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

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Executive Summary

Application Date: January 7, 2015
Applicant Name: Quincy-Columbia Basin Irrigation District
City: Quincy
County: Grant County
State: Washington State
Estimated Project Timeframe: September 2015 through March 2016
Project Location: United States Bureau of Reclamation's Columbia Basin Project

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, an estimated 3% of the average annual flow of the Columbia River for farm deliveries on the Columbia Basin Project.

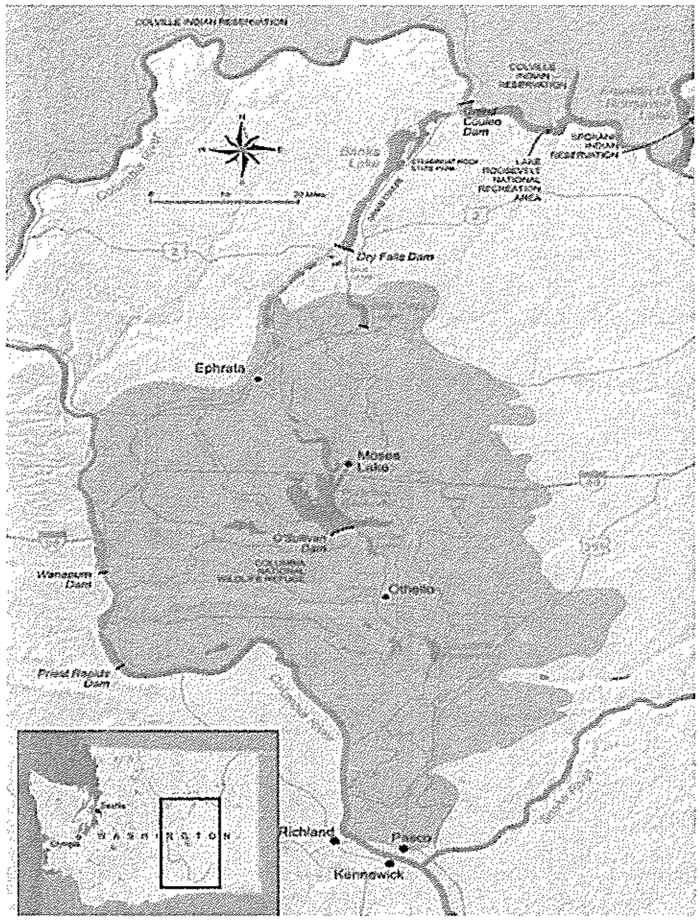
Water conversation on the Project is essential to Reclamation's ability to deliver needed quantities of water and power to agricultural, tribal, municipal, and industrial water users and for environmental flows. The District, along with the East and South Columbia Basin Irrigation Districts and the Washington 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 plan goals.

The District proposes to line 7,000 feet of the W53.1D, conserving 841 acre-feet of irrigation water with energy savings of over 329,174 kWh per year. The total cost to implement the proposed lining project is $700,000. Of this amount, $400,000 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 2015 and March 2016.

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

Background Data

The Quincy-Columbia Basin Irrigation District (District) in 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, habitat creation, flood control, and power generation.



District Headquarters are 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 approximately 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 on the Columbia River. Long-term planning is essential to solving future water resource problems such as project water shortages caused by drought. Since 2009, the Districts on the project have conserved over 7,200 acre-feet of water by completing over 65,000 feet of piping and canal lining projects.

Technical Project Description

General Overview

The District has identified water conservation opportunities and ranked them in order of priority based on estimated water loss. This project will install concrete lining over a geomembrane liner in the W53.1D lateral to eliminate water loss and meet performance goals in the District's coordinated water conservation plan. Approximately 7,000 feet of earthen canal will be lined. Construction work will be performed by a contractor. The District has developed project specification 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. Please provide sufficient detail supporting how the estimate was determined, including all supporting calculations. Please be sure to consider the questions associated with your project type (listed below) when determining the estimated water savings, along with the necessary support needed for a full review of your proposal (please note, the following is not an exclusive list of eligible project types. If your proposed project does not align with any of the projects listed below, please be sure to provide support for the estimated project benefits, including all supporting calculations and assumptions made).

ANSWER: The amount of water expected to be conserved is 841 acre-feet per year as a direct result of the project. Supporting details and calculations of how the estimate was determined are included in the following discussion points of this section.

In addition, all applicants should be sure to address the following:

•What is the applicant's average annual acre-feet of water supply?

ANSWER: The District's average acre-feet of water supply is 1.45 million acre-feet per year.

•Where is that water currently going (e.g., back to the stream, spilled at the end of the ditch, seeping into the ground, etc.)?

ANSWER: Water diverted for the Columbia Basin Project travels through a network of canals, laterals, wasteways, and drains for agricultural uses. Excess water is lost due to evaporation and seepage with any remaining being returned to the Columbia River. Water conservation leaves water in the Columbia River which lessens the potential for water contamination occurring in agricultural return flows.

•Where will the conserved water go?

ANSWER: Conserved water will remain in the Columbia River where it will be available for other uses such as to meet hydropower and fishery demands.

Please include a specific quantifiable water savings estimate; do not include a range of potential water savings.

ANSWER: The estimated average annual water savings that will result from the project is 841 acre-feet.

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 the project is 841 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 58% of the test area will be lined. This amounts to a savings of 841 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

$$\left(3.4\frac{\text{ft}^3}{\text{s}}\right)\left(\frac{60\ \text{s}}{\text{min}}\right)\left(\frac{60\ \text{min}}{\text{hr}}\right)\left(\frac{24\ \text{hr}}{\text{day}}\right)(215\ days) = (63{,}158{,}400\ \text{ft}^3)\left(\frac{acre - ft}{43{,}560\ \text{ft}^3}\right)$$
$$= 1{,}450\ acre - feet\ x\ 0.58 = 841\ acre - feet$$

(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). By measuring the Doppler shift from signals reflected off particles in the water and the canal bottom, the ADCP determines water velocity, depth, and the speed of the instrument over the bottom. 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	1.6	87.1
2	Left	15:26:23	36.4	-5.0	10.6	1.9	95.2
3	Right	15:28:24	40.3	5.2	12.1	1.9	75.3
Average			38.3	0.0	11.4	1.8	
Std Dev.			2.0	5.1	0.8	0.0	

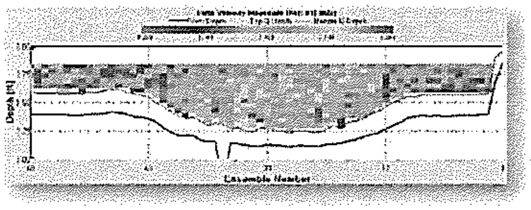


Figure 2: W53.1D inflow testing

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	11.2	1.4	93.5
Average			30.9	0.0	11.8	1.4	
Std Dev.			1.2	3.8	0.3	0.0	

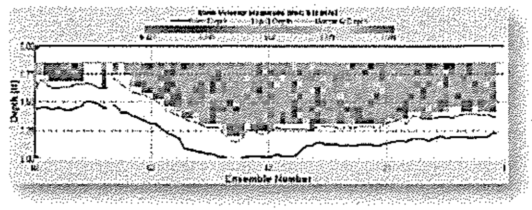


Figure 3: W53.1D outflow testing

<u>(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)?</u>

ANSWER: Geocomposite lining in combination with concrete is impervious and there is no expected post project water loss. Expected post project canal loss seepage reductions will be verified using ADCP technology, the same technology which was used to determine seepage loss.

<u>(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?</u>

ANSWER:

Calculation 3: current annual transit loss

$$841\ acre-feet/_{1.3\ miles} = 647\ \frac{acre-feet}{mile}$$

<u>(e) How will actual canal loss seepage reductions be verified?</u>

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:

4.5" 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 District shall furnish and the Contractor shall install 20-mil thick HDPE geotextile with an 3-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 geosynthetic 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:

$$841\ acre-feet / 1{,}450{,}000\ acre-feet = 0.001\ x\ 100 = 0.06\%$$

Evaluation Criterion B: Energy-Water Nexus

Describe any energy efficiencies that are expected to result from implementation of the water conservation or water management project (e.g., reduced pumping).

ANSWER: Energy efficiency is expected to result from implementation of the water conservation project by reduced pumping. It is expected that 560,075 kWh will be conserved.

•Please provide sufficient detail supporting the calculation of any energy savings expected to result from water conservation improvements. If quantifiable energy savings are expected to result from water conservation improvements, please provide sufficient details and supporting calculations. If quantifying energy savings, please state the estimated amount in kilowatt hours per year.

ANSWER: The W53.1D lateral receives water from the Frenchman Springs Pumping Plant. Four pump units lift water 264 feet. Water conservation would reduce the energy requirement by the amount conserved water. It is expected that conserving 2.0 ft^3/s over a (841 acre-feet over 215 day irrigation season) would save 329,174 kWh per year.

Calculation 5: energy and cost required to lift water

Calculate gallons of water pumped per day:

$$\left(897\frac{gal}{min}\right)\left(\frac{60\,min}{hr}\right)(24\,hours) = 1{,}291{,}680\,gallons$$

Calculate weight of water pumped per day:

$$1{,}291{,}680\,gal\,\left(\frac{8.345\,lbs}{gal}\right) = 10{,}779{,}070\,lbs$$

Calculate energy requirement:

$$(10{,}779{,}070\,lbs)(264\,ft) = 2{,}845{,}674{,}374\,ft - lbs$$

Conversion of ft-lbs to kWh:

$$2{,}845{,}674{,}374\,ft - lbs\,\left(\frac{1\,kWh}{2{,}655{,}220\,ft - lbs}\right) = 1072\,kWh\,per\,day$$

It is assumed that Frenchman Hills Pumping Plant operates at 70% efficiency.

$$1072\,kWh/_{0.70} = 1531\,kWh\,per\,day$$

Calculate to kWh per 215 day irrigation season:

$$\underline{1531\,kWh(215\,days) = 329{,}174\,kWh\,peryear}$$

•Please describe the current pumping requirements and the types of pumps(e.g., size) currently being used. How would the proposed project impact the current pumping requirements?

ANSWER: Each unit has an 800 hp motor that is designed to run at 1200 rpm on 2,300 volts at 157 amps. This project would reduce the amount of energy needed to ensure uninterrupted irrigation delivery.

•Please indicate whether you energy savings estimate originates from the point of diversion, or whether the estimate is based upon an alternate site of origin.

ANSWER: Energy savings estimates are based on the W43.1D point of diversion. Additional energy savings at the Grand Coulee Dam pumping facilities point of diversion would be achieved.

•Does the calculation include the energy required to treat the water?

ANSWER: Irrigation water is untreated, thus calculations do not include the energy required to treat the water.

•Will the project result in reduced vehicle miles driven, in turn reducing carbon emissions? Please provide supporting details and calculations. Describe any renewable energy components

that will result in minimal energy savings/production (e.g., installing small-scale solar as part of a SCADA system).

ANSWER: This project is not expected to reduce carbon emissions.

Evaluation Criterion C: Benefits to Endangered Species

For projects that will directly benefit federally-recognized candidate species, please include the following elements:

•What is the relationship of the species to water supply?

ANSWER: Instream flows are critical to protect and sustain endangered salmon species and habitat. Irrigated agriculture within the Columbia Basin Project is the largest consumptive use of water on the Columbia River.

Salmon and steelhead stocks that are threatened or endangered under the federal Endangered Species Act in the Columbia River domain include:

1) Snake River fall Chinook salmon, threatened
2) Snake River spring/summer Chinook salmon, threatened
3) Mid-Columbia River steelhead, threatened
4) Snake River sockeye salmon, endangered
5) Upper Columbia River spring Chinook salmon, endangered
6) Upper Columbia River steelhead, endangered

•What is the extent to which the proposed project would reduce the likelihood of listing or would otherwise improve the status of the species?

Columbia Basin Project water conservation measures decrease withdrawals needed from the Columbia River which increases water availability for federally endangered and threatened salmon and steelhead.

The highly managed Columbia River system exhibits significant variability of flow on many different time scales. Partly as a result of this variability, migration flow targets are not always met, and it has generally proven difficult to maintain main-stem flows above the target for the entire fish migration period. In years of low to moderate precipitation, decreased flows in the

Columbia River exacerbate this phenomenon. Furthermore, because of consumptive use and hydropower demands during low-flow years, tradeoffs between fishery demands often come into play, particularly between biological needs within storage reservoirs and the associated outlets and anadromous migration conditions in the main stream. (Managing the Columbia River: Instream Flows, Water Withdrawals, and Salmon Survival; The Committee on Water Resources Management, Instream Flows, and Salmon Survival, 2004.)

Evaluation Criterion D: Water Marketing

ANSWER: Water marketing is not applicable.

Evaluation Criterion E: Other Contributions to Water Supply Sustainability

Subcriterion E.4: Other Water Supply Sustainability Benefits

o Will the project help to address an issue that could potentially result in an interruption to the water supply if unresolved?

ANSWER: On average, the W53.1D lateral's maximum designed capacity of 35 ft^3/s is reached 46.7 days per year over the last three years. When designed capacity is reached, no more water can be added to the canal which results in water supply interruption if demand exceeds capacity. The W53.1D is one of the most rationed laterals in the Quincy District. Water conservation will lessen interruption to the water supply which will lessen impacts to irrigated agriculture while remaining water budget neutral on the Columbia River.

Table 1: Number of days that the W53.1D reached maximum design capacity

Year	Days
2014	44 days
2013	46 days
2012	50 days

• Will the project make additional water available for Indian tribes?

ANSWER: Water left in the Columbia River would be available for additional uses, including Indian tribes.

• Will the project make water available for rural or economically disadvantaged communities?

ANSWER: Water left in the Columbia River would be available for additional uses, including adjacent economically disadvantaged communities.

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

ANSWER: The threat of drought on the Columbia River, such as that caused by climate change has the potential to impact designated Columbia River uses which include water supply and aquatic life uses. Endangered salmon rely on timely, abundant, cold, clean water to spawn and rear young. During 2001, hundreds of thousands of juvenile salmon were stranded by low flows in the Columbia River and were unable to travel to the Pacific Ocean (Washington State Department of Ecology). Water conservation will help ensure water availability for all uses along the Columbia River.

• Is there frequently tension or litigation over water in the basin?

ANSWER: 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.

• Will the project increase awareness of water and/or energy conservation and efficiency efforts?

ANSWER: Water and energy conservation are goals of the State of Washington and work on the Federal Columbia Basin Project is highly publicized by State agencies such as the Department of Ecology on their website. This project will increase awareness of water conservation and efficiency efforts in Washington State.

•Will the project serve as an example of water and/or energy conservation and efficiency within a community?

ANSWER: Lining the W53.1D will serve as an example of water and energy conservation and efficiency within Washington State. As part of Washington State Governor's Results Washington initiative, the Washington State Department of Agriculture and Ecology have set state water conservation goals. Water conservation work, including the Columbia Basin coordinated water conservation plan is highly publicized in Washington State as a model that protects agriculture and the environment.

• *Does the project integrate water and energy components?*

ANSWER: By conserving water, less water is pumped which has an energy component. It is estimated that this project will conserve 560,000 kWh and 1,450 acre-feet of water.

Evaluation Criterion F: Implementation and Results

Subcriterion No. F.1: Project Planning

Does the project have a Water Conservation Plan, System Optimization Review (SOR), and/or district or geographic area drought contingency plans in place? Does the project relate/have a nexus to an adaptation strategy developed as part of a WaterSMART Basin Study)? Please self-certify, or provide copies of these plans where appropriate, to verify that such a plan is in place.

ANSWER: This project is part of a 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.

Provide the following information regarding project planning:

(1) Identify any district-wide, or system-wide, planning that provides support for the proposed project. This could include a Water Conservation Plan, SOR, Basin Study, drought contingency plan, or other planning efforts done to determine the priority of this project in relation to other potential projects.

ANSWER: This project is part of the Columbia Basin Project Coordinated Water Conservation Plan.

(2) 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).

ANSWER: The Columbia Basin Project Coordinated Water Conservation Plan seeks to identify water conservation projects that will allow for additional farm acreage to be served while remaining water budget neutral on the Columbia River. The proposed water conservation project meets the goals of this plan.

Subcriterion No. F.2: Readiness to Proceed

Describe the implementation plan of the proposed project. Please include an estimated project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates. (Please note, under no circumstances may an applicant begin any ground-disturbing activities— including grading, clearing, and other preliminary activities—on a project before environmental compliance is complete and Reclamation explicitly authorizes work to proceed).

ANSWER: The following major tasks are expected to take place within the following timelines.

Planning / Bidding	September 2015
Mobilization	October 2015
Earthwork	November 2015 through February 2016
Geo Liner	November 2015 through February 2016
Concrete	November 2015 through February 2016
Demobilization	March 2016

Please explain any permits that will be required, along with the process for obtaining such permits.

ANSWER: There are no permits that will be required for the proposed project.

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

ANSWER: Using Manning's Equation, QCBID will size a shotcrete trapizotal channel to convey the original design flow at the original design water surface elevation set by the U.S.B.R. The Mannings's friction factor will be 0.022 with 1.5 : 1 side slopes on the channel. Earthwork will be calculated using AutoCAD Civil 3D software which compares the existing elevations to the subgrade elevations and calculates volumes of material to move, import, or export.

Subcriterion No. F.3: Performance Measures

Provide a brief summary describing the performance measure that will be used to quantify actual benefits upon completion of the project (e.g., water saved, marketed, or better managed, or energy saved). For more information calculating performance measure, see Section VIII.A.1 "FY2015 WaterSMART Water and Energy Efficiency Grants: Performance Measures."
Note: All WaterSMART Grant applicants are required to propose a "performance measure" (a method of quantifying the actual benefits of their project once it is completed). A provision will be included in all assistance agreements with WaterSMART Grant recipients describing the performance measure, and requiring the recipient to quantify the actual project benefits in their final report to Reclamation upon completion of the project. If information regarding project benefits is not available immediately upon completion of the project, the financial assistance agreement may be modified to remain open until such information is available and until a Final Report is submitted. Quantifying project benefits is an important means to determine the relative effectiveness of various water management efforts, as well as the overall effectiveness of WaterSMART Grants.

ANSWER: Actual water conserved will be used to quantify actual benefits upon completion of the project. Pre-project test results will be compared with post-project test results using inflow/outflow tests. The same instrumentation and methodologies to determine water loss will be used to determine water savings.

Subcriterion No. F.4: Reasonableness of Costs

Please include information related to the total project cost, annual acre-feet conserved, energy capacity, or other project benefits and the expected life of the improvement(s).
For all projects involving physical improvements, specify the expected life of the improvement in number of years and provide support for the expectation (e.g., manufacturer's guarantee, industry accepted life-expectancy, description of corrosion mitigation for ferrous pipe and fittings, etc.). Failure to provide this information may result in a reduced score for this section.

ANSWER: The total project cost is $700,000, the annual acre-feet conserved is 841 acre-feet, and the amount of energy conserved due to reduced pumping costs is 329,174 kWh per year. The expected life expectancy of the project is 50 years which is typical of other concrete lined canals and laterals within the District.

Evaluation Criterion G: Additional Non-Federal Funding

*Up to **4 points** may be awarded to proposals that provide non-Federal funding in excess of 50 percent of the project costs. State the percentage of non-Federal funding provided.*

Non-Federal Funding / Total Project Cost = ($400,000 / $700,000) x 100 = 57%

Evaluation Criterion H: Connection to Reclamation Project Activities

(1) 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.

(2) Does the applicant receive Reclamation project water?

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

(3) Is the project on Reclamation project lands or involving Reclamation facilities?

ANSWER: The proposed project is on Reclamation lands and involves maintenance of reclamation facilities.

(4) 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.

(5) 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 on the Columbia River.

Performance Measures

Canal Lining / Piping

Inflow/outflow testing was used to determine seepage losses in the W53.1D lateral and calculate potential water savings.

The estimated average annual water savings that will result from the project is 841 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 58% of the test area will be lined which equates to approximately 841 acre-feet of conserved water. 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.

The same inflow/outflow testing procedures and seepage loss methodology will be used to determine post project water loss.

Transect	Start Bank	Start Time	Total Q	Delta Q	Width	Flow Speed	Duration
			ft^3/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
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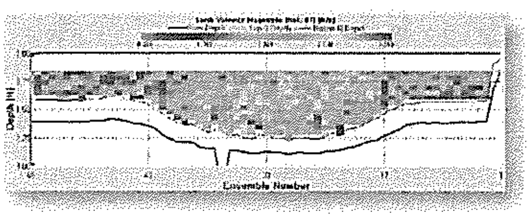

Figure 2: W53.1D inflow testing

Transect	Start Bank	Start Time	Total Q	Delta Q	Width	Flow Speed	Duration
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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	

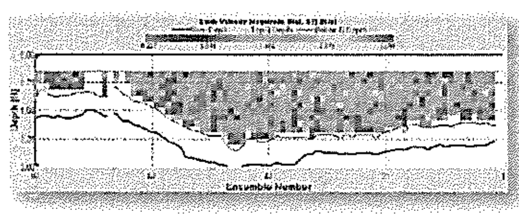


Figure 3: W53.1D outflow testing

Environmental and Cultural Resources Compliance

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 as 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.

Resolution – Board Commitment

QUINCY-COLUMBIA BASIN IRRIGATION DISTRICT

RESOLUTION 2015 -

WaterSMART Grant

WHEREAS, the Quincy-Columbia Basin Irrigation District is in receipt of the U.S. Bureau of Reclamation Funding Opportunity Announcement No. R15AS00002, *WaterSMART: Water and Energy Efficiency Grants for FY 2015*; 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 supports 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 6th day of January 2015.

BOARD OF DIRECTORS

(SEAL)

ATTEST

Secretary

Project Budget

Funding Plan

The District's contribution to the cost share requirement will be approximate 96% monetary and 4% in-kind. Source funds will come from 2015 assessments. The District will not seek to include in-kind costs incurred before the anticipated project start date. Project expenses that have already occurred, but which will not be included in the project include administrative and engineering work to plan and design the project.

Funding Sources	**Funding Amount**
Non-Federal Entities (Quincy-Columbia Basin Irrigation District)	
Project Management	$ 18,000
Contract Lining & Piping	$ 382,000
Non-Federal Entities Subtotal	**$ 400,000**
Non-Federal subtotal	$ -
Other Federal Entities Subtotal	$ -
Requested Reclamation Funding Subtotal	**$ 300,000**
Total Project Funding	**$ 700,000**

Budget Proposal

The District's contribution to the cost share requirement will be approximate 96% monetary and 4% in-kind. The district proposes to contribute $400,000 and is seeking $300,000 in federal funds. Source funds will come from 2015 assessments. The District will not seek to include in-kind costs incurred before the anticipated project start date. Project expenses that have already occurred, but which will not be included in the project include administrative and engineering work.

Funding Sources	**Percent of Total Project Cost**	**Total Cost by Source $**	
Recipient Funding	57 %	$	400,000
Reclamation Funding	43 %	$	300,000
Other Federal funding	0 %	$	-
Totals	**100 %**	**$**	**$700,000**

Budget Item & Description	$/Unit		Quantity	Total Cost
Salaries & Wages				
Technical Services Manager, Roger Sonnichsen	$ 45.00	hr	40	$ 1,800
District Engineer, John Mele	$ 35.00	hr	160	$ 5,600
O&M Field Supervisors, Stan Butler & Dennis Smith	$ 30.00	hr	120	$ 3,600
Fringe Benefits	$ 15.00	hr	320	$ 4,800
Contractual & Construction				
Task 1: Earthwork	$ 100.00	cyd	849	$ 84,900
Task 2: Liner / Concrete*	$ 85.00	ft	7000	$ 595,000
Other				
Reporting				$ 2,000
Environmental & Regulatory				$ 2,200
Indirect Costs				$ 1,000
Total				**$ 700,000**

*See Graph 1 on Page 26 for cost analysis

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 and is included in indirect costs.

Fringe Benefits

Fringe benefits are estimated to be approximately $15 per hour. Costs were reported by the District's Human Resource Manager and are based on a 2014 survey of all employees.

Travel

Travel expense is not expected for the proposed project.

Equipment

The District does not expect to purchase new equipment for the proposed project. Equipment needed for construction has is included in costs for specific tasks based on past projects. Refer to graph 1 on page 26 for cost analysis.

Materials and Supplies

Materials and supplies furnished by the District are expected to be nominal. Materials and supplies needed for construction are included in specific project task orders based on previous projects and are included in the District's cost analysis sheet in Graph 1 on page 26.

Contractual

The installation of the concrete and geomembrane liner will be performed by a contractor. Cost of work is estimated to be $85 per foot based on a cost analysis determined by past District projects. The District's cost analysis does not include earthwork, thus this item has been tasked separately in the budget. Cost analysis is displayed and described in Graph 1 on page 26. This work includes 4 tasks which include earthwork, geomembrane installation, concrete installation, and mobilization / demobilization. The earthwork includes shaping the subgrade, installing a 3 inch layer of base gravel, and backfill after the liners are installed. Geomembrane installation includes providing the liner, rolling it out, and gluing the liner. Concrete installation includes setting and removing needed forms, placing concrete and trowling the concrete. This project will go out for sealed bids.

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.

Reporting

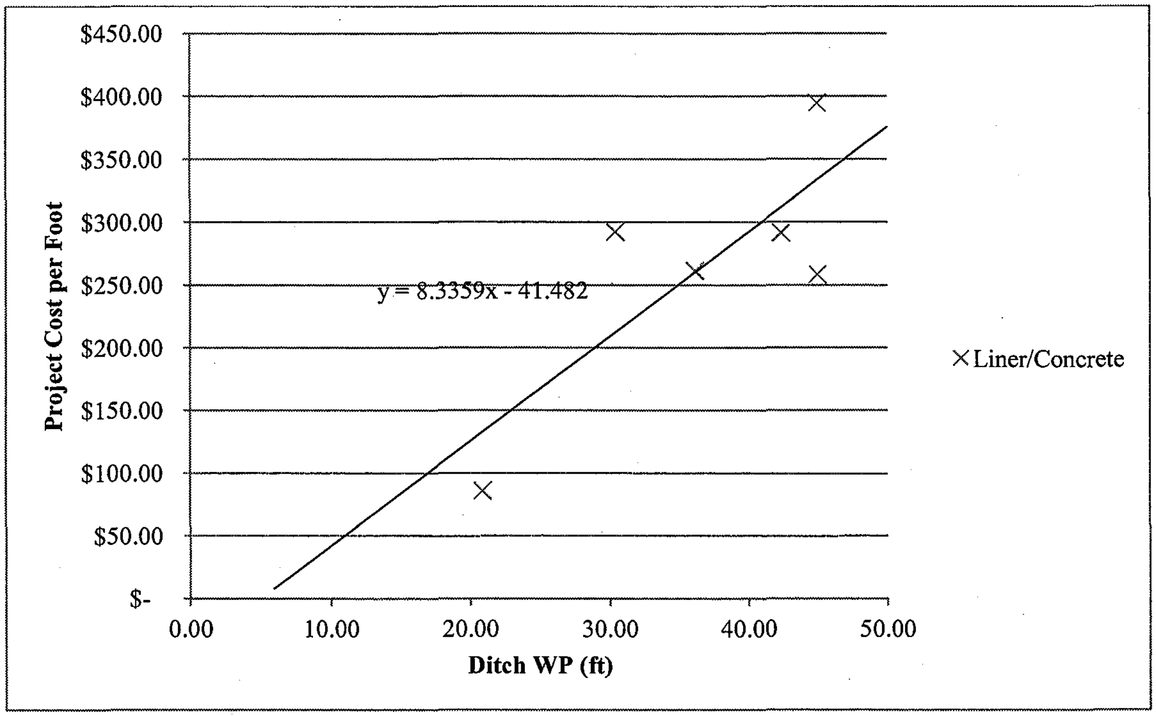
Reporting expense has been included on the budget to cover costs associated with reporting requirements. All reporting will be performed by District staff

Indirect Costs

Indirect costs include any general administrative costs. It is estimated that approximately 50 hours at a rate of $20 per hour will be expensed as administrative costs.

Total Costs

Total project total cost is expected to be $700,000.



Graph 1: QCBID Average Construction Cost for Contract Liner/Concrete Projects

The W53.1D lateral has an approximate 15 foot wide wetted perimeter. (8.3359 x 15)-41.482 = $85 per foot.

APPENDIX:

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

COLUMBIA BASIN PROJECT COORDINATED WATER CONSERVATION PLAN – FINAL DRAFT

Prepared for

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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

Table A-1
Long Term Projects - Quincy District

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

Table A-1
Long Term Projects - Quincy District

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

Table A-1
Long Term Projects - Quincy District

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

Table A-1
Long Term Projects - Quincy District

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

Table A-2a
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
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
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
49	PE 20C3	15" Pipe	800	Columbia River	Qfg	$19,817	31.6	$627
49		Rereg		Columbia River				
		TOTAL	**149,674**			**$6,329,735**	**6,376.7**	**$993**

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

Table A-2b
Long Term Projects - East District - Blocks 40-44

Block	Location	Project Description	Length (ft)	Drainage Basin	Geology	Estimated Cost	Estimated Savings (ac-ft/yr)	Cost per AF Savings
42	EL 36.3J	12" PVC	1330	Potholes Reservoir		$ 24,352	40	$611
42	RCD	Rereg		Potholes Reservoir				
42	EL 39	Shotcrete	900	Potholes Reservoir		$ 16,180	45	$356
43	EL 41	15" PVC	150	Potholes Reservoir		$ 3,716	6	$653
43	EL 42	24" PVC	4400	Potholes Reservoir		$ 227,480	232	$981
43	EL 43	24" PVC	4000	Potholes Reservoir		$ 206,800	199	$1,037
43	EL 44	18" PVC	1350	Potholes Reservoir		$ 45,077	51	$880
43	EL 45	15" PVC	1500	Potholes Reservoir		$ 37,155	162	$229
43	EL 45A	24" PVC	1400	Potholes Reservoir		$ 72,380	51	$1,426
43	EL 45A	15" PVC	2400	Potholes Reservoir		$ 59,448	87	$683
43	EL 45A	12" PVC	3800	Potholes Reservoir		$ 69,578	138	$505
43	EL 45F2	10" PVC	2600	Potholes Reservoir		$ 39,208	70	$561
43	EL 45BB	15" PVC	2050	Potholes Reservoir		$ 50,779	66	$767
43	EL 45CC	12" PVC	200	Potholes Reservoir		$ 3,662	5	$682
43	EL 45D	15" PVC	2700	Potholes Reservoir		$ 66,879	117	$572
43	EL 45B	15" PVC	1700	Potholes Reservoir		$ 42,109	60	$705
43	EL 45B4	18" PVC	1000	Potholes Reservoir		$ 33,390	27	$1,243
43	EL 45J	12" PVC	430	Potholes Reservoir		$ 7,873	12	$682
43	EL 45F1	10" PVC	1450	Potholes Reservoir		$ 21,866	55	$398
43	EL 45H	15" Pipe	2000	Potholes Reservoir		$ 49,540	54	$922
43	EL 48	18" Pipe	1200	Potholes Reservoir		$ 40,068	32	$1,243
43	EL 48	12" Pipe	2700	Potholes Reservoir		$ 49,437	73	$682
43	EL 49	24" PVC	3500	Potholes Reservoir		$ 180,950	236	$767
43	EL 52	12" Pipe	1400	Potholes Reservoir		$ 25,634	49	$521
43	EL 52	12" Pipe	2200	Potholes Reservoir		$ 40,282	77	$521
43	EL 53	15" Pipe	500	Potholes Reservoir		$ 12,385	13	$922
43	EL 53	12" Pipe	1000	Potholes Reservoir		$ 18,310	27	$682
43	EL 53	10" Pipe	1800	Potholes Reservoir		$ 27,144	48	$561
43	EL 55A	15" PVC	500	Potholes Reservoir		$ 12,385	12	$1,025
43	EL 55B	12" PVC	2500	Potholes Reservoir		$ 45,775	88	$521
43	EL 55.8	Shotcrete	1500	Potholes Reservoir		$ 53,934	154	$351
44	EL 56	12" PVC	950	Potholes Reservoir		$ 17,395	39	$451
44	EL 60.6	Shotcrete	7000	Potholes Reservoir		$ 172,590	800	$216
44	EL 60.6C	12" PVC	900	Potholes Reservoir		$ 16,479	22	$757
44	EL 63B	15" PVC	3200	Potholes Reservoir		$ 79,264	121	$653
44	EL 63.1B1	12" PVC	2600	Potholes Reservoir		$ 47,606	70	$682
44	EL 63.1C1	10" PVC	1650	Potholes Reservoir		$ 24,882	44	$561
44	EL 63.8D1	12" PVC	1500	Potholes Reservoir		$ 27,465	45	$611
44	EL 63.8D	18" Pipe	2000	Potholes Reservoir		$ 66,780	100	$670
44	EL 63.8D	12" Pipe	2200	Potholes Reservoir		$ 40,282	110	$367
44	EL 63.8E1	15" PVC	3000	Potholes East Canal		$ 74,310	134	$553
44	EL 63.8F3	15" Pipe assumed	3750	Potholes Reservoir		$ 92,888	101	$922

Table A-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
44	EL 66B	18" PVC	1200	Potholes East Canal		$ 40,068	24	$1,689
44	EL 66	12" PVC	1200	Potholes East Canal		$ 21,972	16	$1,401
44	Warden Coulee	Rereg		Potholes East Canal		$ 6,691,525	7900	$847
44	EL66WW	Rereg		Potholes East Canal				
40-49	East Low Canal	Lining		Potholes Res/Canal				
40-49	Pump Modernization	Pumps		Potholes Res/Canal				
		TOTAL	**174,305**			**$ 10,966,481**	**15,023.8**	**$730**

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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

Table A-3
Long Term Projects - South District

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**