

Quincy-Columbia Basin Irrigation District W61F

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Table of Contents

| | |
|--|----|
| Executive Summary..... | 2 |
| Background Data..... | 3 |
| Technical Project Description and General Overview..... | 4 |
| Evaluation Criteria..... | 4 |
| Evaluation Criterion A: Water Conservation..... | 4 |
| Evaluation Criterion B: Water Supply Reliability..... | 6 |
| Evaluation Criterion C: Implementing Hydropower..... | 9 |
| Evaluation Criterion D: Complementing On Farm Improvements..... | 9 |
| Evaluation Criterion E: Department of Interior Priorities..... | 9 |
| Evaluation Criterion F: Implementation and Results..... | 10 |
| Evaluation Criterion G: Nexus to Reclamation Project Activities..... | 11 |
| Evaluation Criterion H: Additional Non Federal Funding..... | 11 |
| Project Budget..... | 12 |
| Funding Plan..... | 12 |
| Budget Proposal..... | 12 |
| Environmental and Cultural Resources Compliance..... | 14 |
| Required Permits or Approvals..... | 16 |
| Official Resolution..... | 17 |

Appendix

- Columbia Basin Water Conservation Plan
- MOU

Executive Summary

Application Date: March 15, 2019

Applicant Name: Quincy-Columbia Basin Irrigation District

Location: Grant County

State: Washington State

Estimated Project Timeframe: October 2019 through April 2020

Location: United States Bureau of Reclamation's Columbia Basin Project; a Federal Facility

The Quincy-Columbia Basin Irrigation District (District) operates in east central Washington State. It is one of three irrigation districts which operate and maintain facilities on the United States Bureau of Reclamation's Columbia Basin Project. The District provides water to over 250,000 irrigated acres of farmland. An average of 1.39 million acre-feet of water is diverted and pumped into the Quincy-Columbia Basin Irrigation District's main canal each year from the Columbia River at Grand Coulee Dam.

The District proposes to line 8,750 feet of the W61F, conserving 1,657 acre-feet annually. The total cost to implement the proposed lining project is \$832,400. Of this amount, \$532,400 has been committed by the District. Reclamation's investment of \$300,000 would complete the funding that we need to complete this project.

Water conservation on the Project is essential to Reclamation's ability to deliver needed quantities of water and power to agricultural, tribal, municipal, and industrial water users and for environmental flows. The District, along with the East and South Columbia Basin Irrigation Districts, the Washington State Department of Ecology, and the Washington Department of Fish and Wildlife have developed a coordinated water conservation plan to allow additional acreage to be served, while remaining water budget neutral on the Columbia River.

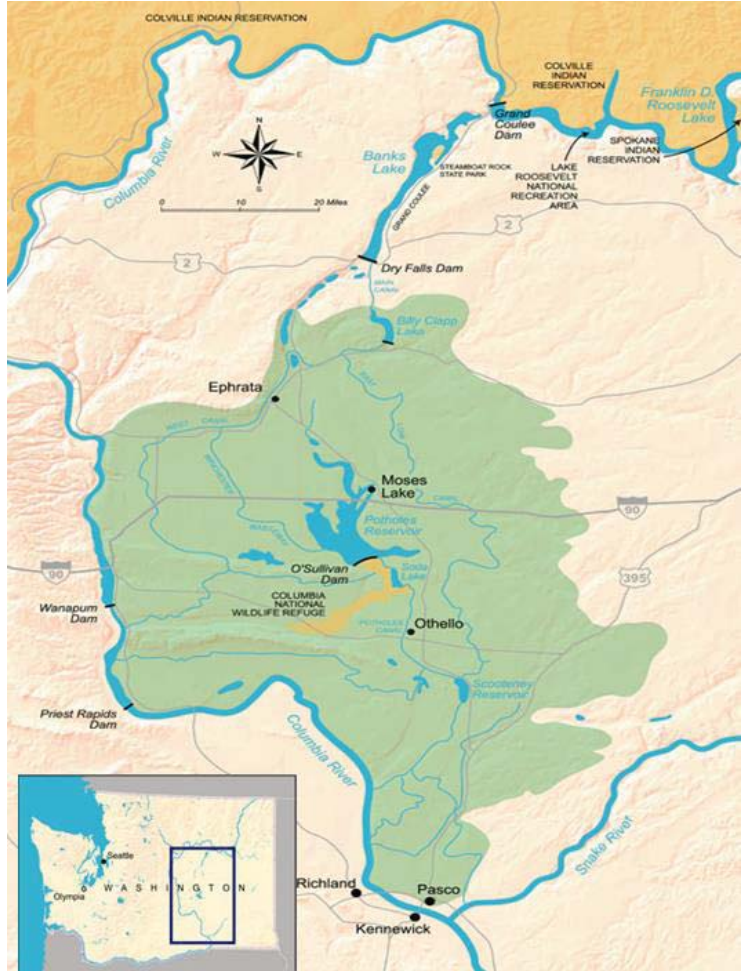
Water conservation and energy savings has substantial economic and environmental value to addressing long-term regional issues such as climate change and endangered species issues and the associated economic and environmental impacts.

Background Data

The Quincy-Columbia Basin Irrigation District (District) is located in east central Washington. The Columbia Basin Project serves approximately 671,000 acres of farmland. Water is pumped uphill from Lake Roosevelt behind Grand Coulee Dam into Banks Lake Reservoir where it is diverted onward through over 300 miles of main canals and about 6,000 miles of laterals, drains, and wasteways. Water is primarily used for irrigation, but in limited circumstances is used for municipal and industrial purposes. Over 90 different crops are grown with apples, wheat, and corn being the largest value crops. Other benefits of the Columbia Basin Project include recreation, created habitat, flood control, and power generation.

The Quincy-District Headquarters is located in Quincy, Washington approximately 17 miles west of Ephrata, Washington. The District operates and maintains a portion of the Columbia Basin Project, under contract with the Bureau of Reclamation's Ephrata Field Office. The District's main canal is 89 miles long in addition to several thousand miles of laterals, wasteways, and drains. The Quincy-District serves over 250,000 acres of farmland. The 5-year average for water diverted to the Quincy-District from the Columbia River is 1,397,000 acre feet.

In an effort to conserve water, the District has entered into agreements with the East and South Columbia Basin Irrigation Districts, the Washington State Department of Ecology, the Washington Department of Fish and Wildlife, and the federal Bureau of Reclamation to allow additional irrigation acreage to be served, while remaining water budget neutral in the Columbia River. Long-term planning is essential to solve future water resource problems such as project water shortages caused by drought.



Technical Project Description

The District has identified water conservation opportunities and ranked them in order of priority based on water loss. This project will install concrete lining over a geomembrane liner in the W61F lateral to eliminate water loss and meet performance goals in the District's Coordinated Water Conservation Plan. Approximately 8,750 feet of earthen canal will be lined. Construction work will be performed by a contractor. The District has developed project specifications and will provide construction oversight.

Evaluation Criteria

Evaluation Criterion A – Quantifiable Water Savings

Describe the amount of estimated water savings.

The estimated amount of water expected to be conserved as a direct result of this project is 1,657 acre-feet per year.

Describe current losses.

The water that will be conserved is currently seeping into the ground.

Describe the support/documentation of estimated water savings.

Water savings were estimated using previous methodologies established by the Quincy-Columbia Basin Irrigation District's Coordinated Water Conservation Plan (attached). The following formula was used for determining the annual seepage loss:

$$\text{Seepage Loss (acre-feet/yr)} = \text{Seepage Rate (ft/day)} * \text{Wetted Perimeter (ft)} * \text{Length (ft)} * 210 \text{ (days)} / 43,560 \text{ (ft}^3\text{/ac-ft)}$$

The seepage rate used depends on the underlying geology. Average seepage rates for different geologic units were determined. Those rates were accepted by the Washington State Department of Ecology and Bureau of Reclamation for use in estimating water conserved in past conservation projects. Table 1 presents those seepage rates by geologic unit.

Table 1
Estimated Seepage Rates by Geologic Unit

| Geology | Seepage Rate (ft/day) | | |
|--|-----------------------|-------|-------|
| | Unlined | Lined | Piped |
| Outburst flood deposits, gravel (Qfg) | 2.0 | 0.2 | 0 |
| Outburst flood deposits, sand and silt (Qfs) | 1.5 | 0.2 | 0 |
| Continental sedimentary rocks (PLMc) | 0.73 | 0.2 | 0 |
| Wanapum basalt (Mv) | 0.99 | 0.2 | 0 |
| Loess (Ql) | 2.24 | 0.2 | 0 |
| Alluvium (Qa) | 1.7 | 0.2 | 0 |
| Dune sand, stabilized dunes (Qds)* | 2.24 | 0.2 | 0 |

The soil characteristics are a mix of Wanapum basalt and Loess in the W61F lateral.

Using the equation in the Coordinated Water Conservation Plan:

$$\text{Seepage Loss} = (1.75 \text{ ft/day})(22.45 \text{ feet})(8,750 \text{ feet})(210 \text{ days}) / (43,560 \text{ cubic feet/ac-ft}) =$$

1,657 acre feet per year

The expected post-project seepage loss is zero. These reductions will be verified with an acoustic Doppler water velocity measurement device.

A description of materials being used include:

3.5" slip form concrete canal lining with minimum compression strength of 3,500 psi at 28 days

The Contractor shall furnish and place all materials for use in concrete, including cement, water, sand, coarse aggregate, specified admixtures and materials for curing concrete. Pozzolan, as specified, is an acceptable partial replacement for cement and may be used to replace 20 percent by weight of cement. The shotcrete shall meet the following requirements:

Portland cement shall meet the requirements of ANSI/ASTM C 150 for type II cement and shall meet the low-alkali and false-set limitations.

Pozzolan shall meet the requirements of ANSI/ASTM C 618 for class N, F, or C.

Water shall be free from objectionable quantities of silt, organic matter, salts, and other impurities.

Sand and coarse aggregate shall meet all requirements of ANSI/ASTM C 33.

Air-entraining admixture. The air-entraining admixture shall conform to ANSI/ASTM C 260.

Chemical admixtures which conform to ANSI/ASTM C 494, type A, or D.

Accelerator shall conform to ANSI/ASTM C 494 for type C, or E, chemical admixtures.

Curing compound shall conform to ASTM C309 Type 1-D, Class B.

HDPE geotextile liner

The Contractor shall furnish and install HDPE geotextile with a 6-ounce per square yard nonwoven polyester geotextile laminated on each face of the material.

The material shall meet the following requirements:

| Properties for Geocomposite Liner | | |
|--|--------------------|-----------------------|
| Property | Test Method | Values |
| Mass per Unit Area | ASTM D-5261 | 18 oz/yd ² |
| Membrane Thickness | ASTM D-5199 | 20 mils |
| Grab Tensile Strength (MD) | ASTM D-4632 | 300 lbs |
| Grab Elongation (MD) | ASTM D-4632 | >50% |
| Trapezoidal Tear Strength (MD) | ASTM D-4533 | 100 lbs |
| Puncture Strength (5/16 Pin) | ASTM D-4833 | 175 lbs |
| Permeability | ASTM D-449 | Non-measurable |

The liner shall be placed over the prepared subgrade in such a manner to ensure minimum handling. The rolls shall be of maximum size and shall be placed in such a manner as to minimize seaming.

Evaluation Criterion B – Water Supply Reliability

Explain and provide detail of the specific issues in the area that is impacting water reliability:

The three Columbia Basin Project irrigation districts (Quincy-Columbia Basin Irrigation District, East Columbia Basin Irrigation District, and South Columbia Basin Irrigation District), the Washington State Department of Ecology, the Washington State Department of Fish and

Wildlife, and the United States Bureau of Reclamation entered into a 2004 Memorandum of Understanding to address regional water reliability concerns.

The parties agreed to use their best efforts to work collaboratively and in good faith to secure economic and environmental benefits from improved water management both within the federal Columbia Basin Project and along the mainstem Columbia River. The parties agreed to advance actions to address water storage, drought relief, reservoir operations, and groundwater issues that impact regional power production, municipal water supplies, irrigation development, and improved stream flows to assist salmon recovery.

Describe how the project will address the water reliability concern:

The conserved water will be available as a replacement water supply for groundwater deliveries in the Odessa Subarea, environmental uses, and for municipal and industrial supply while remaining water budget neutral to the Columbia River.

Provide a description of the mechanism that will be used to put the conserved water to the intended use and indicate the quantity of conserved water that will be used for the intended purpose.

Water conservation projects implemented by the Quincy-Columbia Basin Irrigation District allow 100% of the water conserved to be used for actions identified in the MOU and Columbia Basin Project Coordinated Water Conservation Plan.

Will the project benefit multiple sectors and or users?

Conserved water will be available as a replacement water supply for groundwater deliveries in the Odessa Subarea, environmental uses, and municipal and industrial water supply.

Will the project benefit species?

Conserved water will be used to meet the water needs of growing communities and their rural and agricultural economies along the mainstem of the Columbia River and do so in a manner that reduces the risk to endangered salmon and steelhead resulting from out-of-stream use of water.

Will the project benefit a larger initiative to address water reliability?

The project will help meet the goals of the Coordinated Water Conservation Plan which was jointly prepared by the Quincy-Columbia Basin Irrigation District, East Columbia Basin Irrigation District, South Columbia Basin Irrigation District, and the Washington Department of Ecology. The project will also help meet the goals of the 2004 Memorandum of Understanding concerning the State of Washington's Columbia River Initiative entered into by the three districts, Bureau of Reclamation, the Washington Department of Ecology, and the Washington Department of Fish and Wildlife.

Will the project benefit Indian Tribes?

The 2004 MOU between the three irrigation Districts, Ecology, Fish and Wildlife, Reclamation along with an agreement in principal with the Confederated Tribes of the Colville Reservation, under the Columbia River Initiative, served as the basis for creating the Columbia River Water Management Program.

Will the project benefit rural or economically disadvantaged communities?

Water conservation will help meet the needs of growing communities and their rural and agricultural economies along the mainstem of the Columbia River. The 2004 MOU and Coordinated Water Conservation Plan identified water conservation as a way to secure economic and environmental benefits along the mainstem of the Columbia River and within the federal Columbia Basin Project.

Describe how the project will help to achieve multiple benefits.

The 2004 MOU and Coordinated Water Conservation Plan identified water conservation as a way to secure economic and environmental benefits along the mainstem of the Columbia River and within the federal Columbia Basin Project. The benefits identified in these plans are numerous and include providing support for salmon recovery, water storage, drought relief, municipal and industrial water supply, and operational benefits.

Does the project promote and encourage collaboration?

The project encourages collaboration between the three Columbia Basin Project Irrigation Districts, the Washington State Department of Ecology, the Department of Fish and Wildlife, and the Bureau of Reclamation to address and achieve regional water conservation goals.

Is there widespread support for the project?

There is widespread support for the project which includes the signatories on the 2004 MOU and coordinated water conservation plan. Signatories include the three Columbia Basin Irrigation Districts, the Washington State Department of Ecology, and the Washington State Department of Fish and Wildlife.

What is the significance of the Collaboration?

Collaboration among the parties helps achieve regional water conservation goals as set forth in the Coordinated Water Conservation Plan. Goals include water storage, drought relief, municipal and industrial water supply, ground water replacement, fish and wildlife protection, and better water management.

Is the possibility of future water conservation improvements by other water users enhanced by this project?

Successful implementation will make future water conservation improvements by other water users enhanced by demonstrating the ability to successfully implement components of the Coordinated Water Conservation Plan. The parties agreed to use their best efforts in working collaboratively and in good faith to secure economic and environmental benefits.

Will the project help prevent a water-related crisis or conflict?

The Coordinated Water Conservation Plan was developed to address action items in the 2004 MOU between the districts, Ecology, Fish and Wildlife, and the Bureau of Reclamation. The 2004 MOU describes the ways in which all parties will work collaboratively and in good faith to secure economic and environmental benefits through improved water management to avoid future conflict.

Frequent litigation has occurred such as involving the Federal Columbia River Power System Biological Opinion which includes Bureau of Reclamation facilities. Water conservation will help address Biological Opinion action items listed in the BiOp, such as to provide adequate flows for Endangered Species Act salmon and steelhead.

Describe the roles of any partners in the process.

The 2004 MOU and Coordinated Water Conservation Plan are attached. The rolls of all partners are to work collaboratively to address regional goals within the federal Columbia Basin Project and along the mainstem of the Columbia River.

Will the project address water supply reliability in other ways not described above?

Water conservation will help support the Odessa Subarea. The Odessa aquifer is declining and the parties in the 2004 MOU agreed to cooperate to support and pursue the diversion and delivery of additional water to supplement the declining groundwater.

Evaluation Criterion C – Implementing Hydropower

Not Applicable

Evaluation Criterion D – On-Farm Irrigation Improvements

Not Applicable

Evaluation Criterion E – Department of Interior Priorities

This project supports the Department of the Interior priority of modernizing infrastructure. The irrigation system carried and delivered water from Grand Coulee Dam starting in 1952. Many of the canals on the Columbia Basin Project were not lined with concrete or other impervious surfaces. Many benefits are achieved by modernizing the United States Bureau of Reclamation's infrastructure such as water and energy conservation, canal safety, and operation and maintenance efficiencies, and aquatic pesticide use reductions.

Evaluation Criterion F – Implementation and Results

Does the applicant have a Water Conservation Plan and/or System Optimization Review in place?

Copies of the 2004 MOU between the three Columbia Basin Irrigation Districts, state Department of Ecology, state Fish and Wildlife, and Bureau of Reclamation and the Coordinated Water Conservation Plan between the state Department of Ecology and the three districts have been attached.

Identify district-wide planning.

The District maintains a system improvement list which factors in water loss, safety, and other factors to prioritize infrastructure projects.

Describe how the project conforms to and meets the goals of any planning efforts.

The project helps meet the goals of the Coordinated Water Conservation Plan which is to find ways to conserve water along the mainstem of the Columbia River and on the federal Columbia Basin Project to support regional priorities.

Provide a summary describing performance measures that will be used to quantify actual benefits upon completion of the project.

The performance measure will be water loss which will be determined by inflow outflow testing after the completion of the project. It is expected that the water loss will be near zero after the completion of this project. Water conservation project results are reported on the Quincy-Columbia Basin Irrigation District's website.

Describe the implementation plan of the proposed project.

The project will be completed between October 2019 and March 2020 when irrigation canals are dewatered.

Describe any permits that will be required.

No permits are required.

Identify and describe any engineering or design work performed specifically in support of the proposed project.

The Quincy-Columbia Basin Irrigation District engineering department has designed the project.

Describe any new policies or administrative actions required to implement the project.

The Quincy-Columbia Basin Irrigation District Board of directors have approved a resolution to apply for Funding Opportunity Announcement No BOR-DO-19-FOO4 and to complete the project if funding is awarded.

Evaluation Criterion G – Nexus to Reclamation Project

Does the applicant receive Reclamation project water?

Yes, the Quincy-Columbia Basin Irrigation District receives approximately 1,397,000 acre-feet of Reclamation project water each year.

Is the project on Reclamation project lands or involving Reclamation facilities?

Yes, the project is on Reclamation project lands and involves Reclamation facilities.

Is the project in the same basin as a Reclamation project or activity?

Yes, the project is within Reclamation's Columbia Basin Project.

Will the proposed work contribute water to a basin where a Reclamation project is located?

Yes, the work will contribute water to Reclamation's Columbia Basin Project.

Evaluation Criterion H – Additional Non-Federal Funding

Non Federal Funding / Total Project Cost = $(532,400/832,400)*100 = 64\%$

Project Budget

Funding Plan

The District’s contribution to the cost-share requirement will be \$610,000 and will be monetary. Though this project will utilize a significant amount of District employee time, no in-kind contributions or other source funds will be accounted for toward the grant. The District will fund 67% of the project. This expense will cover contract construction costs and materials.

| Funding Sources | Funding Amount |
|---|-----------------------|
| Non-Federal Entities (Quincy-Columbia Basin Irrigation District) | |
| Contract Lining & Piping, Environmental Review | \$ 532,400 |
| Non-Federal Entities Subtotal | \$ 532,400 |
| Non-Federal subtotal | \$ - |
| Other Federal Entities Subtotal | \$ - |
| Requested Reclamation Funding Subtotal | \$ 300,000 |
| | |
| Total Project Funding | \$ 832,400 |

Budget Proposal

To simplify accounting procedures and reduce the cost of grant management, the District is only applying construction and environmental review toward the grant. It is expected that a significant amount of staff time, overhead, and indirect costs will occur on this project, but the District is only budgeting contracting / construction costs toward the grant. All other costs will be paid for out of the District’s general operating budget.

| Funding Sources | Percent of Total Project Cost | Total Cost by Source |
|--------------------------------------|--------------------------------------|-----------------------------|
| Costs paid by Applicant | 64 % | \$ 532,400 |
| Cost reimbursed with Federal Funding | 36 % | \$ 300,000 |
| Other funding | 0 % | \$ 0 |
| Totals | 100 % | \$ 832,400 |

| Budget Item & Description | \$/Unit | | Quantity | Total Cost |
|---------------------------------------|---------|----|----------|-------------------|
| Salaries & Wages | | | | |
| not putting toward grant | \$0 | hr | 0 | \$0 |
| Fringe Benefits | \$0 | hr | 0 | \$0 |
| Contractual & Construction | | | | |
| *See Construction Detail Below | 1 | | 1 | * \$812,400 |
| Other | | | | |
| Reporting | 1 | | 1 | \$ 0 |
| Environmental & Regulatory | 1 | | 1 | \$ 20,000 |
| Indirect Costs | | | | \$ 0 |
| Total | | | | \$ 832,400 |

***Contractual & Construction breakdown**

| Quincy-Columbia Basin Irrigation District W61F Materials Cost Estimate 7 Foot Bottom Width Thursday, March 7, 2019 By JSM | | | | |
|--|--|------|--------------|-----------|
| Quantity | Item | Unit | Price | Total |
| 1 | Mobilization | EA | \$ 60,000.00 | \$60,000 |
| 12,250 | Mass/Common Excavation | CY | \$ 2.50 | \$30,625 |
| 2,000 | Native Common Backfill | CY | \$ 3.00 | \$6,000 |
| 1 | Lateral Subgrade Preparation | EA | \$ 5,000.00 | \$5,000 |
| 254,315 | Geomembrane Liner Furnished | SF | \$ 0.46 | \$116,985 |
| 254,315 | Geomembrane Liner Installed | SF | \$ 0.30 | \$76,295 |
| 2,250 | Concrete Liner Furnished and Installed | CY | \$ 225.00 | \$506,250 |
| 1 | Final Site Grading | EA | \$ 2,500.00 | \$2,500 |
| 218,750 | Hydro Seed Furnished and installed | SF | \$ 0.04 | \$8,750 |
| | Subtotal | | | \$812,404 |

Salaries and Wages

Project planning and engineering will be conducted by the District's Technical Service Manager, District Engineer and Operation and Maintenance Field Supervisors. Additional administrative work may be needed. The District is not including these costs toward the project to simply grant management and they are not reflected in the budget. These expenses will be paid out of the Districts general operating budget.

Fringe Benefits

There will be no fringe benefits to report.

Travel

There will be no travel to report.

Equipment

No equipment will be purchased.

Materials and Supplies

No materials and supplies will be purchased.

Contractual

The installation of the concrete and geomembrane liner will be performed by a contractor. Cost of work is estimated based on prior District projects.

Environmental and Regulatory Compliance Costs

There are no environmental permits required for the completion of the project. A line item has been included in the budget to cover cost incurred to determine the level of environmental compliance required for the project.

Other Expense

There will be no other expenses.

Indirect Costs

No indirect costs will be included in the grant.

Total Costs

Total project total cost is expected to be \$832,400.

Environmental and Cultural Resources Compliance

Cultural resources and historic preservation act compliance have already been completed for this project.

- 1) Will the project impact the surrounding environment (e.g., soil [dust], air, water [quality and quantity], animal habitat)? Please briefly describe all earth-disturbing work and any work that will affect the air, water, or animal habitat in the project area. Please also explain the impacts of such work on the surrounding environment and any steps that could be taken to minimize the impacts.

The project will reshape a constructed irrigation lateral. Dust abatement may be needed. There are no known impacts to air and water quality or animal habitat.

- 2) Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project?

There are no known listed or proposed to be listed Federal threatened or endangered species, or designated critical habitat in the project area. This was verified by Reclamation's Ephrata Field Office.

- 3) Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as "waters of the United States?" If so, please describe and estimate any impacts the project may have.

There are no wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction.

- 4) When was the water delivery system constructed?

The water delivery system was constructed in 1966.

- 5) Will the project result in any modification of or effects to, individual features of an irrigation system (e.g., head gates, canals, or flumes)? If so, state when those features were constructed and describe the nature and timing of any extensive alterations or modifications to those features completed previously.

Modification to the irrigation canal system will occur. Earthen canal will be lined with geomembrane liner and concrete. Original irrigation features were constructed in 1966. There are no known prior extensive alterations or modifications to proposed project features.

- 6) Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places? A cultural resources specialist at your local Reclamation office or the State Historic Preservation Office can assist in answering this question.

There are no buildings, structures, or features listed or eligible for listing on the National Register of Historic Places. This was verified by Reclamation's Ephrata Field Office.

- 7) Are there any known archeological sites in the proposed project area?

There are no known archaeological sites in the proposed project area.

- 8) Will the project have a disproportionately high and adverse effect on low income or minority populations?

The project will not have a disproportionately high and adverse effect on low income or minority populations.

- 9) Will the project limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands?

There project will not limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands.

- 10) Will the project contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area?

The project will not contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area.

Required Permits or Approvals

There are no known required permits or approvals needed to complete the W61F canal lining project.

Official Resolution

QUINCY-COLUMBIA BASIN IRRIGATION DISTRICT

RESOLUTION 2019 - ||

WaterSMART Grant

WHEREAS, the Quincy-Columbia Basin Irrigation District is in receipt of the U.S. Bureau of Reclamation Funding Opportunity Announcement No. BOR-DO-19-F004, *WaterSMART: Water and Energy Efficiency Grants for FY 2019*; and

WHEREAS, the Quincy-Columbia Basin Irrigation District has legal authority to enter into a grant agreement with the U.S. Bureau of Reclamation; and

WHEREAS, the Board of Directors of the Quincy-Columbia Basin Irrigation District support the application submitted; and

WHEREAS, the Quincy-Columbia Basin Irrigation District is capable of providing the amount of funding and/or in-kind contributions specified in the funding plan; and

WHEREAS, the Quincy-Columbia Basin Irrigation District will work with the U.S. Bureau of Reclamation to meet established deadlines for entering into a cooperative agreement; and

WHEREAS, receiving financial assistance through a WaterSMART Grant does not subject the Quincy-Columbia Basin Irrigation District to the discretionary provisions of the Reclamation Reform Act of 1982;

NOW, THEREFORE, BE IT HEREBY RESOLVED by the Board of Directors that the Quincy-Columbia Basin Irrigation District is committed to the financial and legal obligations associated with receipt of WaterSMART Grant financial assistance.

DULY ADOPTED during the regular meeting of the Board of Directors this 5th day of March 2019.

BOARD OF DIRECTORS









ATTEST:



Secretary

APPENDIX:

Memorandum of Understanding Concerning the State of Washington's Columbia River Initiative

PARTIES

This Memorandum of Understanding (MOU) is entered into between the State of Washington (State), acting through the state agencies which are signatories hereto; the Pacific Northwest Region of the U.S. Bureau of Reclamation (Reclamation); and the South Columbia Basin Irrigation District, the East Columbia Basin Irrigation District, and the Quincy-Columbia Basin Irrigation District (collectively, the Districts). The State, Reclamation, and the Districts are collectively referred to as the "parties" herein.

EFFECT

Section 1. This MOU is intended only to coordinate and facilitate cooperation between the parties to advance the actions described in this MOU and is not intended to and does not create a legally binding contract or any right or benefit, substantive or procedural, enforceable at law or in equity by any party against another party, its directors, officers, employees or other persons.

This MOU does not constitute an explicit or implicit agreement by the parties to subject any of the parties to the jurisdiction of any federal or state court over and above any rights or procedures presently available to the parties. This MOU does not create any right or benefit, substantive or procedural, enforceable at law or in equity, by any person or entity against the parties. This MOU shall not be construed to create any right to judicial review involving the compliance or noncompliance of the parties with this MOU.

Section 2. Nothing in this MOU shall (a) result in any impairment to the existing water supplies or water rights for the Columbia Basin Project (Project), (b) result in an amendment or modification of the rights and obligations of the Districts and Reclamation under the existing Project repayment contracts, (c) affect the priority dates of any existing water rights, (d) impair the current operations of the Project, (e) impair or interfere with eventual completion of the Project as congressionally authorized, or (f) result in an increase in the Districts' construction cost obligations and operation and maintenance obligations under the existing Project repayment contracts.

PURPOSE AND OBJECTIVES

Section 3. The parties will use their best efforts in working collaboratively and in good faith to secure economic and environmental benefits from improved water management both within the federal Project and along the mainstem of the Columbia River by advancing the actions described in this MOU.

Section 4. Through the Columbia River Initiative (CRI), the State is developing a program for the mainstem of the Columbia River that will allow access to the river's water resources while

providing support for salmon recovery. The objectives of the CRI are to meet the water needs of growing communities and their rural and agricultural economies along the mainstem of the Columbia River, and to do so in a manner that reduces the risk to fish resulting from out-of-stream use of water. While the CRI is focused on the mainstem of the Columbia River, the State recognizes that there are important needs within the Project that remain unmet and that require and warrant increased attention and resources from the State. As established in state statute and state-based water rights, the parties hereby affirm their long-standing and mutual commitment to the Project as congressionally authorized.

MAINSTEM STORAGE PROGRAM

Section 5. The parties recognize the growing water needs of the region will require development and use of new water storage facilities that are properly designed, constructed and managed to meet both economic and environmental needs — including power production, municipal water supplies, irrigation development, and improved stream flows to assist salmon recovery.

Section 6. The parties will cooperate in initiating an appraisal level assessment of the potential to store additional water from the Columbia River mainstem, including an assessment of the costs and benefits of alternative water storage sites (the Storage Assessment). The State will be responsible for conducting the Storage Assessment with existing state funds. The State will, in consultation with other parties, develop a scope of work for the Storage Assessment by December 31, 2004. The State will also secure by February 28, 2005, a contractor to conduct the Storage Assessment. The State will request additional state funding for the Storage Assessment for the coming state fiscal biennium. Reclamation will participate in and support the Storage Assessment to the extent funding is available to it within its Washington Investigations budget line item in federal fiscal years 2005 and 2006, as determined by it.

Section 7. If and as warranted by the initial results of the Storage Assessment, the State and the Districts will propose by July 2005 federal legislation to authorize and fund a mainstem storage program, including feasibility studies by Reclamation for proposed storage projects; provided, however, the Districts may participate and support one or more of these feasibility studies, as they determine. By December 20, 2004, the State will submit a budget request to support the new mainstem storage program during the state 2005-2007 biennium to include funding for feasibility studies. Reclamation's position regarding the authorization and funding of the mainstem storage program and feasibility studies will be determined by the views of the Administration at the time Congress considers authorizing legislation and appropriations. If and as authorized by Congress, the State and Reclamation will negotiate and enter into one or more feasibility study contracts. If federal authorization is not secured by January 2006, the State will fund the initiation of one or more feasibility studies to evaluate potential new storage sites, while continuing to pursue federal authorization. By July 2006, the parties will develop a schedule of future milestones for the mainstem storage program.

Section 8. If and as warranted by the feasibility studies, the State and the Districts agree to pursue federal authorization of mainstem storage projects to be undertaken by Reclamation, with the State as local sponsor for the storage projects. As authorized and as necessary to support the

new mainstem storage program, or as specific storage projects are identified for feasibility studies, Reclamation and the State will work together to secure a new federal withdrawal of water from the mainstem pursuant to Chapter 90.40 RCW.

MAINSTEM DROUGHT RELIEF

Section 9. Reclamation and the State, acting through the Department of Ecology (Ecology), will use their best efforts to negotiate and enter into a contract by March 31, 2005 (the Drought Relief Contract), to make available up to 50,000 acre-feet from the Project storage rights from Lake Roosevelt for release into the Columbia River in any year in which the March 1 runoff forecast at the Dalles for April through September, as provided by the National Weather Service in their "Water Supply Outlook for the Western United States," is less than 60 MAF, and in which the Governor of the State of Washington makes a formal request in accordance with the Reclamation States Drought Relief Act of 1991 (P.L. 102-250) (the Drought Relief Act).

Section 10. The Drought Relief Contract, if entered into, will allow the use of the water to be made in accordance with applicable state and federal laws by existing water rights which divert from the Columbia River downstream of Grand Coulee Dam and to benefit fish in the Columbia River. Of the amount to be made available under the Drought Relief Contract, if entered into, up to 33,000 acre-feet would be made available for existing state-based water rights along the mainstem and up to 17,000 acre-feet would be made available for improving stream flows for fish during the drought. The Drought Relief Contract, if entered into, will be effective for a term not exceeding the maximum period authorized by law and will, as needed and if and when allowed by law, provide for renewal of the contract for a longer period of time.

Section 11. The parties acknowledge that the Drought Relief Act is set to expire on September 30, 2005, and that any subsequent renewals of the Drought Relief Contract, if entered into, will be contingent, in part, upon the Drought Relief Act being extended or otherwise reauthorized. The State and the Districts agree to seek and support favorable congressional action to extend or otherwise reauthorize the Drought Relief Act and to pursue authorization for drought relief contracts that could exceed the current two-year statutory limit. Reclamation's position will be determined by the views of the Administration at the time Congress considers any such extension, amendment or reauthorization. The State will request support for reauthorization of the Drought Relief Act from the Western States Water Council and the Western Governor's Association and will introduce federal legislation by no later than March 2005.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

Section 12. Reclamation and the State, acting through Ecology, will use their best efforts to negotiate and enter into a water service contract, in accordance with subsection 9(c) of the Reclamation Project Act of 1939 (53 Stat. 1187) by December 31, 2005 (the M&I Contract) to make available up to 37,500 acre-feet of water annually from the storage rights of the Project, of which up to 25,000 acre-feet would be available for municipal and industrial purposes and up to 12,500 acre-feet would be available to benefit stream flows and fish in the Columbia River.

Most of this water would be delivered to the State by Reclamation in the Columbia River at the foot of Grand Coulee Dam, though a smaller portion of this water would be made available for

direct withdrawal from Lake Roosevelt. Under the terms of the M&I Contract, if entered into, the State would accept this water and place it into the state trust water rights program as a water right for instream flow purposes to serve as mitigation for new water rights to be issued to qualifying municipalities and industries along the Columbia River.

Section 13. The term of the M&I Contract, if entered into, will be as allowed under federal reclamation law and policy and may be renewed as provided by the Act of June 21, 1963 (77 Stat. 68) pertaining to the renewal of certain municipal, domestic, and industrial water supply contracts entered into under the Reclamation Project Act of 1939. Allocation of water under the M&I Contract shall be in increments of time and quantity based on satisfactory performance in meeting the terms and milestones provided for the Odessa Subarea in Section 14 of this MOU. Water allocated for a given increment will be made available for the duration of the M&I Contract, while the remaining portion of the unallocated water will remain subject to satisfactory performance under this MOU. The initial increment for the contract will be the period of January 2006 through December 2007. Thereafter, the increments will run for a six-year period, to align water supply decisions with the next increment of municipal growth as projected through municipal water supply plans required by state law. These timeframes may be amended by the parties during negotiation of the contract. Release of future increments of water is subject to performance deemed satisfactory by all parties to this MOU. A decision to limit access to water under the contract based on unsatisfactory performance shall not result in loss of water previously committed and distributed under the contract. The amount of water available during the initial increment shall be specified in the contract, and the amount of water available for future increments shall be based on projected municipal and industrial water supply needs.

ODESSA SUBAREA

Section 14. The parties will cooperate to support and pursue the diversion and delivery of an additional 30,000 acre-feet of water from Lake Roosevelt to the Odessa Subarea. In an effort to satisfy this objective, Reclamation will file by March 2005 an application with the State for a water right permit to divert 30,000 acre-feet of water from the federal withdrawal and storage rights for the Project to serve the Odessa Subarea. The State will process the application and issue a permit decision by September 2005. If the permit decision is challenged, the State commits to active and good faith defense of the permit, with assistance from Reclamation and the Districts, as appropriate. The goal is to make up to 30,000 acre-feet of water available to the Odessa Subarea no later than December 2006 for use during the 2007 irrigation season. Use of this water is limited to existing agricultural lands, with priority for use on lands currently irrigated under state ground water permits in areas where the Odessa aquifer is declining. Lands receiving water under this section which are also covered by state ground water permits shall not divert water under the permits. This water is separate from and in addition to other ongoing programs to deliver water within the Project.

Section 15. In addition to the quantity of water described in Section 14, the parties will cooperate to explore opportunities for delivery of water to additional existing agricultural lands within the Odessa Subarea. As opportunities become known, the State will seek state funding to cost share the potential development of infrastructure to deliver this water. Reclamation's

position regarding the future delivery of water under this section will be determined by the views of the Administration at the time.

Section 16. In addition, the State will conduct an appraisal level assessment of the potential to store additional water from the Columbia mainstem in the Odessa aquifer (the Odessa Assessment). Reclamation will participate in the Odessa Assessment to the extent funding is available in its Washington Investigations program. The Districts will assist in evaluating the infrastructure implications of delivering water to the aquifer.

POTHOLES RESERVOIR OPERATIONS

Section 17. The parties will cooperate in completing by March 2006 an appraisal level assessment of alternatives for managing Potholes Reservoir, including an alternative water feed route, changes in the storage rule curves, improving the water evacuation route, and evaluating potential solutions to the delivery constraints of the East Low Canal below Interstate 90 (the Potholes Assessment). The parties will cooperate to develop and execute a study contract to define and assign the remaining tasks of the Potholes Assessment. As part of the Potholes Assessment, Reclamation will initiate by January 2005 an appraisal level analysis of the hydrology of Potholes Reservoir and the implications of changes in the feed route, increased seasonal storage and flood evacuation. The State will request funding for its 2005-2007 biennium to complete the Potholes Assessment. Reclamation and the Districts will make available, subject to Reclamation security policies, studies and cost estimates previously prepared for the Potholes feed and evacuation routes, and for the improvements to the East Low Canal.

Section 18. The purpose of the Potholes Assessment is to determine whether changes in operations could secure additional benefits without jeopardizing existing Project benefits. These additional benefits could include increased reliability of irrigation water supply, the ability to irrigate additional lands, improved water quality in Project reservoirs, increased fish and wildlife habitat within the Project, and reduced reliance on the Columbia mainstem during the summer months. The parties recognize that Potholes Reservoir is first and foremost a water supply for two of the Project districts, and agree that the actions under this MOU are not intended to, and shall not, jeopardize the reliability of this water supply. The parties further recognize that any evaluation of the reservoir must be conducted within the context of the overall Project, as the feed route, reservoir operations and evacuation route must be considered together, and that the reservoir is central to the proper functioning of the Project as a whole.

Section 19. If and as warranted by the results of the Potholes Assessment, the State and the Districts will pursue appropriate feasibility level studies, including the authorization and funding of feasibility studies by Reclamation. Reclamation's position regarding authorization and funding of such feasibility studies will be determined by the views of the Administration at the time Congress considers authorizing legislation and appropriations. The State will cost share in any such feasibility studies should Reclamation be authorized and funded to conduct the studies. The State will request feasibility study funds for the next state fiscal biennium. The tasks and responsibilities for feasibility studies will be specified by contract. If and as warranted by the results of such feasibility studies, the parties will work in good faith to develop and implement a

specific proposal for changes to the operation of Potholes Reservoir. Subject to congressional authorization, feasibility studies, if undertaken, would be completed by June 2008.

WATER FROM CANADA

Section 20. The parties acknowledge that the State will seek to secure, through the United States, water from Canadian reservoir storage facilities. The State and Reclamation will use their best efforts to cooperate in ensuring that water released from Canadian facilities is moved through Lake Roosevelt in an acceptable manner. In this regard, the State and Reclamation will consider whether a written agreement regarding the delivery of water from Canada through Lake Roosevelt would be desirable. If so, they will endeavor in good faith to negotiate and execute an operating agreement in this regard during calendar year 2005 and invite the Bonneville Power Administration to be a signatory to any such operating agreement.

ADDITIONAL PROVISIONS

Section 21. Reclamation will submit to the State a proof of appropriation form to request issuance of a state water right certificate for the perfected portions of the existing permit held by Reclamation for the Project. The State will issue a water right certificate reflecting the amount of Project water and land developed under the existing permit, and will issue a superceding permit for the amount of Project water and land that may continue to be developed under the superceding permit.

Section 22. In partial consideration of the State's contribution toward the Storage Assessment, the Potholes Assessment including an alternative feed route, improved evacuation route and solutions to East Low Canal delivery constraints, and the State's timely implementation and performance of other actions described in this MOU, the parties will cooperate to make available up to 15,000 acre-feet of water annually from the Project storage rights in Lake Roosevelt to benefit stream flows for fish. This water will be made available after December 2006. The timing of release of the water will be determined by Reclamation, in consultation with parties responsible for salmon recovery on the mainstem.

Section 23. The State will consult with the Colville Confederated Tribes and the Spokane Tribe of Indians regarding the CRI and will secure the concurrence of these tribal governments. Given the concurrence obtained by the State, Reclamation will be responsible for Government to Government consultation with the Tribes.

Section 24. The State will consult with NOAA Fisheries and the US Fish and Wildlife Service (USFWS) regarding the CRI and will obtain their concurrence. Given the concurrence obtained by the State, Reclamation will consult with NOAA Fisheries and USFWS as required by the Endangered Species Act.

IMPLEMENTING CONTRACTS

Section 25. Implementation of the actions described in this MOU is subject to the authority of the parties and the availability of funding as approved by the State Legislature and Congress and

will be undertaken pursuant to any contracts that may be subsequently entered into among the parties as described in this MOU. The contracts involving Reclamation as a party shall be prepared, negotiated, and executed in accordance with federal reclamation laws, rules and regulations, and policies.

Section 26. Any contracts prepared under this MOU shall be available for review by all parties to this MOU prior to execution of the contract. Where a party will not be a signatory to a contract, such party may request consultation with the other MOU parties to address any questions or concerns with a proposed contract. Any party requesting consultation concerning a contract shall be provided an opportunity for consultation before the contract is executed.

OVERSIGHT PANEL

Section 27. The parties will create an Oversight Panel to provide oversight and coordination for all aspects of this MOU. The Oversight Panel shall consist of one designated representative of each of the signatories to this MOU. The Oversight Panel's functions include, but are not limited to: (a) monitoring implementation of the actions set forth in this MOU, (b) tracking and reporting of performance by the parties under any contract executed under this MOU, (c) reviewing and evaluating, at least on an annual basis, this MOU and its implementation by the parties, and (d) resolving disagreements between the parties.

Section 28. In the event disagreements arise between the parties and cannot be resolved, any party to this MOU may request the Oversight Panel to attempt to resolve the disagreement. Within 45 days of any such request, the Oversight Panel shall notify the parties of its recommended proposal for resolving the disagreement; provided, however, such decision or proposal shall be advisory only and not binding on the parties.

GENERAL PROVISIONS

Section 29. The period of performance of this MOU shall commence on the date when it is signed by the last signatory. This MOU shall terminate on December 31, 2014, unless it is extended by mutual written consent of the parties. Termination of this MOU does not invalidate contracts executed under the MOU.

Section 30. Notwithstanding Section 29 above, any party desiring to terminate its participation in this MOU will give 90 days written notice to the other parties. Upon receipt of a notice of termination, the parties may meet or elect to convene the Oversight Panel within 45 days in a good faith effort to resolve any disagreements relating to the notice of termination. Termination by a party does not in any way invalidate contracts executed under this MOU; contracts may be terminated only through the provisions of the contract. Where one party terminates from this MOU, other parties may agree to continue to implement the MOU within the scope of their authority and funding.

Section 31. This MOU may only be amended by mutual written consent of the parties. No amendment shall be effective for any purpose unless it is made in writing and signed by authorized representatives of all the parties to this MOU.

Section 32. Notwithstanding any other provision of this MOU, the parties acknowledge that Reclamation's actions are subject to federal reclamation law, as amended and supplemented, and the policies, rules and regulations promulgated by the Secretary of the Interior under federal reclamation law; and applicable federal law, including but not limited to, the National Environmental Policy Act (NEPA), and the Endangered Species Act (ESA). NEPA compliance activities may include public scoping meetings and hearings, Fish and Wildlife Coordination Act and cultural resource consultations, and consultations with Tribes on Indian Trust Assets. ESA activities may include consultation with NOAA Fisheries and the USFWS.

Section 33. Notwithstanding any other provision of this MOU, the parties acknowledge that any contract executed under this MOU where Project benefits are afforded shall be subject to federal reclamation law, policies, and rules and regulations governing recovery of Project costs. The parties further acknowledge that the costs of development, review and approval of proposed actions, including but not limited to, environmental compliance activities, preparation, negotiation and execution of contracts, and any costs of mitigation determined to be required, shall be incurred by the benefiting contractor. Costs to the benefiting contractor may be mitigated by other enhancements or contributions that benefit the parties to this MOU, at the discretion of Reclamation. Any contract executed under this MOU that implements a joint federal and state program, as authorized and directed by federal law and funded through federal appropriations, shall be subject to federal cost sharing laws, policies and practices.

Section 34. The signatures of the Districts on this MOU shall not be interpreted as an acknowledgment or endorsement by the Districts of the technical conclusions and proposed policies of the State related to the Columbia River mainstem water management program, or in any way to be acceptance of or agreement with a "no net loss" policy for management of water resources in the Columbia River.

Section 35. As necessary to support budget development and legislative review of budget requests, the State and/or the Districts may request an estimate of costs for actions proposed under this MOU. Reclamation will provide estimates based on information available at the time of the request.

Section 36. All actions and schedules called for by this MOU are subject to and contingent upon the availability and allocation of future federal and state appropriations, existing and future limitations on a party's statutory authorities, and state and federal regulatory approvals as needed. The parties recognize that if any necessary authority and/or funding is not forthcoming, the schedules identified in this MOU will be reviewed and adjusted as necessary, by mutual consent.

Section 37. This MOU is executed in multiple originals, with one originally executed copy for each of the below signatories.

SIGNATORIES

William D. ... Dec 17, 2004
Director, Pacific Northwest Region, U.S Bureau of Reclamation DATE

Rainy Lode Dec 17, 2004
Governor, State of Washington DATE

J. K. ... Dec 17, 2004
Director, Washington State Department of Fish and Wildlife DATE

Attest

Sharon M. ...
Secretary

**SOUTH COLUMBIA BASIN
IRRIGATION DISTRICT PO Box
1066**

By J. D. ...
President, Board of Directors

Attest

Richard ...
Secretary

**EAST COLUMBIA BASIN IRRIGATION DISTRICT
PO Box E**

By D. ...
President, Board of Directors

Attest:

Rebecca ...
ASSISTANT Secretary

**QUINCY-COLUMBIA BASIN
IRRIGATION DISTRICT
PO Box 188**

Quincy WA 98848
By Mike ...
President, Board of Directors

ANCHOR
OEA



COLUMBIA BASIN PROJECT
COORDINATED WATER CONSERVATION PLAN - FINAL DRAFT

Prepared for

East Columbia Basin Irrigation District Quincy-
Columbia Basin Irrigation District South Columbia
Basin Irrigation District Washington State Department
of Ecology

Prepared by

Anchor QEA, LLC
811 Kirkland Avenue, Suite 200
Kirkland, WA 98033

March 2010

Ecology Publication Number: 10-12-010



COLUMBIA BASIN PROJECT

**COORDINATED WATER CONSERVATION
PLAN – FINAL DRAFT**

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East Columbia Basin Irrigation District
Quincy-Columbia Basin Irrigation District
South Columbia Basin Irrigation District
Washington State Department of Ecology

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March 2010

TABLE OF CONTENTS

| | | |
|----------|--|-----------|
| 1 | INTRODUCTION..... | 1 |
| 1.1 | Project Goals..... | 1 |
| 1.2 | Columbia Basin Project..... | 1 |
| 1.3 | Past Water Conservation Studies and Actions | 2 |
| 2 | METHODOLOGY | 4 |
| 2.1 | Identifying Water Conservation Projects..... | 4 |
| 2.2 | Estimating Water Savings..... | 4 |
| 2.3 | Estimating Costs | 5 |
| 2.4 | Fate of Seepage Water..... | 5 |
| 3 | DISCUSSION OF PROPOSED WATER CONSERVATION PROJECTS..... | 10 |
| 3.1 | Short-term Projects..... | 10 |
| 3.2 | Long-term Projects..... | 12 |
| 4 | EFFECT ON SEEPAGE AND WATER SUPPLY..... | 14 |
| 4.1 | Short-term Projects..... | 14 |
| 4.2 | Long-term Projects..... | 14 |
| 5 | ADDITIONAL STUDIES REQUIRED | 16 |
| 6 | REFERENCES..... | 18 |

List of Tables

| | | |
|---------|---|----|
| Table 1 | Estimated Seepage Rates by Geologic Unit | 4 |
| Table 2 | Breakdown of Assumed 1,000 Acre-feet Seepage Loss Based on Drainage Area. 9 | |
| Table 3 | Proposed 2009-2010 Projects – Quincy District | 10 |
| Table 4 | Proposed 2009-2010 Projects – East District | 11 |
| Table 5 | Proposed 2009-2010 Projects – South District..... | 12 |
| Table 6 | Summary of Long-term Projects | 13 |
| Table 7 | Effects on Seepage and Water Supply from Short-term Projects..... | 14 |
| Table 8 | Effects on Seepage and Water Supply from Long-term Projects | 15 |

List of Maps

| |
|---|
| Map 1 – District and Laterals |
| Map 2 – Geology |
| Map 3 – Drainage Basins |
| Map 4 – Quincy District Short-term Projects |
| Map 5 – East District Short-term Projects Map |
| 6 – South District Short-term Projects |

List of Appendices

| |
|---------------------------------------|
| Appendix A List of Long-term Projects |
|---------------------------------------|

1 INTRODUCTION

1.1 Project Goals

The three Columbia Basin Project (CBP) irrigation districts; Quincy-Columbia Basin Irrigation District (Quincy District), East Columbia Basin Irrigation District (East District), and South Columbia Basin Irrigation District (South District); and the Washington State Department of Ecology (Ecology) jointly agreed to prepare this Coordinated Water Conservation Plan (Plan) with the goal to identify water conservation projects that will allow additional acreage to be served without disrupting the water supply to existing acreage while also remaining water budget neutral to the Columbia River. The water conservation projects are proposed in an effort to address goals established in the December 2004 Memorandum of Understanding between the districts, Ecology, and the U.S. Bureau of Reclamation (Reclamation), the April 2005 Memorandum of Understanding between the East District, Ecology and Reclamation and RCW 90.90, Columbia River basin water supply. The conserved water would be available as a replacement water supply for groundwater deliveries in the Odessa Subarea, environmental uses, and municipal and industrial water supply. Ecology funded the preparation of the Plan through the Columbia River Water Management Program.

1.2 Columbia Basin Project

Reclamation's CBP is a congressionally authorized multipurpose development located in central Washington (see Map 1). The project's principal multiple use facility, Grand Coulee Dam, is on the main stem of the Columbia River about 90 miles west of Spokane, Washington, at the head of the Grand Coulee. Project irrigation works extend southward on the Columbia Plateau for 125 miles to the vicinity of Pasco, Washington, at the confluence of the Snake and Columbia Rivers. Beginning near Quincy, the Columbia River forms the western project boundary; the eastern project boundary is about 60 miles east near the communities of Odessa and Lind. CBP lands include portions of Grant, Lincoln, Adams, Franklin, and Walla Walla counties, with some northern facilities located in Douglas County. Construction of the CBP began in 1933 with Grand Coulee Dam, which is the source of water and energy for the project. Construction of irrigation facilities commenced following World War II with first water delivery from Grand Coulee Dam in 1952.

Irrigation development continued through the next two decades. Irrigation facilities were largely completed by the 1970s. Farm development has now caught up with the capacity of

the "first half" canal and drainage system with approximately 671,000 acres being irrigated currently. This area represents platted farm units, Master Water Service contracts, Article 28 contracts, and artificially stored groundwater-irrigated acreage. The project is currently authorized to irrigate 1,029,000 acres at its completion. The remaining acreage lies mostly within the East District and is located east of the East Low Canal (called East High land) with some acreage in the South District located south of the East Low Canal.

The Quincy District, headquartered in Quincy, operates and maintains the West Canal system. The Potholes East Canal system is operated and maintained by the South District from Pasco. The East District, headquartered in Othello, operates the East Low Canal system.

There are more than 300 miles of main canals, 2,000 miles of laterals, and 3,500 miles of drains and wasteways within the three districts. Map 1 also shows the canals and laterals within the CBP.

1.3 Past Water Conservation Studies and Actions

1.3.1 Comprehensive Water Conservation Plans

All three districts have completed Comprehensive Water Conservation Plans within the past 7 years. The East District's most recent plan was completed in 2007 (Anchor Environmental 2007), while the South District's and Quincy District's plans were completed in 2002 (Montgomery Water Group [MWG] 2002a, 2002b). These plans identified opportunities for improvements that could be implemented to improve water use efficiencies.

1.3.2 Water Use, Supply, and Efficiency Report

The *Columbia Basin Project Water Supply, Use and Efficiency Report* (MWG 2003) was first published in 1997 and updated in 2003. The purpose of those reports was to summarize data collected on CBP operations into a comprehensive format that is easy to interpret. The reports documented the effects of water conservation activities on diversions from the Columbia River, spills within the CBP, and deliveries to farms. The reports also documented the importance of return flow from the Quincy and East districts to the water supply for the South District, and how that reuse of water contributes to the very high efficiency of the overall CBP.

1.3.3 Seepage Analyses

The *Phase I and Phase II Seepage Analyses East Columbia Basin Irrigation District Water Conservation Projects* (MWG 2004a, 2004b) were prepared to determine the volume of water conserved from East District lining and piping projects that were previously completed with grants and loans from Ecology's Referendum 38 program. This conserved water could then be put to beneficial use for water service contracts on the east side of the East Low Canal and replace groundwater currently being pumped. The reports estimated seepage rates by geologic unit and analyzed the fate of seepage water, which was then used to determine the estimated volume of water savings available to be put to beneficial use.

2 METHODOLOGY

2.1 Identifying Water Conservation Projects

Projects analyzed in this Plan were obtained from the districts' water conservation plans with additional projects provided by district managers and staff. The projects were grouped by district and irrigation block and input onto GIS layers. The GIS database was provided to Ecology and the districts separately for use as desired. The GIS layers also contain summaries of water savings and cost that were estimated using the methodology described in the following sections.

2.2 Estimating Water Savings

Water savings were estimated using previous methodologies established by the Phase I and Phase II reports. The following formula was used for determining the annual seepage loss:

$$\text{Seepage Loss (acre-feet/yr)} = \text{Seepage Rate (ft/day)} * \text{Wetted Perimeter (ft)} * \text{Length (ft)} \\ * 195 \text{ (days)} / 43,560 \text{ (ft}^3\text{/ac-ft)}$$

The seepage rate used depends on the underlying geology. Average seepage rates for different geologic units were determined in the Phase I and Phase II reports. Those rates were accepted by Ecology and Reclamation for use in estimating water conserved in past conservation projects. Table 1 presents those seepage rates by geologic unit.

Table 1
Estimated Seepage Rates by Geologic Unit

| Geology | Seepage Rate (ft/day) | | |
|--|-----------------------|-------|-------|
| | Unlined | Lined | Piped |
| Outburst flood deposits, gravel (Qfg) | 2.0 | 0.2 | 0 |
| Outburst flood deposits, sand and silt (Qfs) | 1.5 | 0.2 | 0 |
| Continental sedimentary rocks (PLMc) | 0.73 | 0.2 | 0 |
| Wanapum basalt (Mv) | 0.99 | 0.2 | 0 |
| Loess (Ql) | 2.24 | 0.2 | 0 |
| Alluvium (Qa) | 1.7 | 0.2 | 0 |
| Dune sand, stabilized dunes (Qds)* | 2.24 | 0.2 | 0 |

Source: MWG 2004b

* - No previous seepage rate established; the seepage rate for dune sand was assumed to be similar to loess based on professional experience

Geologic units that underlie the three districts are shown in Map 2. The estimated water savings for piping and lining projects was calculated for each project using the geologic information from Map 2 and information on the length of project and wetted perimeter of canal or lateral lined or piped. Some projects include relining laterals or canals and replacing piped laterals with new pipe. The seepage savings for these projects were estimated to be 0.4 ft/day for the purpose of this plan.

The seepage estimates provided in this plan are based upon average seepage rates encountered for certain geologic units and canal or lateral condition. These estimates are considered to be adequate for planning purposes, but actual seepage rates may vary from these estimates and should be confirmed using field data such as ponding tests or inflow/outflow measurements.

2.3 Estimating Costs

Costs were estimated using unit costs for pipelines, canal lining, and other lining obtained from the districts and other recent bidding experience. The costs of the short-term projects (see Section 3.1) include sales tax but not engineering and administrative costs as the districts are designing and managing the construction contracts. The same assumptions were used for the long-term projects (see Section 3.2). However, if a program of aggressively implementing the long-term projects is in place, the districts may have to hire outside consultants to design and manage construction of projects, which would increase the costs from those listed in this Plan.

2.4 Fate of Seepage Water

The fate of seepage water from canals and laterals was reviewed in the Phase II report for the East District. It is assumed that the methodology used in that report to estimate the fate of seepage can also be applied to this Plan for the Quincy and South districts.

Water that seeps from canals and laterals in the CBP typically flows into shallow groundwater systems that contribute flow to surface waters. Some of that flow ends up in Potholes Reservoir or the Potholes East Canal, both of which are relied upon by the South District for its water supply. Therefore, a reduction in seepage water from water conservation projects in the Quincy and East districts may result in a reduction in supply to

the South District. An exception is seepage water that flows directly to the Columbia River and does not enter Potholes Reservoir or the Potholes East Canal.

The Phase II report estimated that 17.1% of seepage flow is lost due to deeper groundwater aquifers, evaporation, and evapotranspiration (ET). The remainder is picked up in project drains or other water bodies. The report also estimated that 18% of the remaining seepage flow returns to a project drain or other water body outside of the irrigation season.

Map 3 shows the fate of seepage water based on three types of drainage areas. Seepage water in the southern and southwestern portions of the project area (denoted as a light yellow color in Map 3) either drains directly to the Columbia River or flows into South District canals and laterals below Scootney Reservoir. The Potholes East Canal, the Eltopia Branch Canal, and the Esquatzel Diversion Canal in the South District all terminate at a wasteway or spillway that discharges into the Columbia River. Water seeping in the northern portion of the project area (denoted as a dark green color in Map 3) drains into Potholes Reservoir and would contribute to South District supply. Water seeping in the central portion of the project area (denoted as a light purple color in Map 3) drains into the Potholes East Canal above Scootney Reservoir and would contribute to South District supply. A discussion of the fate of seepage water from projects implemented by each district and their potential use of the conserved water is provided in the following sections.

2.4.1 Quincy District

Water conservation projects implemented by the Quincy District in areas that currently drain to the Columbia River would allow 100 percent of the water conserved to be delivered elsewhere in the Quincy District, depending on available canal capacity. The West Canal would have capacity to deliver at least to the point where the conservation project is proposed. For water conservation projects located in areas that drain to Potholes Reservoir, the seepage that currently reaches Potholes Reservoir would still need to be delivered to Potholes Reservoir to ensure the South District's supply is not reduced. That would be accomplished through delivery of feed water through district wasteways. The capacity in the West Canal that would be available for other uses would be the amount of water that is lost from the project through deep groundwater infiltration, evaporation, and ET, which is an estimated 17.1% of the seepage volume. Although seepage water also returns to Potholes

Reservoir outside of the irrigation season, that water is stored in the reservoir and may be used by the South District the following year.

2.4.2 East District

The East District wants to improve capacity in the East Low Canal south of I-90 where it is capacity limited and allow pumping from the canal to undeveloped East District lands including groundwater users in the Odessa Subarea. Additional capacity to serve those water users can be provided through water conservation projects south of I-90. However the effect on South District water supplies has to be considered. Previously, the effect on South District water supplies from a decrease in return flow from seepage in the East District was thought to be minor since there is more operational spill in the South District than in the Quincy or East districts. The higher operational spill is thought to be caused in part by the difficulty in accommodating return flows caused by irrigated agriculture and seepage from canals and laterals in the East District. In 2005, as part of the Conserved Water Pilot Program (Reclamation 2005), the East District was allowed by Ecology and Reclamation to reallocate conserved water, which included return flow to the Potholes East Canal.

However, South District operational spills have been declining, due in part to water conservation activities in the East District and to the implementation of extensive canal automation, and the South District does not want further reductions in return flow. An approach that balances water conservation in the East and Quincy districts with water supply to the South District would be to implement projects in the South District that have equivalent water savings as the reduced return flow from projects in the East and Quincy districts. The credit for water savings and future use of capacity in any of the canals will need to be negotiated between the districts.

Water conservation projects implemented in the East District would provide East Low Canal capacity equal to the portion of conserved water lost to deep groundwater systems, evaporation, and ET (estimated 17.1% of seepage). Those projects draining to the Potholes East Canal would provide an additional volume equal to the seepage that returns outside of the irrigation season (18% of remaining seepage; seepage minus groundwater losses) without affecting return flow to the Potholes East Canal. That volume is equal to 32% of the total seepage ($0.171 + 0.18 * [1 - 0.171] = 0.32$). If additional feed water was supplied, or the

reduced return flow is balanced by water conservation in the South District, the capacity could equal the total seepage loss reduced.

One block within the East District (Block 49) is supplied from the Potholes East Canal and drains to the Columbia River. Water conserved in that block would provide capacity in the Potholes East Canal but not the East Low Canal unless used to help offset a reduction in return flow from implementing other East District projects that drain to Potholes East Canal.

2.4.3 South District

Water conservation projects implemented in areas of the South District whose water supply originates from the East Low Canal would provide capacity in the East Low Canal. These projects are generally located in Block 18. However, those projects may also reduce return flow that is captured by South District canals. The calculation of capacity provided would be the same as described for the East District above for areas south of I-90.

South District water conservation projects in areas that drain directly to the Columbia River (such as the Wahluke Branch Canal) would allow the same volume of water conserved to be delivered elsewhere in the South District depending on available canal capacity. That capacity could also be used to offset reduced return flow from water conservation projects implemented by the East or Quincy districts.

South District water conservation projects in some areas served by the Potholes East Canal or Eltopia Branch Canal may reduce return flow to other district canals or laterals. The potential improvement in canal capacity may not be equal to the volume of water conserved as additional flow may be needed to offset the return flow, similar to the situation in the East District.

2.4.4 Example of Seepage Calculations and Capacity Calculation

A hypothetical situation is presented in Table 2 where 1,000 acre-feet is conserved in each of the three drainage areas. The potential reduction in groundwater seepage and water supply to drains and other water bodies, including Potholes Reservoir and the Potholes East Canal, is presented. The reduction in water supply is further broken down by the season in which the seepage water returns (within the irrigation season and outside of the irrigation season).

Table 2
Breakdown of Assumed 1,000 Acre-feet Seepage Loss Based on Drainage Area

| Implementing District | Source of Supply | Drainage Basin (see Map 3) | Assumed Total Water Savings (acre-feet) | Currently Lost to Deep Groundwater, Evaporation, and ET (acre-feet) | Returns to Project during Irrigation Season (acre-feet) | Returns to Project outside of Irrigation Season (acre-feet) | Amount that could be Reallocated (and affected canal) (acre-feet) |
|-----------------------|---------------------|---|---|---|---|---|---|
| East | East Low Canal | Potholes East Canal above Scootenev | 1,000 | 171 | 680 | 149 | 320 (East Low Canal) |
| East | Potholes East Canal | Columbia River | 1,000 | 171 | 0 | 0 | 1,000 (Potholes East Canal or as offset to projects in East District) |
| East | East Low Canal | Potholes Reservoir | 1,000 | 171 | 680 | 149 | 171 (East Low Canal) |
| South | East Low Canal | Columbia River or Potholes East Canal below Scootenev | 1,000 | 171 | Up to 680 | Up to 149 | Up to 1,000 (East Low Canal) |
| South | Potholes East Canal | Columbia River or Potholes East Canal below Scootenev | 1,000 | 171 | Up to 680 | Up to 149 | Up to 1,000 (Potholes East Canal) |
| Quincy | West Canal | Potholes Reservoir | 1,000 | 171 | 680 | 149 | 171 (West Canal) |
| Quincy | West Canal | Columbia River | 1,000 | 171 | 0 | 0 | 1,000 (West Canal) ¹ |

ET = evapotranspiration

¹ – No projects in this report fall in this designation.

3 DISCUSSION OF PROPOSED WATER CONSERVATION PROJECTS

3.1 Short-term Projects

Ecology is providing \$1 million in grant funding from the Columbia River Water Management Program to implement water conservation projects in 2009-2010 within the three districts. The districts were asked to propose projects that could be funded by the grant. The following sections describe those short-term projects. These projects have been designed and are ready to construct. The total cost of the projects is slightly over \$1 million; the districts would either cover the remaining costs or slightly scale back a project to meet the grant funding available. The conserved water generated by these projects will be used as a replacement water supply for groundwater-irrigated acreage in the Odessa Subarea.

3.1.1 Quincy District

Table 3 lists the short-term projects identified for the Quincy District. The table includes the location, drainage basin, geologic unit, estimated savings, and estimated cost for the proposed projects. Map 4 shows the location of the projects.

Table 3
Proposed 2009-2010 Projects – Quincy District

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Total Savings (acre-feet) | Cost per acre-foot |
|--------------|--------------------------|---------------------|--------------|----------------|---------|-------------------|-------------------------------------|--------------------|
| 86 | West Canal - 5th Section | Huesker & Shotcrete | 500 | Columbia River | PLMc | \$ 90,125 | 57.2 | \$ 1,576 |
| 86 | West Canal - 5th Section | Huesker & Shotcrete | 1,000 | Columbia River | Mv | \$ 164,150 | 153.8 | \$ 1,067 |
| TOTAL | | | 1,500 | | | \$ 254,275 | 211.0 | \$ 1,205 |

3.1.2 East District

Table 4 lists the short-term projects identified for the East District. The table includes the location, drainage basin, geologic unit, estimated savings, and estimated cost for the proposed projects. Map 5 shows the location of the projects.

Table 4
Proposed 2009-2010 Projects – East District

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Total Savings (acre-feet) | Cost per acre-foot |
|--------------|-----------|---------------------------------------|----------------------------------|---------------------|---------|-------------------|-------------------------------------|--------------------|
| 45 | EL 68X | 18" Pipe | 3,900 | Potholes East Canal | Ql | \$ 120,900 | 220.1 | \$ 549 |
| 45 | EL 68V7 | 18" Pipe | 3,160 | Potholes East Canal | Qfg | \$ 97,960 | 147.8 | \$ 663 |
| 46 | EL 71A | 18" Pipe | 3,180 | Potholes East Canal | Ql | \$ 98,580 | 179.5 | \$ 549 |
| 46 | EL 71B | 15" Pipe | 2,650 | Potholes East Canal | Ql | \$ 60,950 | 171.0 | \$ 356 |
| 44 | EL 63.8#2 | 30" Pipe | 1,600 | Potholes East Canal | PLMc | \$ 82,750 | 73.5 | \$ 1,126 |
| 46 | EL 68H | 42" Pipe & Eliminate Lateral Sections | 2,650 (piped) 16,896 total | Potholes East Canal | PLMc | \$ 180,000 | 360.1 | \$ 500 |
| TOTAL | | | 17,140 (piped) 31,386 | | | \$ 641,140 | 1,152.0 | \$ 557 |

3.1.3 South District

Table 5 lists the short-term projects identified for the South District. The table includes the location, drainage basin, geologic unit, estimated savings, and estimated cost for the proposed projects. Map 6 shows the location of the projects.

Table 5
Proposed 2009-2010 Projects – South District

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Total Savings (acre-feet) | Cost per acre-foot |
|--------------|----------|---------------------|--------------|----------------|---------|-------------------|-------------------------------------|--------------------|
| 18 | EL 85CC1 | 18" Pipe | 1,050 | Columbia River | PLMc | \$ 34,243 | 20.7 | \$ 1,654 |
| 18 | EL 85CC1 | 18" Pipe | 1,500 | Columbia River | PLMc | \$ 47,493 | 38.4 | \$ 1,237 |
| 18 | EL 85CC2 | 24" Pipe | 1,220 | Columbia River | PLMc | \$ 61,167 | 34.5 | \$ 1,773 |
| 18 | EL 85DD | 27" Pipe | 1,650 | Columbia River | Qfs | \$ 98,184 | 111.3 | \$ 882 |
| 18 | EL 85Z | 24" Pipe | 1,770 | Columbia River | PLMc | \$ 87,699 | 52.3 | \$ 1,677 |
| 19 | PE 41.2D | 18" Pipe | 1,620 | Columbia River | Qfg | \$ 57,720 | 79.5 | \$ 663 |
| TOTAL | | | 8,810 | | | \$ 381,504 | 336.7 | \$ 1,133 |

3.2 Long-term Projects

Long-term projects are those identified by the districts which could be implemented beyond 2010. These projects will require additional study or design before implementation. The projects are listed in tables in Appendix A. The tables include the location, type of project, drainage basin, geologic unit, estimated water savings, and cost for the proposed projects.

GIS layers provided to Ecology and the districts show the location of the projects, grouped by irrigation block. The GIS layers also contain the same information on the projects as listed in Appendix A.

For the East District, two levels of projects were included. The first level contains projects located in Blocks 45 to 49 for which conservation savings would provide East Low Canal capacity and not affect Potholes Reservoir supply. Those projects are shown on GIS layers. The second level contains projects located in Blocks 40 to 44 for which conservation savings would affect Potholes Reservoir supply. This list of projects was obtained from the East District's Comprehensive Water Conservation Plan (Anchor 2007) and was not analyzed as thoroughly as those projects in the first level. Costs from the Water Conservation Plan were

updated using new unit costs for pipe and Reclamation's construction cost composite trend. The second level projects are not shown on the GIS layers.

Table 6 summarizes the total cost and water savings for the long-term projects. The total cost of the projects identified is \$75.3 million and would result in an estimated 76,500 acre- feet of water savings. The cost per acre-foot would be \$980.

Table 6
Summary of Long-term Projects

| District | Number of Projects | Estimated Cost | Estimated Total Savings (acre-feet) | Cost per acre-foot |
|-----------------|---------------------------|-----------------------|--|---------------------------|
| Quincy | 165 | \$ 30,860,000 | 22,760 | \$ 1,360 |
| East | 176 | \$ 17,300,000 | 21,400 | \$ 810 |
| South | 349 | \$ 27,150,000 | 32,380 | \$ 840 |
| TOTAL | 690 | \$ 75,310,000 | 76,540 | \$ 980 |

4 EFFECT ON SEEPAGE AND WATER SUPPLY

4.1 Short-term Projects

The effect of implementing the short-term projects on seepage and water supply was estimated. Table 7 presents a summary of calculations using the methodology presented in Section 2.4.

Table 7
Effects on Seepage and Water Supply from Short-term Projects

| Implementing District | Source of Supply | Drainage Basin (see Map 3) | Total Water Savings (acre-feet) | Currently Lost to Deep Groundwater, Evaporation, and ET (acre-feet) | Returns to Project during Irrigation Season (acre-feet) | Returns to Project outside of Irrigation Season (acre-feet) | Amount that could be Reallocated (and affected canal) (acre-feet) |
|-----------------------|---------------------|---|---------------------------------|---|---|---|---|
| East | East Low Canal | Potholes East Canal above Scootenev | 1,152 | 197 | 783.1 | 171.9 | 368.9 (East Low Canal) |
| South | East Low Canal | Columbia River or Potholes East Canal below Scootenev | 257.2 | 44.0 | Up to 174.8 | Up to 38.4 | Up to 257.2 (East Low Canal) |
| South | Potholes East Canal | Columbia River or Potholes East Canal below Scootenev | 79.5 | 13.6 | Up to 54.0 | Up to 11.9 | Up to 79.5 (Potholes East Canal) |
| Quincy | West Canal | Columbia River | 211 | 36 | 0 | 0 | 211 (West Canal) |

ET = evapotranspiration

4.2 Long-term Projects

The effect of implementing the long-term projects on seepage and water supply was estimated. Table 8 presents a summary of calculations using the methodology presented in Section 2.4. Note that some of the water conservation projects are not yet well defined so the overall estimate of water savings may be conservatively low.

Table 8
Effects on Seepage and Water Supply from Long-term Projects

| Implementing District | Source of Supply | Drainage Basin (see Map 3) | Total Water Savings (acre-feet) | Currently Lost to Deep Groundwater, Evaporation, and ET (acre-feet) | Returns to Project during Irrigation Season (acre-feet) | Returns to Project outside of Irrigation Season (acre-feet) | Amount that could be Reallocated (and affected canal) (acre-feet) |
|-----------------------|---------------------|--|---------------------------------|---|---|---|---|
| East | East Low Canal | Potholes East Canal above Scooteny | 11,137 | 1,904 | 7,571 | 1,662 | 3,566 (East Low Canal) |
| East | Potholes East Canal | Columbia River | 3,314 | 567 | 0 | 0 | 3,314 (Potholes East Canal or as offset to projects in East District) |
| East | East Low Canal | Potholes Reservoir | 6,950 | 1,188 | 4,724 | 1,038 | 1,188 (East Low Canal) |
| South | Potholes East Canal | Columbia River or Potholes East Canal below Scooteny | 30,415 | 5,201 | Up to 20,676 | Up to 4,538 | Up to 30,415 (Potholes East Canal) |
| South | East Low Canal | Columbia River or Potholes East Canal below Scooteny | 1,965 | 336 | Up to 1,336 | Up to 293 | Up to 1,965 (East Low Canal) |
| Quincy | West Canal | Potholes Reservoir | 0 ¹ | - | - | - | - |
| Quincy | West Canal | Columbia River | 22,758 | 3,892 | 0 | 0 | 22,758 (West Canal) |

ET = evapotranspiration

¹ – No projects in this report fall in this designation.

5 ADDITIONAL STUDIES REQUIRED

Water conservation savings have been estimated using data from previous studies. The water savings should be confirmed through field tests or water balance calculations if a more accurate estimate of water savings is desired. Water savings for pipeline replacement projects were estimated using judgment and should be confirmed with field tests or water balances. Water savings were not estimated for some of the long-term projects such as construction of reregulation reservoirs and pumping seepage and return flow back into district canals or laterals. The long-term projects will need additional engineering and cost estimating to better define the projects and their benefits and costs.

Additional analysis is required on the effects conservation projects have on operational spill within the South District. This plan assumes all seepage from water conservation projects that currently returns to South District canals must be replaced by additional feed water or comparable water savings within the South District. The districts will also need to decide how to allocate the water savings as some projects in the East District may provide additional capacity within the Potholes East Canal and not provide additional capacity in the East Low Canal. In addition, the reaches of canal that will benefit from additional capacity will need to be identified to ensure additional water deliveries are made through canal reaches with available capacity.

A meeting was held among the Districts on December 10, 2009 regarding the potential effect of reducing seepage return flow that currently drains to the Potholes East Canal when water conservation projects are implemented in the East District. The Phase II Seepage Analyses (MWG, 2004b) contained a discussion of that potential effect. The reduction in seepage from implementation of water conservation projects described in that report was concluded to be a small proportion of operational spill from the Potholes East Canal. Therefore the effect on operations of the Potholes East Canal would be very small and 100 percent of the water conservation savings were allowed to be used in the East District to serve additional water users. However as seepage is increasingly reduced from more water conservation projects in the East District and operational spill is reduced from improvements to the Potholes East Canal system (such as canal automation already implemented and future reregulation reservoirs) the effect may be much greater creating the need for the South District to divert additional flow from Potholes Reservoir to make up the difference. For that reason, the East

and South Districts agreed the East District could use the quantity equal to 32 percent of conserved water per the calculations contained in Section 2.4 for serving additional water users off the East Low Canal. This calculation may be reviewed in the future with mutual consent of the Districts and utilizing more detailed data on Potholes East Canal operational spill and the effect of water conservation projects.

This report documents and quantifies the total water savings and the net savings available for other uses that will be achieved by the short-term projects being constructed in the 2009- 2010 time period. The number of long-term projects identified in this report will take many years to implement. Some of those may never be implemented and other projects are likely to be identified. It is recommended the Districts develop a reporting process to track these types of projects and the resulting seepage water reduction and change in return flows. Such a process will enable the Districts to better judge whether adverse effects are developing (and how to take remedial actions) and whether conservation benefits are more or less than anticipated. To ensure an overall perspective of the effects of water conservation, the process should include all water conservation projects regardless of funding method and regardless of conservation savings reallocation. This report provides a framework for that accounting process and can be refined over time as additional hydrologic data is collected.

6 REFERENCES

- Anchor Environmental, L.L.C. 2007. East Columbia Basin Irrigation District Comprehensive Water Conservation Plan. May 2007.
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- United States Bureau of Reclamation (Reclamation). 2005. Conserved Water Pilot Program, East Columbia Basin Irrigation District (District), Columbia Basin Project (Project), Washington. Letter to East Columbia Basin Irrigation District. March 31, 2005.

LIST OF MAPS

Map 1 – District and Laterals

Map 2 – Geology

Map 3 – Drainage Basins

Map 4 – Quincy District Short-term Projects

Map 5 – East District Short-term Projects Map

6 – South District Short-term Projects

APPENDIX A

LIST OF LONG-TERM PROJECTS

Table A-1

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|------------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 80 | West Canal | Huesker & Shotcrete | 1,034 | Columbia River | Mv | \$188,781 | 154.8 | \$1,220 |
| 80 | West Canal | Huesker & Shotcrete | 4,994 | Columbia River | Mv | \$911,907 | 748 | \$1,219 |
| 80 | West Canal | Huesker & Shotcrete | 2,036 | Columbia River | PLMc | \$324,148 | 174.7 | \$1,855 |
| 80 | West Canal | Huesker & Shotcrete | 2,637 | Columbia River | PLMc | \$419,884 | 226.2 | \$1,856 |
| 80 | West Canal | Huesker & Shotcrete | 1,351 | Columbia River | Ql | \$192,703 | 392 | \$492 |
| 80 | West Canal | Huesker & Shotcrete | 681 | Columbia River | PLMc | \$69,982 | 34.3 | \$2,040 |
| 80 | W78.8J | 24" Pipe | 1,814 | Columbia River | Ql | \$93,974 | 135.1 | \$696 |
| 80 | W78.8J | 21" Pipe | 1,366 | Columbia River | Ql | \$58,963 | 82.9 | \$711 |
| 80 | W61J | Bituminous Liner | 8,125 | Columbia River | Ql | \$223,894 | 104.9 | \$2,134 |
| 80 | W61J | Bituminous Liner | 4,029 | Columbia River | Ql | \$107,162 | 49.6 | \$2,161 |
| 80 | W61J | Bituminous Liner | 8,370 | Columbia River | Ql | \$209,301 | 94.9 | \$2,205 |
| 80 | W61J | Bituminous Liner | 6,446 | Columbia River | Mv | \$151,605 | 67.2 | \$2,256 |
| 80 | W61J | Bituminous Liner | 4,152 | Columbia River | Ql | \$93,209 | 40.6 | \$2,296 |
| 80 | W61J | Bituminous Liner | 2,748 | Columbia River | Ql | \$60,407 | 26.1 | \$2,314 |
| 80 | W61J | Bituminous Liner | 3,990 | Columbia River | Ql | \$83,350 | 35.2 | \$2,368 |
| 80 | W61J | Bituminous Liner | 1,467 | Columbia River | Ql | \$39,678 | 18.5 | \$2,145 |
| 80 | W61J | Bituminous Liner | 5,450 | Columbia River | Ql | \$139,537 | 63.8 | \$2,187 |
| 80 | W61J | Bituminous Liner | 5,540 | Columbia River | Ql | \$134,155 | 60.1 | \$2,232 |
| 80 | W61J | Bituminous Liner | 2,097 | Columbia River | Ql | \$48,241 | 21.2 | \$2,276 |
| 80 | W61J | Bituminous Liner | 6,516 | Columbia River | Ql | \$138,008 | 58.6 | \$2,355 |
| 80 | W61J | Bituminous Liner | 2,241 | Columbia River | Ql | \$50,210 | 21.8 | \$2,303 |
| 80 | W61J | Bituminous Liner | 1,993 | Columbia River | Ql | \$37,055 | 14.7 | \$2,521 |
| 80 | W61J | Bituminous Liner | 1,960 | Columbia River | Ql | \$33,092 | 12.4 | \$2,669 |
| 80 | W61J | Bituminous Liner | 1,686 | Columbia River | Ql | \$26,483 | 9.5 | \$2,788 |
| 80 | W61E | 30" Pipe | 3,086 | Columbia River | Ql | \$243,100 | 293.1 | \$829 |
| 81 | West Canal | Huesker & Shotcrete | 917 | Columbia River | PLMc | \$183,364 | 102.1 | \$1,796 |
| 81 | West Canal | Huesker & Shotcrete | 3,241 | Columbia River | PLMc | \$648,381 | 361.2 | \$1,795 |
| 81 | West Canal | Huesker & Shotcrete | 1,269 | Columbia River | PLMc | \$253,755 | 141.4 | \$1,795 |
| 81 | West Canal | Huesker & Shotcrete | 599 | Columbia River | Mv | \$119,870 | 99.5 | \$1,205 |
| 81 | W61F1 | Bituminous Liner | 3,110 | Columbia River | Ql | \$32,988 | 7.7 | \$4,284 |
| 81 | W61F1 | Bituminous Liner | 1,509 | Columbia River | Ql | \$22,306 | 7.6 | \$2,935 |
| 81 | W61C20 | 27" Pipe | 1,713 | Columbia River | Ql | \$109,070 | 103.1 | \$1,058 |
| 81 | W61C20 | 21" Pipe | 645 | Columbia River | Ql | \$27,851 | 29.5 | \$944 |
| 81 | W61C1 | 24" Pipe | 500 | Columbia River | Ql | \$25,917 | 34.3 | \$756 |
| 81 | W61C1 | 21" Pipe | 1,975 | Columbia River | Ql | \$85,250 | 119.8 | \$712 |
| 82 | RB5N | 27" Pipe | 712 | Columbia River | Ql | \$45,307 | 59 | \$768 |
| 82 | RB5L | 24" Pipe | 1,387 | Columbia River | Mv | \$71,811 | 43.6 | \$1,647 |
| 82 | RB5L | 18" Pipe | 686 | Columbia River | Mv | \$22,955 | 15.9 | \$1,444 |
| 82 | RB5K | 21" Pipe | 3,439 | Columbia River | Mv | \$148,419 | 98.3 | \$1,510 |
| 82 | RB5C | 24" Pipe | 592 | Columbia River | PLMc | \$30,646 | 13.2 | \$2,322 |
| 82 | RB5C | 27" Pipe | 1,334 | Columbia River | PLMc | \$84,950 | 36 | \$2,360 |
| 82 | RB5 | 36" Pipe | 3,476 | Columbia River | Ql | \$322,564 | 350 | \$922 |

Table A-1

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|--------------------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 82 | RB4H | 27" Pipe | 454 | Columbia River | Ql | \$28,930 | 37.7 | \$767 |
| 82 | RB4H | 24" Pipe | 1,232 | Columbia River | Ql | \$63,829 | 112.9 | \$565 |
| 82 | RB4C1 | 27" Pipe | 2,723 | Columbia River | Ql | \$173,341 | 225.7 | \$768 |
| 82 | RB4C1 | 24" Pipe | 2,681 | Columbia River | Ql | \$138,846 | 210.9 | \$658 |
| 82 | RB4C1 | 21" Pipe | 1,214 | Columbia River | Ql | \$52,385 | 86.3 | \$607 |
| 82 | RB4 | 21" Pipe | 1,485 | Columbia River | Mv | \$64,093 | 37.2 | \$1,723 |
| 82 | RB4 | 21" Pipe | 1,244 | Columbia River | Ql | \$53,696 | 65.3 | \$822 |
| 83 | RB5J3 | 21" Pipe | 3,071 | Columbia River | PLMc | \$132,523 | 64.7 | \$2,048 |
| 83 | RB5J18 | 18" Pipe | 1,796 | Columbia River | PLMc | \$60,078 | 30.7 | \$1,957 |
| 83 | RB5J16 | 30" Pipe | 1,972 | Columbia River | PLMc | \$155,314 | 58.5 | \$2,655 |
| 83 | RB5J16 | 27" Pipe | 767 | Columbia River | PLMc | \$48,843 | 20.7 | \$2,360 |
| 83 | RB5J16 | 18" Pipe | 1,643 | Columbia River | PLMc | \$54,951 | 30.3 | \$1,814 |
| 83 | RB5J | Huesker & Shotcrete | 1,043 | Columbia River | PLMc | \$134,428 | 74.6 | \$1,802 |
| 83 | RB5J | Huesker & Shotcrete | 2,801 | Columbia River | PLMc | \$284,488 | 152.2 | \$1,869 |
| 83 | RB5J | Huesker & Shotcrete | 2,619 | Columbia River | PLMc | \$265,999 | 142.3 | \$1,869 |
| 83 | RB5J | Huesker & Shotcrete | 3,990 | Columbia River | PLMc | \$332,883 | 171.3 | \$1,943 |
| 83 | RB5J | Huesker & Shotcrete | 6,296 | Columbia River | PLMc | \$396,012 | 189 | \$2,095 |
| 83 | RB5J | Huesker & Shotcrete | 2,748 | Columbia River | PLMc | \$116,441 | 47.1 | \$2,472 |
| 83 | RB5J | Huesker & Shotcrete | 1,339 | Columbia River | PLMc | \$44,534 | 15.3 | \$2,911 |
| 83 | RB5 | Huesker & Shotcrete | 3,318 | Columbia River | Mv | \$241,479 | 179.2 | \$1,348 |
| 83 | RB5 | Huesker & Shotcrete | 1,690 | Columbia River | Mv | \$138,804 | 106.1 | \$1,308 |
| 83 | RB5 | Huesker & Shotcrete | 659 | Columbia River | Ql | \$43,008 | 79.9 | \$538 |
| 83 | RB5 | 36" Pipe | 7,425 | Columbia River | Ql | \$688,968 | 778.9 | \$885 |
| 83 | RB5 | 36" Pipe | 1,841 | Columbia River | Ql | \$170,862 | 193.2 | \$884 |
| 85 | Royal Branch Canal | Huesker & Shotcrete | 15,702 | Columbia River | PLMc | \$3,801,770 | 2164.9 | \$1,756 |
| 85 | RB9B | 21" Pipe | 779 | Columbia River | PLMc | \$33,640 | 16.4 | \$2,051 |
| 85 | RB9A | 24" Pipe | 487 | Columbia River | PLMc | \$25,223 | 11.8 | \$2,138 |
| 85 | RB9A | 24" Pipe | 1,222 | Columbia River | PLMc | \$63,281 | 28.8 | \$2,197 |
| 85 | RB9A | 18" Pipe | 3,982 | Columbia River | PLMc | \$133,180 | 68.1 | \$1,956 |
| 85 | RB7.4 | 24" Pipe | 1,044 | Columbia River | PLMc | \$54,069 | 24.6 | \$2,198 |
| 85 | RB6E | 12" Pipe | 1,545 | Columbia River | PLMc | \$28,333 | 20.2 | \$1,403 |
| 85 | RB6D | 21" Pipe | 1,110 | Columbia River | PLMc | \$47,889 | 22.8 | \$2,100 |
| 85 | RB6D | 18" Pipe | 1,269 | Columbia River | PLMc | \$42,448 | 23.4 | \$1,814 |
| 85 | RB6BB1 | 15" Pipe | 1,459 | Columbia River | PLMc | \$36,220 | 22.9 | \$1,582 |
| 85 | RB6A | 24" Pipe | 1,389 | Columbia River | PLMc | \$71,935 | 33.7 | \$2,135 |
| 85 | RB6A | 24" Pipe | 1,828 | Columbia River | PLMc | \$94,659 | 43.1 | \$2,196 |
| 85 | RB6A | 21" Pipe | 985 | Columbia River | PLMc | \$42,517 | 19.5 | \$2,180 |
| 85 | RB6.8 | 18" Pipe | 2,881 | Columbia River | PLMc | \$96,353 | 53.2 | \$1,811 |
| 85 | RB4.2Q | 21" Pipe | 2,329 | Columbia River | PLMc | \$100,529 | 46 | \$2,185 |
| 85 | RB4.2J | 24" Pipe | 1,266 | Columbia River | PLMc | \$65,578 | 28.3 | \$2,317 |
| 85 | RB4.2J | 15" Pipe | 1,020 | Columbia River | PLMc | \$25,311 | 16 | \$1,582 |
| 85 | RB4.2C | 24" Pipe | 1,305 | Columbia River | PLMc | \$67,568 | 29.1 | \$2,322 |

Table A-1

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|------------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 85 | RB4.2 | Huesker & Shotcrete | 1,424 | Columbia River | PLMc | \$142,262 | 75.9 | \$1,874 |
| 85 | RB4.2 | Huesker & Shotcrete | 2,387 | Columbia River | PLMc | \$235,276 | 125.2 | \$1,879 |
| 85 | RB4.2 | Huesker & Shotcrete | 2,819 | Columbia River | PLMc | \$248,223 | 129.2 | \$1,921 |
| 85 | RB4.2 | Huesker & Shotcrete | 4,606 | Columbia River | PLMc | \$405,591 | 211.1 | \$1,921 |
| 85 | RB4.2 | Huesker & Shotcrete | 3,075 | Columbia River | PLMc | \$265,712 | 137.7 | \$1,930 |
| 85 | RB4.2 | Huesker & Shotcrete | 4,277 | Columbia River | PLMc | \$324,864 | 163.5 | \$1,987 |
| 85 | RB4.2 | Huesker & Shotcrete | 1,329 | Columbia River | PLMc | \$98,826 | 49.5 | \$1,996 |
| 85 | RB4.2 | Huesker & Shotcrete | 2,066 | Columbia River | PLMc | \$119,268 | 55.3 | \$2,157 |
| 86 | West Canal | Huesker & Shotcrete | 795 | Columbia River | PLMc | \$158,988 | 88.6 | \$1,794 |
| 86 | West Canal | Huesker & Shotcrete | 10,180 | Columbia River | Mv | \$2,036,302 | 1690.9 | \$1,204 |
| 86 | W71.4 | 21" Pipe | 573 | Columbia River | PLMc | \$24,741 | 12.1 | \$2,045 |
| 86 | W71.4 | 21" Pipe | 2,664 | Columbia River | PLMc | \$114,966 | 52.6 | \$2,186 |
| 86 | W69F | Huesker & Shotcrete | 5,160 | Columbia River | PLMc | \$314,176 | 148.4 | \$2,117 |
| 86 | W69F | Huesker & Shotcrete | 1,081 | Columbia River | PLMc | \$57,318 | 25.8 | \$2,222 |
| 86 | W69.7 | 18" Pipe | 1,727 | Columbia River | PLMc | \$57,751 | 34.1 | \$1,694 |
| 86 | W69 | Huesker & Shotcrete | 1,508 | Columbia River | PLMc | \$132,767 | 69.1 | \$1,921 |
| 86 | W69 | Huesker & Shotcrete | 5,344 | Columbia River | PLMc | \$470,523 | 244.9 | \$1,921 |
| 86 | W69 | Huesker & Shotcrete | 1,902 | Columbia River | PLMc | \$128,877 | 62.9 | \$2,049 |
| 86 | W69 | Huesker & Shotcrete | 1,790 | Columbia River | PLMc | \$106,088 | 49.7 | \$2,135 |
| 86 | W69 | Huesker & Shotcrete | 3,501 | Columbia River | PLMc | \$185,612 | 83.4 | \$2,226 |
| 86 | W69 | Huesker & Shotcrete | 2,063 | Columbia River | PLMc | \$99,599 | 43 | \$2,316 |
| 86 | W69 | Huesker & Shotcrete | 3,857 | Columbia River | PLMc | \$161,539 | 64.9 | \$2,489 |
| 86 | W66.7 | 36" Pipe | 1,707 | Columbia River | PLMc | \$158,367 | 63.9 | \$2,478 |
| 86 | W66.7 | 30" Pipe | 260 | Columbia River | PLMc | \$20,500 | 8.2 | \$2,500 |
| 86 | W66.7 | 30" Pipe | 1,682 | Columbia River | PLMc | \$132,508 | 52.8 | \$2,510 |
| 86 | W66.7 | 24" Pipe | 973 | Columbia River | PLMc | \$50,415 | 25 | \$2,017 |
| 86 | W64.2 | 18" Pipe | 2,551 | Columbia River | PLMc | \$85,341 | 59.1 | \$1,444 |
| 86 | W64.2 | 18" Pipe | 1,477 | Columbia River | PLMc | \$49,407 | 29.2 | \$1,692 |
| 87 | West Canal | Huesker & Shotcrete | 2,975 | Columbia River | PLMc | \$362,544 | 185.4 | \$1,955 |
| 87 | West Canal | Huesker & Shotcrete | 1,007 | Columbia River | PLMc | \$122,720 | 62.8 | \$1,954 |
| 87 | W84E | 18" Pipe | 1,500 | Columbia River | Qfg | \$50,186 | 70.3 | \$714 |
| 87 | W84BB | 21" Pipe | 854 | Columbia River | PLMc | \$36,858 | 18 | \$2,048 |
| 87 | W84BB | 21" Pipe | 1,689 | Columbia River | PLMc | \$72,894 | 31.2 | \$2,336 |
| 87 | W84A2 | 21" Pipe | 2,669 | Columbia River | PLMc | \$115,202 | 26.7 | \$4,315 |
| 87 | W84A | Huesker & Shotcrete | 1,140 | Columbia River | PLMc | \$47,640 | 19.2 | \$2,481 |
| 87 | W84A | 24" Pipe | 1,758 | Columbia River | PLMc | \$90,898 | 42.7 | \$2,129 |
| 87 | W84A | 18" Pipe | 1,299 | Columbia River | PLMc | \$43,379 | 26.7 | \$1,625 |
| 87 | W84 | Huesker & Shotcrete | 2,294 | Columbia River | Qfg | \$147,937 | 241.7 | \$612 |
| 87 | W81G | 42" Pipe | 1,366 | Columbia River | PLMc | \$159,144 | 58.4 | \$2,725 |
| 87 | W81G | 18" Pipe | 2,118 | Columbia River | PLMc | \$70,831 | 43.5 | \$1,628 |
| 87 | W81G | 21" Pipe | 1,228 | Columbia River | PLMc | \$53,006 | 21 | \$2,524 |
| 87 | W81B | 15" Pipe | 1,325 | Columbia River | PLMc | \$32,889 | 20.8 | \$1,581 |

Table A-1

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|--------------------|---------------------|----------------|----------------|---------|---------------------|------------------------------|---------------------|
| 87 | W81.9 | 24" Pipe | 2,465 | Columbia River | PLMc | \$127,650 | 63.2 | \$2,020 |
| 87 | W81.9 | 18" Pipe | 309 | Columbia River | PLMc | \$10,323 | 6.3 | \$1,639 |
| 87 | W81.9 | 18" Pipe | 383 | Columbia River | PLMc | \$12,812 | 7.9 | \$1,622 |
| 87 | W81 | 21" Pipe | 1,700 | Columbia River | Ql | \$73,363 | 120.8 | \$607 |
| 87 | W81 | 24" Pipe | 3,892 | Columbia River | Ql | \$201,597 | 306.2 | \$658 |
| 87 | W81 | 24" Pipe | 1,393 | Columbia River | PLMc | \$72,154 | 33.8 | \$2,135 |
| 87 | W81 | 18" Pipe | 3,279 | Columbia River | PLMc | \$109,665 | 74.7 | \$1,468 |
| 87 | W77E | 30" Pipe | 1,949 | Columbia River | PLMc | \$153,527 | 57.8 | \$2,656 |
| 87 | W77E | 24" Pipe | 1,134 | Columbia River | PLMc | \$58,754 | 29.1 | \$2,019 |
| 87 | W77E | 24" Pipe | 1,230 | Columbia River | PLMc | \$63,698 | 27.5 | \$2,316 |
| 87 | W77E | 18" Pipe | 954 | Columbia River | PLMc | \$31,921 | 17.6 | \$1,814 |
| 87 | W77A3 | 21" Pipe | 1,364 | Columbia River | PLMc | \$58,865 | 27 | \$2,180 |
| 87 | W77A1 | 27" Pipe | 1,188 | Columbia River | PLMc | \$75,657 | 32.1 | \$2,357 |
| 87 | W77A1 | 24" Pipe | 1,527 | Columbia River | PLMc | \$79,091 | 36 | \$2,197 |
| 87 | W77 | Huesker & Shotcrete | 761 | Columbia River | PLMc | \$67,944 | 35.5 | \$1,914 |
| 87 | W77 | Huesker & Shotcrete | 909 | Columbia River | PLMc | \$78,518 | 40.7 | \$1,929 |
| 87 | W77 | Huesker & Shotcrete | 1,091 | Columbia River | PLMc | \$65,515 | 30.8 | \$2,127 |
| 87 | W77 | Huesker & Shotcrete | 2,786 | Columbia River | PLMc | \$156,576 | 71.9 | \$2,178 |
| 87 | W77 | Huesker & Shotcrete | 4,200 | Columbia River | PLMc | \$222,687 | 100 | \$2,227 |
| 87 | W77 | Huesker & Shotcrete | 1,066 | Columbia River | PLMc | \$54,768 | 24.3 | \$2,254 |
| 87 | W77 | Huesker & Shotcrete | 668 | Columbia River | PLMc | \$28,635 | 11.6 | \$2,468 |
| 87 | W77 | Huesker & Shotcrete | 966 | Columbia River | PLMc | \$38,115 | 14.8 | \$2,575 |
| 87 | W77 | Huesker & Shotcrete | 625 | Columbia River | PLMc | \$22,762 | 8.4 | \$2,710 |
| 87 | W77 | Huesker & Shotcrete | 975 | Columbia River | PLMc | \$34,005 | 12.1 | \$2,810 |
| 87 | W74.6 | 36" Pipe | 2,220 | Columbia River | PLMc | \$206,020 | 74.4 | \$2,769 |
| 87 | W74.6 | 30" Pipe | 2,554 | Columbia River | PLMc | \$201,162 | 79 | \$2,546 |
| 87 | W74.6 | 30" Pipe | 1,227 | Columbia River | PLMc | \$96,659 | 33.1 | \$2,920 |
| 87 | W73.5 | 21" Pipe | 1,575 | Columbia River | PLMc | \$67,955 | 31.1 | \$2,185 |
| 87 | W72.5K | 24" Pipe | 1,564 | Columbia River | PLMc | \$81,008 | 37.9 | \$2,137 |
| 87 | W72.5K | 18" Pipe | 1,474 | Columbia River | PLMc | \$49,315 | 27.2 | \$1,813 |
| 87 | W72.5H | 24" Pipe | 2,562 | Columbia River | PLMc | \$132,712 | 62.2 | \$2,134 |
| 87 | W72.5H | 21" Pipe | 2,419 | Columbia River | PLMc | \$104,392 | 51 | \$2,047 |
| 87 | W72.5G | 24" Pipe | 535 | Columbia River | PLMc | \$27,696 | 12.6 | \$2,198 |
| 87 | W72.5G | 15" Pipe | 520 | Columbia River | PLMc | \$12,902 | 8.2 | \$1,573 |
| 87 | W72.5E | 21" Pipe | 1,488 | Columbia River | PLMc | \$64,206 | 33.2 | \$1,934 |
| 87 | W72.5D | 30" Pipe | 305 | Columbia River | PLMc | \$23,990 | 8.9 | \$2,696 |
| 87 | W72.5B | 21" Pipe | 1,783 | Columbia River | PLMc | \$76,962 | 39.8 | \$1,934 |
| 88 | Crab Creek Lateral | Rereg | | Columbia River | | TBD | TBD | - |
| | West Canal | Rereg | | Columbia River | | \$5,000,000 | 6000 | \$834 |
| | | TOTAL | 363,606 | | | \$30,864,985 | 22,758.3 | \$1,356 |

Table A-2a

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|------------|---------------------|-------------|---------------------|---------|----------------|------------------------------|---------------------|
| 45 | EL 68 | Check structures | | Potholes East Canal | | | | |
| 45 | EL 68 | Shotcrete | 1,500 | Potholes East Canal | PLMc | \$53,613 | 25 | \$2,145 |
| 45 | EL 68 | Pumpback | | Potholes East Canal | | | | |
| 45 | EL 68B1 | 15" Pipe | 500 | Potholes East Canal | Ql | \$12,386 | 26.2 | \$473 |
| 45 | EL 68B2 | 24" Pipe | 3,150 | Potholes East Canal | Ql | \$162,842 | 216 | \$754 |
| 45 | EL 68D | 15" Pipe | 1,000 | Potholes East Canal | Ql | \$24,771 | 54.3 | \$456 |
| 45 | EL 68H1 | 18" Pipe | 670 | Potholes East Canal | PLMc | \$22,369 | 13.2 | \$1,695 |
| 45 | EL 68H5 | 12" Pipe | 1,000 | Potholes East Canal | PLMc | \$18,309 | 14.4 | \$1,271 |
| 45 | EL 68K | 18" Pipe | 2,600 | Potholes East Canal | PLMc | \$86,806 | 54.7 | \$1,587 |
| 45 | EL 68KK | 12" Pipe | 1,900 | Potholes East Canal | PLMc | \$34,787 | 27.4 | \$1,270 |
| 45 | EL 68L1 | Shotcrete | 1,800 | Potholes East Canal | PLMc | \$58,520 | 20.6 | \$2,841 |
| 45 | EL 68L2 | 12" Pipe | 800 | Potholes East Canal | Qfg | \$14,647 | 28.8 | \$509 |
| 45 | EL 68T22 | 12" Pipe | 900 | Potholes East Canal | Qfg | \$16,478 | 35.6 | \$463 |
| 45 | EL 68T29 | 15" Pipe | 1,700 | Potholes East Canal | PLMc | \$42,111 | 26.8 | \$1,571 |
| 45 | EL 68T4 | 15" Pipe | 2,500 | Potholes East Canal | Qfg | \$61,928 | 126 | \$491 |
| 45 | EL 68T41 | 12" Pipe | 1,400 | Potholes East Canal | PLMc | \$25,633 | 18.4 | \$1,393 |
| 45 | EL 68T8 | 15" Pipe | 650 | Potholes East Canal | PLMc | \$16,101 | 11.1 | \$1,451 |
| 45 | EL 68V2 | 10" Pipe | 350 | Potholes East Canal | Qfg | \$5,277 | 11.3 | \$467 |
| 45 | EL 68V5 | 12" Pipe | 1,800 | Potholes East Canal | Qfg | \$32,956 | 71.2 | \$463 |
| 45 | | Rereg | | Potholes East Canal | | | | |
| 46 | EL 70.7 | 15" Pipe | 1,450 | Potholes East Canal | Ql | \$35,918 | 76 | \$473 |
| 46 | EL 71D | 18" Pipe | 1,150 | Potholes East Canal | Ql | \$38,395 | 69.5 | \$552 |
| 46 | EL 74.8A10 | 15" Pipe | 1,300 | Potholes East Canal | Ql | \$32,202 | 68.1 | \$473 |
| 46 | EL 74.8A2 | 12" Pipe | 1,300 | Potholes East Canal | Ql | \$2,380 | 6.3 | \$378 |
| 46 | EL 74.8A3 | 18" Pipe | 3,000 | Potholes East Canal | Ql | \$100,161 | 193.6 | \$517 |
| 46 | EL 74.8A9 | 15" Pipe | 2,600 | Potholes East Canal | Ql | \$64,405 | 157.2 | \$410 |
| 46 | EL 74.8B | 12" Pipe | 1,250 | Potholes East Canal | Ql | \$22,886 | 50.3 | \$455 |
| 46 | EL 74.8BB | 15" Pipe | 850 | Potholes East Canal | Ql | \$21,055 | 41.1 | \$512 |
| 46 | EL 74.8L1 | 18" Pipe | 1,200 | Potholes East Canal | PLMc | \$40,064 | 22.1 | \$1,813 |
| 46 | EL 76A | 10" Pipe | 2,700 | Potholes East Canal | Qa | \$40,711 | 82.5 | \$493 |
| 46 | EL 81A | 10" Pipe | 3,500 | Potholes East Canal | Ql | \$52,773 | 155.1 | \$340 |
| 46 | EL 81B | 15" Pipe | 2,500 | Potholes East Canal | Ql | \$61,928 | 141.1 | \$439 |
| 46 | EL 81D | 15" Pipe | 2,600 | Potholes East Canal | Ql | \$64,405 | 125.7 | \$512 |
| 46 | EL 81F | 18" Pipe | 2,700 | Potholes East Canal | Ql | \$90,145 | 152.4 | \$592 |
| 46 | EL 82E | 15" Pipe | 3,000 | Potholes East Canal | Ql | \$74,313 | 132.9 | \$559 |
| 46 | EL 82G1 | 21" Pipe | 1,800 | Potholes East Canal | Ql | \$77,544 | 123.4 | \$628 |
| 46 | EL 82H | 21" Pipe | 1,850 | Potholes East Canal | Ql | \$79,698 | 126.8 | \$629 |
| 46 | EL 82HH | 21" Pipe | 1,000 | Potholes East Canal | Ql | \$43,080 | 68.6 | \$628 |
| 47 | EL 85C10 | 12" Pipe | 1,100 | Potholes East Canal | Ql | \$20,140 | 53.2 | \$379 |
| 47 | EL 85C10 | 15" Pipe | 700 | Potholes East Canal | Ql | \$17,340 | 49.4 | \$351 |
| 47 | EL 85C10 | 18" Pipe | 1,000 | Potholes East Canal | Ql | \$33,387 | 74.5 | \$448 |
| 47 | EL 85C15 | Shotcrete | 3,960 | Potholes East Canal | PLMc | \$162,170 | 69.8 | \$2,323 |

Table A-2a

Long Term Projects - East District - Blocks 45-49

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|-----------|---------------------|-------------|---------------------|---------|----------------|------------------------------|---------------------|
| 47 | EL 85C16 | 15" Pipe | 1,700 | Potholes East Canal | PLMc | \$42,111 | 29 | \$1,452 |
| 47 | EL 85C9 | 15" Pipe | 1,350 | Potholes East Canal | Ql | \$33,441 | 76.2 | \$439 |
| 47 | EL 85F4 | Shotcrete | 1,340 | Potholes East Canal | Ql | \$50,546 | 78.7 | \$642 |
| 47 | EL 85H | 15" Pipe | 1,200 | Potholes East Canal | Ql | \$29,725 | 58 | \$513 |
| 49 | PE 14.7 | 12" Pipe | 1,800 | Columbia River | Qa | \$32,956 | 66.1 | \$499 |
| 49 | PE 14.7 | 30" Slipline | 260 | Columbia River | PLMc | \$49,865 | 3.7 | \$13,477 |
| 49 | PE 14.7 | Shotcrete | 3,670 | Columbia River | Qa | \$243,084 | 356.5 | \$682 |
| 49 | PE 14.7 | Shotcrete | 2,060 | Columbia River | PLMc | \$136,526 | 68.7 | \$1,987 |
| 49 | PE 14.7 | Shotcrete | 3,400 | Columbia River | PLMc | \$225,333 | 110.2 | \$2,045 |
| 49 | PE 14.7 | Shotcrete | 5,480 | Columbia River | PLMc | \$334,635 | 167.1 | \$2,003 |
| 49 | PE 14.7 | Shotcrete | 2,740 | Columbia River | PLMc | \$158,464 | 77.1 | \$2,055 |
| 49 | PE 14.7 | Shotcrete | 3,690 | Columbia River | PLMc | \$163,035 | 73.8 | \$2,209 |
| 49 | PE 14.7H | 18" Pipe | 1,576 | Columbia River | PLMc | \$52,618 | 17.7 | \$2,973 |
| 49 | PE 14.7H1 | 18" Slipline | 4,950 | Columbia River | Qa | \$581,580 | 41.8 | \$13,913 |
| 49 | PE 16 | 15" Pipe | 1,000 | Columbia River | PLMc | \$24,771 | 14.4 | \$1,720 |
| 49 | PE 16.4 | Shotcrete | 2,308 | Columbia River | PLMc | \$154,610 | 92.7 | \$1,668 |
| 49 | PE 16.4 | Shotcrete | 5,675 | Columbia River | PLMc | \$501,477 | 270.5 | \$1,854 |
| 49 | PE 16.4 | Shotcrete | 3,760 | Columbia River | PLMc | \$312,667 | 168.5 | \$1,856 |
| 49 | PE 16.4 | Shotcrete | 1,977 | Columbia River | Qfs | \$141,325 | 185 | \$764 |
| 49 | PE 16.4 | Shotcrete | 296 | Columbia River | Qfs | \$19,618 | 24.2 | \$811 |
| 49 | PE 16.4 | Shotcrete | 2,555 | Columbia River | Qfs | \$169,331 | 227.1 | \$746 |
| 49 | PE 16.4 | Shotcrete | 800 | Columbia River | Qfs | \$39,514 | 46.8 | \$844 |
| 49 | PE 16.4 | Shotcrete | 3,577 | Columbia River | Qfs | \$158,042 | 184 | \$859 |
| 49 | PE 16.4 | Shotcrete | 1,133 | Columbia River | PLMc | \$44,157 | 21.6 | \$2,044 |
| 49 | PE 16.4 | Shotcrete | 1,179 | Columbia River | Qfg | \$48,282 | 82.1 | \$588 |
| 49 | PE 16.4 | Shotcrete | 1,100 | Columbia River | Qfg | \$45,048 | 73 | \$617 |
| 49 | PE 16.4 | Shotcrete | 530 | Columbia River | Qa | \$17,231 | 25.3 | \$681 |
| 49 | PE 16.4 | Shotcrete | 768 | Columbia River | Qa | \$20,967 | 28.2 | \$744 |
| 49 | PE 16.4B | 10" Pipe | 2,300 | Columbia River | Qfg | \$34,679 | 74.4 | \$466 |
| 49 | PE 16.4B1 | 10" Pipe | 1,300 | Columbia River | Qfg | \$19,601 | 46.7 | \$420 |
| 49 | PE 16.4B1 | 18" Pipe | 350 | Columbia River | Qfg | \$11,685 | 17.6 | \$664 |
| 49 | PE 16.4B2 | Shotcrete | 3,000 | Columbia River | Qfg | \$111,164 | 179.8 | \$618 |
| 49 | PE 16.4D | 15" Pipe | 2,700 | Columbia River | Qfg | \$66,882 | 136 | \$492 |
| 49 | PE 16.4D | 12" Pipe | 1,550 | Columbia River | Qfg | \$28,379 | 55.7 | \$509 |
| 49 | PE 16.4N | 15" Pipe | 1,800 | Columbia River | Qfs | \$44,588 | 63.2 | \$706 |
| 49 | PE 16.4P | 18" Pipe | 1,040 | Columbia River | Qfs | \$34,722 | 42.1 | \$825 |
| 49 | PE 16.4PP | 15" Pipe | 300 | Columbia River | Qfs | \$7,431 | 9.7 | \$766 |
| 49 | PE 16.4U | 15" Pipe | 600 | Columbia River | Qfg | \$14,863 | 21.6 | \$688 |
| 49 | PE 16.4U | Shotcrete | 2,000 | Columbia River | Qfg | \$75,442 | 110.2 | \$685 |
| 49 | PE 17 | 24" Pipe | 2,000 | Columbia River | PLMc | \$103,392 | 36.8 | \$2,810 |
| 49 | PE 17B | 10" Pipe | 1,200 | Columbia River | Qfg | \$18,094 | 38.8 | \$466 |

| | | | | | | | | |
|----|---------|----------|-------|----------------|------|----------|------|---------|
| 49 | PE 17D2 | 18" Pipe | 1,300 | Columbia River | PLMc | \$43,403 | 23.9 | \$1,816 |
|----|---------|----------|-------|----------------|------|----------|------|---------|

Table A-2a

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|----------------|----------------|---------|--------------------|------------------------------|---------------------|
| 49 | PE 20C3 | 15" Pipe | 800 | Columbia River | Qfg | \$19,817 | 31.6 | \$627 |
| 49 | | Rereg | | Columbia River | | | | |
| | | TOTAL | 149,674 | | | \$6,329,735 | 6,376.7 | \$993 |

Table A-2a

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|-----------|---------------------|-------------|--------------------|---------|----------------|------------------------------|---------------------|
| 40 | EL 6.9 | 27"-39" Pipe | 5760 | Potholes Reservoir | | | | |
| 40 | EL 6.9F | 12" Pipe | 1000 | Potholes Reservoir | | \$ 18,310 | 36 | \$509 |
| 40 | EL 6.9H1 | 30" Pipe | 850 | Potholes Reservoir | | \$ 43,945 | 13 | \$3,380 |
| 40 | EL 7.6 | Shotcrete | 7900 | Potholes Reservoir | | \$ 67,957 | 50 | \$1,359 |
| 40 | EL 16G1 | Shotcrete | 2600 | Potholes Reservoir | | \$ 43,148 | 110 | \$394 |
| 40 | EL 18 | 36"-39" Pipe | 9450 | Potholes Reservoir | | | | |
| 40 | EL 22 | Shotcrete | 2000 | Potholes Reservoir | | \$ 21,574 | 8 | \$2,697 |
| 41 | EL 20N | 12" PVC | 1280 | Potholes Reservoir | | \$ 23,437 | 55 | \$425 |
| 41 | EL 20S | 15" PVC | 3000 | Potholes Reservoir | | \$ 74,310 | 152 | \$490 |
| 41 | EL 28A | 15" PVC | 1000 | Potholes Reservoir | | \$ 24,770 | 27 | \$922 |
| 41 | EL 20 | 21" PVC | 1625 | Potholes Reservoir | | \$ 70,005 | 105 | \$666 |
| 41 | EL 20ZF | 12" PVC | 1300 | Potholes Reservoir | | \$ 23,803 | 47 | \$511 |
| 41 | EL 29 | Shotcrete | 1000 | Potholes Reservoir | | \$ 48,541 | 301 | \$161 |
| 41 | EL 29 | Shotcrete | 1500 | Potholes Reservoir | | \$ 80,902 | 198 | \$409 |
| 41 | EL 29 | Pumpback | | Potholes Reservoir | | | | |
| 41 | EL 31B | 18" PVC | 1250 | Potholes Reservoir | | \$ 41,738 | 95 | \$440 |
| 421 | EL 29 | Shotcrete | 800 | Potholes Reservoir | | \$ 30,203 | 148 | \$204 |
| 421 | EL 29 | Shotcrete | 550 | Potholes Reservoir | | \$ 21,574 | 103 | \$209 |
| 42 | ELC | Shotcrete | 2500 | Potholes Reservoir | | \$ 355,967 | 265 | \$1,343 |
| 42 | EL 29HH | Shotcrete | 3000 | Potholes Reservoir | | \$ 17,259 | 84 | \$206 |
| 42 | EL 29K | 15" PVC | 960 | Potholes Reservoir | | \$ 23,779 | 23 | \$1,021 |
| 42 | EL 29L4 | 15" PVC | 1500 | Potholes Reservoir | | \$ 37,155 | 57 | \$653 |
| 42 | EL 29L5 | 12" PVC | 1300 | Potholes Reservoir | | \$ 23,803 | 39 | \$611 |
| 42 | EL 29L9 | 15" Pipe | 2200 | Potholes Reservoir | | \$ 54,494 | 66 | \$826 |
| 42 | EL 29N3 | 15" PVC | 2700 | Potholes Reservoir | | \$ 66,879 | 46 | \$1,449 |
| 42 | EL 29RWW | Rereg | | Potholes Reservoir | | | | |
| 42 | EL 29S | 15" PVC | 3000 | Potholes Reservoir | | \$ 74,310 | 81 | \$922 |
| 42 | EL 29S | 12" PVC | 2300 | Potholes Reservoir | | \$ 42,113 | 62 | \$682 |
| 42 | EL 29U1 | 15" PVC | 3000 | Potholes Reservoir | | \$ 74,310 | 152 | \$490 |
| 42 | EL 29W | 15" PVC | 1700 | Potholes Reservoir | | \$ 42,109 | 86 | \$490 |
| 42 | EL 29W | 12" PVC | 1200 | Potholes Reservoir | | \$ 21,972 | 61 | \$362 |
| 42 | EL 29X | 12" PVC | 2800 | Potholes Reservoir | | \$ 51,268 | 121 | \$425 |
| 42 | EL 29V | 10" PVC | 650 | Potholes Reservoir | | \$ 9,802 | 21 | \$468 |
| 42 | EL 29N8 | 15" PVC | 1350 | Potholes Reservoir | | \$ 33,440 | 18 | \$1,895 |
| 42 | EL 29N2 | 12" PVC | 1000 | Potholes Reservoir | | \$ 18,310 | 27 | \$682 |
| 42 | EL 29ZE2 | 15" PVC | 1350 | Potholes Reservoir | | \$ 33,440 | 54 | \$620 |
| 42 | EL 29ZA1 | 12" PVC | 3000 | Potholes Reservoir | | \$ 54,930 | 107 | \$511 |
| 42 | EL 29ZA2 | 15" PVC | 3200 | Potholes Reservoir | | \$ 79,264 | 138 | \$575 |
| 42 | EL 36 | 12" PVC | 1200 | Potholes Reservoir | | \$ 21,972 | 32 | \$682 |
| 42 | EL 36.3F | 10" PVC | 2650 | Potholes Reservoir | | \$ 39,962 | 64 | \$624 |
| 42 | EL 36.3F1 | 15" PVC | 970 | Potholes Reservoir | | \$ 24,027 | 34 | \$705 |
| 42 | EL 36.3F2 | 24" Pipe | 2600 | Potholes Reservoir | | \$ 134,420 | 130 | \$1,034 |

Table A-2b

Long Term Projects - East District - Blocks 40-44

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|-----------|---------------------|-------------|---------------------|---------|----------------|------------------------------|---------------------|
| 42 | EL 36.3J | 12" PVC | 1330 | Potholes Reservoir | | \$ 24,352 | 40 | \$611 |
| 42 | RCD | Rereg | | Potholes Reservoir | | | | |
| 42 | EL 39 | Shotcrete | 900 | Potholes Reservoir | | \$ 16,180 | 45 | \$356 |
| 43 | EL 41 | 15" PVC | 150 | Potholes Reservoir | | \$ 3,716 | 6 | \$653 |
| 43 | EL 42 | 24" PVC | 4400 | Potholes Reservoir | | \$ 227,480 | 232 | \$981 |
| 43 | EL 43 | 24" PVC | 4000 | Potholes Reservoir | | \$ 206,800 | 199 | \$1,037 |
| 43 | EL 44 | 18" PVC | 1350 | Potholes Reservoir | | \$ 45,077 | 51 | \$880 |
| 43 | EL 45 | 15" PVC | 1500 | Potholes Reservoir | | \$ 37,155 | 162 | \$229 |
| 43 | EL 45A | 24" PVC | 1400 | Potholes Reservoir | | \$ 72,380 | 51 | \$1,426 |
| 43 | EL 45A | 15" PVC | 2400 | Potholes Reservoir | | \$ 59,448 | 87 | \$683 |
| 43 | EL 45A | 12" PVC | 3800 | Potholes Reservoir | | \$ 69,578 | 138 | \$505 |
| 43 | EL 45F2 | 10" PVC | 2600 | Potholes Reservoir | | \$ 39,208 | 70 | \$561 |
| 43 | EL 45BB | 15" PVC | 2050 | Potholes Reservoir | | \$ 50,779 | 66 | \$767 |
| 43 | EL 45CC | 12" PVC | 200 | Potholes Reservoir | | \$ 3,662 | 5 | \$682 |
| 43 | EL 45D | 15" PVC | 2700 | Potholes Reservoir | | \$ 66,879 | 117 | \$572 |
| 43 | EL 45B | 15" PVC | 1700 | Potholes Reservoir | | \$ 42,109 | 60 | \$705 |
| 43 | EL 45B4 | 18" PVC | 1000 | Potholes Reservoir | | \$ 33,390 | 27 | \$1,243 |
| 43 | EL 45J | 12" PVC | 430 | Potholes Reservoir | | \$ 7,873 | 12 | \$682 |
| 43 | EL 45F1 | 10" PVC | 1450 | Potholes Reservoir | | \$ 21,866 | 55 | \$398 |
| 43 | EL 45H | 15" Pipe | 2000 | Potholes Reservoir | | \$ 49,540 | 54 | \$922 |
| 43 | EL 48 | 18" Pipe | 1200 | Potholes Reservoir | | \$ 40,068 | 32 | \$1,243 |
| 43 | EL 48 | 12" Pipe | 2700 | Potholes Reservoir | | \$ 49,437 | 73 | \$682 |
| 43 | EL 49 | 24" PVC | 3500 | Potholes Reservoir | | \$ 180,950 | 236 | \$767 |
| 43 | EL 52 | 12" Pipe | 1400 | Potholes Reservoir | | \$ 25,634 | 49 | \$521 |
| 43 | EL 52 | 12" Pipe | 2200 | Potholes Reservoir | | \$ 40,282 | 77 | \$521 |
| 43 | EL 53 | 15" Pipe | 500 | Potholes Reservoir | | \$ 12,385 | 13 | \$922 |
| 43 | EL 53 | 12" Pipe | 1000 | Potholes Reservoir | | \$ 18,310 | 27 | \$682 |
| 43 | EL 53 | 10" Pipe | 1800 | Potholes Reservoir | | \$ 27,144 | 48 | \$561 |
| 43 | EL 55A | 15" PVC | 500 | Potholes Reservoir | | \$ 12,385 | 12 | \$1,025 |
| 43 | EL 55B | 12" PVC | 2500 | Potholes Reservoir | | \$ 45,775 | 88 | \$521 |
| 43 | EL 55.8 | Shotcrete | 1500 | Potholes Reservoir | | \$ 53,934 | 154 | \$351 |
| 44 | EL 56 | 12" PVC | 950 | Potholes Reservoir | | \$ 17,395 | 39 | \$451 |
| 44 | EL 60.6 | Shotcrete | 7000 | Potholes Reservoir | | \$ 172,590 | 800 | \$216 |
| 44 | EL 60.6C | 12" PVC | 900 | Potholes Reservoir | | \$ 16,479 | 22 | \$757 |
| 44 | EL 63B | 15" PVC | 3200 | Potholes Reservoir | | \$ 79,264 | 121 | \$653 |
| 44 | EL 63.1B1 | 12" PVC | 2600 | Potholes Reservoir | | \$ 47,606 | 70 | \$682 |
| 44 | EL 63.1C1 | 10" PVC | 1650 | Potholes Reservoir | | \$ 24,882 | 44 | \$561 |
| 44 | EL 63.8D1 | 12" PVC | 1500 | Potholes Reservoir | | \$ 27,465 | 45 | \$611 |
| 44 | EL 63.8D | 18" Pipe | 2000 | Potholes Reservoir | | \$ 66,780 | 100 | \$670 |
| 44 | EL 63.8D | 12" Pipe | 2200 | Potholes Reservoir | | \$ 40,282 | 110 | \$367 |
| 44 | EL 63.8E1 | 15" PVC | 3000 | Potholes East Canal | | \$ 74,310 | 134 | \$553 |

| | | | | | | | | |
|----|-----------|------------------|------|--------------------|----|--------|-----|-------|
| 44 | EL 63.8F3 | 15" Pipe assumed | 3750 | Potholes Reservoir | \$ | 92,888 | 101 | \$922 |
|----|-----------|------------------|------|--------------------|----|--------|-----|-------|

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|--------------------|---------------------|----------------|---------------------|---------|----------------------|------------------------------|---------------------|
| 44 | EL 66B | 18" PVC | 1200 | Potholes East Canal | | \$ 40,068 | 24 | \$1,689 |
| 44 | EL 66 | 12" PVC | 1200 | Potholes East Canal | | \$ 21,972 | 16 | \$1,401 |
| 44 | Warden Coulee | Rereg | | Potholes East Canal | | \$ 6,691,525 | 7900 | \$847 |
| 44 | EL66WW | Rereg | | Potholes East Canal | | | | |
| 40-49 | East Low Canal | Lining | | Potholes Res/Canal | | | | |
| 40-49 | Pump Modernization | Pumps | | Potholes Res/Canal | | | | |
| | | TOTAL | 174,305 | | | \$ 10,966,481 | 15,023.8 | \$730 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 11 | PE17 | 27" Pipe | 463 | Columbia River | PLMc | \$28,940 | 12.5 | \$2,315 |
| 11 | PE17 | 24" Pipe | 872 | Columbia River | PLMc | \$45,094 | 21.2 | \$2,127 |
| 11 | PE17 | 18" Pipe | 2,704 | Columbia River | PLMc | \$90,278 | 49.7 | \$1,816 |
| 11 | PE17 | 24" Pipe | 2,117 | Columbia River | PLMc | \$109,465 | 54.2 | \$2,020 |
| 11 | PE17 | 24" Pipe | 2,895 | Columbia River | PLMc | \$149,672 | 70.3 | \$2,129 |
| 11 | PE17 | 24" Pipe | 3,174 | Columbia River | PLMc | \$164,083 | 70.9 | \$2,314 |
| 11 | PE17 | 27" Pipe | 2,693 | Columbia River | PLMc | \$168,244 | 14.4 | \$11,684 |
| 11 | PE17 | 27" Pipe | 2,610 | Columbia River | PLMc | \$163,013 | 14.8 | \$11,014 |
| 11 | PE25.9 | 18" Pipe | 2,304 | Columbia River | Qfg | \$76,924 | 116.1 | \$663 |
| 11 | PE27A5 | 15" Pipe | 879 | Columbia River | Qfg | \$21,774 | 53.8 | \$405 |
| 12 | PE35.8C | 18" Pipe | 1,227 | Columbia River | Qfg | \$40,966 | 57.4 | \$714 |
| 12 | PE35.8C | 18" Pipe | 1,693 | Columbia River | Qfg | \$56,511 | 85.3 | \$663 |
| 12 | PE35.8C | 27" Pipe | 1,301 | Columbia River | Qfg | \$81,293 | 96 | \$847 |
| 12 | PE36 | 18" Pipe | 342 | Columbia River | Qfg | \$11,416 | 16 | \$714 |
| 12 | PE36 | 27" Pipe | 276 | Columbia River | Qfg | \$17,269 | 20.4 | \$847 |
| 12 | PE36 | 27" Pipe | 325 | Columbia River | Qfg | \$20,293 | 25.1 | \$808 |
| 12 | PE36 | 18" Pipe | 1,055 | Columbia River | Qfg | \$35,239 | 58.8 | \$599 |
| 12 | PE36 | 15" Pipe | 2,413 | Columbia River | Qfg | \$59,777 | 104.2 | \$574 |
| 12 | PE36A | 15" Pipe | 1,290 | Columbia River | Qfg | \$31,957 | 55.7 | \$574 |
| 12 | PE37.9 | 18" Pipe | 1,069 | Columbia River | Qfg | \$35,699 | 50 | \$714 |
| 12 | PE37.9 | 21" Pipe | 1,921 | Columbia River | Qfg | \$82,767 | 103.7 | \$798 |
| 12 | PE38B | 21" Pipe | 35 | Columbia River | Qfg | \$1,497 | 2.2 | \$680 |
| 12 | PE38B | 27" Pipe | 105 | Columbia River | Qfg | \$6,559 | 7.7 | \$852 |
| 12 | PE38B | 27" Pipe | 660 | Columbia River | Qfg | \$41,228 | 51.1 | \$807 |
| 12 | PE38B | 18" Pipe | 1,118 | Columbia River | Qfg | \$37,327 | 52.3 | \$714 |
| 12 | PE38B | 24" Pipe | 1,795 | Columbia River | Qfg | \$92,794 | 126 | \$736 |
| 12 | PE38BB | 12" Pipe | 508 | Columbia River | PLMc | \$9,301 | 6.7 | \$1,388 |
| 12 | PE39 | 27" Pipe | 224 | Columbia River | Qfg | \$13,961 | 17.3 | \$807 |
| 12 | PE39 | 18" Pipe | 987 | Columbia River | Qfg | \$32,956 | 49.7 | \$663 |
| 12 | PE39 | 12" Pipe | 1,528 | Columbia River | Qfg | \$27,974 | 54.9 | \$510 |
| 12 | PE39 | 18" Pipe | 2,380 | Columbia River | Qfg | \$79,461 | 128.5 | \$618 |
| 12 | PE40.5 | 15" Pipe | 1,404 | Columbia River | Qfg | \$34,776 | 55.5 | \$627 |
| 12 | PE40.5 | 15" Pipe | 1,576 | Columbia River | Qfg | \$39,032 | 68 | \$574 |
| 12 | PE40.5 | 24" Pipe | 1,284 | Columbia River | PLMc | \$66,367 | 32.9 | \$2,017 |
| 13 | PE38.9 | 18" Pipe | 2,308 | Columbia River | Mv | \$77,064 | 53.4 | \$1,443 |
| 13 | PE38.9E | 18" Pipe | 567 | Columbia River | Qfg | \$18,914 | 28.5 | \$664 |
| 13 | PE38.9E | 27" Pipe | 954 | Columbia River | Qfg | \$59,593 | 73.8 | \$807 |
| 13 | PE38.9E | 24" Pipe | 3,092 | Columbia River | Qfg | \$159,844 | 217 | \$737 |
| 13 | PE38.9E | 24" Pipe | 4,214 | Columbia River | Qfg | \$217,821 | 265.2 | \$821 |
| 13 | PE38.9E2 | 18" Pipe | 139 | Columbia River | Qfg | \$4,650 | 7 | \$664 |
| 13 | PE38.9E2 | 24" Pipe | 1,948 | Columbia River | Mv | \$100,704 | 67.7 | \$1,488 |
| 13 | PE38.9E8 | 18" Pipe | 1,850 | Columbia River | Qfg | \$61,778 | 86.6 | \$713 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|-----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 13 | PE38.9E8 | 15" Pipe | 2,344 | Columbia River | Qfg | \$58,055 | 109.6 | \$530 |
| 13 | PE38.9F | 21" Pipe | 1,619 | Columbia River | Mv | \$69,725 | 46.2 | \$1,509 |
| 13 | PE38.9F | 21" Pipe | 1,787 | Columbia River | Qfg | \$76,962 | 102.9 | \$748 |
| 13 | PE38.9L | 24" Pipe | 1,118 | Columbia River | Qfg | \$57,811 | 72.5 | \$797 |
| 13 | PE38.9L | 27" Pipe | 1,000 | Columbia River | Qfg | \$62,466 | 77.4 | \$807 |
| 13 | PE38.9L | 18" Pipe | 2,745 | Columbia River | Qfg | \$91,654 | 128.4 | \$714 |
| 13 | PE38.9L | 27" Pipe | 2,294 | Columbia River | Qfg | \$143,297 | 177.5 | \$807 |
| 13 | PE38.9L | 27" Pipe | 2,524 | Columbia River | Qfg | \$157,654 | 186.2 | \$847 |
| 13 | PE38.9L | 27" Pipe | 4,600 | Columbia River | Qfg | \$287,344 | 356 | \$807 |
| 13 | PE38.9P | 24" Pipe | 629 | Columbia River | Mv | \$32,517 | 19.1 | \$1,702 |
| 13 | PE38.9P | 21" Pipe | 1,315 | Columbia River | Qfg | \$56,646 | 75.7 | \$748 |
| 13 | PE38.9P2 | 18" Pipe | 869 | Columbia River | Mv | \$28,997 | 21.7 | \$1,336 |
| 13 | PE38.9P2 | 27" Pipe | 690 | Columbia River | Qfg | \$43,102 | 50.9 | \$847 |
| 13 | PE38.9P2 | 21" Pipe | 2,442 | Columbia River | Qfg | \$105,180 | 149.5 | \$704 |
| 13 | PE38.9Q | 15" Pipe | 355 | Columbia River | Qfg | \$8,803 | 15.3 | \$575 |
| 13 | PE38.9T | 15" Pipe | 819 | Columbia River | Mv | \$20,276 | 16 | \$1,267 |
| 13 | PE38.9X | 18" Pipe | 2,052 | Columbia River | Mv | \$68,494 | 47.5 | \$1,442 |
| 13 | PE38.9X | 27" Pipe | 1,333 | Columbia River | Mv | \$83,236 | 51 | \$1,632 |
| 13 | PE38.9X2 | 15" Pipe | 458 | Columbia River | Mv | \$11,345 | 10.6 | \$1,070 |
| 13 | PE38.9Z | 24" Pipe | 1,971 | Columbia River | Qfg | \$101,904 | 131.2 | \$777 |
| 13 | PE38.9Z | 21" Pipe | 2,306 | Columbia River | Qfg | \$99,351 | 132.9 | \$748 |
| 13 | PE38.9Z | 24" Pipe | 2,128 | Columbia River | Mv | \$109,998 | 70.1 | \$1,569 |
| 14 | PE38.9B1 | 24" Pipe | 1,854 | Columbia River | PLMc | \$95,850 | 47.5 | \$2,018 |
| 14 | PE38.9B1 | 24" Pipe | 3,417 | Columbia River | PLMc | \$176,630 | 87.5 | \$2,019 |
| 14 | PE38.9B15 | 21" Pipe | 644 | Columbia River | PLMc | \$27,744 | 12.7 | \$2,185 |
| 14 | PE38.9B17 | 21" Pipe | 1,340 | Columbia River | PLMc | \$57,708 | 30.8 | \$1,874 |
| 14 | PE38.9B17 | 18" Pipe | 2,436 | Columbia River | PLMc | \$81,318 | 44.8 | \$1,815 |
| 14 | PE38.9B17 | 27" Pipe | 3,335 | Columbia River | PLMc | \$208,353 | 89.8 | \$2,320 |
| 14 | PE38.9B17 | 27" Pipe | 4,872 | Columbia River | PLMc | \$304,303 | 137.6 | \$2,212 |
| 14 | PE38.9B28 | 15" Pipe | 1,596 | Columbia River | PLMc | \$39,535 | 27.3 | \$1,448 |
| 14 | PE38.9B3 | 18" Pipe | 241 | Columbia River | PLMc | \$8,045 | 4.4 | \$1,828 |
| 14 | PE38.9B3 | 21" Pipe | 1,020 | Columbia River | PLMc | \$43,944 | 22.1 | \$1,988 |
| 14 | PE38.9B3 | 21" Pipe | 2,854 | Columbia River | PLMc | \$122,950 | 65.6 | \$1,874 |
| 14 | PE38.9B38 | 18" Pipe | 773 | Columbia River | PLMc | \$25,821 | 16.8 | \$1,537 |
| 14 | PE38.9B4 | 24" Pipe | 150 | Columbia River | PLMc | \$7,754 | 4 | \$1,939 |
| 14 | PE38.9B4 | 18" Pipe | 1,625 | Columbia River | PLMc | \$54,254 | 27.7 | \$1,959 |
| 14 | PE38.9B4 | 21" Pipe | 2,215 | Columbia River | PLMc | \$95,431 | 46.6 | \$2,048 |
| 14 | PE38.9B5 | 24" Pipe | 2,026 | Columbia River | PLMc | \$104,727 | 46.5 | \$2,252 |
| 14 | PE38.9B6A | 18" Pipe | 1,396 | Columbia River | PLMc | \$46,608 | 25.7 | \$1,814 |
| 15 | PE47AA | 18" Pipe | 175 | Columbia River | Qds | \$5,843 | 13.8 | \$423 |
| 15 | PE47AA | 24" Pipe | 1,274 | Columbia River | Qds | \$65,861 | 87.3 | \$754 |
| 15 | PE47AA | 21" Pipe | 2,004 | Columbia River | Qds | \$86,337 | 137.4 | \$628 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 15 | PE47B | 27" Pipe | 2,647 | Columbia River | Qds | \$165,329 | 218.7 | \$756 |
| 15 | PE47D | 15" Pipe | 2,472 | Columbia River | Qds | \$61,232 | 109.5 | \$559 |
| 15 | PE47D | 24" Pipe | 3,355 | Columbia River | Qds | \$173,445 | 263.7 | \$658 |
| 15 | PE47G | 15" Pipe | 190 | Columbia River | Qds | \$4,706 | 9.2 | \$512 |
| 15 | PE47H | 21" Pipe | 2,612 | Columbia River | Qds | \$112,525 | 168.5 | \$668 |
| 15 | PE47J | 18" Pipe | 1,217 | Columbia River | Qds | \$40,632 | 68.7 | \$591 |
| 15 | PE47J | 27" Pipe | 5,669 | Columbia River | Qds | \$354,120 | 468.4 | \$756 |
| 15 | PE47J1 | 15" Pipe | 1,308 | Columbia River | Qds | \$32,406 | 63.3 | \$512 |
| 15 | PE47J1 | 24" Pipe | 1,295 | Columbia River | Qds | \$66,946 | 94 | \$712 |
| 15 | PE47J1 | 27" Pipe | 1,365 | Columbia River | Qds | \$85,266 | 118.3 | \$721 |
| 15 | PE47J2 | 15" Pipe | 982 | Columbia River | Qds | \$24,325 | 47.5 | \$512 |
| 15 | PE47J2 | 21" Pipe | 1,329 | Columbia River | Qds | \$57,236 | 85.7 | \$668 |
| 15 | PE47J2 | 27" Pipe | 1,300 | Columbia River | Qds | \$81,206 | 112.7 | \$721 |
| 15 | PE47J3 | 12" Pipe | 2,418 | Columbia River | Qds | \$44,263 | 97.3 | \$455 |
| 15 | PE47J3 | 27" Pipe | 1,920 | Columbia River | Qds | \$119,935 | 158.7 | \$756 |
| 15 | PE47J6 | 21" Pipe | 734 | Columbia River | Qds | \$31,621 | 44.4 | \$712 |
| 15 | PE47L | 21" Pipe | 1,380 | Columbia River | Qds | \$59,450 | 66.7 | \$891 |
| 15 | PE47L | 21" Pipe | 1,340 | Columbia River | Qds | \$57,736 | 110.7 | \$522 |
| 15 | PE47L | 27" Pipe | 1,228 | Columbia River | Qds | \$76,677 | 123.7 | \$620 |
| 15 | PE47N | 24" Pipe | 2,611 | Columbia River | Qds | \$134,978 | 215.8 | \$625 |
| 15 | PE47N3 | 15" Pipe | 331 | Columbia River | Qds | \$8,199 | 18.7 | \$438 |
| 15 | PE47P | 15" Pipe | 2,656 | Columbia River | Qds | \$65,801 | 128.4 | \$512 |
| 15 | PE47P | 21" Pipe | 2,608 | Columbia River | Qds | \$112,331 | 168.2 | \$668 |
| 15 | PE47Q | 15" Pipe | 1,316 | Columbia River | Qds | \$32,591 | 58.3 | \$559 |
| 15 | PE47Q | 24" Pipe | 1,344 | Columbia River | Qds | \$69,485 | 100.2 | \$693 |
| 15 | PE47Q | 27" Pipe | 1,290 | Columbia River | Qds | \$80,581 | 111.8 | \$721 |
| 15 | PE47Q1 | 18" Pipe | 794 | Columbia River | Qds | \$26,500 | 41.6 | \$637 |
| 15 | PE47Q1 | 24" Pipe | 3,478 | Columbia River | Qds | \$179,788 | 238.4 | \$754 |
| 15 | PE47Q2 | 27" Pipe | 995 | Columbia River | Qds | \$62,152 | 82.2 | \$756 |
| 15 | PE47Q2 | 21" Pipe | 2,579 | Columbia River | Qds | \$111,095 | 156 | \$712 |
| 15 | PE47X | 15" Pipe | 477 | Columbia River | Qds | \$11,804 | 30.7 | \$384 |
| 15 | PE47Y | 24" Pipe | 787 | Columbia River | Qds | \$40,685 | 61.8 | \$658 |
| 15 | PE51 | 24" Pipe | 79 | Columbia River | Qds | \$4,065 | 6.2 | \$656 |
| 15 | PE51 | 21" Pipe | 604 | Columbia River | Qds | \$26,016 | 36.5 | \$713 |
| 15 | PE51A | 21" Pipe | 739 | Columbia River | Qds | \$31,823 | 58.1 | \$548 |
| 15 | PE51A | 27" Pipe | 3,629 | Columbia River | Qds | \$226,664 | 299.8 | \$756 |
| 15 | PE51A1 | 15" Pipe | 672 | Columbia River | Qds | \$16,646 | 29.8 | \$559 |
| 15 | PE51C | 15" Pipe | 691 | Columbia River | Qds | \$17,117 | 33.4 | \$512 |
| 15 | PE56A | 18" Pipe | 1,407 | Columbia River | Qds | \$46,976 | 87.8 | \$535 |
| 15 | PE60 | 27" Pipe | 1,417 | Columbia River | Qds | \$88,520 | 117.1 | \$756 |
| 15 | PE60 | 15" Pipe | 3,004 | Columbia River | Qds | \$74,417 | 145.3 | \$512 |
| 15 | PE64 | 24" Pipe | 3,704 | Columbia River | Qds | \$191,456 | 276.1 | \$693 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 15 | PE64A | 12" Pipe | 493 | Columbia River | Qds | \$9,018 | 19.8 | \$455 |
| 15 | PE65 | 27" Pipe | 1,447 | Columbia River | Qds | \$90,357 | 119.5 | \$756 |
| 15 | PE65 | 21" Pipe | 2,229 | Columbia River | Qds | \$96,004 | 134.8 | \$712 |
| 16 | EB1 | 15" Pipe | 48 | Columbia River | Qds | \$1,199 | 2.7 | \$444 |
| 16 | EB1 | 12" Pipe | 1,232 | Columbia River | Qds | \$22,562 | 59.6 | \$379 |
| 16 | EB1 | 15" Pipe | 1,460 | Columbia River | Qds | \$36,166 | 82.4 | \$439 |
| 16 | EB1 | 24" Pipe | 1,353 | Columbia River | Qds | \$69,955 | 141.8 | \$493 |
| 16 | EB1 | 21" Pipe | 2,500 | Columbia River | Qds | \$107,700 | 206.6 | \$521 |
| 16 | EB11 | 21" Pipe | 382 | Columbia River | Qfg | \$16,472 | 20.6 | \$800 |
| 16 | EB11 | 27" Pipe | 304 | Columbia River | Qfg | \$18,990 | 22.4 | \$848 |
| 16 | EB11 | 21" Pipe | 1,740 | Columbia River | Qfg | \$74,948 | 100.2 | \$748 |
| 16 | EB1D | 21" Pipe | 1,485 | Columbia River | Qds | \$63,974 | 137.6 | \$465 |
| 16 | EB1D | 27" Pipe | 1,375 | Columbia River | Qds | \$85,891 | 138.5 | \$620 |
| 16 | EB1D | 15" Pipe | 1,228 | Columbia River | Qds | \$30,419 | 109 | \$279 |
| 16 | EB1D | 24" Pipe | 2,572 | Columbia River | Qds | \$132,962 | 202.1 | \$658 |
| 16 | EB2 | 15" Pipe | 744 | Columbia River | Qds | \$18,418 | 55.4 | \$332 |
| 16 | EB2 | 12" Pipe | 1,810 | Columbia River | PLMc | \$33,134 | 23.7 | \$1,398 |
| 16 | EB2 | 12" Pipe | 1,882 | Columbia River | PLMc | \$34,458 | 29.7 | \$1,160 |
| 16 | EB2 | 27" Pipe | 3,935 | Columbia River | Qds | \$245,804 | 380.5 | \$646 |
| 16 | EB3.7 | 18" Pipe | 813 | Columbia River | PLMc | \$27,134 | 18.2 | \$1,491 |
| 16 | EB3.7 | 24" Pipe | 1,412 | Columbia River | PLMc | \$73,010 | 18.5 | \$3,946 |
| 16 | EB3.7 | 15" Pipe | 1,187 | Columbia River | PLMc | \$29,411 | 28.8 | \$1,021 |
| 16 | EB3.7 | 15" Pipe | 1,690 | Columbia River | PLMc | \$41,871 | 33.3 | \$1,257 |
| 16 | EB3.7A | 15" Pipe | 1,294 | Columbia River | PLMc | \$32,042 | 18.7 | \$1,713 |
| 16 | EB8 | 12" Pipe | 46 | Columbia River | Qfg | \$842 | 2.8 | \$301 |
| 16 | EB8 | 15" Pipe | 367 | Columbia River | Qfg | \$9,101 | 15.9 | \$572 |
| 16 | EB8 | 21" Pipe | 1,254 | Columbia River | Qfg | \$54,022 | 83.5 | \$647 |
| 16 | EB8 | 18" Pipe | 1,970 | Columbia River | Qfg | \$65,759 | 106.4 | \$618 |
| 16 | EB8 | 24" Pipe | 3,141 | Columbia River | Qfg | \$162,351 | 271.2 | \$599 |
| 16 | EB8A | 15" Pipe | 98 | Columbia River | Qfg | \$2,433 | 12.6 | \$193 |
| 16 | EB8A | 18" Pipe | 709 | Columbia River | Qfg | \$23,675 | 44.6 | \$531 |
| 16 | EB8A | 18" Pipe | 1,632 | Columbia River | Qfg | \$54,478 | 76.3 | \$714 |
| 16 | EB8C | 12" Pipe | 1,412 | Columbia River | Qfg | \$25,852 | 55.9 | \$462 |
| 16 | EB8C | 15" Pipe | 1,545 | Columbia River | Qfg | \$38,259 | 66.7 | \$574 |
| 16 | EB8C | 15" Pipe | 1,527 | Columbia River | Qfg | \$37,835 | 71.5 | \$529 |
| 16 | EB8C | 18" Pipe | 1,190 | Columbia River | Qfg | \$39,731 | 74.9 | \$530 |
| 16 | EB8C | 18" Pipe | 1,620 | Columbia River | Qfg | \$54,087 | 113.7 | \$476 |
| 16 | EB8D | 18" Pipe | 993 | Columbia River | Qfg | \$33,157 | 50 | \$663 |
| 16 | EB8D | 15" Pipe | 1,912 | Columbia River | Qfg | \$47,368 | 75.6 | \$627 |
| 16 | PE52.9 | 15" Pipe | 1,016 | Columbia River | PLMc | \$25,173 | 16 | \$1,573 |
| 16 | PE52.9 | 27" Pipe | 719 | Columbia River | Qds | \$44,895 | 62.3 | \$721 |
| 16 | PE52.9 | 18" Pipe | 2,565 | Columbia River | PLMc | \$85,631 | 43.8 | \$1,955 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 16 | PE52.9 | 21" Pipe | 939 | Columbia River | PLMc | \$40,461 | 18.5 | \$2,187 |
| 16 | PE52.9 | 24" Pipe | 3,691 | Columbia River | PLMc | \$190,825 | 82.5 | \$2,313 |
| 16 | PE55 | 27" Pipe | 1,949 | Columbia River | Qfg | \$121,715 | 143.8 | \$846 |
| 16 | PE55 | 24" Pipe | 1,900 | Columbia River | Qfg | \$98,222 | 140.2 | \$701 |
| 16 | PE55 | 24" Pipe | 2,428 | Columbia River | PLMc | \$125,492 | 73.3 | \$1,712 |
| 16 | PE55D | 24" Pipe | 2,084 | Columbia River | PLMc | \$107,745 | 32.8 | \$3,285 |
| 16 | PE55D | 24" Pipe | 2,073 | Columbia River | PLMc | \$107,166 | 43.6 | \$2,458 |
| 16 | PE55H | 18" Pipe | 2,540 | Columbia River | PLMc | \$84,787 | 58.4 | \$1,452 |
| 16 | PE55K | 27" Pipe | 1,015 | Columbia River | PLMc | \$63,403 | 28 | \$2,264 |
| 16 | PE59 | 18" Pipe | 75 | Columbia River | Qds | \$2,504 | 3.9 | \$642 |
| 16 | PE59 | 18" Pipe | 1,350 | Columbia River | Qds | \$45,083 | 76.2 | \$592 |
| 16 | PE59 | 24" Pipe | 1,540 | Columbia River | Qds | \$79,586 | 121 | \$658 |
| 16 | PE59 | 15" Pipe | 1,806 | Columbia River | Qds | \$44,735 | 87.3 | \$512 |
| 16 | PE59 | 21" Pipe | 3,086 | Columbia River | Qds | \$132,984 | 199.1 | \$668 |
| 16 | PE59.4B | 18" Pipe | 1,657 | Columbia River | Qds | \$55,316 | 86.8 | \$637 |
| 16 | PE59.4B | 24" Pipe | 2,130 | Columbia River | Qds | \$110,112 | 167.4 | \$658 |
| 16 | PE59.4D | 15" Pipe | 1,359 | Columbia River | Qds | \$33,664 | 87.7 | \$384 |
| 16 | PE59.4D | 12" Pipe | 2,616 | Columbia River | Qds | \$47,896 | 137.1 | \$349 |
| 16 | PE59.4D | 27" Pipe | 1,953 | Columbia River | Qds | \$122,003 | 169.3 | \$721 |
| 16 | PE59.4D4 | 27" Pipe | 2,130 | Columbia River | Qds | \$133,053 | 180.1 | \$739 |
| 16 | PE59.4D5 | 18" Pipe | 710 | Columbia River | Qds | \$23,705 | 50.1 | \$473 |
| 16 | PE59.4D5 | 24" Pipe | 1,170 | Columbia River | Qds | \$60,484 | 87.2 | \$694 |
| 16 | PE59.4D6 | 21" Pipe | 167 | Columbia River | Qds | \$7,173 | 11.4 | \$629 |
| 16 | PE59.4D6 | 15" Pipe | 4,834 | Columbia River | Qds | \$119,733 | 253.2 | \$473 |
| 16 | PE66 | 15" Pipe | 2,708 | Columbia River | Qds | \$67,078 | 120 | \$559 |
| 16 | PE66 | 24" Pipe | 1,708 | Columbia River | Qds | \$88,308 | 127.3 | \$694 |
| 16 | PE66D | 27" Pipe | 2,363 | Columbia River | Qds | \$147,589 | 195.2 | \$756 |
| 16 | PE66E | 15" Pipe | 1,451 | Columbia River | Qds | \$35,948 | 70.2 | \$512 |
| 16 | PE66F | 18" Pipe | 893 | Columbia River | Qds | \$29,811 | 54 | \$552 |
| 16 | PE66J | 15" Pipe | 1,357 | Columbia River | Qds | \$33,614 | 65.6 | \$512 |
| 16 | PE66M | 24" Pipe | 330 | Columbia River | Qds | \$17,060 | 24.6 | \$693 |
| 16 | PE66M | 24" Pipe | 882 | Columbia River | Qds | \$45,570 | 65.7 | \$694 |
| 16 | PE66M | 24" Pipe | 1,700 | Columbia River | Qds | \$87,883 | 133.6 | \$658 |
| 17 | EB15 | 21" Pipe | 604 | Columbia River | Qfg | \$26,029 | 43.5 | \$598 |
| 17 | EB15 | 15" Pipe | 4,014 | Columbia River | Qfg | \$99,431 | 202.3 | \$492 |
| 17 | EB15 | 27" Pipe | 3,223 | Columbia River | Qfg | \$201,315 | 324.8 | \$620 |
| 17 | EB15 | 21" Pipe | 4,148 | Columbia River | Qfg | \$178,696 | 336 | \$532 |
| 17 | EB20 | 12" Pipe | 679 | Columbia River | Qfg | \$12,432 | 36.7 | \$339 |
| 17 | EB20 | 21" Pipe | 5,326 | Columbia River | Qfg | \$229,444 | 412.2 | \$557 |
| 17 | EB20 | 24" Pipe | 3,149 | Columbia River | Qfg | \$162,811 | 317.4 | \$513 |
| 17 | EB20 | 24" Pipe | 3,545 | Columbia River | Qfg | \$183,262 | 318.9 | \$575 |
| 17 | EB20A | 21" Pipe | 680 | Columbia River | Qfg | \$29,294 | 56.3 | \$520 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 17 | EB20A | 21" Pipe | 1,984 | Columbia River | Qfg | \$85,453 | 107.1 | \$798 |
| 17 | EB20A | 24" Pipe | 2,125 | Columbia River | Qfg | \$109,854 | 206.5 | \$532 |
| 17 | EB20A | 24" Pipe | 2,683 | Columbia River | Qfg | \$138,700 | 251 | \$553 |
| 17 | EB22 | 15" Pipe | 2,96 | Columbia River | Qfg | \$7,332 | 19.7 | \$372 |
| 17 | EB22 | 15" Pipe | 3,354 | Columbia River | Qfg | \$83,082 | 211.1 | \$394 |
| 17 | EB22 | 24" Pipe | 5,065 | Columbia River | Qfg | \$261,840 | 437.3 | \$599 |
| 17 | EB22A | 18" Pipe | 2,632 | Columbia River | Qfg | \$87,878 | 151.6 | \$580 |
| 17 | EB24A | 21" Pipe | 1,914 | Columbia River | Qfg | \$82,455 | 103.4 | \$797 |
| 17 | EB24A | 21" Pipe | 2,800 | Columbia River | Qfg | \$120,624 | 236.9 | \$509 |
| 17 | EB24C | 21" Pipe | 2,620 | Columbia River | Qfg | \$112,857 | 160.4 | \$704 |
| 17 | EB24C | 24" Pipe | 3,344 | Columbia River | Qfg | \$172,871 | 300.8 | \$575 |
| 17 | EB24D | 18" Pipe | 2,580 | Columbia River | Qfg | \$86,138 | 209 | \$412 |
| 18 | EL85DD3 | 24" Pipe | 1,259 | Columbia River | Qfs | \$65,085 | 62.8 | \$1,036 |
| 18 | EL85DD3 | 21" Pipe | 1,725 | Columbia River | Qfs | \$74,313 | 79.2 | \$938 |
| 18 | EL85FF | 24" Pipe | 280 | Columbia River | PLMc | \$14,475 | 7.2 | \$2,010 |
| 18 | EL85FF | 18" Pipe | 1,341 | Columbia River | PLMc | \$44,772 | 28.2 | \$1,588 |
| 18 | EL85FF | 12" Pipe | 2,400 | Columbia River | Qfg | \$43,938 | 129.6 | \$339 |
| 18 | EL85GG | 18" Pipe | 1,198 | Columbia River | PLMc | \$40,004 | 22 | \$1,818 |
| 18 | EL85JJ | 24" Pipe | 595 | Columbia River | Qfg | \$30,759 | 51.4 | \$598 |
| 18 | EL85JJ | 24" Pipe | 952 | Columbia River | Qfg | \$49,215 | 63.4 | \$776 |
| 18 | EL85JJ | 21" Pipe | 1,376 | Columbia River | Qfg | \$59,278 | 96.6 | \$614 |
| 18 | EL85JJ | 18" Pipe | 2,373 | Columbia River | Qfg | \$79,211 | 128.1 | \$618 |
| 18 | EL85JJ | 21" Pipe | 1,779 | Columbia River | Qfg | \$76,639 | 131.3 | \$584 |
| 18 | EL85JJ1 | 18" Pipe | 730 | Columbia River | Qfg | \$24,369 | 34.1 | \$715 |
| 18 | EL85JJ1 | 18" Pipe | 1,714 | Columbia River | Qfg | \$57,225 | 92.6 | \$618 |
| 18 | EL85JJ1 | 21" Pipe | 3,871 | Columbia River | Mv | \$166,741 | 141.4 | \$1,179 |
| 18 | EL85JJ4 | 24" Pipe | 476 | Columbia River | Qfg | \$24,607 | 33.4 | \$737 |
| 18 | EL85JJ4 | 21" Pipe | 1,283 | Columbia River | Qfg | \$55,272 | 90 | \$614 |
| 18 | EL85JJ5 | 18" Pipe | 400 | Columbia River | Qfg | \$13,355 | 18.7 | \$714 |
| 18 | EL85K | 18" Pipe | 1,149 | Columbia River | Ql | \$38,346 | 83.4 | \$460 |
| 18 | EL85KK | 18" Pipe | 3,525 | Columbia River | Qfg | \$117,689 | 177.6 | \$663 |
| 18 | EL85M | 21" Pipe | 1,502 | Columbia River | PLMc | \$64,706 | 44.4 | \$1,457 |
| 18 | EL85M | 24" Pipe | 1,518 | Columbia River | PLMc | \$78,475 | 44.9 | \$1,748 |
| 18 | EL85MM | 18" Pipe | 329 | Columbia River | Qfg | \$10,984 | 16.6 | \$662 |
| 18 | EL85N | 18" Pipe | 860 | Columbia River | Ql | \$28,713 | 52 | \$552 |
| 18 | EL85N | 12" Pipe | 1,233 | Columbia River | Ql | \$22,580 | 59.6 | \$379 |
| 18 | EL85NN2 | 15" Pipe | 1,253 | Columbia River | Qfg | \$31,038 | 58.6 | \$530 |
| 18 | EL85SS | 15" Pipe | 2,572 | Columbia River | Qfg | \$63,713 | 129.6 | \$492 |
| 18 | EL85X | 21" Pipe | 1,016 | Columbia River | PLMc | \$43,769 | 27.4 | \$1,597 |
| 18 | EL85X | 27" Pipe | 1,509 | Columbia River | PLMc | \$94,261 | 40.6 | \$2,322 |
| 18 | EL85XA | 24" Pipe | 790 | Columbia River | PLMc | \$40,840 | 20.2 | \$2,022 |
| 19 | PE41.2A | 18" Pipe | 570 | Columbia River | Mv | \$19,044 | 2.7 | \$7,053 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 19 | PE41.2A | 21" Pipe | 840 | Columbia River | Qfg | \$36,187 | 48.4 | \$748 |
| 19 | PE41.2C | 27" Pipe | 509 | Columbia River | PLMc | \$31,795 | 14.4 | \$2,208 |
| 19 | PE41.2C | 24" Pipe | 3,437 | Columbia River | PLMc | \$177,653 | 76.8 | \$2,313 |
| 19 | PE41.2D | 18" Pipe | 2,035 | Columbia River | Qfg | \$67,943 | 10.9 | \$6,233 |
| 19 | PE41.2D | 24" Pipe | 3,145 | Columbia River | Qfg | \$162,584 | 15.8 | \$10,290 |
| 19 | PE41.2D | 27" Pipe | 3,666 | Columbia River | Qfg | \$228,969 | 20.8 | \$11,008 |
| 19 | PE46 | 24" Pipe | 4,199 | Columbia River | Qfg | \$217,072 | 257 | \$845 |
| 19 | PE46 | 27" Pipe | 3,798 | Columbia River | Qfg | \$237,246 | 280.2 | \$847 |
| 19 | PE46 | 24" Pipe | 5,620 | Columbia River | Qfg | \$290,532 | 394.4 | \$737 |
| 19 | PE46.2 | 21" Pipe | 1,899 | Columbia River | PLMc | \$81,818 | 39.9 | \$2,051 |
| 19 | PE46.2A | 21" Pipe | 2,791 | Columbia River | PLMc | \$120,215 | 55 | \$2,186 |
| 19 | PE46.2A | 24" Pipe | 2,850 | Columbia River | PLMc | \$147,308 | 73 | \$2,018 |
| 19 | PE46.2A1 | 24" Pipe | 2,621 | Columbia River | PLMc | \$135,495 | 67.1 | \$2,019 |
| 19 | PE46.2A2 | 21" Pipe | 784 | Columbia River | PLMc | \$33,775 | 15.5 | \$2,179 |
| 19 | PE46.2E | 21" Pipe | 1,855 | Columbia River | PLMc | \$79,913 | 39 | \$2,049 |
| 19 | PE46.2F | 24" Pipe | 945 | Columbia River | PLMc | \$48,853 | 21.7 | \$2,251 |
| 19 | PE46.2F | 24" Pipe | 1,523 | Columbia River | PLMc | \$78,733 | 39 | \$2,019 |
| 19 | PE46A | 18" Pipe | 350 | Columbia River | Qfg | \$11,685 | 17.6 | \$664 |
| 19 | PE46A | 15" Pipe | 1,840 | Columbia River | Qfg | \$45,576 | 92.7 | \$492 |
| 19 | PE46A | 27" Pipe | 1,493 | Columbia River | Qfg | \$93,262 | 115.5 | \$807 |
| 19 | PE46A | 21" Pipe | 1,783 | Columbia River | Qfg | \$76,820 | 125.1 | \$614 |
| 19 | PE46A | 27" Pipe | 2,474 | Columbia River | Qfg | \$154,528 | 191.4 | \$807 |
| 19 | PE46A3 | 18" Pipe | 17,753 | Columbia River | Qfg | \$592,706 | 894.5 | \$663 |
| 20 | WB5.4 | 24" Pipe | 1,976 | Columbia River | PLMc | \$102,125 | 50.6 | \$2,018 |
| 20 | WB5.4 | 21" Pipe | 3,702 | Columbia River | PLMc | \$159,465 | 77.8 | \$2,050 |
| 20 | WB5A | 27" Pipe | 57 | Columbia River | PLMc | \$3,561 | 1.5 | \$2,374 |
| 20 | WB5A | 27" Pipe | 126 | Columbia River | PLMc | \$7,871 | 0.7 | \$11,244 |
| 20 | WB5A | 21" Pipe | 1,252 | Columbia River | PLMc | \$53,919 | 24.7 | \$2,183 |
| 20 | WB5A | 21" Pipe | 1,256 | Columbia River | PLMc | \$54,087 | 26.4 | \$2,049 |
| 20 | WB5A | 24" Pipe | 1,380 | Columbia River | PLMc | \$71,340 | 34.5 | \$2,068 |
| 20 | WB5A | 27" Pipe | 3,304 | Columbia River | PLMc | \$206,388 | 17.6 | \$11,727 |
| 20 | WB5B | 27" Pipe | 479 | Columbia River | PLMc | \$29,890 | 12.6 | \$2,372 |
| 20 | WB5B | 21" Pipe | 1,201 | Columbia River | PLMc | \$51,739 | 23.7 | \$2,183 |
| 20 | WB5B | 27" Pipe | 1,879 | Columbia River | PLMc | \$117,342 | 10 | \$11,734 |
| 20 | WB5C | 21" Pipe | 160 | Columbia River | PLMc | \$6,906 | 3.4 | \$2,031 |
| 20 | WB5C | 18" Pipe | 1,840 | Columbia River | PLMc | \$61,432 | 7.5 | \$8,191 |
| 20 | WB5D | 21" Pipe | 1,770 | Columbia River | PLMc | \$76,260 | 37.2 | \$2,050 |
| 20 | WB5D | 27" Pipe | 1,496 | Columbia River | PLMc | \$93,462 | 40.3 | \$2,319 |
| 20 | WB5E3 | 18" Pipe | 496 | Columbia River | PLMc | \$16,560 | 2 | \$8,280 |
| 20 | WB5E3 | 24" Pipe | 627 | Columbia River | PLMc | \$32,413 | 3.1 | \$10,456 |
| 20 | WB5G | 21" Pipe | 1,802 | Columbia River | PLMc | \$77,609 | 37.9 | \$2,048 |
| 20 | WB5G | 27" Pipe | 3,135 | Columbia River | PLMc | \$195,809 | 84.4 | \$2,320 |

Table A-3

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|-------------|----------------|---------|----------------|------------------------------|---------------------|
| 20 | WB5G3 | 24" Pipe | 237 | Columbia River | PLMc | \$12,237 | 6.1 | \$2,006 |
| 20 | WB5G3 | 24" Pipe | 3,322 | Columbia River | PLMc | \$171,734 | 85.1 | \$2,018 |
| 20 | WB5G7 | 21" Pipe | 703 | Columbia River | Qfg | \$30,268 | 40.5 | \$747 |
| 20 | WB5G7 | 21" Pipe | 727 | Columbia River | Qfg | \$31,336 | 44.5 | \$704 |
| 20 | WB5HH | 24" Pipe | 1,697 | Columbia River | Qds | \$87,739 | 123.2 | \$712 |
| 20 | WB5J1 | 24" Pipe | 827 | Columbia River | Qds | \$42,735 | 60 | \$712 |
| 20 | WB5JJ | 18" Pipe | 547 | Columbia River | PLMc | \$18,269 | 9.3 | \$1,964 |
| 20 | WB5K | 21" Pipe | 1,730 | Columbia River | Qds | \$74,537 | 111.6 | \$668 |
| 20 | WB5K | 24" Pipe | 2,110 | Columbia River | Qds | \$109,073 | 165.8 | \$658 |
| 20 | WB5K1 | 24" Pipe | 990 | Columbia River | Qds | \$51,179 | 67.9 | \$754 |
| 20 | WB5K1 | 21" Pipe | 1,060 | Columbia River | Qds | \$45,660 | 68.4 | \$668 |
| 20 | WB5K1 | 27" Pipe | 2,643 | Columbia River | Qds | \$165,091 | 218.4 | \$756 |
| 20 | WB5K2 | 18" Pipe | 290 | Columbia River | Qds | \$9,666 | 15.2 | \$636 |
| 20 | WB5K2 | 24" Pipe | 3,936 | Columbia River | Qds | \$203,475 | 269.9 | \$754 |
| 20 | WB5K3 | 18" Pipe | 1,410 | Columbia River | Qds | \$47,060 | 85.2 | \$552 |
| 20 | WB5K5 | 21" Pipe | 1,287 | Columbia River | Qds | \$55,427 | 77.8 | \$712 |
| 20 | WB5K5 | 27" Pipe | 1,386 | Columbia River | Qds | \$86,553 | 114.5 | \$756 |
| 20 | WB5L | 18" Pipe | 844 | Columbia River | Qds | \$28,172 | 47.6 | \$592 |
| 20 | WB5L | 24" Pipe | 1,835 | Columbia River | Qds | \$94,866 | 144.2 | \$658 |
| 20 | WB5M | 18" Pipe | 2,753 | Columbia River | PLMc | \$91,914 | 47 | \$1,956 |
| 20 | WB5M | 24" Pipe | 2,360 | Columbia River | PLMc | \$121,982 | 52.7 | \$2,315 |
| 20 | WB5M2 | 18" Pipe | 446 | Columbia River | PLMc | \$14,891 | 8.2 | \$1,816 |
| 20 | WB5P | 15" Pipe | 1,596 | Columbia River | PLMc | \$39,523 | 23 | \$1,718 |
| 20 | WB5P | 21" Pipe | 2,762 | Columbia River | PLMc | \$118,987 | 58.1 | \$2,048 |
| 20 | WB5Q | 21" Pipe | 825 | Columbia River | PLMc | \$35,541 | 18.4 | \$1,932 |
| 20 | WB5Q | 18" Pipe | 1,555 | Columbia River | Qds | \$51,917 | 87.8 | \$591 |
| 20 | WB5Q | 24" Pipe | 3,320 | Columbia River | PLMc | \$171,631 | 78.6 | \$2,184 |
| 21 | WB3A1 | 24" Pipe | 330 | Columbia River | Qfs | \$17,039 | 16 | \$1,065 |
| 21 | WB3A1 | 21" Pipe | 1,278 | Columbia River | Qfs | \$55,073 | 51.8 | \$1,063 |
| 21 | WB3A2 | 21" Pipe | 1,104 | Columbia River | Qfs | \$47,556 | 44.7 | \$1,064 |
| 21 | WB3A3 | 27" Pipe | 549 | Columbia River | Qfs | \$34,281 | 25.2 | \$1,360 |
| 21 | WB3B1 | 27" Pipe | 650 | Columbia River | Qfs | \$40,572 | 34.2 | \$1,186 |
| 21 | WB3B1 | 24" Pipe | 1,855 | Columbia River | Qfs | \$95,896 | 80.1 | \$1,197 |
| 21 | WB3B12 | 21" Pipe | 1,304 | Columbia River | Ql | \$56,159 | 84.1 | \$668 |
| 21 | WB3B12 | 27" Pipe | 3,321 | Columbia River | Ql | \$207,474 | 274.5 | \$756 |
| 21 | WB3B6 | 21" Pipe | 1,344 | Columbia River | Ql | \$57,882 | 81.3 | \$712 |
| 21 | WB3B6 | 21" Pipe | 2,192 | Columbia River | Ql | \$94,440 | 141.4 | \$668 |
| 23 | WB10B | 24" Pipe | 2,546 | Columbia River | Qds | \$131,598 | 174.5 | \$754 |
| 23 | WB10B2 | 21" Pipe | 411 | Columbia River | Qds | \$17,714 | 26.5 | \$668 |
| 23 | WB10B2 | 27" Pipe | 2,558 | Columbia River | Qds | \$159,796 | 211.4 | \$756 |
| 23 | WB10B2A | 24" Pipe | 2,641 | Columbia River | Qds | \$136,550 | 186.2 | \$733 |
| 23 | WB10B2B | 24" Pipe | 14 | Columbia River | Qds | \$724 | 1 | \$724 |

| Block | Location | Project Description | Length (ft) | Drainage Basin | Geology | Estimated Cost | Estimated Savings (ac-ft/yr) | Cost per AF Savings |
|-------|----------|---------------------|----------------|----------------|---------|---------------------|------------------------------|---------------------|
| 23 | WB10B2B | 24" Pipe | 86 | Columbia River | Qds | \$4,446 | 5.9 | \$754 |
| 23 | WB10B2B | 21" Pipe | 1,859 | Columbia River | Qds | \$80,103 | 112.5 | \$712 |
| 23 | WB10B6 | 24" Pipe | 20 | Columbia River | Qds | \$1,034 | 1.4 | \$739 |
| 23 | WB10D | 18" Pipe | 2,167 | Columbia River | Qds | \$72,346 | 113.5 | \$637 |
| 23 | WB10D | 27" Pipe | 2,012 | Columbia River | Qds | \$125,669 | 166.2 | \$756 |
| 23 | WB10D | 24" Pipe | 3,715 | Columbia River | Qds | \$192,030 | 254.7 | \$754 |
| 23 | WB10H | 18" Pipe | 1,772 | Columbia River | Qds | \$59,171 | 132.1 | \$448 |
| 23 | WB10H1 | 21" Pipe | 1,985 | Columbia River | Qds | \$85,492 | 136.1 | \$628 |
| 23 | WB10H1 | 24" Pipe | 6,975 | Columbia River | Qds | \$360,580 | 548.2 | \$658 |
| 23 | WB10K | 27" Pipe | 50 | Columbia River | Qds | \$3,123 | 4.1 | \$762 |
| 23 | WB10K | 21" Pipe | 2,088 | Columbia River | Qds | \$89,951 | 126.3 | \$712 |
| 23 | WB10L | 21" Pipe | 2,078 | Columbia River | Qds | \$89,529 | 125.7 | \$712 |
| 201 | WB10A | 18" Pipe | 2,439 | Columbia River | Qds | \$81,437 | 177.1 | \$460 |
| | | TOTAL | 610,874 | | | \$27,147,277 | 32,379.5 | \$838 |