Quincy-Columbia Basin Irrigation District
W53.1D & E Canal Lining

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Executive Summary

Application Date: April 19, 2018
Applicant Name: Quincy-Columbia Basin Irrigation District
Location: Grant County
State: Washington State
Estimated Project Timeframe: September 2018 through April 2019
Project 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 1.45 million acre-feet of water is diverted and pumped each year from the Columbia River at Grand Coulee Dam for farm deliveries on the Columbia Basin Project.

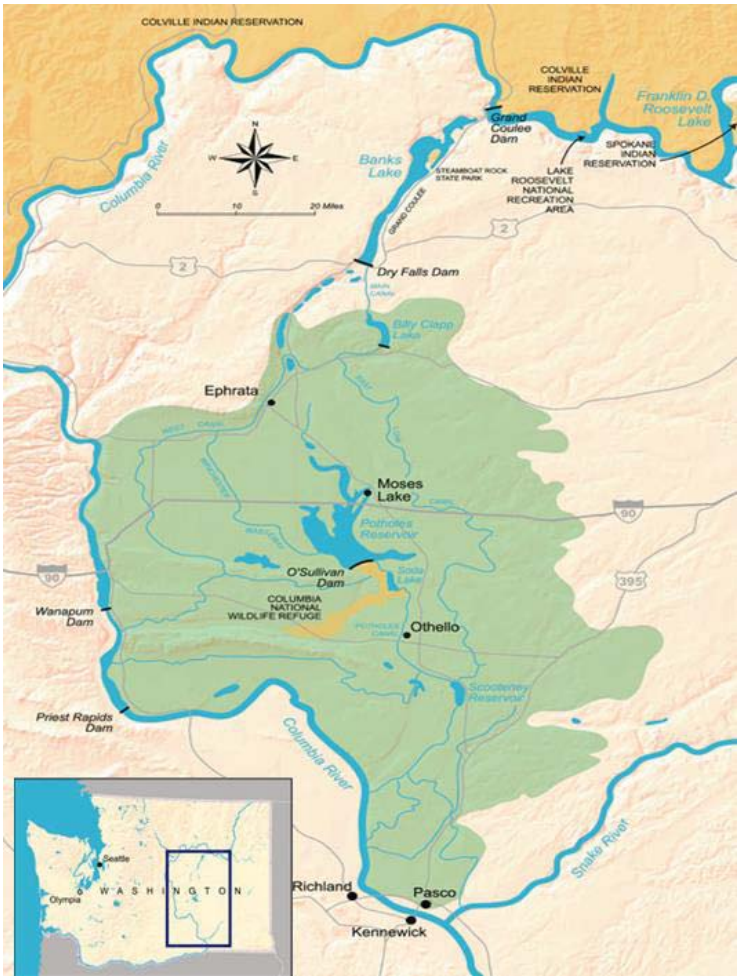
The District proposes to line 8,422 feet of the W53.1D and E laterals, conserving 855 acre-feet annually with energy savings of over 329,100 kWh per year. The total cost to implement the proposed lining project is $910,000. Of this amount, $610,000 has been committed by the District. Reclamation's investment of $300,000 would complete the funding that we need to complete this project between September 2018 and March 2019. All Cultural Resource Review and Section 106 of the Historic Preservation Act has already been completed for this work. In addition, all engineering has been completed. This is a shovel ready 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 and the Washington State Department of Ecology have developed a coordinated water conservation plan to allow additional acreage to be served, while remaining water budget neutral on the Columbia River. With the technical support of the Bonneville Power Administration, the District has conducted over 20 seepage loss assessments and prioritized those areas identified to have the highest water loss to meet coordinated water conservation goals. This project will be the completion of lining one of our highest priority areas in which we have been working on for 3 years.

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 project main canals and about 5,500 project 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.

In an effort to conserve water, the District has entered into a coordinated water conservation plan with the East and South Columbia Basin Irrigation Districts and the Washington State Department of Ecology 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 & General Overview

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 W53.1D and W53.1E laterals to eliminate water loss and meet performance goals in the District's coordinated water conservation plan. Approximately 8,422 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: Water Conservation

Subcriterion No. A.1: Quantifiable Water Savings

Describe the amount of water saved. For projects that conserve water, please state the estimated amount of water expected to be conserved (in acre-feet per year) as a direct result of this project.

ANSWER: The amount of water expected to be conserved is 855 acre-feet per year as a direct result of this project. Supporting details and calculations of how the estimate was determined are included in the following discussion points of this section.

Describe current losses: Please explain where the water that will be conserved is currently going.

ANSWER: Water diverted for the Columbia Basin Project travels through a network of canals, laterals, wasteways, and drains for agricultural purposes. Water conservation leaves water in the Columbia River where it becomes available for other uses, such as maintaining instream flows to protect endangered salmon.

Please provide sufficient detail supporting how the estimate was determined, including all supporting calculations.

Please address the following questions according to the type of project you propose for funding.

(1) Canal Lining/Piping: Canal lining/piping projects can provide water savings when irrigation delivery systems experience significant losses due to canal seepage. Applicants proposing lining/piping projects should address the following:

(a) How has the estimated average annual water savings that will result from the project been determined? Please provide all relevant calculations, assumptions, and supporting data.

ANSWER: The estimated average annual water savings that will result from this project is 855 acre-feet and has been determined by inflow / outflow testing conducted by the Bonneville Power Administration. The measured difference between canal inflow and outflow was 7.4 ft^3/s. On the day of the study, farm unit records indicate 4 ft^3/s was being diverted. This indicates that 3.4 ft^3/s is continually lost due to seepage over the irrigation season. A loss of 3.4 ft^3/s was extrapolated over a 215 day average irrigation season to determine the average annual loss of 1,450 acre-feet. Due to budgetary constraints, approximately 59% of the test area will be lined. This amounts to a savings of 855 acre-feet per year. The average annual loss also represents the estimated average annual water savings because seepage loss is estimated to be zero when the project is complete.

Calculation 1: current seepage loss

$$\left(7.4\frac{\text{ft}^3}{\text{s}}\ \text{inflow/outflow difference}\right) - \left(4.0\frac{\text{ft}^3}{\text{s}}\ \text{farm unit deliveries}\right)$$
$$= \ 3.4\ \frac{\text{ft}^3}{\text{s}}\ \ \text{seepage loss}$$

To calculate annual water savings, a rate of 3.4 ft^3/s seepage loss was extrapolated over an average operating season of 215 days.

Calculation 2: current annual canal seepage loss

$$\left(3.4\frac{\text{ft}^3}{\text{s}}\right)\left(\frac{60\ \text{s}}{\text{min}}\right)\left(\frac{60\ \text{min}}{\text{hr}}\right)\left(\frac{24\ \text{hr}}{\text{day}}\right)(215\ days) = (63{,}158{,}400\ \text{ft}^3)\left(\frac{acre-ft}{43{,}560\ \text{ft}^3}\right)$$
$$= 1{,}450\ acre-feet\ x\ 0.59 = 855\ acre-feet$$

(b) How have average annual canal seepage losses been determined? Have ponding and/or inflow/outflow tests been conducted to determine seepage rates under varying conditions? If so, please provide detailed descriptions of testing methods and all results. If not, please provide an explanation of the method(s) used to calculate seepage losses. All estimates should be supported with multiple sets of data/measurements from representative sections of canals.

ANSWER: The estimated canal seepage losses have been determined by inflow / outflow testing conducted by the Bonneville Power Administration using an acoustic Doppler current profiler (ADCP). Canal inflow and outflow is determined using these measurements. This data is displayed in Figure 2 and Figure 3.

Transect	Start Bank	Start Time	Total Q	Delta Q	Width	Flow Speed	Duration
			ft³/s	%	ft	ft/s	s
1	Right	15:24:44	38.2	-0.3	11.4	1.8	87.1
2	Left	15:26:29	36.4	-5.0	10.6	1.9	95.8
3	Right	15:28:24	40.3	5.2	12.1	1.8	75.3
Average			38.3	0.0	11.4	1.8	
Std Dev.			2.0	5.1	0.8	0.0	

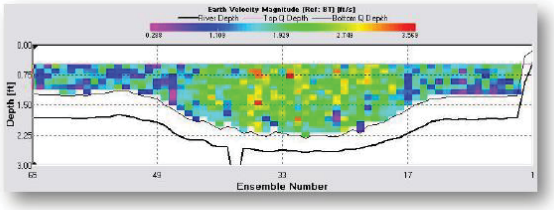


Figure 2: W53.1D inflow testing

Transect	Start Bank	Start Time	Total Q	Delta Q	Width	Flow Speed	Duration
			ft³/s	%	ft	ft/s	s
1	Right	15:49:55	30.4	-1.7	11.8	1.4	91.6
2	Left	15:51:46	29.5	-4.5	11.6	1.4	95.9
3	Right	15:53:51	31.7	2.4	11.9	1.4	101.3
4	Left	15:55:50	32.1	3.7	12.2	1.4	93.5
Average			30.9	0.0	11.8	1.4	
Std Dev.			1.2	3.8	0.3	0.0	

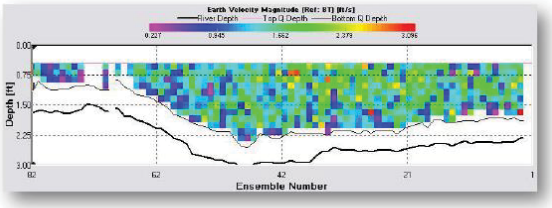


Figure 3: W53.1D outflow testing

(c) What are the expected post-project seepage/leakage losses and how were these estimates determined (e.g., can data specific to the type of material being used in the project be provided)?

ANSWER: Geocomposite lining in combination with concrete is impervious and there is no expected post project water loss. Previous projects have verified this assumption.

(d) What are the anticipated annual transit loss reductions in terms of acre-feet per mile for the overall project and for each section of canal included in the project?

ANSWER:

Calculation 3: current annual transit loss

$$855\ acre-feet/1.6\ miles = 534\ \frac{acre-feet}{mile}$$

(e) How will actual canal loss seepage reductions be verified?

ANSWER: Actual canal seepage reductions will be verified with inflow / outflow testing using the same ADCP technology as was used to determine pre-project canal seepage loss.

(f) Include a detailed description of the materials being used.

ANSWER:

3.5" pneumatically applied shotcrete canal lining with minimum compression strength of 3,500 psi at 28 days

The Contractor shall furnish and place all materials for use in shotcrete, 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/yd2
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.

Subcriterion No. A.2: Percentage of Total Supply

Provide the percentage of total water supply conserved: State the applicant's total average annual water supply in acre-feet. Please use the following formula:

ANSWER:

Calculation 4:

$$855\ acre - feet / 1{,}450{,}000\ acre - feet = 0.001\ x\ 100 = 0.06\%$$

Evaluation Criterion B: Water Supply Reliability

Does the project promote and encourage collaboration among parties in a way that helps increase the reliability of the water supply?

ANSWER: The Quincy-Columbia Basin Irrigation District, East Columbia Basin Irrigation District, South Columbia Basin Irrigation District, and the Washington State Department of Ecology have developed a coordinated Water Conservation Plan to increase the reliability of the

water supply. Successful implementation of this plan will encourage future collaboration among parties.

Is there widespread support for this project?

ANSWER: This project accomplishes goals set forth in the Coordinated Conservation Plan and has widespread support.

What is the significance of the collaboration/support?

ANSWER: This project addresses 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 water conservation has widespread support.

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

ANSWER: Successful implementation of the Coordinated Water Conservation Plan will make future water conservation improvements by other water users enhanced. Other water users would be more competitive for funding opportunities by demonstrating the ability to successfully implement components of the plan.

Will the project make water available to address a specific water reliability concern? Please address:

Explain and provide detail of the specific issue(s) in the area that is impacting water reliability, such as shortages due to drought, increased demand, or reduced deliveries.

ANSWER: The goal of the Coordinated Water Conservation Plan is to identify and implement 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. This project will help increase reliability for finite water supplies and competing uses.

Describe where the conserved water will go/how it will be used. Will the project directly address a heightened competition for finite water supplies and over-allocation?

ANSWER: The conserved water will be available as a replacement water supply for groundwater deliveries in the Odessa Subarea where there are severe water shortages for

agriculture, environmental uses such as to meet instream flow requirements for endangered species, and municipal and industrial water supply where shortages exist.

Describe how the project will address the water reliability concern?

ANSWER: This project will conserve water in the mainstem Columbia River and assist with meeting growing water needs for power production, municipal water supply, irrigation, and improved flows to assist salmon recovery.

Will the project help to prevent a water-related crisis or conflict? Is there frequent tension or litigation over water in the basin?

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

Frequent litigation has occurred 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.

Provide a description of the mechanism that will be used, if necessary, to put the conserved water to the intended use.

ANSWER: Water conserved will be available to meet the goals of the Columbia River Water Management Program as described in the Coordinated Water Conservation Plan and MOU.

Describe the roles of any partners in the process. Please attach any relevant supporting documents.

ANSWER: Ecology, the Bureau of Reclamation and the East, South, and Quincy Irrigation Districts are all working on water conservation projects to meet the goals of the Coordinated Water Conservation Plan and MOU. (See the MOU in the appendix for additional details.)

Indicate the quantity of conserved water that will be used for the intended purpose.

ANSWER: 855 acre feet per year will be conserved to help meet the goals of the Coordinated Water Conservation Plan and MOU.

Will the project benefit Indian tribes?

ANSWER: An MOU between Ecology, the Bureau of Reclamation and the East, South, and Quincy Irrigation Districts 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 main stem of the Columbia River.

Will the project benefit federally threatened or endangered species?

ANSWER: Water conservation will provide improved access to the Columbia River's water resources including providing additional salmon recovery support.

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

ANSWER: Conserved water on the Columbia Basin Project also supports the diversion and delivery of additional water for the Odessa Subarea for irrigation use.

Evaluation Criterion C: Implementing Hydropower

Questions in this section do not apply.

Evaluation Criterion D: Complementing On-Farm Irrigation Improvements

Questions in this section do not apply.

Evaluation Criterion E: Department of the Interior Priorities

Modernizing our infrastructure

This project supports the Department of the Interior priority of modernizing infrastructure. Originally constructed in 1959, 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, safety, and operation and maintenance cost savings.

Evaluation Criterion F: Implementation and Results

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

ANSWER: This project is part of a Coordinated Water Conservation Plan between the East, South, and Quincy Columbia Basin Irrigation Districts and the Washington State Department of Ecology. The Water Conservation Plan has been attached.

Identify any district-wide, or system-wide, planning that provides support for the proposed project.

ANSWER: This project is part of the Columbia Basin Project Coordinated Water Conservation Plan. In addition, the Quincy-Columbia Basin Irrigation District maintains a water conservation priority list which it has developed through inflow/outflow testing to identify high seepage areas.

Describe how the project conforms to and meets the goals of any applicable planning efforts, and identify any aspect of the project that implements a feature of an existing water plan(s).

The goals of the Coordinated Water Conservation plan are to identify water conservation projects and to implement water conservation projects. The Quincy-Columbia Basin Irrigation District has developed a list to identify high priority water conservation projects and by implementing these projects, we are meeting the goals of the Plan.

Provide a brief summary describing the performance measure 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. All water conservation project results are reported on the District's website.

Evaluation Criterion G: Nexus to Reclamation Project Activities

How is the proposed project connected to Reclamation project activities?

ANSWER: The Quincy-Columbia Basin Irrigation District operates and maintains a portion of the United States Bureau of Reclamation owned Columbia Basin Project under the Amendatory, Supplemental, And Replacement Contract #14-06-100-6418.

Does the applicant receive Reclamation project water?

ANSWER: Water received on the Columbia Basin Project is Reclamation project water.

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

ANSWER: The proposed project is on Reclamation owned lands and involves maintenance of reclamation owned facilities on the federal Columbia Basin Project.

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

ANSWER: The project is located within the Bureau of Reclamation's Columbia Basin Project.

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

ANSWER: The proposed work would contribute water to the Columbia Basin while remaining water budget neutral in the Columbia River.

Evaluation Criterion H: Additional Non-Federal Funding

State the percentage of non-Federal funding provided.

Non-Federal Funding / Total Project Cost = ($610,000 / $910,000) x 100 = 67%

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	$ 610,000
Non-Federal Entities Subtotal	**$ 610,000**
Non-Federal subtotal	$ -
Other Federal Entities Subtotal	$ -
Requested Reclamation Funding Subtotal	**$ 300,000**
Total Project Funding	**$ 910,000**

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 $**
Recipient Funding	67 %	$ 610,000
Reclamation Funding	33 %	$ 300,000
Other Federal funding	0 %	$ -
Totals	**100 %**	**$ $910,000**

Budget Item & Description	$/Unit		Quantity	Total Cost
Salaries & Wages				
Not Accounting Toward Grant	$0	hr	0	$0
Fringe Benefits	$0	hr	0	$0
Contractual & Construction				
*See Construction Detail Below	1		1	* $900,000
Other				
Reporting	1		1	$ 0
Environmental & Regulatory	1		1	$ 10,000
Indirect Costs				$ 0
Total				**$ 910,000**

***Contractual & Construction breakdown**

W53.1D Lateral Lining Engineer's Estimate				
	Sta 127+16 to Sta 183+61	Quantity	Unit Price	Subtotal
1	Mobilization and Demobilization	1	$ 56,000.00	$ 56,000
2	Mass/Common Excavation	12,520	$ 2.00	$ 25,040
3	Rock Excavation	330	$ 6.50	$ 2,145
4	Native/Common Backfill	4,115	$ 2.50	$ 10,288
5	Lateral Subgrade Preparation	1	$ 5,000.00	$ 5,000
6	Lateral Geomembrane Liner Material Furnished	1	$ 137,195.10	$ 137,195
7	Lateral Geomembrane Liner Installed	152,439	$ 0.30	$ 45,732
8	Lateral Concrete Liner Furnished and Installed	1,447	$ 225.00	$ 325,575
9	Final Site Grading	1	$ 2,098.00	$ 2,098
10.00	Hydro seed Furnished and Installed	149,550	$ 0.04	$ 5,982
Total				$ 615,054
W53.1E Lateral Lining Engineer's Estimate				
	Sta 149+81 to Sta 177+58	Quantity	Unit Price	Subtotal
1	Mobilization and Demobilization	1	$26,000.00	$26,000
2	Mass/Common Excavation	4,672	$2.00	$9,344
3	Rock Excavation	200	$14.00	$2,800
4	Native/Common Backfill	2,783	$7.00	$19,481
5	Lateral Subgrade Preparation	1	$5,000.00	$5,000
6	Lateral Geomembrane Liner Material Furnished	1	$43,306.00	$43,306
7	Lateral Geomembrane Liner Installed	72,176	$0.30	$21,653
8	Lateral Concrete Liner Furnished and Installed	675	$225.00	$151,875
9	Final Site Grading	1	$2,500.00	$2,500
10.00	Hydro seed Furnished and Installed	69,400	$0.04	$2,776
Total				$284,735

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 expected environmental permits required for the completion of the proposed 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. Cultural resources and historical review has already been completed for this 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 $910,000.

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 1959.

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 1959. 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 W53.1D canal lining project.

Official Resolution

QUINCY-COLUMBIA BASIN IRRIGATION DISTRICT

RESOLUTION 2018 - 15

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-18-F006, *WaterSMART: Water and Energy Efficiency Grants for FY 2018*; 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 3rd day of April 2018.

BOARD OF DIRECTORS

(SEAL)

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- strcam 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 detennined 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

Director, Pacific Northwest Region, U.S Bureau of Reclamation — DATE: Dec 17, 2004

Governor, State of Washington — DATE: Dec 17, 2004

Director, Washington State Department of Fish and Wildlife — DATE: Dec 17, 2004

Attest

Secretary

SOUTH COLUMBIA BASIN IRRIGATION DISTRICT PO Box 1066

By _____
President, Board of Directors

Attest

Secretary

EAST COLUMBIA BASIN IRRIGATION DISTRICT

PO Box E

By _____
President, Board of Directors

Attest:

Asst Secretary

QUINCY-COLUMBIA BASIN IRRIGATION DISTRICT
PO Box 188

Quincy WA 98848

By _____
President, Board of Directors

ANCHOR QEA

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

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March 2010

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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 whilealso 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:

> Seepage Loss (acre-feet/yr) = Seepage Rate (ft/day) * Wetted Perimeter (ft) * Length (ft) * 195 (days)/43,560 (ft^3/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 Scooteney 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 Scooteney 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 Scooteney	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 Scooteney	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 Scooteney	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 Scooteney	1,152	197	783.1	171.9	368.9 (East Low Canal)
South	East Low Canal	Columbia River or Potholes East Canal below Scooteney	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 Scooteney	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 Scooteney	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 Scooteney	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 Scooteney	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

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LIST OF MAPS

APPENDIX A

LIST OF LONG-TERM PROJECTS

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

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

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

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**

Block	Location	Project Description	Length (ft)	Drainage Basin	Geology	Estimated Cost	Estimated Savings (ac-ft/yr)	Cost per AF Savings
45	EL 68	Check structues		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	130	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 74.8L,L1	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**

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

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**

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

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

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

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

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	$132,964	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

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	296	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

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

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**