Chapter S: Summary

S.1 Background of the Project and Organization of This Summary

S.1.1 Background of the Project

In July 2009, a landslide occurred along a hillside in the city of Logan in Cache County, Utah. As a result of the landslide, a section of the Logan Northern Canal (LN Canal), a locally managed irrigation canal, broke away. This landslide caused a breach of the canal, which prevented the canal from distributing water and required the indefinite closure of a section of the canal. This closure affects other parts of the local irrigation water delivery system, with the result that the canal is not delivering all water allocated to local water shareholders.

Which agencies are responsible for this EIS?

The agencies responsible for this EIS are the Natural Resources Conservation Service (NRCS), Cache County, the U.S. Forest Service (USFS), and the U.S. Army Corps of Engineers (USACE).

Cache County is seeking assistance through the Emergency Watershed Protection Program (EWPP) to design and construct an irrigation system that will restore irrigation water delivery to LN Canal shareholders. The proposed action that would be funded through the EWPP is called the Logan Northern Canal Reconstruction project. Cache County is the sponsoring local organization (SLO). The EWPP is administered by the Natural Resources Conservation Service (NRCS), an agency of the U.S. Department of Agriculture. Because the EWPP is a Federal program, assistance granted through the program is considered a Federal action.

The National Environmental Policy Act (NEPA) requires Federal agencies to identify and disclose the expected effects of Federal actions. Because assistance through the EWPP is a Federal action, NRCS must ensure that a solution offered under the EWPP complies with the requirements of NEPA.

The proposed action could affect National Forest System land in Logan Canyon administered by the U.S. Forest Service (USFS) and waters of the United States (waters of the U.S.) regulated under Section 404 of the Clean Water Act (CWA) by the U.S. Army Corps of Engineers (USACE). Because of this, USFS and USACE are participating in the Environmental Impact Statement (EIS) process as cooperating agencies.

NEPA requires Federal agencies to prepare an EIS if a proposed action has the potential to significantly affect the quality of the human environment. NRCS is preparing this EIS in cooperation with USFS and USACE because of the degree of controversy surrounding the

proposed action. While the degree of controversy might not cause a significant impact, the Council on Environmental Quality's (CEQ) NEPA regulations direct Federal agencies to consider the degree to which effects on the quality of the human environment are likely to be highly controversial (40 Code of Federal Regulations [CFR] 1508.27). NRCS uses this EIS to analyze the potential of the proposed action to significantly affect the quality of the human environment.

S.1.2 Changes from the Draft EIS

This Final EIS contains the same text presented in the Draft EIS but with changes. Some of the changes were applied document-wide and others were specific to a section. The document-wide changes were as follows:

- Updated all language and that applies to the description of the Purple Alternative to reflect the 1500 North option, which was mentioned in the Draft EIS but was not presented throughout the text. This change is also reflected in Figure 3-1, Purple Alternative.
- Updated all language that describes the pipeline that would be used to deliver LN Canal water to shareholders along the LN Canal between the LN Canal point of diversion (POD) and the Laub Diversion. The Draft EIS stated that this pipeline would be 6 inches in diameter. NRCS has updated the information to reflect that the pipeline would be 10 inches in diameter for all of the action alternatives.
- Updated all language that refers to the purchase of structures from 14 properties as proposed under all of the action alternatives. The text clarifies that NRCS can purchase structures from willing sellers only.
- Updated all language that refers to *in-stream flow* to *Logan River flow* to avoid confusion with other waterways.
- Corrected all references to the Cache Highline Water Users' Association.

Table S-1 summarizes other changes that are reflected in this Final EIS.

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
Chapter S: Summary			
		Updated entire chapter for consistency with text changes.	
Chapter 1: Introduction			
1-5	1.2	Added reference to new appendix (Appendix D3) under **Organization of This Document**.	1-6
Chapter 2: Purpose of and Need for Action			
2-3	2.1.2.1	Updated text that describes how irrigation water is delivered through the canal system under **Management of the Canal System in Cache County**.	2-3
2-11 – 2-13	2.2.2	Updated headings and subheadings under **Purposes of Action**.	2-11 – 2-13
2-16	Table 2-1	Clarified responsibilities for Utah laws, regulations, or policies.	2-14 – 2-16
2-18	Table 2-2	Updated Logan River flow text to reflect scoping comment missed in Draft EIS.	2-19
Chapter 3: Alternatives			
3-5	Figure 3-2	Updated **Typical Cross-Section A** to show vegetated cover.	3-6
3-9	3.2.2.1	Under **Operation**, updated text about service to LN Canal shareholders between the 2009 landslide zone and about 400 North for the Purple Alternative.	3-11
3-10	3.2.2.1	Under **Operation**, updated text about long-term operation and maintenance of the canal system for the Purple Alternative.	3-11
3-10	3.2.2.2	Under **Structural Features**, updated fifth bullet on page to reflect conditions for restoration of privately installed landscaping along the Logan Hyde Park Smithfield (LHPS) Canal for the Purple Alternative.	3-12
3-12	3.2.2.3	Under **Purple Alternative Costs**, updated cost information for the 1500 North option.	3-13
3-13	3.2.2.4	Under **Permit and Compliance Requirements**, corrected reference to USFS special-use permit for the Purple Alternative.	3-14
3-13	3.2.2.4	Under **Permit and Compliance Requirements**, deleted permanent change in the LN Canal water rights. The State Engineer approved this change on August 17, 2011.	3-14
3-16	3.2.3.1	Under **Operation**, updated text about using the LHPS Canal POD, service to LN Canal shareholders between the 2009 landslide zone and about 400 North, and long-term operation and maintenance of the canal system for the Orange Alternative.	3-17

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
3-17	3.2.3.2	Under **Structural Features**, added bullet to reflect conditions for restoring privately installed landscaping along the LHPS Canal for the Orange Alternative.	3-18
3-19	3.2.4.1	Under **Location**, updated text to reflect the potential condemnation of structures if property owners are not willing to sell for the Blue Alternative.	3-20
3-21	3.2.4.1	Under **Operation**, updated text about service to LN Canal shareholders between the 2009 landslide zone and about 400 North for the Blue Alternative.	3-22
3-24	3.2.4.2	Under **Management Controls in Zones 1 and 2**, updated text of second bullet to clarify long-term operation and maintenance of the canal system for the Blue Alternative.	3-25
3-25	3.2.4.2	Under **Structural Controls in Zones 1 and 2**, updated second bullet to reflect that structures might need to be acquired through condemnation for the Blue Alternative.	3-26
3-29 – 3-30	Table 3-5	Corrected alternatives summary table for consistency with text.	3-29 – 3-30
3-32	3.4.1.1	Updated text to clarify focus for identifying initial alternatives under **Step 1: Initial Alternatives**.	3-32
3-34	Table 3-6	Modified entries in the initial alternatives comparison table for the Yellow Alternative.	3-34
3-41	3.4.1.2	Under **Acceptable to Affected Individuals and Communities**, corrected text about Yellow and Blue Alternatives.	3-41
3-43	3.4.1.2	Under **Efficient in Achieving the Desired Outcome**, updated text about utility service interruption.	3-43
3-43	3.4.1.2	Under **Economical and Can Be Accomplished Using Least-Damaging Construction Techniques That Retain Existing Landscape and Habitat Characteristics**, corrected reference to action alternatives.	3-43
3-44	3.4.1.2	Under **Could Be Implemented Consistent with USFS Standards and Guidelines**, corrected references to USFS special-use permit.	3-44
3-47	3.4.1.3	Under **Gravity and Pump Options**, updated text about potential effects on hydropower generation.	3-47
3-47	3.4.1.3	Under **Gravity and Pump Options**, updated text about seepage along the LHPS Canal.	3-48
3-52	3.4.1.5	Under **Step 5: Alternatives Eliminated from Further Study**, clarified text about utility impacts of the Yellow Alternative.	3-52
Chapter 4: Affected Environment			
4-2	4.2.1	Added clarification about the difference between land use and zoning.	4-2
4-13	4.3.3.3	Corrected reference to market value of irrigated *crops* (not *cropland*) under **Agricultural Production**.	4-13
4-19	4.3.5.1	Included information about the length of the LHPS Canal that is on National Forest System land under **Logan Canyon (National Forest System Land)**.	4-19

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
4-26	4.4.1.1	Included additional information about safflower under **Agricultural Snapshot**.	4-26
4-30	4.4.1.5	Clarified information about urban (non-agricultural) water under **Water Available for Agriculture**.	4-30
4-30	4.4.2.1	Corrected text about extent of riparian habitat along Logan River under **Vegetation**.	4-30
4-33	4.4.2.2	Corrected reference to fish species stocked by Utah Division of Wildlife Resources under **Aquatic Wildlife Species**.	4-33
4-33	4.4.2.2	Corrected text about the location of the reach of Logan River being discussed (between LHPS Canal POD and First Dam) under **Aquatic Wildlife Species**.	4-33
4-33	4.4.2.2	Added information about aquatic invertebrates under **Aquatic Wildlife Species**.	4-33
4-33	4.4.2.3	Updated list of small to mid-sized mammals under **Terrestrial Wildlife Species**.	4-34
4-34	4.4.2.3	Corrected text about urban-adapted wildlife under **Terrestrial Wildlife Species**.	4-34
4-35	4.4.2.3	Corrected text about winter ranges for deer and elk under **Big Game**.	4-35 – 4-36
4-38	4.4.3.2	Corrected species list under **ESA Candidate, Sensitive, and Conservation Agreement Species**.	4-39
4-39	4.4.3.4	Corrected text about sensitive species and MIS under **Management Indicator Species (MIS)**.	4-40
4-40	4.4.4	Added information about a reconnaissance-level architectural survey conducted after release of the Draft EIS under **Cultural and Tribal Resources**.	4-41
4-61	4.4.6.1	Corrected text about the river's course under **Logan River**.	4-64
4-63	4.4.6.1	Corrected length of canal on National Forest System land under **Logan River**.	4-65
4-69	4.4.6.2	Updated information about Logan River's status under Clean Water Act Section 303(d) under **Impaired Waters**.	4-71
4-73	4.4.6.5	Corrected reference for confining layers under **Groundwater Resources**.	4-76
4-76	4.4.6.6	Updated information about the permanent change in some of Logan & Northern Irrigation Company's water rights under **Surface Water Rights**.	4-81
4-84 – 4-85	Figures 4-18 and 4-19	Added Uinta-Wasatch-Cache National Forest boundary line to figures showing LHPS Canal.	4-88 –4-89
Chapter 5: Environmental Consequences			
5-2	5.1.2.1	Added information about long-term land-use effects of the No-Action Alternative under **Land-Use Effects**.	5-3
5-8	5.1.5.1	Under **Land-Use Effects**, clarified information about acquisition of structures for the Blue Alternative.	5-8
5-24	5.2.5.3	Under **Impacts Associated with Constructing the Box Culvert between the LHPS Canal POD and Lundstrom Park/1500 North**, corrected list of parties responsible for new fencing.	5-24

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
5-24	5.2.5.3	Under **Impacts Associated with Constructing the Box Culvert between the LHPS Canal POD and Lundstrom Park/1500 North**, clarified what the unauthorized uses of the LHPS Canal are and how the Purple Alternative might affect such uses.	5-24
5-26	5.2.5.3	Under **Impacts Associated with Constructing the Box Culvert between the LHPS Canal POD and Lundstrom Park/1500 North**, clarified effect of the Purple Alternative on walking and bicycling along the LHPS Canal.	5-26
5-38	5.2.7.3	Under **Power Requirements of Pumping Canal Water**, clarified information about energy use for the Purple Alternative.	5-38
5-38 – 5-39	5.2.7.3	Under **Power Generation by Logan City Light and Power** and **Cumulative and Long-Term Effects**, updated information about the agreement between the Cache Highline Water Users' Association and the City of Logan for the Purple Alternative.	5-38 –5-39
5-42	5.2.7.6	Under **Summary of Impacts and Mitigation**, updated information about the agreement between the Cache Highline Water Users' Association and the City of Logan.	5-42
5-44	5.3.1.2	Under **No-Action Alternative**, clarified text about irrigation effects.	5-44
5-47	5.3.2.1	Under **Laws, Policies, and Direction**, replaced the word *Policy* with *Sub-Goal* in heading and under bullets.	5-47
5-49	5.3.2.3	Under **Effects of General Habitat, Vegetation, and Wildlife**, corrected text about urban-adapted wildlife for the Purple Alternative.	5-49
5-49	5.3.2.3	Under **Effects of General Habitat, Vegetation, and Wildlife**, corrected text about potential effects to riparian vegetation for the Purple Alternative.	5-49 –5-50
5-50	5.3.2.3	Under **Effects of General Habitat, Vegetation, and Wildlife**, corrected text about impacts to general wildlife habitat for the Purple Alternative.	5-50
5-50	5.3.2.3	Under **Effects of General Habitat, Vegetation, and Wildlife**, corrected text about flat plate fish screen for the Purple Alternative.	5-51
5-51	5.3.2.3	Under **Effects of Noxious Weeds and Invasive Species**, corrected references to USFS noxious weed guidance for the Purple Alternative.	5-52
5-55	5.3.3	Added cross-reference for special-status species appendix under **Special-Status Species**.	5-56
5-55	5.3.3.1	Deleted incorrect conclusion about goshawk occurrence in Logan Canyon under **Special-Status Species** listing of Guideline 15.	5-56
5-57	5.3.3.3	Updated information about sensitive species effects under **Purple Alternative**.	5-57
5-60	5.3.4.3	Updated structure eligibility and impact information under **Purple Alternative**.	5-61
5-61	5.3.4.4	Updated structure eligibility and impact information under **Orange Alternative**.	5-62

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
5-61	5.3.4.5	Updated structure eligibility and impact information under **Blue Alternative**.	5-62
5-62	5.3.4.6	Updated structure eligibility and impact information under **Cumulative and Long-Term Effects**.	5-63
5-70	5.3.6.2	Under **Surface Waters**, **Logan River**, added information about effects below ordinary high-water mark of the Logan River for the Purple Alternative.	5-71
5-70	5.3.6.2	Under **Surface Waters**, **Logan River**, clarified language about diversion of LN Canal water at the LHPS Canal POD for the Purple Alternative.	5-71
5-70	5.3.6.2	Under **Surface Waters**, **Logan River**, specified distance of LHPS Canal on National Forest System land in Logan Canyon for the Purple Alternative.	5-72
5-71 – 5-72	5.3.6.2	Under **Surface Waters**, **Logan River**, updated and clarified text about the potential effect of the Purple Alternative on Logan River flows.	5-72 –5-73
5-72	5.3.6.2	Under **Surface Waters**, **LHPS and LN Canals**, clarified that the LHPS Canal is a non-wetland water of the U.S. for the Purple Alternative.	5-73
5-73	5.3.6.2	Under **Surface Waters**, **LHPS and LN Canals**, clarified that the LHPS Canal is a non-wetland water of the U.S. for the Orange Alternative.	5-75
5-74	5.3.6.2	Under **Surface Waters**, **Logan River**, added information about effects below ordinary high-water mark of the Logan River for the Orange Alternative.	5-75
5-75	5.3.6.2	Under **Surface Waters**, **Logan River**, added information about effects below ordinary high-water mark of the Logan River for the Blue Alternative.	5-76
5-75	5.3.6.2	Under **Summary of Impacts and Mitigation**, clarified potential effects to and mitigation for effects on Logan River flows.	5-77 –5-78
5-77	5.3.6.3	Under **Water Quality**, added information about effects on Cutler Reservoir Total Maximum Daily Load (TMDL) load reduction and load allocation for the Purple Alternative.	5-79
5-78	5.3.6.3	Under **Water Quality**, added information about effects on Cutler Reservoir TMDL load reduction and load allocation for the Orange Alternative.	5-80 –5-81
5-79	5.3.6.3	Under **Water Quality**, added information about effects on Cutler Reservoir TMDL load reduction and load allocation for the Blue Alternative.	5-81
5-88	5.3.6.6	Under **Groundwater Resources**, clarified information about USFS recommendation for Logan River flow that is allowed to pass the LHPS Canal POD for the Purple Alternative.	5-90
5-94	5.3.6.8	Under **Water Use and Water Rights**, updated water rights discussion for the Purple Alternative.	5-96
5-95	5.3.6.8	Under **Water Use and Water Rights**, updated water rights discussion for the Orange Alternative.	5-97

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
5-97	Table 5-5	Revised numbers of easements for Purple Alternative.	5-99
5-101	5.4.2.2	Added information about communicating with people having limited English proficiency during construction for all alternatives.	5-103 –5-104
5-108	5.4.3.2	Under **Biological Resources**, corrected information about construction impacts to wildlife for the Purple Alternative.	5-109 –5-110
5-109	5.4.3.2	Under **Biological Resources**, corrected references to USFS noxious weed guidance for the Purple Alternative.	5-111
5-109	5.4.3.2	Under **Biological Resources**, clarified box culvert cover assumptions for the Purple Alternative.	5-111
5-109	5.4.3.2	Under **Biological Resources**, updated information regarding construction effects on vegetation and wildlife for the Orange Alternative.	5-111
5-110	5.4.3.2	Under **Biological Resources**, clarified that the Blue Alternative would not affect crucial range for deer, elk, or moose.	5-112
5-111	5.4.3.3	Under **Special-Status Species**, corrected status of Logan buckwheat for the Purple Alternative.	5-114
5-112	5.4.3.3	Under **Special-Status Species**, added information about potential effects to northern goshawk during construction of the Purple Alternative.	5-114
5-112	5.4.3.3	Under **Special-Status Species**, added clarifying reference about special-status species for all alternatives.	5-114 –5-115
5-113	5.4.3.4	Under **Cultural and Tribal Resources**, updated eligibility and impact information for all alternatives.	5-116
5-125 – 5-126	5.5.1	Under **Impacts Considered in This Cumulative Analysis**, clarified the type of impacts considered.	5-128
5-128	5.5.1	Under **Past, Present, and Reasonably Foreseeable Actions**, updated information about large-scale road construction details.	5-131
5-130	5.5.2.3	Under **Recreation**, corrected list of parties responsible for new fencing.	5-133
5-130	5.5.2.3	Under **Recreation**, added information about recreation effects of actions considered in the cumulative effects discussion.	5-133
5-131	5.5.2.5	Under **Vegetation Removal**, clarified potential effects of project.	5-134 –5-135
5-132	5.5.2.5	Under **Fish Entrapment**, corrected text about flat plate fish screen.	5-135
—	5.5.2.5	Added new section to **Biological Resources** that discusses disturbance of crucial habitat for deer, elk, and moose.	5-136
5-133	5.5.2.6	Under **Cultural Resources**, updated information about eligibility of structures.	5-137
5-158	5.9.1	Under **Social and Economic Environment**, deleted discussion about energy because agreement between Cache Highline Water Users' Association and City of Logan has been finalized.	—
5-164	Table 5-8	Updated table for consistency with text changes.	5-167 –5-172

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
Chapter 6: Consultation and Public Participation			
		Updated entire chapter to reflect public involvement activity since release of the Draft EIS.	
Chapter 7: List of Preparers			
		Updated list of preparers.	
Chapter 8: Distribution			
		Updated list to reflect distribution of the Final EIS.	
Chapter 9: References			
—		New reference for Barbour and others for *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish*.	9-1
—		New reference for HDR Engineering, Inc. for *Reconnaissance-Level Survey for the Logan Northern Canal Project, Logan, Utah*.	9-5
—		New reference for OMB for Circular A-94, Appendix C.	9-6
—		New reference for SWCA for *Middle Bear River and Cutler Reservoir Total Maximum Daily Load (TMDL)*.	9-7
—		New reference for USDA NRCS for *Discount Rates for Federal Water Projects*.	9-8
—		New reference for USFS for *Wasatch-Cache National Forest Noxious Weed Treatment Program Final EIS*.	9-8
—		New reference for WSU for *Safflower production tips*.	9-9
9-4		Updated reference to HDR Engineering, Inc. for *Notes from the February 3, 2011, work group meeting with Logan & Northern Irrigation Company; Logan, Hyde Park and Smithfield Canal Company; City of Logan; and Cache County* due to additional new 2011 reference.	9-5
9-7		Corrected reference for U.S. Geological and Mineral Survey 1988 to AGRC 1993.	9-1
9-8		Corrected reference for USGS 1999 to AGRC 2007.	9-1
9-9		Deleted Utah Department of Natural Resources and U.S. Geological Survey because this was an incorrect, duplicate reference.	—
9-9		Updated references for Utah Division of Wildlife Resources files about moose, elk, and mule deer.	9-10

Table S-1. Summary of Changes to the Draft EIS

Draft EIS Page	Draft EIS Section	Change	Final EIS Page
Chapter 10: Acronyms and Abbreviations			
		No changes.	
Chapter 11: Index			
		Updated to reflect page number changes for Final EIS.	
Appendices			
Appendix C1	Table C1-1	Corrected typographical error. Added cost information for the Purple Alternative 1500 North option.	Appendix C1
Appendix C1	Table C1-2	Corrected length of pressure pipe segment from 20,300 feet to 21,000 feet.	Appendix C1
Appendix C1	Table C1-3	Corrected length of pressure pipe segment from 20,300 feet to 18,900 feet.	Appendix C1
Appendices C5-3 and C5-4	2.0	Corrected information about Canada lynx.	Appendices C5-3 and C5-4
Appendix C5-6	3.0	Corrected information about northern goshawk.	Appendix C5-6
Appendix C5-7	3.0	Corrected information about Townsend's big-eared bat.	Appendix C5-7
Appendix C5-10	5.0	Corrected information about MIS.	Appendix C5-10
Appendix C5-12	Table 1	Added snowshoe hare.	Appendix C5-12
Appendix C5-13	Table 1	Added northern goshawk.	Appendix C5-13
Appendix C5-14	6.0	Added new references for corrected text.	Appendix C5-14
Appendix C6-2	Item S5	Corrected information about potential flow impacts.	Appendix C6-2
Appendix C6-5	Item G15	Corrected information about northern goshawk.	Appendix C6-5
Appendix C6-6	Item G30	Corrected information about winter range for deer and elk.	Appendix C6-6
Appendix C6-10	References	Added new reference for corrected text.	Appendix C6-10

S.1.3 Organization of This Summary

This Final EIS analyzes and presents conclusions about the expected effects of the proposed alternatives for the Logan Northern Canal Reconstruction project on the natural and built environment.

The remainder of this summary presents a synopsis of the Final EIS and is organized as follows:

- Section S.2, Proposed Action and Preferred Alternative
- Section S.3, Purpose of and Need for the Proposed Action (Chapter 2 of the EIS)
- Section S.4, Project Alternatives (Chapter 3 of the EIS)
- Section S.5, Affected Environment (Chapter 4 of the EIS)
- Section S.6, Environmental Consequences of the Proposed Action (Chapter 5 of the EIS)
- Section S.7, Public Participation and Agency Consultation (Chapter 6 and Chapter 12 of the EIS)

S.2 Proposed Action and Preferred Alternative

The proposed action is to construct a system that will safely restore delivery of water that was diverted using the LN Canal before the 2009 landslide. Rather than identify very specific proposed elements, NRCS chose to evaluate project alternatives at an equal level of detail in order to identify a preferred alternative. These project alternatives are listed in Section S.4, Project Alternatives.

What is the proposed action?

The proposed action is to construct a system that will safely restore delivery of water that was diverted using the LN Canal before the 2009 landslide.

S.2.1 Elements of the Preferred Alternative

NRCS has identified the **Purple Alternative** as the preferred alternative. This alternative would re-establish delivery of LN Canal water in the following manner:

Which alternative is the preferred alternative?

NRCS has identified the Purple Alternative as the preferred alternative.

- Move the POD for some of the LN Canal water upstream to the LHPS Canal POD structure on the Logan River below Second Dam.
- Reconstruct the LHPS Canal POD to accommodate an increase in the amount of water that could be diverted, which would allow water to be diverted for LN Canal shareholders and LHPS Canal shareholders.
- Reconstruct the LHPS Canal as a box culvert between the POD and about Lundstrom Park/1500 North in Logan.

- Divert the LN Canal shares from the box culvert at Lundstrom Park/1500 North into a pipeline that travels under city streets and discharges to the existing LN Canal at about 1500 North. The box culvert would end at Lundstrom Park/1500 North, and LHPS Canal shares would continue to flow in the existing LHPS Canal to its shareholders downstream.
- At the new 1500 North discharge point on the LN Canal, send some water to upstream users in a pressure pipe that is installed in the existing canal maintenance road. The remaining water would be discharged into the existing LN Canal for delivery to downstream users.
- For LN Canal shareholders between the POD and the Laub Diversion, construct a 10-inch-diameter pipeline in the existing canal.

The Purple Alternative would include removing structures from 14 properties along Canyon Road in Logan at the toe of the historically unstable part of the Logan Bluff. NRCS could buy structures from willing sellers only. Although this alternative could be constructed if property owners are not willing to sell, any structures that remain in the unstable area would be subject to damage during future landslides.

S.2.2 Structural Features of the Preferred Alternative

The structural features of the Purple Alternative include the following:

- Modified LHPS Canal POD structure on the Logan River just below Second Dam. This modification would be needed to accommodate diversion of as much as 130 cubic feet per second (cfs), hydraulic gates, trash racks, and a fish screen.
- Reconstruct the existing flow gage in the LHPS Canal (which is just downstream of the POD).
- About 2.4 to 2.6 miles of new box culvert to convey irrigation water from the LHPS Canal POD to Lundstrom Park/1500 North in the existing LHPS Canal alignment. Preliminary calculations show that about 1.6 miles of 6-foot-wide by 6-foot-deep box culvert would be needed between the LHPS Canal POD and the mouth of Logan Canyon (called the Logan Canyon section), and about 0.8 to 1.0 mile of 12-foot-wide by 5-foot-deep box culvert would be needed from the Logan Golf & Country Club (golf course) to Lundstrom Park/1500 North.
- A new stormwater channel for about 0.8 to 1.0 mile in the LHPS Canal alignment to convey stormwater.
- Modify Cedar Heights Drive and 1500 North where they cross the LHPS Canal to accommodate the new box culvert. Also modify several private driveways and pedestrian crossings that cross the LHPS Canal and LN Canal.
- Restore vegetation and landscaping that is removed during project construction from private property outside the canal easement along the LHPS Canal.

- A water-control structure at Lundstrom Park/1500 North to transition water from the box culvert to the existing open channel. The new structure would combine irrigation water and stormwater for conveyance downstream.
- A new headgate structure at Lundstrom Park/1500 North to allow LN Canal water to be diverted into a new pressurized pipeline system running west to the LN Canal.
- About 1.2 miles of new 42-inch-diameter pressure pipe to convey 40 cfs of LN Canal water from the LHPS Canal to the LN Canal. The pipeline, which would require air vents and a flow meter, would be routed under city streets and through and under a field to connect to the LN Canal at 1500 North.
- A new water-control structure at the LN Canal to discharge water from the pipe system to the LN Canal system. The structure would include pressure-reducing valves, flow control, and energy-dissipation measures. Water would be divided at the structure into the existing LN Canal open channel to serve shareholders to the north (downstream of 1500 North) and into a pressurized pipeline system traveling to the south (upstream of about 1500 North).
- About 1 mile of 10-inch-diameter pressure pipe from 1500 North to 400 North installed in the existing canal maintenance road. The pressure pipe, which would not affect the existing LN Canal, would convey about 2 cfs for use by shareholders in this reach. These shareholders could access water from the pressure pipe or from the LN Canal. Access from the canal would be available for water not taken from the pressure pipe and that is discharged from the pipe into the LN Canal at about 400 North.
- A new water-control structure to discharge water not taken directly from the pressure pipe into the existing LN Canal at 400 North. This water would supply the Temple Ditch (a LN Canal shareholder) and would provide water in the canal to the north (downstream) to prevent stagnant pools between 400 North and 1500 North.
- About 1 mile of 10-inch-diameter pipe in the current LN Canal alignment between the LN Canal POD and the Laub Diversion at about 1100 East. This pipeline would carry up to 2 cfs for delivery to shareholders in this area. The POD would not need to be modified to accommodate the 10-inch pipeline.

The Purple Alternative Lundstrom Park option would cost between $20.4 million and $22.4 million. The 1500 North option would cost between $21.5 million and $23.7 million.

S.3 Purpose of and Need for the Proposed Action

S.3.1 Need for Action

The proposed action is needed to:

- Restore the safe delivery of water that was conveyed by the LN Canal before the 2009 landslide, and
- Address the remaining hazards associated with the landslide zone between about 750 East and 1100 East.

Why is the proposed action needed?

The proposed action is needed to restore the safe delivery of water that was conveyed by the LN Canal before the 2009 landslide and address the remaining hazards associated with the landslide zone between about 750 East and 1100 East.

S.3.1.1 Restore the Safe Delivery of Water

Since the landslide and subsequent breach of the LN Canal in 2009, the amount of water delivered to the LN Canal's shareholders has been greatly reduced. A temporary system put in place to deliver some water to shareholders with the LN Canal also reduced the amount of water delivered to LHPS Canal shareholders. This temporary system, which was used in 2009 and 2010, cannot and will not be used in the long term. The Logan & Northern Irrigation Company wishes to restore full delivery of water to its shareholders, and the Logan, Hyde Park and Smithfield Canal Company wishes to return to full delivery to its shareholders using the LHPS Canal.

Before the landslide, the LN Canal diverted an average of about 60 cfs from the LN Canal POD just below First Dam. Since the landslide, the overall amount of both LN Canal and LHPS Canal shares that is being delivered has decreased by about 50%. The temporary system allowed the continued delivery of some water, but all shareholders experienced adverse effects from not receiving their full shares of water. This reduction has affected the financial performance of agricultural production (only 50% of the water is delivered, but production costs are nearly the same as they would be if 100% of the water were delivered); the irrigation of public land such as the golf course, parks, and school grounds; and the amount of water available for drinking-water exchanges downstream.

S.3.1.2 Address the Remaining Hazards Associated with the Landslide Zone

The 2009 landslide occurred in an area that has a history of slope instability. A recent landslide compilation map shows landslide areas in the area of the Logan Bluff south of US 89 in the study area (for a description of the study area, see Section S.5, Affected Environment). The historic landslides date back to about 1906 and have had various effects on the LN Canal. Several landslides caused the LN Canal to fill and overflow, and other landslides have caused canal breaks. The 2009 landslide resulted in loss of life.

NRCS believes that there is a need to address the hazards that remain in the area around the 2009 landslide site. Based on the long history of landslides in this area and the hydrology and

geologic conditions of the Logan Bluff, future landslides are likely to occur in the area. NRCS did not conduct any detailed geologic investigations for this EIS but instead reviewed historic landslide information about the area. A preliminary review of this information, existing conditions, and the location of structures relative to the slope indicate that the area where the 2009 landslide occurred, which is between about 750 East and 1100 East, continues to pose the greatest risk to life and property. Areas west of 750 East and east of 1100 East are adjacent to this historic landslide zone but could also be susceptible to landslides in the future. However, because EWPP funds cannot be used to solve watershed or natural problems that existed prior to the natural disaster, NRCS is limited to addressing the remaining hazards associated with the 2009 landslide zone.

Even if the proposed action addresses some risks associated with the remaining landslide hazards in the historic landslide zone, the proposed action would not eliminate the future threat of landslides, potential property damage, and loss of life in this area of the Logan Bluff.

S.3.2 Purposes of Action

The purposes of the proposed action are to restore safe water delivery capability to the LN Canal and to address remaining hazards in the 2009 landslide zone.

What are the purposes of the proposed action?

The purposes of the proposed action are to restore safe water delivery capability to the LN Canal and to address remaining hazards in the 2009 landslide zone.

In addition to addressing the need for and purposes of the proposed action, NRCS has identified a number of objectives that the proposed action should achieve.

- Provide measures that are economically, socially, and environmentally defensible and technically sound. *Defensibility* means the extent to which an action is:
  - More beneficial than adverse in the extent and intensity of its environmental and economic effects;
  - In compliance with Federal, State, and local laws;
  - Acceptable to affected individuals and communities;
  - Effective in restoring or protecting the natural resources;
  - Complete with all necessary components included; and
  - Efficient in achieving the desired outcome.
- Emphasize measures that are the most economical and are to be accomplished using the least damaging practical construction techniques and equipment that retain as much of the existing characteristics of the landscape and habitat as possible.
- Meet the applicable standards and guidelines of the *Revised Forest Plan for the Wasatch-Cache National Forest* (USFS 2003) and the requirements of the special-use permit process.
- Avoid and minimize impacts to waters of the U.S. that are regulated under Section 404 of the CWA.

In addition to the EWPP requirements; National Forest policies, standards, and guidelines; and Section 404 objectives; the SLO has identified a number of objectives it wants the proposed action to achieve.

1. Restore water for all canal users, which includes farmers, ranchers, Towns, and Cities, while optimizing safety.
2. Promote amenities and citizen use along the canal route for recreation and aesthetic appreciation, including preserving or restoring vegetation.
3. Promote secondary benefits of the rebuilt canal for the betterment of existing and future citizens of Cache County which include, but are not limited to, water conservation, improved water quality, and energy conservation.
4. Minimize temporary and permanent impacts to private and public property, including roadways.
5. Minimize unknown cost and time associated with the project and avoid unnecessary delay.
6. Minimize the need for specialized construction techniques and foster competitiveness within the bid process.
7. Minimize the operation and management cost for overseeing the canal system in the future.

S.4 Project Alternatives

NRCS identified a range of initial alternatives that would meet the need for and purposes of the proposed action. These action alternatives were:

- Purple Alternative: LHPS Canal POD, LHPS Canal to 1500 North, west to LN Canal at 1500 North (the preferred alternative described in Section S.2, Proposed Action and Preferred Alternative)
- Orange Alternative: LHPS Canal POD, LHPS Canal to 2900 North or 3100 North, west to LN Canal at 2900 North or 3100 North
- Green Alternative: LHPS Canal POD, LHPS Canal to US 89 at canyon mouth, US 89 to LN Canal
- Yellow Alternative: LN Canal POD, LN Canal to Canyon Road, Canyon Road to LN Canal at about 400 North
- Blue Alternative: LN Canal POD, historic LN Canal alignment to 400 North

After a multi-step alternatives development and screening process, NRCS eliminated the Green and Yellow Alternatives from detailed analysis (these alternatives are discussed in Section S.4.4, Alternatives Considered but Eliminated from Further Study). The following sections summarize the No-Action Alternative and the Orange and Blue Alternatives. The Purple Alternative is described in Section S.2, Proposed Action and Preferred Alternative.

S.4.1 No-Action Alternative

Under the No-Action Alternative, the LN Canal irrigation water delivery system would not be temporarily or permanently modified or reconstructed, and the LN Canal irrigation water would not be delivered to users downstream of the Laub Diversion (a diversion structure along Canyon Road at about 1100 East in Logan) using the LN Canal.

What is the No-Action Alternative?

The No-Action Alternative describes what would happen if NRCS does not supply the project funding and the SLO is unable to implement the proposed action. The No-Action Alternative shows how not restoring water delivery would affect the human and natural environment.

The No-Action Alternative would not result in any physical changes to the LN Canal, LN Canal POD, LHPS Canal, or LHPS Canal POD. Under the No-Action Alternative, NRCS would not distribute funding to the SLO to repair the LN Canal system. The No-Action Alternative would not address the existing landslide area along Canyon Road in Logan.

Because the temporary system used in 2009 and 2010 cannot and will not be used in the long term, the No-Action Alternative assumes that the temporary system would not be used to deliver LN Canal shares in the future.

Under the No-Action Alternative, LN Canal shareholders between the existing LN Canal POD and the Laub Diversion would continue to receive water using the existing LN Canal. No more than 2 cfs would be diverted from the POD and conveyed in the canal to the Laub Diversion. At the Laub Diversion, unused irrigation water would be routed back to the Logan River. Shareholders downstream of the Laub Diversion would not receive water through the LN Canal. The reach of the LN Canal downstream of the Laub Diversion would be abandoned in place by the Logan & Northern Irrigation Company. Intact sections of the canal could still be used to collect and convey stormwater and water from other sources along the canal (such as water from seeps and springs).

Under this alternative, it is likely that the long-term maintenance and management of the canal sections that are intact would become the responsibility of parties who continue to use the canal for conveying stormwater (that is, the Cities of Logan and North Logan, Utah State University [USU], the Utah Department of Transportation [UDOT], and/or Cache County).

Because estimating how the irrigation practices of affected shareholders might change under a No-Action Alternative is speculative, this EIS assumes that LN Canal shareholders downstream of the Laub Diversion would not irrigate any of the land that was irrigated using LN Canal water before the 2009 landslide. This would affect the amount of land in agricultural production and how municipalities that rely on LN Canal shares would operate their irrigation systems and, possibly, other municipal systems that rely on canal water exchanges.

If the No-Action Alternative were implemented, the SLO and the Logan & Northern Irrigation Company could seek funding from other sources in order to restore safe water

delivery to LN Canal shareholders. However, because identifying other sources of funding and the amounts of funding that the SLO and irrigation company might be able to secure is speculative, this EIS assumes that adequate funding to restore safe delivery of irrigation water would not be available under the No-Action Alternative.

S.4.2 Orange Alternative

S.4.2.1 Elements of the Orange Alternative

If selected, the Orange Alternative would re-establish delivery of LN Canal water in the following manner:

- Move the POD for the some of the LN Canal water upstream to the LHPS Canal POD structure on the Logan River below Second Dam (same as proposed for the Purple Alternative).
- Reconstruct the LHPS Canal POD to accommodate an increase in the amount of water that could be diverted, which would allow water to be diverted for LN Canal shareholders and LHPS Canal shareholders (same as proposed for the Purple Alternative).
- Reconstruct the LHPS Canal as a box culvert between the POD and either 2900 North (2900 North option) or 3100 North (3100 North option) in North Logan.
- Divert the LN Canal shares from the box culvert at 2900 North/3100 North into a pipeline that travels under undeveloped land and/or city streets and discharges to the existing LN Canal at 2900 North/3100 North. The box culvert would end at either 2900 North or 3100 North, and LHPS Canal shares would continue to flow in the existing LHPS Canal to its shareholders downstream.
- At the new 2900 North/3100 North discharge point on the LN Canal, send some water to upstream users in a pressure pipe that is installed in the existing canal maintenance road. The remaining water would be discharged into the existing LN Canal for delivery to downstream users.
- For LN Canal shareholders between the POD and the Laub Diversion, construct a 6-inch-diameter pipeline in the existing canal.

Like the Purple Alternative, the Orange Alternative would include removing structures from 14 properties along Canyon Road in Logan at the toe of the historically unstable part of the Logan Bluff.

S.4.2.2 Structural Features of the Orange Alternative

The structural features of the Orange Alternative include the following:

- Modified LHPS Canal POD structure on the Logan River just below Second Dam, as described for the Purple Alternative.
- About 1.6 miles of new 6-foot-wide by 6-foot-deep box culvert, as described for the Purple Alternative. With this alternative, the 12-foot-wide by 5-foot-deep box culvert described for the Purple Alternative would extend for about 3.3 miles from the golf course to 2900 North or about 3.6 miles from the golf course to 3100 North in the LHPS Canal alignment.
- A new stormwater channel for about 3.3 miles to 2900 North or 3.6 miles to 3100 North in the LHPS Canal alignment to convey stormwater.
- Modify Cedar Heights Drive, 1770 East, 1800 East, and Cottonwood Lane where these streets cross the LHPS Canal to accommodate the new box culvert. Also modify several private driveways and pedestrian crossings that cross the LHPS Canal and LN Canal.
- Restore vegetation and landscaping that is removed during project construction from private property outside the canal easement along the LHPS Canal.
- A water-control structure at either 2900 North or 3100 North to transition water from the box culvert to the existing open channel. The new structure would allow stormwater to combine with irrigation water.
- A new headgate structure at either 2900 North or 3100 North to allow LN Canal water to be diverted into a new pressurized pipeline system running west to the LN Canal.
- About 0.5 mile to 0.6 mile of new 36-inch-diameter pressure pipe to convey 30 cfs from the LHPS Canal and the LN Canal along 2900 North or 3100 North, respectively. The new pipeline would require air vents and a flow meter.
- A new water-control structure at the LN Canal to discharge water from the pipe system to the LN Canal system. The structure would include pressure-reducing valves, flow control, and energy-dissipation measures. Water would be divided at the structure into the existing LN Canal flow to serve shareholders to the north (downstream of 2900 North or 3100 North) and into a pressurized pipeline system traveling to the south (upstream of about 2900 North or 3100 North).
- About 2.1 miles of 26-inch-diameter pressure pipe from 2900 North to 1500 North, or 2.5 miles from 3100 North to 1500 North, to convey 15 cfs of irrigation water to upstream shareholders. This pipeline would be installed in the existing canal maintenance road.

- As described for the Purple Alternative, about 1 mile of 10-inch-diameter pressure pipe to deliver water to shareholders between 1500 North and 400 North.
- As described for the Purple Alternative, a new water-control structure to discharge water into the existing LN Canal at 400 North.
- As described for the Purple Alternative, about 1 mile of 10-inch-diameter pipe to deliver water to shareholders between the LN Canal POD and the Laub Diversion.

The Orange Alternative would cost between $39.5 million and $43.4 million.

S.4.3 Blue Alternative

NRCS chose to evaluate the Blue Alternative as a result of public comments received during scoping (for more information about scoping, see Section S.7.1, Scoping). If selected, the Blue Alternative would re-establish delivery of LN Canal water in the following manner:

- Use the existing LN Canal POD.
- Reconstruct the LN Canal POD to accommodate a closed conduit instead of an open canal.
- Reconstruct the LN Canal as a pipeline between the POD and about 400 North in Logan.
- Discharge LN Canal water into the LN Canal at 400 North for delivery to downstream users.
- For LN Canal shareholders between the POD and the Laub Diversion, construct a 10-inch-diameter pipeline in the existing canal.

Like the Purple and Orange Alternatives, the Blue Alternative would include removing structures from 14 properties along Canyon Road in Logan at the toe of the historically unstable part of the Logan Bluff. The EWPP guidelines allow NRCS to purchase structures using EWPP funds from willing sellers only. However, because the Blue Alternative would require most of the area that abuts the LN Canal along the north side of Canyon Road between about 750 East and 1100 East to support structural controls (see Section S.4.3.3, Structural Controls of the Blue Alternative), all structures would need to be removed from this area. If sellers are not willing, the structures would need to be condemned in order for the alternative to be constructed.

The Blue Alternative is the only alternative that would restore LN Canal water delivery solely using the historic LN Canal alignment. Because the Logan Bluff area remains unstable, this alternative includes special structural measures intended to address the continued risks to life and property in and near this area. The Blue Alternative would not eliminate these future risks but proposes structural features, management controls, and structural controls that would address some of the risk.

For the purpose of this alternative, NRCS defined two zones along the Logan Bluff to help determine specific management and structural controls. These zones, called Zone 1 and

Zone 2, are based on topography, landslide history, geology or soil characteristics, and available documentation. The Blue Alternative focuses on potential management and structural controls in the two zones that would provide engineered structures to ensure that the public would be generally protected against a pipeline failure due to a future landslide. Zone 2 is the historic landslide area within which structures would be purchased under the Purple and Orange Alternatives.

The general structural features and management and structural controls of the Blue Alternative are described in the following sections.

S.4.3.1 General Structural Features of the Blue Alternative

The structural features of the Blue Alternative would include the following:

- Demolish the existing LN Canal conveyance structure between the LN Canal POD and 400 North.
- Modified LN Canal POD structure on the Logan River just below First Dam to accommodate a design flow of up to 80 cfs and a new flow-control gate.
- About 1.7 miles of 60-inch-diameter to 72-inch-diameter steel pipe in the existing LN Canal alignment to convey irrigation water (using gravity flow) from the LN Canal POD to 400 North/600 East.
- About 1.6 miles of a new 4-foot-wide lined drainage channel to convey stormwater and other water (such as water from seeps and springs) from the hillside upslope of the new pipeline. This channel would convey water parallel to the pipeline alignment and would eventually discharge into the existing irrigation canal at 400 North/600 East.
- A top-of-slope runoff-control network consisting of a berm or other system at the top of the bluff to prevent stormwater runoff from traveling down the hillside. This berm would be about 2 feet high, would be protected from erosion, and would be about 5,000 linear feet long.
- A new water-control structure at about 400 North/600 East to discharge water from the irrigation pipe system and drainage channel to the existing LN Canal. The structure would include flow-control measures and energy-dissipation measures.
- As described for the Purple and Orange Alternatives, about 1 mile of a 10-inch-diameter pipe to deliver water to shareholders between the LN Canal POD and the Laub Diversion.

S.4.3.2 Management Controls of the Blue Alternative

Management controls in Zones 1 and 2 would include the following:

- A flow-detection system that would monitor flows along the length of the pipeline. In case of a drop in flow rate, this system could broadcast an alarm or otherwise alert the canal operators and local public safety agencies. The flow-detection system could be coordinated to activate a shutoff gate at the POD.
- A canal management plan as required by the Water Conveyance Facilities Safety Act. This plan would identify the cities and counties that the canal passes through, would identify the canal components (such as PODs, bridges, and stormwater entry points), and would include a maintenance and improvement plan, information about insurance coverage, a slope stability assessment, a stormwater assessment, and an emergency response plan. The emergency response plan would explain how public safety and emergency response agencies would be notified in the event of an emergency, their respective roles in the event of an emergency, how the public would be protected in the event of an emergency, and how the canal would be repaired following an emergency. The Utah Division of Water Resources and NRCS funding for the Blue Alternative would also require long-term operation and maintenance plans and service agreements.
- A public outreach and information plan to inform the general public and the adjacent landowners about the presence of the pipeline, instructions on whom to contact and what to do in case of an emergency associated with a future landslide, and how such a landslide might affect the pipeline.
- A visual assessment plan that would identify appropriate intervals for visual inspections of the pipeline and pipeline corridor for evidence of landslides or other problems.
- Benchmarks such as survey monuments installed along the pipeline and along the hillside above and below the pipeline and annual monitoring of these benchmarks to identify land movements. The SLO would be responsible for the recordkeeping associated with annual monitoring.
- Public warning signs along the alignment with emergency phone numbers.

S.4.3.3 Structural Controls of the Blue Alternative

The Blue Alternative would also require additional structural controls in Zones 1 and 2 to protect the pipeline against future landslides. These structural controls would include the following:

- About seventy-five 36-inch-diameter drilled shaft foundations placed about every 20 feet. These shaft foundations would be drilled to a depth of about 75 feet to support 1.4 miles of pipe (Zone 1 exclusive of Zone 2). These foundations would protect the pipeline against landslide movement since they would extend through the sliding mass and into stable, undisturbed material. These foundations would include tie-backs, which are steel bars drilled horizontally about 100 feet into the slope. These tie-backs would provide added lateral stability.
- About 90 subsurface sub-horizontal drains placed about every 50 feet. These drains would be drilled horizontally into the uphill slope to collect and control groundwater that is trapped, or perched, on top of an underlying impervious layer. The drains, which would increase the stability of the structural controls in Zones 1 and 2, would extend far enough to reach the point where gravels contact the underlying finer-grained sands and would convey groundwater to the drainage channel described in Section S.4.3.1, General Structural Features of the Blue Alternative. An array of five or six horizontal drains would be installed about 50 feet into the bluff in a fan pattern at each of the 90 primary drain locations.
- Assuming that residential structures on the 14 properties would be acquired or condemned, a soil buttress below the pipeline would be constructed for about 0.6 mile in Zone 2. This buttress, which would be a large mass of soil, would retain the slope and reduce the potential for slope failure below the pipeline. The buttress would consist of about 130,000 cubic yards of granular fill (gravels) placed about 40 feet from the toe of the existing hillside and sloping upward at a ratio 1.5 to 1 (horizontal to vertical).

The Blue Alternative would cost between $24.1 million and $26.5 million.

S.4.4 Alternatives Considered but Eliminated from Further Study

NRCS considered two additional alternatives but did not evaluate them in detail because NRCS judged that they were not significantly different from or did not provide any environmental advantages over the Purple, Orange, or Blue Alternatives. The following sections briefly describe these alternatives and why they were eliminated from further study.

S.4.4.1 Green Alternative

This alternative would use the LHPS Canal POD below Second Dam and carry LN Canal and LHPS Canal water in a box culvert installed in the LHPS Canal to the golf course. From the

golf course, this alternative would carry the LN Canal water west to the existing LN Canal via US 89 in a pipe under the road. LN Canal water would be discharged back into the existing canal at about 400 North/600 East. This alternative would include continued delivery to LN Canal shareholders between the LN Canal POD and the Laub Diversion using a 10-inch-diameter pipe. The Green Alternative would include purchasing structures from 14 properties located in the historic landslide zone at the toe of the Logan Bluff as described for the Purple, Orange, and Blue Alternatives.

This alternative would require extensive work under the surface of US 89, a major east-west highway in this part of Cache County. Parts of US 89 are designated a State and Federal Scenic Highway, including most of the segment that would be affected by this alternative. Construction activity would disrupt traffic and utility service, but these impacts would be temporary. Design and construction would be challenged by existing pedestrian underpasses on US 89 between parking lots on the south side of the highway to the USU campus on the north side; this might temporarily disrupt use of the underpass or might require permanently closing the underpass. Construction would also temporarily disrupt use of the Logan Golf & Country Club.

NRCS considered two options for the Green Alternative: (1) combine the LN Canal and LHPS Canal water at the LHPS Canal POD just below Second Dam (as described in the first paragraph of this section) and deliver the water using gravity, and (2) use the LN Canal POD, build a small pumping plant, and pump the water up to US 89, where it would be placed in a pipe under the highway. NRCS eliminated the pumping option (which was also considered for the Purple and Orange Alternatives) because its operation and maintenance costs would have been $4.9 million more over the life of the project than the gravity option and it would have introduced a potentially noisy pumping plant into a residential area.

Ultimately, NRCS judged that the Green Alternative did not provide any benefit over other alternatives in the same geographical location (the south end of the study area). The Green Alternative accomplished the same goal in generally the same area as the Blue Alternative, and, since the Blue Alternative had a lot of public support and the Green Alternative had very little public support, NRCS eliminated the Green Alternative from further study.

S.4.4.2 Yellow Alternative

This alternative would use the LN Canal POD below First Dam and carry LN Canal water in a pipe. The pipe would generally follow Canyon Road to 400 North. LN Canal water would be discharged back into the existing canal at about 400 North/600 East. This alternative would include continued delivery to LN Canal shareholders between the LN Canal POD and the Laub Diversion using a 10-inch-diameter pipe. The Yellow Alternative would include purchasing structures from 14 properties located in the historic landslide zone at the toe of the Logan Bluff as described for the Purple, Orange, Blue, and Green Alternatives.

NRCS decided that the Yellow Alternative would not be carried forward for further study because it would not provide substantial benefits over the Blue Alternative, which was

suggested and supported by comments received during scoping. The Yellow Alternative is in the same general area, would use the same POD, received only moderate support during scoping (especially compared to the Blue Alternative), and would deliver water to the same location. The Yellow Alternative would include the same number of structure acquisitions in order to remove the risks to life and property in the historic landslide zone but would not address the stability of the 2009 landslide site. The Blue Alternative would provide the benefit of addressing some of the risk associated with the unstable area, although it would not completely remove future risks to life and property.

Lastly, the construction impacts of the Yellow Alternative would be much greater than those from the Blue Alternative and would require relocating a sanitary sewer line, temporarily relocating residents living in and near the construction area for several weeks during construction, and closing local streets to traffic for an extended time. For these reasons, NRCS eliminated the Yellow Alternative from further study.

S.5 Affected Environment

The study area, which includes the environment that could be affected by the Logan Northern Canal Reconstruction project, is roughly bounded by 3100 North on the north (near Hyde Park), the Logan River on the south (in Logan), about 600 East on the west (in Logan and North Logan), and about 2000 East on the east (in Logan and North Logan). A narrow corridor also extends into Logan Canyon along the Logan River to about Second Dam.

What is the project study area?

The project study area includes unincorporated areas of Cache County and parts of the cities of Logan, North Logan, and Hyde Park.

Two of the project alternatives that use the LHPS Canal would require work on about 1 mile of canal easement on National Forest System land administered by USFS in Logan Canyon. From the LHPS Canal POD, the canal travels for about 0.8 mile on National Forest System land before reaching private land. The canal then travels for 0.4 mile on private land before again entering Federal land. From this point, the canal travels for another 0.2 mile before finally leaving National Forest System land.

The analysis of the expected effects of each alternative focuses on the alternative alignments. These alignments generally follow existing canals and existing roads. The Purple Alternative and the 2900 North option for the Orange Alternative would each affect small areas of undeveloped land by constructing a new underground pipeline that would connect the LHPS and LN Canals. These undeveloped areas have historically been used for agriculture and do not support any native, undisturbed habitats.

The following sections summarize the analysis of existing conditions and/or environments in Chapter 4, Affected Environment.

S.5.1 Land-Use Plans, Policies, and Controls

This section of the EIS discusses the plans of the Cities of Logan and North Logan, Cache County, and USFS.

S.5.2 Social and Economic Conditions

- **Community resources:** The study area includes four elementary schools, none of which are adjacent to any of the alternative alignments; Utah State University and City of North Logan administrative facilities, which are near but not along any of the alternative alignments; and churches, some of which are near but not along any of the alternative alignments. In general, the quality of life judgments of people living in the study area vary based on the perceptions of individuals. The quality of life of people living along the canals is based on perceptions of the canals as a benefit that enhances their properties and/or experiences. People who do not live along the canals but who use them for recreation also perceive the canals as an important resource that adds to their overall quality of life.
- **Environmental justice:** There are potential environmental justice populations concentrated in the southwestern part of the study area. Some of these populations are near the LN Canal in the developed part of Logan.
- **Economics:** Compared to other areas of the nation and state, the study area had lower-than-average unemployment in 2010 and a higher-than-average median income. In 2009, the market value of irrigated crops produced in Cache County was $342.36 per acre.
- **Recreation:** The study area includes public parks and trails along or near the alternative alignments, a private golf course along the LHPS Canal, and National Forest System land in Logan Canyon. There is unauthorized use of canals and canal maintenance roads for recreation.
- **Scenic beauty and landscape resources:** Landforms, buildings, water, and vegetation contribute to the overall scenic quality of the study area. National Forest System land in Logan Canyon is subject to scenic quality management based on USFS guidelines. The scenic quality and landscape of the area ranges from developed/urban in Logan to rural residential in parts of Logan and North Logan to National Forest System land in Logan Canyon.
- **Energy:** The Logan City Light and Power Department generates electricity along the Logan River in the study area, but most electricity is provided by Rocky Mountain Power. Minor amounts of energy are used along canals to pump water to areas where sprinkler irrigation systems are used.

S.5.3 Natural Resources

- **Agriculture:** There are minor amounts of prime farmland (if irrigated) and locally important farmland in the northwest corner of the study area near the LN Canal. Before the 2009 landslide, 76% of the LN Canal shares were used for agriculture, while 33% of the LHPS Canal shares were used for agriculture. Irrigated crop production in the study area is dominated by alfalfa, grain, and pasture.

- **Biological resources:** Habitats along the canals in the study area include riparian along the Logan River, dry canyon slope in Logan Canyon, and urban landscaped and agricultural land in Logan and North Logan. The river supports common native and non-native fish species. Terrestrial habitats support wildlife that uses canyon slopes and foothills, riparian areas, and agricultural land. Parts of the study area are crucial winter range for deer, elk, and moose and crucial summer range for moose.

> **What is riparian habitat?**
>
> *Riparian* habitat is habitat along a river, stream, canal, or other waterway.

- **Special-status species:** The study area could support species listed under the Endangered Species Act (ESA) including Maguire's primrose (*Primula maguirei*), Ute ladies'-tresses (*Spiranthes diluvialis*), and Canada lynx (*Lynx canadensis*). Only Maguire's primrose is known to be present in Logan Canyon near the LHPS Canal POD. Several other special-status species (species that are ESA candidates, identified by the State or USFS as sensitive, part of conservation agreements, or USFS management indicator species) could be present in the study area. Of these, only Logan buckwheat (*Eriogonum loganum*) is present along the Purple and Orange Alternative alignments. Northern goshawk could forage in Logan Canyon but is not known to nest in the study area.

- **Cultural and tribal resources:** Canals and POD structures are probably eligible for listing on the National Register of Historic Places (NRHP). The results of a reconnaissance-level architectural survey of buildings along the LN Canal on the north side of Canyon Road between about 750 East and 1100 East show that one of the residential structures is probably eligible for listing on the NRHP. Other buildings along the canals are probably also eligible.

- **Topography, soils, and geology:** The topography of the study area ranges from steep canyon along the Logan River to valley flatlands. Topographic and geologic features include the Logan Bluff, the "Island," the Lake Bonneville shoreline and Lake Bonneville sediments, and the East Cache fault zone. Soils are primarily gravelly loams and silt loams.

- **Water resources:** Water resources in the study area include the Logan River, Green Canyon Creek, the LN and LHPS Canals, and a few wetland features. Logan River flows are controlled through dams in and upstream of the study area. Mapped

floodplains in the study area include those of the Logan River and Green Canyon Creek. The canal system has historically been used to convey stormwater. Groundwater in the area is influenced by water that leaks from the canals. There are several drinking water wells in the study area, but only two of these are near one or more alternative alignments.

S.6 Environmental Consequences of the Proposed Action

S.6.1 Impacts and Mitigation

In summary, the project alternatives could cause adverse and/or beneficial effects to the following resources:

- Land use
- Community resources
- Quality of life
- Economics
- Recreation
- Scenic beauty and landscape resources
- Energy
- Utilities
- Agriculture
- Biological resources
- Special-status species
- Cultural resources
- Topography, soils, and geology
- Water resources
- Noise
- Air quality

Table S-3 on page S-35 summarizes the specific impacts of the project alternatives and identifies potential ways to mitigate some of the impacts. None of the adverse effects that are expected would be significant.

S.6.2 Cumulative Effects

The CEQ NEPA regulations (40 CFR 1500–1508) require consideration of cumulative effects that could result from each project alternative. Specifically, the regulations require an analysis of how the identified adverse effects of each alternative would contribute to cumulative effects on the affected resources.

What are cumulative effects?

Cumulative effects are the resulting impacts from the proposed action combined with impacts from other past, present, and reasonably foreseeable future actions.

In general, if an alternative would not cause direct or indirect impacts on a resource, it would not contribute to a cumulative impact on the resource. The analyses found that the alternatives could have permanent effects on the following resources:

- Land use (all action alternatives)
- Community resources, quality of life, and scenic beauty (all action alternatives)
- Recreation (Purple and Orange Alternatives)
- Agriculture (Purple and Orange Alternatives)
- Biological resources (all action alternatives)
- Cultural resources (all action alternatives)
- Geology (all alternatives)
- Water resources (all action alternatives)

None of these permanent effects are significant, but some are unavoidable. The cumulative effects analysis generally did not consider construction effects because they would be temporary.

To evaluate cumulative effects, NRCS identified a reasonable geographic area for the analysis and identified the past, present, and reasonably foreseeable actions that might affect the natural and built environment in ways that are similar to the proposed action. For the purpose of this analysis, the area of focus is Cache Valley and Logan Canyon up to Third Dam.

NRCS considered the following past, present, and reasonably foreseeable actions in its cumulative effects analysis:

- Regional growth
- Groundwater development
- Large-scale road construction
- Stormwater management

The cumulative effects analysis considers land use; community resources, quality of life, landscape resources, and scenic beauty; recreation; agriculture; biological resources; cultural resources; geologic hazards; water resources; and air quality. The conclusions in Section 5.5, Cumulative Effects, show that none of the alternatives would cause or contribute to cumulative effects in the study area.

S.6.3 Hazard Potential of Each Alternative

The NRCS General Manual states that an EIS must include a description of the hazard potential of each alternative. Section 5.6, Hazard Potential of Each Alternative, discusses the hazard potential of the No-Action, Purple, Orange, and Blue Alternatives. In general, NRCS found that the following hazards could be associated with any of the alternatives:

- Flooding from a lack of adequate canal maintenance
- Flooding from combined stormwater and irrigation water flows and insufficient downstream canal capacity
- Damage to property and people from future landslides along the Logan Bluff
- Flooding from potential surface fault rupture where the canals cross the East Cache fault zone
- Flooding from seismically induced ground shaking, liquefaction, landslides, and subsidence
- Damage to property and people or flooding from rock fall in Logan Canyon

What is a surface fault rupture?

A *surface fault rupture* is the displacement seen on the ground surface when the sides of the fault have moved up or down as a result of a large earthquake.

Additionally, the Orange Alternative would present a hazard from flooding associated with Green Canyon Creek.

S.6.4 Permits and Approvals

In addition to EWPP requirements and mitigation measures that might be identified as part of this EIS, construction of the action alternatives would require the following permits or authorizations:

- Special-use permit from USFS for work on land administered by USFS (Purple and Orange Alternatives).
- CWA Section 404 authorization for modifying the LHPS and LN Canals and PODs. If USACE determines that the activity requires an individual permit, then a separate Section 401 water quality certification would also be required (all action alternatives).
- Compliance with the Clean Water Act Section 402 National Pollutant Discharge Elimination System (NPDES) general permit for construction-related stormwater discharges (file a Notice of Intent and compile a Storm Water Pollution Prevention Plan [SWPPP]) (all action alternatives).
- National Historic Preservation Act (NHPA) Section 106 concurrence and Memorandum of Agreement with the State Historic Preservation Officer (SHPO) for

modifying the LHPS Canal POD, LHPS and LN Canals, and possibly the LN Canal POD (all action alternatives).

- Stream alteration permit from the Utah Division of Water Rights for modifying the PODs (all action alternatives).
- Antidegradation review by the Utah Division of Water Quality for potential impacts to the Logan River (all action alternatives).
- Letter of map revision or map amendment from Cache County and the Federal Emergency Management Agency (FEMA) for effects to mapped floodplains (Orange and Blue Alternatives).
- Construction easements from UDOT (US 89), the City of Logan and City of North Logan (city streets and other city property), USU, and property owners along the LHPS and LN Canals (all action alternatives).

In all cases, the SLO or its contractors would be responsible for obtaining the authorizations ensuring compliance with any conditions of permit approval.

S.7 Public Participation and Agency Consultation

S.7.1 Scoping

NRCS conducted scoping for the EIS according to the NEPA guidelines and NRCS guidance. Scoping activities included a public meeting on August 11, 2010; correspondence with interested persons, organizations, and Federal, State, and local agencies, including Native American tribal organizations; and an agency scoping meeting on August 11, 2010.

What is scoping?

Scoping is an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action.

The scoping period for the Logan Northern Canal Reconstruction project began on July 22, 2010, with a Notice of Intent to prepare an EIS advertised in the U.S. government's Federal Register. The Notice of Intent was also published in the local newspaper, the Logan *Herald Journal*.

The scoping period ran from July 22 to August 31, 2010. NRCS received over 100 individual comments during scoping. These comments primarily focused on project options (or alternatives) but also addressed potential impacts on recreational use of the canals; fish, wildlife, and plant resources along the canals; socioeconomic conditions of individuals and the region; public safety; and water rights. Several people also commented on the project schedule and the process and administration of the EWPP.

NRCS used information gathered during the scoping process to identify project alternatives and to identify subjects that require specific focus in the EIS. Appendix A, Scoping Summary Report, contains the entire scoping summary report.

S.7.2 Agency Consultation

NRCS is currently consulting with the following agencies:

- Utah SHPO under Section 106 of the National Historic Preservation Act
- Tribal organizations under government-to-government consultation guidelines
- U.S. Fish and Wildlife Service (USFWS) and Utah Division of Wildlife Resources under the Fish and Wildlife Coordination Act

Once a preferred alternative is selected, NRCS and the SLO will initiate informal or formal consultation with other agencies as needed to support the permits and approvals listed in Section S.6.4, Permits and Approvals.

USFS and USACE are participating in the EIS process as cooperating agencies. NRCS has consulted and will continue to consult with representatives of these agencies throughout the EIS process.

S.7.3 Public Review of the Draft EIS

NRCS held a public meeting for the Draft EIS on March 31, 2011, at Bridgerland Applied Technology College West Campus, 1000 West 1400 North, Logan, Utah. The meeting used an open-house format. NRCS invited people to attend any time between 5:30 PM and 7:30 PM. People who attended the meeting provided written comments or oral comments to a court reporter. Additionally, NRCS gave a presentation about the Draft EIS at a joint council meeting (a meeting of the Cache County Council and councils of the Cities of Logan, North Logan, Hyde Park, and Smithfield) on March 29, 2011, at 7 PM in the Cache County Council Chambers.

NRCS encouraged comments on the Draft EIS through e-mail and U.S. mail as well as at the public meeting. The official Draft EIS comment period ran from March 17, 2011, to May 2, 2011. NRCS received a total of 58 individual comment letters, e-mails, comment forms, or oral comments (which were recorded at the open house by a court reporter). Table S-2 summarizes the number of scoping comments received by affiliation.

Table S-2. Draft EIS Comments Received by Affiliation

Affiliation	Number	Percent of Total
Individual	51	88%
Federal or State agency	4	7%
Local government	3	5%

Many of the comments were specific to the options presented during scoping. Other comments focused on the alternatives studied in the Draft EIS and conclusions about the

alternatives, potential effects on the environment, and potential effects on hydropower generation. The following list summarizes the general categories of comments that NRCS received on the Draft EIS. See Chapter 12, Comments on the Draft EIS, for copies of the comments received.

- Alternatives: comments regarding options not studied in detail, general support for specific alternatives, and general opposition to specific alternatives
- Preference to leave affected canals open for reasons related to recreation, quality of life, and wildlife
- Concern regarding vegetation removal along affected canals and how that might affect quality of life and habitat along the canals
- Concern regarding loss of recreational use of canal easements
- Concern regarding safety of canal system (safe conveyance of water and emergency response planning), especially in areas that are historically unstable
- Comments about the potential effects of changed Logan River flows on hydropower generation by the City of Logan and on the river ecosystem
- Comments about the value of hydropower generation
- Concerns and questions regarding the removal of structures from 14 properties that are in an area of historic landslide activity
- Comments regarding project costs and project funding
- Comments about canal system management and concern about statements by and planning of canal companies
- Concern about continued service to shareholders along the LN Canal upstream of about 400 North
- Comments about the alternatives' technical details such as pipe sizes, queues, and materials
- Disagreement with conclusions presented in the Draft EIS
- Comments regarding acquisition of easements to complete construction
- Comments about community disruption
- Comments about changes related to secondary benefits such as stormwater conveyance and seepage
- Comments about stabilizing the landslide area along the Logan Bluff

NRCS used the information gathered through the Draft EIS comments to make changes to this Final EIS as appropriate.

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Table S-3. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Long-Term or Permanent Impacts on Land Use							
General Land Use	None.	Permanent easements from about 2.6 acres of land for the pipeline between the LHPS Canal and LN Canal, in about 4,000 linear feet of local roads, and from about 10 properties along the LHPS Canal. Convert 14 properties from residential use to use-restricted undeveloped land.	None proposed.	Permanent easements from about 3.6 acres of land for the pipeline between the LHPS Canal and LN Canal, in about 3,100 linear feet of local roads, and from about 27 properties along the LHPS Canal. Convert 14 properties from residential use to use-restricted undeveloped land.	None proposed.	Convert 14 properties from residential use to use-restricted undeveloped land.	None proposed.
Land-Use Plans, Policies, and Controls	None.	Would require new USFS special-use permit.	None proposed.	Would require new USFS special-use permit.	None proposed.	None.	None proposed.
Long-Term or Permanent Impacts on Social and Economic Conditions							
Community Resources	None.	Modification of one road-crossing structure. Acquire 14 at-risk properties along Canyon Road and relocate residents.	None proposed.	Modification of four road-crossing structures. Acquire 14 at-risk properties along Canyon Road and relocate residents.	None proposed.	Acquire 14 at-risk properties along Canyon Road and relocate residents.	None proposed.
Quality of Life	Shareholders along LN Canal would not be able to access water from the canal system; some consider open canals a safety risk, others consider them a social amenity.	Enclose about 1 mile of LN Canal and 2.4 to 2.6 miles of LHPS Canal. Adjacent property owners and other area residents might view enclosure as positive or negative. Improve safety by removing structures from 14 at-risk properties along Canyon Road. Allow agricultural production to continue.	None proposed.	Enclose about 3.1 or 3.4 miles of LN Canal and 4.9 or 5.2 miles of LHPS Canal. Adjacent property owners and other area residents might view enclosure as positive or negative. Improve safety by removing structures from 14 at-risk properties along Canyon Road. Allow agricultural production to continue.	None proposed.	Enclose about 1.7 miles of LN Canal. Adjacent property owners and other area residents might view enclosure as positive or negative. Repair the 2009 landslide site and address some of the instability along the LN Canal alignment, which could improve safety. Further improve safety by removing structures from 14 at-risk properties along Canyon Road. Allow agricultural production to continue.	None proposed.
Economics	No shareholder access to water from the canal system. About $21 million in lost agricultural revenue over 50 years.	No adverse effects. Could provide opportunity for some shareholders to switch from flood irrigation to sprinkler irrigation between 400 North and 1500 North along the LN Canal. Otherwise the energy cost associated with pumping would remain the same.	None proposed.	No adverse effects. Would provide opportunity for shareholders to switch from flood irrigation to sprinkler irrigation between 400 North and 2900 North or 3100 North along the LN Canal. This would result in an energy savings of about $48,000 per year associated with no pumping costs.	None proposed.	None.	None proposed.
Recreation	None.	Canal structures would be constructed on or would cross National Forest System land, Logan Golf & Country Club, Ray Hugie Park, Lundstrom Park, and Bonneville Shoreline Trail. Loss of unauthorized recreation use of LHPS Canal.	None proposed.	Canal structures would be constructed on or would cross National Forest System land, Logan Golf & Country Club, Ray Hugie Park, Lundstrom Park, Riverside Trail, and Bonneville Shoreline Trail. Loss of unauthorized recreation use of LHPS Canal.	None proposed.	Would not affect any formal recreation resources and would probably not affect unauthorized use of the LN Canal easement between the LN Canal POD and 400 North.	None proposed.
Scenic Beauty and Landscape Resources	Potential aesthetic degradation due to loss of irrigation practices and less-scenic land development.	Would modify the LHPS Canal, a change that would be noticeable to people living and recreating along the affected canal reach. Removing the structures from 14 properties would affect the appearance of the affected area.	None proposed.	Same as Purple Alternative.	None proposed.	Would modify the LN Canal between the POD and 400 North, a change that would be noticeable to people living along this reach. Removing the structures from 14 properties and constructing a soil buttress would significantly affect the appearance of the area.	None proposed.

Table S-3. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Energy	Potential energy savings from decreased pumping from the canal system; potential increased energy consumption from accessing other water sources; no effect to water available to Logan City Light and Power.	Minor energy conservation benefits if shareholders along the LN Canal between 400 North and 1500 North choose to convert to pressurized systems. Could cause minor effects to power generation at the Logan City Light and Power Hydro 2 facility if the City and Logan & Northern Irrigation Company do not reach an agreement.	None proposed.	Substantial energy conservation benefits because shareholders could use the pressurized line along the LN Canal between 1500 North and 2900 North/3100 North instead of pumping. Could cause minor effects to power generation at the Logan City Light and Power Hydro 2 facility if the City and Logan & Northern Irrigation Company do not reach an agreement.	None proposed.	None.	None proposed.
Long-Term or Permanent Impacts on Natural Resource Conditions							
Agriculture	Decrease agricultural production. Shareholder access to irrigation water from the LN Canal system would not be restored.	Permanent loss of 0.3 acre of irrigated farmland.	None proposed.	2900 North option would cause the loss of about 3.0 acres of irrigated farmland and about 0.1 acre of nonirrigated farmland. The 3100 North option would not cause the loss of any farmland.	None proposed.	None.	None proposed.
Biological Resources – Habitat, Vegetation, and Wildlife	Potential spread of noxious weeds affecting habitat on or near the nonmaintained canal alignment and the landslide area that would not be repaired.	Permanent loss of riparian vegetation at the LHPS Canal POD. Potential entrapment of fish at the LHPS Canal POD. Permanent loss of vegetation along the LHPS Canal between the golf course and Lundstrom Park/1500 North. Loss of use of the open canal by locally common wildlife during the irrigation season between the LHPS Canal POD and Lundstrom Park/1500 North.	Use native riparian plants for restoration where possible. Modification of the LHPS Canal POD structure would include a device to prevent fish from entering the canal or from becoming trapped at the POD structure. Modifications to the LHPS Canal would include components that would allow the installation of low-flow irrigation systems to serve land in the canal easement.	Permanent loss of riparian vegetation at the LHPS Canal POD. Potential entrapment of fish at the LHPS Canal POD. Permanent loss of vegetation along the LHPS Canal between the golf course and 2900 North/3100 North. Loss of use of the open canal by locally common wildlife during the irrigation season between the LHPS Canal POD and 2900 North/3100 North.	Same as Purple Alternative.	Permanent loss of riparian vegetation at the LN Canal POD. Potential entrapment of fish at the LN Canal POD. Permanent loss of vegetation along the LN Canal between the POD and 400 North. Loss of use of the open canal by locally common wildlife during the irrigation season between the LN Canal POD and 400 North.	Use native riparian plants for restoration where possible. Modification of the LN Canal POD structure would include a device to prevent fish from entering the canal or from becoming trapped at the POD structure. Modifications to the LN Canal would include components that would allow the installation of low-flow irrigation systems to serve land in the canal easement.
Cultural and Tribal Resources	None.	Modify potentially NRHP-eligible structures including the LHPS Canal POD, 2.4 to 2.6 miles of the LHPS Canal, and 1 mile of the LN Canal. Remove one NRHP-eligible residential structure from along Canyon Road; requires consultation with Utah SHPO to verify eligibility.	NRCS/SHPO Memorandum of Agreement {MOA) will specify required mitigation.	Modify potentially NRHP-eligible structures including the LHPS Canal POD, between 4.9 and 5.2 miles of the LHPS Canal, and 1 mile of the LN Canal. Remove one NRHP-eligible residential structure from along Canyon Road; requires consultation with Utah SHPO to verify eligibility.	Same as Purple Alternative.	Modify potentially NRHP-eligible structures including the LN Canal POD and 1.7 miles of the LN Canal. Remove one NRHP-eligible residential structure from along Canyon Road; requires consultation with Utah SHPO to verify eligibility.	Same as Purple Alternative.
Topography, Soils, and Geology	None.	None.	None proposed.	None.	None proposed.	Topographic impacts from regrading the 2009 landslide area and constructing the 0.5-mile-long soil buttress. No impacts to soils or geology.	None proposed.
Water Resources – Surface Waters: Logan River and Green Canyon Creek	Connection between Logan River and Smithfield Creek would not be restored. Logan River would continue to receive return flow from irrigation diversion above Laub Diversion.	Minor effect to the Logan River at the LHPS Canal POD. Enclose 2.4 to 2.6 miles of the LHPS Canal. Place 1 mile of the LN Canal in a pipe outside the canal easement between 400 North and 1500 North. Place 1 mile of the LN Canal in a pipe between the LN Canal POD and the Laub Diversion. Potential effect to Logan River flow downstream of the LHPS Canal POD.	Develop and implement a plan to determine an irrigation season flow requirement for the Logan River below the LHPS Canal POD. This requirement would be part of a special-use permit for operating the Purple Alternative on USFS-administered land.	Minor effect to the Logan River at the LHPS Canal POD. Enclose between 4.9 and 5.2 miles of the LHPS Canal. New culvert would cross over Green Canyon Creek. Place 3.1 to 3.4 miles of the LN Canal in a pipe outside the canal easement. Place 1 mile of the LN Canal in a pipe between the LN Canal POD and the Laub Diversion. Potential effect to Logan River flow downstream of the LHPS Canal POD.	Same as Purple Alternative.	Minor effect to the Logan River at the LN Canal POD. Enclose about 1.7 miles of the LN Canal.	None proposed.

Table S-3. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Water Resources – Water Quality	None.	Potential improvement of irrigation water quality in LN and LHPS Canals due to separating stormwater from irrigation water in 0.8 to 1.0 mile of the LHPS Canal and about 2 miles of the LN Canal.	None proposed.	Potential improvement of irrigation water quality in LN and LHPS Canals due to separating stormwater from irrigation water in about 4.1 to 4.4 miles of the LHPS Canal and in about 4.1 to 4.4 miles of the LN Canal.	None proposed.	Potential improvement of irrigation water quality in LN Canal due to separating stormwater from irrigation water between the LN Canal POD and about 400 North.	None proposed.
Water Resources – Stormwater	Beneficial effect because of increased stormwater capacity of the LN Canal.	Increase LN Canal stormwater capacity in the LN Canal between the LN Canal POD and the Laub Diversion and between 400 North and 1500 North. Separate stormwater system in LHPS Canal alignment and combined irrigation and stormwater system in the LN Canal would require maintenance as a stormwater facility.	Develop a stormwater management and maintenance program for the LHPS Canal between the Logan Golf & Country Club and Lundstrom Park/1500 North and the LN Canal between the LN POD and 1500 North.	Increase LN Canal stormwater capacity in the LN Canal between the LN Canal POD and the Laub Diversion and between 400 North and either 2900 North or 3100 North. Separate stormwater system in LHPS Canal alignment and combined irrigation and stormwater system in the LN Canal would require maintenance as a stormwater facility.	Develop a stormwater management and maintenance program for the LHPS Canal between the Logan Golf & Country Club and 2900 North or 3100 North and the LN Canal between the LN Canal POD and 2900 North or 3100 North.	Separate stormwater system in LN Canal alignment would require maintenance as a stormwater facility.	Develop a stormwater management and maintenance program for the LN Canal between the LN Canal POD and 400 North.
Water Resources – Floodplains	None.	None.	None proposed.	Construction of box culvert in LHPS Canal alignment through the Green Canyon Creek Zone A floodplain (designed to avoid adverse effects). Construction of the 2900 North connecting pipe would cross the Green Canyon Creek Zone A floodplain (designed to avoid adverse effects).	None proposed.	Construction of new LN Canal POD in Logan River Zone A2 floodplain (designed to avoid adverse effects).	None proposed.
Water Resources – Groundwater	About 4,000 acre-feet of canal water per year no longer lost from seepage.	About 7,400 acre-feet of irrigation water would no longer be lost to seepage due to canal enclosures, resulting in a 3% reduction in annual groundwater recharge.	None proposed.	About 13,000 acre-feet of irrigation water would no longer be lost to seepage due to canal enclosures, resulting in a 6% reduction in annual groundwater recharge.	None proposed.	About 1,300 acre-feet of irrigation water would no longer be lost to seepage due to canal enclosures, resulting in a 0.5% reduction in annual groundwater recharge.	None proposed.
Water Resources – Public Water Supply	None.	Would cross one drinking water source protection Zone 1 and five Zone 4s; operation of the system would not affect any drinking water source protection zone.	None proposed.	Same as Purple Alternative.	None proposed.	Construction of the soil buttress would be within one drinking water source protection Zone 1.	None proposed.
Water Resources – Water Use and Water Rights	Limited shareholder use of water from the LN Canal.	Conservation of 7,400 acre-feet of water per year due to canal enclosures. Provide opportunities for shareholders along about 1 mile of the LN Canal to convert from flood to sprinkler irrigation, which would conserve water.	None proposed.	Conservation of 13,000 acre-feet of water per year due to canal enclosures. Provide opportunities for shareholders along between 3.1 and 3.4 miles of the LN Canal to convert from flood to sprinkler irrigation, which would conserve water.	None proposed.	Conservation of 1,300 acre-feet of water per year due to canal enclosure.	None proposed.
Construction Impacts							
Land Use	None.	About 158 construction easements required on public land, private residential/agricultural land, and private nonagricultural land.	None proposed.	About 354 construction easements required on public land, private residential/agricultural land, and private nonagricultural land.	None proposed.	About 63 construction easements required on public land and private residential/agricultural land.	None proposed.
Social and Economic Environment – Community Resources, Quality of Life, and Scenic Beauty	None.	Short-term, construction-related effects such as noise, dust, and traffic interruptions.	Develop a plan that specifies acceptable work hours and days, describes how access to private properties and businesses would be maintained, and describes how the contractor would communicate with area residents.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.
Social and Economic Environment – Environmental Justice	None.	Temporary effects to four block groups of low-income populations and three blocks of minority populations; effects would be the same as those on non–environmental justice populations.	None proposed.	Temporary effects to four block groups of low-income populations and four blocks of minority populations; effects would be the same as those on non–environmental justice populations.	None proposed.	Temporary effects to one low-income block group; effects would be the same as those on non–environmental justice populations.	None proposed.

Table S-3. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Social and Economic Environment – Economics	None.	Short-term benefit to local economy during construction.	None proposed.	Same as Purple Alternative.	None proposed.	Same as Purple Alternative.	None proposed.
Social and Economic Environment – Recreation	None.	Construction activities along the canal alignments might temporarily affect use of or access to the Riverside Trail along the Logan River, USFS-administered land, Bonneville Shoreline Trail, Ray Hugie Park, the golf course, and Lundstrom Park. Could temporarily interrupt water delivery to golf course if construction takes place during irrigation season. Would temporarily affect unauthorized recreation use of the maintenance roads along both canals.	Work with Logan Golf & Country Club to ensure that this facility remains accessible during construction and that water delivery during construction meets the golf course operator's turf irrigation needs. Work with the City of Logan to ensure that Lundstrom Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas. Place signs on the segment of the Bonneville Shoreline Trail that would be affected to inform the public of the work schedule, work activity, and potential temporary trail closures and detours.	Construction activities along the canal alignments might temporarily affect use of or access to the Riverside Trail along the Logan River, USFS-administered land, Bonneville Shoreline Trail, Ray Hugie Park, the golf course, Lundstrom Park, pocket parks between 2950 North and 3100 North, and Elk Ridge Park. Could temporarily interrupt water delivery to golf course if construction takes place during irrigation season. Would temporarily affect unauthorized use of the maintenance roads along both canals.	Work with Logan Golf & Country Club to ensure that this facility remains accessible during construction and that water delivery during construction meets the golf course operator's turf irrigation needs. Work with the City of Logan to ensure that Lundstrom Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas. Place signs on the segment of the Bonneville Shoreline Trail that would be affected to inform the public of the work schedule, work activity, and potential temporary trail closures and detours. Work with the City of North Logan to ensure that Elk Ridge Park remains accessible during construction and that construction areas are fenced to prevent park users from accessing potentially unsafe work areas.	Construction activities along the LN Canal alignment might temporarily affect use of or access to public recreation areas along the Logan River and the Boulevard Trail. Would temporarily affect unauthorized use of the maintenance road along the LN Canal.	None proposed.
Social and Economic Environment – Energy	None.	Construction activities would require energy and fuel for equipment.	None proposed.	Same as Purple Alternative.	None proposed.	Same as Purple Alternative.	None proposed.
Social and Economic Environment – Utilities	None.	Construction activities could affect utilities and/or require temporary utility service interruptions.	Contact Blue Stakes and utility owners to ensure that impacts to utilities and utility service are minimized during construction.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.
Natural Resources – Agriculture	None.	Temporarily affect use of irrigated and nonirrigated farmland in some areas along the alternative alignment by restricting access or temporarily using farmland for construction staging. If construction occurs during irrigation season, could disrupt irrigation water service to LHPS Canal and LN Canal shareholders.	If necessary, work with the Logan & Northern Irrigation Company; the Logan, Hyde Park and Smithfield Canal Company; the Cities of Logan and North Logan; USU; and other canal companies as appropriate to identify ways that the shareholders' allocated water can be delivered during construction.	Same as Purple Alternative.	Same as Purple Alternative.	None.	None proposed.

Table S-3. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Natural Resources – Biological Resources	None.	Construction activities would require removing riparian vegetation at the LHPS Canal POD on the Logan River and upland and landscaped vegetation along the canal alignments. Modifications to the LHPS Canal POD could temporarily affect aquatic habitat in the Logan River. Temporary effects to locally common wildlife. Construction and restoration activities could contribute to the spread of noxious weeds.	Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place. Define a work zone along the alternative alignment within which all activity would take place. Provide extra protection measures for sensitive areas such as private residential landscaping and public parks to ensure that impacts to surrounding vegetation are avoided. Apply best management practices (BMPs) to ensure that construction does not introduce noxious weeds or invasive species and does not cause the spread of existing populations of noxious weeds or invasive species.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.
Natural Resources – Special-Status Species	None.	Construction could damage a known population of Logan buckwheat in Logan Canyon. Construction could disturb birds protected under the Migratory Bird Treaty Act. Construction could disturb nesting bald eagles, if any are present in Logan Canyon.	Verify extent of Logan buckwheat populations in order to avoid them during construction activities. If construction activities occur between April 10 and August 31, conduct survey for nesting migratory birds in the work areas; if nesting migratory birds are found, protect active nests from construction activities until the young have fledged. If construction activities occur during December to February in Logan Canyon, coordinate with USFWS to determine if a survey for bald eagles is needed. If a survey is needed, the results would determine whether construction restrictions are imposed to protect nesting bald eagles.	Same as Purple Alternative.	Same as Purple Alternative.	Construction could disturb birds protected under the Migratory Bird Treaty Act.	If construction activities occur between April 10 and August 31, conduct survey for nesting migratory birds in the work areas; if nesting migratory birds are found, protect active nests from construction activities until the young have fledged.
Natural Resources – Cultural and Tribal Resources	None.	No additional effects to NRHP-eligible or listed resources not already identified as permanent effects under *Long-Term or Permanent Impacts on Natural Resource Conditions, Cultural and Tribal Resources* above in this table for the Purple Alternative.	In the event of an unanticipated discovery of archaeological materials during construction, work would cease and Cache County or its contractor would contact the NRCS Cultural Resources Specialist. NRCS would investigate the discovery and would enter into consultation per 36 CFR 800.6 to develop the appropriate methods for treating the discovery.	No additional effects to NRHP-eligible or listed resources not already identified as permanent effects under *Long-Term or Permanent Impacts on Natural Resource Conditions, Cultural and Tribal Resources* above in this table for the Orange Alternative.	Same as Purple Alternative.	No additional effects to NRHP-eligible or listed resources not already identified as permanent effects under *Long-Term or Permanent Impacts on Natural Resource Conditions, Cultural and Tribal Resources* above in this table for the Blue Alternative.	Same as Purple Alternative.
Natural Resources – Topography, Soils, and Geology	None.	Construction activities would disturb more than 1 acre and require soil protection and erosion-control measures and restoration for compliance with CWA Section 402.	None proposed.	Same as Purple Alternative.	None proposed.	Construction activities would disturb more than 1 acre and require soil protection and erosion-control measures and restoration for compliance with CWA Section 402. Construction activities would affect the topography of the Logan Bluff along the LN Canal.	None proposed.

Table S-3. Comparison of Alternatives – Summary of Impacts and Potential Mitigation Measures

Subject	No-Action Alternative	Purple Alternative		Orange Alternative		Blue Alternative	
	Effects	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures	Effects	Potential Mitigation Measures
Natural Resources – Water Resources	None.	Potential impacts to the Logan River channel and stream bank during construction of the LHPS Canal POD structure depending on the final design of the POD structure. Construction activity would require compliance with Sections 401 and 404 of the CWA and would require a USFS special-use permit. Potential impacts to the jurisdictional wetland along 1500 North if the wetland is not avoided. Potential inability to use the canals for stormwater conveyance during construction if temporary conveyance measures are not implemented. Potential effects to the City of Logan's 700 North well if construction disturbs the well head. Potential interruption in delivery of irrigation water to shareholders during construction.	Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place. Protect the wetland along 1500 North by excluding all equipment from the area, not storing materials in the area, and ensuring that construction workers know to avoid the area. The contractor would fully fence the area. Wetland hydrology outside the delineated wetland would also be protected from excavation or other ground-disturbing activities. The boundaries of the wetland area would be shown on construction plans. Develop a temporary stormwater-conveyance plan for the canals during construction. Construction plans would identify the location of the 700 North well head, and the construction contractor would ensure that the well head is protected from disturbance during construction. Develop an irrigation-water-delivery plan for the LHPS Canal if construction occurs during the irrigation season.	Potential impacts to the Logan River channel and stream bank during construction of the LHPS Canal POD structure depending on the final design of the POD structure. Construction activity would require compliance with Sections 401 and 404 of the CWA and would require a USFS special-use permit. Potential inability to use the canals for stormwater conveyance during construction if temporary conveyance measures are not implemented. Potential effects to the Green Canyon Creek floodplain if materials and equipment are stored in the floodplain. Potential effects to the City of Logan's 700 North well if construction disturbs the well head. Potential interruption in delivery of irrigation water to shareholders during construction.	Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place. Develop a temporary stormwater-conveyance plan for the canals during construction. Equipment or materials would not be stored in mapped floodplains. The boundaries of the flood zones would be shown on construction plans, and construction workers would be made aware of the limitations on equipment and material storage. Construction plans would identify the location of the 700 North well head, and the construction contractor would ensure that the well head is protected from disturbance during construction. Develop an irrigation-water-delivery plan for the LHPS Canal if construction occurs during the irrigation season.	Potential effects to the Logan River floodplain if materials and equipment are stored in the floodplain. Potential inability to use the canals for stormwater conveyance during construction if temporary conveyance measures are not implemented. Potential effects to the Logan River floodplain if materials and equipment are stored in the floodplain. Potential effects to the City of Logan's Crockett Avenue well if construction disturbs the well head. Potential interruption in delivery of irrigation water to shareholders during construction.	Prepare a site-specific construction-management plan that addresses how construction near or in the Logan River would take place. Develop a temporary stormwater-conveyance plan for the canals during construction. Equipment or materials would not be stored in mapped floodplains. The boundaries of the flood zones would be shown on construction plans, and construction workers would be made aware of the limitations on equipment and material storage. The construction plans would identify the location of the Crockett Avenue well head. The construction contractor would ensure that the well head is protected from disturbance during construction. Develop an irrigation-water-delivery plan for the LHPS Canal if construction occurs during the irrigation season.
Natural Resources – Noise	None.	Temporary noise impacts to people recreating near, visiting businesses and community facilities in, and living near construction areas.	Develop a work plan that identifies hours and days of work and limitations in areas close to highly sensitive receptors at specific times, if warranted. The plan would identify the highly sensitive receptors that are very close to the construction areas. Cache County or its contractor would communicate its construction schedule with people at sensitive receptors and would work with potentially affected parties to identify appropriate work time restrictions. Apply BMPs to reduce construction-related noise impacts.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.
Natural Resources – Air Quality	None.	Construction activities could generate dust and particulate matter. This impact would be short term.	Develop an air-quality-management plan that identifies dust-control measures for equipment use along the construction corridor, appropriate staging locations and measures to reduce dust at those locations, and potential restrictions during times when the State determines that the air quality is unhealthy. Communicate the construction schedule with people living, working, and recreating near the construction area so that all potentially affected people are aware that construction activity could temporarily reduce local air quality.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.	Same as Purple Alternative.