SELECTED FOR INCORPORATION INTO ALTERNATIVES

C = Compatible/Combinable, M = Mutually Exclusive or Unecessarily Redundant

PHASE III & IV: PAIRWISE COMPATIBILITY FOR EACH MANAGEMENT MEASURE AND COMBINATION INTO ALTERNATIVE P

M = Mutually Exclusive or Incompatible

C = Compatible in an alternative

	Pairwise Compatibility	DEFICIENCY #1: CORN CREEK DAM & DEBRIS BASIN							DEF. #2: SEEPAGE LOSSES CCIC		DEF. #3: KANOSH BAND SECONDARY		DEF. #4: FLOODING IN KANOSH TOWN		Preliminary Evaluation of Combinations	Carried Forward?
		Reconstruct the Current Debris Basin	Reconstruct the Primary & Secondary Spillway	Reconstruct the Emergency & Auxiliary Spillway	Floodproofing of Structures	Relocations of Structures/Buyouts	Remove the Debris Basin	Remove the Dam Embankment	Gravity Pipe Network	Splitting Structures for Pipe Network	Construct Secondary Water System for Kanosh Band	Relocate Secondary Regulating Pond to Higher Elevation	Berm Flood Prevention	Channel Improvements		
DEFICIENCY #1: CORN CREEK DAM AND DEBRIS BASIN	Reconstruct the Current Debris Basin	NA	C	C	M	M	M	M	C	C	C	C	C	C	Reconstructing the current debris basin is compatible for combination into an alternative plan with all other considered measures except for the nonstructural options of either floodproofing structures or conducting property buyouts and the option to remove the dam and debris basin.	Y
	Reconstruct the Primary & Secondary Spillway	C	NA	C	M	M	M	M	C	C	C	C	C	C	Reconstructing the primary & secondary spillways is compatible for combination into an alternative plan with all other considered measures except for the nonstructural options of either floodproofing structures or conducting property buyouts and the option to remove the dam and debris basin.	Y
	Reconstruct the Emergency & Auxiliary Spillway	C	C	NA	M	M	M	M	C	C	C	C	C	C	Reconstructing the emergency and auxiliary spillway is compatible for combination into an alternative plan with all other considered measures except for the nonstructural options of either floodproofing structures or conducting property buyouts and the option to remove the dam and debris basin.	Y
	Floodproofing of Structures	M	M	M	NA	M	M	M	C	C	C	C	M	M	Floodproofing of structures is not compatible with any structural flood prevention measures. It is also incompatible with the nonstructural measure to conduct property buyouts. However, it can be combined with structural ag. Water management measures to be formed into an alternative plan.	Y
	Relocation of Structures/Buyouts	M	M	M	M	NA	M	M	C	C	C	C	M	M	Property buyouts/relocations is not compatible with any structural flood prevention measures or the nonstructural measures to floodproof downstream structures. However, it can be combined with structural ag. Water management measures to be formed into an alternative plan.	Y
	Remove the Debris Basin	M	M	M	M	M	NA	C	C	C	C	C	M	M	Removal of the Debris Basin is compatible only with the removal of the embankment and the agricultural water management measures. Cannot be combined with any other flood prevention measures.	Y
	Remove the Dam Embankment	M	M	M	M	M	C	NA	C	C	C	C	M	M	Removal of the Dam Embankment is compatible only with the removal of the debris basin and the agricultural water management measures. Cannot be combined with any other flood prevention measures.	Y
DEFICIENCY #2: SEEPAGE & EVAPORATION LOSSES IN CCIC SYSTEM	Gravity Pipe Network	C	C	C	C	C	C	C	NA	C	C	C	C	C	The gravity pipe network measure is compatible with all considered structural and nonstructural management measures.	Y
	Splitting Structures for Pipe Network	C	C	C	C	C	C	C	C	NA	C	C	C	C	The splitting structures for pipe network measure is compatible with all considered structural and nonstructural management measures.	Y
DEFICIENCY #3: KANOSH BAND SECONDARY WATER ACCESS	Construct Secondary Water System for Kanosh Band	C	C	C	C	C	C	C	C	C	NA	C	C	C	The secondary water system for the Kanosh Band is compatible with all considered structural and nonstructural management measures.	Y
	Relocate Secondary Regulating Pond to Higher Elevation	C	C	C	C	C	C	C	C	C	C	NA	C	C	Relocating the secondary pond to a higher elevation for pressure and to supply the Kanosh Band secondary system is compatible with all considered structural and nonstructural management measures.	Y
DEFICIENCY #4: FLOODING ISSUES IN KANOSH TOWN	Berm Flood Prevention	C	C	C	M	M	M	M	C	C	C	C	NA	C	A berm is compatible for combination into an alternatve plan with all other considered measures except for the nonstructural options of either floodproofing structures or condutcting property buyouts and the option to remove the dam and debris basin.	Y
	Channel Improvements	C	C	C	M	M	M	M	C	C	C	C	C	NA	The Channel Modifications are compatible for combination into an alternative plan with all other considered measures except for the nonstructural options of either floodproofing structures or condutcting property buyouts and the option to remove the dam and debris basin.	Y

PHASE V: FIRST SCREENING OF THE INITIAL ARRAY AGAINST THE FEDERAL/PROJECT OBJECTIVES & PLANNING CONSTRAINTS

TABLE 6: SUMMARY OF INITIAL ALTERNATIVES AND 1ST SCREENING BASED ON OBJECTIVES AND CONSTRAINTS

N = not met, Y = met, NA = not applicable

ID	ALTERNATIVE DESCRIPTION	Federal Objective	Dam Safety Objective	Breach Hazards Objective	Access to Secondary Water Objective	Drought Resilience Objective	Property Disruptions Constraint	Cultural/Historic Impacts Constraint	Transportation Impacts Constraint	Irrigation Water Access Constraint	Environmental Justice Constraint	CARRIED FORWARD Y/N?
Alternative 1 -- No Action -- FWOFI Alternative	No Action Alternative (FWOFI) Alternative Existing conditions would continue, the problems and opportunities would not be met and conditions would generally worsen. However, required to be carried forward as an analytic baseline in NEPA analysis.	N	N	N	N	N	Y	N	Y	Y	N	Y
Alternative 2 -- Proposed Action -- Dam Replacement Alternative	Dam Replacement Alternative • Reconstruct the Current Debris Basin • Reconstruct the Primary & Secondary Spillways • Reconstruct the Emergency & Auxiliary Spillways • Berm and Channel Modifications • Gravity Pipe Network in Kanosh • Splitting Structures for Pipe Network • Construct Secondary Water System for Kanosh Band • Relocate Secondary Regulating Pond to Higher Elevation	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Alternative 3 -- Proposed Action -- Buyouts Alternative (Nonstructural)	Buyouts Alternative (Nonstructural) • Conduct Relocations/Buyouts of Properties in the Floodplain • Gravity Pipe Network in Kanosh • Splitting Structures for Pipe Network • Construct Secondary Water System for Kanosh Band • Relocate Secondary Regulating Pond to Higher Elevation	N	N	Y	Y	Y	N	N	Y	Y	Y	Y
Alternative 4 -- Proposed Action -- Floodproofing Alternative (Nonstructural)	Floodproofing Alternative (Nonstructural) • Floodproofing of Structures in the Floodplain • Gravity Pipe Network in Kanosh • Splitting Structures for Pipe Network • Construct Secondary Water System for Kanosh Band • Relocate Secondary Regulating Pond to Higher Elevation	N	N	Y	Y	Y	N	N	N	Y	Y	N
Alternative 5 -- Proposed Action -- Dam Removal Alternative	Dam Removal Alternative • Remove the Dam Embankment • Remove the Debris Basin • Gravity Pipe Network in Kanosh • Splitting Structures for Pipe Network • Construct Secondary Water System for Kanosh Band • Relocate Secondary Regulating Pond to Higher Elevation	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y

PHASE VI: SECOND SCREENING OF THE INITIAL ARRAY AGAINST THE ECOYSTEM SERVICES AND ECONOMIC BENEFITS/B/C RATIO

TABLE 7: SUMMARY OF 2ND SCREENING OF INITIAL ARRAY OF ALTERNATIVES BY ECOSYSTEM SERVICES AND ECONOMICS

N = not met/Decreased or Did Not Increase Service Provision, Y = met/Increased Service Provision, NA = not applicable

ID	ALTERNATIVE NAME	PROVISIONING	REGULATING	CULTURAL	SUPPORTING	BCR	ANNUAL NET BENEFITS	CARRIED FORWARD?
Alternative 1: No Action (FWOFI)	**Alternative 1 -- No Action -- FWOFI Alternative.** Although this alternative does not improve the provision of any ecosystem service categories or meet the minimum BCR, it is carried forward into the final array because it is required under NEPA and the PR&G.	N	N	N	NA	0	$0	Y
Alternative 2: Dam Replacement Alternative	**Alternative 2 -- Proposed Action -- Dam Replacement Alternative.** The Dam Replacement Alternative would improve the provision of provisioning, regulating, and cultural ecosystem services in the watershed and would meet the BCR requirement, with a BCR of **3.53** and net benefits of **$3,112,796**. This plan provides significantly greater economic and ecosystem service benefits than any other plan considered. Additionally, this plan is also the more cost-effective solution of the considered plans that meet the purpose and need.	Y	Y	Y	NA	3.53	$3,112,796	Y
Alternative 3: Buyouts Alternative (Nonstructural)	**Alternative 3 -- Proposed Action -- Buyouts Alternative (Nonstructural)** The Buyouts Alternative would improve the provision of provisioning, regulating, and cultural ecosystem services in the watershed, it would meet the BCR requirement, with a BCR of **1.06** and net benefits of **$2,520,432**. The costs of this alternative, however, are exorbitant, with annual costs of $3,794,486. However, because this alternative is a nonstructural-structural combination alternative, which is required to be carried forward for flood prevention projects, it was carried forward to the final array despite its high costs and significantly lower benefits compared to the Dam Replacement plan.	Y	Y	Y	NA	1.06	$215,995	Y
Alternative 4: Dam Removal Alternative	**Alternative 4 -- Proposed Action -- Dam Removal Alternative** The Dam Removal Alternative was eliminated because it did not benefit all ecosystem service categories. In those service categories where the service would be improved, it would be improved to a significantly lower margin than the other alternatives in the initial array. For this reason, the Plan was not analyzed quantitatively under the economic screening. Becuase it does not fully support the ecosystem framework of the PR&G, the Dam Removal Alternative was not carried forward into the final array of alternatives.	Y	Y	N	NA	NA	NA	N

PHASE VII: IDENTIFICATION OF THE FINAL ARRAY OF ALTERNATIVES (TO BE SCREENED USING C,E,E,& A)

TABLE 8: FINAL ARRAY OF ALTERNATIVES

Alternative 1 -- No Action -- FWOFI Alternative	Taking no action would consist of activities carried out if no federal funding were provided. The debris basin's high hazard dam would continue to pose a high risk of failure during a large flood, due to the seepage problem occurring in the dam's foundation. This could result in devastating flood damage to the Town of Kanosh. Flood flows would pass through the historic channels with the flooding events continuing. Irrigation flows would continue to be lost through seepage and evaporation from the earthen canals. The Town's secondary water system would keep receiving insufficient pressures for irrigation and would continue increasing the demand on their culinary water systems. The Tribe would continue to have culinary water shortages due to outdoor water use and no effective way to utilize their CCIC shares and water from Corn Creek. Existing conditions and trends would continue. The No-Action Alternative would not meet the purpose and need for the project. However, the No-Action Alternative is carried forward as the basis of comparison for impact analysis.
Alternative 2 -- Proposed Action -- Dam Replacement Alternative	The current debris basin would be reconstructed. The new debris basin would have an updated alignment farther downstream and a taller embankment. The proposed embankment crest elevation is designed to be 5,208.75 feet and the height of the embankment measured from the lowest downstream toe elevation is approximately 50 feet. The proposed primary spillway/low level outlet is a 42-inch conduit with a crest elevation of 5,177 feet. This conduit would discharge into a box that would dissipate energy, split water between two pipelines, and measure flow. This outlet pipe would have a trash rack and be controlled with a guard gate at the inlet of the pipe.The proposed secondary spillway is a morning glory and standpipe type design with a crest elevation of 5,199 feet and effective weir length of 22 feet. The 84-inch standpipe would have a 100-inch trash ring that would keep floating debris from blocking the flow of water into the spillway and blocking downstream culverts. The proposed emergency spillway is a side channel spillway design with a crest elevation of 5,203.8 feet and width of 200 feet. A concrete weir wall would discharge into a concrete side channel that would route the water to the existing emergency channel. The road would be regraded to remove the culverts and create a broad swale that would convey floodwater to the existing flood channel. The proposed auxiliary spillway would be constructed as an armored spillway over the dam with a crest elevation of 5,205.4 feet and width of 200 feet. The proposed armoring is a fabric-formed concrete mattress. The Plan would install bypasses near the existing splitting structure to prevent the Hatton and East/Middle Ditches from breaching. The first bypass would route water that exceeds the capacity of the East/Middle Ditch to the Hatton Ditch. The second bypass would route water that exceeds the capacity of the Hatton Ditch to the West Ditch. Additionally this plan would install a large capacity culvert to prevent the water fromovertopping I-15, which is critical infrastructure. The plan would enlarge the West Ditch downstream of the Main Street culvert and Construct a berm north of the culvert to prevent the floodwater from flowing north routes more water through the large culvert. Finally, 800 feet of an eixsting dirt road would be raised to prevent the water from flowing north. For agricultural water management, a gravity pipe system would be installed to greatly reduce seepage and evaporation losses and increase irrigation water deliveries to the farmers in the area. Diversion boxes would be installed at current irrigation

	turnouts. The proposed pipe system would replace approximately 4.9 miles of open ditches. Up to approximately 14.1 miles of ditches would have pipe installed adjacent to the ditch because the ditch would be needed to convey floodwater. Multiple splitting/measurement structures would be installed for the for the piped system and a sharp crested weir would be used in the splitting structures to ensure uniform controlled flow. The regulating pond would be relocated approximately a half mile upstream of the current pond location. The new pond would supply both the Kanosh Town and the Kanosh Band of Paiutes secondary systems from a higher elevation. This would provide additional pressure in the two secondary systems. Lastly, the plan would add a secondary system to the existing pipeline between the debris basin and the Kanosh Band Tribal community.
Alternative 3 -- Proposed Action -- Buyouts Alternative (Nonstructural)	This Alternative Plan would address flood prevention problems in the watershed through nonstructural measures, which is a requirement for projects having that authorized purpose under PL 83-566. The nonstructural measures for flood control have been combined with "fewer or smaller" structural agricultural water management measures for this alternative, as described in the NWPM and DM 9500-013 in order to meet both purposes of the project. The nonstructural flood prevention measures would consist of conducting property buyouts of all homes in the breach zone of Corn Creek Dam and Debris Basin, effectively removing the risk to life and property for the homes downstream of the Dam and eliminating the flood prevention hazards in this area. The dam would remain at high hazard level and could be expected to breach eventually, causing environmental problems downstream. However, the nonstructural approach would provide a nonstructural solution to the problem, which is required to be fully analyzed as part of the final array of Alternative Plans under the PR&G. The structural agricultural water management measures would include a gravity pipe secondary system to greatly reduce seepage and evaporation losses and increase irrigation water deliveries to the farmers in the area. Diversion boxes would be installed at current irrigation turnouts. The proposed pipe system would replace approximately 4.9 miles of open ditches. Up to approximately 14.1 miles of ditches would have pipe installed adjacent to the ditch. Multiple splitting/measurement structures would be installed for the for the piped system and a sharp crested weir would be used in the splitting structures to ensure uniform controlled flow. The regulating pond would be relocated approximately a half mile upstream of the current pond location. The new pond would supply both the Kanosh Town and the Kanosh Band of Paiutes secondary systems from a higher elevation. This would provide additional pressure in the two secondary systems. Lastly, the plan

	would add a secondary system to the existing pipeline between the debris basin and the Kanosh Band Tribal community.
Environmentally Preferred Alternative (from NEPA)	The NEPA process mandates that an environmentally preferred alternative be identified as a part of the planning process. Additionally, if a CWA Section 404 permit (any potential impacts to WOTUS) is required, the principles of the U.S. Army Corps of Engineers (USACE) Least Environmentally Damaging Practicable Alternative (LEDPA) should be followed and complied with during the development of alternative plans. LEDPA principles are best adhered to using the framework of first, avoidance, then, minimization, then, and only then, mitigation. Action Alternative 1 – Dam Replacement Alternative is the environmentally preferable/LEDPA alternative for this Plan-EA.
Locally Preferred Alternative	Under the PR&G, it is required to identify an alternative plan that is locally preferred. This alternative was developed with sponsors and local interests that have oversight or implementation authorities and responsibilities. In the case of this project, the locally preferred alternatives in Action Alternative 1 – Dam Replacement Alternative.

TABLE 9: SUMMARY AND COMPARISON OF ALTERNATIVES -- PLANNING PROCESS

Green = Met, Red = Not Met

ITEM OR CONCERN	ALTERNATIVE 1 - NO ACTION/FWOFI	ALTERNATIVE 2 - DAM REPLACEMENT	ALTERNATIVE 3 - BUYOUTS
NEPA PURPOSE AND NEED			
PURPOSE & NEED	This alternative would not meet the purpose and need. Flood control, ag. Water management and problems would persist.	Flood Prevention and Ag. Water Mgmt. purposes would be met. Needs would be addressed. Is the environmentally preferred (LEDPA) and locally preferred alternative.	Flood Prevention and Ag. Water Mgmt. purposes would be met using nonstructural measures for flood control. However, would relocate many residents and be very costly.
PROJECT OBJECTIVES			
FEDERAL OBJECTIVE	The FWOFI Alternative would not meet the Federal Objective as it would not meet the Guiding Principles of the PR&G, promote sustainable economic development, protect the environment, or protect the floodplain. Federal Objective not met.	Alternative 2 would meet the Federal Objective by meeting all the Guiding Principles of the PR&G, promoting sustainable economic development, being the LEDPA Plan, and protecting the floodplain downstream of the Dam. Federal Objective met.	Alternative 3 would not meet the Federal Objective, although it would meet parts of it such as some of the Guiding Principles of the PR&G. However, the Plan would not promote sustainable economic development, protect the environment, or protect the downstream floodplain. Federal Objective not met.
OBJECTIVE #1. Dam Safety Compliance	The FWOFI Alternative would not address dam safety compliance problems with Corn Creek Dam and Debris Basin as no funding would be provided to address the issue. Objective would not be met.	The Dam Replacement Alternative would replace Corn Creek Dam and Debris Basin and bring it into compliance with State and NRCS safety standards, meeting this project objective.	The Buyouts Alternative would not bring Corn Creek Dam and Debris Basin into compliance with State and NRCS dam safety standards as the nonstructural measures would remove properties rather than repairing the deficiencies at the dam itself. Objective not met.
OBJECTIVE #2. Breach Hazards	This Plan would not increase awareness of breach/flood hazards in the watershed as no funding would be provided. Objective would not be met.	The replacement of the Dam would be visible to all residents of the watershed and public notices issued, increasing awareness of the problem(s) posed by the current dam and the risks of a breahc. Objective met.	The Plan would certainly increase awareness of breach hazards as many properties and their owners would be relocated and bought out, which would inherently inform them of the rationale supporting that decision. Objective met.
OBJECTIVE #3. Secondary Water Access	Secondary water in the CCIC system would not be conserved and the Kanosh Band would continue to rely on their culinary supply for secondary uses. Objective would not be met.	This Plan would install a gravity pipe secondary system in the CCIC service area to reduce losses and conserve water and install a secondary system for the Kanosh Band to reduce their reliance on culinary water for outdoor use. Objective met.	This Plan would install a gravity pipe secondary system in the CCIC service area to reduce losses and conserve water and install a secondary system for the Kanosh Band to reduce their reliance on culinary water for outdoor use. Objective met.
OBJECTIVE #4. Drought Resilience	Residents of the watershed would not be more drought resilient as a result of this plan because not measures would be implemented to conserve water supply. Objective not met.	The Agricultural Water Management measures of this plan would conserve water and increase water use efficiency, making the communities of Kanosh and the Kanosh Band more resilient to drought conditions. Objective met.	The Agricultural Water Management measures of this plan would conserve water and increase water use efficiency, making the communities of Kanosh and the Kanosh Band more resilient to drought conditions. Objective met.
CONSTRAINTS			
CONSTRAINT #1. Disruptions to Property	No construction would occur under this alternative, and so, no disruptions to property would occur. This alternative meets this constraint.	Implementation of the Plan would avoid direct disruptions to residential and commercial properties and would meet this planning constraint.	Implementation of this Plan would not meet this planning constraint as various residential and commercial properties would be disrupted in order to conduct the nonstructual flood prevention measure of property buyouts/relocations.
CONSTRAINT #2. Cultural Site Impacts	This alternative does not meet this planning constraint. By not installing any flood control infrastructure, all historic/cultural sites in the indirect/No Action APE would be damaged in this scenario.	Although this Plan would have adverse impacts to some historic sites, the constraint specifies avoidance to the extent practicable. The historic sites in the Indirect APE would be protected by this Plan. This planning constraint is met by this Plan.	This Plan would not provide flood prevention protection to historic properties in the indirect APE which would eventually experience significant damage, or even destruction, when the dam eventually breached. Does not meet this constraint.
CONSTRAINT #3. Transportation Impacts	No construction would occur under this alternative, and so, no existing transportation infrastructure would be impacted. This alternative meets this constraint.	This Plan would meet this constraint because, although traffic delays may occur during construction, the roads would still be available for use by emergency services during the implementation period.	This plan would meet this planning constraint as property buyouts and relocations would not affect transportation routes or access for emergency services.
CONSTRAINT #4. Irrigation Water Access	No construction would occur under this alternative, and so, no changes would be made to the ability of farmers to access their irrigation water during the irrigation season.	Agricultural Water Management measures would be implemented outside of the typical irrigation season so that access to irrigation water for farmers would not be impeded.	Agricultural Water Management measures would be implemented outside of the typical irrigation season so that access to irrigation water for farmers would not be impeded.
CONSTRAINT #5. Environmental Justice	Problems related to secondary water access for the Kanosh Band of Paiutes would continue, impeding their ability to fully utilize their unique cultural role in the community and allowing adverse conditions for an EJ population to continue.	This Plan would provide significant direct benefits to an EJ population (the Kanosh Band) by installing a secondary system for them and relocating the Kanosh Town regulating pond, allowing the Band to better prioritize their unique cultural role in the area.	This Plan would provide significant direct benefits to an EJ population (the Kanosh Band) by installing a secondary system for them and relocating the Kanosh Town regulating pond, allowing the Band to better prioritize their unique cultural role in the area.
PR&G EVALUATION CRITERIA			

COMPLETENESS	This alternative would not constitute a complete alternative as no Problems or Opportunities would be addressed.	This alternative would account for all necessary investments to achieve the planned effects and is a complete solution that fully addresses the Problems and Opportunities.	This alternative would account for all necessary investments to achieve the planned effects and is a complete solution that fully addresses the Problems and Opportunities.
EFFECTIVENESS	This alternative would not constitute an effective solution as no problems would not be solved and no project objectives met, including the Federal Objective.	This alternative would address all the identified problems and meet all of the project objectives to constitute an effective solution.	This alternative would constitute only a partially effective solution as the Federal Objective and one of the project objectives would not be met by the plan.
EFFICIENCY	This alternative would not cost anything to implement and so would constitute a cost effective alternative that would be an efficient solution.	This alternative is the NEE alternative and has net positive economic benefits and a BCR of 4.07. This alternative constitutes a cost efficient solution.	This alternative has net positive economic benefits but has a BCR of 1.06 which is significantly lower than the other action plan even though it does meet the minimum value of 1.0, due to the exorbitant cost to conduct property buyouts. Because this plan would require a much higher financial investment to achieve less benefits than a cheaper plan, it is not a cost efficient solution.
ACCEPTABILITY	This alternative would not be acceptable or consistent with existing Federal laws as it would not protect the environment and would not address any of the problems in the watershed.	This alternative would comply with all Federal and State regulatory frameworks and is the environmentally preferred alternative from NEPA and the locally preferred alternative. The problems in the watershed would be addressed. This alternative constitutes an acceptable solution.	This alternative would not be acceptable as it is highly unlikely that property buyouts could be conducted on an entirely voluntary basis, requiring the use of eminent domain to accomplish it. This alternative does not constitute an acceptable solution.

PR&G Ecosystem Services Scoping and Evaluation Worksheet

Franson Civil Engineers

PROJECT NAME	Corn Creek Watershed Plan-EA
PROJECT NUMBER	20112
PROJECT MANAGER	Layne Jensen

Overview of Framework

The PR&G Ecosystem Services Framework is an analysis approach that traces the pathways of natural ecosystem processes to the benefits which they grant to society in monetary and non-monetary terms. NRCS requires that an ecosystem services framework be worked within throughout the preliminary investigation and planning process. Ecosystem services are broken into four service categories which include:

(1) Provisioning Services: tangible goods for human use such as food, clean air, fresh water, energy, fuel, forage, fiber, and minerals.
(2) Regulating Services: maintain natural processes which provide buffers against environmental catastrophe such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood prevention/control; and disease regulation.
(3) Supporting Services: underlying processes maintaining conditions for life such as pollination, seed dispersal, soil formation, and nutrient cycling.
(4) Cultural Services: services related to the cultural or spiritual needs of people such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities.

Evaluation Approach

Ecosystem services are first evaluated from a qualitative perspective during scoping to identify the types of services present in the watershed, and then specifically to identify those that could interact with (impact or be impacted by) the authorized project purpose(s)/problems.

Regulatory Requirement (Level II PR&G Analysis)

The National Watershed Program Manual (NWPM) requires a level II PR&G analysis for any WSOP or REHAB program that will have a Federal construction cost-share of more than $10 million. This level of PR&G analysis requires the robust development of an ecosystem service framework and resulting ecosystem services flows.

Use of this Worksheet

This worksheet was created as a way to document our incorporation and use of the ecosystem services framework and to provide written evidence of the evaluation approach described above. Fill in all the applicable fields on this worksheet for the project you are working on. If it is not a text form or dropdown list, it should not be changed. Depending on the project, not every form or field will be applicable.

AFFECTED ENVIRONMENT: IDENTIFICATION/SCOPING FOR ECOSYSTEM SERVICES

In the tables below, identify ecosystem services that currently exist in the project area and place them under the appropriate service categories as described in the "Overview of Framework" section of this worksheet. Remember, the initial evaluation of ecosystem services should be conducted from a qualitative perspective. The services identified should be directly related to the PL-566 authorized purpose(s)/Problem(s) for the project. Incidental service benefits will be identified in a later section.

Table 1 Scoped Provisioning Services in the Project Area

PROVISIONING SERVICES
Water Savings/Seepage Control
Food Production/Agriculture
Drinking Water Supply
NA

Provisioning Services: tangible goods for human use such as food, clean air, fresh water, energy, fuel, forage, fiber, and minerals.

Table 2 Scoped Regulating Services in the Project Area

REGULATING SERVICES
Flood Prevention/Public Safety Generated by Dam and Debris Basin
Secondary Water Quality
Drought/Climate Change Resiliency
NA

Regulating Services: maintain natural processes which provide buffers against environmental catastrophe such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood prevention/control; and disease regulation.

Table 3 Scoped Supporting Services in the Project Area

SUPPORTING SERVICES
Evaluated as an intermediate ecosystem service, therefore it is not carried forward in this ecosystem services analysis.
NA
NA
NA

Supporting Services: underlying processes maintaining conditions for life such as pollination, seed dispersal, soil formation, and nutrient cycling.

Table 4 Scoped Cultural Services in the Project Area

CULTURAL SERVICES
Agricultural Development of Watershed
Support of Tribal Community
Aesthetic/Scenic Value of the Watershed
Existence Value of Cultural/Historic Sites

Cultural Services: services related to the cultural or spiritual needs of people such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities.

FORECASTED FUTURE CONDITIONS (NO ACTION/FWOFI/ANALYTIC BASELINE)

In the section below, evaluate the reasonably projected changes in the ecosystem service benefits you identified in the previous section. The main focus of this projections should be on how the change in the provision of the service will alter the benefits they provide to society/human welfare. Again, this section should be qualitative and does not necessarily need to provide any specific quantities of services. This write-up (or some slight variation of it) will be included in the Plan-EA/EIS.

The projected changes in the provision of ecosystem services in the project area if no Federal Investment were made would result in overall reductions in the ecosystem service benefits that the natural systems in the project area provide to society. The following changes in ecosystem service benefits would be expected if existing conditions are to continue:

1. Water Savings/Seepage Control Provisioning Service:
- Unreliable irrigation water deliveries to Kanosh farmers would continue.

2. Food Production/Agriculture Provisioning Service:
- Crop yields in the watershed would remain in their current conditions until a Dam breach
- Once the dam breaches, agricultural land would be largely damaged, reducing crop yields.

3. Drinking Water Supply Provisioning Service:
- Kanosh Town's secondary system would function, but with low pressure in high elevation areas.
- The Kanosh Band's culinary system would continue to be strained due to outdoor demands.

4. Flood Prevention/Public Safety Regulating Service:
- The Corn Creek Dam and Debris Basin would remain at high risk of failure.
-The Dam can be reasonably expected to fail if existing conditions continue.
- The Kanosh Community would be at high risk of flooding and damages when the dam breaches.

5. Secondary Water Quality Regulating Service:
- Water quality delivered to farmers would not change, which is currently subject to pollution/contamination

6. Drought/Climate Change Resiliency Regulating Service:
- Continued groundwater withdrawals to supplement irrigation water deliveries to the existing CCIC system.
- Continued seepage/evaporation losses from the open irrigation ditch system, providing inadequate supply.
- As long-term climate trends develop, Kanosh and the surrounding community will become less resilient to environmental catastrophe than they currently are.

7. Agricultural Development Cultural Service:
- Agriculture as an economic sector would remain in its current condition until the dam breached.
- A dam breach would significantly impact the agricultural viability of the area, potentially destroying some cropland.

8. Tribal Community Cultural Service:
- The Kanosh Band would continue to have inadequate water supply and would not become more resilient to long-term climate impacts.

9. Aesthetic/Scenic Value Cultural Service:
- The scenic value of the watershed would not change if existing conditions were allowed to continue until a dam breach.
- When the dam breaches, the damages and removal of the dam itself would negatively impact the aesthetic value.

10. Cultural/Historic Site Existence Value Cultural Service:
- Cultural and historic sites would remain in their current condition prior to a dam breach.
- When the dam breaches, the sites within the Indirect APE would be adversely impacted.

MONETIZING, QUANTIFYING, AND QUALIFYING ECOSYSTEM SERVICES

The decision tree below was provided by the National Watershed Management Center (NWMC) and should be a helpful reference in completing this section of the worksheet.

NWMC Decision Tree for Ecosystem Services

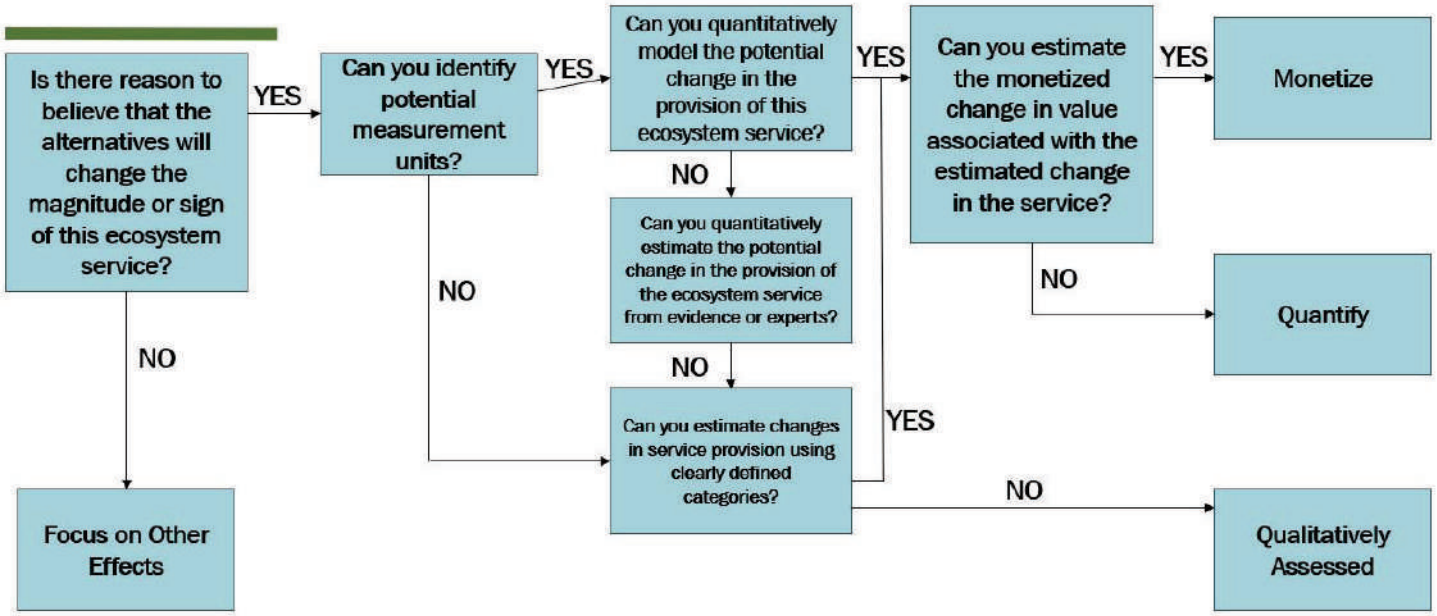

Table 5 Summary of Ecosystem Services & Their Representative Metrics

PROVISIONING SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
Water Savings/Seepage	Quantified	Average Annual Water Savings (AF)
Food Production/Agriculture	Quantified	Annual Change in Crop Yields (tons/yr)
Drinking Water Supply	Monetized	Cost/Benefits of Ag. Water Measures
NA	Not Applicable	NA
REGULATING SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
Flood Prevention/Public Safety	Monetized	Cost/Benefits of Flood Damages/Breach
Secondary Water Quality	Qualified/Non-Monetized	Observed Parameter Improvements
Drought/Climate Resiliency	Quantified	Average Annual Water Savings (AF)
NA	Not Applicable	NA
SUPPORTING SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
NA	Not Applicable	NA
NA	Not Applicable	NA
NA	Not Applicable	NA
NA	Not Applicable	NA
CULTURAL SERVICES		
SERVICE	**MONETIZED/QUANTIFIED/QUALIFIED?**	**REPRESENTATIVE METRIC**
Agricultural Development	Quantified	Average Annual Water Savings (AF)
Tribal Community	Monetized	Cost/Benefits of Ag. Water Measures
Aesthetic/Scenic Value	Qualified/Non-Monetized	Subjective Changes in Viewshed
Cultural/Historic Site Value	Quantified	No./Sites at Risk of Damage in Breach

Examples of Monetized Representative Metrics: flood damage benefits (dollars), expected tourism (dollars)

Examples of Quantified Representative Metrics: protected/restored acres of farmland, crop yields, acre-feet of saved water, WQ Index, habitat units, wildlife/fish/plant species population changes

Examples of Qualified Representative Metrics: aesthetic improvements, vegetation restoration, new recreational opportunities, improved access to the outdoors

MONETIZED ECOSYSTEM SERVICES BENEFITS SUMMARY FOR ALTERNATIVES

Fill in the table below to summarize the estimated monetized benefits of the ecosystem services you identified (if applicable). This table should be provided to the project economist to be included in the economic analysis. It should also be noted that, if necessary, the non-monetized ecosystem service benefits should be provided to the economist to serve as a tradeoff if the B/C ratio does not meet at least 1. These benefits may be used to raise the B/C ratio given subjective values.

Also note, if there were no monetized benefits identified or if any of the ecosystem service categories were eliminated during scoping, note that in the table by including a line that says, "not monetized for this plan".

Table 6 Monetized Benefits Summary for Ecosystem Services

	No Action	Action Alternative 1	Action Alternative 2
PROVISIONING SERVICES			
Water Savings/Seepage	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Food Production/Agriculture	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Drinking Water Supply	$0 Ag. Water Benefit	$1,490,049 Ag. Water Benefit	$1,490,049 Ag. Water Benefit
NA	NA	NA	NA
REGULATING SERVICES			
Flood Prevention/Public Safety	$0 Reduction Benefit	$2,855,348 Reduction Benefit	$2,520,432 Reduction Benefit
Secondary Water Quality	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Drought/Climate Change Resiliency	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
NA	NA	NA	NA
SUPPORTING SERVICES			
Intermediate Service, Not Analyzed	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
NA	NA	NA	NA
CULTURAL SERVICES			
Agricultural Development	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Benefits to Tribal Community	$0 Ag. Water Benefit	$1,490,049 Ag. Water Benefit	$1,490,049 Ag. Water Benefit
Aesthetic/Scenic Value of Watershed	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Existence Value of Cultural/Historic Sites	Not Monetized for this Plan	Not Monetized for this Plan	Not Monetized for this Plan
Total Annual Monetized Benefits	$0	$4,345,396	$4,010,481
Total Annual Monetized Costs	$0	$1,232,600	$3,794,486
Benefit-Cost Ratio	0.0	3.53	1.06
Annual Monetized Net Benefit	$0	$3,112,796	$215,995

IDENTIFICATION OF INCIDENTAL ECOSYSTEM SERVICES

If necessary (usually meaning the B/C ratio for alternative(s) are not reaching 1 with the benefits of problem/authorized purpose related ecosystem benefits), incidental ecosystem services may be used to help raise the B/C ratio to 1 subjectively. The identification of incidental ecosystem services can also help support the environmental/NEPA analysis in the Plan-EA/EIS document.

If desired, fill in the tables below for incidental ecosystem services in the project area.

Table 7 Incidental Provisioning Services in the Project Area

PROVISIONING SERVICES
Soil Characteristics/Underlying Geology
Fish and Wildlife Habitat/Migratory Birds
NA
NA

Provisioning Services: tangible goods for human use such as food, clean air, fresh water, energy, fuel, forage, fiber, and minerals.

Table 8 Incidental Regulating Services in the Project Area

REGULATING SERVICES
Debris Basin Protection of Irrigation Ditches/Channels
Air Quality/GHG Emissions
Riparian Areas
NA

Regulating Services: maintain natural processes which provide buffers against environmental catastrophe such as long-term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood prevention/control; and disease regulation.

Table 9 Incidental Supporting Services in the Project Area

SUPPORTING SERVICES
NA
NA
NA
NA

Supporting Services: underlying processes maintaining conditions for life such as pollination, seed dispersal, soil formation, and nutrient cycling.

Table 10 Incidental Cultural Services in the Project Area

CULTURAL SERVICES
NA
NA
NA
NA

Cultural Services: services related to the cultural or spiritual needs of people such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities.

ENVIRONMENTAL CONSEQUENCES: IMPACTS OF ALTERNATIVES ON ECOSYSTEM SERVICES

In the environmental consequences chapter of the Plan-EA/EIS, the impacts of each alternative in the final array on ecosystem services must be evaluated. If the service is monetized or quantified, the dollars or values associated with that service under each alternative should be listed in the descriptions. In the sections below, generate write-ups for the Plan-EA/EIS that evaluate the environmental consequences/impacts to the ecosystem services in the project area.

Ecosystem Services Impact Write-Ups:

No Action/FWOFI: Provisioning Services would not be improved but would diminish over time under this Alternative Plan. See the "Forecasted Future Conditions" section of this worksheet/documentation.

Action Alternative 1: Provisioning Services would be improved under this alternative. Average water conservation of ~3,148 AF would result in an expected crop yield increase of ~64% for Alfalfa and ~73% for grass hay over ~3,000 acres of land. This equates to an average annual crop yield increase of ~7,400 tons of Alfalfa and ~983 tons of Grass Hay. The installation of the proposed agricultural water management measures would provide an average annual monetary benefit of $1,490,049 to the area, demonstrating benefits to the provisioning service of drinking water supply.

Action Alternative 2: Provisioning Services would be improved under this alternative. Average water conservation of ~3,148 AF would result in an expected crop yield increase of ~64% for Alfalfa and ~73% for grass hay over ~3,000 acres of land. This equates to an average annual crop yield increase of ~7,400 tons of Alfalfa and ~983 tons of Grass Hay. The installation of the proposed agricultural water management measures would provide an average annual monetary benefit of $1,490,049 to the area, demonstrating benefits to the provisioning service of drinking water supply.

No Action/FWOFI: Regulating Services would not be improved but would diminish over time under this Alternative Plan. See the "Forecasted Future Conditions" section of this worksheet/documentation.

Action Alternative 1: This alternative would protect the Town of Kanosh against the 100-year storm event/the Dam Breach and would provide annual monetary flood damage reduction benefits of $2,921,303. The quality of secondary water would be improved as the water would be piped and would not be subject to contamination via pollutants, this will created an observed decrease in turbidity. The watershed would become more resilient to drought/climate change under this Plan as significant water savings would occur (~3,148 AF), decreasing reliance on the groundwater system for late season irrigation needs.

Action Alternative 2: This alternative would relocate the structures within the breach zone of Corn Creek Dam by conducting property buyouts, which is a very costly option. However, the avoided annual damage reduction benefit of doing this would be $3,600,905. The quality of secondary water would be improved as the water would be piped and would not be subject to contamination via pollutants, this will create an observed decrease in turbidity. The watershed would experience ~3,148 AF of water savings, but would lose the storage of Corn Creek Dam when it eventually breached, leaving the community in a worse position to combat drought/climate change impacts than if the dam were rehabilitated. Although the damage reduction benefit is higher under this Plan than Action Plan 1, it comes with significantly higher costs, bringing the B/C ratio of this Plan down substantially lower than Action Plan 1.

SUPPORTING SERVICES EVALUATED AS INTERMEDIATE SERVICE IN THIS PLAN, NO ADDITIONAL INFORMATION NECESSARY.

No Action/FWOFI: Cultural Services would not be improved but would be diminished over time under this Alternative Plan. See the "Forecasted Future Conditions" section of this worksheet/documentation.

Action Alternative 1: Agricultural development and viability would be supported/improved by this plan as it would protect the open space viewshed and encourage the perpetuation of the agricultural sector. Additionally, there would be benefits to the Kanosh Band Tribal community as a result of the agricultural water management measures which would provide an average annual monetary benefit of $1,490,049. Although this Plan would include some adverse impacts to cultural/historic properties, it would ultimately protect the historic properties that would otherwise be damaged during a dam breach within the indirect APE.

Action Alternative 2: Agricultural development and viability would be supported/improved by this plan as it would protect the open space viewshed and encourage the perpetuation of the agricultural sector. However, there would be significant damages to agricultural land when the dam breach eventually occurs. There would also be benefits to the Kanosh Band Tribal community as a result of the agricultural water management measures, resulting in an average annual monetary benefit of $1,490,049. This plan would not protect historic properties within the indirect APE, which would ultimately be damaged by the eventual dam breach.

CORN CREEK CUMULATIVE EFFECTS ANALYSIS

STEP 1: IDENTIFY THE SIGNIFICANT CUMULATIVE EFFECTS ISSUES ASSOCIATED WITH THE PROPOSED ACTION(S) AND DEFINE THE ASSESSMENT GOALS

Resource Concern	Alternative	Effect Type & Duration	Significant?
Prime/Unique Farmland	Dam Replacement	Direct Permanent Benefits	**Yes**
Prime/Unique Farmland	Buyouts Alternative	Direct Permanent Benefits	**Yes**
Prime/Unique Farmland	Buyouts Alternative	Direct Permanent Impact	**Yes**
Erosion/Sedimentation	Dam Replacement	Direct Temporary Impact	No
Erosion/Sedimentation	Dam Replacement	Direct Permanent Benefits	No
Erosion/Sedimentation	Buyouts Alternative	Direct Temporary Impact	No
Erosion/Sedimentation	Buyouts Alternative	Direct Permanent Benefit	No
Surface Water Quantity	Dam Replacement	Direct Permanent Benefit	No
Surface Water Quantity	Buyouts Alternative	Direct Permanent Benefit	No
Beneficial Use Impairment	Dam Replacement	Direct Permanent Benefit	No
Beneficial Use Impairment	Buyouts Alternative	Direct Permanent Benefit	No
Sediment Management (WQ)	Dam Replacement	Direct Temporary Impact	No
Sediment Management (WQ)	Dam Replacement	Direct Permanent Benefit	No
Sediment Management (WQ)	Buyouts Alternative	Direct Temporary Impact	No
Sediment Management (WQ)	Buyouts Alternative	Direct Permanent Impact	No
Surface Water Quality	Dam Replacement	Direct Temporary Impacts	No
Surface Water Quality	Dam Replacement	Direct Permanent Benefit	No
Surface Water Quality	Buyouts Alternative	Direct Temporary Impacts	No
Surface Water Quality	Buyouts Alternative	Direct Permanent Benefit	No
Groundwater Quantity	Dam Replacement	Direct Permanent Benefits	**Yes**

Resource Concern	Alternative	Effect Type & Duration	Significant?
Groundwater Quantity	Dam Replacement	Indirect Permanent Impacts	No
Groundwater Quantity	Buyouts Alternative	Direct Permanent Benefits	**Yes**
Groundwater Quantity	Buyouts Alternative	Indirect Permanent Impacts	No
Groundwater Quality	Dam Replacement	Indirect Permanent Impact	No
Groundwater Quality	Dam Replacement	Direct Permanent Benefit	No
Groundwater Quality	Buyouts Alternative	Indirect Permanent Impact	No
Groundwater Quality	Buyouts Alternative	Direct Permanent Benefit	No
Floodplain Management	Dam Replacement	Direct Permanent Benefit	**Yes**
Floodplain Management	Buyouts Alternative	Direct Permanent Benefit	**Yes**
Wetlands/Aquatic Sites	Dam Replacement	Direct Permanent Impact	No
Wetlands/Aquatic Sites	Buyouts Alternative	Direct Permanent Impact	No
Air Quality	Dam Replacement	Direct Temporary Impact	No
Air Quality	Buyouts Alternative	Direct Temporary Impact	No
Climate Change/GHG	Dam Replacement	Direct Temporary Impact	No
Climate Change/GHG	Buyouts Alternative	Direct Temporary Impact	No
Invasive Species/Weeds	Dam Replacement	Indirect Permanent Impact	**Yes**
Invasive Species/Weeds	Buyouts Alternative	Indirect Permanent Impact	**Yes**
Migratory Birds	Dam Replacement	Indirect Temporary Impact	No
Migratory Birds	Buyouts Alternative	Indirect Temporary Impact	No
Wildlife Habitat/Species	Dam Replacement	Indirect Temporary Impact	No
Wildlife Habitat/Species	Buyouts Alternative	Indirect Temporary Impact	No
Riparian Vegetation	Dam Replacement	Direct Permanent Impact	No

Resource Concern	Alternative	Effect Type & Duration	Significant?
Riparian Vegetation	Buyouts Alternative	Direct Permanent Impact	No
Cultural/Historic Sites	Dam Replacement	Direct Permanent Impacts	**Yes**
Cultural/Historic Sites	Buyouts Alternative	Direct Permanent Impacts	**Yes**
Environmental Justice	Dam Replacement	Direct Permanent Benefits	**Yes**
Environmental Justice	Buyouts Alternative	Direct Permanent Benefits	**Yes**
Population/Socioeconomics	Buyouts Alternative	Direct Permanent Impacts	**Yes**
Employment/Socioeconomics	Dam Replacement	Direct Temporary Benefit	No
Employment/Socioeconomics	Buyouts Alternative	Direct Permanent Impact	**Yes**
Income/Socioeconomics	Dam Replacement	Direct Permanent Benefits	**Yes**
Income/Socioeconomics	Buyouts Alternative	Indirect Permanent Impact	No
Income/Socioeconomics	Buyouts Alternative	Direct Permanent Benefit	**Yes**
Occupation/Socioeconomics	Dam Replacement	Direct Permanent Benefit	**Yes**
Occupation/Socioeconomics	Buyouts Alternative	Direct Permanent Benefit	**Yes**
Risk of Dam Failure	Dam Replacement	Direct Permanent Benefits	No
Risk of Dam Failure	Buyouts Alternative	Indirect Permanent Impacts	No
Public Safety/Drowning Risk	Dam Replacement	Direct Permanent Benefit	No
Public Safety Drowning Risk	Buyouts Alternative	Direct Permanent Benefit	No
Transportation Infrastructure	Dam Replacement	Direct Temporary Impact	No
Transportation Infrastructure	Dam Replacement	Direct Permanent Benefit	No
Transportation Infrastructure	Buyouts Alternative	Direct Temporary Impact	No
Scenic Beauty/Visual	Dam Replacement	Direct Temporary Impacts	No

Resource Concern	Alternative	Effect Type & Duration	Significant?
Scenic Beauty/Visual	Dam Replacement	Indirect Temporary Impacts	No
Scenic Beauty/Visual	Buyouts Alternative	Direct Temporary Impacts	No
Scenic Beauty/Visual	Buyouts Alternative	Indirect Temporary Impacts	No
Land Use Designations	Dam Replacement	Direct Permanent Impact	No
Land Use Designations	Buyouts Alternative	Direct Permanent Impact	No
Agricultural Land Use	Dam Replacement	Direct Permanent Benefit	No
Agricultural Land Use	Buyouts Alternative	Direct Permanent Benefit	No
Residential Land Use	Dam Replacement	Direct Permanent Benefit	No
Residential Land Use	Buyouts Alternative	Direct Permanent Benefit	No
Residential Land Use	Buyouts Alternative	Direct Permanent Impacts	No
Provisioning Ecos. Services	Dam Replacement	Direct Permanent Benefits	No
Provisioning Ecos. Services	Buyouts Alternative	Direct Permanent Benefits	No
Regulating Ecos. Services	Dam Replacement	Direct Permanent Benefits	No
Regulating Ecos. Services	Buyouts Alternative	Direct Permanent Impacts	No
Cultural Ecos. Services	Dam Replacement	Direct Permanent Benefits	No
Cultural Ecos. Services	Buyouts Alternative	Direct Permanent Benefits	No

STEP 2: ESTABLISH THE GEOGRAPHIC SCOPE FOR THE ANALYSIS

Resource Concern Category in Plan-EA	Geographic Area for CE Analysis
Prime and Unique Farmland	Corn Creek Watershed, Utah
Surface Water Quantity	Corn Creek Watershed, Utah
Groundwater Quantity	Groundwater Basin
Floodplain Management	Corn Creek Watershed, Utah
Invasive Species/Noxious Weeds	Millard County, Utah
Cultural and Historic Resources	Corn Creek Watershed, Utah
Environmental Justice and Civil Rights	Millard County, Utah
Socioeconomics (Local, Regional, and National Economy)	Millard County, Utah

- The largest geographic area identified for the significant CE issues is **Millard County,** which will be used as the Geographic Scope for the entire CE Analysis.

STEP 3: ESTABLISH A TIME FRAME FOR THE ANALYSIS

TOTAL PROJECT PERIOD OF ANALYSIS IS 52 YEARS

Significant CE Issue	Expected Duration of Effects	Time Frame for CE Analysis
Farmland/Benefits/Alt. 2	50-Years	5-Years
Farmland/Benefits/Alt. 3	50-Years	5-Years
Farmland/Impacts/Alt. 3	50-Years	5-Years
Water Quantity/Benefits/Alt. 2	50-Years	5-Years
Water Quantity/Benefits/Alt. 3	50-Years	5-Years
GW Quantity/Benefits/Alt. 2	50-Years	5-Years
GW Quantity/Benefits/Alt. 3	50-Years	5-Years
Floodplains/Benefits/Alt. 2	50-Years	5-Years
Floodplains/Benefits/Alt. 3	50-Years	5-Years
Invasive Sp./Impacts/Alt. 2	5-Years	1-Year
Invasive Sp./Impacts/Alt. 3	5-Years	1-Year
Cultural/Impacts/Alt. 2	50-Years	1-Year
Cultural/Impacts/Alt. 3	50-Years	1-Year
Env. Justice/Benefits/Alt. 2	50-Years	5-Years
Env. Justice/Benefits/Alt. 3	50-Years	5-Years
Population/Impacts/Alt. 3	50-Years	5-Years

Significant CE Issue	Expected Duration of Effects	Time Frame for CE Analysis
Employment/Impacts/Alt. 3	2-Years	2-Years
Occupation/Benefits/Alt. 2	50-Years	5-Years
Occupation/Benefits/Alt. 3	50-Years	5-Years

- The longest time frame identified for the significant CE issues **is 5 years**, which will be used as the time frame for the entire CE Analysis. This will include a review of recently completed projects (in the past 1 year) and a forecast of projects expected to either (A) be constructed, or (B) begin construction in the next 5 years.

STEP 4: IDENTIFY OTHER ACTIONS AFFECTING THE RESOURCES, ECOSYSTEMS, AND HUMAN COMMUNITIES OF CONCERN.

- *FEDERAL PROJECTS* (Corn Creek Watershed – 5-Year Forecast)
  - Natural Resources Conservation Service
    - Millard County EWP 2023-Spring Site & Water Crossing
      - *This Emergency Watershed Protection (EWP) project includes the installation of riprap, concrete wall replacement, grading, earthen dike building, and a concrete low-water crossing. Bids for construction were opened in May 2024.*
    - Lower Sevier Watershed Plan-EA
      - *This project is being funded by NRCS through the PL 83-566 program, like this one, for the Lower Sevier River Watershed near Delta in Millard County. The project seeks to make improvements to the "C" Canal Water Efficiency Project to reduce water loss from leakage and evapotranspiration and to improve public safety along the canal. The scoping phase was completed in 2022. The Plan-EA is currently still in development. If approved, the project would likely begin construction sometime in the next 5-years.*
  - U.S. Forest Service
    - Desert Experimental Range in Pine Valley
      - *The USFS established the Desert Experimental Range in Pine Valley, Millard County in 1933 as a center for cold desert rangeland research. It encompasses 87 square miles and is designated as a biosphere reserve. Recent projects in this experimental range include Utah State University's Quantitative Soil Survey and Interpretation project, funded by the USDA REEIS program and supported by the U.S. Geological Survey as well. The study focused on soil erosion, vegetation dynamics, and climate change impacts using portable wind tunnels. The project studies took place in 2023.*
    - White Sage Flat Habitat Restoration Project Phase 2
      - *The USFWS conducts pinyon-juniper woodland management to restore ecosystems, reduce wildfire risks, and improve wildlife habitats. This project consists of the reduction of pinyon-juniper fuel*

loading southeast of Kanosh, Utah. This project will consist of different methods to reduce fuel loading such as anchor chaining, reseeding, bull hog mastication of smaller trees with skid steers and hand removal. Expected to be completed in 2025.

- Intermountain Power Agency (IPA)
  - Intermountain Power Project (IPP)
    - *The Intermountain Power Project (IPP) began construction in October 2022 and is anticipated to be completed in 2025. The project is transitioning the existing coal-fired power plant near Delta, Utah, in Millard County, to a combined-cycle natural gas facility capable of utilizing Hydrogen.*
- Federal Energy Regulatory Commission
  - Kern River Delta Lateral Project
    - *A Record of Decision (ROD) was approved in January 2023 for the Kern River Delta Lateral Project which would install a 24-inch diameter high pressure natural gas pipeline and ancillary facilities on 6.9 miles of BLM managed public land in Millard County. The BLM will issue a 30-year right-of-way grant and a temporary use permit to construct and operate the pipeline. This project connects the project to the Intermountain Power Project (IPP) north of Delta. Construction began in 2023 and was completed in Spring 2024.*
- Bureau of Land Management
  - Renewable Energy Development in Millard County
    - *The BLM purchased two parcels, covering ~3,045 acres in Millard County, within the Fishlake National Forest to put toward geothermal energy development in January 2023. Leases for the project were announced in March 2023.*
  - Three Knolls Project Phase II
    - *This project will expand and improve ~1,035 acres of sagebrush habitat at the south end of the Valley Mountains by removing existing juniper via mastication and seeding techniques. The project is located ~12 miles southeast of Scipio in the foothills of the Valley Mountains in Millard County, Utah. The project is expected to be implemented in 2025.*

- *STATE PROJECTS* (Corn Creek Watershed – 5-Year Forecast)
  - Utah Division of Wildlife Resources (DWR)
    - Pahvant Wildlife Management Area (WMA) Habitat Improvement
      - *The DWR has been implementing habitat improvement projects on the Pahvant WMA in Millard County to improve habitat conditions for vegetation management and infrastructure improvements. These improvements occur annually and are ongoing.*
    - Fillmore WMA Habitat and Private Land Habitat Improvement Project
      - *Phase II of this project will improve wildlife habitat in WMA in Millard County. Also, co-sponsored by the USFWS through their Partners Program to improve winter habitat for deer, elk, and wild turkeys through improvements like pinyon-juniper removal and fencing.*

Located in the Fillmore and Holden areas of Millard County. Expected to be implemented in 2025.

- Utah Department of Transportation
  - US-6 Delta to Juab County Line & SR-174
    - *This project seeks to make various road improvements to US-6 between Delta and the Juab County Line/SR-174. Work began on this project in May 2024, and it is 86% complete at the time of writing this Plan-EA.*
  - I-70/I-15 Interchange Bridge Maintenance
    - *This project consisted of routine maintenance to the I-70/I-15 Interchange Bridge in Millard County. The project began work in April 2022 and was completed in September 2024.*

- *LOCAL PROJECTS* (Corn Creek Watershed – 5-Year Forecast)
  - Kanosh Band of Paiute Indians
    - Geothermal Energy Development
      - *The Kanosh Band was awarded a grant from the Department of the Interior's Energy and Mineral Development Program in September 2024 to support geophysical studies to evaluate the feasibility of geothermal energy development on Tribal lands.*
    - RV Park Enhancement
      - *The Kanosh Band was awarded a Department of Agriculture grant through the Rural Business Development Grant Program (RBDG) to provide technical assistance, training, and a computerized financial system for an RV park on their land.*
    - Park and Playground Upgrades
      - *The Kanosh Band is collaborating with the Native American Initiative (NAI) program to upgrade an existing park and playground on Tribal land. The NAI also recently helped install new streetlights for the community.*

STEP 5: PERFORM CUMULATIVE EFFECTS ANALYSIS FOR THE PROJECT

Action Alternative 2 – Proposed Action – Dam Replacement Alternative

- Prime and Unique Farmland Benefits – Cumulative Effects
  - Improved farmland productivity/crop yield
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
  - agricultural viability
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to benefits to ag. Water management in the county.*
  - crop damage from flooding reduced
    - *Interactive Benefit to Kanosh Band Geothermal Energy Development. Less risk of damage to lands due to flooding.*
  - reduce the risk of economic loss for farmers.
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Surface Water Quantity Benefits – Cumulative Effects

  - Seepage/Evaporation reduction/Water Savings
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to the benefits of water conservation and ag. Water management in Millard County.*
- Groundwater Quantity Benefits – Cumulative Effects
  - Reduced demand on groundwater
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
  - Increased system sustainability for Kanosh Band
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Floodplain Management Benefits – Cumulative Effects
  - Reduce flooding and flood damages to the community
    - *Interactive Benefit to all three Kanosh Band projects as damages from flooding would be less likely to occur, promoting geothermal development and protecting the RV park and playground.*
  - Protection of the floodplain from damages
    - *Interactive Benefit to the White Sage Flat Habitat Restoration project. Protection of floodplain functionality promotes natural ecosystem function, a goal of the project which takes place in the upper Corn Creek Watershed.*
- Invasive Species/Noxious Weeds Adverse Impacts – Cumulative Effects
  - Potential introduction of additional or more invasive species/noxious weeds
    - *Interactive Adverse Effect to the White Sage Flat Habitat Restoration project. By potentially bringing more/additional invasive plants into the watershed during construction, the goal to restore vegetative conditions in the watershed of this project could be diminished somewhat. Although there is not a guarantee that invasive species would be introduced and BMPs will be used, there is always potential during construction.*
- Cultural & Historic Resources Adverse Impacts – Cumulative Effects
  - Irreversible adverse effects to NRHP site(s)
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Environmental Justice & Civil Rights Benefits – Cumulative Effects
  - Support of the Kanosh Band (EJ Pop.) through implementation
    - *Interactive Benefit to all projects from the Kanosh Band, as damages from flooding would be less likely to occur, promoting geothermal development and protecting the RV park and playground. Improves conditions for an EJ population in Millard County.*
- Socioeconomics (Occupation) Benefits – Cumulative Effects
  - Saved water/Extended growing season/Long-term agricultural development
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to benefits to ag. Water management in the county.*
  - Tribal Land agricultural expansion
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to benefits to ag. Water management in the county.*

Action Alternative 3 – Nonstructural-Structural Combination – Buyouts Alternative

- Prime and Unique Farmland Benefits – Cumulative Effects
  - Improved farmland productivity/crop yield
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
  - agricultural viability
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to benefits to ag. Water management in the county.*
  - crop damage from flooding reduced
    - *Interactive Benefit to Kanosh Band Geothermal Energy Development. Less risk of damage to lands due to flooding.*
  - reduced the risk of economic loss for farmers.
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Prime and Unique Farmland Adverse Impacts – Cumulative Effects
  - Imminent flood damage from breach to agricultural fields
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Surface Water Quantity Benefits – Cumulative Effects
  - Seepage/Evaporation reduction/Water Savings
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to the benefits of water conservation and ag. Water management in Millard County.*
- Groundwater Quantity Benefits – Cumulative Effects
  - Reduced demand on groundwater
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
  - Increased system sustainability for Kanosh Band
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Floodplain Management Benefits – Cumulative Effects
  - Reduce flooding and flood damages to the community
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Invasive Species/Noxious Weeds Adverse Impacts – Cumulative Effects
  - Potential introduction of additional or more invasive species/noxious weeds
    - *Interactive Adverse Effect to the White Sage Flat Habitat Restoration project. By potentially bringing more/additional invasive plants into the watershed during construction, the goal to restore vegetative conditions in the watershed of this project could be diminished somewhat. Although there is not a guarantee that invasive species would be introduced and BMPs will be used, there is always potential during construction.*

- Cultural & Historic Resources Adverse Impacts – Cumulative Effects
  - Irreversible adverse effects to NRHP site(s)
    - *No interactive or additive adverse or beneficial effects from any of the projects.*

- Environmental Justice & Civil Rights Benefits – Cumulative Effects
  - Support of the Kanosh Band (EJ Pop.) through implementation
    - *Interactive Benefit to all projects from the Kanosh Band, as damages from flooding would be less likely to occur, promoting geothermal development and protecting the RV park and playground. Improves conditions for an EJ population in Millard County.*
- Socioeconomics (Population) Adverse Impacts – Cumulative Effects
  - Relocations reduce county population
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Socioeconomics (Employment) Adverse Impacts – Cumulative Effects
  - Relocations driving out business owners
    - *No interactive or additive adverse or beneficial effects from any of the projects.*
- Socioeconomics (Occupation) Benefits – Cumulative Effects
  - Saved water/Extended growing season/Long-term agricultural development
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to benefits to ag. Water management in the county.*
  - Tribal Land agricultural expansion
    - *Additive Benefit to Lower Sevier Watershed Plan-EA. Adds to benefits to ag. Water management in the county.*

CONCLUSION

NRCS reviewed the potential for there to be additive or interactive effects from the two Action Alternatives in combination with projects that have occurred or will occur in the next 5-years in Millard County, Utah. Effects on various resources are anticipated as a result of the implementation of either Alternative Plan, but only the resource concerns identified above were deemed to have impacts significant enough to potentially be cumulative. Several effects would have interactive or additive cumulative benefits to other projects in the area. The only adverse cumulative effect that could occur under either Alternative, is the potential to introduce invasive/noxious botanical species into the watershed during construction. However, BMPs will be implemented in either case to avoid or minimize the extent of these effects.

Notably, the Proposed Actions would result in permanent beneficial cumulative effects to environmental justice communities within Millard County by providing benefits to the Kanosh Band of Paiutes.

Economic Investigation and Analysis Report

Corn Creek Watershed Plan

Proposed Floodwater Retarding Structures

Millard County, Utah

Prepared for:

November 2024

Prepared by:

Hal Gordon, Economist

1.0 SUMMARY OF REQUIREMENTS AND GUIDELINES

The NRCS National Watershed Program Manual (NWPM) was used as a reference for the economic analysis along with three other documents: the National Resource Economics Handbook, Part 611 Water Resources Handbook for Economics, USDA/Natural Resources Conservation Service, July 1998; Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G), December 1983; and Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (PR&G), DM 9500-013. The latter includes requirements set forth in the Council on Environmental Quality (CEQ) Principles and Requirements for Federal Investments in Water Resources (P&R) and Interagency Guidelines (IAG). DM 9500-013 provides guidance on completing a PR&G analysis, including steps in the planning and evaluation process, differences between project- and programmatic-level evaluations, direction on incorporating an ecosystem services framework, and techniques for economic analysis.

According to the PR&G, the alternative that maximizes net economic benefits is referred to as the National Efficiency Evaluation (NEE) alternative and will be the preferred alternative. PR&G requires that public benefits (monetary and non-monetary) be maximized relative to cost. Furthermore, there is not a hierarchal relationship among the economic, social, or environmental goals regardless of whether they can be monetized. Agency policy allows for the use of social effect goals to make the case for flood control activities, even if the associated benefit-cost (B/C) ratio is less than 1:1. This is due to the difficulty in monetizing the value of life and quality of life, which is laden with subjective value judgments. Threat to human life and quality factors can therefore be used to outweigh purely economic considerations when appropriate. PR&G allows a wide range of alternatives to illustrate the range of potential tradeoffs among environmental, economic, and social goals.

The Federal Objective, as set forth in the Water Resources Development Act of 2007, specifies that Federal water resources investments shall reflect national priorities, encourage economic development, and protect the environment by: (1) seeking to maximize sustainable economic development; (2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and (3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

The guiding principles in P&G and PR&G constitute the concepts that should consider when analyzing Federal investments in water resources and the P&G and PR&G General Requirements are topics that

agencies must consider when analyzing Federal investments in water resources. The following Principles constitute the overarching concepts the Federal government seeks to promote through Federal investments in water resources now and into the foreseeable future.

A. Healthy and Resilient Ecosystems. Federal investments in water resources should protect and restore the functions of ecosystems and mitigate any unavoidable damage to these natural systems.

B. Sustainable Economic Development. Federal investments in water resources should encourage sustainable economic development.

C. Floodplains. Federal investments in water resources should avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used.

D. Public Safety. Threats to people, including both loss of life and injury from natural events, should be assessed in the determination of existing and future conditions and, ultimately, in the decision-making process.

E. Environmental Justice. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Agencies should ensure that Federal actions identify any disproportionately high and adverse public safety, human health, or environmental burdens of projects on minority, Tribal, and low-income populations.

F. Watershed Approach. A watershed approach to analysis and decision-making facilitates evaluation of a more complete range of potential solutions and is more likely to identify the best means to achieve multiple goals over the entire watershed.

2.0 ALTERNATIVES EVALUATED

According to the PR&G and the NWPM, “Flood Prevention” was the purpose analyzed for the Corn Creek Watershed Plan-EA. Table 6, Comparison of NEE Benefits and Costs, contains a summary of the average annual project costs and benefits. The Excel Workbook “CornCreekFloodDamagesBenefits.xml”, with associated sheets within the workbook, provide the detail for the complete economic analysis. The

project area contains one sub-basin surrounding the town of Kanosh, Utah. Incremental analysis was conducted considering two improvements: Dam/Channel Work and Gravity Pipeline. The individual dam and channel improvements work in conjunction with each other and the omission of any item within the increment would render the remaining options ineffective. The gravity pipeline was analyzed as a separate increment.

Once flood waters pass Interstate Highway-15, waterways dissipate into farm and desert grazing land, there are no additional flood damages. Incremental analysis was conducted considering two flood control measures.

As described in the General Plan EA, the main purpose of the watershed plan is to reduce the average annual flood damages and improve irrigation water management. While only flood-damage and irrigation water management related benefits were quantified, other types of benefits serving the project purposes were still considered qualitatively when evaluating the costs and benefits of project alternatives.

According to PR&G, after preliminary consideration, agencies may remove from detailed study those alternatives that do not achieve the Federal Objective and Guiding Principles. In addition, alternatives that may at first appear reasonable but clearly become unreasonable because of cost, logistics, existing technology, social, or environmental reasons may also be eliminated from further analysis. These alternatives were briefly discussed to indicate that they were considered, and the analysis documented the reason(s) why they were eliminated (e.g., they do not achieve the Federal Objective and Guiding Principles).

In general, the NEE alternative was developed in accordance with PR&G by evaluating economic, social, and environmental impacts from flood damage reduction in the rural community. Given the emphasis placed on the construction of flood control structures by the local steering committee to provide flood mitigation, the geographic extents of evaluated alternatives are limited to the area in which one or more of the proposed structural alternatives would have an estimated impact to the 500-year flood depth. The project life was 50-years, the flood protection design was for 100-year flood event and the average annual flood benefits were based on 2-year through the 500-year flood event (because any of the flood events could occur during the 50-year project life). The annual benefits of the project alternatives are based on the estimated reduction in average annual floodwater damages with proposed flood control measures in place compared to future conditions without mitigative action (No Action Alternative). Two

categories: 1) Flood Control and 2) Agricultural Water Management were identified in the development of action alternatives.

Alternatives considered included the No Action Alternative, nonstructural alternatives, the locally preferred alternative, and the NEE Alternative. Alternatives were compared against the No Action Alternative which involved projecting existing resources and conditions into the future to establish a benchmark against which alternatives were evaluated. Tradeoffs between alternatives with respect to environmental, economic, and social goals were identified.

The project area, including the city of Kanosh, has the possibly of flooding over 234 structures (valued at over $27 million) in the 500-year floodplain.

Both structural and nonstructural alternatives were evaluated for this planning study. However, nonstructural alternatives were eliminated from detailed study by the planning team due to exorbitant cost compared to the potential benefits. Following are summaries of eliminated alternatives, which propose to mitigate damages from the 100-year flood.

Flood Control Alternatives Evaluated but Eliminated

Floodproofing Alternative

Flood proofing of structures for both homes and businesses include several possible options, of which the following have been considered:

Dry floodproofing (sealing a structure to prevent floodwaters from entering the structure), wet floodproofing (allowing water to enter and exit the structure), floodwalls built around structures and raising structures.

Floodproofing does not manage the overall flood concerns. The construction and easement costs are extreme compared to the benefits and are not supported locally compared to other alternative options. Politically, this option would be unpopular because it would make access to a property difficult and would be visually unappealing.

Another flood proofing scenario considered was to construct a berm along the south and east of Kanosh. This would provide flood proofing for Kanosh with a bigger berm instead of the individual structures. This scenario was rejected because constructing berms on this alignment would complicate the routing

of irrigation water and traffic, be politically and locally unpopular, have high easement costs, restrict land use by property owners and would not protect farm land from damage by sediment and debris.

Relocations and Buyouts and Irrigation Pipeline Alternative

A non-structural alternative would be to leave the dam in place, relocate structures out of the floodway and implement the pipeline improvement (Alternative 1B - Agricultural Water Management). With no change to the existing dam, the existing structures in the floodway would be removed and no longer incur damages. The roads, crossings and cropland would continue to have flood damages. This Alternative would meet the project purpose of reducing flood damages to structures in town and improve irrigation water management but would not reduce flood damages to cropland and roads. The Relocation and Irrigation Pipeline annual costs would be about $3.8 million and the annual benefits of reduced flooding to Relocated Structures and the Irrigation Pipeline would be about $4.0 million – with a benefit cost ratio of about 1.06. This Alternative would be unacceptable to the sponsors and residences because of its high cost, disruption to the local community, it does not address all the flood concerns, the dam may not meet current dam safety standards and there is a high possibility of dam failure in the near future.

Remove Dam and Channel Improvements Alternative

Remove the debris basin dam and divert the water upstream to an emergency channel. This action was rejected because the results would be similar to the No-Action alternative. The diversion structure would have difficulty handling debris and still function. The removal of the debris basin eliminates the potential flooding from a failed dam but it increases flooding potential in all cases other than the worst-case scenario where the debris basin dam fails. The removal of the debris basin does not meet the purpose and need to protect Kanosh from flooding and was eliminated from further study.

Other Flood Actions Evaluated but Eliminated

The existing debris basin and system of ditches currently being used to provide flood control for the town of Kanosh and surrounding area has been determined to be insufficient to provide the necessary protection. Several additional flood control actions were considered but eliminated:

- Repairing and upgrading the existing dam and debris basin
- Using the agricultural water management system for flood control
- Removal of Debris Basin with Direct Connection to Existing Channels and/or Flood Channels

- Routing all excess flood water though the emergency channel
- Flood channels to route the floodwater downstream of Kanosh
- Enlarging existing channels to convey floodwater downstream of Kanosh

Agricultural Water Management Actions Evaluated but Eliminated

On an average year, it is estimated that 44% of the irrigation water in the Corn Creek Irrigation Company system is lost due to seepage. To save the water lost due to seepage, canal lining and piping actions were considered.

Canal Lining

Canal lining with membrane liners was considered as a method to reduce canal seepage, however, this action has a shorter life and lacked local support.

Concrete lined canals were initially considered to mitigate seepage within the CCIC canal system. Presently, the existing double ditches (low water ditches) are already lined with concrete. CCIC's experience has been unsatisfactory with the lined ditches. This unfavorable experience mainly stems from the accelerated deterioration caused by delivering stock water during the winter months, leading to upheaval during freeze/thaw cycles. Consequently, CCIC's preferred approach involves replacing deteriorating concrete-lined ditches with pipes rather than reinstalling concrete linings.

Landowners expressed a preference for buried pipe systems rather than open canals. This choice has both political and safety considerations. Furthermore, the proposed canal lining action falls short in terms of cost-effectiveness and durability when compared to piped systems. As a result, these cumulative factors contributed to the elimination of concrete lined canals as a viable option for the project.

Pressurized Irrigation Pipeline

The pressurized irrigation (PI) system delivers the total flow evenly across all acres served. The true PI system would allow shareholders to take water at almost any time, but the flow would be less than the 5 or 10 cfs delivery capacities that assume a form of a turn system. Laterals in a true PI system could be smaller due to the lower flow. In the pressurized actions, both pressure reducing valves (PRVs) and higher pressure rated pipe were modeled to handle the high pressures at the end of the system.

Pressurized pipe that carried the full water right were expensive but did not have sufficient capacity to provide significant relief for the flooding conditions. Additionally, a flow of 85 cfs in Corn Creek when crops could benefit from that flow is very rare. The extra cost of a larger capacity system that could usually only be utilized for a few weeks when crop water demand is low could not be justified. Since the proposed alternative for flood control included the maintenance and continued use of the existing ditches to convey flood water, it was felt that these ditches could also convey high water during years when high water is available. With the pipe system delivering the actual crop demand the seepage losses in the unlined ditches is acceptable to CCIC shareholders.

In addition to pressurized irrigation systems being more expensive than a gravity flow system, CCIC shareholders felt that a pressurized system could not be operated equitably without the expense of a full-time water master to monitor water use. Additionally, laterals on the gravity flow system could be more easily reduced in length or eliminated to provide flexibility if cost reduction became necessary.

Recreation Action Evaluated but Eliminated

Recreation actions in the project area included creating trails, public lookouts and water access at the debris basin, and better access to Corn Creek for recreation. However, these recreation actions were ruled out because there was a lack of local interest and support. Sponsors felt that they lacked the resources available to fund and maintain a recreation action.

Alternatives Considered for Detailed Study

The following sections describes the alternatives carried forward for a detailed resource impact analysis. These included a No Action and a Proposed Action Alternative 1. The No Action Alternative represents a baseline condition, while the Proposed Action Alternative 1 was developed to meet project needs in the most effective way possible. Along with the No Action Alternative, Alternative 1 contains two measures proposing construction of flood control structures and irrigation water management were identified and evaluated in detail. These are further described below.

<u>No Action Alternative</u>

Under the No Action Alternative, there would be no federal technical and/or financial assistance through the Watershed Protection and Flood Prevention Program for implementation on any part in the project area. The debris basin's high hazard dam would continue to pose a high risk of failure during a large flood, due to the seepage problem occurring in the dam's foundation. This could result in devastating

flood damage to the Town of Kanosh. Flood flows would pass through the same historic channels and waterways with the severity of the flooding events continuing, dependent upon the nature, timing, and severity of the event. Irrigation flows would continue to be lost through seepage and evaporation from the earthen canals. The Town secondary water systems would keep receiving insufficient pressures for sprinkler irrigation and would continue encroaching on and increasing the demand on their culinary water systems. The Tribe would continue to have culinary water shortages due to outdoor water use and no effective way to utilize their CCIC shares and water from Corn Creek. No federally funded project measures would be implemented. Existing conditions and trends would continue. The No Action Alternative would not meet the purpose and need for the project. However, the No Action Alternative is carried forward as the basis of comparison for impact analysis.

Two scenarios of the existing conditions were considered. One where the debris basin embankment breached (Catastrophic) and one where the debris basin embankment functioned as designed. The Catastrophic or breached model was ultimately used to represent the No Action Alternative because of the current foundation seepage will eventually cause failure of the dam.

Proposed Action Alternative 1

Alternative 1 contains two measures: A) Construction of flood control structures and B) Agricultural water management. The Proposed Action meets the purpose and need of the project.

Alternative 1A - Flood Control

- Reconstruct the debris basin and dam embankment to eliminate the existing seepage problem that has structurally compromised the dam and to construct the structure to comply with all Utah Dam Safety and NRCS standards.
- Relocate the existing town secondary pond that is downstream of the debris basin since the proposed dam alignment crosses the current pond location. This will also increase pressures in the Town's secondary water system. The new pond will also have the elevation necessary to provide the Tribe's secondary system sufficient pressure. Both secondary systems will reduce the demand on their culinary water systems.
- Construct the Main Spillway or low-level outlet.
- Construct the Secondary Spillway using a standpipe design that would allow flood waters to pass without the need of human adjustments while capturing floating debris and a large portion of the sediment in the debris basin.

- Construct an Emergency Spillway and use the existing Emergency Channel to convey flood water away from Kanosh
- Construct an Auxiliary Spillway that will create the spillway capacity necessary to pass the PMF without overtopping the debris basin embankment.
- Create bypass channels that prevent flow in ditches from exceeding their capacity and route flows above the existing ditches capacity to the West ditch /natural channel where other improvements will be made to increase capacity.
- Improve the West Ditch/natural channel to prevent flooding in Kanosh. The natural channel ends when it reaches town and transitions to the West Ditch.
- Construct berms and raise a road in the project area to better utilize existing culverts under I-15 to prevent overtopping I-15 and protect structures in the project area

Alternative 1B - Agricultural Water Management

- Construct a gravity pipe system to greatly reduce seepage and evaporation losses. This will also reduce a public safety hazard of having open ditches in town with the potential for children and animals to fall into the ditches.
- Construct Structures for flow measurement and better water management.

3.0 THE PREFERED ALTERNATIVE

The National Efficiency Evaluation (NEE) alternative and the Federally Recommended alternative is Alternative 1. The NEE alternative is defined as the federally assisted alternative with the greatest public benefits, with appropriate consideration of costs. Public benefits (i.e., positive ecosystem services) encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures.

Alternative 1 is the preferred alternative. Alternative 1 was selected by the sponsor based on the beneficial outcomes and proposed costs. Each sub-measures in Alternative 1 had benefit cost ratios that were greater than 1.00 as shown in Table 2.

Table 2. Comparison of Benefits and Costs [1/]

	Average Annual Costs [3/]	Average Annual Benefits [2/]	Benefit Cost Ratio	Net Benefits
Alternative 1A - Dam/Channel	$602,800	$2,855,348	4.74	$2,252,548
Alternative 1B - Pipeline	$629,800	$1,490,049	2.37	$860,249
Grand Total	$1,232,600	$4,345,396	3.53	$3,112,796

[1/] Discount rate 2.5% with a 52-year period of analysis. Price base 2023

Agency policy allows for the use of the other social effects to justify a proposed action, even if the associated B/C ratio were less than 1:1. This is due to a priority placed on protecting lives. Also, trying to monetize the value of life, or in the case of flood control structures, avoidance of loss of life, is laden with subjective value judgments. Threat to human life can therefore be used to supersede purely economic considerations when deemed appropriate.

The preferred alternative will allow the sponsors to protect existing property and infrastructure downstream of the flood control structures. Average annual monetary benefits are estimated to be $4,345,396. Average annual cost is estimated at $1,232,600 resulting in net benefits of $3,112,796. Socially, the threat to human life will be minimized. Environmentally, adverse impacts will be minimized during construction. Long-term there would be adverse, although negligible, impacts.

Benefit to Cost Ratio: 3.53 to 1.0

Net beneficial Effects: $3,112,796

Funding Schedule: The most likely scenario is for the project to be implemented over two years including the design and construction.

Funding Schedule*				
Fiscal Year		PL-83-566	Other Funds	Total
2025	Alternative 1A - Dam/Channel	$1,367,000	$0	$1,367,000
2026	Alternative 1A - Dam/Channel	$14,579,000	$185,000	$14,764,000
2025	Alternative 1B - Pipeline	$1,300,500	$0	$1,300,500
2026	Alternative 1B - Pipeline	$12,151,500	$3,664,000	$15,815,500

Period of Analysis: 52 years (including 2 years for design and construction)

Project Life: 50 years

4.0 PERIOD OF ANALYSIS

The Period of Analysis used was 52-years (including 2 years for design and construction). Floods from the 2, 5, 10, 25, 50, 100, 200 and 500-year storm events were analyzed to estimate average annual flood-related damages.

A net present value analysis was conducted to compare the costs of project alternatives. Average annual values were also estimated. All costs of installation, operation and maintenance were based on 2023 prices. The costs associated with designing and implementing all structural measures were assumed to be implemented over a two-year period immediately preceding operation. The NEE alternative with a 52-year period of analysis yielded the highest net benefits using the mandated 2.5% discount rate for all federal water resource projects for FY23 to discount and amortize the anticipated streams of costs and benefits.

5.0 ECONOMIC ANALYSIS AND DOCUMENTATION

A customized Excel worksheet, including Federal Emergency Management Agency (FEMA) depth-damage curves and locally-obtained data, was used to evaluate benefits and costs of alternatives. Each project alternative, storm event and flood damage category were included in the worksheet to estimate average annual damages. Alternative cost estimates provided by the project engineers were also included in the worksheet. Economic data and results were linked in the worksheet to create the required PR&G tables for the final project report.

6.0 ENVIRONMENTAL AND SOCIAL BENEFITS

Environmental and social benefits were not monetized but are further explained for each alternative studied in detail in the Environmental Consequences Section of the Plan EA.

Environmentally adverse impacts will be minimized during construction. Long-term, there would only be negligible adverse impacts anticipated from any of the evaluated alternatives. The region is arid with sparse trees along the banks of intermittently dry streams.

Socially, the threat of loss of life or property will be minimized with reduced flood depths at buildings and roads. The annual average daily traffic (five-year average) near Kanosh is variable as displayed in the table below:

Location Description	5-Year Avg
Interstate-15 Kanosh	14,600
SR 133 Meadow	21,800
200 N via Main St - I 15 Meadow	1,356
I 15 Kanosh via Six Mile Rd - SR 133 (Approx 350 S) Kanosh	184

Interstate 15 on the western edge of the watershed is a major route from Salt Lake City to Arizona and southern California. There are about 25 miles of county major collector and rural roads near the project area (Utah Department of Transportation, 2020).

Incidental recreation after construction will continue and may possibly benefit from the structural alternatives through enhancement of wildlife and scenic improvement. Waterbodies developed from the impoundments would likely attract wildlife for short periods of time, but not significantly increase hunting, fishing, and general outdoor activity in the vicinity of the dams. The flood control structures were not designed to hold water for a significant amount of time and were not designed for recreational purposes.

7.0 RURAL COMMUNITY AND AGRICULTURAL DAMAGES

The stream of monetary benefits was described in average annual equivalent terms. The average annual expected benefits were the difference between the No Action Alternative and each project Alternative. The expected average annual damages for each alternative, storm event (8-events), and damage category below were estimated with the following equation:

$$\sum_{I=1}^{8} (\underline{PFED_{i-1} + FED_i})/2 * (PPFE_{i-1} - PFE_i)$$

$PFED_{i-1}$ – Previous Flood Event Damages
FED_i – Flood Event Damages
$PPFE_{i-1}$ – Probability of Previous Flood Event
PFE_i – Probability of Flood Event

7.1 STRUCTURE, CONTENT & VEHICLE DAMAGES

Structure, building contents and vehicle damages for each storm event and project alternative were estimated based on structures identified from aerial imagery, property data provided by the Millard

County, Utah tax assessor, and water depths obtained from hydraulic simulation of the evaluated storm events. The structure damages were estimated using methodology described in the Structural Damages Calculations Template (Tim Goody, NWMC). The value of the structures was estimated by subtracting the depreciated replacement value from the County Tax Accessor's structure value. The structures in the project area that are affected by flooding are located in a small rural town. Most if not all the structures are 40-60 years old, most typical about 45-years old. Based on the Life Cycle Chart (Swiftestimator.com, building cost reports online 2/2007) the Depreciated Multiplier ranges from 17% to 36% (20-30 years effective age). A Depreciated Multiplier of .20 was selected because most homes and businesses are well kept and necessary repairs and maintenance have been made. The structure value used in the flood damage analysis was estimated as: The County Tax Accessed Value * (1- Depreciated Replacement Value Factor) (see: CornCreekFloodDamagesBenefitsData.xls for calculations). For vehicles, local project managers estimated the typical vehicle replacement dollar value.

This estimated Depreciated Replacement Values is also consistent with the USACE National Structure Inventory documentation: "Structure Valuation - These replacement values for structures are then depreciated in order to obtain depreciated replacement value; each structure is depreciated by 1% per year for the first 20 years, after which it is assumed that routine maintenance would keep structure values at 80% of their replacement values".

(https://www.hec.usace.army.mil/confluence/nsi/technicalreferences/latest/technical-documentation).

Areas flooded and flood depths where damage occurs with and without project were estimated by Franson Civil Engineers, Logan, Utah. Building types, contents, and the typical number of vehicles and vehicle values associated with impacted buildings were estimated using interpolation of flood depth-damage curves developed by FEMA. The percent damage factor was multiplied by each building structure and vehicle dollar value to estimate flood damages. Total value of structures on impacted properties is shown below. This value does not include land values, only structure values. There were 234 structures valued at over $27 million in the 500-year floodplain.

Table 3. Watershed Project Number and Value of Structures Summary

Kanosh, Utah	Total Structures	Residences & Apartments	Commercial Properties	Public Properties	Ag Buildings
Number	234	224	8	1	1

Value	$27,662,036	$26,374,163	$1,057,526	$222,658	$7,689

The number of structures that could be flooded and their total structural value are displayed below. Also displayed are the present value and average annual damages to the structures, contents and associated vehicles for each flood event, for each of the two sub-basins:

	Home			Commercial			Public			Shed			Present Value	Annual
Event	< 1 ft	1 to 3 ft	> 3 ft	< 1 ft	1 to 3 ft	> 3 ft	< 1 ft	1 to 3 ft	> 3 ft	< 1 ft	1 to 3 ft	> 3 ft	Damage	Damage
2-yr	11	0	0	0	0	0	1	0	0	0	0	0	$650,274	-
5-yr	70	0	0	0	0	0	0	0	0	2	0	0	$4,287,510	$740,668
10-yr	163	6	0	2	0	0	0	0	0	3	0	0	$9,730,572	$700,904
25-yr	177	12	0	5	0	0	0	0	0	3	1	0	$11,042,911	$623,204
50-yr	189	14	0	5	0	0	0	0	0	3	1	0	$11,914,129	$229,570
100-yr	193	19	0	5	0	0	0	0	0	3	1	0	$12,491,685	$122,029
200-yr	196	24	0	5	0	0	0	0	0	3	1	0	$13,052,940	$63,862
500-yr	193	33	0	4	1	0	0	0	0	3	1	0	$13,743,392	$40,194
													Total:	$2,520,432

Maximum structure and content damage values were estimated as a percentage (about 75% structure and 60% content damages at 10-feet flood depth in a 1-story, no basement home) of assessed property values. Estimated floodwater depths (where damage occurs) for various storms (including the 500-year storm) for each structure were based on the results of the hydrology and hydraulics (H&H) simulation modeling. Floodwater data was then used with water depth to damage functions to estimate structural and content damages based on the ground elevation of each structure where damages occur. A similar analysis was conducted for vehicles located at the property within the floodplain area. Damages to vehicles was estimated to begin at 0.5 foot of flood depth. Each affected property was estimated to have a minimum of two vehicles. The vehicle value was estimated to be $13,000/vehicle.

7.2 ROAD DAMAGES

Road damages for each storm event and project alternative were estimated. Road location, flood depth and road surface area impacted by floodwater were identified. Areas flooded, flood depths and monetary damages with and without project were estimated by Franson Civil Engineers, Logan, Utah. The cost of road repair or replacement was estimated. The roads evaluated were assumed stay open during the flooding since they are the routes in and out of Kanosh. Roads can be damaged to the point of needing full replacement when there is traffic during flooding. To be conservative, damages were assumed to be less than full replacement value at various depths. There were no road damages estimated if the flood depth was less than 0.1 foot. If flood depth was between 0.1- and 0.5-foot, flood damages were estimated to be half the road repair or replacement cost. If flood depth was greater than .5-foot, flood damages were estimated to be 75% of the total road repair replacement cost.

7.3 CROP DAMAGES

Crop flood damages from each storm event and project alternative were estimated. About 3,400 acres of cropland is flooded over one-foot flood depth during the 500-year storm event. Many crops are grown in the project area; however, three crops make up 94-percent of total cropland and are: Alfalfa, Grass (mixed) Hay and Grass Pasture. Only Alfalfa and Grass (Mixed) Hay were evaluated. It was assumed that no damages occurred to Grass Pasture. Areas flooded and flood depths with and without project were estimated by the project GIS specialist with Franson Civil Engineers, Logan, Utah. Crop yield data from a review of the USDA Web Soil Survey and estimated using a five-year average crop yields and prices from Utah Agricultural Statistics and Annual Summary Report - 2021 (Utah Department of Agriculture and Food). Flood depths were estimated to be 1 foot or less, 1 to 3 feet and over 3 feet.

Over the evaluated flood area, the topography does not lead to inundation for more than 48 hours so crop respiration damage was minimal. However, it was assumed that scour damage would occur in the flooded areas. Crop damage from scour was assumed to occur at 2 feet per second velocities or higher. This is the NRCS maximum velocity when designing a vegetated flood channel. Franson Civil Engineers correlated the amount of flooded area with the areas that had velocities that were greater than 2 feet per second. This resulted in an Inundation damage factor about forty-percent crop loss for all flood depths. The "Seasonal Damage Factor" represents the probability that the flood event occurs during the crop growing/harvest season, and then is multiplied by the crop damage factor. The Seasonal (crop) Damage Factor was estimated as: [0.5 times (Harvest Starts minus Plant Starts), plus 0.5 times (Harvest Ends minus Harvesting Starts)], divided by 365 Days.

The Average Crop Value per acre was estimated as: The Average Unit Price times Average Yield. The dollar crop damages per flood event were estimated by the sum of the Seasonal Damage Factor, the Inundation Factor, and the Average Crop Value per Acre. The flood event losses were estimated as the sum of Damage Value per Acre times Acres Flooded, for each flood event.

7.4 IMPROVED WATER MANAGEMENT

An irrigation water pipeline was evaluated to improve irrigation water delivery. The pipeline will be installed adjacent to the existing ditches, and the ditches will be left in place to allow the routing of floodwater off-site reducing flood damages.

Only improved crop yield was included as a monetary benefit. Many crops are grown in the project area; however, three crops make up 94-percent of total cropland and are: Alfalfa, Grass (mixed) Hay and Grass Pasture. The project crop acres were estimated by multiplying the total crop area by the weighted percentage of the three largest crop acres, to account for all the acreage without having to separate the analysis into all the different crops. The table below shows the top 3 irrigated crops, number of acres, and increase in yield with project. Crop yield data from a review of the USDA Web Soil Survey and estimated using a five-year average crop yields and prices from Utah Agricultural Statistics and Annual Summary Report - 2021 (Utah Department of Agriculture and Food).

Crop	Irrigated Acres (both with and without project)	Assumed 5-Yr Average Yield Increase with Project (ton/acre)
Alfalfa	2,486	3.01
Other Hay	387	2.54
Pasture	125	0.00

The Pipeline increment was evaluated for the entire project area. Thirteen areawide pipeline scenarios were evaluated to determine the preferred pipeline design. Both pressurized and non-pressure systems were considered. Criteria considered included: Flow Capacity, Delivery Capacity, Pressurized/Gravity Flow and Pressure Reducing Valves. The pipeline design that provided the capacity to meet irrigators crop demand and the irrigation company's desired operation method (and was the most cost effective), was the gravity flow system with a capacity of 40 cfs. The system also allows the accurate measurement of water, allowing irrigators to better manage their water use and maximize crop production. The greatest benefit of this alternative will be increasing the water supply by at least 44% from 4,016 acre-feet to 7,164 acre-feet of available irrigation water. These water savings are available to 2,998 irrigation acres in the service area or 12.6 inches per acre annually. The pipeline will not require a separate stockwater pipeline and will have the capability to deliver stockwater during the non-irrigation season.

7.5 OTHER AGRICULTURAL DAMAGES

There are several ranches in the project area. Based on modeling, no significant flood damage or disruptions to livestock operations or rangeland is expected. Flood waters are shallow and livestock move

to higher ground. There were no other livestock operation damages identified within the project area affected by storms up to and including the 500-year event.

Over the evaluated flood area, the topography does not generate significant ponding. Ponding across all the flood models did not occur for more than 48 hours so damage from saturated soil was not evaluated. Pasture accounts for less than 4% of land, so pasture erosion and sedimentation were not calculated.

7.6 SCOUR & SEDIMENT DAMAGES

Flood erosion scour and sediment deposition damages from each storm event and project alternative were estimated. Areas and quantity of scour and sediment with and without projects were estimated by Franson Civil Engineers, Logan, Utah. Scour was assumed to occur at 2 feet per second velocities or higher. This is the NRCS maximum velocity when designing a vegetated flood channel. Franson Civil Engineers correlated the amount of flooded area with the areas that had velocities that were greater than 2 feet per second. The cost per acre to clean-up or regrade soil on eroded areas was then estimated.

Sediment deposition damages was defined as a percentage of the annual sediment deposited in the sedimentation basin above town, and was estimated to be up to about 2,625 Cubic Yards in the flooded area without improvements. Damages were estimated as the cost to remove sediment from deposition areas.

7.7 RECREATION

Based on evidence found at the site and information from local residences, the dam site and upstream and downstream waterways are used by some people for recreational purposes. Incidental recreational activities such as fishing, hunting, and hiking/walking are expected to be minimal. Since there is no official or unofficial count of usage, estimated annual visitor-days is not available. Therefore, incidental recreation impacts were not evaluated.

7.8 OTHER DAMAGES

No additional damages affected by storms up to and including the 500-year were identified. Urban damages (emergency aid, clean-up, sewer, debris removal, etc.) were not identified or estimated by local county officials. Beyond Interstate-15, there were no additional structures, culverts, bridges or stream crossings damaged.

7.9 PROJECT BENEFITS SUMMARY

The planning policy used for this plan/environmental document (PR&G) state that Federal investments in water resources as a whole should strive to maximize public benefits, with appropriate consideration of costs. Public benefits (i.e., positive ecosystem services) encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures. The preferred alternative will allow the Sponsors to reduce flood damages and reduce the potential for loss of life. The preferred alternative maximizes public benefits.

As reflected in the table below, current average annual floodwater damages without project (present condition) are $2,936,192. Floodwater damages with project (NEE Alternative 1) flood control structures were estimated to be $80,845.

Table 4. Summary of Annual Expected Damages

	No Action	Alt 1A
Structure, Contents & Vehicles	$2,520,432	$57,403
Roads/Crossings	$397,331	$17,408
Crop - Flood	$5,200	$3,458
Crop - Non-Pressurized Pipeline	-	$0
Erosion	$8,151	$2,577
Sediment	$5,079	$0
Total:	$2,936,192	$80,845

As reflected in the Table below, the benefits to downstream properties were estimated as the difference between with and without project damages reflect the average annual benefits. Alternative 1 would provide to downstream properties about $4,345,397 average annual benefits.

Table 5. Summary of Floodwater Reduction Benefits

Plan Annual Expected Benefits		
Category	Alt 1A	Alt 1B
Structure, Contents & Vehicles	$2,463,029	
Roads/Crossings	$379,923	

Crop - Flood	$1,742	
Crop - Non-Pressurized Pipeline	$0	$1,490,049
Erosion	$5,574	
Sediment	$5,079	
Total:	$2,855,348	$1,490,049

Other Alternative 1 Beneficial Effects

- Reduces the threat to loss of life to over 690 people who live and/or work in the inundation zone (assuming 3 people/residence, 2 people/commercial and public property).
- Provide flood protection to 224 residences and apartments, 8 commercial structures, 1 public property and roadways within the inundation zone.
- Provides protection for dozens of vehicles and their occupants who utilize the five major roads in the inundation area.
- Reduces the threat of loss of access and loss of emergency services for downstream properties and property owners.
- Provides downstream flood protection for the residents in the area, as well as those working, recreating, or traversing within the downstream floodplains, for 50 years.

7.10 WATERSHED PROJECT COSTS

Project costs for flood control and channel work were estimated by Franson Civil Engineers, Logan, Utah in September, 2023. Installation and operation & maintenance costs for each activity are described in detail in the cost tabs in the project engineer's Excel worksheet.

All costs were allocated to the flood prevention purpose according to the procedure in the National Resource Economics Handbook, Part 611 Water Resources Handbook for Economics, Chapter 6 Costs and Cost Allocation (NRCS 2014b). Work Plan-EA tables were constructed based on the calculated cost allocated to flood prevention. Within this purpose the costs were shared between NRCS and the local and state entities as specified in the NWPM, in this case cost share for flood prevention is 100 percent federal and 0 percent local. Within these guidelines, engineering is 100 percent federal; and operation, maintenance, and replacement is 100 percent local. See Work Plan in the Plan-EA for the results of the cost allocation/cost sharing process.

All costs were amortized at the Fiscal Year 2023 Federal Water Resource Discount of 2.50 percent for 52 years. Average Annual Costs are computed as the sum of the amortized construction cost and the annual operation and maintenance cost. Engineers estimate that each of the structures would last 50 years, the life of the project.

All project implementation costs were estimated by the project engineers, including installation and annual operation and maintenance. All costs were converted to Present Values by discounting each cost to the beginning of the period of analysis using the applicable project discount rate. Installation expenditures before the project is installed were brought forward to the end of the period of installation by charging compound interest at the project discount rate from the date the costs are incurred. Finally, the project discount rate was used to convert the present values to average annual equivalent terms.

Replacement costs are necessary if the installed structure's life is less that the project life. Average Annual Replacement Costs are calculated by amortizing the Present Value of the worn-out structure's construction cost, with the current FY discount rate over the project structure's life. If the physical life of the alternative is the same as the project, replacement costs are not included and we assume the Replacement Costs are the same as the Average Annual Costs. In this project the structure's life was equal to the project life and replacement costs were not necessary and not calculated. All estimated values and damages were assessed within a customized Excel template.

Table 6. Watershed Project Annual Cost Summary

Evaluation Unit	Project Outlays		Total
	Amortization of Installation Cost[1/]	Operation, Maintenance & Replacement	
Alternative 1A - Dam/Channel	$584,300	$18,500	$602,800
Alternative 1B - Pipeline	$619,800	$10,000	$629,800
Total Project	$1,204,100	$28,500	$1,232,600

[1/] Discount rate 2.5% with a 52-year period of analysis. Price base 2023

7.11 WATERSHED PROJECT BENEFITS AND COSTS

For the preferred Alternative 1, the average annual monetary benefits are estimated to be $4,345,396. Average annual cost is estimated at $1,232,600 resulting in net benefits of $3,112,796. Alternative 1, produces a B/C ratio of 3.53 to 1.00. Incidental recreation after construction will continue.

Environmentally adverse impacts will be minimized during construction. Long-term there would be adverse, although negligible, environmental impacts.

Table 7. Watershed Project Benefit-Cost Summary[1/]

	Average Annual Costs [3/]	Average Annual Benefits [2/]	Benefit Cost Ratio	Net Benefits
Alternative 1A - Dam/Channel	$602,800	$2,855,348	4.74	$2,252,548
Alternative 1B - Pipeline	$629,800	$1,490,049	2.37	$860,249
Grand Total	$1,232,600	$4,345,396	3.53	$3,112,796

[1/] Discount rate 2.5% with a 54-year period of analysis. Price base 2023

Final Economic Tables

All economic tables for Alternative 1 are displayed below. The economic table names are defined in Title 390 – National Watershed Program Manual, Subpart B – Economic and Structural Tables. The following table shows cost-share percentages and amounts for watershed project plan implementation for each of the sub-basins.

Table X-X: Alternative 1 Cost-Share Summary

Alternative 1

Works of Improvement	%[3]	NRCS	%[3]	Sponsors	Total
Cost-Sharable Items					
Construction Costs	100%	$24,063,000	0%	$0	$24,063,000
Engineering Technical Assistance Costs[4]	100%	$5,054,000	0%	$0	$5,054,000
Project Admin. Costs [1]	100%	$281,000	0%	$0	$281,000
Subtotal: Cost-Share Costs		$29,398,000		$0	$29,398,000
Non Cost-Sharable Items [2]					
Construction Costs	0%	$0	100%	$3,589,000	$3,589,000
Engineering Costs	0%	$0	100%	$0	$0
Real Property Landrights[5]	0%	$0	100%	$150,000	$150,000
Mitigation	0%	$0	100%	$0	
Permits	0%	$0	100%	$110,000	$110,000
Project Admin. Costs [1]	0%	$0	100%	$0	$0
Subtotal: Non Cost-Share Costs		$0		$3,849,000	$3,849,000
TOTAL:	88%	$29,398,000	12%	$3,849,000	$33,247,000

[1/] The sponsors and NRCS will each bear the costs of project administration that each incurs.

[2/] If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.

[3/] As per NWPM Section 500.42 and Figure 500-E2. PL-566 cost share rates depend on the authorized purposes of the particular watershed plan. For flood prevention measures, PL-566 pays 100% of construction and engineering. Installation of compensatory mitigation is considered part of the construction of the flood control measure (per text between Figures 500-E1 and 500-E2). Real property rights acquisition is 100% sponsor cost for most PL-566 activities. However, acquisition of property rights for mitigation and recreation may be cost-shared (see referenced sections).

[4/] Cost-sharable at 100% NRCS if Sponsor hires engineering for structure design. Not cost-shareable if sponsor's engineering is for elements required for real property rights (road improvements, power line modification, livestock water supply line, etc.).

[5/] Construction elements required to satisfy real property rights are also 100% Sponsor cost.

Watershed Works of Improvement	NRCS Cost	%	Sponsors Cost	%	Total Cost
Cost-Sharable Items					
Flood Control [1/]	$15,946,000	100%	$0	0%	$15,946,000
Agricultural Water Management	$13,326,000	75%	$3,575,000	25%	$16,901,000
Tribe	$126,000	90%	$14,000	10%	$140,000
Recreation	$0	50%	$0	50%	$0
Subtotal: Cost-Sharable Costs	$29,398,000		$3,589,000		$32,987,000
Non-Cost-Sharable Items [3/]					
NRCS Technical Assistance/Engineering	$0	0%	$185,000	100%	$185,000
Project - Construction Administration	$0	0%	$75,000	100%	$75,000
Permits			$0	100%	$0
Land Acquisition			$0	100%	$0
Subtotal: Non-Cost-Sharable Costs	$0	0%	$260,000	0%	$260,000
Grand Total:	$29,398,000		$3,849,000		$33,247,000

Economic Table 1: Estimated Installation Cost for Alternative 1 [1/]

Installation Cost Items	Estimated Costs		
	PL-83-566 Funds	Other Funds	Total
Alternative 1A - Dam/Channel	$15,946,000	$185,000	$16,131,000
Alternative 1B - Pipeline	$13,452,000	$3,664,000	$17,116,000
Total Project	$29,398,000	$3,849,000	$33,247,000

[1/] Price base 2023

Economic Table 2: Estimated Cost Distribution for Alternative 1 [1/]

Installation Cost Items	Installation Costs: PL-83-566 Funds				Installation Costs: Other Funds							
	Construction Costs	Engineering Technical Assistance Costs	Project Admin. Costs	**Total PL-83-566 Costs**	Construction Costs	Engineering Costs	Real Property Landrights	Mitigation	Permits	Project Admin. Costs	**Total Other Funds**	Total Project Cost
Alternative 1A - Dam/Channel	$13,212,000	$2,598,000	$136,000	$15,946,000	$0	$0	$75,000	$0	$110,000	$0	$185,000	$16,131,000
Alternative 1B - Pipeline	$10,851,000	$2,456,000	$145,000	$13,452,000	$3,589,000	$0	$75,000	$0	$0	$0	$3,664,000	$17,116,000
Total Project	$24,063,000	$5,054,000	$281,000	$29,398,000	$3,589,000	$0	$150,000	$0	$110,000	$0	$3,849,000	$33,247,000

Installation Cost Items	Amortized Costs, FY2022 Rate	Annual OM&R	Total Annual Costs
Alternative 1A - Dam/ Channel	$584,300	$18,500	$602,800
Alternative 1B - Pipeline	$619,800	$10,000	$629,800
Total Project	$1,204,100	$28,500	$1,232,600

[1/] Discount rate 2.5% with a 52 year period of analysis. Price base 2023

Economic Table 4: Estimated Average Annual Costs for Alternatives 1 [1/]

Evaluation Unit	Project Outlays		Total
	Amortization of Installation Cost	Operation, Maintenance & Replacement	
Alternative 1A - Dam/Channel	$584,300	$18,500	$602,800
Alternative 1B - Pipeline	$619,800	$10,000	$629,800
Total Project	$1,204,100	$28,500	$1,232,600

[1/] Discount rate 2.5% with a 52 year period of analysis. Price base 2023

[2/] From Table 2

Economic Table 5: Estimated Average Annual Flood Damage Reduction Benefits
Alternative 1

Item	Average Annual Damages Without Project		Average Annual Damages With Project		Average Annual Benefits	
	Ag Related	Non-Ag Related	Ag Related	Non-Ag Related	Ag Related	Non-Ag Related
Floodwater Damage						
Structures, Contents, Vehicles		$2,520,432		$57,403		$2,463,029
Roads/Crossings		$397,331		$17,408		$379,923
Crop	$5,200		$3,458		$1,742	
Subtotal	$5,200	$2,917,762	$3,458	$74,810	$1,742	$2,842,952
Sediment/Erosion Damage	$13,230		$2,577		$10,653	
Subtotal	$13,230		$2,577		$10,653	
Indirect Damage[2]						
Non-Pressurized Pipeline					$1,490,049	
Subtotal					$1,490,049	
Grand Total	$18,430	$2,917,762	$6,035	$74,810	$1,502,444	$2,842,952

[1/] Discount rate 2.5% with a 52 year period of analysis. Price base 2023

[2/] Irrigation Pipe is additional benefits and does not eliminate existing damages

Economic Table 6: Comparison of Benefits and Costs [1/]
Alternative 1

	Average Annual Costs [3/]	Average Annual Benefits [2/]	Benefit Cost Ratio	Net Benefits
Alternative 1A - Dam/Channel	$602,800	$2,855,348	4.74	$2,252,548
Alternative 1B - Pipeline	$629,800	$1,490,049	2.37	$860,249
Grand Total	$1,232,600	$4,345,396	3.53	$3,112,796

[1/] Discount rate 2.5% with a 54 year period of analysis. Price base 2023
[2/] From Table 5.
[3/] From Table 4.