Appendix A

Comments and Responses

Table A-1. Topics and Associated Codes.

[To be completed after public review of Draft Plan–EA]

Table A-2. Responses to Comments Received During the Public Comment Period for Go to File > Info > Properties > Advanced > Summary --> Fill in Name Irrigation District Watershed Plan–EA

[To be completed after public review of Draft Plan-EA]

Appendix B

Project Map

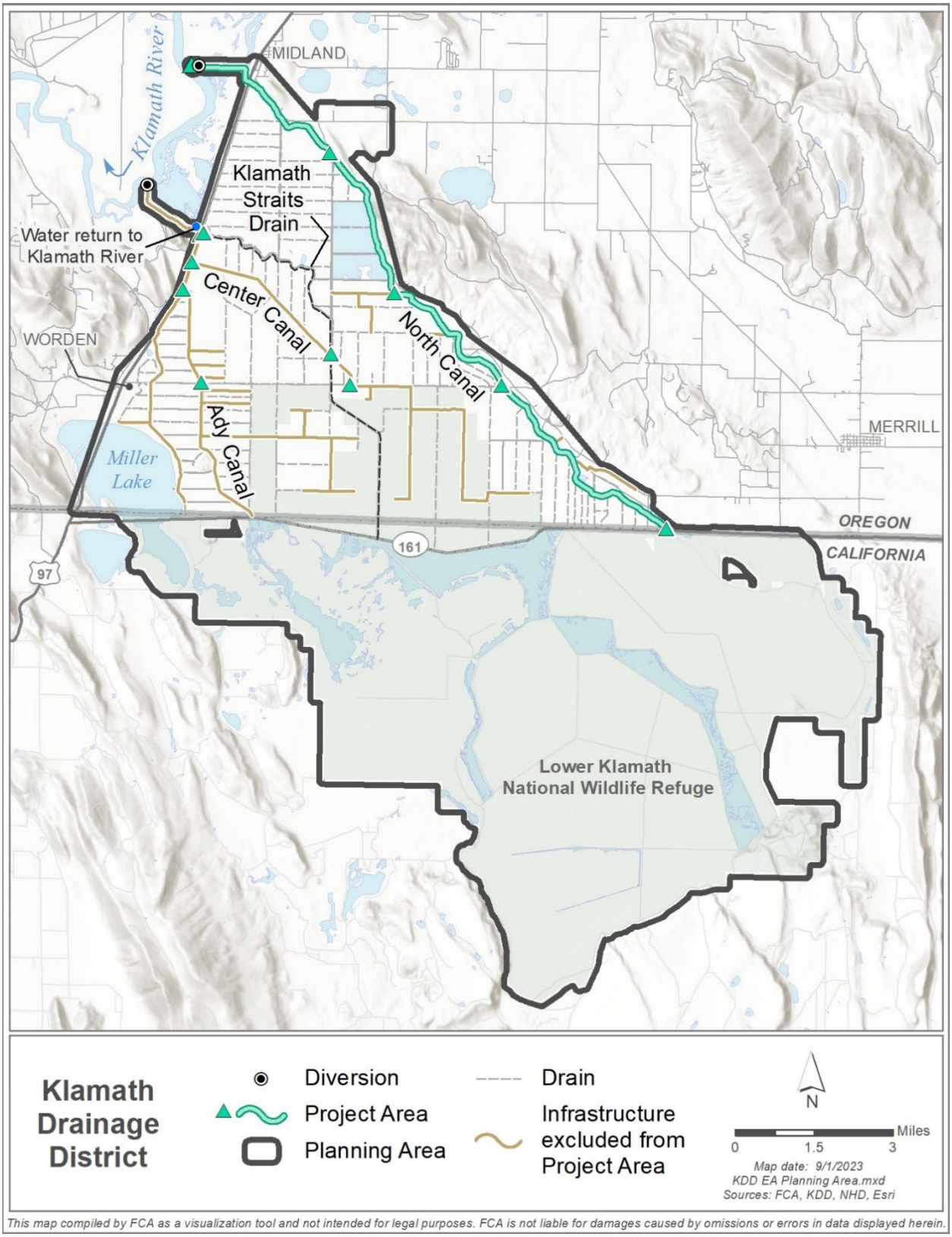


Figure B-1. Klamath Drainage District planning area and project area.

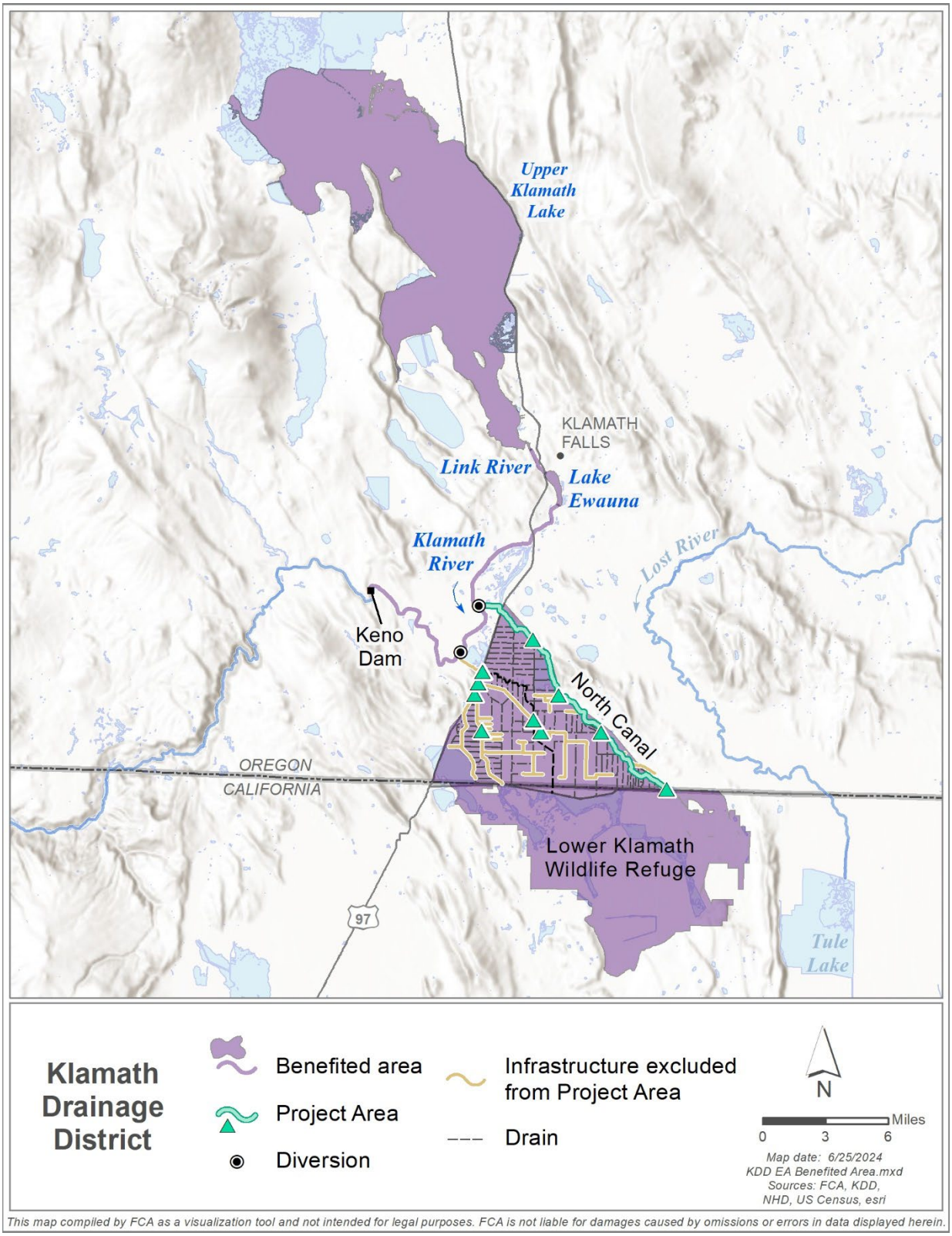


Figure B-2. Areas benefited by the Klamath Drainage District Project.

Appendix C

Supporting Maps

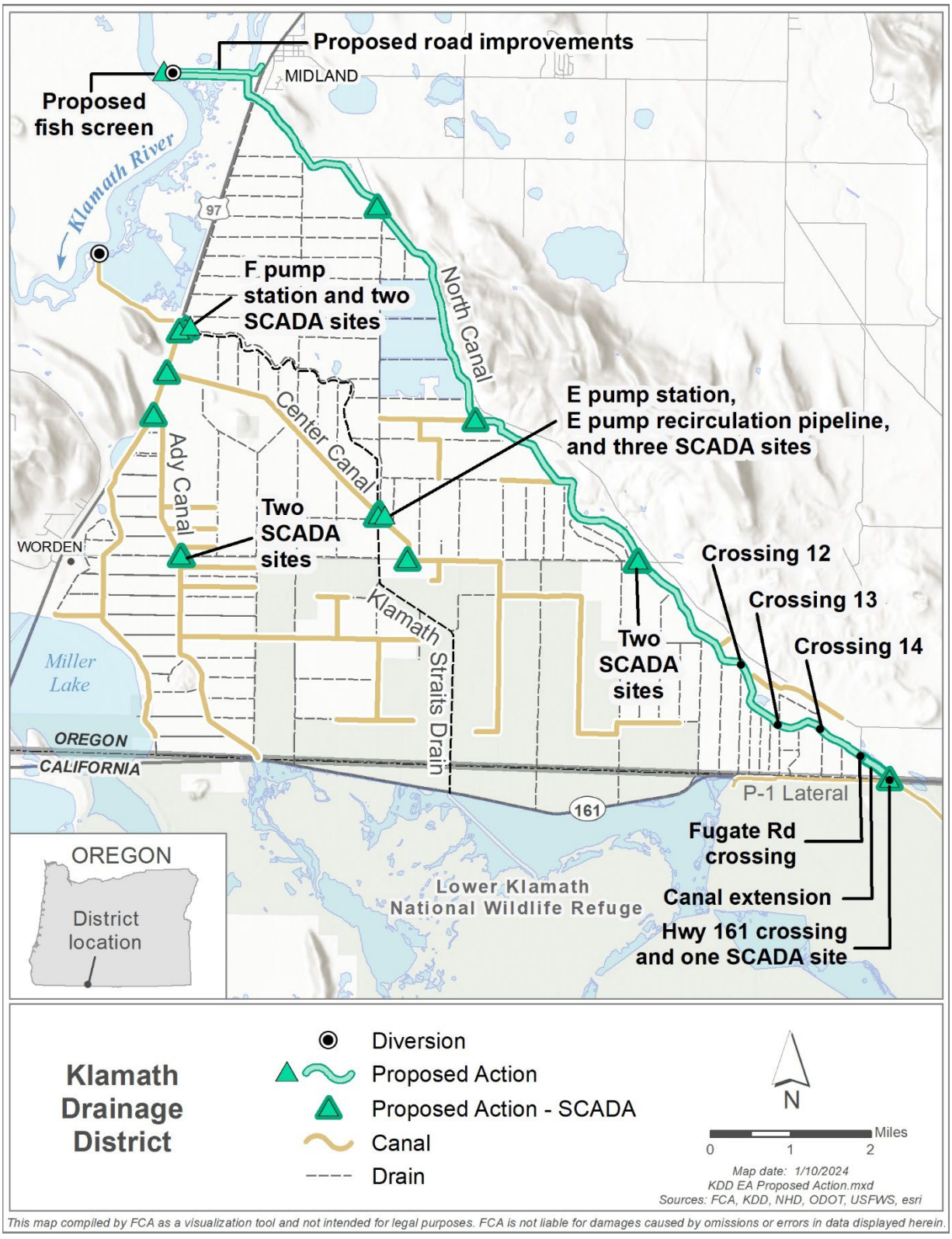


Figure C-1. District Infrastructure Modernization Alternative.

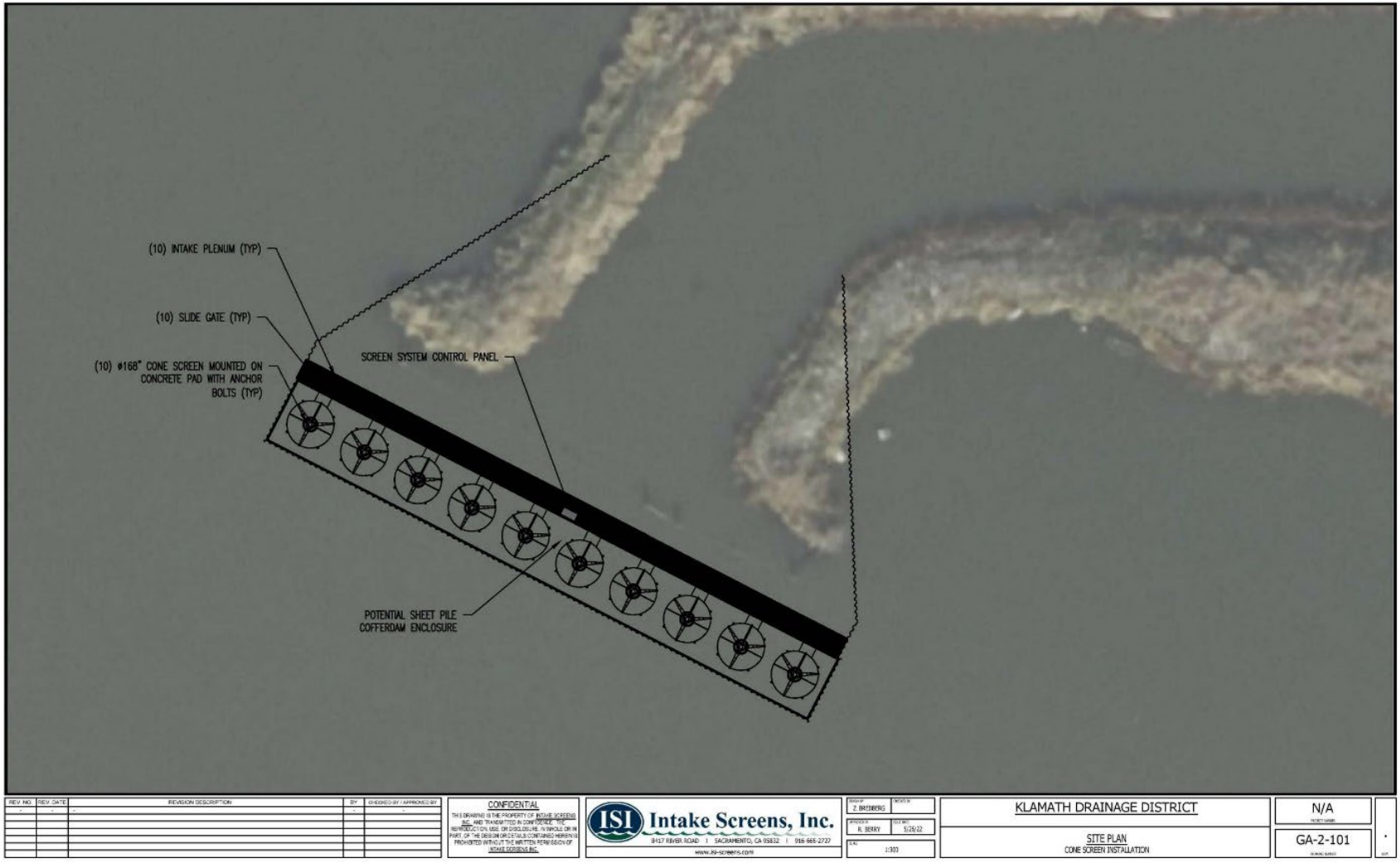


Figure C-2. North Canal Diversion fish screen overview design.

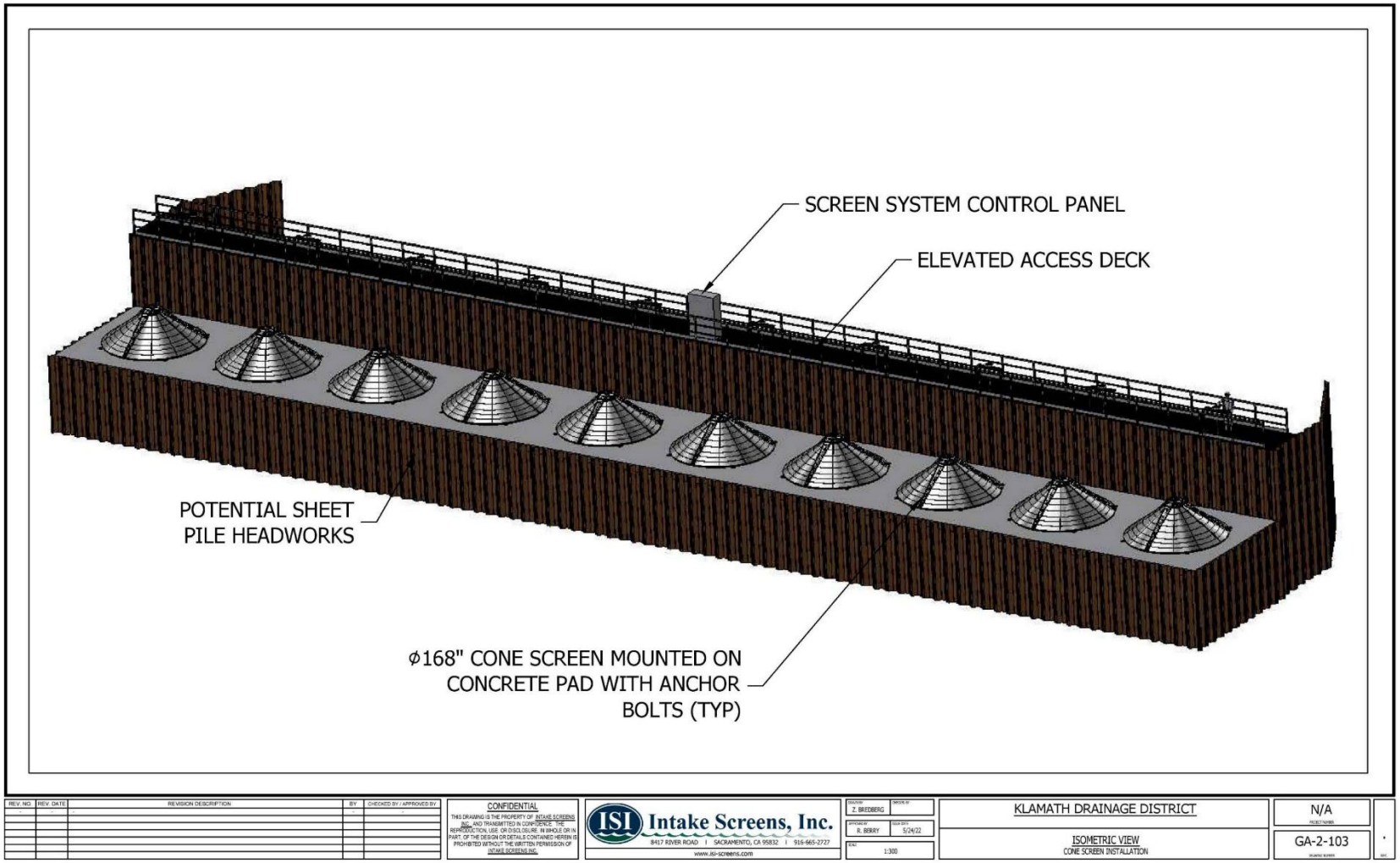


Figure C-3. Isometric view of North Canal fish screen.

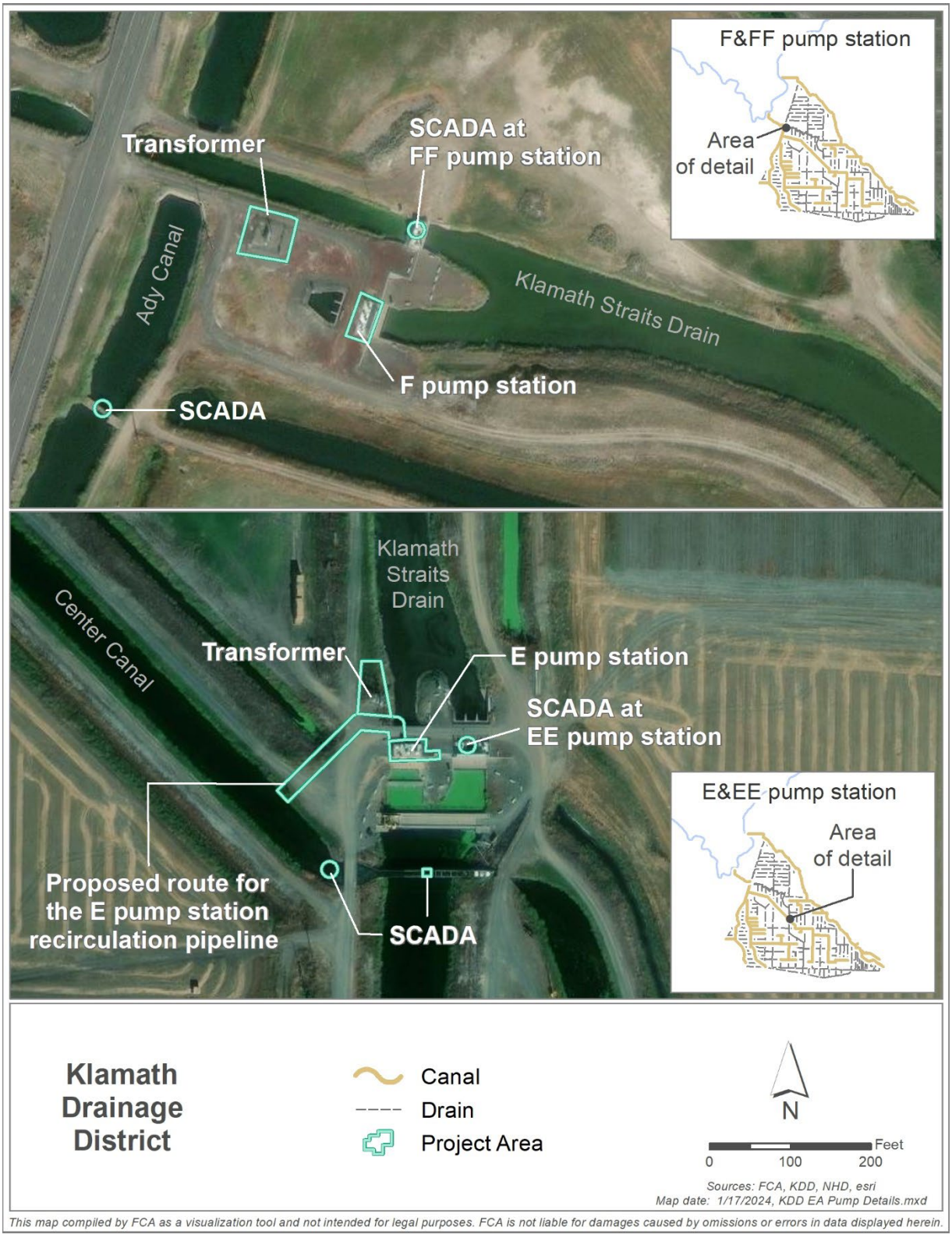


Figure C-4. E and F Pump Station Project overview.

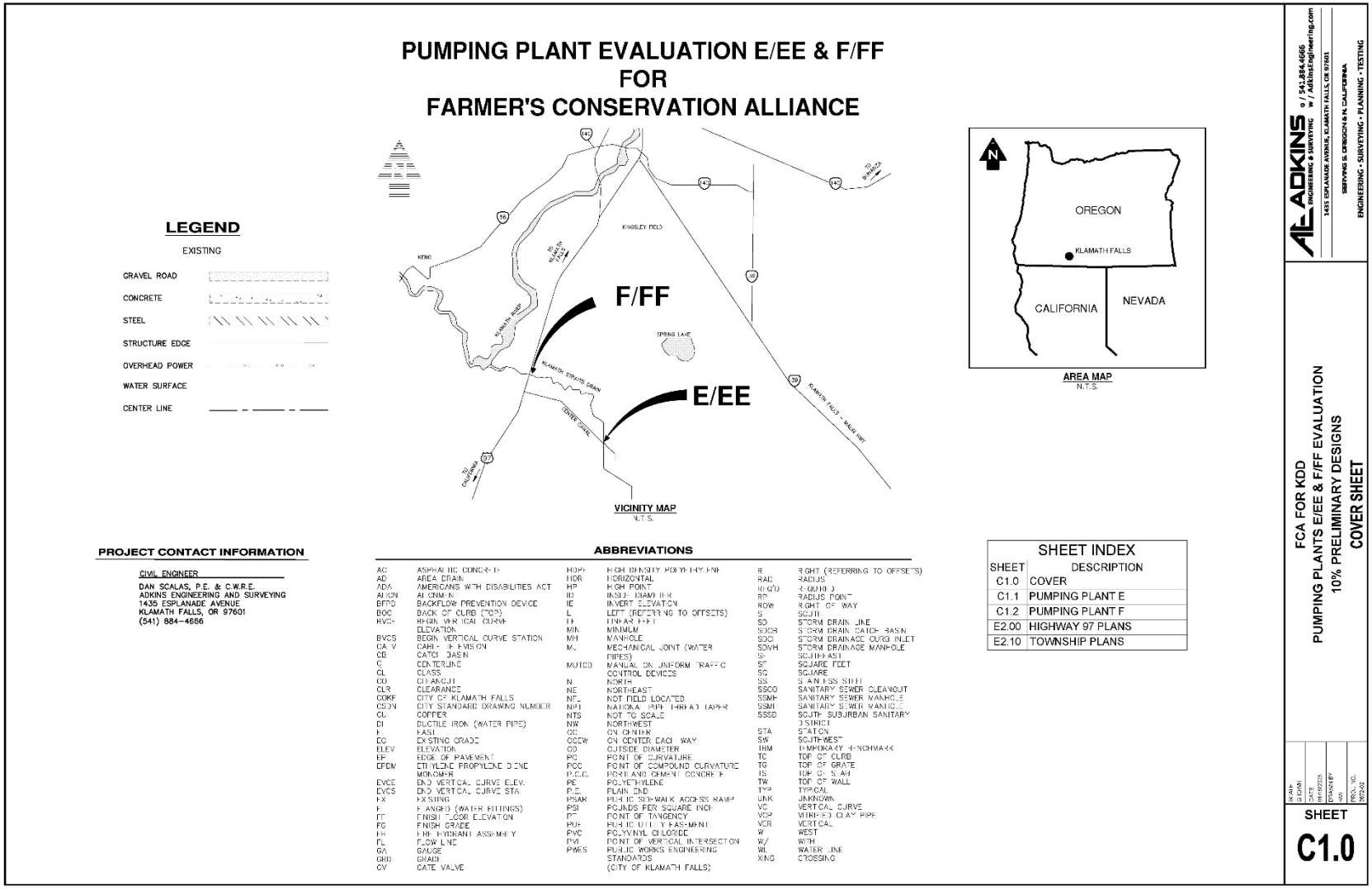


Figure C-5. Pumping plant evaluation overview.

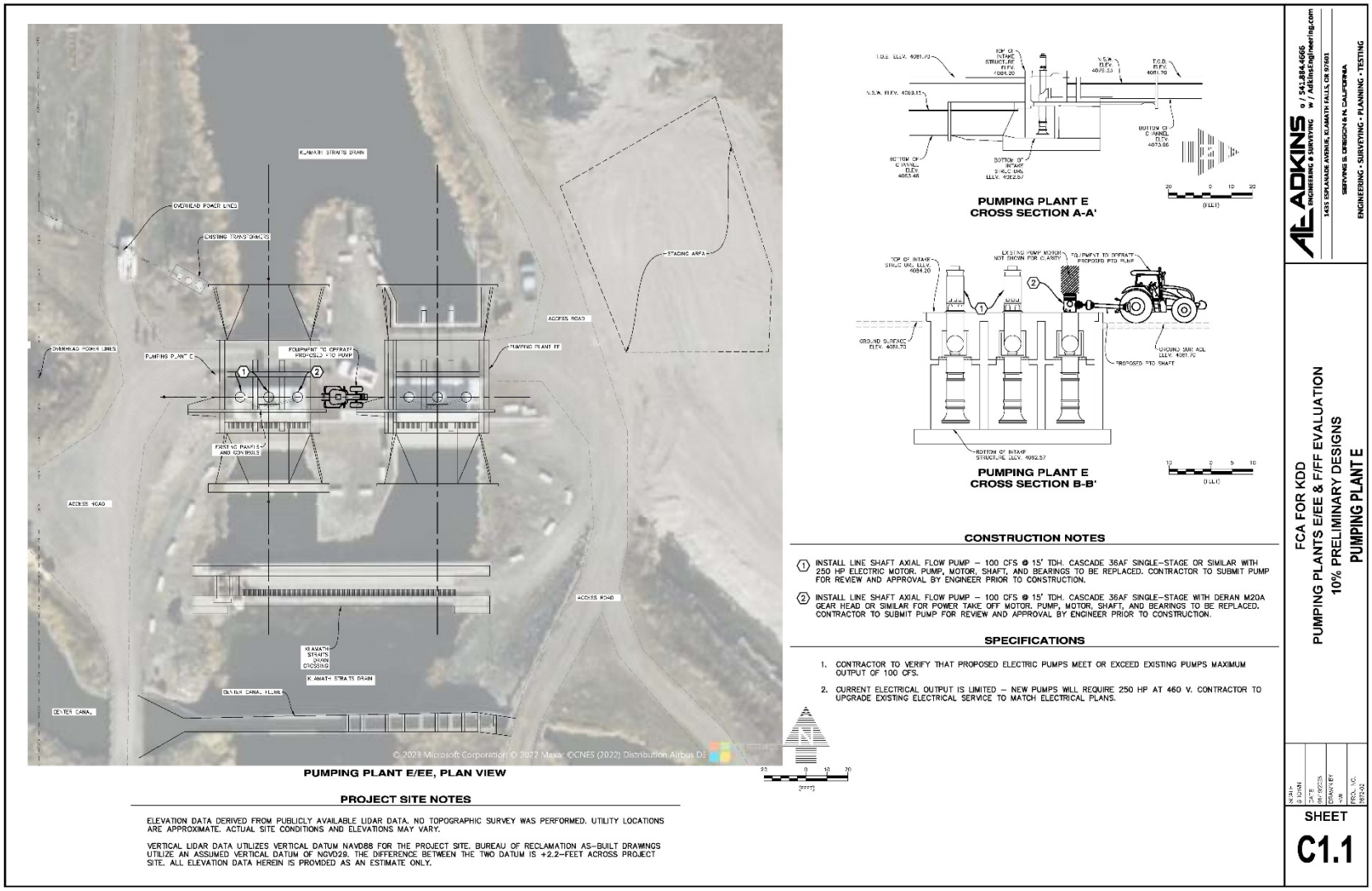


Figure C-6. Pumping Plant E/EE overview.

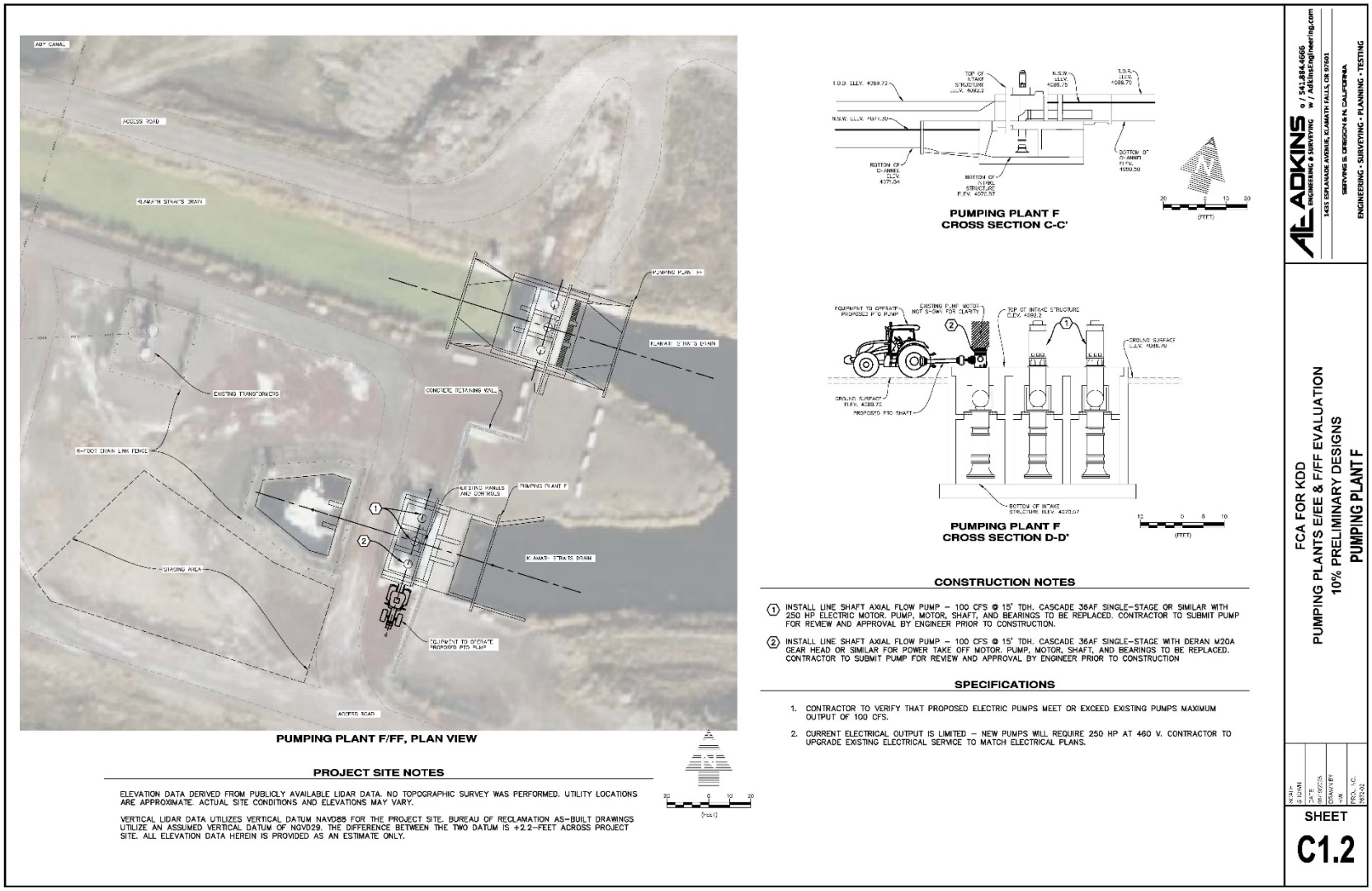


Figure C-7. Pumping Plant F/FF overview.

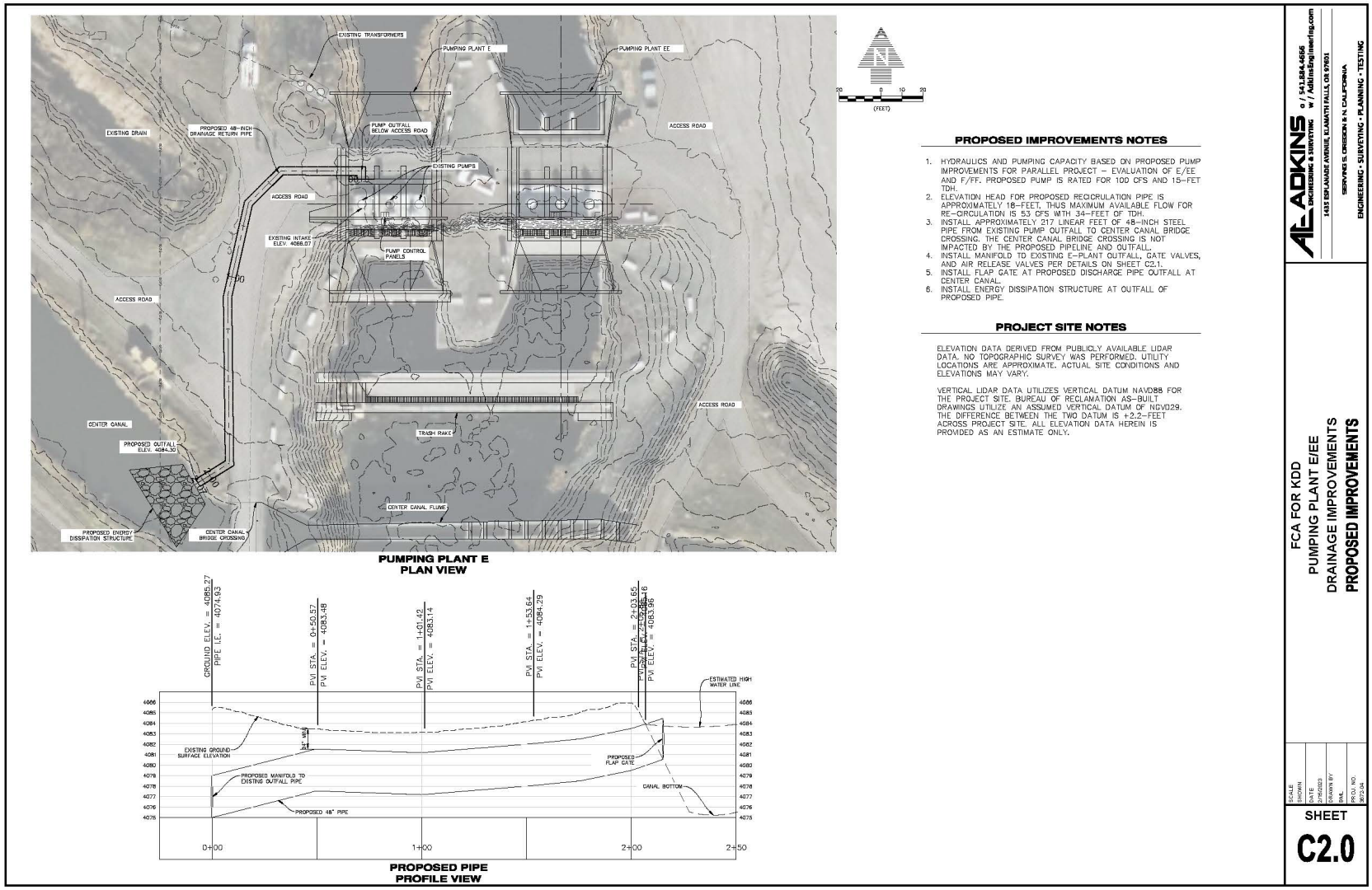


Figure C-8. Overview of proposed E Pumping Plant recirculation pipeline.

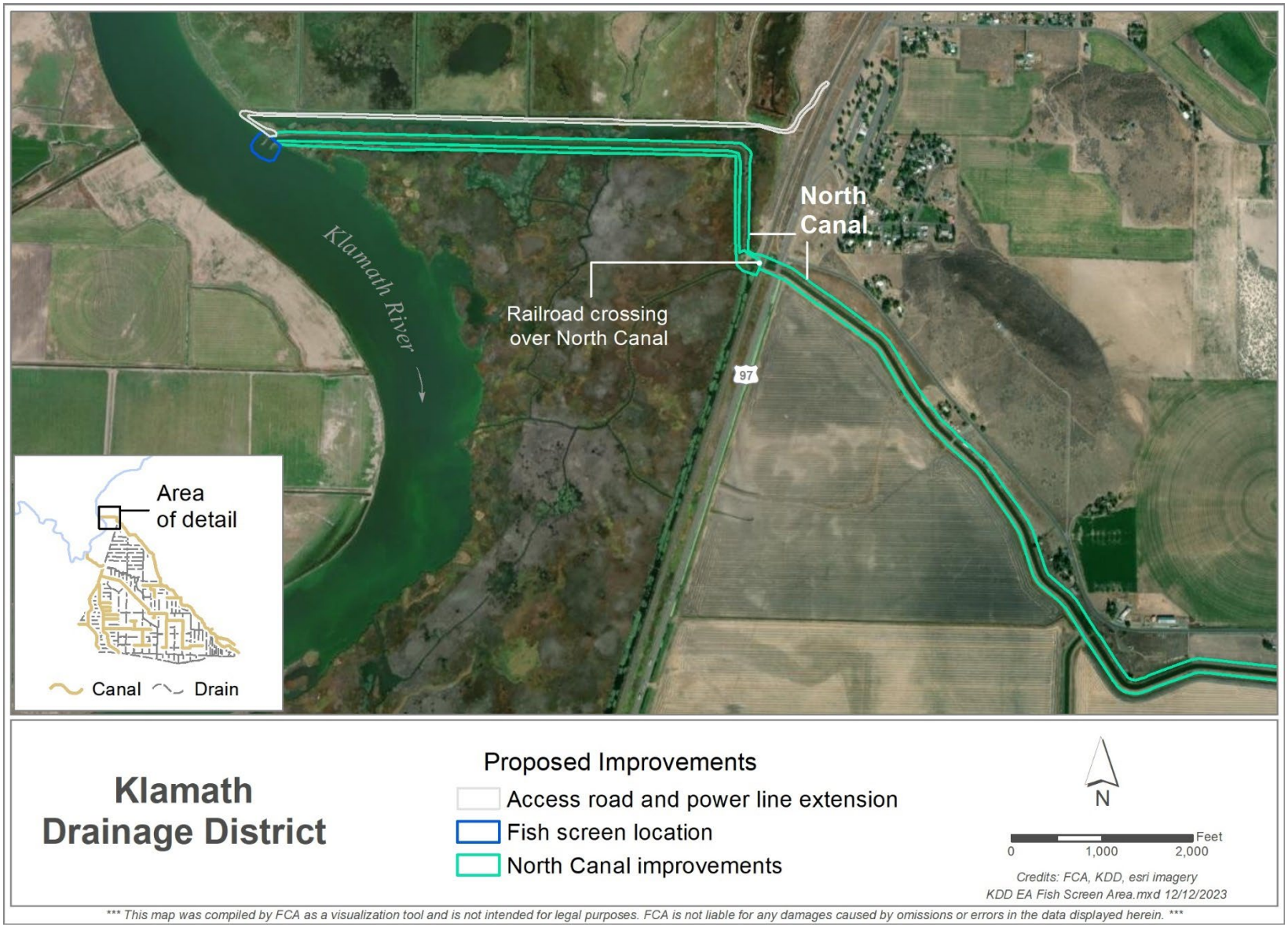


Figure C-9. Location of Klamath Drainage District North Canal railroad crossing.

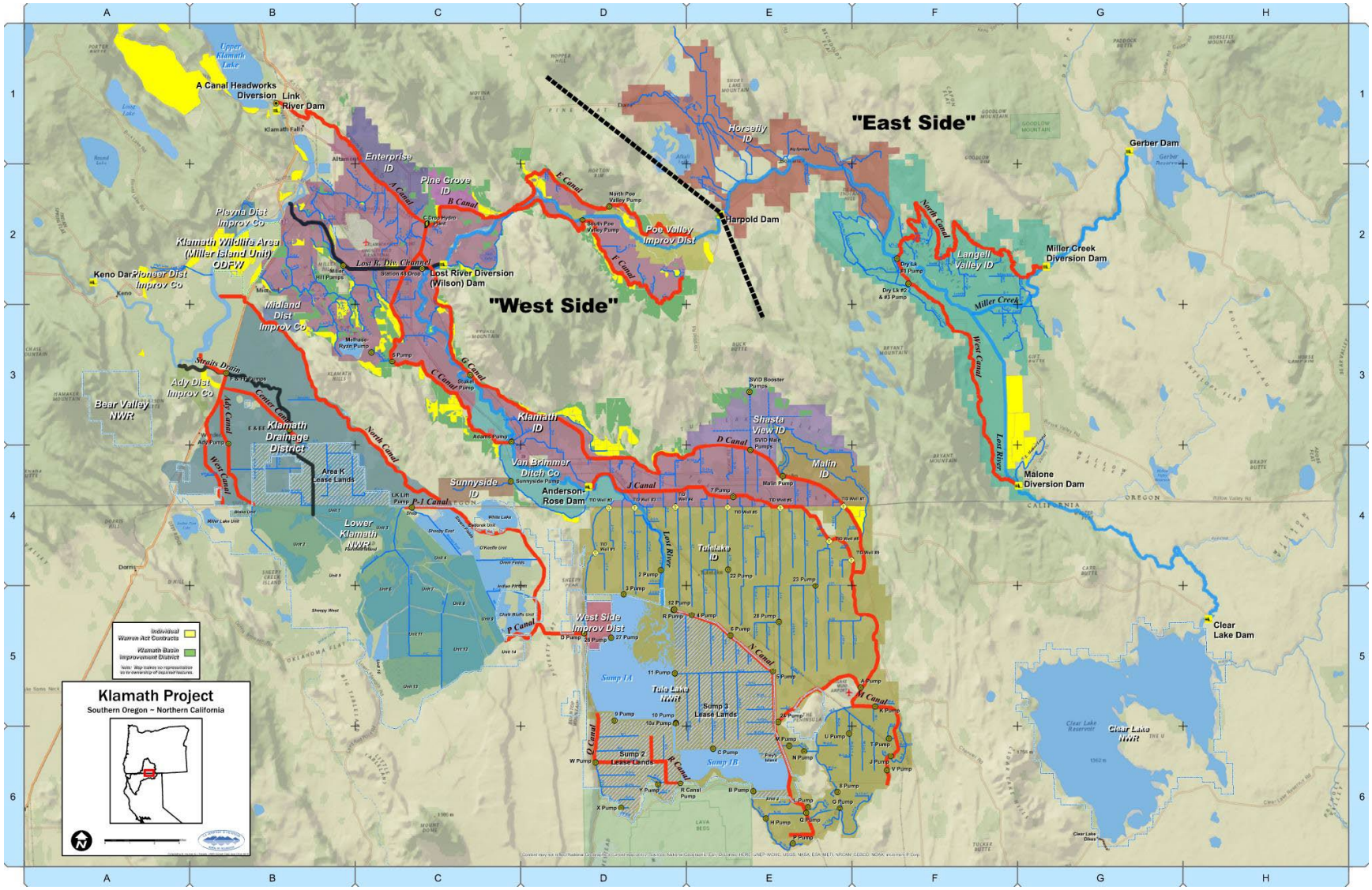


Figure C-10. Klamath Project Irrigation Districts.

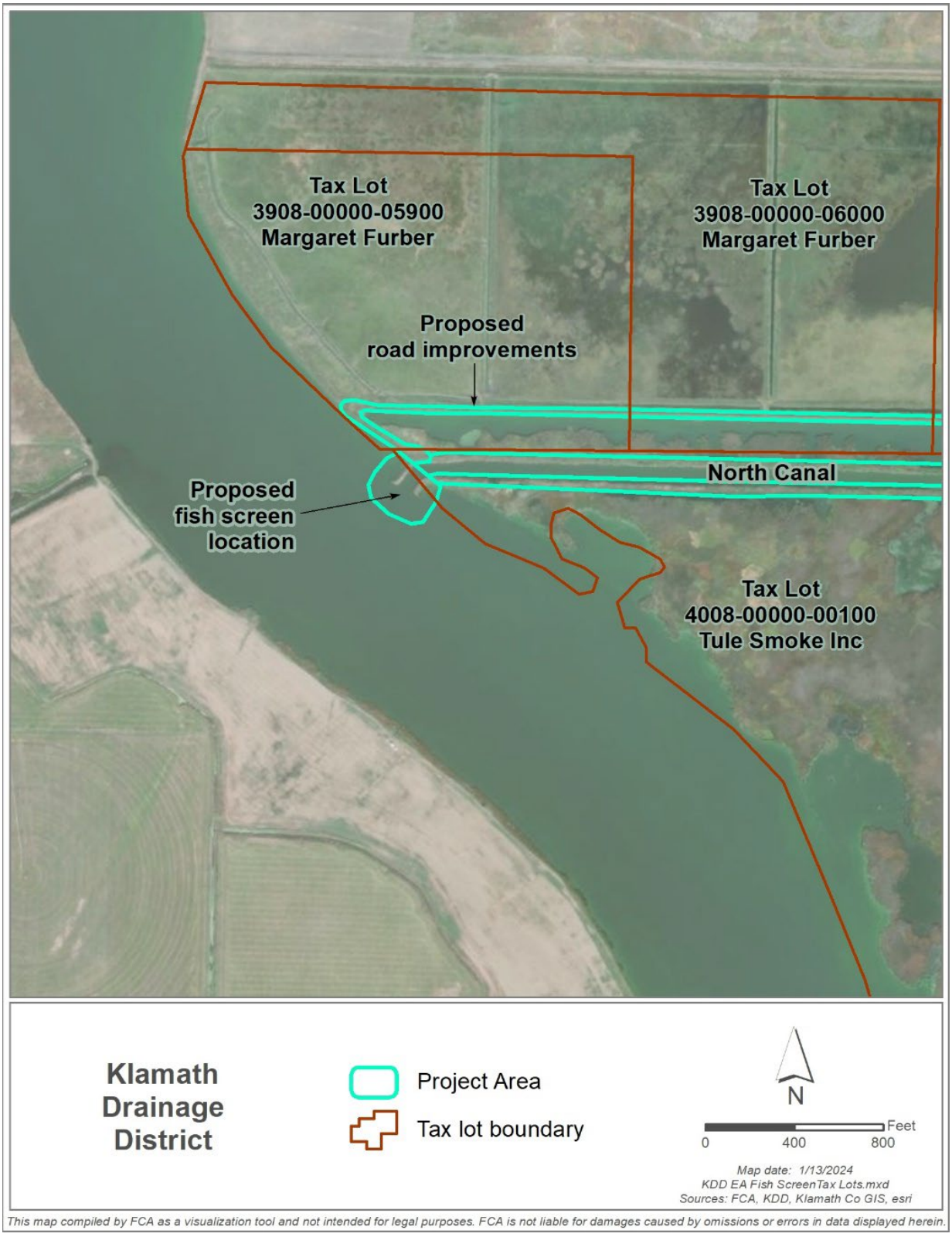


Figure C-11. Tax lots associated with the North Canal Fish Screen Project.

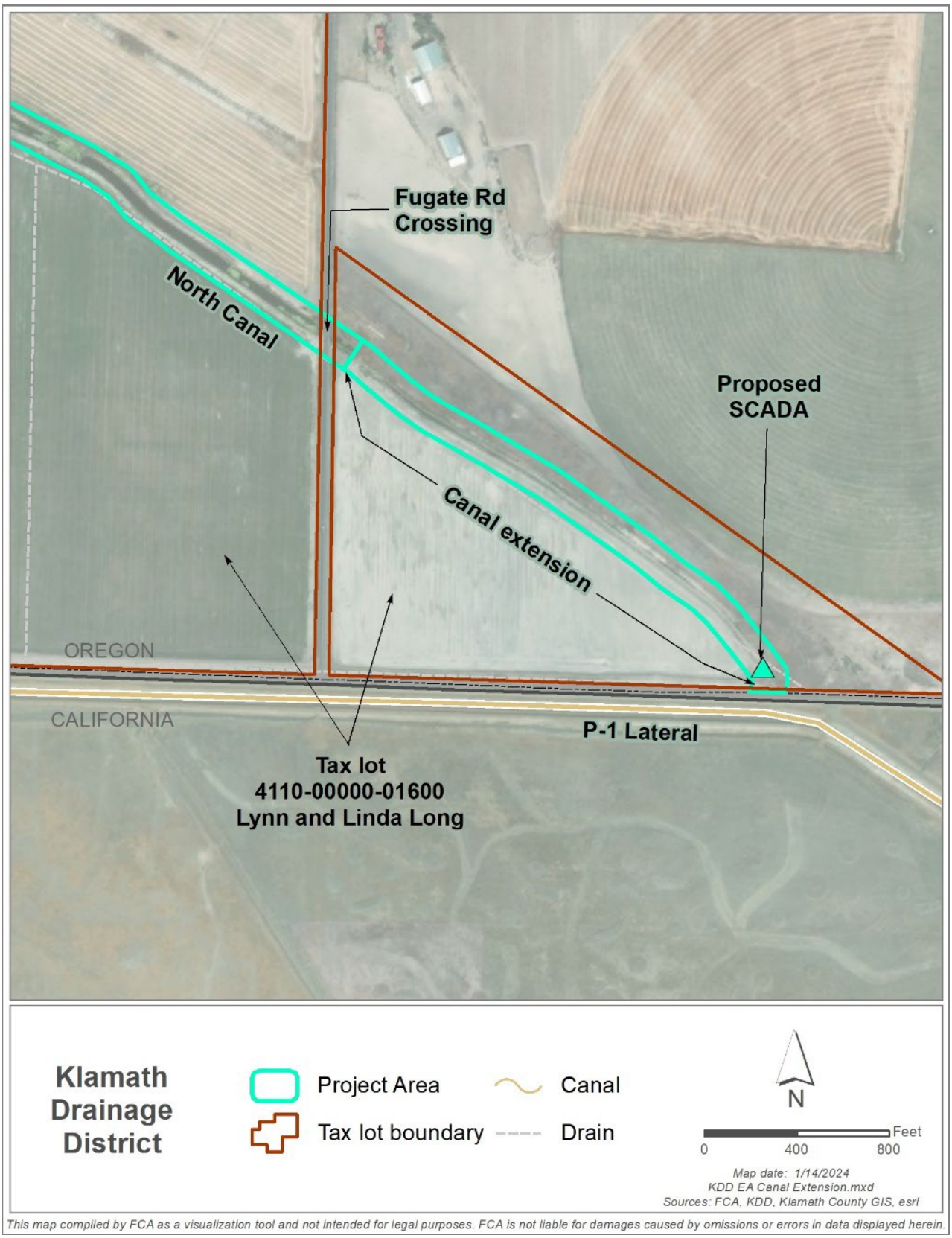


Figure C-12. Tax lots associated with the North Canal Extension Project.

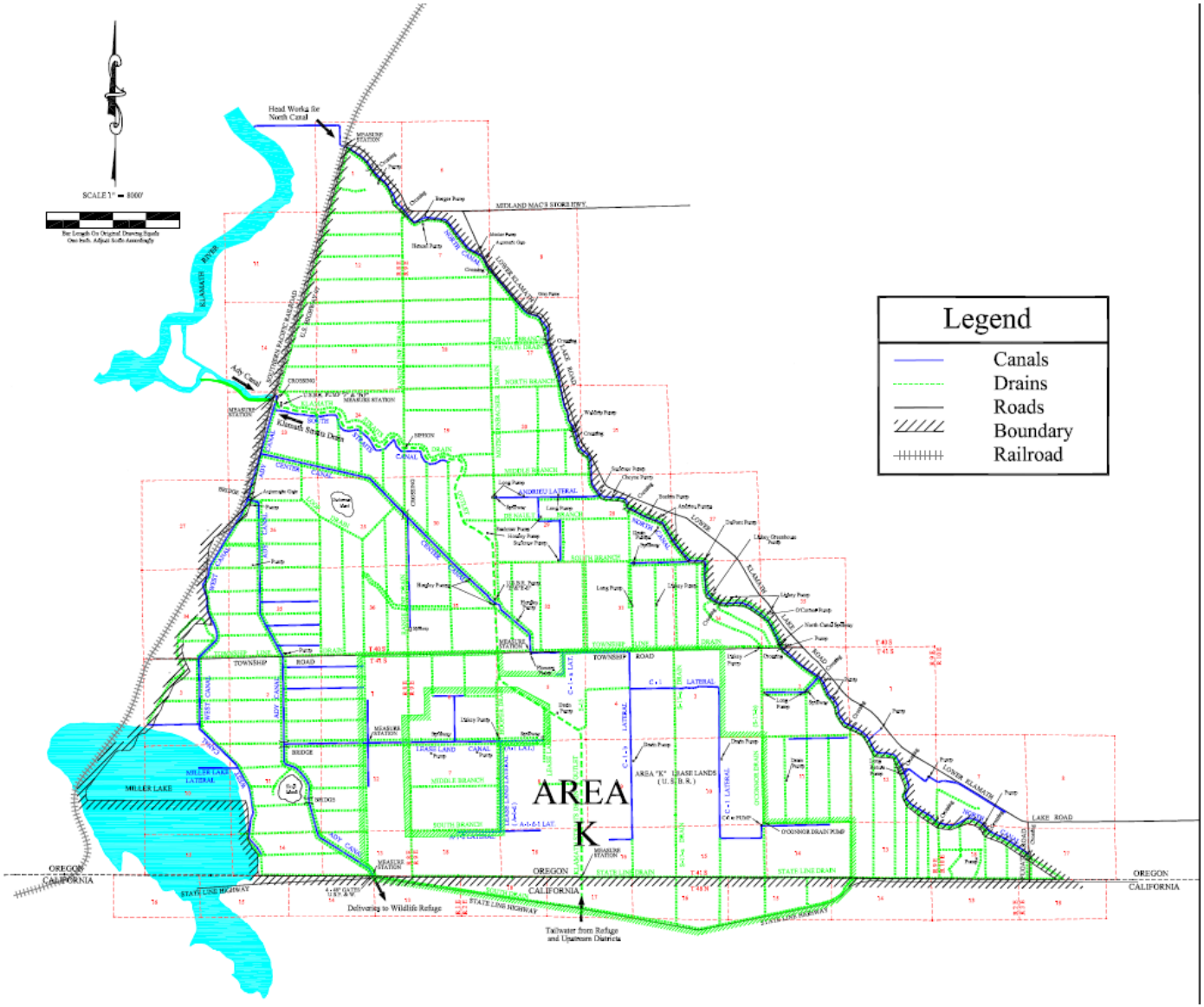


Figure C-13. Klamath Drainage District flow diagram.

Figure C-14. Example of break in southern North Canal levee.

Appendix D

Investigation and Analyses Report

D.1 National Economic Development Analysis

Highland Economics LLC

Klamath Drainage District

Barbara Wyse and Winston Oakley

7/3/2024

1 Introduction

This appendix outlines the costs and benefits of the Modernization Alternative (also referred to as the Project) and the No Action Alternative. The Modernization Alternative represents future conditions with federal funding through Public Law No. (Pub. L. No.) 83-566. The No Action Alternative represents the future if Klamath Drainage District (KDD or District) does not receive federal funding through Pub. L. No. 83-566 and continues current operation and management.

This National Economic Development (NED) analysis is divided into six sections. Following this introduction, the second section describes key economic analysis parameters. The third section describes the costs of the alternatives, while the fourth section presents benefits. The fifth section compares benefits and costs of the Modernization Alternative over the No Action Alternative. References are presented in the sixth section.

All economic values are presented in 2023 dollars rounded to the nearest $1,000. Unless otherwise noted, all NED values are presented in average annual values (following the approach described in the NRCS Water Resources Handbook for Economics) using the 2.5 percent planning rate for federal water projects for fiscal year 2023 (U.S. Bureau of Reclamation, 2022). Under this method, all costs and benefits are evaluated at the 2023 price level for all applicable years in the study period, then converted to a present value over the entire analysis period using the 2.5 percent planning rate as the discount rate. Finally, each present value is amortized to average annual values over the evaluation period using the 2.5percent rate.

1.1 Project Overview

The Klamath Drainage District (KDD or District) Infrastructure Modernization Project is an agricultural water conveyance efficiency and habitat improvement project. The Modernization Alternative would extend the North Canal to the Lower Klamath National Wildlife Refuge (LKNWR), install Supervisory Control and Data Acquisition (SCADA) systems, install a fish screen at North Canal diversion point on the Klamath River, replace the E and F pump stations, install recirculation piping infrastructure in the E Pumping Plant, and upgrade turnouts.

1.2 Project Location

The District is located just south of Midland in Klamath County, Oregon. The District serves roughly 27,000 acres of irrigated farmland. KDD diverts natural flow from the Klamath River and its tributaries, and also diverts stored water released from Upper Klamath Lake. The planning area is defined as the entire District.

1.3 Watershed Plan–EA Alternatives

1.3.1 No Action Alternative

Under the No Action Alternative, federal funding through Pub. L. No. 83-566 would not be available to implement the Project. The District and the Bureau of Reclamation (Reclamation), which operates pump plants in KDD, would continue to operate and maintain infrastructure consistent with past and current operations. The No Action Alternative assumes that modernization of the District's system to meet the purpose and need of the Project would not be reasonably certain to occur. The No Action Alternative is a near-term continuation of the standard operation procedures, which maximize the operational efficiency of the district with the current infrastructure.

1.3.2 Modernization Alternative

The Modernization Alternative is KDD's desired alternative. Under this alternative, federal funding through Pub. L. No. 83-566 would be available. The District would perform the following actions:

- Extend North Canal to LKNWR (2,451 feet or 0.46 miles)
- Install 14 SCADA systems
- Install a fish screen at the North Canal Diversion
- Upgrade the E and F Pumping Plants (currently owned and operated by Reclamation)
- Install recirculation piping infrastructure at the E Pumping Plant
- Upgrade 76 turnouts

2 Economic Analysis Parameters

This NED analysis compares the economic benefits and costs of the Modernization Alternative that differ from the No Action Alternative to estimate the net benefits of implementing the Modernization Alternative. All economic values are presented in 2023 dollars rounded to the nearest $1,000. Unless otherwise noted, all NED values are presented in average annual values (following the approach described in the NRCS Water Resources Handbook for Economics) using the 2.5-percent planning rate for federal water projects for fiscal year 2023 (U.S. Bureau of Reclamation, 2022). Under this method, all costs and benefits are evaluated at the 2023 price level for all applicable years in the study period, then converted to a present value over the entire analysis period using the 2.5 percent planning rate as the discount rate. Finally, each present value is amortized to average annual values over the evaluation period using the 2.5 percent rate.

2.1 Evaluation Unit

The proposed project consists of six project groups, which are the evaluation units for this analysis. Each of the project actions noted above under the Modernization is an evaluation unit. These are the project groups

1. Project Group (PG) 1 North Canal Extension
2. PG2 SCADA System
3. PG3 Fish Screen
4. PG4 E and F Pumping Plants
5. PG5 E Pump Recirculation
6. PG6 Upgraded Turnouts

An important note for the incremental analysis is that the costs for constructing any given project group would not change if it were the only project group to be constructed.

2.2 Project Implementation and Analysis Timeline

District staff predict that, if Pub. L. No. 83-566 funds are made available, construction of the six project groups would likely be completed over approximately three years, with some overlap in construction timing between project groups. For each project group, this analysis assumes that full benefits would be realized the year after construction is completed (e.g., for PG1 North Canal Improvements, which would be constructed in Year 0, full benefits would be realized in Year 1). This information is summarized in Table D-1.

2.3 Analysis Period

The analysis period is defined as 103 years, which includes three years of project construction/installation and 100 years of project life, based on the expected life of the North Canal Extension (during which time it is expected to bring significant project benefits). Accordingly, the study period extends from Year 0 (construction start) to Year 102 (last year of potential useful life for the project). The anticipated installation/construction timing, as well as the life of each project group, is summarized in Table D-1.

Table D-1. Construction Timeline and Project Life for the Modernization Alternative, Klamath River Watershed, Oregon.

Works of Improvement	Construction Start Year	Construction End Year	Project Life Start Year	Project Life End Year
PG1 North Canal Improvements	0	0	1	100
PG2 SCADA System	0	0	1	100
PG3 Fish Screen	1	2	3	102
PG4 E and F Pumping Plants	2	2	3	102
PG5 E Pump Recirculation	2	2	3	102
PG6 Upgraded Turnouts	1	1	2	101

Prepared July 2024

3 NED Costs

3.1 Costs of the No Action Alternative

Under the No Action Alternative, federal funding through Pub. L. No. 83-566 would not be available to implement the project. The District and Reclamation (which operates the E/EE and F/FF pumping plants within the District) would continue to operate and maintain the existing system consistent with past and current management, which would include replacing infrastructure that reaches the end of its useful life before the end of the period of analysis. Part of this continued management under the No Action Alternative would include planned replacement of several infrastructure components that would also be replaced under the Modernization Alternative. Specifically, under No Action, Reclamation anticipates replacing the E and F pumping plants (which would also be replaced in the PG4 under the Modernization Alternative, but in an earlier year) and KDD anticipates replacing a temporary pump (that would be rendered unnecessary by PG5 E Pump Recirculation in the Modernization Alternative). We present these No Action replacement costs in this section, and then compare them against the costs of the Modernization Alternative to estimate the NED cost difference between the No Action and Modernization Alternatives.

In the No Action Alternative, Reclamation plans to replace the 10 pumps that operate the current E, EE, F, and FF pumping plants during the period of analysis. Reclamation is currently replacing one pump every other year until all pumps are replaced; to date it has replaced two pumps in the EE and FF pumping plants (White, 2023). Reclamation would then have to replace these pumps roughly every 30 years after their initial replacement. Reclamation estimates that it would cost $1.44 million to replace all three E pumps (average cost of $480,000 per pump) and $1.405 million to replace all three F pumps (average cost of $468,000 per pump). The F pumps are assumed to be replaced in Years 1, 3, and 5, and again in every following 30-year increment based on a 30-year pump life. The E pumps are estimated to be replaced in years 7, 9, 11 and again in every following 30-year increment.[1] Because the timing and costs of replacing the EE and FF pumps would be unaffected by the Modernization Alternative, these replacement costs are not included.

Currently, recirculation on the Klamath Straits Drain is aided by a temporary, mobile pump. Under the No Action Alternative, KDD would have to replace this pump in roughly Year 20 at an estimated cost of $70,000, and again every 30 years afterwards (White, 2023). Accordingly, our analysis models a cost of $70,000 in Years 20, 50, and 80. This cost would be avoided in the Modernization Alternative by the PG5 E Pump Recirculation.

As shown in Table D-2, the annualized replacement costs under the No Action Alternative (that would be avoided under the Modernization Alternative) total $124,000.

[1] Reclamation did not provide information on the order of pump replacement for the 12 pumps. We assume that Reclamation would replace the E and F pumping plants first, since those were prioritized for replacement under the Modernization Alternative. We model the less expensive F Pumping Plant being replaced before the E Pumping Plant, which provides the most conservative estimate of the benefits of the Modernization Alternative (since discounting reduces the present value of future avoided costs).

Table D-2. Replacement Costs of the No Action Alternative, Klamath River Watershed, Oregon, 2023 dollars[1]

Works of Improvement	Cost per Replacement	Remaining Useful Life of Current Infrastructure (years)	Useful Life of Replacement Infrastructure (years)	Annualized Costs of Replacement
PG1 North Canal Improvements	N/A	N/A	N/A	$0
PG2 SCADA System	N/A	N/A	N/A	$0
PG3 Fish Screen	N/A	N/A	N/A	$0
PG4 E and F Pumping Plants	$2,845,000	1-11	30	$122,000
PG5 E Pump Recirculation	$70,000	20	30	$2,000
PG6 Upgraded Turnouts	N/A		N/A	$0
Total	**N/A**	**N/A**	**N/A**	**$124,000**

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent. Prepared July 2024

3.2 Costs of the Modernization Alternative

The costs of the Modernization Alternative include the initial construction/installation costs of each project group, as well as other costs that are the direct result of project implementation that would occur during the analysis period. These costs are referred to as "Other Direct Costs" and include costs of operations, maintenance, and replacement (OMR). All costs are presented in 2023 dollars and converted to present value in the current year (and not the construction year), so no inflation of construction costs was included.

3.3 Project Installation Costs

Project installation costs include mobilization and staging of construction or installation equipment, delivery of construction materials to project areas, dewatering (where necessary), installation/construction of equipment, excavation (where necessary), compaction of backfill that is native material, restoration and reseeding of the disturbed areas, and any costs associated with obtaining easements or land acquisitions. There are no expected installation costs associated with cultural mitigation. In the case of PG2 SCADA System, the project installation costs include the equipment, installation (including providing power through solar panels or grid power), and set-up of the system.

The total cost of installation/construction of the Modernization Alternative is estimated at $16,878,000 (Farmers Conservation Alliance, 2023). This includes the costs of construction; engineering, construction management, survey costs (estimated at 10 to 30 percent of construction costs); contractor markup (estimated at 11 to 18 percent of construction costs); contingency costs (estimated at 12 to 30 percent of the subtotal of other cost components).

The total costs also include project administration costs for KDD and NRCS (7 percent of the subtotal of previously mentioned cost components; 5 percent for KDD, which would be covered by NRCS, and 2 percent for NRCS), and technical assistance from NRCS (estimated at 8 percent of the subtotal of previously mentioned cost components). Permitting costs are estimated at 1 to 5 percent of construction costs. Easement costs (including associated contingency costs) are estimated to total $77,000. The costs of project installation are provided in Table D-3 and Table D-4 (which

correspond to NWPM 506.11 Economic Table 1 and NWPM 506.12 Economic Table 2, respectively). The average annualized cost of installation/construction of the Modernization Alternative is $445,000.

Table D-3. Estimated Installation Cost, Klamath River Watershed, Oregon, 2023 dollars.[1]

Works of Improvement	Unit	Federal Land – Number	Nonfederal Land – Number	Total – Number	Pub. L. No. 83-566 Federal Land NRCS[2]	Pub. L. No. 83-566 Nonfederal Land NRCS[2]	Pub. L. No. 83-566 Estimated Total	Other Funds Federal Land	Other Funds Nonfederal Land	Other Funds Estimated Total	Estimated Cost – Total
PG1 North Canal Improvements	acres	0.0	250.6	250.6	$0	$677,000	$677,000	$0	$250,000	$250,000	$927,000
PG2 SCADA System	square feet	4,055.9	3,822.0	7,877.9	$181,000	$170,000	$351,000	$57,000	$53,000	$110,000	$461,000
PG3 Fish Screen	acres	0.0	16.6	16.6	$0	$8,269,000	$8,269,000	$0	$2,693,000	$2,693,000	$10,962,000
PG4 E and F Pumping Plants	acres	0.1	0.0	0.1	$2,915,000	$0	$2,915,000	$914,000	$0	$914,000	$3,829,000
PG5 E Pump Recirculation	square feet	3,933.0	0.0	3,933.0	$495,000	$0	$495,000	$176,000	$0	$176,000	$671,000
PG6 Upgraded Turnouts	square feet	0.0	1,900.0	1,900.0	$0	$22,000	$22,000	$0	$6,000	$6,000	$28,000
Total project	**N/A**	**N/A**	**N/A**	**N/A**	**$3,591,000**	**$9,138,000**	**$12,729,000**	**$1,147,000**	**$3,002,000**	**$4,149,000**	**$16,878,000**

[1]Price base: 2023 dollars. Prepared July 2024

[2]Federal agency responsible for assisting in installation of works of improvement.

Table D-4. Estimated Cost Distribution-Water Resource Project Measures, Klamath River Watershed, Oregon, 2023 dollars.[1]

Works of Improvement	Pub. L. No. 83-566 Construction	Pub. L. No. 83-566 Engineering	Pub. L. No. 83-566 Project Admin Subtotal [2]	Total Pub. L. No. 83-566	Other Funds – Construction	Other Funds – Engineering	Other Funds – Real Property Rights	Other Funds – Permitting	Total Other	Total – Installation Costs
PG1 North Canal Improvements	$545,000	$22,000	$110,000	$677,000	$181,000	$7,000	$32,000	$30,000	$250,000	$927,000
PG2 SCADA System	$286,000	$10,000	$55,000	$351,000	$95,000	$12,000	$0	$3,000	$110,000	$461,000
PG3 Fish Screen	$6,758,000	$227,000	$1,284,000	$8,269,000	$2,252,000	$296,000	$45,000	$100,000	$2,693,000	$10,962,000
PG4 E and F Pumping Plants	$2,382,000	$80,000	$453,000	$2,915,000	$793,000	$101,000	$0	$20,000	$914,000	$3,829,000
PG5 E Pump Recirculation	$348,000	$33,000	$114,000	$495,000	$116,000	$45,000	$0	$15,000	$176,000	$671,000
PG6 Upgraded Turnouts	$17,000	$1,000	$4,000	$22,000	$5,000	$1,000	$0	$0	$6,000	$28,000
Total project	**$10,336,000**	**$373,000**	**$2,020,000**	**$12,729,000**	**$3,442,000**	**$462,000**	**$77,000**	**$168,000**	**$4,149,000**	**$16,878,000**

[1]Price base: 2023 dollars. Prepared July 2024

[2]Includes project administration costs and technical assistance costs.

3.4 Other Direct Costs

Other direct costs are costs that result from the project but occur after installation/construction. For the Modernization Alternative, other direct costs include additional OMR. In PG1 North Canal Improvements, the District estimates that operating and maintaining (O&M) the new infrastructure would require roughly $60,000 annually, which includes a new full-time equivalent (FTE) position. Furthermore, transporting an additional 1,000 acre-feet (AF) per year of water to LKNWR through the North Canal (as is further explained in Section 4.2.1.1.2) would cost roughly $75 per AF in additional O&M, or $75,000 per year. In PG2 SCADA System, KDD estimates that staff training and system maintenance would require about $10,000 per year. KDD estimates that maintaining the fish screen in PG3 Fish Screen will cost approximately $20,000 annually in O&M. Finally, KDD estimates that PG5 E Pump Recirculation will incur $10,000 per year in labor to adjust gates and $19,000 in annual energy costs (White, 2023).[2]

Accounting for timing of costs, (i.e., future costs are discounted) the average annualized cost of O&M under the Modernization Alternative is estimated at approximately $192,000, as shown in Table D-5.

Table D-5. O&M Costs Under the Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Project Group	Increase in Average Annual O&M Costs	Annualized O&M Costs
PG1 North Canal Improvements	$135,000	$135,000
PG2 SCADA System	$10,000	$10,000
PG3 Fish Screen	$20,000	$19,000
PG4 E and F Pumping Plants	$0	$0
PG5 E Pump Recirculation	$29,000	$28,000
PG6 Upgraded Turnouts	$0	$0
Total	**$194,000**	**$192,000**

Note: Totals may not sum due to rounding. Prepared July 2024

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent.

In addition to the O&M costs, some of the project components will require replacement prior to the end of the project life. SCADA and telemetry equipment has a useful life of roughly 20 years, while pumps in PG4 E and F Pumping Plants have a useful life of around 30 years. Accordingly, PG2

[2] This assumes equivalent energy use between diesel fuel under the No Action and electricity use under the Modernization Alternatives. The conversion uses factors of 3.79 gallons per liter, 30 percent efficiency in diesel's conversion to kinetic energy, and 10 kWh per liter of diesel, for a total of 162,364 kWh equating to 14,280 gallons of diesel. The cost of electricity is $0.12 per kWh (Neuman, 2023).

SCADA System will require replacement in Years 21, 41, 61, and 81 (20 years after installation and every 20 years thereafter); and PG4 E and F Pumping Plants will require pump replacements in Years 33, 63, and 93 (30 years after construction and every 30 years thereafter). The replacement costs under the Modernization Alternative are summarized in Table D-6.

Table D-6. Replacement Costs Under the Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Works of Improvement	Cost per Replacement	Useful Life (years)	Annualized Costs of Replacement
PG1 North Canal Improvements	N/A	N/A	$0
PG2 SCADA System	$48,000	20	$2,000
PG3 Fish Screen	N/A	N/A	$0
PG4 E and F Pumping Plants	$1,797,000 [A]	30	$37,000
PG5 E Pump Recirculation	N/A	N/A	$0
PG6 Upgraded Turnouts	N/A	N/A	$0
Total	**N/A**	**N/A**	**$39,000**

[1] Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent. Prepared July 2024

[A]The cost of replacement is less than the cost of installation under the Modernization Alternative because it only includes the cost of pumps, motors, and gearheads, and does not include the design, engineering, and other non-infrastructure costs included in the Modernization Alternative.

In total, the other direct costs (including OMR costs) under the Modernization Alternative are estimated at $231,000, as shown in Table D-7.

Table D-7. Other Direct Costs of the Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Works of Improvement	Annualized O&M Costs	Annualized Costs of Replacement	Annualized Other Direct Costs
PG1 North Canal Improvements	$135,000	$0	$135,000
PG2 SCADA System	$10,000	$2,000	$12,000
PG3 Fish Screen	$19,000	$0	$19,000
PG4 E and F Pumping Plants	$0	$37,000	$37,000
PG5 E Pump Recirculation	$28,000	$0	$28,000

Works of Improvement	Annualized O&M Costs	Annualized Costs of Replacement	Annualized Other Direct Costs
PG6 Upgraded Turnouts	$0	$0	$0
Total	**$192,000**	**$39,000**	**$231,000**

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent. Prepared July 2024

3.5 Summary of Costs under the Modernization Alternative

The costs of the Modernization Alternative are equal to the estimated average annual installation/construction plus the other direct costs outlined above for each project group. In total across all project groups, the average annual project costs are $676,000. These costs are summarized in Table D-8. Because there are costs under the No Action Alternative (as described in Section 3.1), the costs shown in the table below are not the NED costs (for the NED costs, see Table D-10).

Table D-8. Estimated Average Annual Costs of the Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Project Group	Project Outlays (Amortization of Installation Cost)	Project Outlays Operation, Maintenance, and Replacement Cost	Total Average Annual Costs
PG1 North Canal Improvements	$25,000	$135,000	$160,000
PG2 SCADA System	$13,000	$12,000	$25,000
PG3 Fish Screen	$289,000	$19,000	$308,000
PG4 E and F Pumping Plants	$100,000	$37,000	$137,000
PG5 E Pump Recirculation	$17,000	$28,000	$45,000
PG6 Upgraded Turnouts	$1,000	$0	$1,000
Total	**$445,000**	**$231,000**	**$676,000**

Note: Totals may not sum due to rounding. Prepared July 2024
[1] Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent.

3.6 Costs of the Modernization Alternative Over the No Action Alternative

As described in Section 3.1, the No Action Alternative will require replacement costs that would be avoided under the Modernization Alternative. To calculate the NED costs, we start by subtracting the replacement costs under the No Action Alternative (shown in Table D-2) from the other direct costs under the Modernization Alternative, which include the replacement costs of the Modernization Alternative (shown in Table D-8). This is shown in Table D-9, where the second

column is subtracted from the third column to generate the values in the last column. In the case of PG4 E and F Pumping Plants, the value in the last column is negative, indicating that the Other Direct Costs of the Modernization Alternative are lower than under the No Action Alternative.

Table D-9. Other Direct Costs of the Modernization Alternative Over the No Action Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Works of Improvement	Annualized Costs of Replacement under No Action Alternative	Other Direct Costs of the Modernization Alternative	Other Direct Costs the Modernization Alternative over the No Action Alternative
PG1 North Canal Improvements	$0	$135,000	$135,000
PG2 SCADA System	$0	$12,000	$12,000
PG3 Fish Screen	$0	$19,000	$19,000
PG4 E and F Pumping Plants	$122,000	$37,000	-$85,000
PG5 E Pump Recirculation	$2,000	$28,000	$26,000
PG6 Upgraded Turnouts	$0	$0	$0
Total	**$124,000**	**$231,000**	**$107,000**

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent. Prepared July 2024

Combining the NED Other Direct Costs in the table above with the annualized installation costs (shown in Table D-8) provides the total annualized NED costs of the Modernization Alternative. These are shown in Table D-10, which corresponds to NWPM 506.18 Economic Table 4.

Table D-10. Estimated Average Annual NED Costs, Klamath River Watershed, Oregon, 2023 dollars.[1]

Project Group	Project Outlays (Amortization of Installation Cost)	Other Direct Costs of the Modernization Alternative over the No Action Alternative	Total Average Annual Costs
PG1 North Canal Improvements	$25,000	$135,000	$160,000
PG2 SCADA System	$13,000	$12,000	$25,000
PG3 Fish Screen	$289,000	$19,000	$308,000
PG4 E and F Pumping Plants	$100,000	-$85,000	$15,000

Project Group	Project Outlays (Amortization of Installation Cost)	Other Direct Costs of the Modernization Alternative over the No Action Alternative	Total Average Annual Costs
PG5 E Pump Recirculation	$17,000	$26,000	$43,000
PG6 Upgraded Turnouts	$1,000	$0	$1,000
Total	**$445,000**	**$107,000**	**$552,000**

Note: Totals may not sum due to rounding. Prepared July 2024
[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent.

4 NED Benefits

4.1 Benefits of the No Action Alternative

Relative to current conditions, there are no additional benefits of the No Action Alternative. Under the No Action Alternative, the District would continue under current management direction and management intensity, with no benefits above those currently provided. Consistent with current management direction and intensity, the District (and Reclamation, in the case of the E and F pumping plants) would replace aging infrastructure such as pumps at the end of their useful life.

4.2 Benefits of the Modernization Alternative

This section describes the benefits of the Modernization Alternative.

4.2.1 Project Benefits

The benefits of the Modernization Alternative include both on-site benefits (such as avoided District O&M costs) and off-site benefits (such as improved wildlife habitat and water quality benefits). The following subsections describe both on- and off-site benefits, some of which are quantified and included in the analysis (such as O&M savings) and others that are considered but not included (such as water quality). Of the Modernization Alternative benefits that are included and quantified in the analysis, the average annual values are summarized in Table D-11 for each project group (which corresponds to NWPM 506.20 Economic Table 5a).

Table D-11. Estimated Average Annual Damage Reduction Benefits, Klamath River Watershed, Oregon, 2023 dollars.[1]

PG1 North Canal Improvement On-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Reduced OMR	$10,000	N/A
On-site Subtotal	$10,000	N/A
PG1 North Canal Improvements Off-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Avoided Carbon Emissions[2]	N/A	$0
Habitat Value	N/A	$150,000
Off-site Quantified Subtotal	N/A	$150,000
Total Quantified Benefits	N/A	$160,000
PG2 SCADA System On-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Reduced OMR	$40,000	N/A
On-site Subtotal	$40,000	N/A
PG2 SCADA System Off-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Avoided Carbon Emissions[2]	N/A	$0
Habitat Value	N/A	$0
Off-site Quantified Subtotal	N/A	$0
Total Quantified Benefits	N/A	**$40,000**
PG3 Fish Screen On-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
On-Site Damage Reduction Benefits	N/A	N/A
Reduced OMR	$0	N/A
On-site Subtotal	$0	N/A

PG3 Fish Screen Off-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Avoided Carbon Emissions[2]	N/A	$0
Habitat Value	N/A	$0
Fish Value	N/A	Positive, Unquantified Benefits
Off-site Quantified Subtotal	N/A	$0
Total Quantified Benefits	**N/A**	**$0**
PG4 E and F Pumping Plants On-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Reduced OMR	$29,000	N/A
On-site Subtotal	$29,000	N/A
PG4 E and F Pumping Plants Off-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Avoided Carbon Emissions [2]	N/A	$0
Habitat Value	N/A	$0
Off-site Quantified Subtotal	N/A	$0
Total Quantified Benefits	N/A	**$29,000**
PG5 E Pump Recirculation On-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Reduced OMR	$77,000	N/A
On-site Subtotal	$77,000	N/A
PG5 E Pump Recirculation Off-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Avoided Carbon Emissions[2]	N/A	$1,000
Habitat Value	N/A	$0
Off-site Quantified Subtotal	N/A	$1,000
Total Quantified Benefits	N/A	**$78,000**

PG6 Upgraded Turnouts On-Site Damage Reduction Benefits	Agricultural-related	Nonagricultural
Reduced OMR	$0	N/A
Water Use Transparency	Positive, Unquantified Benefits	N/A
On-site Subtotal	$0	N/A
PG6 Upgraded Turnouts Off-Site Damage Reduction Benefits	**Agricultural-related**	**Nonagricultural**
Avoided Carbon Emissions[2]	N/A	$0
Habitat Value	N/A	$0
Off-site Quantified Subtotal	N/A	$0
Total Quantified Benefits	N/A	**$0**

Note: Totals may not sum due to rounding. Prepared July 2024

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent.

[2]This value represents the benefit of avoided carbon emissions as measured by the social cost of carbon. These benefits would also accrue to local residents, but the majority of the value would be experienced outside the proposed project area.

4.2.1.1 Benefits Considered and Included in Analysis

4.2.1.1.1 O&M Cost Savings

Relative to the No Action Alternative, the Modernization Alternative would result in O&M cost savings for most project groups. In PG1 North Canal Improvements, KDD expects that $10,000 per year in O&M will be avoided due to reduced pumping in the Klamath Straits Drain. PG2 SCADA System is expected to save $40,000 per year in labor costs by avoiding the need to manually adjust water delivery infrastructure. PG5 E Pump Recirculation would save approximately $10,000 per year in labor costs needed to operate a temporary pump and avoid $71,000 per year in costs to fuel the pump (White, 2023).

PG4 E and F Pumping Plants will also result in O&M savings, to KDD and Reclamation, who currently owns and manages the E, EE, F, and FF Pumping Plants.[3] These four pumping plants share the work of pumping Klamath Straits Drain water. The E and EE plants are colocated, and the F and FF pumping plants are collocated. Because these four plants share the total District pumping demand on the Klamath Straits Drain, their O&M is interrelated. By replacing the E and F pumping plants, the Modernization Alternative will impact O&M of all four pumping plants.

[3] KDD has initiated talks to transfer OMR responsibility for the E and F Pumping Plants from Reclamation to KDD, and it is assumed KDD would take responsibility for these plants under the Modernization Alternative.

Under the Modernization Alternative, KDD would assume control over the E and F pumping plants, which are expected to account for 99 percent of the total pumping load for the four plants (White, 2023). The four plants currently incur a total of roughly $428,000 per year in O&M costs under Reclamation management, including labor and materials (Brown, 2023).[4] Reclamation records indicate that annual O&M at the plants is proportional to the amount of pumping done at the plants.[5] Therefore, when the E and F pumping plants assume 99 percent of the total pumping, they are expected to assume 99 percent of the total O&M costs, or about $423,000 per year. Due to KDD's proximity to the pumping plants and associated reduce travel costs and lower labor costs of KDD personnel, KDD anticipates a 33 percent cost reduction in O&M relative to current Reclamation O&M costs (White, 2023). Given that Reclamation costs are an estimated $423,000 annually for the two primary pumping plants, this would represent a savings of $140,000 per year. We adopt this value as the estimated annual O&M savings when KDD has control of the E and F pumping plants. Under the No Action Alternative, we assume that KDD would take over the E and F pumping plants after Reclamation finished replacing all the E and F pumping plants in Year 11 (as explained further in Section 3.1). Therefore, O&M cost savings benefits of PG4 E and F Pumping Plants ($140,000 per year) would accrue from Year 3 to Year 11, when KDD would assume control over the pumping plants under the Modernization Alternative but not under the No Action Alternative. After Year 11, KDD would have control of the plants under both scenarios, so there would be no additional benefits of the Modernization Alternative.

The estimated annual O&M savings are shown Table D-12. In total, the project is expected to reduce District O&M costs by $156,000 per year.

Table D-12. Avoided District OMR Savings Under the Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Project Group	Average Annual O&M Savings	Annualized O&M Savings
PG1 North Canal Improvements	$10,000	$10,000
PG2 SCADA System	$40,000	$40,000
PG3 Fish Screen	$0	$0
PG4 E and F Pumping Plants	$140,000[A]	$29,000
PG5 E Pump Recirculation	$81,000	$77,000

[4] This does not include the cost of energy use, which is expected to remain roughly the same under the Modernization Alternative (White, 2023).

[5] Reclamation records indicate that E and EE Pumping Plants do 45 percent of the pumping and require 44 percent of the O&M (Brown, 2023).

Project Group	Average Annual O&M Savings	Annualized O&M Savings
PG6 Upgraded Turnouts	$0	$0
Total	**$271,000**	**$156,000**

Note: Totals may not sum due to rounding. Prepared July 2024

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent.

[A]Benefits accrue only from Years 3 to 11.

4.2.1.1.2 Habitat Value

The Modernization Alternative is expected to enhance wetland habitat in LKNWR by (1) increasing operational flexibility in the distribution of water throughout LKNWR, and (2) increasing the average annual amount of drainage water from KDD available to wetlands in LKNWR. The wetland habitat at LKNWR is directly reliant on delivery of water through KDD. Without water deliveries from KDD, the amount of wetland habitat at LKNWR declines, and consequently, the wildlife population supported at the refuge also declines.

Currently, LKNWR can only receive tailwater from KDD through the Klamath Straits Drain and Ady Canal. The North Canal Extension Project increases operational flexibility by making it possible to deliver water directly to eastern areas of LKNWR that currently can only receive water after the more western portions of LKNWR have been over-watered. This operational flexibility may increase the acreage of wetlands that receive water in a given year. The Modernization Alternative would also allow KDD to deliver drain water from North Canal to LKNWR, which would provide LKNWR with an estimated 1,000 AF per year of additional water on average (White, 2023). An additional 1,000 AF per year water delivered to LKNWR would translate into 300 acres of additional wetland habitat at the refuge (Austin, 2022). In sum, by providing flexibility in water management and potentially increasing water deliveries, the Modernization Alternative would allow LKNWR to support a larger area of wetlands, which provide critical habitat to waterfowl and recreational opportunities to hunters and wildlife watchers.

4.2.1.1.3 Background on the Value of LKNWR

LKNWR was established in 1908 as the Nation's first waterfowl refuge (U.S. Fish and Wildlife Service, 2023a). As part of the Klamath Basin National Wildlife Refuge Complex, LKNWR is one of the most important sources of habitat for waterfowl on the West Coast's Pacific Flyway – a major waterfowl migration corridor that connects breeding grounds in the northern North America with major wintering grounds in South America (Gilmer, Yee, Mauser, & Hainline, 2004). Approximately 80 percent of the Flyway's migrating waterfowl travel through the Klamath Basin during spring and fall migrations, and around half of these waterfowl visit LKNWR, with totals reaching as many as 1.8 million birds (U.S. Fish and Wildlife Service, 2023a). These migrating birds rely on the refuge for rest, refueling, breeding, molting, and staging (California Waterfowl Association, 2023).

The refuge produces between 30,000 and 60,000 waterfowl annually and hosts a panoply of species: as many as 100,000 shorebirds, 500 bald eagles, 30,000 tundra swans, 500,000 ducks, 50,000 geese, sandhill cranes, white-faced ibis, heron, egret, cormorant, grebe, white pelican, and gulls (U.S. Fish and Wildlife Service, 2023a; U.S. Fish & Wildlife Service, 2022). Among the species hosted by

LKNWR are 25 species listed as threatened or sensitive by California and Oregon (U.S. Fish and Wildlife Service, 2023a; U.S. Fish & Wildlife Service, 2022).

Historically, the abundance of waterfowl in the Klamath Basin has offered a variety of quality recreational opportunities. Ducks are the most hunted species, and average bags range from three to four ducks when populations are plentiful (U.S. Fish & Wildlife Service, 2022). The variety and profusion of waterfowl also draw many bird watchers to LKNWR. Based on personal observations, refuge managers have historically estimated that visitation by birdwatchers and hunters is approximately 20,000 people annually (Austin, 2022). However, a recent count based on cell phone tracking indicated that there may have been as many as 61,000 non-local people visiting the Refuge in a recent year.

Recent water shortages at LKNWR have led to drastic decreases in the acreage of wetland habitat and the number of waterfowl visiting the Refuge. This, in turn, has led to declines in the number of recreators. From 1982 to 2012, the refuge averaged approximately 25,000 acres of wetlands; from 2013 to 2019, wetland acreage fell by nearly half (13,000 acres) (National Wildlife Refuge Association, 2022). LKNWR needs approximately 100,000 acre-feet of water per year to maintain 25,000 acres of wetlands (Trail, 2022). In 2022, there were no water deliveries to the refuge and, as a result, no wetlands (Trail, 2022). Spatial imaging suggests that around 95 percent of the Klamath Basin's wetlands have been lost (Trail, 2022).

The lack of water in LKNWR has a devasting impact on the populations of visiting waterfowl. Despite historical records exceeding 1 million birds, LKNWR has not seen more than 0.5 million since 2002, and in 2022 the estimate was around 93,000, which was the lowest peak ever recorded (Trail, 2022). The lack of birds results in fewer outdoor recreationists visiting the refuge to hunt and watch wildlife (National Wildlife Refuge Association, 2022).

Recent federal funding allocations to support the Klamath Basin waterfowl habitats indicate the public importance of restoring the area's wetlands. For example, the 2021 Infrastructure Investment and Jobs Act included $162 million to support restoration of Klamath Basin wildlife habitat (U.S. Congress, 2021). In May 2021, the NRCS allocated $3.8 million to enhance habitat for migratory waterbirds, fish, and other wildlife in the Klamath Basin (Dennis, 2022). Further, in 2022, the U.S. Fish and Wildlife Service announced $2.6 million in grant funding to Ducks Unlimited to improve wetland habitats in LKNWR and neighboring Tule Lake National Wildlife Refuge (Ducks Unlimited, 2022).

By increasing the water available for wetland habitats in LKNWR, the Proposed Action is expected to support greater numbers of waterfowl and recreation values both at LKNWR and throughout the Pacific Flyway, thereby increasing the value of the recreational and habitat benefits provided by LKNWR.

4.2.1.1.4 Estimates of the Economic Value of Wetland Habitat

Values of wetland habitat from economic literature vary broadly, ranging from a few dollars per acre up to hundreds of thousands of dollars per acre. Value varies depending on the type and location of the wetland, types of ecosystem services provided, and study methodology. In general, the highest values provided by wetlands are associated with the provision of the following ecosystem services: a) flood regulation and storm buffering, b) aesthetic views and open space, c) water quality enhancement, d) carbon storage, and e) biodiversity and habitat. Depending on the population, socioeconomic activities, and land uses near the wetland location, these ecosystem services can translate into economic, social, and cultural benefits related to recreation, food provision (e.g., from

hunting), scenic amenities, avoided storm damages, climate regulation, and avoided water treatment costs. Additionally, many people directly value habitat function and species preservation. The following section summarizes the magnitude of these values as estimated in the natural resource economics literature. All values have been converted to 2023 dollars using the Gross Domestic Product Implicit Price Deflator (GDPIPD), unless noted otherwise.

Although conducted several decades ago, a particularly pertinent 1991 study estimated the value of San Joaquin Valley (SJV) wetlands to California residents. This study is pertinent because SJV is also part of the Pacific Flyway and provides habitat to some of the same waterfowl populations as LKNWR. The study found California residents' willingness prevent removal of 58,000 acres of wetlands in SJV averaged payments of $331 per household per year and $546 per year to increase wetlands by 40,000 acres[6] (Loomis, Hanemann, Kanninen, & Wegge, 1991). This translates to a value of $0.006 to $0.014 per acre per household per year. In 2021, there were an estimated 50,900 households in Upper Klamath Basin counties (Klamath, Siskiyou, and Modoc) (U.S. Census Bureau, 2021). If these households value the wetlands at rates similar to those California holds for SJV wetlands, the annual value of LKNWR wetlands to households in the Basin would range from approximately $300 to $700 per acre.

A follow-on 1997 study also examined the effect of distance on willingness to pay, with California households outside SJV willing to pay roughly $440 per year to increase SJV wetlands by 40,000 acres, and Oregon households willing to pay $140 per year (Pate & Loomis, 1997). This translates to values of $0.004 (for Oregon) to $0.011 (for California outside the SJV) per household per acre per year. The study's results indicate that the value of wetlands in the Modernization Alternative may extend well beyond the Klamath Basin. If we apply these values to the households of California and Oregon that lie outside the Klamath Basin counties,[7] and conservatively use the Oregon household value of $0.004 per household per acre per year, the annual value per acre of LKNWR wetlands (including the previously cited values within the three-county area) would be roughly $17,000 per acre.

In addition to the studies specific to wetland areas of the Pacific Flyway, there are numerous studies of wetland value in the economics literature. One 2008 review and meta-analysis of U.S. wetland valuation studies aimed to use values from the economics literature to quantify the economic benefits of U.S. agricultural conservation programs (Randall, Kidder, & Chen, 2008). For wetland habitat, the study identified 72 valuations of terrestrial habitat from 34 U.S. studies. This study found that the average value per acre per year of all services provided by freshwater wetlands was approximately $580 per acre[8], including the value for habitat, aesthetics, and general open space value. For a Prairie Pothole region wetland (which may be similar to LKNWR wetlands in the sense that they are shallow and are particularly important for birds in the Central Flyway), however, the estimated average value was approximately $43 per acre per year.[9] On the other hand, compared to the average Prairie Pothole region wetland, LKNWR wetlands would be expected to have much higher recreation and aesthetic benefits as they are open and accessible to the public (in contrast to

[6] The study presented values of $154 and $254 in 1988 dollars, which we inflated to 2022 dollars using the GDPIPD.

[7] California households totaled 13,217,586 in 2021, while Oregon households totaled 1,658,091 (U.S. Census Bureau, 2021).

[8] The study presented this value as $424.46 in 2007 dollars.

[9] The study presented per acre value as $31.30 in 2007 dollars.

conservation reserve program lands that are on private land). LKNWR wetland habitat would likely also have relatively high habitat benefits given that there are Refuge staff actively managing the habitat.

A 2006 review of 215 wetland value observations obtained from 80 studies found an average wetland values per acre of $2,002 annually, but a much lower median value of $107 per acre per year (Brander, Raymond, & Vermaat, 2006).[10] This same study, however, found that for wetlands providing biodiversity services, the biodiversity benefit was valued at $12,200 per acre per year on average.[11] Finally, a 2001 review of 39 wetland valuation studies estimated average wetland value per acre at $1,825 per year (Woodward & Wui, 2001).[12] This study also estimated value for single service wetlands. This study indicated that the highest valued service provided by wetlands is birdwatching, with an average value of $2,417 per acre per year.[13] As LKNWR is managed for biodiversity and is open and accessible to the public for birdwatching (and hunting), these values may be reasonable for LKNWR habitat.

As another approach, we review the value per acre that the NRCS is paying for wetlands as part of the Wetland Reserve Easement (WRE) program. As part of its Agricultural Conservation Easement Program, NRCS purchases WRE on private farmland. The easement value is based on the lowest of the following three values: an appraisal, a Geographic Area Rate Cap (GARC), or a landowner offer. In Modoc and Siskiyou counties for the Fiscal Year 2023, the GARC for WRE payment for a permanent easement on irrigated pasture and wet meadow is $4,640 per acre; payment for a permanent easement on wild rice or cropland with a marginal water supply is $3,000 per acre; and payment for a permanent easement on wild rice or cropland with 100 percent water supply is $5,325 per acre (Natural Resources Conservation Service, 2022). Over 100 years using a 2.5 percent discount rate this equates to approximately $145 per acre per year that NRCS is willing to pay for an acre of wetland in Siskiyou and Modoc counties. This payment is based on the agricultural value of the land but indicates that NRCS expects that the ecosystem service value of wetlands on farms is at least $145 per acre.

WRE payments are intended to compensate landowners for the value of their land in exchange for restoring habitat areas; by enrolling the WRP, landowners sell most of their use rights with the exception of hunting, fishing, and other recreational use. In other words, WRE payments do not represent the value of the wetland habitat, but rather the difference in the market value of the land with and without the easement. However, the WRE payments nonetheless indicate government agencies' willingness to pay for the habitat and other benefits provided by wetlands.

As another approach, we review the price of credits in regional wetland mitigation banks. Wetland mitigation banks are wetlands that have been created or restored to offset the loss of wetlands elsewhere in the region due to development or other causes. The price of wetland mitigation banking provides a useful reference point because it indicates the cost of providing the wetland benefits of PG1 North Canal Improvements through alternative means. Because wetland mitigation

[10] Values reported in the study were $2,800 and $155 per hectare in 1995 dollars, which we inflated to 2022 dollars and converted to per acre values.

[11] Value reported in the study was $17,000 per hectare in 1995 dollars, which we inflated to 2022 dollars and converted to per acre values.

[12] Value reported in the study was $915 per acre in 1990 dollars, which we inflated to 2022 dollars.

[13] Values in the study were reported as $1,212 in 1990 dollars, which we inflated to 2022 dollars.

is typically required by law to ensure continued provision of ecosystem services, the public policy of requiring mitigation indicates that the perceived value of benefits of ecosystem services provided by mitigated wetlands outweigh the costs of mitigation.

The Oregon Department of State Lands (DSL) administers the State's wetland mitigation program and provides a calculator to compute the costs of DSL-provided wetland mitigation. According to this calculator, the cost of wetland mitigation banking in the Klamath River Basin ranges from roughly $59,000 to $206,000 per acre depending on the number of mitigation credits generated per acre (Oregon Department of State Lands, 2021).[14] Amortizing over 100 years at a 2.5-percent discount rate, this equates to approximately $1,610 per acre per year to $5,600 per acre per year.

Table D-13 summarizes the values described above from the literature. As noted above, wetlands differ in type and quality, and both ecological and economic benefits from their protection vary by location. In addition, wetland benefits are not constant for every acre, but vary depending on size and configuration. As noted by authors of one of the wetland meta-analysis studies, "The use of benefits transfer to estimate wetland values faces substantial challenges. From our analysis it is clear that the prediction of a wetland's value based on previous studies is, at best, an imprecise science" (Woodward & Wui, 2001). So, while the benefit estimates from previous studies relate to the conservation of wetlands, it is difficult to know how the average value from these studies would compare to the value per acre of wetlands in the LKNWR.

Table D-13. Wetland Values from Scientific Literature, 2023 dollars.[1]

Study or Source	Value per acre per year (2023$)	Description of Value
Loomis, Hanemann, Kanninen, and Wegge (1991)[2]	$56,200	Willingness to pay of California households to prevent loss of wetlands in the San Joaquin Valley
Loomis, Hanemann, Kanninen, and Wegge (1991)[2]	$134,300	Willingness to pay of California households to increase wetlands in the San Joaquin Valley
Pate and Loomis (1997)[2]	$121,900	Willingness to pay of California households outside the San Joaquin Valley to increase wetlands in the San Joaquin Valley
Pate and Loomis (1997)[2]	$4,200	Willingness to pay of Oregon households to increase wetlands in the San Joaquin Valley
Randle, Kidder, and Chen (2008)	$600	Average value of wetlands from 34 U.S. studies

[14] This calculation is based on a real market value of land set at $1,899 per acre, which is the most common assessed value of land for a sample of parcels in Klamath County that lie within LKNWR boundaries (Klamath County, 2023). The restoration cost in the Klamath Basin ($35,899 in 2021 dollars) was adjusted for inflation to $39,710 in 2023 dollars using the GDPIPD.

Study or Source	Value per acre per year (2023$)	Description of Value
Randle, Kidder, and Chen (2008)	$40	Average value of wetlands in the Prairie Pothole region
Brander, Raymond, Vermaat (2006)	$2,000	Average value of wetlands from 80 studies
Brander, Raymond, Vermaat (2006)	$100	Median value of wetlands from 80 studies
Brander, Raymond, Vermaat (2006)	$12,200	Average value of wetlands providing biodiversity benefits
Woodward and Wui (2001)	$2,400	Value of wetland that provides bird watching opportunities
Natural Resources Conservation Service (2022)	$145	GARC for WRE payment for a permanent easement on wild rice or cropland with a 100% water supply in Modoc and Siskiyou Counties, amortized to an annual payment.
Oregon Department of State Lands (2021)	$1,610	Estimated cost of wetland mitigation banking when each acre is worth 1 mitigation credit, amortized to an annual payment.
Oregon Department of State Lands (2021)	$5,600	Estimated cost of wetland mitigation banking when each acre is worth 3.5 mitigation credits, amortized to an annual payment.

[1]All values in the original studies were converted to 2023 dollars per acre per year. Prepared July 2024
[2]Values were derived by multiplying per-household values by the number of households in the original study and dividing by the acreage change.

However, as noted above, relative to other wetlands, LKNWR wetlands would be expected to have relatively high habitat value based on their location in the Pacific Flyway and their use by a diverse range of waterfowl, including many special status species. It is also expected to have relatively high recreation and aesthetic value given it is a public refuge. To be conservative, we apply the approximate midpoint of the range of values (about $300 to $700 per acre per year) estimated for the value of SJV wetlands[15], which support the same migratory waterfowl as the LKNWR: $500 per acre per year. We expect that this is a conservative or minimum per acre value of LKNWR wetlands. Accordingly, when presenting this value in the NED, we indicate a + sign after this value to indicate that it is likely an underestimate of total value.

KDD expects to supply the LKNWR with an additional 1,000 AF of water on average each year (White, 2023). This water is expected to support 300 acres of additional wetland habitat (Austin,

[15] This per acre value reflects only the estimated value of LKNWR wetlands to Upper Klamath Basin households (based on per household values per acre for wetlands derived in the San Joaquin Valley), and thus, is a conservative estimate of value.

2022). At a value of $500 per acre per year, the additional 300 acres of wetland would provide benefits of $150,000 per year. Because PG1 North Canal Improvements would contribute all the additional water, it would generate all the additional benefits, as shown in Table D-14.

Table D-14. Annual Average Wetland Habitat Benefits of Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Project Group	Annual Additional Water Deliveries to LKNWR (AF/yr)	Additional Wetland Habitat Supported (acres)	Average Annual Net Benefit of Wetland Habitat
PG1 North Canal Improvements	1,000	300	$150,000+
PG2 SCADA System	0	0	$0
PG3 Fish Screen	0	0	$0
PG4 E and F Pumping Plants	0	0	$0
PG5 E Pump Recirculation	0	0	$0
PG6 Upgraded Turnouts	0	0	$0
Total	**1,000**	**300**	**$150,000+**

Note: Totals may not sum due to rounding. Prepared July 2024

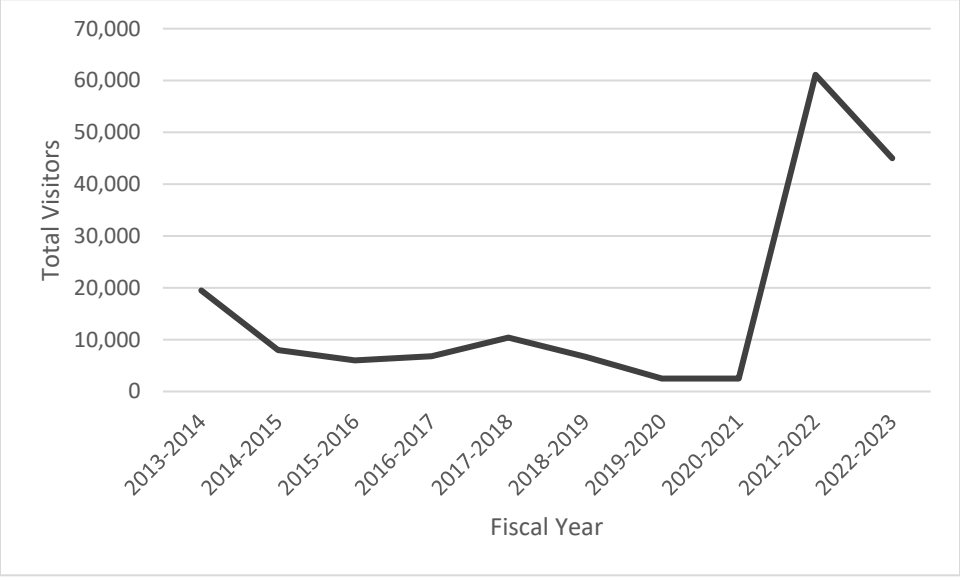
[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent.

4.2.1.1.5 Recreation Value of Habitat

Another method of assessing the benefits of PG1 North Canal Improvements is to estimate the value of increased recreation due to the additional wetland habitat. LKNWR hosts tens of thousands of visitors each year who birdwatch, hunt, explore the Refuge by vehicle and by foot, take photographs, and visit the visitor center (U.S. Fish and Wildlife Service , 2023b). Because the amount of wetland habitat is a key determinant in the size of bird populations migrating through the Refuge, and because the birds are the primary attraction for visitors (whether hunting or observing), the amount of wetland habitat has an indirect but important impact on visitation levels at the LKNWR (Austin, 2022). By increasing the amount of wetland habitat, PG1 North Canal Improvements could positively impact recreation levels at the LKNWR. However, we do not estimate this value due to the inadequacy of available data, as explained further below.

Data on visitation at the LKNWR comes from U.S. Fish and Wildlife Service's National Wildlife Refuge System's Annual Performance Reports from Fiscal Years (FY) 2013–2014 and 2022–2023 (U.S. Fish and Wildlife Service , 2023b). This data is shown in Figure D-1. The chart shows a drastic increase in visitors to the LKNWR in FY 2021–2022, which is unexpected given it was a dry year with little to no water deliveries. We would expect visitation to be much higher in 2017, given that water deliveries in this year were over eight times higher than in 2022 and peak fall duck counts were at their highest level since 2014 (White, 2023; Vradenburg, 2023).

This unexpected pattern is due to a change the Refuge made in the method of visitor counting. Prior to 2022, the Refuge used professional judgement to estimate visitation levels, but starting in 2022, they began using a service that tracked cell phone locations. The service counted any cell phone that was turned on and had location tracking enabled, stopped for 15 minutes or more at one of the Refuge's main lots, and had a billing address farther than 50 miles distant. In this way, the service counts a portion of the non-local visitors to Refuge parking lots; it does not count local visitors, visitors without cell phones, or any visitor who did not have their cell phone turned on with tracking enabled during their visit. Because of this, the Klamath National Wildlife Refuge Complex's Visitor Services Manager considers the more recent counts "an accurate minimum" of the Refuge's actual visitation (Fitzroy, 2022).



Source: (U.S. Fish and Wildlife Service , 2023b)

Figure D-1. Total Visitation to the LKNWR, FY 2013–2014 to 2022–2023.

The drastic difference in visitor counts between the previous method and the new method make it difficult to ascertain what the actual level of visitation is at the LKNWR, and how it varies depending on water deliveries. Because of a lack of water deliveries in 2022, the Refuge had the lowest peak population count of waterfowl ever recorded, and the 2022/2023 hunting season was closed (U.S. Fish & Wildlife Service, n.d.; Trail, 2022). Accordingly, we would expect that visitation would be lower than normal in 2022. Because the data shows a drastic increase, it is likely that the counts prior to 2022 were inaccurately low. However, it is also unclear why so many people visited the Klamath Basin Complex Refuges when there were so few birds and no hunting opportunities, although it is possible the COVID-19 pandemic played a role in people's outdoor recreation decisions.

Given the issues with the data, we are not able to reliably estimate the change in visitor levels that are likely to result from an increase in wetland habitat under the Modernization Alternative. It is possible, and even likely, that the change in visitation would be small given the small relative increase in wetland acreage. The 300-acre increase that is expected to occur under the Modernization Alternative represents less than one percent of the roughly 33,000 acres of wetland habitat provided at the LKNWR over the last decade (U.S. Fish and Wildlife Service , 2023b). Given the small relative increase, it is possible that visitation response may be small under the Modernization Alternative.

However, even if visitation response or value per visit effects at the LKNWR are small, total recreation value of enhanced habitat and waterfowl productivity could still be large as wildlife-related recreation throughout the entire Pacific Flyway may be enhanced by increased bird populations. Recreation value is also just one portion of the value provided by the Refuge, as it does not include benefits to people who value the existence of the Refuge's habitat and the ability to maintain the habitat for future generations, or values related to other ecosystem services provided by wetlands. In summary, because of a lack of reliable visitor data, and because recreation would only represent a fraction of the total value of increasing wetland habitat, this analysis does not estimate the value to recreation of increased wetland habitat at LKNWR.

4.2.1.1.6 Carbon Emission Reductions

The Modernization Alternative is expected to reduce carbon dioxide (CO_2) emissions by switching the fuel used to recirculate drain water. Specifically, PG5 E Pump Recirculation will replace a temporary, diesel-powered, mobile pump with permanent electric pumps in the E Pumping Plant. The switch from diesel fuel to electricity is expected to reduce CO_2 emissions. The current diesel pump uses approximately 14,280 gallons of diesel per year.[16] At 22.45 pounds of CO_2 per gallon of diesel, the annual fuel use generates approximately 145 metric tons (Mt) of CO_2 (U.S. Energy Information Administration, 2023). Every megawatt-hour (MWh) of energy used by electric pumps is estimated to translate into approximately 0.7525 Mt of carbon emissions.[17] By assuming the new pump will require an equivalent amount of energy to the old pump, we estimate the electric pumping will require approximately 162 MWh per year.[18] The associated CO_2 emissions would be approximately 121 Mt per year. Accordingly, the Modernization Alternative would result in an estimated reduction of 23 Mt of CO_2 each year.[19]

To value the potential decrease in carbon emissions, this analysis uses the social cost of carbon (SCC) per ton of carbon dioxide, which is the estimated incremental additional cost to society per unit of carbon emitted based on the expected damages associated with climate change. There are many estimates of the SCC, and the estimates vary based on what types of damages are included, the discount rate chosen, the geographic area under consideration (such as global damages versus U.S. domestic damages), and the projected level of global warming and associated damages. The Office

[16] Estimate based on KDD's total fuel cost of $71,400 in Fiscal Year 2021-2022 and a fuel cost of $5.00 per gallon (White, 2023).

[17] This assumes that marginal changes in energy demand are met with fossil fuel-based production, such that 100 percent of District hydro energy production results in reduced fossil fuel powered generation. This is reasonable since PacifiCorp's baseload power is almost entirely fossil fuel-based, and the hydropower generated under the Modernization Alternative is expected to displace PacifiCorp's baseload power (Perkins, 2022). Furthermore, this estimate assumes 0.7521 metric tons of carbon emitted from one MWh of fossil fuel powered electricity generation based on 1) the current proportion of fuel sources—oil, natural gas, and coal—for fossil fuel powered electrical power generation in the West, and 2) the associated metric tons of CO_2 produced per MWh powered by each fossil fuel source, as reported by the Energy Information Administration.

[18] Using a conversion factor of one liter of diesel equating to 10 kWh of electricity and 30 percent energy conversion efficiency.

[19] While some construction activities under the Modernization Alternative would increase carbon emissions through the use of vehicles and heavy machinery, the amount of emissions from these sources is relatively small and temporary. These emissions would also likely be offset by the annual vehicle emissions avoided when the need to inspect and maintain canals is reduced (as described in the Operations and Maintenance Cost Savings section). For these reasons, we do not include vehicle emissions in the analysis of carbon.

of Management and Budget convened an Interagency Working Group (IWG) on the Social Costs of Greenhouse Gases, which in 2013 developed a set of SCC estimates that could be used across federal agencies (Interagency Working Group on Social Cost of Greenhouse Gases, 2013). In February 2021, the IWG updated its estimates of the SCC. They estimated that in the year 2020, at a 3 percent discount rate, the SCC value was $59 per Mt (Interagency Working Group on Social Cost of Greenhouse Gases, 2021).[20] We apply this value to the net change in carbon emissions each year throughout the project life to estimate the change in carbon emissions from the Modernization Alternative.

At an SCC value of $59 per Mt, the 23 Mt of annual avoided carbon emissions would have a value of roughly $1,000 (as shown in Table D-15).

Table D-15. Annual Average Reduction in Carbon Costs of Modernization Alternative, Hood River Watershed, Oregon, 2023 dollars.[1]

Project Group	Annual Carbon Emissions Under No Action Alternative (Mt/yr)	Annual Carbon Emissions Under Modernization Alternative (Mt/yr)	Annual Carbon Emissions Avoided (Mt/yr)	Average Annual Net Benefit of Avoided Carbon Costs
PG1 North Canal Improvements	0	0	0	$0
PG2 SCADA System	0	0	0	$0
PG3 Fish Screen	0	0	0	$0
PG4 E and F Pumping Plants	0	0	0	$0
PG5 E Pump Recirculation	145	121	23	$1,000
PG6 Upgraded Turnouts	0	0	0	$0
Total	**145**	**122**	**23**	**$1,000**

Note: Totals may not sum due to rounding. Prepared July 2024

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent.

4.2.1.2 Benefits Considered but Not Included in Analysis

This section describes potential benefits of the Modernization Alternative that are not quantified in the analysis.

4.2.1.2.1 Fish Value

The PG3 Fish Screen is expected to prevent fish from the Klamath River from entering the North Canal Diversion and becoming entrained in KDD's water conveyance system. The Oregon

[20] This value has been adjusted for inflation to 2023 dollars using the GDP Implicit Price Deflator.

Department of Fish and Wildlife has found that "more than 98 percent of young salmon and steelhead survive an encounter with a properly designed fish screen" (Oregon Department of Fish and Wildlife, 2013). Entrained fish are likely to perish in KDD's conveyance system. The project will protect fish populations in the Klamath River, including the shortnose sucker and Lost River sucker, which are federally listed endangered species (U.S. Fish and Wildlife Service, 2023c). The Upper Klamath River is designated Critical Habitat for these species.

The importance of the fish screen would increase in the near future as salmon (which are protected at both state and federal levels) are reintroduced to the Upper Klamath River. Reintroduction is planned after the four dams that once blocked salmon passage on the Klamath River are removed, a process that is expected to be completed in 2024 (California Trout, 2023). Once salmon repopulate the Upper Klamath River, the PG3 Fish Screen would help ensure that KDD's North Canal diversion does not negatively impact their recovery.

Reestablishing fish habitat in the Klamath River is a national priority due to the ecological and cultural values supported by this habitat. Prior to the dams' construction, the Klamath River was the third-largest salmon-producing river on the West Coast, and it served as an important food source for native tribes in the area (National Oceanic and Atmospheric Administration, 2022). The River was once home to Chinook salmon, coho salmon, steelhead, Pacific lamprey, bull trout, and Redband trout, among other species; all of which have experienced declines in population due to various sources of habitat degradation, including the erection of dams (O'Keefe, Pagluico, Scott, Cianciolo, & Holycross, 2022). This has changed the lives of native tribes that have relied on the fish as a major source of food, cultural practices, and way of life. Removing the dams will reopen access to more than 400 miles of habitat for these fish species, including the stretch of river where the PG3 Fish Screen would be located (National Oceanic and Atmospheric Administration, 2022).

The PG3 Fish Screen has been designated as an important component in the federal planning process to restore the Upper Klamath River. To prioritize the projects most important to reestablishing salmon species in the Klamath River, a team of experts comprised of staff at the National Oceanic and Atmospheric Administration (NOAA), the Pacific State Marine Fisheries Commission (PSMFC), and Trout Unlimited (TU) ranked the importance of potential Klamath habitat restoration and fish screening projects. Among the projects evaluated in their 2022 report was the PG3 Fish Screen at the North Canal Diversion. The team assessed projects based on their size, the number of fish species affected, and the impact on fish. Out of 91 diversions that were evaluated for fish screening projects, 26 projects received the highest priority ranking. The PG3 Fish Screen was one of these 26 projects receiving the highest priority ranking. Only one fish screen received a higher overall priority score than the PG3 Fish Screen (O'Keefe, Pagluico, Scott, Cianciolo, & Holycross, 2022).

The 2022 study prioritizing projects did not directly estimate the number of fish deaths that would be avoided by each fish screen, nor were there other sources available for quantifying the ecological benefit of the PG3 Fish Screen. For this reason, we do not attempt to quantify the benefits of the PG3 Fish Screen. However, for context, we note that people in the Pacific Northwest highly value salmon species, even if they do not consume them for food or enjoy them recreationally. One recent economic study found that, on average, households in the Pacific Northwest value a one-year increase of 1,000 salmon between $0.09 and $0.22 (Lewis, Kling, Dundas, & Lew, 2022).[21] Applying the average of $0.16 per household to 9.4 million households in the Pacific Northwest (as the

[21] We adjusted the original values of $0.08 and $0.19 from 2017 dollars to 2023 dollars using the GDPIPD.

original study did) results in total value of roughly $1,500 per fish. At this rate, PG3 Fish Screen would have to save approximately 200 salmon per year in order to outweigh its total annual costs of $308,000. In addition to the value to the general Pacific Northwest population, enhancing salmon restoration provides cultural value of the fish to the tribes, whose traditional way of life depends on the species.

The Modernization Alternative includes PG3 Fish Screen because it will provide ecological and cultural benefits and is an important component of restoring the Upper Klamath River, a federal priority. This fish screen was chosen as the Modernization Alternative for PG3 Fish Screen because it represents the least expensive alternative that still met the efficacy standards for the fish screen. A discussion of the alternatives, their associated costs, and efficacy is provided in Section 5 of the Plan-EA.

4.2.1.2.2 Water Use Transparency and Control

PG6 Upgraded Turnouts would install new monitoring equipment at 76 patron turnouts that would allow KDD to measure the amount of water going to each patron. This would provide the District and its patrons with a variety of benefits. First, KDD would be able to ensure the correct allocation of water for each patron, ensuring fairness and compliance with water right quantity and seniority. The upgraded turnouts would also help avoid and resolve conflicts over water, since accurate measurements would enhance accountability and help ensure use of water in accordance with allotment. This would help to foster cooperation and trust within the District. It would also provide patrons with the ability to monitor their own water use, which may help them better manage their allotted water and optimize their crop yields. The likelihood of any change in on-farm production and the magnitude of any change is not known, nor are there known case studies to draw from to make an educated estimate, so this potential benefit is not quantified. While the social benefits of monitoring and measuring water use are also not quantifiable, they are expected to be valuable to the community. In sum, while PG6 Upgraded Turnouts does not have any quantified benefits in this analysis, it is included in the Modernization Alternative because the qualitative benefits are believed to outweigh its small, annualized cost ($1,000).

In addition to reducing O&M costs, PG2 SCADA System will generate agricultural water management benefits. The system will allow the District to deliver water with more precision, providing the desired amount of water when it is needed to the areas that require it. This will increase water management efficiencies, which has the potential to reduce water waste and improve patron yields. Because these benefits to water management are difficult to predict and quantify, we do not include them in this analysis. However, they are expected to be positive.

4.2.1.2.3 Instream Flow Quantity and Quality

PG5 E Pump Recirculation would allow KDD to increase their reuse of water drained off District fields, which would effectively increase the total amount of usable water available to the District and reduce pollutants entering the Klamath River. This could help alleviate some of the water quantity and quality problems in the Klamath River. In dry water years, the Klamath River suffers from low flows (Neumann, 2022). The river typically has poor water quality in the summer as a result of natural processes and man-made pollution, including agricultural runoff from KDD's system (Sullivan, Sogutlugil, Deas, & Rounds, 2014).

Reusing the drain water could result in more water staying in the Klamath River. If KDD extracts less than its full water rights in a given year, the amount of water recirculated by PG5 E Pump Recirculation would offset water KDD would otherwise extract from the Klamath River (White,

2023).[22] In this way, PG5 E Pump Recirculation could allow for more water to remain instream. Additionally, when drain water is reused rather than flowing into the Klamath River, it reduces the amount of agricultural runoff into the river. A 2014 study by the U.S. Geological Survey found that recirculating water in the Klamath Straits Drain (as PG5 E Pump Recirculation would do) could reduce pollutant loads in the Klamath River (Sullivan, Sogutlugil, Deas, & Rounds, 2014).

If PG5 E Pump Recirculation improves instream flow, it could have beneficial effects on wildlife. Multiple protected species rely on the river, including the shortnose sucker, Lost River sucker, coho salmon, and Southern Resident Killer Whales (through their reliance on Chinook salmon as food) (Neumann, 2022). If the improved flows benefited these species, it would likely generate economic benefits. Numerous scientific studies have demonstrated that people derive value from protecting and supporting endangered species and salmon specifically (Bell, Huppert, & Johnson, 2003; Loomis J. , 1996; Layton, Brown, & Plummer, 2001; Olsen, Richards, & Scott, 1991; Richardson & Loomis, 2009). Consequently, PG5 E Pump Recirculation could generate economic benefits by enhancing instream flow conditions.

While improved instream flow (water quantity and quality) is a potential benefit of the Modernization Alternative, we do not quantify it due to the uncertainty surrounding the magnitude of the water improvements (i.e., how much additional water and the improvement to water quality) and the degree to which those improvements would improve species populations.

4.2.1.3 Benefits of the Modernization Alternative over the No Action Alternative

Because the No Action Alternative provides no benefit above current conditions, the NED benefits of the Modernization Alternative over the No Action are equal to the NED benefits of the Modernization Alterative. These are summarized above in Table D-11.

5 NED Benefits Compared to Costs

Across all project groups, the Modernization Alternative would provide quantified net average annual NED benefits of -$245,000. The NED costs and benefits are summarized in Table D-16 (which corresponds to NWPM 506.21 Economic Table 6). Overall, in addition to the quantified benefits, the Modernization Alternative would provide benefits by protecting wildlife, providing water use transparency, improving water quality, and bolstering the reliability and efficiency of KDD. The Project also helps to increase the overall reliability of water necessary to sustain the rural way of life and the Klamath Basin community identity rooted in historic agricultural land uses.

[22] If KDD uses its full water rights in addition to the water reused with PG5 E Pump Recirculation, the reused water would not be offsetting extractions from the Klamath River, it would simply be augmenting the District's water supply and helping to alleviate agricultural damages. These potential benefits are described in Section 4.

Table D-16. Comparison of NED Costs and Benefits of the Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Works of Improvement	Agriculture-related Reduced OMR	Nonagri-cultural Carbon Value	Nonagri-cultural Habitat Value	Average Annual Benefits	Average Annual Cost[2]	Benefit Cost Ratio
PG1 North Canal Improvements	$10,000	$0	$150,000	$160,000	$160,000	1.0
PG2 SCADA System	$40,000	$0	$0	$40,000	$25,000	1.6
PG3 Fish Screen	$0	$0	$0	$0	$308,000	0.0
PG4 E and F Pumping Plants	$29,000	$0	$0	$29,000	$15,000	1.9
PG5 E Pump Recirculation	$77,000	$1,000	$0	$78,000	$43,000	1.8
PG6 Upgraded Turnouts	$0	$0	$0	$0	$1,000	0.0
Total	**$156,000**	**$1,000**	**$150,000**	**$307,000**	**$552,000**	**0.6**

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent. Prepared July 2024
[2]From Table D-10.

5.1 Incremental Analysis

The Modernization Alternative is evaluated using an incremental analysis, which identifies how total costs and benefits change as project groups are added (or removed). The design of each project group is independent of the number of project groups included and the order of installation. Table D-17 presents the incremental costs and benefits of the Modernization Alternative.

Table D-17. Incremental Analysis of Annual NED Costs and Benefits Under the Modernization Alternative, Klamath River Watershed, Oregon, 2023 dollars.[1]

Project Groups	Total Costs	Incremental Costs	Total Benefits	Incremental Benefits	Net Benefits
5	$43,000	N/A	$78,000	N/A	$35,000
5, 2	$68,000	$25,000	$118,000	$40,000	$50,000
5, 2, 4	$83,000	$15,000	$147,000	$29,000	$64,000
5, 2, 4, 1	$243,000	$160,000	$307,000	$160,000	$64,000
5, 2, 4, 1, 6	$244,000	$1,000	$307,000	$0	$63,000

5, 2, 4, 1, 6, 3	$552,000	$308,000	$307,000	$0	-$245,000

[1]Price base: 2023 dollars amortized over 100 years at a discount rate of 2.5 percent. Prepared July 2024

5.2 Modernization Alternative

The No Action Alternative provides no benefits relative to current conditions. As the Modernization Alternative would provide net quantified NED benefits of -$245,000, plus potential other unquantified values, the Modernization Alternative is the Preferred Alternative.

6 References

Austin, G. (2022, November 15). Lower Klamath National Wildlife Refuge Manager. (A. Schroeder, B. Wyse, & W. Oakley, Interviewers)

Bell, K., Huppert, D., & Johnson, R. (2003). Willingness to pay for local coho salmon enhancement in coastal communities. *Marine Resource Economics, 18*, 15-31. Retrieved from https://core.ac.uk/download/pdf/6679062.pdf

Brander, L., Raymond, F., & Vermaat, J. (2006). The Empirics of Wetland Valuation: A Comprehensive Summary and a Meta-Analysis of the Literature. *Environmental and Resource Economics*, 223-250.

Brown, T. (2023, November 1). Program and Management Analyst, Bureau of Reclamation, Klamath Area Office. (S. White, Interviewer)

California Trout. (2023, March 31). Klamath Dam Removal: It's Happening. *Caltrout News*. Retrieved from https://caltrout.org/news/klamath-dam-removal-its-happening

California Waterfowl Association. (2023). *Save the Lower Klamath National Wildlife Refuge*. Retrieved July 14, 2023, from https://calwaterfowl.org/lower-klamath

Dennis, J. (2022, November). *Wetland, Waterbirds, and Water: A visual journey through a century of change*. Retrieved from https://storymaps.arcgis.com/stories/5065b47cebff4e3b8b0a3a747acbf121

Ducks Unlimited. (2022, August 22). DU awarded $2.5 million for Klamath Basin projects. *Ducks Unlimited*. Retrieved from https://www.ducks.org/newsroom/du-awarded-26-million-for-klamath-basin-projects

Farmers Conservation Alliance. (2023, June 20). 2023.06.20 KDD PlanEA ProjectCosts.xlsx.

Fitzroy, J. (2022, November 22). Email - Re: Lower Klamath NWR Visitor use numbers.

Gilmer, D., Yee, J., Mauser, D., & Hainline, J. (2004). *Waterfowl migration on Klamath Basin National Wildlife Refuges 1953-2001: U.S. Geological Survey, Biological Resources Discipline Biological Science Report USGS/BRD/BSR—2003-0004*. U.S. Geological Survey. Retrieved from https://pubs.usgs.gov/bsr/2003/0004/bsr030004.pdf

Interagency Working Group on Social Cost of Greenhouse Gases. (2013). *Technical Support Document: Techical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. Retrieved from https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf

Interagency Working Group on Social Cost of Greenhouse Gases. (2021). *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide - Interim Estimates under Executive Order 13990*. The White House. Retrieved from https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf

Klamath County. (2023). *Klamath County Taxlot Finder*. Retrieved from https://kcgis.maps.arcgis.com/apps/webappviewer/index.html?id=664411956da94614a80be24849b74c1b&extent=-13553292.6841%2C5191250.3666%2C-13550999.5732%2C5192298.9871%2C102100

Layton, D., Brown, G., & Plummer, M. (2001). *Valuing Multiple Programs to Improve Fish Populations*. Washington State Department of Ecology.

Lewis, D., Kling, D., Dundas, S., & Lew, D. (2022). Estimating the value of threatened species abundance dynamics. *Journal of Environmental Economics and Management, 113*.

Loomis, J. (1996). Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey. *Water Resources Research, 32*(2), 441-447.

Loomis, J., Hanemann, M., Kanninen, B., & Wegge, T. (1991). Willingness to Pay to Protect Wetlands and Reduce Wildlife Contamination from Agricultural Drainage. In A. Dinar, & D. Zilberman, *The Economics and Management of Water and Drainage in Agriculture.* (pp. 411-429). Boston: Springer.

National Oceanic and Atmospheric Administration. (2022, December 22). As Dam Removals Move Forward, NOAA Explores Next Steps for Habitat Restoration in Klamath Watershed. *News*. Retrieved from https://www.fisheries.noaa.gov/feature-story/dam-removals-move-forward-noaa-explores-next-steps-habitat-restoration-klamath

National Wildlife Refuge Association. (2022, March 17). *Restoring Klamath Basin and its National Wildlife Refuges to Wildlife Havens*. Retrieved from https://www.refugeassociation.org/news/2022/3/16/restoring-klamath-basin-and-its-national-wildlife-refuges-to-wildlife-havens

Natural Resources Conservation Service. (2022, November). *California Wetland Reserve Easements (WRE & RCPP WRE), FY 2023 - Geographic Area Caps (GARC)*. Retrieved from https://www.nrcs.usda.gov/sites/default/files/2022-11/California%20WRE%20GARCs%202023.pdf

Neuman, M. (2023, August 10). Chief, Resource Management Division, Klamath Basin Area Office, Bureau of Reclamation. (W. Oakley, Interviewer)

Neumann, E. (2022, December 22). Feds consider reducing Klamath River flows by up to 40%. *OPB*. Retrieved from https://www.opb.org/article/2022/12/22/feds-consider-reducing-klamath-river-flows-by-up-to-40/

O'Keefe, C., Pagluico, B., Scott, N., Cianciolo, T., & Holycross, B. (2022). *Klamath Reservoir Reach Restoration Plan: A Summary of Habitat Conditions and Restoration Actions in the Mainstem Klamath River and Tributaries Between Iron Gate Dam and Link River Dam*. NOAA Fisheries, Pacific States Marine Fisheries Commission, and Trout Unlimited.

Olsen, D., Richards, J., & Scott, R. D. (1991). Existence and Sport Values for Doubling the Size of Columbia river Basin Salmon and Steelhead Runs. *Rivers, 2*(1), 44-56. Retrieved from

https://www.dfw.state.or.us/agency/commission/binders/19/06_Jun/Beaver%20Petition%20Bibliography/Olsen%20et%20al_1991.pdf

Oregon Department of Fish and Wildlife. (2013). *Economic Incentives for Water Users to Protect Fish, 2011-2013 Report to the Oregon Legislature*. Oregon Department of Fish and Wildlife. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwivosOihOCBAxVJHjQIHWP8A5UQFnoECCMQAQ&url=http%3A%2F%2Fdfw.state.or.us%2Ffish%2Fscreening%2Fdocs%2F11-13_Legislative_Report.pdf&usg=AOvVaw1muJ2u2mluhvF6wuGykVEB&opi=89978449

Oregon Department of State Lands. (2021, June). DSL Mitigation Payment Calculator (ILF/PIL). Retrieved from https://www.oregon.gov/dsl/WW/Documents/DSL_MitigationPaymentCalculator_EffectiveJune2021.xlsx

Pate, J., & Loomis, J. (1997). The effect of distance on willingness to pay values: a case study of wetlands and salmon in California. *Ecological Economics, 20*, 199-207. Retrieved from https://www3.uwsp.edu/cnr-ap/UWEXLakes/Documents/people/economics/12_wetlandsSalmonCa_pate_paper.pdf

Randall, A., Kidder, A., & Chen, D.-R. (2008). Meta-Analysis for Benefits Transfer - Toward Value Estimates for Some Outputs of Multifunctional Agriculture. *12th Congress of European ASsociation of Agricultural Economists*.

Richardson, L., & Loomis, J. (2009). The total economic value of threatened, endangered and rare species: An updated meta-analysis. *Ecological Economics, 68*, 1535-1548.

Sullivan, A., Sogutlugil, I., Deas, M., & Rounds, S. (2014). *Water-Quality Modeling of Klamath Straits Drain Recirculation, a Klamath River Wetland, and 2011 Conditions for the Link River to Keno Dam Reach of the Klamath River, Oregon*. Klamath River, Oregon: U.S. Geological Survey. Retrieved from https://pubs.usgs.gov/of/2014/1185/pdf/ofr2014-1185.pdf

Trail, P. (2022, March 11). The Klamath Basin's Water Crisis Is a Growing Disaster for Waterfowl. *Audubon News*. Retrieved from https://www.audubon.org/news/the-klamath-basins-water-crisis-growing-disaster-waterfowl

U.S. Bureau of Reclamation. (2022, November 4). Change in Discount Rate for Water Resources Planning. *Federal Register*, p. 66745. Retrieved from https://www.federalregister.gov/documents/2022/11/04/2022-24084/change-in-discount-rate-for-water-resources-planning#:~:text=The%20discount%20rate%20for%20Federal,monetary%20values%20to%20present%20values.

U.S. Census Bureau. (2021). 2021 American Community Survey 5-Year Estimates, Table DP02. Retrieved from data.census.gov

U.S. Congress. (2021, November 15). *Public Law 117-58*. Retrieved from https://www.congress.gov/117/plaws/publ58/PLAW-117publ58.pdf#page=961

U.S. Energy Information Administration. (2023, September 7). *Carbon Dioxide Emissions Coefficients*. Retrieved from https://www.eia.gov/environment/emissions/co2_vol_mass.php

U.S. Fish & Wildlife Service. (2022, August 26). *Hunting - Lower Klamath National Wildlife Refuge*. Retrieved from https://www.fws.gov/refuge/lower-klamath/visit-us/activities/hunting

U.S. Fish & Wildlife Service. (n.d.). *Lower Klamath National Wildlife Refuge is closed to all hunting*. Retrieved October 25, 2023, from Lower Klamath National Wildlife Refuge: https://www.fws.gov/refuge/lower-klamath/visit-us/activities/hunting

U.S. Fish and Wildlife Service. (2023a). *Lower Klamath National Wildlife Refuge*. Retrieved July 14, 2023, from https://www.fws.gov/refuge/lower-klamath/about-us

U.S. Fish and Wildlife Service. (2023b). National Wildlife Refuge System's Annual Performance Reports, Fiscal Years 2013-2023.

U.S. Fish and Wildlife Service. (2023c, September 11). USFWS Threatened & Endangered Species Active Critical Habitat Report. Retrieved from https://ecos.fws.gov/ecp/report/table/critical-habitat.html

Natural Resources Conservation Service. (2022). *Rate for Federal Water Projects | NRCS Economics*. Retrieved from https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/prices/?cid=nrcs143_009685

Vradenburg, J. (2023, September 1). Peak Fall Migration Duck Populations, Klamath Basin National Wildlife Refuge Complex.

White, S. (2023, July 5). Klamath Drainage District Manager. (B. Wyse, & W. Oakley, Interviewers)

Woodward, R., & Wui, Y.-S. (2001). The economic value of wetland services: a meta-analysis. *Ecological Economics*, 257-270.

D.2 Project Formulation – Alternatives Considered

This appendix section presents the alternatives considered in the formulation phase.

During the formulation phase, alternatives were evaluated based on meeting both National Environmental Policy Act (NEPA) and environmental review requirements specific to NRCS federal investments in water resources projects (PR&G) (Table D-13). According to NEPA, "agencies shall rigorously explore and objectively evaluate all reasonable alternatives" (40 C.F.R. 1502.14). According to PR&G DM9500-013, alternatives should reflect a range of scales and management measures and be evaluated against the Federal Objective and Guiding Principles; against the extent to which they address the problems and opportunities identified in the purpose and need; and against the criteria of completeness, effectiveness, efficiency, and acceptability:

1. Completeness is the extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. It does not necessarily mean that alternative actions need to be large in scope or scale.
2. Effectiveness is the extent to which an alternative alleviates the specified problems and achieves the specified opportunities.
3. Efficiency is the extent to which an alternative alleviates the specified problems and realizes the specified opportunities at the least cost.
4. Acceptability is the viability and appropriateness of an alternative from the perspective of the Nation's general public and consistency with existing federal laws, authorities, and public policies. It does not include local or regional preferences for particular solutions or political expediency.

Alternatives eliminated during formulation are shown in Table D-18 and discussed. Alternatives selected for further evaluation are discussed in the Plan-EA.

Table D-18. Alternatives Considered During the Formulation Phase and Criteria in PR&G Achieved.

Alternative	Completeness	Effectiveness	Efficiency	Acceptability	Selected for Further Evaluation
Canal Lining	Yes	No	Yes	Yes	Yes
Treated Wastewater Reuse	Yes	Yes	No	Yes	No
On-District Storage	Yes	Yes	No	No	No
North Canal Piping	No	No	No	Yes	No
Re-routing the Klamath Straits Drain	No	Yes	Yes	Yes	No
Pumped Storage via the Klamath Straits Drain	No	Yes	No	No	No
Improving Water Supply to the Ady Canal Via the F and FF Pumping Plants	No	Yes	Yes	Yes	No
Klamath River Ady Diversion Fish Screen	No	Yes	Yes	Yes	No

Alternative	Completeness	Effectiveness	Efficiency	Acceptability	Selected for Further Evaluation
East Side State Line Drain Recirculation Pump	Yes	No	No	Yes	No
No Action (Future without Federal Investment)	No	No	Yes	Yes	Yes
Modernization Alternative	Yes	Yes	Yes	Yes	Yes

D.2.1 Treated Wastewater Reuse

This project would increase water supply to the District and eliminate the discharge of treated wastewater to the Klamath River by building a pipeline between the Klamath Falls wastewater treatment plant and North Canal. The 6-mile-long pipeline would supply approximately 1,344 acre-feet of class A treated wastewater to KDD each year, bolstering water supply and potentially reducing diversions from the Klamath River. The City of Klamath Falls and the South Suburban Sanitary District (SSSD) both support this initiative. The infrastructure to treat and convey the wastewater would cost an estimated $47.4 million. In addition to high costs, this alternative would require coordination with two entities, the City of Klamath Falls and SSSD, that were not included in the Scoping Process. This alternative would not meet the purpose and need. Additional high costs and logistics complexities of this project would not make it efficient, therefore it was eliminated from detailed study.

D.2.2 On-District Storage

To increase water supply, reduce tailwater, and decrease pumping costs, the District would like to construct re-regulation reservoirs at key locations in its conveyance system. However, acquiring and excavating land to build re-regulation reservoirs may be costly or reduce irrigable acreage within the District. This alternative would be consistent with existing federal laws; however because it would require the conversion of existing agricultural land to storage, which would not be viable or appropriate from the perspective of the general public, this alternative would not be acceptable. This alternative was eliminated due to lack of acceptability and efficiency.

D.2.3 North Canal Piping

Piping the North Canal would address water supply issues by reducing evaporation and transpiration from open canal. Several factors precluded this project from reaching further evaluation: the size and topography over which North Canal flows would require large diameter pipe that is costly to manufacture, deliver and install; low water velocities could allow sediment to fall out of suspension in the pipeline, creating maintenance issues; and the shallow groundwater table in the former lakebed could cause a pipeline to float when empty, requiring special construction to secure the pipeline to the underlying area. This project was eliminated due to lack of completeness, effectiveness, and efficiency.

D.2.4 Re-routing the Klamath Straits Drain

This project would increase water supply to LKNWR by re-routing the Klamath Straits Drain south across the Oregon-California border and into the refuge rather than north via the E/EE and F/FF pumping plants. Energy consumption at the pump stations would also decrease. Functional changes to the Klamath Straits Drain may be required to overcome the topography of the area to allow water deliveries by gravity or pumping. Also, KDD currently relies on drainage water from the Klamath Straits Drain to supply re-use water for irrigation to lands in

the southwest corner of the District. This project was excluded from further discussion due to lack of completeness.

D.2.5 Pumped Storage via the Klamath Straits Drain

This project aims to create renewable electricity by simulating a pumped storage scenario river between LKNWR and the Klamath River via the Klamath Straits Drain. This alternative would generate revenue through electricity sales that would offset the high pumping costs the District currently faces. The environmental effects of drawing water too and from the Klamath River are potentially large. As a result of the Klamath Dam Removal efforts, salmonoids will be returning to the Klamath River as far as Keno Dam in the coming years. While this alternative would be consistent with existing federal laws, the environmental effects of drawing water too and from the Klamath River in a reach that provides salmonoid habitat would not be viable or appropriate from the perspective of the general public. As a result this alternative would not be acceptable. Furthermore, the available head between the Klamath River and LKNWR is low, limiting the potential for developing financially-feasible low-head hydropower in the Klamath Straits Drain. This alternative was eliminated from further study due to lack of completeness, efficiency, and acceptability.

D.2.6 Improving Water Supply to the Ady Canal via the F and FF Pump Stations

This project would allow the F and FF pump plants to supply drainage water from Klamath Straits Drain to Ady Canal near its head to re-use for irrigation purposes. Currently, the FF Pumping Plant pumps water through a siphon to the Klamath River. The F Pumping Plant is mostly idle. By enabling Reclamation to move water from Klamath Straits Drain to Ady Canal rather than the Klamath River, water quality could improve in the Klamath River and water supply could increase for KDD patrons served off KDD Canal. Additionally, the District already functions in this manner by pumping water from Klamath Straits Drain into Ady Canal via the Township Pumps. This alternative was eliminated from further study due to lack of completeness.

D.2.7 Klamath River Ady Diversion Fish Screen

Screening the Ady Diversion would keep anadromous and residential fish from entering Ady Canal, which will be especially important once the Klamath Dams are removed. However, Reclamation owns the Ady Diversion, therefore installing the Ady Diversion fish screen is outside of the scope of this Plan-EA and could not be funded using Pub. L. No. 83-566. This alternative was eliminated from further study due to lack of completeness.

D.2.8 East Side State Line Drain Recirculation Pump

Installing a new District recirculation pump and motor along the East Side State Line Drain would improve the District's capacity to recirculate water and deliver water to LKNWR and would reduce the amount of tailwater discharge to the Klamath River. However, this project has been funded by U.S. Fish and Wildlife Service and managed by Ducks Unlimited and therefore eliminated from further study.

D.3 Engineering

The Klamath Drainage District System Improvement Plan, a summary of engineering analyses completed to date for KDD proposed projects, is included below.

Technical Memorandum

To: Klamath Drainage District

From: Daniel B. Scalas, P.E. & C.W.R.E.
Date: August 25, 2022
Re: Cost Estimate

Executive Summary
This technical memorandum provides the existing conditions, proposed solutions, design assumptions, and approximate construction costs as originally proposed by the permit application drawings, as prepared by MWH and received by Klamath Drainage District (KDD) on September 4, 2009. The proposed project includes the construction of approximately 2,400 linear feet of irrigation canal, the implementation of two paved roadway crossings, a canal-mounted flow measurement device, and three additional rural unpaved road crossings. The purpose of the project is to increase the total flow through the canal and connect the North Canal to the existing P-1 Lateral. This increase in flow rate will allow for additional water to be provided to the refuge without disrupting KDD water delivery operations. The design flow rate to the P-1 Lateral, based on the proposed construction documents, is 92 cubic feet per second (cfs). KDD has requested that the provided cost estimate reflect a 100 cubic feet per second allowable throughput. The technical memo, as provided by MWH on February 10, 2009, indicated that replacing the 48" corrugated metal pipe (CMP) culverts indicated on the construction documents with 4'x5' concrete box culverts would increase the total throughout from 92cfs to 100cfs. The associated cost estimate follows the AACE Class 4 methodology, which is expected to be accurate to the -30% to +50% range.

Due to the lack of existing topography data, some assumptions and/or approximations were made regarding the cross-section data and approximate quantities derived throughout construction. Additional assumptions are included in Cost Estimate Assumptions below.

Existing Conditions

MWH identified fifteen crossings along the existing North Canal. Three (3) crossings must be upgraded to allow for the design flow rate to be achieved. Each crossing has an existing culvert with various diameters, variable roadway width, paving material, design flow volume. Two paved crossings, Fugate Road and California State Highway 161 (CSH161) will need to be modified to achieve the design flow volume. Fugate Road currently has one (1) 48" diameter culvert installed. This allows for some irrigation to pass beyond the roadway until it encounters an existing terminal embankment, approximately Station 1+25 of the construction documents. Highway 161 does not allow for any flow to pass under the roadway.

Crossing 12 currently utilizes two (2) culverts of size 42" and 48" diameter. Crossings 13 and 14 have a single culvert of diameter 42" and 36", respectively. Full crossing details, including culvert diameter and approximate location can be found in Table 1 of the *North Canal Hydraulic Evaluation Memo* prepared on February 10, 2009 by MWH.

Proposed Conditions

MWH has proposed the removal and reconstruction of the previously mentioned crossings, a flow measurement device, and a canal extension between Fugate Road and CSH161. Canal construction is expected to remove existing material from center alignment and construct embankments along either side of the centerline of the canal. It is anticipated that the project will require more embankment material than can be removed from the center alignment. Additional fill material may be collected from the surrounding areas or provided from another location. Transportation costs associated with soil infill from an off-site

location have not been included within the cost estimate.

Per the *North Canal Hydraulic Evaluation Memo,* Crossing 12, Fugate Road and CSH 161 will require the implementation of two (2) additional 48" culverts to meet the 92cfs design flow volume. Crossings 13 & 14 require three (3) 48" culverts to meet the 92cfs design flow volume. To achieve 100cfs flow, the 4'x5' box culverts will need to be implemented instead of the 48" culverts for the Fugate Road and CSH 161 crossing locations. Excavation and removal costs for existing drainage systems have been added to the cost estimate. An inlet structure at CSH161 and the flow measurement device are proposed. Structures were estimated as unit and construction placement costs. Fixed and variable items were adjusted for installation costs.

Installation of a bridge crossing instead of culverts is a possibility but was not evaluated within the scope of this memo. The original design, as proposed by MWH, incorporated a series of culverts and design flow values were based on these assumptions. Further evaluation of bridges could be pursued within the pre-design phase at KDD's direction.

Alternatively, implementing a gaging station rather than the proposed flow meter is a possibility. Proposed design and cost estimate was based on flow meter installation in a similar fashion to the culverts. Alternative design could be pursued in pre-design phases. Some implementation of intelligent infrastructure could be included, but has not been included at this time.

Cost Estimate Assumptions

Submitted drawings were reviewed for unit and quantity values required for construction. Unit prices were derived from past and current projects with similar project scopes and service. Past project numbers were adjusted for inflation and other construction costs.

Due to the lack of existing topography, some inference and estimation was applied to the provided plan and profile drawings. Earthworks quantities were calculated using provided cross-sections and a series of linear interpolation between stations to determine total cut/fill quantities. It is assumed that cross-sectional volumes are approximate and may be subject to change as additional data is available.

Conclusion

Presented within the previously mentioned memo, there are multiple potential solutions based on different design flow volumes. This cost estimate is primarily based on the construction drawings as submitted for permit, with the substitution of box culverts for the Fugate Road and CSH 161 crossings. As previously mentioned, this equates to 100 cubic feet per second of water delivered to the P-1 Lateral. It does not account for variations relating to alternative flow volume rates.

Please feel free to contact us if you have any questions, comments, or concerns about what has been presented in this memo.

Sincerely,

Daniel Scalas

Daniel B. Scalas, P.E. & C.W.R.E.

Attached: Cost Estimate

Estimate of Probable Construction Costs

Project: North Canal Extension Project

DRAFT

Prepared by: T. Lundsten
Reviewed by: D. Scalas
Date: August 24, 2022

BID ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
1	Mobilization (5% of construction cost)	LS	1	$25,000	$25,000
2	Temporary Work Zone Traffic Control, Complete-In-Place	LS	1	$15,000	$15,000
3	Temporary Water Management Practices	LS	1	$10,000	$10,000
4	Earthworks	CY	8838	$10	$88,378
5	Crossing 12 Improvements	LS	1	$38,734	$38,734
6	Crossing 13 Improvements	LS	1	$57,887	$57,887
7	Crossing 14 Improvements	LS	1	$37,183	$37,183
8	Fugate Road Crossing	LS	1	$78,456	$78,456
9	Highway 161 Crossing	LS	1	$154,093	$154,093
10	Outlet Headwall Structure	LS	1	$53,120	$53,120
11	Water Flow Meter Weir	LS	1	$19,750	$19,750
	SUM OF ESTIMATED CONSTRUCTION COST				**$577,602**
	CONSTRUCTION CONTINGENCY (15%)				**$86,640**
	SUBTOTAL OF ESTIMATED CONSTRUCTION COSTS				**$664,243**
	ENGINEERING/SURVEYING (10%)				**$66,424**
	CONSTRUCTION ADMINISTRATION (10%)				**$66,424**
	ENVIRONMENTAL/PERMITTING				**$30,000**
	TOTAL ESTIMATED PROJECT COST (YEAR 2022 PRICES)				**$827,091**

MWH

BUILDING A BETTER WORLD

MEMORANDUM

TO: Greg Austin - KBNWRC
Monique King - EN

DATE: February 10, 2009

FROM: Bill Cutting / Dave Whitbeck - MWH

REFERENCE: 1520894

SUBJECT: North Canal Hydraulic Evaluation Memo

Klamath Drainage District's North Canal presently terminates at an earthen embankment approximately 100 feet east of Fugate Road. The Lower Klamath NWR would like to extend the North Canal approximately 0.5 miles to the southeast and connect it with the P-1 Lateral located on the south side of California State Highway 161. This extension would provide means to deliver water from the Klamath River to the Refuge through the North Canal. The Service has set a delivery target of 100 cfs as its ultimate objective. Both KDD and the Service believe that there are mutual benefits to extending the North Canal in this manner. This memo summarizes the preliminary results of an analysis of the improvements necessary to the North Canal to allow efficient delivery of 100 cfs through to the P-1 Lateral. An analysis of the requirements to deliver lesser amounts, 30, 50, and 80 cfs, is also included.

Existing Conditions

The North Canal has 15 crossings along its length. See Figure 1 for the structure locations. The capacity of the crossings decreases progressively along the canal's length. See Table 1 for a description of the structures. Flow capacity in the upper reaches of the canal has been estimated to be 250 cfs. Due to hydraulic restrictions created by the structures, capacity in the lower reaches is significantly less. See Figures 2 through 5 for typical crossing structures.

Table 1 Description of Existing Crossings along the North Canal

Crossing	KDD Structure Number(s)	Approx. Canal Mile	Structure Description	Location Notes
1	1, 2, 3	0.00	Pipe Culvert with Triple 54"-Dia Barrels	BNSF Railroad
2	4, 5, 6	0.04	Pipe Culvert with Triple 54"-Dia Barrels	Highway 97
3	N/A	0.56	Box Culvert with Triple 5'x6' Barrels	
4	N/A	1.07	Box Culvert with Triple 5'x6' Barrels	
5	N/A	2.38	Box Culvert with Triple 5'x6' Barrels	
6	N/A	3.47	Box Culvert with Triple 5'x6' Barrels	
7	N/A	4.51	Box Culvert with Triple 5'x6' Barrels	
8	457	5.75	3 x 48"-Dia CPE Pipes	
9	483	7.44	3 x 48"-Dia CPE Pipes	Township Road
10	564	8.44	3 x 48"-Dia CPE Pipes	
11	569,638	8.91	2 x 48"- and 1 x 36"-Dia CPE Pipes	
12	577,639	9.66	1 x 48"- and 1 x 36"-Dia CPE Pipes	
13	583	10.34	1 x 42"-Dia CPE Pipe	
14	588	11.30	1 x 36"-Dia CPE Pipe	
15	641	12.49	1 x 36"-Dia CPE Pipe	Fugate Road

North Canal Extension

As a separate effort, MWH is evaluating the construction measures necessary to extend the North Canal from Fugate Road, across California State Highway 161, and to connect it with the P-1 Lateral. The proposed alternative resulting from that evaluation involves the following upgrades. First, the existing 36-inch diameter culvert beneath Fugate Road will be removed and replaced by two 48-inch diameter culverts. Second, the existing embankment at the terminus of the North Canal, located just downstream of Fugate Road, will be removed. The existing drainage ditch running to the southeast towards Highway 161 will be expanded and its embankments will be raised. Finally, beneath Highway 161 new conveyance in the form of a two 48-inch diameter culverts will be constructed. The design capacity of these improvements is 100 cfs, although the existing North Canal is not currently capable of delivering that flow to the end of the canal.

System Hydraulic Analysis

A hydraulic analysis of the system was performed to assess which crossing structures will need to be modified in order to deliver a steady-state flow of 100 cfs through the North Canal to the P-1 Lateral. Friction losses in each reach between structures was estimated using physical data obtained during an October 2008, survey of the canal and Manning's Equation. Losses through the structures were estimated by using the orifice equation and coefficients determined by empirical equations developed by Yarnell et al ('1926). Culvert equations were compared to values determined by the Manning Equation.

Existing Structures,
If no modifications are made to existing structures with the exception of adding new culverts beneath Highway 161, a maximum of approximately 39 cfs can be delivered through the system, assuming no other diversions in the North Canal are operating. Any additional withdrawals from the upper reaches will increase energy losses in the system and reduce the potential to deliver water to the P-1 Lateral.

Fugate Road Modifications
If the existing culvert beneath Fugate Road is removed and replaced by two 48-inch diameter culverts, as described previously, the potential maximum flow that can be delivered to the P-1 Lateral will increase to approximately 47 cfs. Again, any additional withdrawals from the upper reaches of the canal will reduce the potential to deliver water to the P-1 Lateral.

50 cfs Capacity
Deliveries of 50 cfs can be achieved in the canal by upgrading the Fugate Road and Highway 161 crossings as described in the North Canal extension efforts, plus adding one additional 48-inch diameter culvert beneath crossing 14.

80 cfs Capacity
Deliveries of 80 cfs can be achieved in the canal by upgrading the Fugate Road and Highway 161 crossings as described previously, plus replacing the structures at crossings 13 and 14 with two 48-inch diameters each.

100 cfs Capacity
In order to be able to deliver up to 100 cfs through the North Canal at times when no other diversions are operating, additional structural modifications will need to be performed at Crossings 12, 13, and 14. At Crossing 12, the 36-inch pipe will need to be removed and replaced with two 48-inch diameter

culverts, for a total of three 48-inch culverts at the crossing. Similarly, the existing culverts at Crossings 13 and 14 will need to be removed and replaced by three 48-inch diameter culverts each.

If modifications to crossing 12, 13, and 14 are performed and the Fugate Road and Highway 161 crossings are constructed as described previously (2 x 48"-Dia CPE pipes each), the maximum capacity of the system to deliver water to the P-1 Lateral will be approximately 92 cfs. In order to increase delivery potential to 100 cfs, the modifications at Fugate Road and Highway 161 need to be changed to ffx4' box culverts, as opposed to 48"-dia CPE pipes. Box culverts would be necessary to provide sufficient capacity to reduce energy losses such that 100 cfs can be delivered.

Impacts

Water delivered to the Refuge through the North Canal will cause drawdown of the canal below current normal operating levels. The extent of this drawdown will increase as more flow is delivered and may cause a notable change in delivery potential to some North Canal customers near the downstream end of the system. To better estimate the impacts of this drawdown, it is recommended that anticipated timing of deliveries to the Refuge be determined and the hydraulic model used in the evaluation refined. The seasonal timing of deliveries will greatly impact the number of crossing modifications that will be necessary to deliver the desired water. For example, if the Refuge anticipates needing water during the height of summer, when irrigation diversion in the North Canal are high, significant increases in capacity will be necessary at most of the downstream crossings. Conversely, if the Refuge only anticipates needing water during times when irrigation diversions in the North Canal are low, fewer modifications will be required. Refinement of the model and a better understanding of the current operations of the North Canal will allow the extent of the modifications to be determined based on typical canal operating conditions.

References

1. D.L. Yarnell, F.A. Nagler, and S.M. Woodward, "Flow of Water through Culverts," *Univ. Iowa Studies in Eng.*, 1926

Figure 2 – Triple 54" Culverts at Crossing 1 (BNSF Railroad)

Figure 3 -Typical Triple Box Culvert Crossing

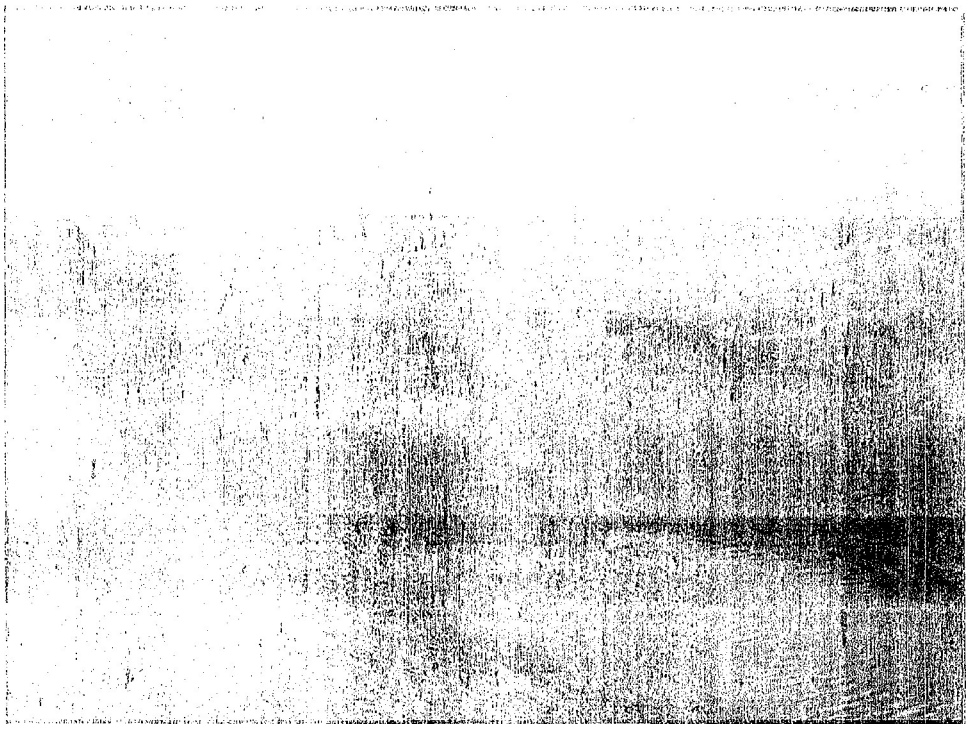


Figure 4 – Typical Triple Culvert Crossing

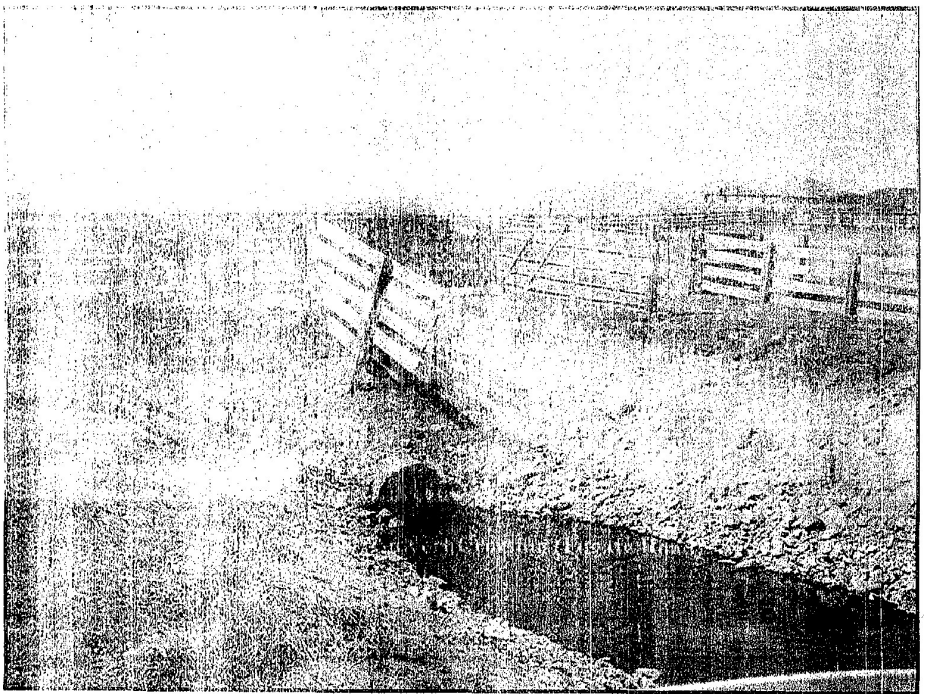


Figure 5 - 36" Culvert Crossing (Fugate Road)

D.4 Capital Costs

D.4.1 Modernization Alternative/Preferred Alternative Costs

This section presents capital costs for the Modernization Alternative (Table D-19), which is identified as the Preferred Alternative. Costs shown in Table D-19 differ from elsewhere in the Plan-EA because they do not include project administration costs.

North Canal Fish Screen

In 2022, Adkins Engineering developed a Fish Screen Feasibility Analysis and 10 percent designs of the District's preferred screen, the cone screen. Costs associated with this project are detailed below in Figure D-2.

FISH SCREEN ALTERNATIVE
FOR
KLAMATH DRAINAGE DISTRICT
PRELIMINARY COST ESTIMATE - CONE SCREEN
(YEAR 2022 COST)

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
General					
1	8% MOBILIZATION	LS	$480,500	All Req'd	$480,500
2	10 SCREENS, 10 SLIDE GATES, 10 INTAKE, CONTROLS INCLUDES DESIGN & FABRICATION, TESTING, TRAINING, 2-YEAR WARRANTY	LS	$2,000,000	All Req'd	$2,000,000
3	SITE PREPARATION	LS	$140,000	All Req'd	$140,000
4	20' PILE FOOTINGS	EA/FT	$160	40	$128,000
5	CONCRETE FOUNDATION	CUYD	$1,228	2,000	$2,456,600
6	SHEET PILE COFFER DAM	LS	$130,000	All Req'd	$130,000
7	DEWATERING	LS	$100,000	All Req'd	$100,000
8	ACCESS ROAD IMPROVEMENT (14FT GRAVEL ROAD)	FT	$17	6,900	$117,300
9	METAL WORK (CATWALK + RAILING)	LS	$69,448	All Req'd	$69,448
10	POWER EXTENSION	FT	$60	4,600	$276,000
11	SHEET PILE FOR SOUTH LEVEE	LS	$110,000	All Req'd	$110,000
12	DEBRIS BOOM	LS	$200,000	All Req'd	$200,000
13	JET SPRAY SYSTEM	EA	$15,000	10	$150,000
14	AIR BUBBLER SYSTEM	LS	$24,000	All Req'd	$24,000
15	EARTHWORK CUT (2649) & FILL (2153)	CUYD	$70	4,802	$336,139
				Sum of Estimated Construction Cost	**$6,717,987**
				Contingency (20%)	$1,343,597
				Engineering (10%)	$671,799
				Permitting and Environmental Compliance	$100,000
				Construction Admin (10%)	$671,799
				TOTAL ESTIMATED PROJECT COST (2022 DOLLARS)	**$9,505,181**

PRELIMINARY COST ESTIMATE
CONE SCREEN
FISH SCREEN ALTERNATIVE
FOR
KLAMATH DRAINAGE DISTRICT

FIGURE 6-h

Figure D-2. Cone Screen Preliminary Cost Estimate.

North Canal Improvements

The North Canal Improvement Project was initially developed in 2009. In 2022, Adkins Engineering updated the costs based on changes to the original designs and to adjust for increased construction costs and inflation. Figure D-3 demonstrates the preliminary costs for these improvements.

Estimate of Probable Construction Costs

PROJECT: **North Canal Extention Project**

DRAFT

Prepared by: T. Lundsten
Reviewed by: D. Scalas
Date: August 24, 2022

ADKINS ENGINEERING & SURVEYING

BID ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
1	Mobilization (5% of construction cost)	LS	1	$25,000	$25,000
2	Temporary Work Zone Traffic Control, Complete-In-Place	LS	1	$15,000	$15,000
3	Temporary Water Management Practices	LS	1	$10,000	$10,000
4	Earthworks	CY	8838	$10	$88,378
5	Crossing 12 Improvements	LS	1	$38,734	$38,734
6	Crossing 13 Improvements	LS	1	$57,887	$57,887
7	Crossing 14 Improvements	LS	1	$37,183	$37,183
8	Fugate Road Crossing	LS	1	$78,456	$78,456
9	Highway 161 Crossing	LS	1	$154,093	$154,093
10	Outlet Headwall Structure	LS	1	$53,120	$53,120
11	Water Flow Meter Weir	LS	1	$19,750	$19,750
				SUM OF ESTIMATED CONSTRUCTION COST	**$577,602**
				CONSTRUCTION CONTINGENCY (15%)	**$86,640**
				SUBTOTAL OF ESTIMATED CONSTRUCTION COSTS	**$664,243**
				ENGINEERING/SURVEYING (10%)	**$66,424**
				CONSTRUCTION ADMINISTRATION (10%)	**$66,424**
				ENVIRONMENTAL/PERMITTING	**$30,000**
				TOTAL ESTIMATED PROJECT COST (YEAR 2022 PRICES)	**$827,091**

Figure D-3. North Canal Improvement preliminary costs.

F and FF and E and EE Pump Station Upgrade

In 2023, Adkins Engineering developed an E/EE and F/FF Pumping Plant Evaluation and 10 percent design. Costs associated with this upgrade are detailed below in Figure D-4.

FARMER'S CONSESRVATION ALLIANCE
PUMPING PLANT EVALUATION E/EE & F/FF
PLANNING LEVEL COST ESTIMATE
(YEAR 2023 COST)

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
General					
1	Mobilization/Demobilization (not to exceed 5% of Total Bid Price)	LS	$112,700	All Req'd	$112,700
New Pump Installation					
2	Install Cascade 36AF axial flow, sinlge-stage pump with 250 HP motor	EA	$308,313	4	$1,233,300
3	Install Cascade 36AF pump with DeRan Model M20A gear head	EA	$281,455	2	$563,000
Electrical & Controls Upgrades (Fluent Engineering)					
5	Utility Service Line Extensions	EA	$43,000	2	$86,000
6	Pads, Fencing, Vaults	LS	$26,000	All Req'd	$26,000
7	Power Distribution MDP	EA	$48,000	2	$96,000
8	VFD's	EA	$26,000	4	$104,000
9	Utility Disconnects	EA	$12,000	4	$48,000
10	Electrical Feeders & Motor VFD Cable	LS	$51,000	All Req'd	$51,000
11	SCADA Controls	EA	$46,000	1	$46,000

Sum of Estimated Construction Cost	**$ 2,366,000**
Contingencies (20%)	$ 474,000
Engineering, Design, and Construction Administration (25%)	$ 592,000
Environmental, Permitting, Legal	$ 20,000
TOTAL ESTIMATED PROJECT COST (2023 DOLLARS)	**$ 3,452,000**

FCA
E/EE F/FF EVALUATION, COMBINED
PLANNING COST ESTIMATE

Figure D-4. E/EE and F/FF Pumping Plant Upgrades Preliminary Costs.

Installation of Recirculation Pipeline at the E Pumping Station

In 2023, Adkins Engineering developed a Recirculation Pipeline at the E Pumping Plant Evaluation and 10 percent design. A wide variety of materials are available for piping; availability of piping materials, prices, and new products change over time. Piping materials that could be used for recirculation pipeline include, but are not limited to, polyvinyl chloride, steel, high-density polyethylene (HDPE), bar-wrapped concrete cylinder, steel, fiberglass, and ductile iron. The

Modernization Alternative was priced using steel pipe, which at the time of this analysis was considered to be the District's preference.

At the time of project implementation, the specific piping material would be selected based on several considerations: the cost of the project would meet NED requirements; meet construction requirements; be appropriate based on local conditions and risk factors; and result in minor or no changes to project effects described in Section 6 of the Plan-EA, as determined through the tiered decision framework approach outlined in Section 1.4. The NRCS State Conservationist and the Sponsoring Local Organization would possess the final discretion to select the appropriate piping material.

Costs associated with this recirculation pipeline are detailed below in Figure D-5.

FARMER'S CONSERVATION ALLIANCE
KDD E-PLANT RECIRCULATION IMPROVEMENTS
PLANNING LEVEL COST ESTIMATE
(YEAR 2023 COST)

NO.	ITEM	UNIT	UNIT PRICE	AMOUNT	TOTAL PRICE
General					
1	Mobilization/Demobilization (not to exceed 5% of Total Bid Price)	LS	$19,000	All Req'd	$19,000
2	Construction Surveying (1% of Total Bid Price)	LS	$4,000	All Req'd	$4,000
3	Erosion and Sediment Control	LS	$10,000	All Req'd	$10,000
Recirculation Pipeline Improvements					
4	Install 48-inch fabricated manifold and T-fitting to attach to existing drainage pipe	LS	$5,000	All Req'd	$5,000
5	Install 48-inch corrugated steel pipe, includes fittings, vents, valves, trenching, and backfilling	LF	$490	217	$107,000
6	Install welded steel access manhole/cleanout	EA	$7,000	1	$7,000
7	Install 48-inchx48-inch cast iron sluice gate with thimble	EA	$90,000	2	$180,000
8	Modify existing catwalk and install new catwalk	LS	$60,000	All Req'd	$60,000
9	Install energy dissipation structure at outfall into Center Canal	LS	$2,000	All Req'd	$2,000

Sum of Estimated Construction Cost	**$**	**394,000**
Contingency (20%)	$	79,000
Engineering, Design, and Construction Administration (25%)	$	99,000
Environmental, Permitting, Legal	$	15,000
TOTAL ESTIMATED PROJECT COST (2023 DOLLARS)	**$**	**587,000**

FCA
KDD E-PLANT RECIRCULATION
PLANNING COST ESTIMATE

Attachment B

Figure D-5. E Pumping Station Recirculation Preliminary Costs.

Installation of SCADA and Automated Gates

A wide variety of SCADA hardware and software are available; availability of SCADA components, prices, and new products change over time. Costs associated with the SCADA and Automated Gates presented in this Draft Plan-EA are derived from similar irrigation district projects. At the time of project implementation, the specific SCADA components would be selected based on several considerations: project cost would meet NED requirements; meet construction requirements; be appropriate based on local conditions and risk factors; and result in minor or no changes to project effects described in Section 6 of the Plan-EA, as determined through the tiered decision framework approach outlined in Section 1.4. The NRCS State Conservationist and the Sponsoring Local Organization would possess the final discretion to select the appropriate SCADA components.

Table D-19. Preferred Alternative Capital Costs.

PG 1 North Canal Extension	Quantity	Quantity Units[2]	Materials and Construction Cost (2023$)[1,3]
Mobilization	N/A	LS	$25,000
Temporary Work Zone Traffic Control	N/A	LS	$15,000
Temporary Water Management Practices	N/A	LS	$10,000
Earthwork	8,838	CY	$88,378
Crossing 12 Improvement	N/A	LS	$38,734
Crossing 13 Improvement	N/A	LS	$57,887
Crossing 14 Improvement	N/A	LS	$37,183
Fugate Road Crossing	N/A	LS	$78,456
Highway 161 Crossing	N/A	LS	$154,093
Outlet Headwall Structure	N/A	LS	$53,120
Water Flow Meter Weir	N/A	LS	$19,750
Construction Contingency, CM, Survey Costs	N/A	N/A	**$158,400**
Engineering	N/A	N/A	**$29,000**
Project Admin[4]	N/A	N/A	**$110,000**
Permitting	N/A	N/A	**$30,000**
Real Property Rights	N/A	N/A	**$32,000**
PG 1 North Canal Extension Subtotal	N/A	N/A	**$927,000**

PG 2 SCADA System	Quantity	Quantity Units[2]	Materials and Construction Cost (2023$)[1,3]
Water Measurement Devices	9	EA	$55,000
Automated Gates	11	EA	$124,000
VFDs	2	EA	$22,000
Flow Meters	11	EA	$72,000
Solar Panel	4	EA	$14,000
Construction Contingency, CM, Survey Costs	N/A	N/A	**$94,000**
Engineering	N/A	N/A	**$22,000**
Project Admin[4]	N/A	N/A	**$55,000**
Permitting	N/A	N/A	**$3,000**
PG 2 SCADA System Subtotal	N/A	N/A	**$461,000**
PG 3 Fish Screen	**Quantity**	**Quantity Units[2]**	**Materials and Construction Cost (2023$)[1,3]**
Mobilization	N/A	LS	$480,500
Cone Screens, Slide Gates, Intake, and Controls	10	EA	$2,000,000
Site Preparation	N/A	LS	$140,000
20' Pile Footings	40	EA	$128,000
Concrete Foundation	2,000	CY	$2,457,000
Sheet Pile Coffer Dam	N/A	LS	$130,000
Dewatering	N/A	LS	$100,000
Access Road Improvement	6,900	FT	$117,000
Metal Work	N/A	LS	$69,000
Power Extension	4,600	FT	$276,000
Sheet Pile for South Levee	N/A	LS	$110,000

Debris Boom	N/A	LS	$200,000
Jet Spray System	10	EA	$150,000
Air Bubbler System	N/A	LS	$24,000
Earthwork	4,802	CY	$336,000
Construction Contingency, CM, Survey Costs	N/A	N/A	**$2,312,500**
Engineering	N/A	N/A	**$523,000**
Project Admin[4]	N/A	N/A	**$1,284,000**
Permitting	N/A	N/A	**$100,000**
Real Property Rights	N/A	N/A	**$45,000**
PG 3 Fish Screen Subtotal	N/A	N/A	**$10,962,000**
PG 4 E and F Pumping Plants	**Quantity**	**Quantity Units[2]**	**Materials and Construction Cost (2023$)[1,3]**
Mobilization/Demobilization	N/A	LS	$113,000
Single-stage pump with 250 HP motor	4	EA	$1,233,000
Pump with DeRan Model M20A gear head	2	EA	$563,000
Utility Service Line Extensions	2	EA	$86,000
Pads, Fencing, Vaults	N/A	LS	$26,000
Power Distribution MDP	2	EA	$96,000
VFDs	4	EA	$104,000
Utility Disconnects	4	EA	$48,000
Electrical Feeders and Motor VFD Cable	N/A	LS	$51,000
SCADA Controls	1	EA	$46,000
Construction Contingency, CM, Survey Costs	N/A	N/A	**$809,000**
Engineering	N/A	N/A	**$181,000**
Project Admin[4]	N/A	N/A	**$453,000**
Permitting	N/A	N/A	**$20,000**

PG 4 E and F Pumping Plants Subtotal	N/A	N/A	**$3,829,000**
PG 5 E Pump Recirculation	**Quantity**	**Quantity Units[2]**	**Materials and Construction Cost (2023$)[1,3]**
Mobilization	N/A	LS	$19,000
Erosion and Sediment Control	N/A	LS	$10,000
48-inch manifold and T-fitting	N/A	LS	$5,000
48-inch steel pipe	217	FT	$107,000
Manhole/Cleanout	1	EA	$7,000
48-inch Sluice Gate	2	EA	$180,000
Catwalk	N/A	LS	$60,000
Energy Dissipation Structure	N/A	LS	$2,000
Construction Contingency, CM, Survey Costs	N/A	N/A	**$74,000**
Engineering	N/A	N/A	**$78,000**
Project Admin[4]	N/A	N/A	**$114,000**
Permitting	N/A	N/A	**$15,000**
PG 4 E Pump Recirculation Subtotal	N/A	N/A	**$671,000**

PG 6 Upgraded Turnouts	Quantity	Quantity Units[2]	Materials and Construction Cost (2023$)[1,3]
Upgraded Turnouts	N/A	LS	$15,000
Construction Contingency, CM, Survey Costs	N/A	N/A	**$74,000**
Engineering	N/A	N/A	**$78,000**
Project Admin[4]	N/A	N/A	**$114,000**
Permitting	N/A	N/A	**$15,000**
PG 5 Upgraded Turnouts Subtotal	N/A	N/A	**$28,000**
Preferred Alternative TOTAL	N/A	N/A	**$16,878,000**

Notes: Prepared November 2023

1. Engineering, Construction Management, and Survey, Construction Management/General Contractor, and Contingency costs range depending on the project components. See above in Figure D-4 for cost distribution for each project.
2. LS=Lump Sum; EA=Each; FT=Foot; CY=Cubic Yard
3. Totals rounded to nearest $1,000 and may not sum.
4. Includes technical assistance and project administration costs.

D.5 Net Present Value of the Preferred Alternative

This section presents the estimated present value of the Modernization Alternative over the course of its anticipated benefit lifespan.

Discount Rate: 2.25 percent

Period of Analysis: 100 years

Table D-20. Present Value of the Modernization Alternative.

Value	Preferred Alternative
Design Life (years)	100
Capital Costs	$16,831,000
Present Value of Replacement Costs	$3,900,000
Annual O&M	$192,000
Present Value of O&M Costs	$19,200,000
Present Value of Costs	**$40,093,000**

Notes: Prepared November 2023
N/A=not applicable. Totals rounded to nearest $1,000.

D.6 Preferred Alternative Memo Regarding Project Groups 3 and 6

Per DM 9500-013, the PR&G is meant to provide "a process to establish new guidance to incorporate a more balanced consideration of economic, social, and environmental objectives." The adoption of the PR&G also instituted the new possibility for projects without a quantified Benefit Cost Ratio greater than one to be part of the preferred alternative. Inclusion in the preferred alternative is based on the projects' beneficial effects to ecosystem services and public benefits, allowing for a more comprehensive view of benefits beyond what is quantified and monetized to be included in the federal investment decision. Per DM 9500-013, "It is recognized that most of the activities pursued will require an assessment of tradeoffs by decision makers and in many cases the final decision will require judgment that considers the extent of both monetized and non-monetized effects."

In the Plan-EA four of six proposed project groups have quantified benefits and benefit/cost ratios greater than 1 (please see Table D-21). Two projects (PG3 Fish Screen and PG 6 Upgraded Turnouts) have public benefits that were not quantifiable or monetized but are expected to be in excess of the cost and worth federal investment. In alignment with DM 9500-013, during the development of the NED "environmental effects disclosed are monetized and quantified to the extent possible." Provided below is the justification and descriptions of the non-monetized benefits that were considered when deciding to include PG 3 and PG 6 as part of the Preferred Alternative.

Table D-21. Project Group Benefits.

Works of Improvement[1]	Agriculture-related Reduced OMR	Nonagri-cultural Carbon Value	Nonagri-cultural Habitat Value	Average Annual Benefits	Average Annual Cost[2]	Benefit Cost Ratio
PG1 North Canal Improvements[3]	$10,000	$0	$150,000	$160,000	$160,000	1.0
PG2 SCADA System[3]	$40,000	$0	$0	$40,000	$25,000	1.6
PG4 E and F Pumping Plants[3]	$29,000	$0	$0	$29,000	$15,000	1.9
PG5 E Pump Recirculation[3]	$77,000	$1,000	$0	$78,000	$43,000	1.8
Subtotal	**$260,000**	**$1,000**	**$150,000**	**$307,000**	**$243,000**	**1.3**
PG3 Fish Screen[4]	$0	$0	$0	Fish abundance values[2] (See text)	$308,000	Not Quantifiable
PG6 Upgraded Turnouts[4]	$0	$0	$0	Operational benefits[2] (See text)	$1,000	Not Quantifiable
Subtotal	**$0**	**$0**	**$0**	**Unquantifiable fish abundance benefits, operational benefits**	**$309,000**	**Not Quantifiable**
Total	**$260,000**	**$1,000**	**$150,000**	**>$307,000**	**$552,000**	**Not Quantifiable**

Note: Prepared July 2024

[1] PG=Project Group

[2] Additional ecosystem services benefits of the Project are described in the NED and Plan-EA. Please refer to these resources for further detail and a description of these benefits.

[3]Projects with quantified benefits.

[4]Projects with unquantified benefits.

Project Group 3 – Fish Screen

Within the Klamath Basin, four dams are being removed as part of the largest dam removal project in U.S. history. The dam removal is intended to help restore the natural flow of the Klamath River (which has been disrupted for over 100 years), benefit fish by opening access to previously blocked spawning and rearing habitat, as well as improve water quality and restore natural river processes. The Modernization Alternative includes PG 3 Fish Screen because it will provide ecological and cultural benefits and is an important component of restoring the 420-mile reach of the Klamath River, where the dam removal is taking place. A Klamath River restoration plan developed by NOAA in 2022 included a prioritization of unscreened diversions on the Klamath River and associated tributaries. The North Canal diversion was ranked the second highest of the 91 diversions and, as a result, would be most likely to benefit salmonid repopulation and recovery. The proposed fish screen would help direct juveniles toward the inundated Keno wetlands to the south which provide important refugia to those fish.

Restoring the Klamath River Basin and its fisheries requires many activities; first and foremost, the removal of four hydroelectric dams that have blocked fish passage to the upper basin for over 100 years. Restoration is aimed at reversing long-term declines in Klamath Basin fisheries. There are several fish species in the basin that are protected by the Federal Endangered Species Act such as coho salmon, Lost River suckers, and shortnose suckers. These fish species are culturally important to Indian Tribes (there are six federally recognized tribes in the Basin) and are also economically and socially important to commercial and recreational fishing communities and others. Water scarcity in the basin has also contributed to the declining fish populations, and irrigation water withdrawals have been severely curtailed in some years to protect fish populations, with effects on the agricultural and ranching community as well.

After several decades of regulatory, planning, and legal processes, dam removal was completed in 2024. Although there is uncertainty regarding the effects on fish populations, modeling suggests that removal of the dams would increase median Chinook adult production over the next 30 years by 50 percent to 189 percent. Other species are also expected to benefit, although effects on other species are less certain or are more modest (National Marine Fisheries Service, U.S. Department of the Interior, March 2013). To realize the full benefits of dam removal, numerous other actions are necessary to restore the Basin, including installation of fish screens.

The Project Group 3 Fish Screen is expected to prevent fish from the Klamath River from entering the North Canal Diversion and becoming entrained in KDD's water conveyance system. The Oregon Department of Fish and Wildlife has found that "more than 98 percent of young salmon and steelhead survive an encounter with a properly designed fish screen." (Oregon Department of Fish and Wildlife, 2013) Entrained fish are likely to perish in KDD's conveyance system. Consequently, the project would protect fish populations in the Klamath River, including the shortnose sucker and Lost River sucker, which are federally listed endangered species (U.S. Fish and Wildlife Service, 2023c). The Upper Klamath River is designated Critical Habitat for these species.

The importance of the fish screen would increase in the near future as salmon (which are protected at both state and federal levels) are reintroduced to the Upper Klamath River. Reintroduction is planned after the four dams that once blocked salmon passage on the Klamath River are removed, a process that is expected to be completed in 2024 (California Trout, 2023). Once salmon repopulate the Upper Klamath River, the Project Group 3 Fish Screen would help ensure that KDD's North Canal diversion does not negatively impact their recovery.

Reestablishing fish habitat in the Klamath River is a national priority due to the ecological and cultural values supported by this habitat. Prior to the dams' construction, the Klamath River was the third-largest salmon-producing river on the West Coast, and it served as an important food source for native tribes in the area (National Oceanic and Atmospheric Administration, 2022). The River was once home to Chinook salmon, coho salmon, steelhead, Pacific lamprey, bull trout, and Redband trout, among other species; all of which have experienced declines in population due to various sources of habitat degradation, including the erection of dams (O'Keefe, Pagluico, Scott, Cianciolo, & Holycross, 2022). This has changed the lives of native tribes that have relied on the fish as a major source of food, cultural practices, and way of life. Removing the dams will reopen access to more than 400 miles of habitat for these fish species, including the stretch of river where the PG3 Fish Screen would be located (National Oceanic and Atmospheric Administration, 2022).

The PG3 Fish Screen has been designated as an important component in the federal planning process to restore the Upper Klamath River. To prioritize the projects most important to reestablishing salmon species in the Klamath River, a team of experts comprised of staff at the NOAA, the Pacific State Marine Fisheries Commission (PSMFC), and TU ranked the importance of potential Klamath habitat restoration and fish screening projects. Among the projects evaluated in their 2022 report was the PG3 Fish Screen at the North Canal Diversion. The team assessed projects based on their size, the number of fish species affected, and the impact on fish. Out of 91 diversions that were evaluated for fish screening projects, 26 projects received the highest priority ranking. The PG3 Fish Screen was one of these 26 projects receiving the highest priority ranking. Only one fish screen received a higher overall priority score than the PG3 Fish Screen (O'Keefe, Pagluico, Scott, Cianciolo, & Holycross, 2022).

The 2022 study prioritizing projects did not directly estimate the number of fish deaths that would be avoided by each fish screen, nor were there other sources available for quantifying the ecological benefit of the PG 3 Fish Screen. For this reason, we do not attempt to quantify the benefits of the PG 3 Fish Screen. However, for context, we note that the people in the Pacific Northwest highly value salmon species, even if they do not consume them for food or enjoy them recreationally. One recent economic study found that, on average, households in the Pacific Northwest value a one-year increase of 1,000 salmon between $0.09 and $0.22 (Lewis, Kling, Dundas, & Lew, 2022).[23] Applying the average of $0.16 per household to 9.4 million households in the Pacific Northwest (as the original study did) results in total value of roughly $1,500 per fish. At this rate, PG 3 Fish Screen would have to save approximately 200 salmon per year in order to outweigh its total annual costs of $308,000. In addition to the value to the general Pacific Northwest population, enhancing salmon restoration provides cultural value of the fish to the tribes, whose traditional way of life depends on the species.

Project Group 6 – Upgraded Turnouts

The Modernization Alternative includes PG 6 Upgraded Turnouts because it will provide water management benefits in the Klamath Basin where transparency in water-use is regionally important.

PG 6 Upgraded Turnouts would install new monitoring equipment at 76 patron turnouts that would allow KDD to measure the amount of water going to each patron. This would provide the District and its patrons with a variety of benefits. First, KDD would be able to ensure that the correct allocation of water goes to each patron, ensuring fairness and compliance with water right quantity

[23] We adjusted the original values of $0.08 and $0.19 from 2017 dollars to 2023 dollars using the GDPIPD.

and seniority. The upgraded turnouts would also help avoid and resolve conflicts over water, since accurate measurements would enhance accountability and help ensure use of water in accordance with allotment. This would help to foster cooperation and trust within the District. It would also provide patrons with the ability to monitor their own water use, which may help them better manage their allotted water and optimize their crop yields. The likelihood of any change in on-farm production and the magnitude of any change is not known, nor are there known case studies to draw from to make an educated estimate, so this potential benefit is not quantified. While the social benefits of monitoring and measuring water use are also not quantifiable, they are expected to be valuable to the community. In sum, while PG 6 Upgraded Turnouts does not have any quantified benefits in this analysis, it is included in the Modernization Alternative because the qualitative benefits are believed to outweigh its small, annualized cost ($1,000).

D.7 Structural Table 3b – Channel Work

Table D-22. Structural Data – Channel Work (Klamath Basin) (OR).

Channel name (reach)	Station	Drain area (mi^2)[1]	( ) Year freq design dischg.[2]	Water surfac elev.	Hydraulic gradient	Channel gradient	Channel bottom width	Channel elev.	Channel side slope	*n* Value: Aged	*n* Value: As built	Velocities: Aged	Velocities: As built	Excavation volume	Type of work[2]	Existing channel[3]	Present flow condition[4]
North Canal - from Fugate Road to 1,200 feet downstream (Station 0+00 to 12+00)	12+00	N/A	100 ft^3/s	4,084.08 ft msl	0.00097 ft/ft	0.0008 ft/ft	20.00 ft	4082 ft msl	2 to 1	0.030	0.025	2.28 ft/s	2.74 ft/s	4,804 yd^3	II	M	N/A
North Canal - 1,200 feet downstream of Fugate Road to California State Highway 161 (Station 12+00 to 24+00)	24+00	N/A	100 ft^3/s	4,083.00 ft msl	0.00090 ft/ft	0.0008 ft/ft	15.00 ft	4081 ft msl	2 to 1	0.030	0.025	2.21 ft/s	2.65 ft/s	4,034 yd^3	II	M	N/A

Notes:
[1]Drain area is not applicable, North Canal only receives controlled flows from an irrigation diversion.
[2]Design discharge corresponds to the maximum design flow that will be diverted into the North Canal, the channel will not receive drainage flows.
[3]Excavation Volumes were estimated by Adkins (2022) in the *KDD North Canal Extension Technical Memo.*
[4]None of the flow categories listed in footnote 4 of Figure 506-B7 in the National Watershed Program Manual are applicable. The flows are controlled from an irrigation diversion.

Appendix E

Other Supporting Information

E.1 Intensity Threshold Table

This section presents the intensity threshold table used to quantify effects to resources of concern because of the proposed action.

Table E-1. Intensity Threshold Table for the KDD Infrastructure Modernization Project.[1]

Negligible	Changes in the resource or resource related values would be below or at the level of detection. If detected, the effects on the resource or environment would be considered slight with no perceptible impacts.
Minor	Changes in resource or resource related values would be measurable but small. The effects on the resource or the environment would be localized.
Moderate	Changes in the resource or resource related values would be measurable and apparent. The effects on the resource or the environment would be relatively local.
Major	Changes in resource or resource related values would be measurable and substantial. The effects on the resource or the environment would be regional.

[1]Impact duration definitions:
Temporary: Transitory effects, which only occur over a period of days or months.
Short-term effect: Resource or resource related values recover in fewer than 5 years
Long-term effect: Resource or resource related values take greater than 5 years to recover

E.2 Supporting Information for Cultural Resources

Supporting information for Cultural Resources is included in the Draft Cultural Resources Assessment for the Klamath Drainage District, Klamath County, Oregon. The assessment is currently under review by Oregon SHPO but will be included in the Appendices once finalized.

E.2.1 Cultural Resources Consultation Letters

USDA
United States Department of Agriculture

Natural Resources Conservation Service

1945 Main St.
Suite 200
Klamath Falls, OR

July 24, 2024
California Office of Historic Preservation
1725 23rd St., Suite 100
Sacramento, CA 95816

Re: Invitation to Participate in Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Michael McGuirt,
I am following up on a letter sent to you by Michael Petrozza, NRCS Oregon State Archaeologist, on January 29, 2024. NRCS invites your participation in Section 106 Consultation, unless you would rather defer to the Oregon SHPO. Nearly all of the APE lies within Klamath County, Oregon, with a 100 ft portion crossing into Siskiyou County, California onto the Lower Klamath NWR.

The Natural Resources Conservation Service (NRCS), Klamath Drainage District (KDD) as the Sponsoring Organization are proposing the Klamath Drainage District Modernization Project (the project) in Klamath County, Oregon. The project is being performed through the NRCS' Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulations 36 CFR Part 800. NRCS is serving as the lead federal agency for the project. Other consulting parties include the Oregon SHPO, US Bureau of Reclamation and the US Fish and Wildlife Service as well as the Klamath Tribes and the Modoc Nation. In this letter, NRCS is following up on Section 106 consultation and requests feedback on the project's Area of Potential Effects and whether California SHPO would like to continue as a consulting party. Most of this project lies within the state of Oregon, and the project APE crosses into California approximately 100 feet.

Project Description
The project will make the following improvements to the Klamath Drainage District (KDD): •Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site. •Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs). •Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD). •Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal. •Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

Area of Potential Effects
A project's APE is defined as the geographic area(s) in which an undertaking may directly or indirectly effect the character or use of historic properties (36 CFR 800.16.c). Effects may be direct or indirect, with the former including any type of effect (i.e., physical, visual, auditory, etc.) resulting from an undertaking and the latter including any type of reasonably foreseeable effect caused by the undertaking after its completion or farther in distance. In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities

will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not anticipated to occur outside of the APE established for direct effects. The APE is shown in the enclosed figure.
Cultural resources studies of the APE have now been performed and the final report is due to us by the end of July. The report will be shared with consulting parties at that time.
If you have any questions or concerns about the project, please contact Rachel Gebauer, NRCS Archaeologist at: rachel.gebauer@usda.gov or 541-887-3511 or Gary Diridoni, NRCS Assistant State Conservationist Water Resources at gary.diridoni@usda.gov or .541-414-3092.

Sincerely,

Rachel LS Gebauer

Rachel Smith Gebauer, M.A., RPA, NRCS Acting State Cultural Resources Specialist
Gary Diridoni, State Watershed Planner
Amy Hendershot, State Resource Conservationist

State of California • Natural Resources Agency — Gavin Newsom, *Governor*
DEPARTMENT OF PARKS AND RECREATION — Armando Quintero, *Director*
OFFICE OF HISTORIC PRESERVATION
Julianne Polanco, State Historic Preservation Officer
1725 23rd Street, Suite 100, Sacramento, CA 95816-7100
Telephone: (916) 445-7000 FAX: (916) 445-7053
calshpo.ohp@parks.ca.gov www.ohp.parks.ca.gov

August 23, 2024

VIA EMAIL — In reply refer to: NRCS_2024_0725_001

Rachel Smith Gebauer, M.A., RPA
Acting State Cultural Resources Specialist
Natural Resources Conservation Service
1945 Main Street, Suite 200
Klamath Falls, OR 97601

Subject: Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Ms. Gebauer:

The State Historic Preservation Officer (SHPO) is in receipt of a consultation letter dated July 24, 2024, from the Natural Resources Conservation Service (NRCS), Klamath Drainage District (KDD) for the above referenced undertaking. The NRCS is initiating consultation with the SHPO to comply with Section 106 of the National Historic Preservation Act of 1966 (as amended) and its implementing regulation at 36 CFR 800. The NRCS is seeking SHPO review on the undertaking's Area of Potential Effects (APE) and whether California SHPO would like to continue as a consulting party given that the majority of the project lies within the state of Oregon, and the project APE crosses into California for approximately 100 feet.

The NRCS KDD is the Sponsoring Organization and is proposing the Klamath Drainage District Modernization Project (undertaking) in Klamath County, Oregon. The project is being performed through the NRCS' Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106. NRCS is serving as the lead federal agency for the project. Other consulting parties include the Oregon SHPO, US Bureau of Reclamation and the US Fish and Wildlife Service, as well as the Klamath Tribes and the Modoc Nation. Nearly all of the APE lies within Klamath County, Oregon, with a 100 ft portion crossing into Siskiyou County, California onto the Lower Klamath National Wildlife Refuge.

The project will make the following improvements to the Klamath Drainage District (KDD):

- Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site.

- Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs).
- Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD).
- Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal.
- Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not anticipated to occur outside of the APE established for direct effects.

Cultural resources studies of the APE have been performed and the final report is expected by the end of July. The NRCS will share the report with consulting parties at that time.

Following review of the submittal, I do not object to the APE as defined, and I look forward to continuing consultation with the NRCS on this undertaking.

If you require further information, please contact Robert Fitzgerald, Associate State Archaeologist, at Robert.Fitzgerald@parks.ca.gov.

Sincerely,

Julianne Polanco
State Historic Preservation Officer

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Oregon State Office
1201 NE Lloyd Blvd. Suite 900
Portland, OR 97232

21 September 2023
Ken Sandusky, Resource and Development Director
Modoc Nation
22 N. Eight Tribes Trail
Miami, OK 74354

Re: Invitation to Participate in Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Mr. Sandusky,

The Farmers Conservation Alliance (FCA) is proposing the Klamath Drainage District Modernization Project (the project) in Klamath County, Oregon. The project is being performed through the Natural Resources Conservation Service's (NRCS) Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulations 36 CFR Part 800. NRCS is serving as the lead federal agency for the project. In this letter, NRCS initiates Section 106 consultation and requests feedback on the project's Area of Potential Effects.

Project Description

The project will make the following improvements to the Klamath Drainage District (KDD):

- Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site.
- Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs).
- Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD).
- Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal.
- Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

Area of Potential Effects

A project's APE is defined as the geographic area(s) in which an undertaking may directly or indirectly effect the character or use of historic properties (36 CFR 800.16.c). Effects may be direct or indirect, with the former including any type of effect (i.e., physical, visual, auditory, etc.) resulting from an undertaking and the latter including any type of reasonably foreseeable effect caused by the undertaking after its completion or farther in distance. In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not

anticipated to occur outside of the APE established for direct effects. The APE is shown in the enclosed figure.
Cultural resources studies of the APE will be performed and shared with consulting parties. If the Modoc Nation is interested in becoming a consulting party for the project, please provide a response within 30-days of receipt of this letter with confirmation of your interest and any key contacts to be included in future correspondence. NRCS is also interested in input regarding the identification of any historic properties that may exist within the project's APE that may have religious and cultural significance to the Modoc Nation. If you have any questions or concerns about the project, please contact Michael Petrozza, NRCS Oregon State Archaeologist at Michael.Petrozza@usda.gov or 503.414.3212.

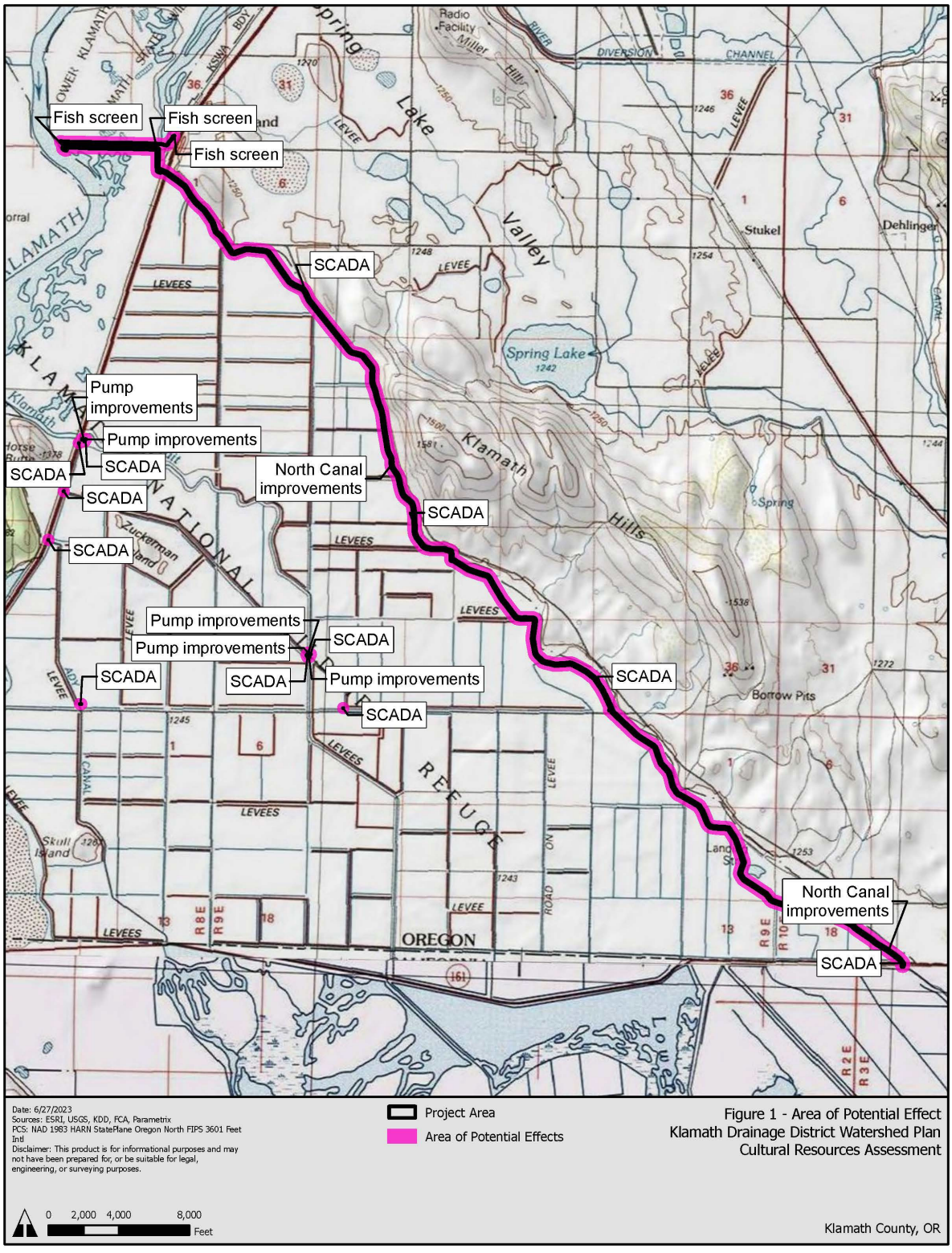
Sincerely,

Michael Petrozza

Michael Petrozza
State Cultural Resources Specialist
USDA NRCS
503.414.3212
Michael.Petrozza@usda.gov

cc:
Gary Diridoni, State Watershed Planner
Amy Hendershot, State Resource Conservationist
Ken Sandusky, Resource and Development Director Modoc Nation
Troy L. LittleAxe, Asst. Tribal Adminstrator Modoc Nation

Enclosure: Area of Potential Effect Figure


Fish screen
Fish screen
Fish screen
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
SCADA
North Canal improvements
SCADA
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
Pump improvements
SCADA
SCADA
North Canal improvements
SCADA
Spring Lake
Klamath Hills
Stukel
Dehlinger
Borrow Pits
Skull Island
OREGON
Project Area
Area of Potential Effects
Date: 6/27/2023
Sources: ESRI, USGS, KDD, FCA, Parametrix
PCS: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes.
0 2,000 4,000 8,000
Feet
Figure 1 - Area of Potential Effect
Klamath Drainage District Watershed Plan
Cultural Resources Assessment
Klamath County, OR

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Oregon State Office
1201 NE Lloyd Blvd. Suite 900
Portland, OR 97232

21 September 2023
Les Anderson, Culture and Heritage Director
Klamath Tribes Culture & Heritage Department
P.O. Box 436
501 Chiloquin Blvd.
Chiloquin, OR 97624

Re: Invitation to Participate in Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Mr. Anderson,

The Farmers Conservation Alliance (FCA) is proposing the Klamath Drainage District Modernization Project (the project) in Klamath County, Oregon. The project is being performed through the Natural Resources Conservation Service's (NRCS) Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulations 36 CFR Part 800. NRCS is serving as the lead federal agency for the project. In this letter, NRCS initiates Section 106 consultation and requests feedback on the project's Area of Potential Effects.

Project Description

The project will make the following improvements to the Klamath Drainage District (KDD):

- Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site.
- Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs).
- Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD).
- Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal.
- Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

Area of Potential Effects

A project's APE is defined as the geographic area(s) in which an undertaking may directly or indirectly effect the character or use of historic properties (36 CFR 800.16.c). Effects may be direct or indirect, with the former including any type of effect (i.e., physical, visual, auditory, etc.) resulting from an undertaking and the latter including any type of reasonably foreseeable effect caused by the undertaking after its completion or farther in distance. In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not

anticipated to occur outside of the APE established for direct effects. The APE is shown in the enclosed figure.
Cultural resources studies of the APE will be performed and shared with consulting parties. If the Klamath Tribes are interested in becoming a consulting party for the project, please provide a response within 30-days of receipt of this letter with confirmation of your interest and any key contacts to be included in future correspondence. NRCS is also interested in input regarding the identification of any historic properties that may exist within the project's APE that may have religious and cultural significance to the Klamath Tribes. If you have any questions or concerns about the project, please contact Michael Petrozza, NRCS Oregon State Archaeologist at Michael.Petrozza@usda.gov or 503.414.3212.

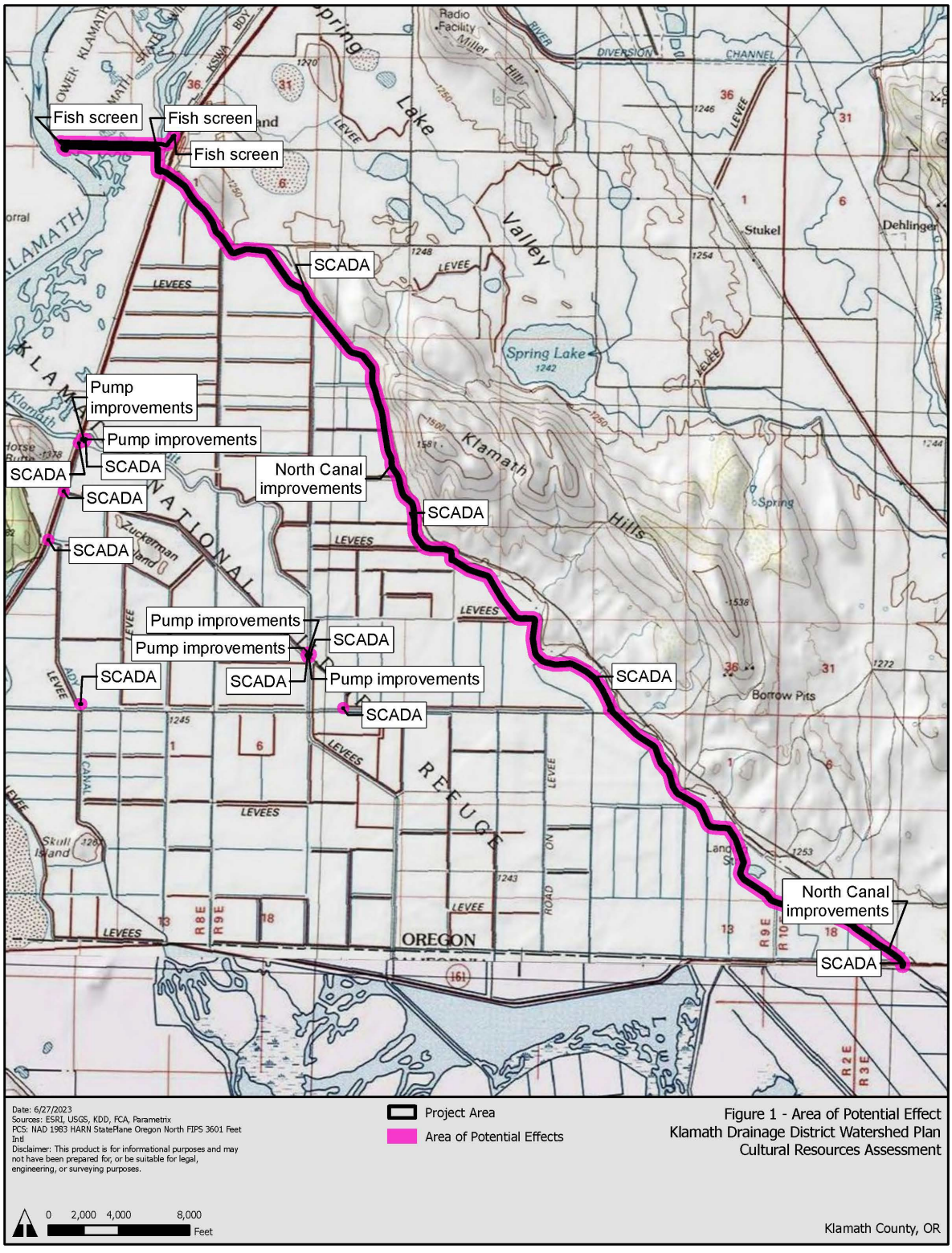
Sincerely,

Michael Petrozza

Michael Petrozza
State Cultural Resources Specialist
USDA NRCS
503.414.3212
Michael.Petrozza@usda.gov

cc:
Gary Diridoni, State Watershed Planner
Amy Hendershot, State Resource Conservationist
Les Anderson, Cultural Resources Coordinator Klamath Tribes

Enclosure: Area of Potential Effect Figure


Fish screen
Fish screen
Fish screen
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
SCADA
North Canal improvements
SCADA
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
Pump improvements
SCADA
SCADA
North Canal improvements
SCADA
Spring Lake
Klamath Hills
Valley
Stukel
Dehlinger
Borrow Pits
Skull Island
OREGON
LEVEES
Project Area
Area of Potential Effects
Date: 6/27/2023
Sources: ESRI, USGS, KDD, FCA, Parametrix
PCS: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes.
0 2,000 4,000 8,000
Feet
Figure 1 - Area of Potential Effect
Klamath Drainage District Watershed Plan
Cultural Resources Assessment
Klamath County, OR

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Oregon State Office
1201 NE Lloyd Blvd. Suite 900
Portland, OR 97232

9 September 2024
Tracy Kennedy, Chair
100 Pasigo Street
Burns, OR 97720

Re: Invitation to Participate in Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Tracy Kennedy,

The Farmers Conservation Alliance (FCA) is proposing the Klamath Drainage District Modernization Project (the project) in Klamath County, Oregon. The project is being performed through the Natural Resources Conservation Service's (NRCS) Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulations 36 CFR Part 800. NRCS is serving as the lead federal agency for the project. In this letter, NRCS initiates Section 106 consultation and requests feedback on the project's Area of Potential Effects.

Project Description

The project will make the following improvements to the Klamath Drainage District (KDD):

- Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site.
- Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs).
- Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD).
- Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal.
- Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

Area of Potential Effects

A project's APE is defined as the geographic area(s) in which an undertaking may directly or indirectly effect the character or use of historic properties (36 CFR 800.16.c). Effects may be direct or indirect, with the former including any type of effect (i.e., physical, visual, auditory, etc.) resulting from an undertaking and the latter including any type of reasonably foreseeable effect caused by the undertaking after its completion or farther in distance. In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not

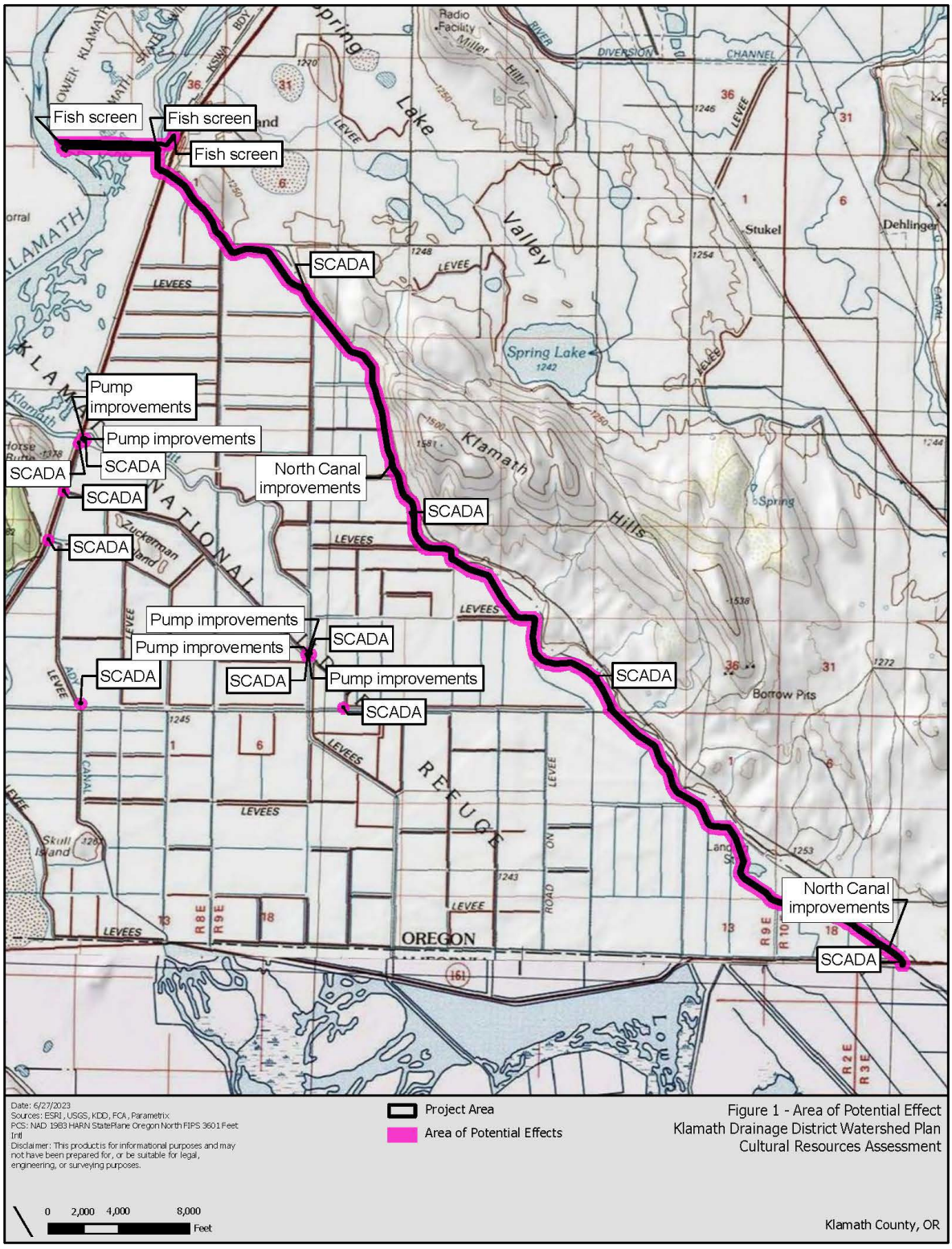
anticipated to occur outside of the APE established for direct effects. The APE is shown in the enclosed figure.
Cultural resources studies of the APE will be performed and shared with consulting parties. If the Burns Paiute Tribe is interested in becoming a consulting party for the project, please provide a response within 30-days of receipt of this letter with confirmation of your interest and any key contacts to be included in future correspondence. NRCS is also interested in input regarding the identification of any historic properties that may exist within the project's APE that may have religious and cultural significance to the Burns Paiute Tribe. If you have any questions or concerns about the project, please contact Rachel Gebauer, NRCS Oregon Acting State Archaeologist at rachel.gebauer@usda.gov or 541.887.3511.

Sincerely,

Rachel LS Gebauer

Rachel Gebauer
Acting State Cultural Resources Specialist
USDA NRCS
541.887.3511
rachel.gebauer@usda.gov

cc:
Gary Diridoni, State Watershed Planner
Amy Hendershot, State Resource Conservationist
Enclosure: Area of Potential Effect Figure


Fish screen
Fish screen
Fish screen
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
SCADA
North Canal improvements
SCADA
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
Pump improvements
SCADA
SCADA
North Canal improvements
SCADA
Lake
Valley
Spring Lake
Klamath
Hills
Stukel
Dehlinger
Borrow Pits
REFUGE
OREGON
LEVEES
Project Area
Area of Potential Effects
Figure 1 - Area of Potential Effect
Klamath Drainage District Watershed Plan
Cultural Resources Assessment
Klamath County, OR
Date: 6/27/2023
Sources: ESRI, USGS, KDD, FCA, Parametrix
PCS: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes.
0 2,000 4,000 8,000
Feet

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Oregon State Office
1201 NE Lloyd Blvd. Suite 900
Portland, OR 97232

9 September 2024
Carla Keene, Chair
Cow Creek Band of Umpqua Indians
2371 NE Stephens St., Suite 100
Roseburg, OR 97470

Re: Invitation to Participate in Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Ms. Keene,

The Farmers Conservation Alliance (FCA) is proposing the Klamath Drainage District Modernization Project (the project) in Klamath County, Oregon. The project is being performed through the Natural Resources Conservation Service's (NRCS) Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulations 36 CFR Part 800. NRCS is serving as the lead federal agency for the project. In this letter, NRCS initiates Section 106 consultation and requests feedback on the project's Area of Potential Effects.

Project Description

The project will make the following improvements to the Klamath Drainage District (KDD):

- Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site.
- Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs).
- Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD).
- Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal.
- Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

Area of Potential Effects

A project's APE is defined as the geographic area(s) in which an undertaking may directly or indirectly effect the character or use of historic properties (36 CFR 800.16.c). Effects may be direct or indirect, with the former including any type of effect (i.e., physical, visual, auditory, etc.) resulting from an undertaking and the latter including any type of reasonably foreseeable effect caused by the undertaking after its completion or farther in distance. In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not

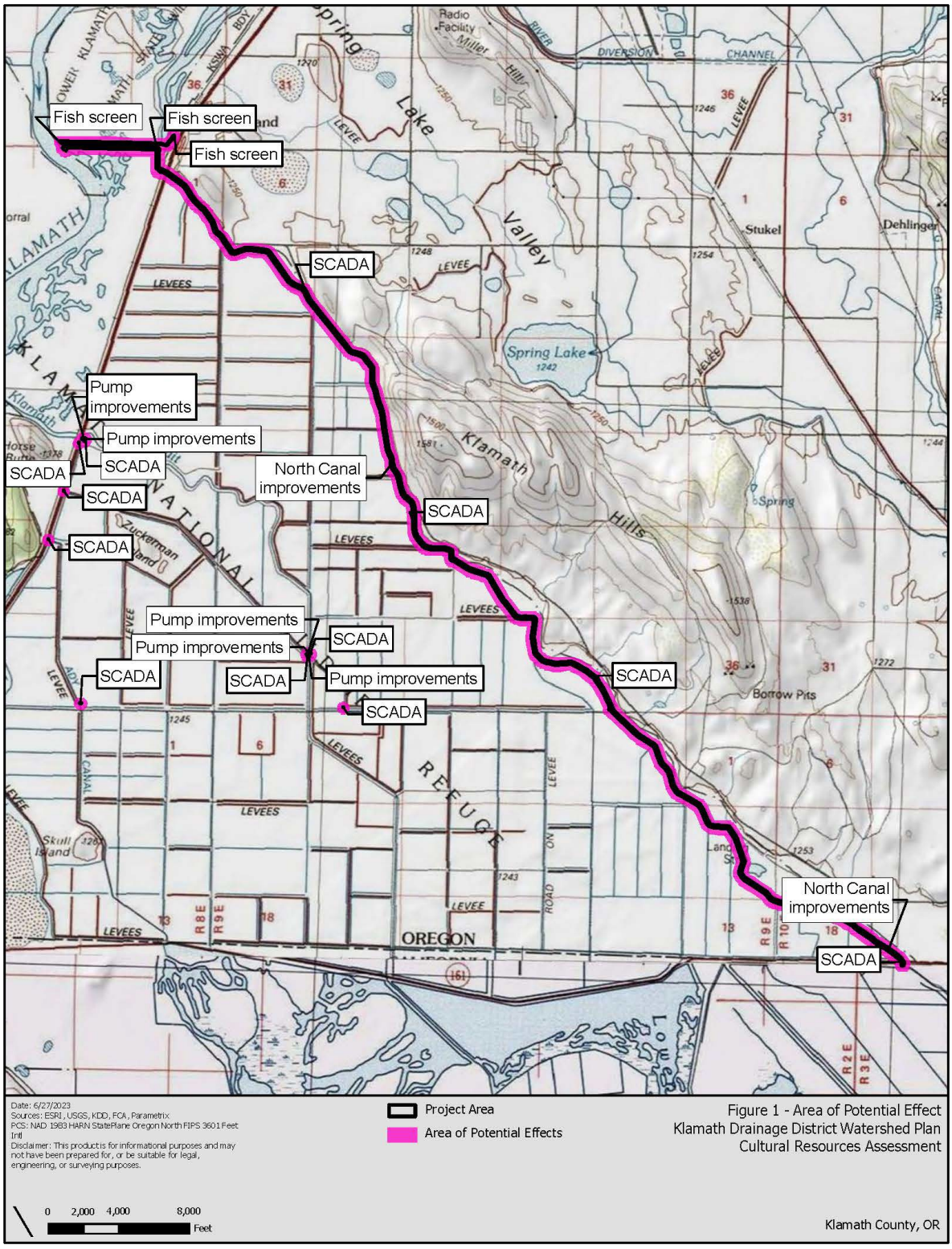
anticipated to occur outside of the APE established for direct effects. The APE is shown in the enclosed figure.
Cultural resources studies of the APE will be performed and shared with consulting parties. If the Cow Creek Band of Umpqua Indians is interested in becoming a consulting party for the project, please provide a response within 30-days of receipt of this letter with confirmation of your interest and any key contacts to be included in future correspondence. NRCS is also interested in input regarding the identification of any historic properties that may exist within the project's APE that may have religious and cultural significance to the Cow Creek Band of the Umpqua Indians. If you have any questions or concerns about the project, please contact Rachel Gebauer, NRCS Oregon Acting State Archaeologist at rachel.gebauer@usda.gov or 541.887.3511.

Sincerely,

Rachel LS Gebauer

Rachel Gebauer
Acting State Cultural Resources Specialist
USDA NRCS
541.887.3511
rachel.gebauer@usda.gov

cc:
Gary Diridoni, State Watershed Planner
Amy Hendershot, State Resource Conservationist
Enclosure: Area of Potential Effect Figure


Fish screen
Fish screen
Fish screen
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
SCADA
North Canal improvements
SCADA
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
Pump improvements
SCADA
SCADA
North Canal improvements
SCADA
Lake
Valley
Spring Lake
Klamath
Hills
Stukel
Dehlinger
Borrow Pits
REFUGE
OREGON
LEVEES
Project Area
Area of Potential Effects
Date: 6/27/2023
Sources: ESRI, USGS, KDD, FCA, Parametrix
PCS: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes.
0 2,000 4,000 8,000
Feet
Figure 1 - Area of Potential Effect
Klamath Drainage District Watershed Plan
Cultural Resources Assessment
Klamath County, OR

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Oregon State Office
1201 NE Lloyd Blvd. Suite 900
Portland, OR 97232

9 September 2024
Jonathan W. Smith Sr., Chair
Confederated Tribes of the Warm Springs Reservation of Oregon
1233 Veterans Way
P.O.Box C
Warm Springs, OR 97761

Re: Invitation to Participate in Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Chairman Smith,

The Farmers Conservation Alliance (FCA) is proposing the Klamath Drainage District Modernization Project (the project) in Klamath County, Oregon. The project is being performed through the Natural Resources Conservation Service's (NRCS) Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulations 36 CFR Part 800. NRCS is serving as the lead federal agency for the project. In this letter, NRCS initiates Section 106 consultation and requests feedback on the project's Area of Potential Effects.

Project Description

The project will make the following improvements to the Klamath Drainage District (KDD):

- Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site.
- Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs).
- Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD).
- Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal.
- Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

Area of Potential Effects

A project's APE is defined as the geographic area(s) in which an undertaking may directly or indirectly effect the character or use of historic properties (36 CFR 800.16.c). Effects may be direct or indirect, with the former including any type of effect (i.e., physical, visual, auditory, etc.) resulting from an undertaking and the latter including any type of reasonably foreseeable effect caused by the undertaking after its completion or farther in distance. In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not

anticipated to occur outside of the APE established for direct effects. The APE is shown in the enclosed figure.
Cultural resources studies of the APE will be performed and shared with consulting parties. If the Confederated Tribes of the Warm Springs Reservation is interested in becoming a consulting party for the project, please provide a response within 30-days of receipt of this letter with confirmation of your interest and any key contacts to be included in future correspondence. NRCS is also interested in input regarding the identification of any historic properties that may exist within the project's APE that may have religious and cultural significance to the Confederated Tribes of the Warm Springs Reservation. If you have any questions or concerns about the project, please contact Rachel Gebauer, NRCS Oregon Acting State Archaeologist at rachel.gebauer@usda.gov or 541.887.3511.

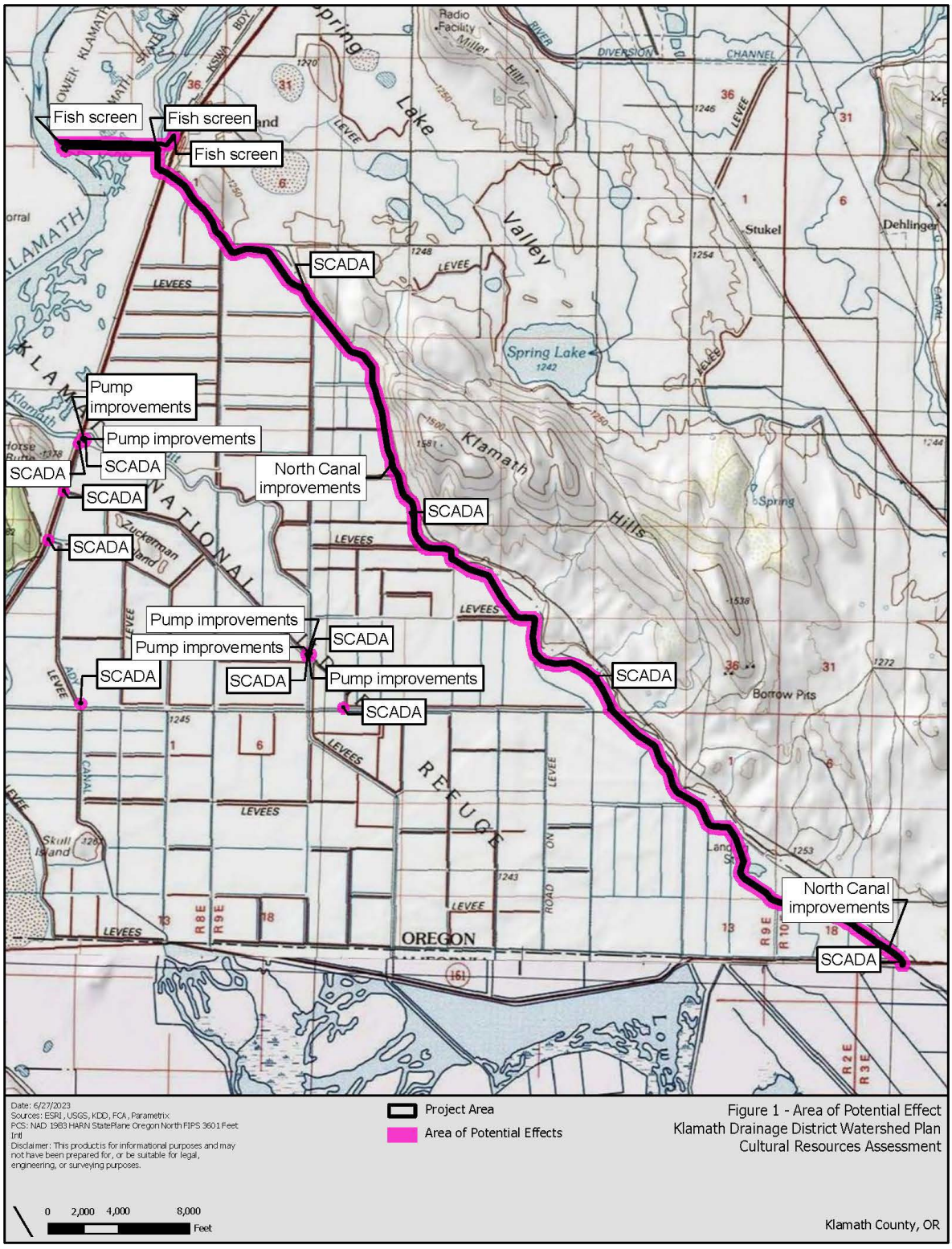
Sincerely,

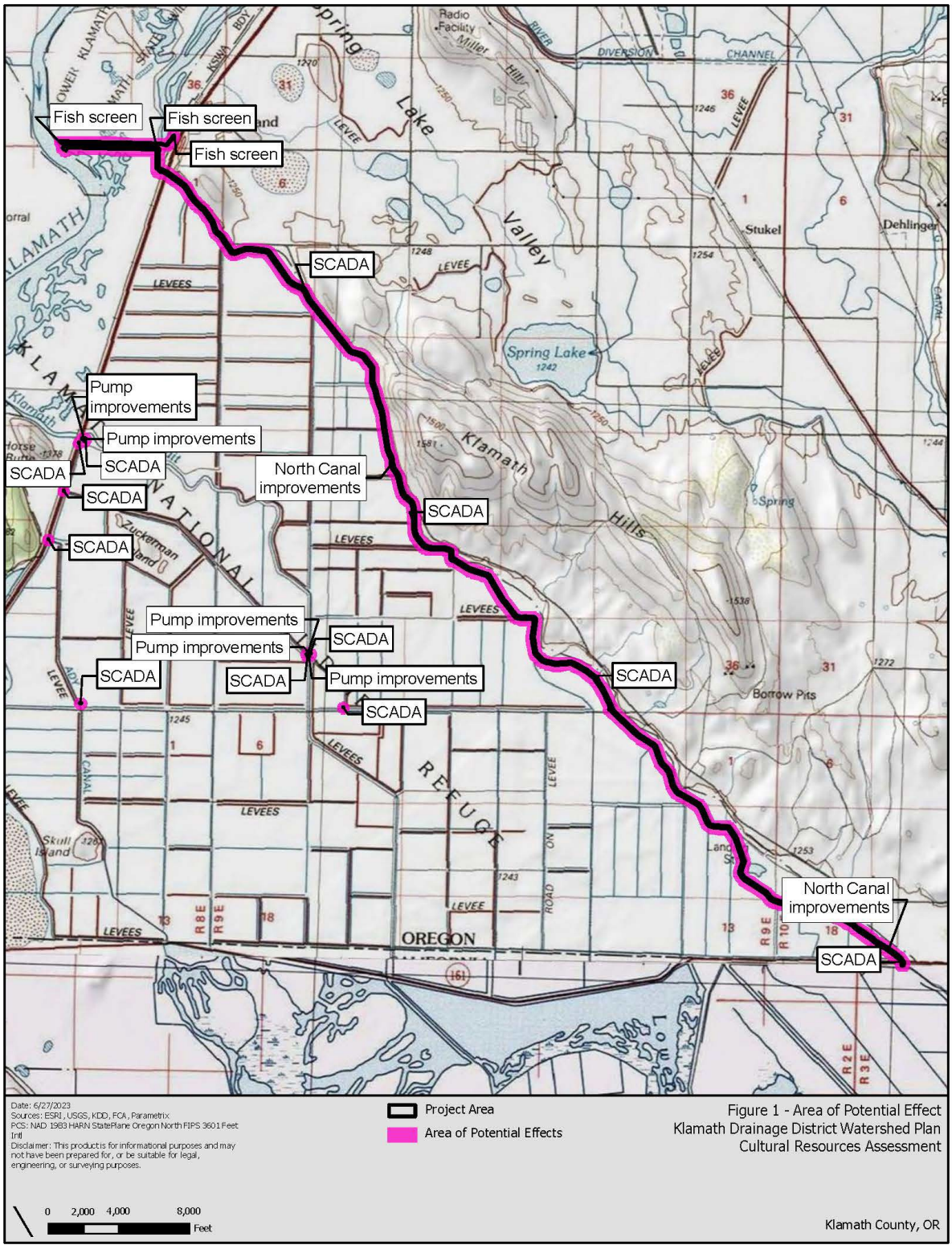
Rachel LS Gebauer

Rachel Gebauer
Acting State Cultural Resources Specialist
USDA NRCS
541.887.3511
rachel.gebauer@usda.gov

cc:
Gary Diridoni, State Watershed Planner
Amy Hendershot, State Resource Conservationist
Enclosure: Area of Potential Effect Figure

USDA is an equal opportunity provider, employer, and lender.


Fish screen
Fish screen
Fish screen
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
SCADA
North Canal improvements
SCADA
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
Pump improvements
SCADA
SCADA
North Canal improvements
SCADA
Lake
Valley
Spring Lake
Klamath
Hills
Stukel
Dehlinger
Borrow Pits
REFUGE
OREGON
LEVEES
Project Area
Area of Potential Effects
Date: 6/27/2023
Sources: ESRI, USGS, KDD, FCA, Parametrix
PCS: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes.
0 2,000 4,000 8,000
Feet
Figure 1 - Area of Potential Effect
Klamath Drainage District Watershed Plan
Cultural Resources Assessment
Klamath County, OR


Fish screen
Fish screen
Fish screen
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
SCADA
North Canal improvements
SCADA
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
Pump improvements
SCADA
SCADA
North Canal improvements
SCADA
Lake
Valley
Spring Lake
Klamath
Hills
Stukel
Dehlinger
Borrow Pits
REFUGE
OREGON
LEVEES
Project Area
Area of Potential Effects
Figure 1 - Area of Potential Effect
Klamath Drainage District Watershed Plan
Cultural Resources Assessment
Klamath County, OR
Date: 6/27/2023
Sources: ESRI, USGS, KDD, FCA, Parametrix
PCS: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes.
0 2,000 4,000 8,000
Feet

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Oregon State Office
1201 NE Lloyd Blvd. Suite 900
Portland, OR 97232

9 September 2024
Kevin Townsend, Chair
P.O. Box 129
130 Me Thee UH Road
Fort Bidwell, CA 96112

Re: Invitation to Participate in Section 106 Consultation for the Klamath Drainage District Modernization Project, Klamath County, Oregon

Dear Chairman Townsend,

The Farmers Conservation Alliance (FCA) is proposing the Klamath Drainage District Modernization Project (the project) in Klamath County, Oregon. The project is being performed through the Natural Resources Conservation Service's (NRCS) Watershed Protection and Flood Prevention Program, Public Law 83-566 (PL 83-566). As a result, the project is considered a federal undertaking and is subject to Section 106 of the National Historic Preservation Act (Section 106) and its implementing regulations 36 CFR Part 800. NRCS is serving as the lead federal agency for the project. In this letter, NRCS initiates Section 106 consultation and requests feedback on the project's Area of Potential Effects.

Project Description

The project will make the following improvements to the Klamath Drainage District (KDD):

- Screen the North Canal Diversion on the Klamath River and improve access to the potential fish screen site.
- Improve the North Canal by extending it 0.47 miles (~2,500 feet) from Fugate Road to California State Highway 161, connecting the North Canal to the P-1 Lateral, adding a point of delivery to the LKNWR. This project action would also include the modification of five road crossings along the North Canal to accommodate an additional flow of 100 cubic feet per second (cfs).
- Upgrade the Reclamation F&FF and E&EE pump stations along the KSD to a more common voltage and with variable frequency drives (VFD).
- Install a recirculation pipeline going from the outlet of the western-most pump in the E Pump Station to the Center Canal.
- Install 14 SCADA12 systems, four of which include automated gates, at 12 locations distributed across the District.

Area of Potential Effects

A project's APE is defined as the geographic area(s) in which an undertaking may directly or indirectly effect the character or use of historic properties (36 CFR 800.16.c). Effects may be direct or indirect, with the former including any type of effect (i.e., physical, visual, auditory, etc.) resulting from an undertaking and the latter including any type of reasonably foreseeable effect caused by the undertaking after its completion or farther in distance. In determining the Project's APE, the APE for direct effects was delineated primarily to account for physical and visual effects, as well as construction-related effects such as vibration, noise, and fugitive dust. The Project's physical APE will be limited to the vertical and horizonal footprint of the areas and/or structures where the proposed project activities will occur. The project's visual APE includes a 100-foot radial buffer around the physical APE to account for effects on the viewsheds of historic properties resulting from alterations to select components of the Klamath Drainage District. The APE for indirect effects is the same as the APE for direct effects as reasonably foreseeable indirect effects are not

anticipated to occur outside of the APE established for direct effects. The APE is shown in the enclosed figure.
Cultural resources studies of the APE will be performed and shared with consulting parties. If the Fort Bidwell Indian Community is interested in becoming a consulting party for the project, please provide a response within 30-days of receipt of this letter with confirmation of your interest and any key contacts to be included in future correspondence. NRCS is also interested in input regarding the identification of any historic properties that may exist within the project's APE that may have religious and cultural significance to Fort Bidwell Indian Community. If you have any questions or concerns about the project, please contact Rachel Gebauer, NRCS Oregon Acting State Archaeologist at rachel.gebauer@usda.gov or 541.887.3511.

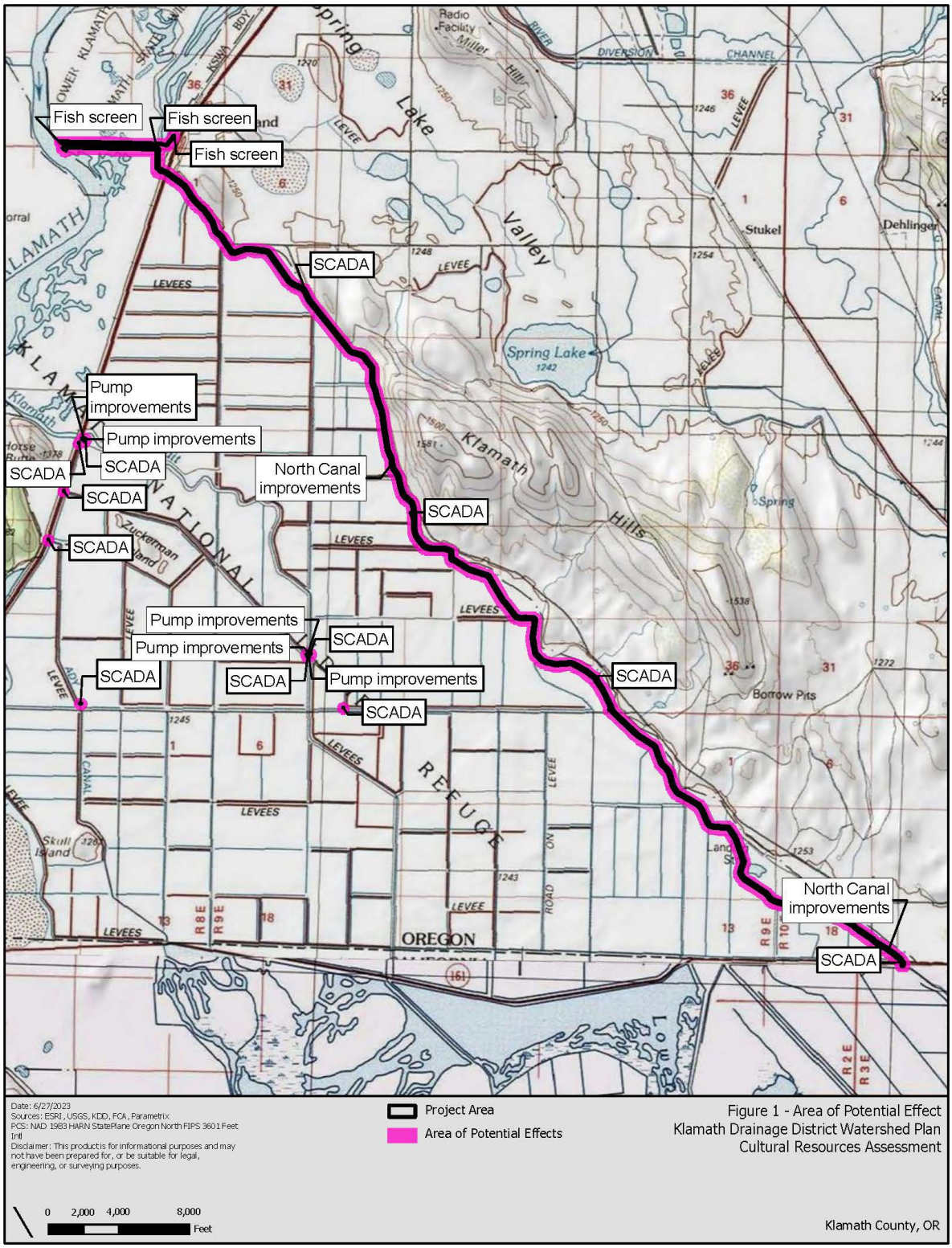
Sincerely,

Rachel LS Gebauer

Rachel Gebauer
Acting State Cultural Resources Specialist
USDA NRCS
541.887.3511
rachel.gebauer@usda.gov

cc:
Gary Diridoni, State Watershed Planner
Amy Hendershot, State Resource Conservationist
Enclosure: Area of Potential Effect Figure

USDA is an equal opportunity provider, employer, and lender.


Fish screen
Fish screen
Fish screen
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
SCADA
North Canal improvements
SCADA
SCADA
Pump improvements
Pump improvements
SCADA
SCADA
Pump improvements
SCADA
SCADA
North Canal improvements
SCADA
Spring Lake
Klamath Hills
Valley
Stukel
Dehlinger
Borrow Pits
Skull Island
REFUGE
OREGON
LEVEES
Date: 6/27/2023
Sources: ESRI, USGS, KDD, FCA, Parametrix
PCS: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Disclaimer: This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes.
Project Area
Area of Potential Effects
Figure 1 - Area of Potential Effect
Klamath Drainage District Watershed Plan
Cultural Resources Assessment
0 2,000 4,000 8,000
Feet
Klamath County, OR

E.3 Supporting Information for Land Use

No additional information.

E.4 Supporting Information for Socioeconomic Resources

Environmental Justice Communities

Areas with over 50 percent or "meaningfully greater" representation of minority or low-income communities are considered environmental justice communities (CEQ 1997), and their propensity to experience disproportionally adverse effects from a given action must be analyzed within NEPA documents per E.O. 12898. For this analysis, low-income is defined as those whose income is less than two times the federal poverty level. Minority is defined as those identifying as a race other than white alone and/or list their ethnicity as Hispanic or Latino. This methodology is consistent with that used in EPA's EJScreen tool.

Race and Ethnicity in Klamath County, Siskiyou County, Oregon, and California are summarized in Table E-2. Approximately 25 percent of the population of Klamath County identifies as a minority, less than that of the State of Oregon, where approximately 28 percent of the population identifies as a minority. Approximately 27 percent of the population of Siskiyou County identifies as a minority, less than that of the State of California, where approximately 65 percent of the population identifies as a minority.

Table E-2. Race and Ethnicity.

Indicator	Klamath County	Siskiyou County	Oregon	California
Total Population in 2020	69,413	44,076	4,237,256	39,538,223
Two or More Races	6.5%	7%	6.1%	4.1%
White alone	74.8%	72.7%	71.7%	34.7%
Black or African American alone	0.7%	1.1%	1.9%	5.4%
American Indian and Alaska Native alone	3.6%	4%	1%	0.4%
Asian alone	1.1%	2%	4.5%	15.1%
Native Hawaiian and Other Pacific Islander alone	0.1%	0.1%	0.4%	0.3%
Hispanic or Latino (of any race)	12.6%	12.5%	13.9%	39.4%
Not Hispanic or Latino	87.4%	87.5%	86.1%	60.6%

Source: U.S. Census Bureau (2020).

Low-income populations in Klamath County, Siskiyou County, Oregon, and California are summarized in Table E-3. Both Klamath and Siskiyou counties have a higher percentage of low-income populations than their respective states.

Table E-3. Low Income Populations.

Indicator	Klamath County	Siskiyou County	Oregon	California
Low Income (household income less than or equal to twice the poverty level)	43%	40%	29%	29%

Source: EPA (2020).

E.5 Supporting Information for Soil Resources

No additional information.

E.6 Supporting Information for Vegetation Resources

Table E-4. Plant Species that Occur Within Planning Area.

Plant Species	Scientific Name
Antelope bitterbrush	*Purshia tridentata*
Biennial wormwood	*Artemisia biennis*
Big sagebrush	*Artemisia tridentata*
Black cottonwood	*Populus balsamifera*
Bluebunch wheatgrass	*Pseudoroegneria spicata*
Broadleaf cattail	*Typha latifolia*
Bulrush	*Scirpus spp.*
California poppy	*Eschscholzia californica*
Canada thistle	*Cirsium arvense*
Carelessweed	*Cyclachaena xanthiifolia*
Catnip	*Nepeta cataria*
Cheatgrass	*Bromus tectorum*
Poison hemlock	*Conium maculatum*
Climbing nightshade	*Solanum dulcamara*
Common duckmeat	*Spirodela polyrrhiza*

Plant Species	Scientific Name
Common duckweed	*Lemna minor*
Common kochia	*Kochia scoparia*
Common lambsquarters	*Chenopodium album*
Common yarrow	*Achillea millefolium*
Coon's tail	*Ceratophyllum demersum*
Desert sweet	*Chamaebatiaria millefolium*
Dwarf mallow	*Malva neglecta*
Greasewood	*Sarcobatus vermiculatus*
Hastate orache	*Atriplex prostrata*
Herb sophia	*Descurainia sophia*
Hoe nightshade	*Solanum sarrachoides*
Hollyhok	*Alcea rosea*
Idaho fescue	*Festuca idahoensis*
Jointed goatgrass	*Aegilops cylindrica*
Low goosefoot	*Chenopodium chenopodioides*
Low sagebrush	*Artemisia arbuscula*
Mapleleaf goosefoot	*Chenopodium simplex*
Mountain rush	*Juncus balticus*
Mouse barley	*Hordeum murinum*
Narrowleaf dock	*Rumex stenophyllus*
Nodding thelypody	*Thelypodium flexuosum*
Nuttall alkaligras	*Puccinellia nuttalliana*
Paiuteweed	*Suaeda calceoliformis*

Plant Species	Scientific Name
Perennial pepperweed	*Lepidium latifolium*
Povertyweed	*Iva axillaris*
Prickly lettuce	*Lactuca serriola*
Prostrate pigweed	*Amaranthus blitoides*
Purple loosestrife	*Lythrum salicaria*
Quackgrass	*Elymus repens*
Red goosefoot	*Chenopodium rubrum*
Redscale saltbush	*Atriplex rosea*
Reed canary grass	*Phalaris arundinacea*
Rough cocklebur	*Xanthium strumarium*
Rubber rabbitbrush	*Ericameria nauseosa*
Russian olive	*Elaeagnus angustifolia*
Russian thistle	*Salsola tragus*
Rye brome	*Bromus secalinus*
Saltgrass	*Distichlis stricta*
Sandberg bluegrass	*Poa sandbergii*
Shortpod thelypody	*Thelypodium brachycarpum*
Short-rayed alkali aster	*Symphyotrichum frondosum*
Silvery lupine	*Lupinus argenteus*
Small-flower fiddleneck	*Amsinckia menziesii*
Smartweed	*Persicaria sp.*
Spiny hopsage	*Grayia spinosa*
Squirreltail	*Elymus elymoides*
Stinging nettle	*Urtica dioica ssp. holosericea*

Plant Species	Scientific Name
Tall annual willowherb	*Epilobium brachycarpum*
Tall hedge-mustard	*Sisymbrium altissimum*
Teasel	*Dipsacus sp.*
Tufted hairgrass	*Deschampsia cespitosa*
Two-scale saltbush	*Atriplex micrantha*
Western juniper	*Juniperus occidentalis*
Western needlegrass	*Achnatherum occidentale*
Wild mint	*Mentha arvensis*
Wyoming Indian paintbrush	*Castilleja linariifolia*
Yellow flag iris	*Iris pseudacorus*
Yellow pondlily	*Nuphar lutea*
Yellow rabbitbrush	*Chrysothamnus viscidiflorus*

Sources: (KDD 2022) and (USFWS 2016)

Noxious Weeds

The Klamath County Weed Control program defines noxious weeds as terrestrial, aquatic or marine plants that represent the greatest public menace and as a top priority for action by weed control programs; and identify three weed categories. "A" designated weeds are weeds of known economic importance which are known to occur in the county in small enough infestations that make eradication or containment possible, or are not known to occur in the county, but their presence in neighboring counties makes future occurrence in a county seems immminent. "B" designated weeds are weeds of known economic importance which in some parts of the county are abundant, but may have limited distribution in other parts of the county. Where implementation of a fully-integrated countywide management plan is infeasible, biological control shall be the main control approach when applicable. "C" designated weeds are weeds which are abundant in most of the county. While not subject to enforcement regulations, these species can cause similar economic and ecological impacts as other noxious weeds. Education and control recommendations will be the main approach.

Table E-5. Noxious Weeds Known to Occur Within the Planning Area With Their State and County Designations.

Common Name	Scientific Name	Oregon State Designation	Klamath County Designation	California State Designation	California Invasive Plant Council
Bermudagrass	*Cynodon dactylon*	-	-	D	Moderate
Bull thistle	*Cirsium vulgare*	List B	-	C	Moderate
Canada thistle	*Cirsium arvense*	List B	List B	B	Moderate
Common St. John's wort	*Hypericum perforatum*	List B	List B	C	Moderate
Creeping bentgrass	*Agrostis stolonifera*	-	-	-	Limited
Cutleaf teasel	*Dipsacus laciniatus*	List B	List A	-	
Dalmatian toadflax	*Linaria dalmatica ssp. dalmatica (= Linaria genistifolia ssp. dalmatica)*	List B	List B	A	Moderate
Diffuse knapweed	*Centaurea diffusa*	List B	List A	A	Moderate
Cheatgrass	*Bromus tectorum*	-	-	C	High
Dyer's woad	*Isatis tinctoria*	List B	List A	B	Moderate
English ivy and Algerian ivy	*Hedera helix and H. canariensis*	List B	-	D	High
Eurasian watermilfoil	*Myriophyllum spicatum*	-	-	C	High
French broom	*Genista monspessulana*	List B	-	C	High
Hairy whitetop	*Lepidium appelianum (= Cardaria pubescens)*	List B	-	B	Limited
Himalayan blackberry	*Rubus armeniacus (= Rubus discolor)*	-	-	-	High
Houndstongue	*Cynoglossum officinale*	List B	List A	-	Moderate
Kochia	*Kochia scoparia*	List B	-	-	Moderate

Common Name	Scientific Name	Oregon State Designation	Klamath County Designation	California State Designation	California Invasive Plant Council
Leafy spurge	*Euphorbia virgata (= Euphorbia esula)*	List B (T)	List B	A	High
Lepidium chalepensis and L. draba	*Lepidium chalepense (= Cardaria chalepensis and C. draba)*	List B	-	B	Moderate
Mediterranean sage	*Salvia aethiopis*	List B	-	B	Limited
Medusahead	*Elymus caput-medusae (= Taeniatherum caput-medusae)*	List B	-	C	High
Musk thistle	*Carduus nutans*	List B	List B	A	Moderate
Myrtle spurge	*Euphorbia myrsinites*	List B	List B	-	
Pampas grass	*Cortaderia selloana*	List B	-	-	High
Perennial pepperweed	*Lepidium latifolium*	List B	List B	B	High
Poison-hemlock	*Conium maculatum*	List B	List B	-	Moderate
Puncture vine	*Tribulus terrestris*	List B	List B	C	Limited
Purple loosestrife	*Lythrum salicaria*	List B	List A	B	High
Purple starthistle	*Centaurea calcitrapa*	List A (T)		B	Moderate
Rush skeletonweed	*Chondrilla juncea*	List B (T)	List A	A	Moderate
Russian knapweed	*Acroptilon repens*	List B	List A	B	Moderate
Russian thistle	*Salsola tragus*	-	-	C	Limited
Scotch broom	*Cytisus scoparius*	List B	List A	C	High
Scotch thistle	*Onopordum acanthium*	List B	List B	A	High
Smallflower tamarisk	*Tamarix parviflora*	-	-	B	High
Spanish broom	*Spartium junceum*	List B	-	C	High

Common Name	Scientific Name	Oregon State Designation	Klamath County Designation	California State Designation	California Invasive Plant Council
Spiny cocklebur	*Xanthium spinosum*	-	List A	-	-
Spotted knapweed	*Centaurea stoebe ssp. micranthos (= Centaurea maculosa)*	List B	List B	A	High
Squarrose knapweed	*Centaurea virgata ssp. squarrosa*	List A (T)	List A	A	Moderate
Tree-of-heaven	*Ailanthus altissima*	List B	-	C	Moderate
Whitetop (hoary cress)	*Lepidium draba (= Cardaria draba)*	List B	List B	-	-
Yellow starthistle	*Centaurea solstitialis*	List B	List B	C	High
Yellowflag iris	*Iris pseudacorus*	List B	List B	B	Limited

Source: iMapInvasives (2022), CalIPC (2022), Site observation, Taya MacLean, Senior Scientist, Parametrix, May 3, 2022.

Planning Area Vegetation

Figure E-1. Representative view of irrigated pasture vegetation and weedy edges of field (May 3, 2022; T. MacLean).

Figure E-2. Representative view of canals (North Canal), wetland fringe vegetation, and upland vegetation along the berms (May 3, 2022; T. MacLean).

Figure E-3. View of Klamath River at the channel mouth for the North Canal point of diversion (May 3, 2022; T. MacLean).

Figure E-4. View of marsh habitat at North Canal Diversion (May 3, 2022; T. MacLean).

Figure E-5. Lower Klamath National Wildlife Refuge (May 3, 2022; T. MacLean).

E.7 Supporting Information for Water Resources

Water Rights KDD History

The agricultural history of the KDD began in the late 1800s when the District's natural grasslands were used for grazing cattle. Since then, development progressed within the basin and on District lands, including urban and agricultural land development, road construction, water diversion, water delivery and drainage infrastructure construction, and other land use practices and irrigation projects. The earliest water right priority date in the District is February 1, 1883. On October 24, 1907, the United States and the two railroad companies entered into agreement acting under the provisions of the National Reclamation Act of 1902; the Act of Congress of February 9, 1905; and the Oregon and California Acts of Legislation of 1905 to develop agriculture in the Klamath River Basin. In 1911, Congress expanded the Secretary of the Interior's authority to develop reclamation projects by passing the Warren Act, which authorized the Secretary to enter into contracts with individuals, associations, and irrigation districts for the irrigation and drainage of lands not included in the scope of the 1902 legislation. Based upon the provisions of the Warren Act, KDD was formed under the laws of the State of Oregon on March 6, 1915. The District was created for the purpose of providing adequate drainage at all times for its landowners as well as for providing a cost-effective water supply to those same landowners.

Streamflow Graphs

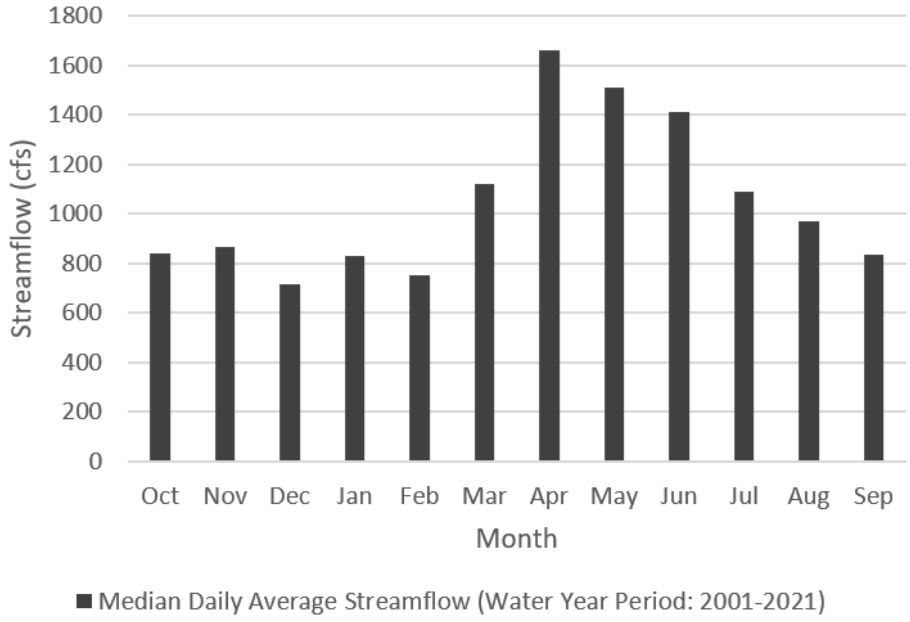


Figure E-6. Median daily average streamflow by month in the Link River at Klamath Falls, Oregon, at OWRD Gauge No. 11507500.

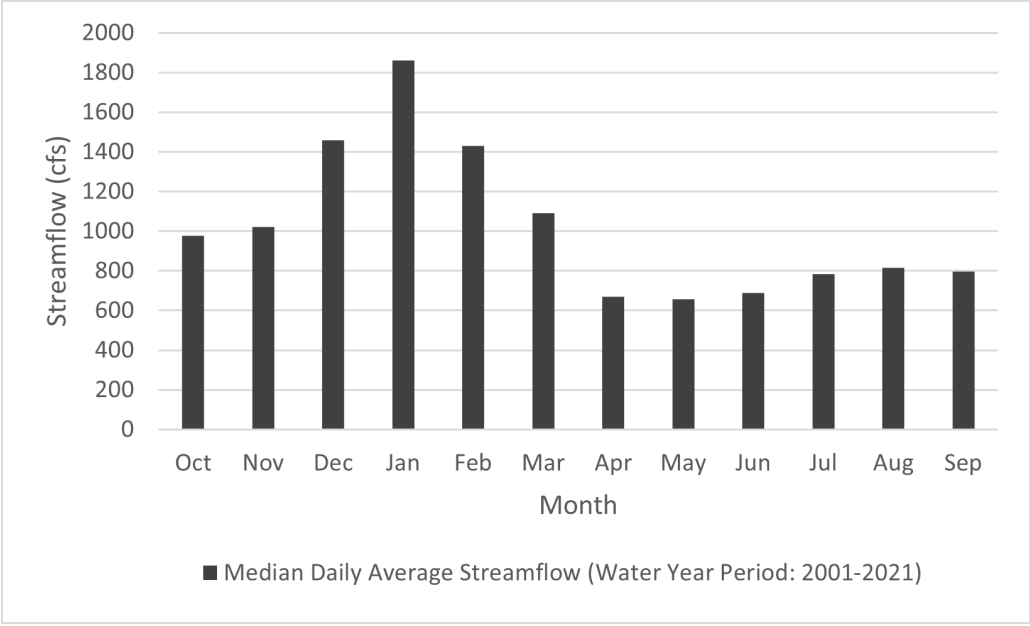


Figure E-7. Median daily average streamflow by month in the Klamath River at Keno, Oregon, at OWRD Gauge No. 11509500.

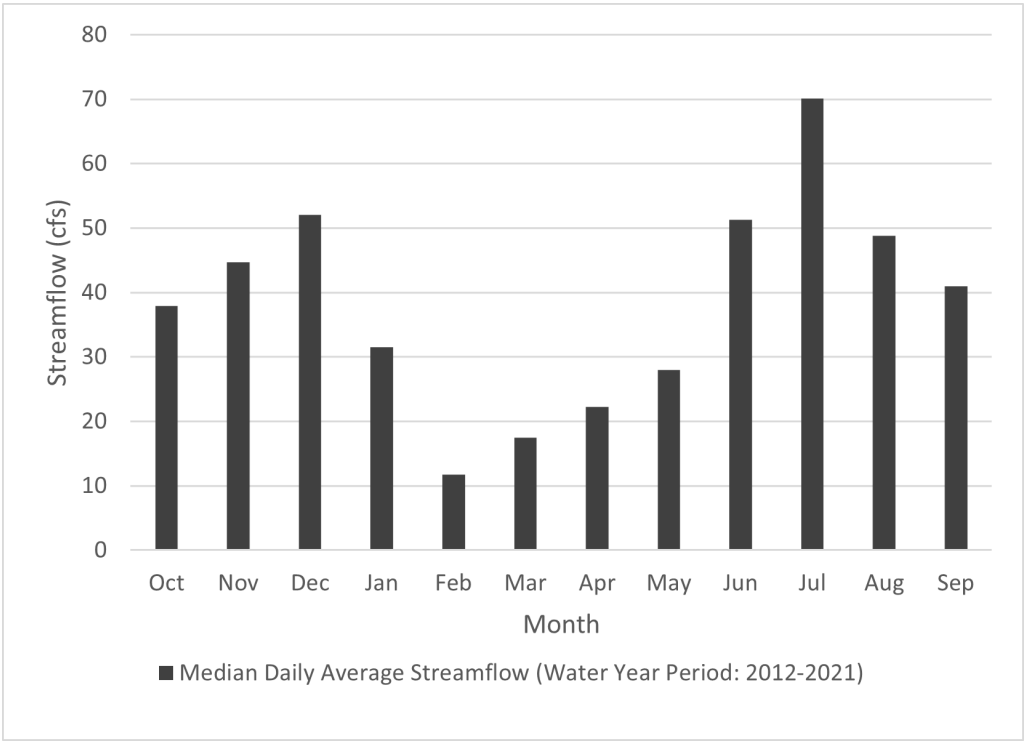


Figure E-8. Median daily average streamflow by month at the North Canal at Highway 97, near Worden, Oregon, at OWRD Gauge No. 11509105.

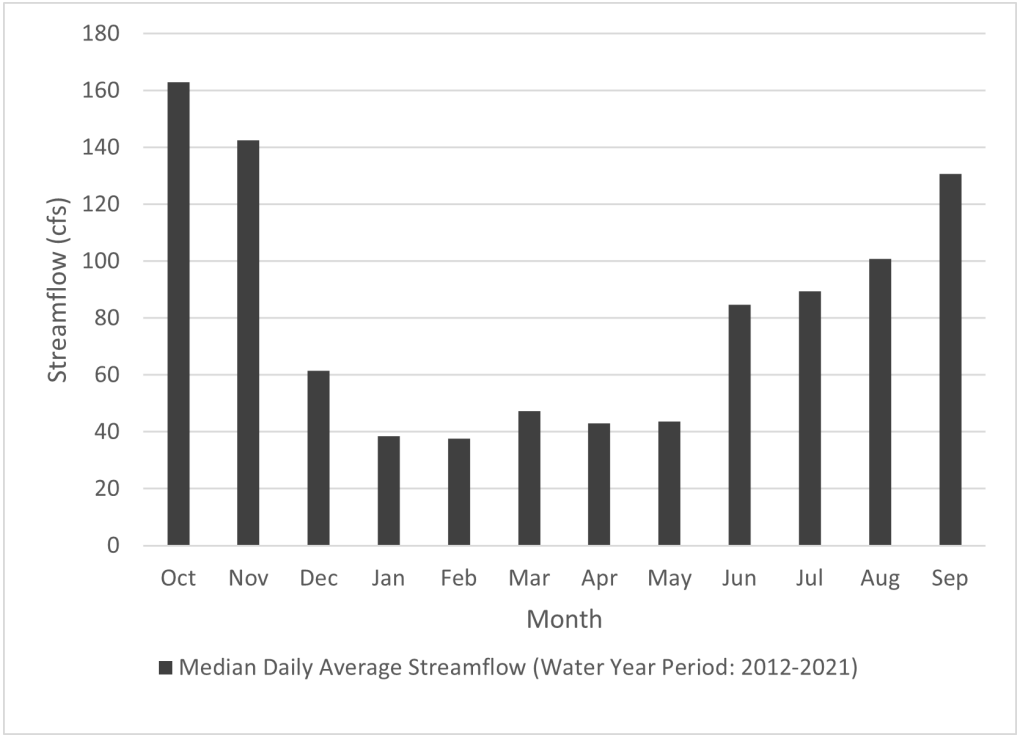


Figure E-9. Median daily average streamflow by month at the Ady Canal at Highway 97, near Worden, Oregon, at OWRD Gauge No. 11509200.

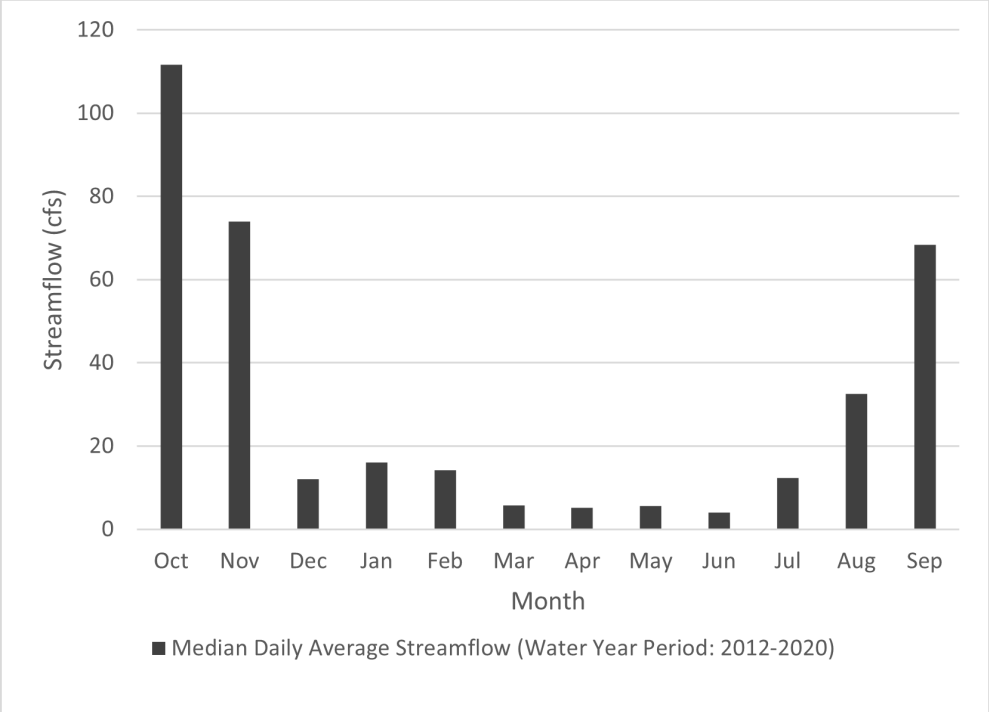


Figure E-10. Median daily average streamflow by month in the Ady Canal above Lower Klamath NWR, near Worden, Oregon, at OWRD Gauge No. 11509250.000-1.

E.8 Supporting Information for Fish and Aquatic Resources

Table E-6. Fish Species that occur within the Project Planning Area.

Fish Species	Scientific Name	Nativity
Blue chub	*Gila coerulea*	native
Black bullhead	*Ameiurus melas*	non-native
Black crappie	*Pomoxis nigromaculatus*	non-native
Bluegill	*Lepomis macrochirus*	non-native
Brook trout	*Salvelinus fontinalis*	non-native
Brown bullhead	*Ameiurus nebulosus*	non-native
Bull trout	*Salvelinus confluentus*	non-native
Channel catfish	*Ictalurus punctatus*	non-native
Chinook salmon	*Oncorhynchus tshawytscha*	native
Coho	*Oncorhynchus kisutch*	native

Fish Species	Scientific Name	Nativity
Fathead minnow	*Pimephales promelas*	non-native
Golden shiner	*Notemigonus chrysoleucas*	non-native
Goldfish	*Carassius auratus*	non-native
Green sunfish	*Lepomis cyanellus*	non-native
Klamath Lake sculpin	*Cottus princeps*	native
Klamath largescale sucker	*Catostomus snyderi*	native
Klamath River lamprey	*Lampetra similis*	native
Klamath smallscale sucker	*Catostomus rimiculus*	native
Klamath Spackled Dace	*Rhinichthys osculus klamathensis*	non-native
Klamath tui chub	*Siphatales bicolor*	native
Kokanee salmon	*Oncorhynchus nerka*	non-native
Largemouth bass	*Micropterus salmoides*	non-native
Lost River sucker	*Deltistes luxatus*	native
Miller Lake Lamprey	*Lampetra milleri*	native
Pacific lamprey	*Entosphenus tridentatus*	native
Pit-Klamath brook lamprey	*Lampetra lethophaga*	native
Pumpkinseed	*Lepomis gibbosus*	non-native
Redband trout	*Oncorhynchus mykiss gairdneri*	native
Sacramento perch	*Archoplites interruptus*	non-native
Shortnose sucker	*Chasmistes brevirostris*	native
Slender sculpin	*Cottus tenuis*	native
Steelhead trout	*Oncorhynchus mykiss*	native
Tui Chub	*Gila bicolor*	native
Upper Klamath marbled sculpin	*Cottus klamathensis*	native

Fish Species	Scientific Name	Nativity
White crappie	*Pomoxis annularis*	non-native
Yellow bullhead	*Ameiurus natalis*	non-native
Yellow perch	*Perca flavescens*	non-native

Sources: ODFW (2022), StreamNet (2023), ORBIC (2022), USFWS (2022). NOAA NMFS (2022), Carter and Kirk (2008), PacifiCorp (2021).

E.9 Supporting Information for Wetlands and Riparian Areas Resources

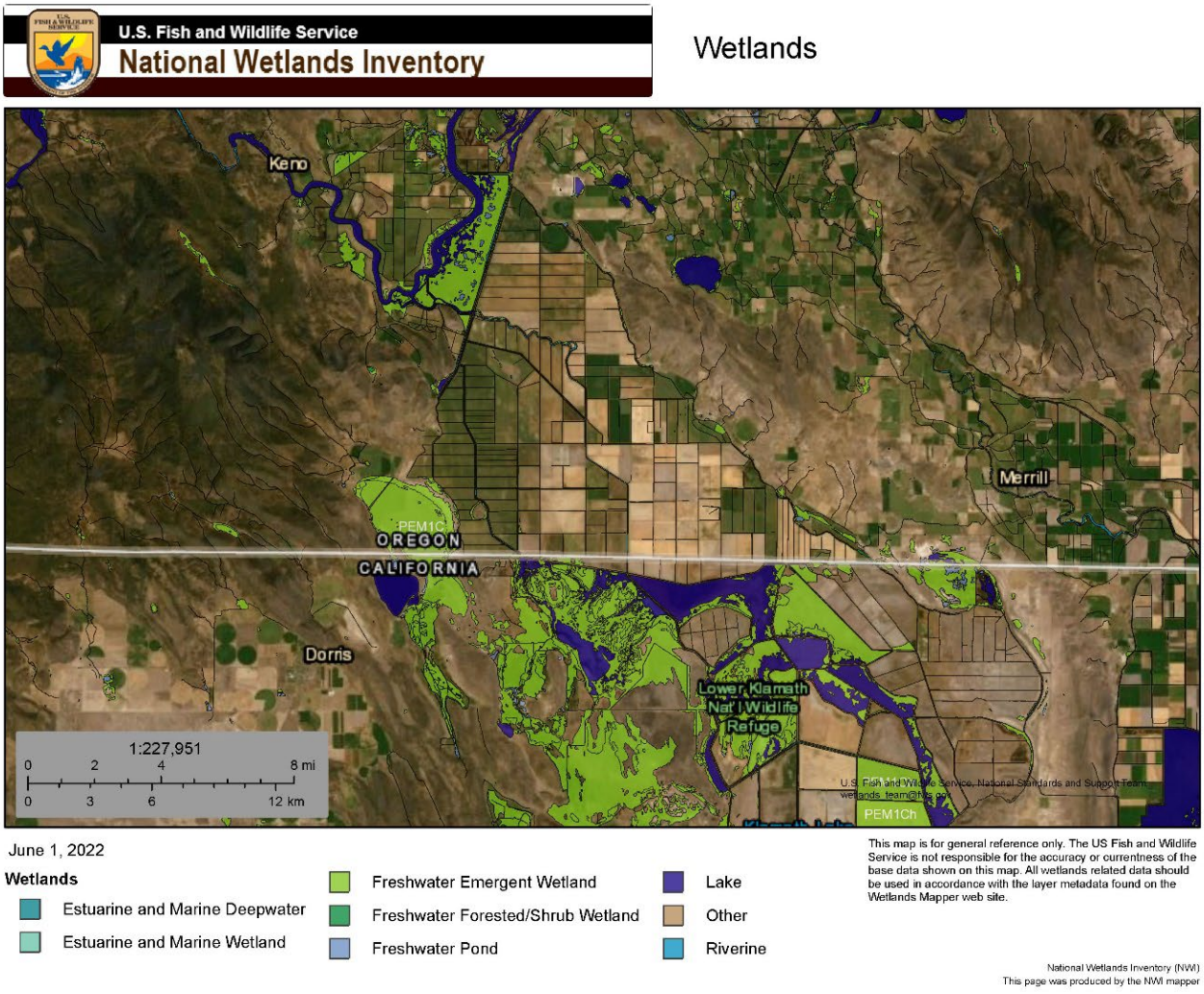


Figure E-11. Nation Wetlands Inventory Analysis for KDD (USFWS 2023).

Based on an analysis of the National Wetland Inventory (NWI) geographic information systems (GIS) data (USFWS 2023) and aerial imagery (Figure E-11), freshwater herbaceous wetlands and deepwater habitats occur in the planning area. As summarized in Table E-7, these habitats include

Furber Marsh which is located at the diversion channels from the Klamath River to Ady Canal and North Canal diversions; freshwater emergent wetlands in the LKNWR and along fringes of canals and ditches; freshwater ponds; and riparian habitat associated with open waterbodies that include Sheepy Lake, Miller Lake, Lower Klamath Lake, and the Klamath River. The NWI data is used as a first-step approach in identifying and evaluating potential wetlands and Waters of the United States in the project area.

Table E-7. National Wetland Inventory Summary.

Cowardin Code	Type of Wetland or Deepwater Habitat	Resources in Planning Area
L2AB – Lacustrine Littoral Aquatic Bed	Lake	Lower Klamath Lake, Sheepy Lake
R2UB – Riverine Lower Perennial Unconsolidated Bottom and R2AB - Riverine Lower Perennial Aquatic Bed	Riverine/Perennial	Klamath Straits Drain and other semi-permanently flooded canals
R4SB – Riverine Intermittent Streambed	Riverine/Intermittent	North Canals, Center Canal, Ady Canal, and other seasonally flowing canals
PUS – Palustrine Unconsolidated Shore and PAB - Palustrine Aquatic Bed	Freshwater Pond	Ponds
PSS – Palustrine Scrub-Shrub	Freshwater Shrub Wetland	Few small localized isolated patches of wetland shrubs. Very minor component.
PEM – Palustrine Emergent	Freshwater Emergent Wetland	Furber Marsh, Miller Lake, fringe wetlands along North Canal and Center Canal, vegetated canals throughout the fields

Source: (USFWS 2023).

A wetland and waters delineation would be conducted prior to the implementation of Modernization Alternative projects to determine limits of direct and indirect impacts on wetlands and waters of the United States and the State. Jurisdictional determination by U.S. Army Corps of Engineers and concurrence by DSL of delineated boundaries of wetlands and waters would be obtained.

If the permitting agencies determine that compensatory mitigation is necessary to offset unavoidable impacts to aquatic resources, the amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. An appropriate functional

assessment tool and methods would be used to determine how much compensatory mitigation is required. There are no U.S. Army Corps of Engineers- or DSL-approved compensatory mitigation banks in the Lower Klamath Lake watershed. Therefore, a permittee-responsible mitigation could be provided on-site or off-site.

E.10 Supporting Information for Wildlife Resources

Table E-8. Wildlife Species Likely to Occur Within the Planning Area.

Wildlife Species	Scientific Name
Bat	*Vespertilionidae* spp.
Coyote	*Canis latrans*
Desert horned lizard	*Phrynosoma platyrhinos*
Golden mantled ground squirrel	*Spermophilus lateralis*
Mule deer	*Odocoileus hemionus*
Northern flicker	*Colaptes auratus*
Osprey	*Pandion haliaetus*
Pygmy rabbit	*Brachylagus idahoensis*
Pygmy short-horned lizard	*Phrynosoma douglasii*
Raccoon	*Procyon lotor*
Red-tailed hawk	*Buteo jamaicensis*
Rufous hummingbird	*Selasphorus rufus*
Turkey vulture	*Cathartes aura*
Western gray squirrel	*Sciurus griseus*
Western rattlesnake	*Crotalus viridus*
Western skink	*Eumeces skiltonianus*
Yellow pine chipmunk	*Eutamias amoenus*
Raccoon	*Procyon lotor*

Source: site observation, Taya MacLean, Senior Scientist, Parametrix, May 3, 2022.

Table E-9. Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act Species Potentially occurring within the Planning Area.

Migratory Bird Treaty Act/Bald and Golden Eagle Protection Act Species	Scientific Name
Bald Eagle	*Haliaeetus leucocephalus*
Black Tern	*Chlidonias niger*
Cassin's Finch	*Carpodacus cassinii*
Clark's Grebe	*Aechmophorus clarkii*
Evening Grosbeak	*Coccothraustes vespertinus*
Franklin's Gull	*Leucophaeus pipixcan*
Lesser Yellowlegs	*Tringa flavipes*
Lewis's Woodpecker	*Melanerpes lewis*
Marbled Godwit	*Limosa fedoa*
Olive-sided Flycatcher	*Contopus cooperi*
Rufous Hummingbird	*Selasphorus rufus*
Sage Thrasher	*Oreoscoptes montanus*
Willet	*Tringa semipalmata*

Source: Site observation, Taya MacLean, Senior Scientist, Parametrix, May 3, 2022.

Project code: 2024-0107000 06/21/2024 00:01:01 UTC

MAMMALS

NAME	STATUS
Gray Wolf *Canis lupus* Population: U.S.A.: All of AL, AR, CA, CO, CT, DE, FL, GA, IA, IN, IL, KS, KY, LA, MA, MD, ME, MI, MO, MS, NC, ND, NE, NH, NJ, NV, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, and WV; and portions of AZ, NM, OR, UT, and WA. Mexico. There is **final** critical habitat for this species. Species profile: https://ecos.fws.gov/ecp/species/4488	Endangered
North American Wolverine *Gulo gulo luscus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5123	Threatened

BIRDS

NAME	STATUS
Northern Spotted Owl *Strix occidentalis caurina* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1123	Threatened
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

FISHES

NAME	STATUS
Lost River Sucker *Deltistes luxatus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5604	Endangered
Shortnose Sucker *Chasmistes brevirostris* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7160	Endangered

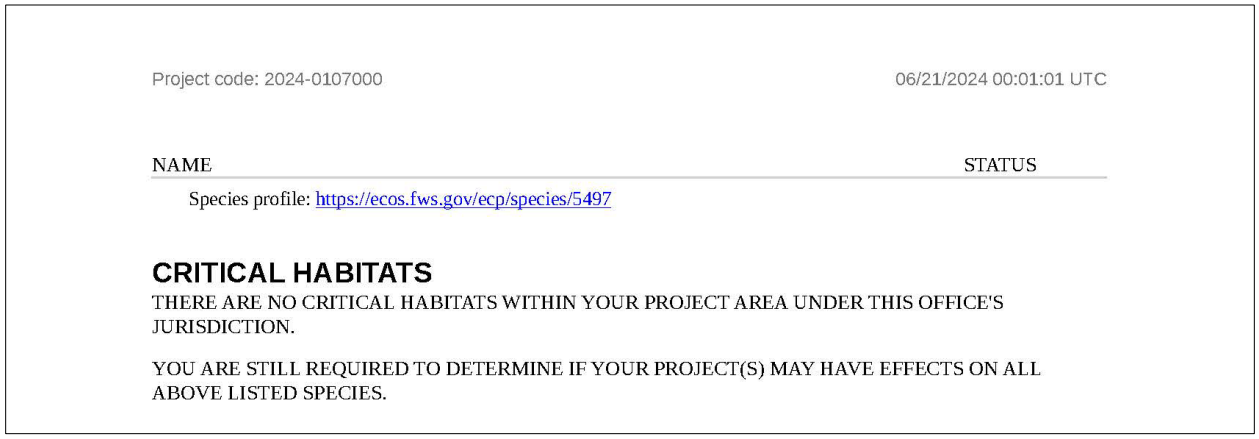
INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

FLOWERING PLANTS

NAME	STATUS
Applegate's Milk-vetch *Astragalus applegatei* No critical habitat has been designated for this species.	Endangered

6 of 17



Project code: 2024-0107000 06/21/2024 00:01:01 UTC

NAME STATUS

Species profile: https://ecos.fws.gov/ecp/species/5497

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

Figure E-12. IPaC Official Species List provided by Klamath Falls Fish and Wildlife Office.

E.11 Supporting Information for Minimization, Avoidance, and Compensatory Mitigation Measures

Temporary Access

Prior to construction, the District would contact each landowner along the proposed route to discuss the KDD Infrastructure Modernization Project and if applicable, approve an easement agreement at the site of the proposed project. Adjacent landowners would be provided a construction schedule before construction begins. Construction limits would be clearly flagged to preserve existing vegetation and private property. Access to residences and farms would be maintained during construction. Construction would occur during the daytime to minimize disturbance to any landowners or other individuals in the construction area vicinity.

Staging, Storage, and Stockpile

Mechanized equipment and vehicles would be selected, operated, and maintained in a manner that minimizes adverse effects on the environment. Construction staging areas would be selected and used to minimize effects on vegetation and avoid the removal of trees. Construction equipment and vehicles would be parked a minimum of 150 feet away from streams, wetlands, ditches, and other waterbodies at the end of each workday. Fueling and maintenance operations would be performed on a flat surface, away from moving equipment, and at least 150 feet away from any water source.

Roads and Traffic Control

Standard construction safety procedures and traffic control measures would be employed to reduce the risk of collisions between construction vehicles and other vehicles, pedestrians, or bicyclists while construction is ongoing in accordance with the requirements of the "Manual of Uniform Traffic Control Devices, Part VI – Traffic Controls for Street and Highway Construction and Maintenance Operations" published by the U.S. Department of Transportation. Street/lane closures on roadways would be avoided during peak travel periods where possible to reduce potential traffic delays from construction vehicles. If a street closure is required a traffic control plan will be developed.

Erosion Control

Silt fencing, straw wattles, geotextile filters, straw bales, or other erosion control measures would be used to minimize soil erosion and prevent soil erosion from entering waterbodies during construction. Erosion control measures would be free of weeds and weed seeds.

In Water Work

All In Water Work will occur during the permitted In Water Work Window (July 1–January 31) to avoid fish spawning, sensitive life stages, and periods of high streamflow. All federal, state, and local permits will be secured prior to any work instream. Water quality protection measures will be implemented including erosion control, sediment control, and pollution control for all In Water Work and all dewatering efforts.

Equipment will be inspected, and power washed prior to entering the water. Equipment will remain in the water for the shortest time possible and not remain in the water while not working.

Coffer dams will be installed to dewater work areas as planned and scheduled. Nuisance water will be removed from the work area and discharged into appropriate locations.

Following the completion of work in dewatered areas, there will be a gradual return of streamflow to the extent possible.

Spill Prevention, Control, and Countermeasure

Spill kits would be located at fuel storage areas and the construction crew would have adequate absorbent materials and containment booms on hand to enable the rapid cleanup of any spill. Immediately upon learning of any fuel, oil, hazardous material including uncured concrete, or other regulated substance spill, or upon learning of conditions that would lead to an imminent spill, the person discovering the situation shall initiate actions to contain the fluid or eliminate the source of the spill and notify the Spill Coordinator or crew Foreperson immediately. If it is determined that a spill is beyond the scope of on-site equipment and personnel, an Environmental Emergency Response Contractor would be contacted immediately to contain or clean up the spill. Any spill into a waterbody or along the adjacent streambed would be reported immediately to Oregon Emergency Response Service at 1-800-452-0311 and the National Response Center at 1-800-424-8802. The Spill Coordinator would complete a Spill Report Form for each release of a regulated substance, regardless of volume.

Invasive Species Control

The measures below would be followed to avoid the introduction of invasive plants and noxious weeds into project areas. Any gear to be used in or near water would be inspected for aquatic invasive species. Ground disturbances would be limited to those areas necessary to safely implement the Preferred Alternative.

Begin activities in areas uninfested with invasive plants or noxious weeds before operating in infested areas.

Use uninfested areas for staging, parking, and cleaning equipment. Avoid or minimize all types of travel through infested areas, restrict to those periods when spread of seed, or plant reproductive parts are least likely.

When it is necessary to conduct soil work in infested roadsides or ditches, schedule activity when seeds or propagules are least likely to be viable to be spread.

Monitor disturbed areas for at least three growing seasons following completion of activities. Provide for follow-up treatments based on inspection results.

Inspect material sources at site of origin to ensure that they are free of invasive plant material before use and transport to the extent practicable. If possible, treat contaminated material before any use.

Revegetation

During excavation, any topsoil would be saved and replaced as the top layer after trenches are filled. Areas disturbed for access purposes or during construction would be regraded to their original contours. When necessary, compacted areas, such as access roads, staging, and stockpile areas would be loosened to facilitate revegetation and improved infiltration. Disturbed areas would be planted with a native seed mix appropriate to the habitat. Revegetation practices would follow NRCS's Oregon and Washington Guide for Conservation Seedings and Plantings (NRCS 2000). Costs of revegetation are included in project installation cost estimates.

Wildlife

In appropriate cases and under consultation with U.S. Fish and Wildlife Service, ramps would be placed in open trenches during construction to avoid the potential for wildlife to become trapped overnight.

During construction, terrestrial wildlife could experience noise disturbance due to heavy equipment operation and habitat disturbance due to vegetation and soil clearing and grading. Most construction would occur in agricultural areas where heavy equipment use is commonplace; therefore, most wildlife in the area is accustomed to noise and these disturbances are anticipated to be minor.

Wintering or migrating birds would be minimally affected by construction disturbance because they have the flexibility to move away from disturbances to other suitable areas. There would be temporary moderate adverse effect on breeding migratory songbirds or water birds due to construction activities occurring withing the nesting season, which lasts from March 1 to August 31. To minimize adverse effects, prior to starting construction, the construction zone would be surveyed for active nests by a biologist qualified to follow the U.S Fish and Wildlife Service and the Oregon Department of Fish and Wildlife survey protocols. If nesting is occurring in or near the construction area, the biologist would work with the contractor to monitor the nest and confirm that chicks have fledged. Construction would commence after young chicks have fledged, or construction clearance has been received from Oregon Department of Fish and Wildlife.

The District would follow U.S. Fish and Wildlife Service guidelines to ensure minimal disturbance to bald or golden eagles nesting near the project area. The critical nesting period for bald and golden eagles in the planning area and vicinity is December 1 through August 31. North Canal in the northern half of the Project is adjacent to known golden eagle nesting sites located to the north of the planning area. Therefore, a seasonal restriction on the use of high noise equipment is in effect for construction in the northern part of the planning area. Additionally, pre-clearance surveys would occur prior to construction to verify the presence or absence of golden eagles in the area. These surveys would be consistent with U.S. Fish and Wildlife Service survey guidelines.

In the long-term, faster moving water of a higher quality in District waterways would potentially provide improved water quality and habitat for wildlife and bird species that may use canals as a water source. Additionally, the Modernization Alternative implementation would provide increased flows to LKNWR which is in critical need of receiving more water to support aquatic habitat for

migratory birds. Improved water flow would allow more consistent access to water for hydrophytic plants and aquatic organisms, and this could in turn enhance riparian wildlife habitat of LKNWR.

Construction activities related to fish screen installation would cause short-term, negligible adverse effects on wildlife due to increased human presence and initial clearing and grubbing of habitat.

Cultural Resources

If archaeological resources were inadvertently discovered during construction, an Inadvertent Discovery Plan would be followed. Construction would stop in the vicinity of the discovery, the area would be secured and protected, a professional archaeologist would assess the discovery, consultation with State Historic Preservation Office and NRCS cultural resources staff would occur as appropriate, and the appropriate tribes would be notified. Continuation of construction would occur in accordance with applicable guidance and law.

Land Rights and Easements

Prior to construction, the District would communicate with landowners and obtain necessary easement agreements or land acquisitions for North Canal Fish Screen, North Canal Extension, and SCADA. Following project installation, as-built surveys would be completed and attached to easements.

E.12 Guiding Principles (USDA 2017)

The Guiding Principles identified in the PR&G are considered when developing and evaluating alternatives, as described below:

Healthy and Resilient Ecosystems	A primary objective of the PR&G analysis is the identification of alternatives that protect and restore the functions of ecosystems. Alternatives should first avoid adverse impact. When environmental consequences occur, alternatives should minimize the impact and mitigate unavoidable damage. If damage occurs, mitigation to offset environmental damage must be included in the alternative's design and costs.
Sustainable Economic Development	Alternatives for resolving water resources problems should improve the economic well-being of the Nation for present and future generations. The PR&G analysis considers the effects of alternatives on both water availability and water quality to evaluate the sustainability of economic activity and ecosystem services. Water use or management factors that provide improved sustainability or reduced uncertainty should be identified in alternatives.

Floodplains	The PR&G seek to avoid unwise use of floodplains and flood prone areas. Alternatives should avoid investments that adversely affect floodplain function, such that the floodplain is no longer self-sustaining. If an alternative impacts floodplain function, then the alternative should describe efforts to minimize and mitigate the impact and the residual loss of floodplain function. The PR&G investment evaluation of alternatives must be consistent with Executive Order 11988 of May 24, 1977 (Floodplain Management), as modified by Executive Order 13690 of January 30, 2015 (Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input), and the Federal Flood Risk Management Standard, which require executive departments and agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. The PR&G investment evaluation is informed by the processes to evaluate the impacts of Federal actions affecting floodplains consistent with Executive Order 11988, as amended.
Public Safety	An objective of the PR&G is to reduce risks to people, including life, injury, property, essential public services, and environmental threats concerning air and water quality. These risks to public health and safety must be evaluated and documented for all alternatives, including those using nonstructural approaches. The residual risks to public health and safety associated with each of the water investment alternatives should be described, quantified if possible, and documented.
Environmental Justice	An objective of the PR&G investment evaluation process is the fair treatment of all people including meaningful involvement in the public comment process. Any disproportionate impact to minority, Tribal, and low-income populations should be avoided. In implementing the PR&G, agencies should seek solutions that would eliminate or avoid disproportionate adverse effects on these communities. For watershed investments, particular attention should be focused to downstream areas. The study area may need to be reexamined to include the concerns of affected communities downstream of the immediate investment area. The PR&G process should document efforts to include the above-mentioned populations in the planning process. The PR&G process must be in compliance with Executive Order 12898 of February 11, 1994 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations). Applications of the PR&G process in USDA agencies must be in compliance with USDA DR 5600-002 (Environmental Justice).

Watershed Approach	A watershed approach must be used when completing a PR&G analysis. This approach recognizes that there may be upstream and downstream impacts of a water resources activity that may be outside of the applicable political or administrative boundaries. A watershed approach is not necessarily limited to analyzing impacts within a specific hydrologic unit. Rather, it is broad, systems-based framework that explicitly recognizes the interconnectedness within and among physical, ecological, economic, and social/cultural systems. A watershed approach enables examination of multiple objectives, facilitates the framing of water resources problems, incorporates a broad range of stakeholders, and allows for identification of interdependence of problems and potential solutions. In many instances, a specific hydrologic unit may be the appropriate scale to examine alternatives to address water resources problems and opportunities. In this case, the watershed would become the study area. In other cases, environmental, economic, or social conditions may merit a study area that is combination of various hydrologic units or other geographic groupings. Ideally, the area of analysis should represent a geographical area large enough to ensure plans address cause and effect relationships among affected resources, stakeholders, and investment options, both upstream and downstream of an investment site. The watershed approach also establishes the framework to examine cumulative effects and the interaction of a potential Federal investment with other water resources projects and programs. When considering the impact of Federal investments against some economic and ecological measures, the analysis may need to be expanded to include regional markets and habitat considerations beyond the initial study area (e.g., beyond the immediate hydrologic unit).

E.13 References

California Invasive Plant Council (CalIPC). (2022). CalWeedMapper. Report for Lower Klamath National Wildlife Refuge. Available at: https://www.cal-ipc.org/resources/calweedmapper/. Generated May 11, 2022.

Carter. K. and S. Kirk. 2008. Fish and Fishery Resources of the Klamath River Basin. North Coast Regional Water Quality Control Board, Oregon Department of Environmental Quality. July 2008.

Council on Environmental Quality (CEQ). (1997). Environmental Justice, Guidance Under the National Environmental Policy Act. Available at: https://www.epa.gov/sites/default/files/2015-02/documents/ej_guidance_nepa_ceq1297.pdf. Accessed April 2022.

Environmental Protection Agency (EPA). (2020). Environmental Justice Screening and Mapping tool. Website: https://ejscreen.epa.gov/mapper/. Accessed November 1, 2021.

iMapInvasives. (2022). NatureServe's Online Data System Supporting Strategic Invasive Species Management. Available at: https://www.imapinvasives.org/. Accessed April 13, 2022.

Klamath Drainage District (KDD). (2022). Site Tour. Observations and Notes from Taya K. MacLean. Parametrix (May 3, 2022)

National Oceanic and Atmospheric Administration and National Marine Fisheries Service (NOAA NMFS). (2022). Protected Resources App. Available at: https://www.webapps.nwfsc.noaa.gov/portal/apps/webappviewer/index.html?id=7514c715b8594944a6e468dd25aaacc9. Accessed April 13, 2022.

Natural Resource Conservation Service (NRCS). (2000). Oregon and Washington Guide for Conservation Seedings and Plantings. Available at: https://efotg.sc.egov.usda.gov/references/public/OR/OR_WA_seeding_guide.pdf. Accessed April 2022.

Oregon Biodiversity Information Center (ORBIC). (2022). Rare, Threatened and Endangered Species in the Vicinity of Project Area. Institute for Natural Resources, Portland State University, Portland, Oregon. 18 pp. Generated April 19, 2022.

Oregon Department of Fish and Wildlife (ODFW). (2022). Oregon Fish Habitat Distribution and Barriers web map. Available at: https://nrimp.dfw.state.or.us/FHD_FPB_Viewer/index.html. Accessed in April 2022.

PacifiCorp. (2021). 2021 Integrated Resource Plan. Available at: https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021-irp/Volume%20I%20-%209.15.2021%20Final.pdf. Accessed April 2022.

StreamNet Mapper. (2023). Explore Fish Distribution and Abundance Data. Available at: https://psmfc.maps.arcgis.com/apps/webappviewer/index.html?id=3be91b0a32a9488a901c3885bbfc2b0b. Accessed June 13, 2023.

U.S. Census Bureau. (2020). American Community Survey 2016-2020. Available at: https://data.census.gov/cedsci/table?t=Employment%20and%20Labor%20Force%20Statu

s&g=0500000US06093,41035_1400000US06093000200,41035970700,41035970800_1600000US4101850,4139700. Accessed April 2022.

U.S. Department of Agriculture (USDA). (2017). Guidance for conducting analyses under the principles, requirements, and guidelines for water and land related resources implementation studies and federal water and resource investments. DM 9500-013. Available at: https://www.usda.gov/directives/dm-9500-013.

U.S. Fish & Wildlife Service (USFWS). (2016). Lower Klamath, Clear Lake, Tule Lake, Upper Klamath, and Bear Valley National Wildlife Refuges Final Comprehensive Conservation Plan/Environmental Impact Statement Volume 2 – Appendices (A-L). December 2016.

U.S. Fish & Wildlife Service (USFWS). (2022). IPaC Resource List for the Klamath Drainage District Infrastructure Modernization Project Location. Generated on May 2, 2022.

U.S. Fish & Wildlife Service (USFWS). (2023). National Wetlands Inventory (NWI), Online Wetlands Mapper. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Available at: http://www.fws.gov/wetlands/Data/Mapper.html. Accessed June 13, 2023.