Kittitas Reclamation District
North Branch Canal Lining Project

Reclamation WaterSMART Water and Energy Efficiency Grant Proposal

Funding Opportunity Announcement

No. R16-FOA-DO-004

Prepared by

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Contents

Section **Page**

Tables

Figures

Attachments

SECTION 1

Technical Proposal

1.1 Executive Summary

Date: February 10, 2016 (Original Submission January 15, 2016)

Applicant: Kittitas Reclamation District

City/County/State: Ellensburg, Kittitas, Washington

This application is for funding by the U.S. Bureau of Reclamation's (Reclamation) WaterSMART: Water and Energy Efficiency Grants for FY 2016 Funding Opportunity Announcement (FOA) No. R16-FOA-DO-004. This application from the Kittitas Reclamation District (District) is seeking $147,104 in federal funding assistance for Federal Funding Group I. The funding will be used to line approximately 850 lineal feet (LF) of earthen canal in the District's canal system to increase water conservation and water-use efficiency by reducing seepage losses. This is the first phase of a larger 3.25-mile lining project through an area with high seepage losses as identified in the recently completed Feasibility Investigation summarizing the District's opportunities for water conservation. The project will provide benefits within Task Area A – Water Conservation; Task Area C – Benefits to Endangered Species; Task Area D – Water Marketing; and Task Area E – Other Water Supply Sustainability Benefits as defined by Reclamation's FOA. The proposed lining would be within lands owned by Reclamation, and the saved water would be delivered to tributaries within the Yakima Basin Project to supplement instream flows in designated critical habitat for ESA-listed steelhead. When complete, the Phase 1 project will result in an annual water savings of at least 166 acre-feet (AF) as well as improved overall water management. The requested funds ($147,104) comprise 50 percent of the $294,208 total Phase 1 project cost and will provide the resources needed to assist the District with implementing the North Branch Canal Lining Project (project). Canal lining for Phase 1 will begin following the 2016 irrigation season and will be complete by spring 2017.

1.2 Background Data

The District is located in central Washington in Kittitas County and is part of the Bureau of Reclamation's Yakima Basin Project. District headquarters are located in the city of Ellensburg, Washington. District lands extend from the Easton Diversion Dam, along both sides of the Yakima River, to approximately 11 miles southeast of the city of Kittitas. The total project service area is approximately 104,588 acres and extends approximately 40 miles long by 10 miles wide.

The District was organized under Revised Code of Washington Title 87, Irrigation Laws of the State of Washington, on September 25, 1911, and in accordance with the District's Federal Repayment Contract. The District encompasses approximately 104,588 acres and currently assesses and delivers water to 59,478 acres. The District has not expanded beyond historical service area boundaries and has no intentions to expand.

The District's primary purpose is to deliver irrigation water to its landowners. Primary crops grown are tree fruit orchards—including apple, pear, and cherry trees—timothy hay, and alfalfa under a combination of pivots, sprinklers, and gravity irrigation systems.

1.2.1 Area Map and Project Map

The District is located in central Washington along the east edge of the Cascade Mountains in the upper Yakima River Basin.

Figure 1 shows an area map that depicts the District's service area. The District has over 330 miles of canals and laterals.

Figure 2 shows the project area, including existing features and future project improvements:

- **North Branch Canal Lining Project (Phase 1 project)** – 850 LF of canal lining on the North Branch Canal (the first 5 percent of the full North Branch Canal Lining Project and the subject of this WaterSMART grant application).
- **North Branch Canal Lining Project from Johnson Siphon to Wippel Pump Station (entire project)** – 17,109 LF (approximately 3.25 miles) of canal lining.

FIGURE 1
Kittitas Reclamation District Service Area Map

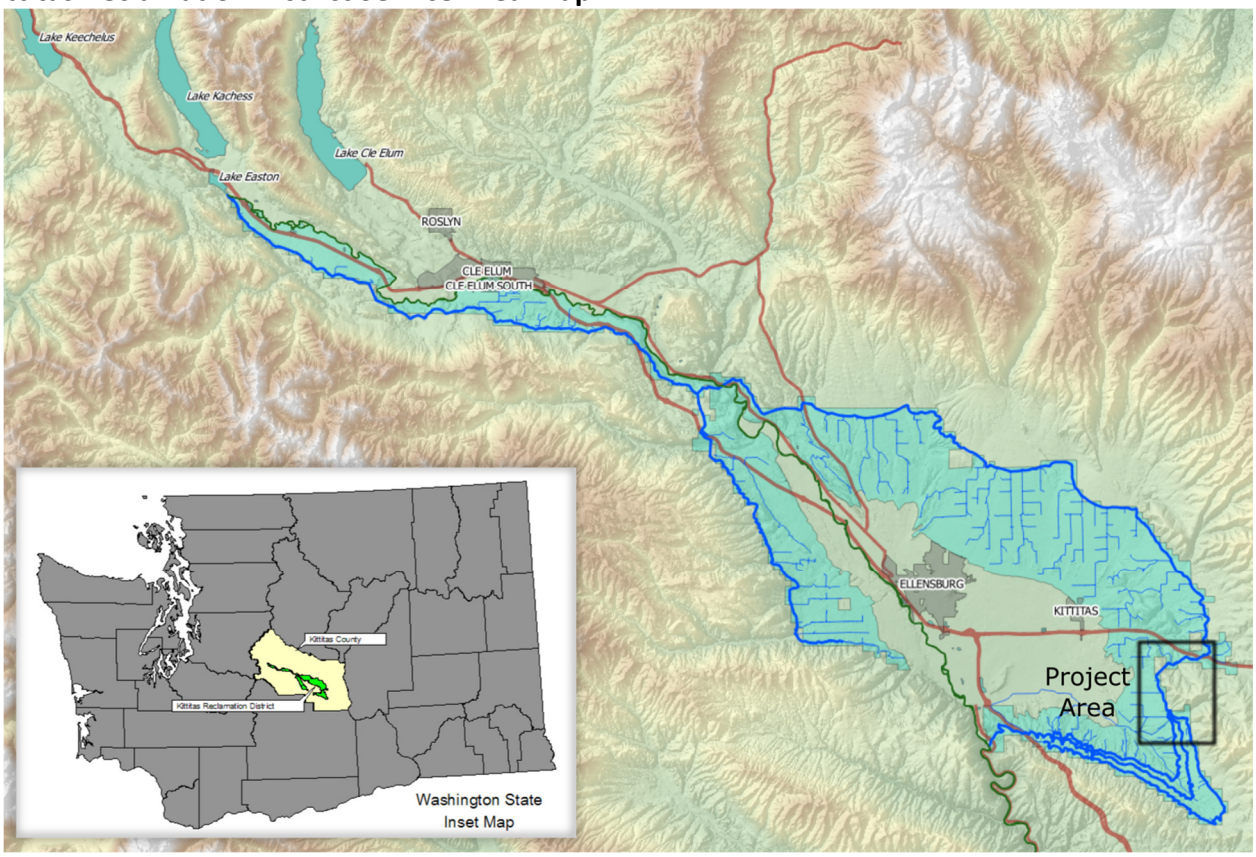
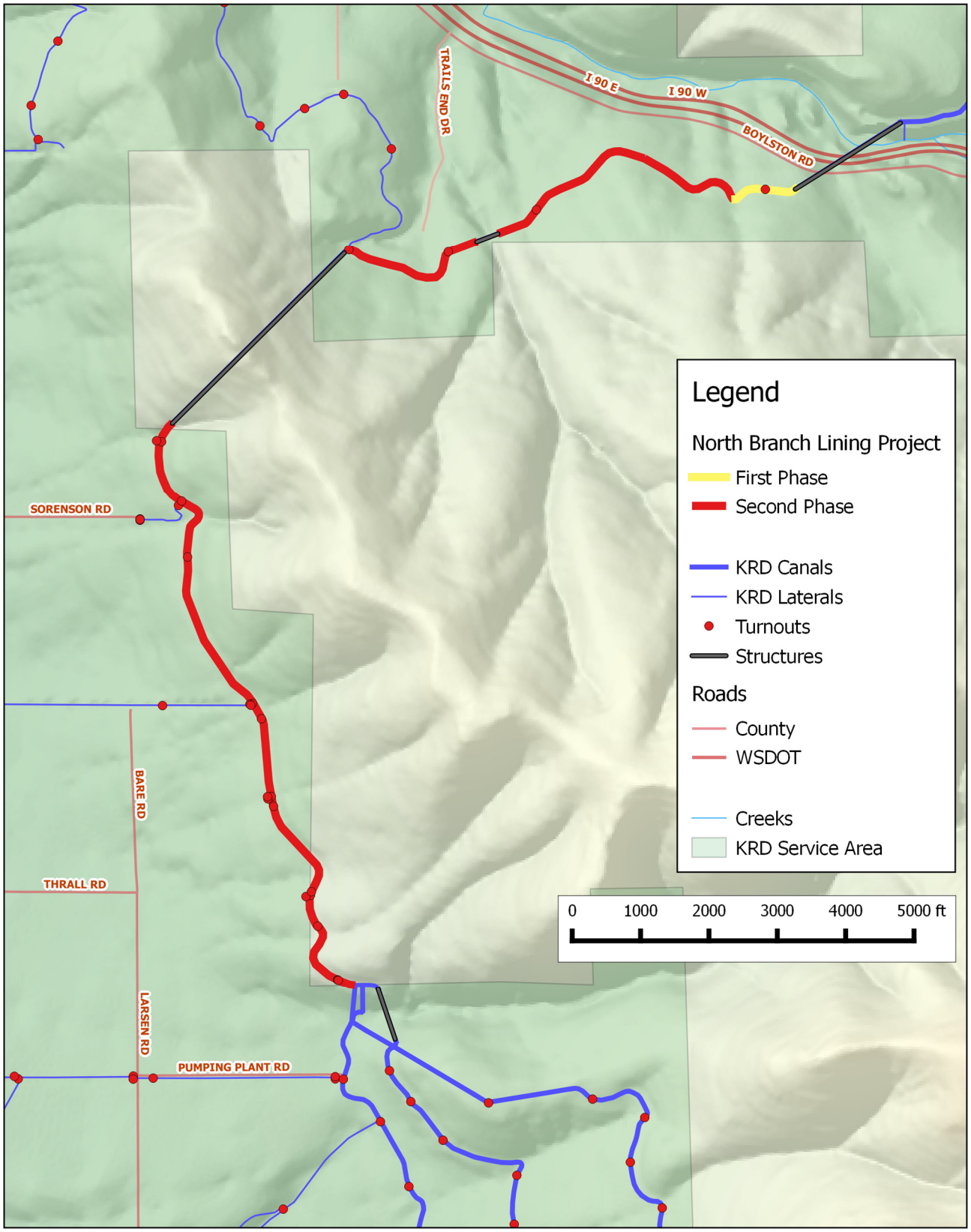


FIGURE 2

Kittitas Reclamation District North Branch Canal Lining Project Map



1.2.2 Water Supply, Water Rights, Water Delivery System, and Current Water Uses

1.2.2.1 Water Supply

The District's water supply comes from surface water sources, which is derived from the Yakima River Basin in Washington. The typical growing season is 178 days, and water is typically delivered from mid-April thru mid-October.

Table 1 summarizes the District's annual water supply from 2000 through 2015.

TABLE 1
District Annual Water Supply

Year	Annual Supply (AF)
2000	305,873
2001	139,168
2002	294,366
2003	278,995
2004	287,313
2005	155,056
2006	286,832
2007	303,050
2008	288,499
2009	312,334
2010	280,446
2011	292,537
2012	314,896
2013	309,433
2014	316,908
2015	154,146
AVERAGE	**269,991**

1.2.2.2 Water Rights

The District delivers 4.5 AF per assessed acre when water is available. The District's water supply during a full water year is 336,000 AF. The District has a pro-ratable water right. In a drought year, when there is less water than it takes to fulfill all of the non-prorated water rights in the Yakima River basin, the District will receive less than its full entitlement. As shown in Table 1, the last major shortfalls were in 2001, 2005, and 2015, when the District received less than half of its full water entitlement.

1.2.3 Water Delivery System and Current Uses

1.2.3.1 Diversion and Storage Facilities

Water is diverted from two storage reservoirs, Keechelus and Kachess, which are both owned and operated by Reclamation. Irrigation water is diverted from the Yakima River at the Easton Diversion Dam. The diversion includes a drum gate, two radial gates, fish ladder, and fish screening facilities. The facility has a diversion capacity of approximately 1,320 cubic feet per second (cfs).

1.2.3.2 Distribution System

From the Easton Diversion Dam, water is diverted into an open-channel canal system. The District has over 330 miles of canals and laterals. Irrigation water is conveyed from the river diversion through the Main Canal. The Main Canal is approximately 26 miles in length and mostly concrete lined. The Main Canal has an initial capacity of 1,320 cfs and includes two tunnels, eight siphons, and three wasteways.

The North Branch Canal is 38 miles long from the bifurcation at the end of the Main Canal to the Wippel Pump Plant. There are six tunnels, six siphons, and one wasteway in this section. The initial capacity of the North Branch Canal is 925 cfs and reduces to 280 cfs at the Wippel Pump Plant. The Wippel Pump Plant is located at the end of the North Branch Canal.

The South Branch Canal is 14.2 miles long starting at the Main Canal bifurcation. There are two tunnels, six siphons, and two wasteways in this section. The initial capacity of the South Branch Canal is 250 cfs, with a final capacity of 55 cfs.

There are 37 laterals that branch off the Main Canal, North, and South Branch Canals. These laterals range from hundreds to thousands of feet long. Sub-laterals branch off the laterals; there are approximately 22 sub-laterals that tend to be much shorter in length than the laterals.

Approximately 1,000 turnouts exist in the District's conveyance system. The turnouts range in size from ¾- to 24-inch diameter.

1.2.3.3 Pumping System

The Wippel Pump Plant has two direct-connected, 500 horsepower, horizontal hydraulic turbines driving two centrifugal pumps with a combined capacity of approximately 50 cfs. There are also two electric vertical turbine pumps. One electric pump is rated at 300 horsepower and 10 cfs; the other electric pump is rated at 150 horsepower and 5 cfs.

At the Wippel Pump Plant, the canal branches into three major laterals. The laterals include the Pump Lateral, which is supplied by the hydro turbines and electric pumps in the Wippel Pump Plant; the Gravity Lateral, which bypasses Wippel Pump Plant and is supplied by open ditch canal from the North Branch Canal; and the Turbine Lateral, which is supplied from the tailwater used by the hydro turbines at the Wippel Pump Plant.

1.2.4 Existing and Previous Reclamation Partnerships

Since 1999, the District, the Department of Ecology (Ecology), and Reclamation have collaborated and partnered to plan, design, and construct the Manastash Creek Project through the Yakima River Basin Water Enhancement Project (YRBWEP). This project was an award-winning water conservation pilot project near Ellensburg, Washington, that replaced 20,000 LF of unlined irrigation lateral with a buried gravity pressure pipeline. The project was completed in spring 2014 and now saves annually an estimated 1,215 AF of water by eliminating seepage, operational spills,

and evaporation. The conserved water is used to increase flow and restore habitat in Manastash Creek. The cleaner, pressurized water also reduces pumping and maintenance costs for irrigators.

1.2.5 Water Conservation Goals and Existing Water Conservation Program

The District's long-term goal is to ensure adequate deliveries. In addition, the District is committed to large-scale water sustainability by supplementing important tributaries of the Yakima River Basin with a significant portion of the saved water. Water savings from the Phase 1 project are expected to total approximately 166 AF per year, or 8,317 AF over the 50-year life cycle of the canal-lining material.

1.3 Technical Project Description

This section includes a technical description of the project based on project planning completed to date. The project will significantly reduce seepage losses. Water conservation benefits from the project will be immediate, and the savings expected from the project will result in enhanced water management.

The full project (Phase 1 and Phase 2) will line the high water loss portion of the North Branch Canal between the Johnson Siphon and the Wippel Pumping Plant (see Figure 2). The existing canal bottom on the North Branch Canal is earth lined, and many sections of the bottom are solid rock while others have some silt. Seepage losses have been apparent for many years based on annual water measurements, visual observations of seepage through the canal banks, and vegetation growth downslope of the canal banks.

The proposed Phase 1 project, as part of this WaterSMART grant application, will install a concrete liner in the North Branch Canal for a length of 850 LF (Phase 1 project).

1.3.1 Planning to Date

As described in Section 1.4.5, the District completed a Feasibility Investigation in March 2015 (see Attachment A for the Executive Summary). The Feasibility Investigation provided the basis for the proposed implementation of the District's water conservation projects that were identified in the District's Comprehensive Water Conservation Plan and associated Addendum No. 1 in 2001. The design criteria used during the Feasibility Investigation serves as a starting point for the design and cost estimation. The design criteria that were evaluated include the following:

- Hydraulics
- Canal Lining Options

1.3.1.1 Project Funding

If awarded the WaterSMART grant, the District will have the required funds to complete Phase 1 of this high-priority project using funds from Department of Ecology (Ecology) and in-kind labor as described in Section 4.

1.3.1.2 Project Location

The District has identified water conservation opportunities and ranked them in order of priority based on estimated water loss. This project will line a high-loss area of the North Branch Canal between Johnson Siphon and the Wipple Pumping Plant. As previously mentioned, seepage losses in the North Branch Canal have been apparent for many years based on annual water measurements, observed seepage, and vegetation growth downslope of the canal banks.

1.3.1.3 Canal Lining

The District plans to use a geomembrane liner with concrete to line the North Branch Canal. The membrane lining with shotcrete protective cover offers good compromise between cost, long-term water loss prevention, and long-term durability over other alternatives evaluated during the Feasibility Investigation. Without the addition of the shotcrete lining cover, maintenance of the canal for cleaning out accumulated sediments and debris becomes a delicate and time consuming procedure. Wildlife such as deer in this somewhat remote area of the District can easily puncture an exposed liner simply by walking on it. Additionally, by selecting a protective shotcrete cover, the waterproof membrane can be of lighter weight and strength than one exposed to the environmental conditions.

The shotcrete used in the lining system will be an easily flowable concrete mix design with a minimum strength of 4,500 pounds per square inch. Additional reinforcing, such as polyester fiber and reinforcing steel, will be investigated during final design to potentially increase long-term durability. The membrane lining will also be evaluated during final design of lining materials, such as polyvinyl chloride (PVC), high-density polyethylene (HDPE), and geotextile/rubber lining are commonly used in canals and reservoirs. The membrane lining will need to be watertight, not be damaged by environmental conditions (fire, wildlife, and maintenance), maintain at least a 50-year life expectancy, and be easily repairable in the field.

1.3.1.4 Turnouts

Typical turnouts in this reach of the canal will require some level of rehabilitation, ranging from replacement of the concrete turnout structure to installation of a new concrete turnout structure and excavation of the ditch bank for the turnout discharge pipe. In addition, rehabilitation of the existing turnout weir boxes could include replacing aging weir blades and the turnout slide gate. There is one turnout within the Phase 1 project reach.

1.4 Evaluation Criteria

1.4.1 Evaluation Criterion A: Water Conservation

The District's long-term goal is to ensure adequate deliveries with minimal water loss. The proposed project will help meet this goal through water conservation by reducing seepage losses.

Subcriterion No. A.1 – Quantifiable Water Savings

Describe the amount of water saved. For projects that conserve water, state the estimated amount of water conserved in AF per year as a direct result of this project.

The Phase 1 project is expected to conserve at least 166 AF on an annual basis, which represents 0.1 percent of the average annual supply. The one-time investment of $294,208 is expected to save approximately 8,317 AF over a 50-year period. Table 3 summarizes the estimated water saved from the entire North Branch Canal Lining Project. Phase 1 of the lining project will line the first 850 LF of canal within the Johnson Siphon to Wippel Pump Station reach, which is 5 percent of the overall project.

What is the applicant's average annual AF of water supply?

The District's average annual water supply is 269,991 AF (see Table 1 in Section 1.2.2).

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

The water is seeping into the ground. Portions of the water enter the shallow groundwater table and are used by downgradient irrigation users as unmetered return flows.

Where will the conserved water go?

Some of the water saved by the system improvements may be needed to satisfy irrigation demand. The remaining saved water can be used to increase upper Yakima River tributaries in stream flows or other purposes. The conserved water could be used to restore important fisheries on Whiskey Creek, Reecer Creek, Wilson Creek, Big Creek, Little Creek, Manastash Creek, and Taneum Creek and increase the reliability and sustainability of irrigation water supplies within the District. A portion of the conserved water may become available to supplement creek water or for users currently diverting from Yakima River tributaries. The System Operations Advisory Committee (SOAC) will determine where it has the most beneficial impact to endangered species.

As described below in Section 1.4.3, as part of the Phase 1 project the District is willing to commit to transferring the estimated water savings and delivering up to 0.47 cfs to the local streams through a water transfer.

Summary of Water Savings Calculations and Methodology

Current metering was performed during the 2014 irrigation season between the Johnson Siphon and the Wippel Pumping Plant to evaluate conveyance losses in the full reach of the North Branch canal.

How has the estimated average annual water savings that will result from the project been determined?

The District has estimated the conveyance losses using current metering, water balances, and accepted engineering practices identified in the Feasibility Investigation document. Table 2 shows the total supply and measurements at turnouts, ditches, and the supply to Wippel Pumping Plant. Figure 2 identifies supply and diversion locations used in the water balance. These facilities are within the reach of canal associated with the entire North Branch Canal Lining Project. The difference between the supply and the total diversions and supply to the Wipple Pumping Plant represents the total conveyance losses in this canal reach as shown in Table 4. It was assumed that 10 percent of the losses identified were from evaporation; therefore, 90 percent of the conveyance losses are from seepage which are the estimated water savings associated with lining this reach of the North Branch Canal, as shown in Table 3.

TABLE 2
Entire North Branch Canal Lining Project - Johnson Siphon to Wippel Pumping (17,109 LF)

Site	8/7/2014 Discharge (cfs)	10/3/2014 Discharge (cfs)	10/9/2014 Discharge (cfs)	Average Discharge (cfs)
Total Supply (NB31.3)	285.8	270.1	253.2	272.0
Johnson Spill	0	2	0.0	0.7
Turnouts (Total)	35	22.0	27.8	28.3
Gravity Ditch	34	26.1	23.9	28.0
Pump Ditch headend	61.1	46.8	46.1	51.3
T0.2 weir	25.8	9.5	11.0	15.4
WW0.00	14.9	115.9	85.5	72.1
Turbine Ditch headend	89.66	52.0	51.1	64.3
Total Diversions and Supply to Wipple Pumping Plant	260.4	274.3	245.4	260.0

TABLE 3
Conveyance Losses – Entire North Branch Canal Lining Project (17,109 LF)

	Average Discharge (cfs)
Total Supply (NB31.3)	272.0
Total Diversions and Supply to Johnson Pumping Plant	260.0
Less Turbine Ditch (not applicable to Project)	1.4
Total Conveyance Loss	**10.6**
Estimated Average Evaporation Loss (10 percent of the total)	1.1
Estimated Average Seepage Loss (90 percent of the total)	9.5

As shown in Table 3, the estimated seepage losses for the entire North Branch Canal from Johnson Siphon to the Wippel Pumping Plant is 9.5 cfs (3,348 AF per year). Phase 1 of the lining project will line the first 850 LF of canal within the entire Johnson Siphon to Wippel Pumping Plant reach, which is 5 percent of the overall project. Therefore, the estimated water savings for Phase 1 of the project as part of this WaterSMART application is 5 percent of the 9.5 cfs estimated average seepage losses identified in Table 3, or 0.47 cfs. The estimated water savings of 0.47 cfs would be available for other uses (supplement tributary flows) for the entire irrigation season.

How have average annual canal seepage losses been determined?

As described above and presented in Tables 2 and 3, the canal seepage rate in the North Branch Canal correlates to approximately 12.3 gal/ft^2/day, which equates to 166 AF per year in seepage losses for the project (Phase 1).

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)?

The post-project seepage/leakage losses are anticipated to be essentially zero. The geomembrane lining will be tested at each seam to ensure integrity of the joint. In addition, the lining will be covered by concrete, which is basically impervious.

What are the anticipated annual transit loss reductions in terms of AF per mile for the overall project and for each section of the canal included in the project?

The anticipated annual transit loss reduction as a result of canal lining associated with this Phase 1 project is 1033 AF per mile for the 850-LF segment of canal, based on annual water savings of 166 AF per year.

How will actual canal loss seepage reductions be verified?

To verify actual quantities of water saved, the District will have to implement the Pre and Post Monitoring Program outlined in the Feasibility Investigation. An assessment of the actual conserved water resulting from the conservation improvements will be made based on the data from the monitoring program. The data will need to be collected over a number of years to take into account shifts in irrigation practices, differences in weather patterns, and restrictions caused by water-short years. The monitoring program will commence during the 2016 irrigation season.

Include a detailed description of the materials being used.

The District plans to use a geomembrane liner and concrete to line the North Branch Canal. This material has a projected 50-year lifespan.

Subcriterion No. A.2 – Percentage of Total Supply

Provide the percentage of total water supply conserved.

Approximately 166 AF per year, or 0.1 percent, of the water used within the District's service area will be conserved. The total annual water supply is based on the average annual water supply over the last 16 years.

$$\frac{\text{Estimated Amount of Water Conserved} = 166\ \text{AF}}{\text{Average Annual Water Supply} = 269{,}991\ \text{AF}} = 0.1\%$$

1.4.2 Evaluation Criterion C: Benefits to Endangered Species

The species listed under the Endangered Species Act (ESA) in the Yakima River in Kittitas County include bull trout and the Middle Columbia River steelhead. Bull trout was listed as threatened in 1998. The Yakima River critical habitat unit, which includes the mainstem Yakima River and its tributaries, supports adfluvial, fluvial, and resident life forms of bull trout. Steelhead are considered protected as of 2006. The water conservation savings resulting from seepage reductions associated with the canal lining project will directly benefit the listed and other species of fish in the Yakima River and its tributaries. Trout Unlimited, North America's largest conservation organization dedicated to the conservation, protection, and restoration of coldwater fish and their habitats, provided a letter of project support for the Phase 1 project which will conserve water and supplement instream flows in designated critical habitat for ESA-listed steelhead (see Section 5).

1.4.3 Evaluation Criterion D: Water Marketing

Water users in the Yakima River Basin are using market-based transactions to offset the impacts of severe drought and competing demands for water. This project will be completed through a partnership with Trout Unlimited's Washington Water Project (WWP) through the Columbia Basin Water Transactions Program (CBWTP). The goal of the CBWTP is to complete water conservation projects to supplement stream flows and provide meaningful water for fish passage and habitat in critical Upper Yakima River tributaries.

Describe the amount of amount of water to be marketed.

The amount of water that will be transferred for instream flow benefits through the agreement with CBWTP is 0.47 cfs (166 AF). One significant benefit of this project is the flexibility to deliver the conserved water (all or a portion) to one or more of seven streams (Big, Little, Tillman, Tucker, Spex Arth, Taneum, and Manastash Creeks). To determine which tributary(ies) will get supplemental flows, WWP will enable the SOAC to use the biological expertise to determine where there is the greatest need for additional instream flows.

Include a detailed description of the mechanism through which water will be marketed (e.g., individual sale, contribution to an existing market, the creation of a new water market, or construction of a recharge facility).

This project will be completed through a partnership with Trout Unlimited's WWP through the CBWTP to complete water conservation projects to supplement stream flows and provide meaningful water for fish passage and habitat in critical Upper Yakima River tributaries.

Describe the number of users, types of water use, etc. in the water market.

The number of users and types of water use vary. As discussed previously, tributary supplementation is a preferred approach, and WWP will enable the SOAC to use the biological expertise to determine where there is the greatest need for additional instream flows.

Provide a description of any legal issues pertaining to water marketing (e.g., restrictions under Reclamation law or contracts, individual project authorities, or State water laws).

Significant legal issues associated with water marketing being considered for this project (such as tributary supplementation) have not been identified at this time and are not anticipated. Legal agreements will need to be put in place similar to the recent Manastash Creek Supplementation agreement. However, all associated parties have agreed in general to the concepts discussed and recognize the benefits.

Describe the estimated duration of the water market.

Water will only be available for other uses, such as stream supplementation, during the irrigation season when the District is diverting water.

1.4.4 Evaluation Criterion E: Other Contributions to Water Supply Sustainability

Subcriterion No. E.3 – Other Water Supply Sustainability Benefits

Water conservation and tributary supplementation has substantial economic and environmental value to addressing long-term, basin-wide issues such as climate change and drought.

Will the project make water available to alleviate water supply shortages resulting from drought? Explain in detail the existing or recent drought conditions in the project area. Describe the impacts that are occurring now or are expected to occur as a result of drought conditions.

In many water years, the District is subject to having its allocation of water cut to make sure water-rights holders with senior priorities in the basin get their full supply. Years with low snowpack can adversely affect prime crops, especially tree fruit orchards such as apple, pear, and cherry trees southeast of Ellensburg. In addition, when growers do not have enough water for a second cutting of hay, it reduces the number of fields getting new seedlings in the fall, reducing the overall yield and quality of crops grown in the subsequent years.

Describe the severity and duration of drought conditions in the project area.

The Yakima Basin is a water-short basin, and the climate in the Basin is changing. Significant droughts occurred in 2001, 2005, and 2015.

Describe how the water source that is the focus of this project (river, aquifer, or other source of supply) is impacted by drought.

The Yakima River Reservoir system supplies water to over 460,000 irrigated acres, including 60,000 acres within the District. Runoff is derived mostly from winter precipitation in the Cascade Mountains, much of which is stored as snowpack and runoff in the spring and early summer. Climate change during the 21st century is expected to result in earlier snowmelt runoff, and reduced summer flows. With earlier and reduced spring snowmelt, water deliveries are curtailed, especially to junior water rights holders such as the District.

Provide a detailed explanation of how the proposed WaterSMART Grant project will improve the reliability of water supplies during times of drought.

Reduced seepage losses will reduce the demand on stored water. In addition, the District is committed to transferring the saved water (0.47 cfs) for instream flow benefits during the irrigation season.

Will the project make water available to address specific concerns such as how the water source that is the focus of this project (river, aquifer, or other source of supply) is impacted by climate variation.

Yes, primarily the project will make water available to address specific concerns associated with climate variation, such as the lack of tributary flow during late summer that can be supplemented with saved water.

Will the project make additional water available for Indian tribes?

The project will make additional water available to Indian Tribes through increased stream flows to benefit ESA-listed steelhead and fisheries important to the Yakama Nation.

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

The project will minimize economic losses from drought conditions by improving the reliability of water supplies during times of drought.

Does the project promote and encourage collaboration among parties?

Since 1999, the District, Ecology, and Reclamation have collaborated and partnered to plan, design, and construct water conservation projects such as the Manastash Creek Pipeline Project through

the YRBWEP. The YRBWEP is a federally authorized program managed by Reclamation to enhance fish and wildlife and improve irrigation reliability in the Yakima River basin. The Integrated Plan is a comprehensive approach to water resources and ecosystem restoration improvements in the entire Yakima River Basin. The Integrated Plan is a result of an extensive planning process involving a large stakeholder group composed of the Yakama Nation; irrigators; Reclamation Ecology, U.S. Fish and Wildlife Service, and National Marine Fisheries service; cities; counties; Yakima Basin Fish and Wildlife Recovery Board; Yakima Basin Storage Alliance; and environmental groups including American Rivers and the National Wildlife Federation. This project is the first phase of many proposed water conservation measures outlined in the Feasibility Investigation (see Section 1.4.5 and Attachment A) that will eventually save 39,300 AF of water as funding becomes available.

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

This project will increase awareness of water conservation efforts similar to the Manastash Creek Pipeline Project. Many newspaper articles, blog posts, and magazine articles resulted from that project. The District's website: www.krdistrict.org/news has links to articles associated with recent District conservation efforts.

1.4.5 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?

The District prepared a Comprehensive Water Conservation Plan (CWCP) in February 1999 (see relevant portions of the CWCP in Attachment B) through the Yakima River Basin Water Conservation Program (Basin Conservation Program). The conservation measures outlined in the District's CWCP are consistent with the components in the Initial Development Phase of the Integrated Plan. The Initial Development Phase represents a set of projects and activities that will quickly achieve tangible improvements in stream flow, habitat, and fish passage as well as to provide increased security of existing out-of-stream water supplies. District improvements, beginning with the North Branch Canal lining, will play a crucial role in meeting some of the Integrated Plan Initial Development phase objectives. In 2001, Addendum No. 1 to the CWCP identified the potential use for conserved water to enhance fish habitat in tributary streams (see Attachment B).

As a second phase of the Basin Conservation Program, the District conducted a Feasibility Investigation of the water conservation measures proposed in the CWCP. The Feasibility Investigation was funded by Ecology, Reclamation, and the District. The Feasibility Investigation of the water conservation measures was completed in March 2015 and provides a basis for the final design of the proposed conservation measures (see Attachment A). Implementation of the conservation measures identified in the Feasibility Investigation will eventually save 39,300 AF of water and will be phased in as funding becomes available. The North Branch Canal Lining Project is one project that was evaluated as part of the Feasibility Investigation that will save 3,348 AF of water annually after the full lining project is completed (approximately 3.25 miles).

Subcriterion No. F.2 – Readiness to Proceed

Describe the implementation plan of the proposed project. Include a project schedule that shows the stages and duration of the proposed work, including major tasks, milestones, and dates.

If awarded the WaterSMART grant by June 2016, the District will obtain all necessary permits and finalize the design for bidding and construction to begin in October 2016. The Phase 1 project will be completed by spring 2017, before the irrigation season.

The construction schedule for canal lining must be carefully planned during the non-irrigation season, which lasts from mid-October to mid-April. Any construction that demolishes or eliminates existing district irrigation facilities must be operational by March 31 to be ready for the irrigation season.

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

Federal approvals for the project include the National Environmental Policy Act (NEPA), National Historic Preservation Act (NHPA), and ESA compliance. If successful in obtaining the WaterSMART grant, the District will work with Reclamation to determine the appropriate level of NEPA compliance. Any work will be limited to the District's right-of-way and adjacent lands that have been grazed or cultivated in prior decades. No known environmental or cultural resources of special value exist. Therefore, activities required for NEPA, NHPA, and ESA compliance likely will be minimal. As part of the design, the District will include a cultural resources investigation to identify any historic structures within the canal lining project. If awarded the WaterSMART grant by June 2016, the District is confident that the necessary approvals can be secured by fall 2016.

There are no state or local permitting requirements.

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, increased energy efficiency).

As described above, the District will have to implement a Pre- and Post-monitoring Program to verify actual quantities of water saved. An assessment of the actual conserved water resulting from the conservation improvements will be made based on the data from the monitoring program. The data will need to be collected over a number of years to take into account shifts in irrigation practices, differences in weather patterns, and restrictions caused by water-short years. The monitoring program will commence during the 2016 irrigation season.

Subcriterion No. F.4 – Reasonableness of Costs

Provide information related to the total project cost, annual AF conserved, and the expected life of the improvement.

As described in detail in Section 7, the assembled cost of the project for planning and installation has been estimated to be $294,208, of which the federal share would be approximately $147,104. The expected life of the project is 50 years. The estimated project cost over the expected 50-year life of the project is $35.45 per AF. If the grant is awarded at the full amount requested, the federal investment from Reclamation through the WaterSMART program would cost an estimated $17.72 per AF of water saved over a 50-year period.

$$\frac{\text{Total Project Cost = \$294,208}}{\text{166 AF Conserved x 50-year Improvement Life}} = \$35.45/AF$$

1.4.6 Evaluation Criterion G: Additional Non-Federal Funding

The non-federal funding portion of the total project cost is 50 percent, assuming a WaterSMART grant of $147,104. This application from the District is seeking $147,104 in federal funding assistance for Federal Funding Group I through the WaterSMART program

$$\frac{\text{Non-Federal Funding = \$147,104}}{\text{Total Project Cost = \$294,208}}$$

1.4.7 Evaluation Criterion H: Connection to Reclamation Project Activities

How is the proposed project connected to Reclamation project activities?

The District is part of Reclamation's Yakima Basin Project. The proposed lining would be within lands owned by Reclamation and the saved water would be delivered to tributaries within the Yakima Basin Project.

On July 9, 2013, Lorri J. Lee, Reclamation Regional Director Pacific Northwest Region U.S., signed and approved the Record of Decision for the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan) Final Programmatic Environmental Impact Statement Yakima Project, Washington. ***District canal modifications to reduce seepage and enhance tributary flows are specifically listed as a priority in the Record of Decision*** under Structural and Operational Changes goals. The District is uniquely situated to provide multiple benefits to improve water supply for agriculture and fish and improve the ability of water and fisheries managers to adapt to climate change because of the District's location relative to many important tributaries in the upper Yakima River Basin.

Does the applicant receive Reclamation project water?

Yes, the District receives stored water from two storage reservoirs, Keechelus and Kachess, which are both owned and operated by Reclamation as part of the Yakima Basin Project.

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

The proposed lining would be within lands owned by Reclamation and the saved water would be delivered to tributaries within the Yakima Basin Project.

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

Yes, the project is in the same basin as other irrigation entities that use water stored in Reclamation's storage facilities as part of the Yakima Basin Project.

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

Yes, the project will benefit Yakima River tributaries within the Yakima Basin Project by supplementing the tributaries with saved water during low flow conditions.

Will the project help Reclamation meet trust responsibilities to Tribes?

Saved water delivered to tributaries with no or low summer flows will help reestablish salmon stocks and contribute to Reclamation's trust responsibilities to tribes.

SECTION 2

Environmental and Cultural Resources Compliance

(1) Will the project impact the surrounding environment (i.e., soil [dust], air, water [quality and quantity], animal habitat, etc.)? 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 canal lining improvements will take place within the existing canal right-of-way. Existing District maintenance roads provide adequate site access, and all work will occur within the District's right-of-way. An environmental review shows that there will be minor or no negative environmental impacts to earth (soils), air, plants, animals, energy and natural resources, environmental health (health hazards and noise), land and shoreline use, housing, aesthetics, light and glare, recreation, historic and cultural preservation, transportation, public services, and utilities. During construction, best management practices (BMPs), such as sprinkling the ground surface for dust control, will be maintained in ground-disturbance areas.

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

No known environmental resources of special value occur, including rivers, streams, lakes, fisheries, threatened plant and animal communities, spawning grounds, or flyways.

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

The majority of the construction will take place along the existing District rights of way, therefore impacts to wetlands and other land uses are not anticipated. No wetlands or other surface waters that could fall under Clean Water Act jurisdiction exist in the project area. Measures will be taken to control erosion, turbidity from de-watering water, dust, and noise. Mitigation of impacts to the environment is not anticipated.

(4) When was the water delivery system constructed?

The North Branch Canal was constructed in 1930.

(5) Will the project result in any modification of or effects to individual features of an irrigation system (e.g., headgates, 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.

The only structure that will be affected by this project is one turnout (headgate) that was originally constructed in 1930. Routine maintenance may have altered or replaced this structure since then, and a cultural review will be conducted in spring 2016 to determine if it is of historical significance.

(6) Are there any buildings, structures, or features in the irrigation District listed or eligible for listing on the National Register of Historic Places?

The land adjacent to this project has been grazed or cultivated in previous years and does not likely represent historic conditions. No aboveground structures are present.

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

No identified or known cultural resources of significance exist within the District service area. During spring 2016, the District will complete a cultural resources survey to verify if there are any known archeological sites within the 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 disproportionally high and adverse effect on low income or minority populations. No communities exist adjacent to the project area.

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

This project will not limit access to and ceremonial use of Indian sacred sites.

(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 spread of noxious weeds or non-native invasive species.

SECTION 3

Required Permits or Approvals

3.1 Federal Permitting

Federal approvals for the project include NEPA, NHPA, and ESA compliance. Construction will be limited to the right-of-way, and there are no known environmental or cultural resources of special value; therefore, it is expected that activities required for NEPA, NHPA, and ESA compliance will be minimal.

- It is anticipated that the project does not have significant impacts on the environment and will fit within a recognized Categorical Exclusion to NEPA. Environmental impacts will be minimized during construction using BMPs.
- Federal cultural resource laws and regulations, including the NHPA and Native American Trust Assets, must also be reviewed before project construction. The District will cost share with Reclamation to conduct all necessary field surveys and literature reviews. It is anticipated that the project does not have the potential to cause effects to historical properties and that the findings will be concluded in the Section 106 process.
- It is anticipated that there are no endangered or threatened species or designated critical habitat in the project area and that no further compliance measures are required.

If awarded the WaterSMART grant by June 2016, the District is confident that necessary approvals can be secured by fall 2016.

3.2 State Permitting

Permits for lining the canal within the District right-of-way are not required. There are no state permitting requirements.

3.3 Local Permitting

Permits for lining the canal within the District right-of-way are not required. There are no local permitting requirements.

SECTION 5

Letters of Commitment and Project Support

The District received funding from Ecology through its 2015 to 2017 Biennium Proposal for Agricultural Water Conservation Projects in the amount of $250,000 on August 11, 2014. The original award was intended to pipe the District 14.3 Lateral. Ecology has agreed to the allocation of $142,308 from the original $250,000 for the construction of the North Branch Canal Lining Project and has provided a letter of commitment on behalf of the District.

Letters of commitment and project support are provided in Attachment E.

SECTION 6

Official Resolution

The District is committed to the financial and legal obligations associated with the receipt of financial assistance under the WaterSMART Grants Program. The District has the resources and capability to provide the amount of funding for contributions specified in the funding plan. The District will work with Reclamation to meet the established deadlines to enter into a cooperative agreement.

An official resolution that identifies the official with legal authority to enter into agreement was adopted by the District Board of Directors at its meeting on February 2, 2016 (see Attachment F).

Attachment A
Feasibility Investigation

Final Report

Kittitas Reclamation District Feasibility Investigation

Prepared for

Kittitas Reclamation District

March 2015

TABLE OF CONTENTS

TABLES

APPENDICES

Executive Summary

History

The Kittitas Reclamation District (KRD), located in central Washington, was organized under RCW Title 87, Irrigation Laws of the State of Washington, on September 25, 1911, and in accordance with KRD's Federal Repayment Contract. The KRD encompasses approximately 104,588 acres and currently assesses 59,478 acres. Irrigation water is currently applied to about 60,000 acres within the District.

Water is supplied to the KRD from two Bureau of Reclamation (BOR) storage reservoirs, Keechelus and Kachess. Irrigation water is diverted from the Yakima River at the Easton Diversion Dam.

On July 9, 2013 Lorri J. Lee, BOR Regional Director Pacific Northwest Region U.S., signed and approved the Record of Decision (ROD) for the Yakima River Basin Integrated Water Resource Management Plan (Integrated Plan) Final Programmatic Environmental Impact Statement (EIS) Yakima Project, Washington. KRD Canal Modifications to reduce seepage and enhance tributary flows are specifically listed as a priority in the ROD under Structural and Operational Changes goals. KRD is uniquely situated to provide multiple benefits to improve water supply for agriculture and fish, and improve the ability of water and fisheries managers to adapt to climate change because of KRD's location relative to many important tributaries in the upper Yakima River Basin. A recent successful example of this benefit is the KRD South Branch Lateral 13.8 – Manastash Creek Conservation and Tributary Enhancement piping project that was constructed by the BOR as the first on the ground construction project of the Integrated Plan.

In 1999, KRD described its facilities and evaluated its operations in a Comprehensive Water Conservation Plan (CWCP). In 2001, Addendum No. 1 to the CWCP was prepared to address items suggested by the Feasibility Investigation Team. At the time the CWCP and Addendum was finalized, it was determined that a Feasibility Investigation was needed to provide a basis for the proposed implementation of the water conservation measures identified in the CWCP and Addendum. This Feasibility Investigation provides the basis for implementing final design of the proposed water conservation measures. The Feasibility Investigation is funded by the Washington State Department of Ecology (Ecology), the United States Bureau of Reclamation (BOR), and KRD.

KRD has been an active participant along with Ecology, BOR and others in the creation of the Integrated Plan. The conservation measures in this Feasibility Investigation are consistent with the components in the Initial Development Phase of the Integrated Plan. The Initial Development phase will span the time frame from passage of Washington State's Integrated Plan authorizing legislation in 2013 through the year 2023. The Initial Development Phase represents a set of projects and activities that will quickly achieve tangible improvements in stream flow, habitat, and fish passage as well as to provide increased security of existing out-of-stream water supplies. The KRD improvements in this Feasibility Investigation will play a crucial role in meeting some of the Integrated Plan Initial Development phase objectives. Some of the key components of the Initial Development Phase that will be sources of funding for these improvements include the

Integrated Plan agricultural conservation projects component, the Integrated Plan flood plain and tributary habitat restoration project and acquisitions component, the Integrated Plan additional fish passage projects component, the Integrated Plan aquifer storage and recovery project component as well as the Integrated Plan water banking and exchange programs component. There also may be other funding sources available for these improvements in the initial development phase through other federal and state agencies in addition to Ecology and BOR funding sources.

Water Conservation Measures - Conceptual Design

Some of the water saved by the system improvements discussed in this feasibility investigation may be needed to satisfy irrigation demand. The remaining saved water may be used to increase upper Yakima River tributaries in stream flows or other purposes. A portion of the conserved water may become available to supplement creek water or for users currently diverting from Yakima River tributaries. In addition, some conserved water and canal capacity made available from water conservation projects could be used for groundwater storage projects.

Conceptual design of the facilities investigated in this feasibility investigation includes the following:

- Line the high water loss portion of the North Branch canal between the Johnson Siphon and the Wippel Pumping Plant.
- Line the high water loss portion of the South Branch canal between the Swede Tunnel and the Robinson Canyon Siphon.
- Pipe specific high water loss open canal laterals and sub-laterals on the North and South Branch canals.
- Construct automated flow control facilities with instrumentation and radio telemetry to regulate flow in the North and South Branch canals and at the Wippel Pumping Plant.
- Construct reregulation reservoirs for the North and South Branch canals (two reservoirs total).

Site Suitability

KRD's system of open irrigation canals and flumes has existed since the original construction and operation of the facilities began in the 1920's. The proposed addition of piping and lining existing laterals and sub laterals and installation of automated facilities within existing easements eliminates the need for an extensive site suitability survey for these facilities. The existing rights-of-way provide locations for new pipelines and lining to connect to the existing irrigation turnouts. These points of connection have been and will continue to define the limits of KRD operation and maintenance responsibility.

General siting of the proposed reregulation reservoirs has been performed as part of this Feasibility Investigation to confirm whether suitable land is available for the proposed reservoir volume and configuration. Geotechnical exploration is still needed at the reservoir sites as well as negotiations with landowners to purchase reservoir site land.

Site suitability is not considered a problem for the proposed addition of piping and turnouts to serve KRD water to creek water diversion points or to supplement creek water flow upstream of the diversion points. A few new pipeline easements outside of the existing KRD right-of-way may be needed to be obtained from landowners along the proposed pipeline alignments for economy of construction.

Design Criteria

Standards and criteria for the conceptual design of the proposed facilities adhere to engineering principles and state of the art design as practiced by the irrigation industry and Ecology – Dam Safety Division criteria and guidelines.

The hydraulic sizing criteria for new pipelines identified in this Feasibility Investigation that are being converted from an existing open ditch lateral, sub lateral, or sub sub lateral to a pipeline are derived from an on-farm application peak flow rate of 7 gpm per acre. The application flow rate is slightly lower than historical usage of 9.17 gpm per acre (North Branch) and 7.90 gpm per acre (South Branch) which accommodate significant conveyance losses. KRD agreed to set the future application flow rate at 7 gpm per acre for the water conservation pipeline projects identified in this Feasibility Investigation with the understanding that the conservation improvements will substantially reduce system losses and permit adequate flows to be delivered to the farmland.

It was determined that standard AWWA C900/C905 or ASTM D2241PVC or other plastic pipe materials offer a cost effecate safety factor for hydraulic surges.

The system operating pressure for the piped irrigation systems was evaluated. The proposed gravity system piping takes advantage of the elevation differential between lateral piping head works and turnout locations along laterals or sub laterals. Pressures will vary from approximately 10 psi to a maximum of 85 psi. In areas where the gravity pressure would exceed 85 psi, some pressure reducing valves may be needed. The piped gravity system minimizes maintenance and operational issues and provides a substantial benefit to the water users.

American Water Works Association (AWWA) rated butterfly valves, resilient wedge gate valves, bronze curb stop valves, and slide gates will be used. Other appurtenances will be standard mechanical propeller type flow meters or battery operated magnetic flowmeters, and continuously acting air vent/vacuum relief valves.

Native materials, free of organic material, trash, and other deleterious material, will be used where suitable for pipe bedding and pipe zone material. 92 percent relative compaction will be obtained in the pipe zone and where the pipeline passes under roadways, with all other areas to have an 85 percent relative compaction.

Review of water hammer control in pipelines shows that adequate protection can be achieved by maintaining low velocities and adequate air/vacuum relief in the enclosed piped system. Solids will be screened and removed at the lateral head gate. Although bed loads are not expected to be excessive, the lateral head gate design will allow the majority of the bed load to flow past the head gate, and any remaining bed load can be carried through the system and discharged at turnouts and periodic blowoff valves. In most cases, drainage

flows that currently enter the open canals will not be connected to the pipeline systems. Arrangements will be made for these flows during detailed design.

An existing franchise agreement is in place between Kittitas County and KRD for installation of facilities and operations within county rights-of-way.

Canal lining hydraulic criteria established by the BOR during the original design will be used to adjust and correct the existing canal cross section. Canal side slopes, and bottom slopes will not change. The only change will be the friction coefficient of the lined portion which will provide smoother flow characteristics when compared to the existing earthen lining.

Reregulating reservoirs will be designed in accordance and in consultation with Ecology – Dam Safety Division. The earth fill reservoirs will be constructed with materials meeting strict gradation and drainage requirements, as well as geotextiles cushions, geomembrane lining, and rock slope protection. The associated reservoir pump stations will be designed in accordance with Hydraulic Institute Standards for vertical turbines installed in pump cans.

Construction Cost Estimates

Direct construction costs including contingency are estimated at $94,900,000. Contingency is estimated at $13,700,000. Indirect costs such as tax, engineering, services during construction, legal, and administration are estimated at $24,600,000. The total cost for upgrades for both direct and indirect costs is approximately $119,500,000 in 2014 dollars.

Factors, such as a limited construction season, oil costs (affecting PVC pipe costs), labor, contractor bidding process, materials, permitting, and environmental impacts may affect both construction scheduling and costs.

Operation, Maintenance, and Replacement Cost Estimates

This project will significantly reduce the operation and maintenance costs associated with KRD's existing open ditch laterals and sub laterals to be piped or lined as well as operation of the Wippel Pump Plant. Some additional operational costs will be associated with the new pipelines and turnouts associated with creek water supplementation as well as operation of the reregulation reservoirs. Maintenance costs for the new system will be insignificant for the first 10 years of operation, and will increase as new facilities require repair and replacement.

Operational Capability

Estimated losses of the current system are 30 percent of the total diversion for both the conveyance and operational spills. An estimated water savings of 39,300 acre-feet annually can be produced by these improvements. In order to assess the actual water savings that result from the system improvements, both Pre and Post Monitoring programs will be implemented.

KRD's currently adjudicated irrigation water rights amount to more than 336,000 acre-feet annually. A portion of this water could be saved. Some of the saved water could be used to supplement creek water flows in Yakima River tributaries that intersect the KRD delivery system as well as for groundwater storage projects in the vicinity of the KRD delivery system.

Measuring, Monitoring, and Reporting

Pre-implementation water measuring data is currently being collected at select locations within the KRD system. The KRD anticipates using Section 1207 - Enhancement of Water Supplies for Yakima Basin Tributaries in Public Law 103-434 October 31, 1994 (SEC. 1207) or as the section is amended consistent with the Integrated Plan as well as other funding sources to accomplish much of the savings in this Feasibility Investigation.

Measuring, monitoring and reporting will be consistent with SEC. 1207 requirements and subsequent agreements.

Financial

KRD has options to obtain funding for its canal improvements. Sources include the Yakima River Basin Water Enhancement Project or other sources made possible because of the Integrated Plan process.

KRD is in sound financial condition. However, costly near-term capital projects for major KRD facilities are in the planning stages at this time. Therefore, it is KRDs expectation that it will use SEC. 1207 or as the section is amended consistent with the Integrated Plan or other funding sources to accomplish much of the savings in this Feasibility Investigation.

KRD will need to indicate its willingness to meet the commitments of this project through actions of its Board of Directors. It is anticipated that funding agreements for the water conservation and/or groundwater storage projects will be developed for review by the KRD.

Environmental

An environmental review shows that there will be minor or no negative environmental impacts to earth (soils), air, plants, animals, energy and natural resources, environmental health (health hazards and noise), land and shoreline use, housing, aesthetics, light and glare, recreation, historic and cultural preservation, transportation, public services, and utilities. The only potential significant impact foreseen is related to locations where leaky open ditch canals are replaced with pipelines or lining. At these locations, existing vegetation growing adjacent to open ditch canals will be impacted when seepage is reduced or eliminated. When the upgraded system is operational, there will be an overall positive effect to the environment, particularly to increasing water quality, increasing tributary stream flows, and/or providing water and capacity for groundwater storage projects.

Conclusions

The proposed system improvements may allow KRD to conserve approximately 39,300 acre-feet in a full water supply year (see Table E1), and at the same time improve water quantity and quality for Yakima Basin tributaries through SEC. 1207 or as the section is amended consistent with the Integrated Plan. River diversions would remain similar to existing diversions with the resulting system capacity used to supplement tributary stream flows and/or provide for increased groundwater storage.

An estimated cost of the conservation measures shown in this Feasibility Investigation is approximately $119,500,000. Table E-1 summarizes the individual water conservation projects benefits and estimated costs. By utilizing the information provided in Table E-1, a

The future benefits to the environment through improvements in water quantity, water quality, ground water storage and instream flows in the Yakima River Basin will justify the proposed improvements. Although the KRD is in sound financial condition, project funding of the proposed conservation measures is beyond the ability of the water users to pay without external assistance. It is anticipated that funding agreements for the water conservation projects and/or groundwater storage projects will be developed for review by the KRD.

It is also important that the KRD continues to address other critical facilities in their system that are in need of costly maintenance and rehabilitation. These facilities were not addressed in this Feasibility Investigation because they are not water conservation projects. However failure of the Main Canal straight wall canal sections, Main Canal lining projects, Yakima Pressure Tunnel, and numerous other siphons and tunnels would impact the District's ability to accomplish fish habitat enhancement associated with ongoing creek water supplementation as well as potential future creek water supplementation and groundwater storage projects discussed in this Feasibility Investigation.

Attachment B
Water Conservation Plan and Addendum No. 1

Report

Kittitas Reclamation District Water Conservation Plan Irrigation Water Conservation Plan of System Improvements

Prepared for

Kittitas Reclamation District

February 1999

CH2MHILL

Contents

Contents, continued

Preface

This Water Conservation Plan (WCP) has been prepared for the Kittitas Reclamation District (KRD) as a requirement of the Yakima River Water Enhancement Project (YRWEP) and is funded by a grant from the Washington State Department of Ecology (DOE) and a grant from the United States Bureau of Reclamation (USBR). It has been prepared by the KRD's consultant, CH2M HILL, with assistance and direction from the KRD Board of Directors and staff. A separate NEPA Categorical Exclusion Checklist is being submitted as part of this WCP to be reviewed and approved by USBR.

In December 1996, the KRD selected CH2M HILL as the District's consultant to develop a WCP. Financial assistance to proceed with the WCP was acquired on February 6, 1997, through grants from the USBR and DOE. USBR funds are from its Basin Conservation Program and DOE funds are from Referendum 38. CH2M HILL and the KRD entered into a contract on December 16, 1996 that allowed CH2M HILL to prepare the WCP.

The purpose of this WCP is to present the necessary information in support of a grant and loan from the DOE to help finance the construction of the proposed water conservation project. The WCP is also intended to identify and evaluate opportunities for improvements in facilities and changes in the operation and management of the KRD that will conserve water throughout the KRD conveyance system. This carries with it the added benefit of enhancement of instream flows in the Yakima River.

All acreage and water rights values presented in this WCP are subject to revision pending the conclusion of the ongoing Yakima River Basin Water Adjudication proceedings.

Executive Summary

General

The Kittitas Reclamation District (KRD) is located in central Washington, near the City of Ellensburg. The KRD encompasses approximately 104,588 acres of land in Kittitas County. The KRD operates under RCW Title 87, Irrigation Laws of the State of Washington.

Water

The KRD's water supply is derived entirely from Warren Act storage surface water diverted from the Yakima River at Easton Dam and is subject to proration in water short years. No natural flow rights are included in this diversion. The legal entitlement of water for the KRD is 336,000 acre-feet per year. This water entitlement includes any water deemed as "flood water" by the Yakima Project Superintendent.

Approximately 30,000 acres within the KRD have full or partial creek water rights that were appropriated by the property owners prior to construction of the KRD. The KRD is under no obligation to convey creek water to these users.

The KRD has agreed to assist in delivery of water for the Cascade Irrigation District (CID) and the Taneum Canal Company (TCC) to help them overcome some physical limitations in their systems. The KRD also holds an agreement with the TCC for the operation and maintenance of TCC facilities during the KRD water season.

The KRD also uses its facilities to convey water, at certain times of the year, for migratory fish habitat enhancement.

Land

The total area within the KRD's jurisdictional boundary is 104,588 acres. The KRD currently assesses 59,377 acres. Land currently classified as irrigable within the KRD is 59,122 acres. Irrigation water is currently being applied to approximately 55,516 acres. The current irrigated acreage is based on the most current crop report data available from 1993, which was a water short year. Roughly 45,466 acres are either not classified or are classified as non-irrigable; these lands are not assessed. Nearly all of the irrigable land within the KRD is flood irrigated.

Land use within the KRD is mostly agricultural. Crop distribution consists of about 92 percent timothy hay and forage crops, 6 percent cereals, one percent orchard, and less than one percent in vegetables. Less than one percent of the land is used for suburban proposes.

The KRD borders the towns of Easton, Kittitas, Ellensburg and Cle Elum. The KRD staff has indicated that the KRD will remain outside any city boundaries for the foreseeable future.

Previous Rehabilitation

The KRD's conveyance system was designed by the USBR and completed in the early 1930's. Over the years, the system has been upgraded and maintained as necessary. The farmers have existed with their current system for some time, making improvements as they could afford them. Major improvements to the system have been the addition of electric pumps at the existing hydroturbine pumping plant, PVC pipe to replace leaking open ditches, and a telemetry system for remote monitoring and data collection of flow conditions.

Need for the Project

In water short years, the KRD water entitlement is prorated due to its junior water rights. The KRD is allowed to move some of its late season water to the current operating month to help make up the lack of water. Although if proration continues into the later months of the season the KRD will have exhausted their entire water entitlement before the season is over. In past years of proration, the KRD has run out of water in early August, resulting in extensive crop damage. The KRD has experienced proration in 1973, 1977, 1979, 1987, 1988, 1992, 1993 and 1994.

The conveyance system within the KRD experiences losses estimated at 33 percent; 27.5 percent in conveyance losses plus another 5.5 percent in operational spills. Observations of the system by the KRD staff have also identified a need for greater manageability of the water resource within the KRD, a desired improvement of the reliability of the water supply, and high operation and maintenance costs. By implementing the proposed project, significant water savings, improved system efficiency and greater system manageability would be realized. Public safety may also be improved by the replacement of selected open canals with closed pipe systems.

Proposed Project

The Preferred Alternative would provide for the construction of a two reregulating reservoirs, two pump stations, the addition of an electric pump at the Wippel Pumping Plant, piping of selected laterals, and automation of the North and South Branch canals.

The total estimated project cost is approximately $36,911,000, which includes contingencies, engineering, administrative costs, and sales tax. The KRD assumes construction easements and rights-of-way will follow the existing canal alignments. It assumes any new easements will be donated. Therefore, no costs for these items are included in the estimate. The cost estimate is in 1998 dollars and has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final cost of the project will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors. As a result, the final project cost may vary from the estimates presented in this Plan, and will vary by +50 percent to –30 percent depending upon site conditions and final design parameters. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding resources.

Repayment

The federal contribution for this project will be $23,993,000; 65 percent of the project costs. The balance of the project funding will be from a grant of $6,459,000 from the Washington State Department of Ecology (DOE) under Referendum 38, and the KRD water users' contribution of $6,459,000. The KRD water users' contribution will consist of loan to be repaid over a 30-year period.

The current assessment rate is insufficient to cover the construction costs for the project. The average assessment rate just to recover the loan, plus interest at the assumed rate of 5 percent, would be $7.08 per acre per year for the 30-year loan repayment period. The repayment obligation appears to be within the KRD water users' ability and/or willingness to pay.

Other potential public funding sources include the Yakima River Basin Water Enhancement Project legislation, the Centennial Clean Water Fund program, the State Revolving Fund program, the United States Bureau of Reclamation, the Bonneville Power Administration, and the Environmental Protection Agency.

Environmental Considerations

The proposed project will have minimal effects on the environment in and around the KRD. A Categorical Exclusion checklist is being submitted with this Water Conservation Plan. The positive effects on the environment will be to maximize the KRD's water distribution efficiency by significantly reducing water losses due to permeable canal sections and ditchworks, as well as providing the KRD with more managerial and operational control over its limited resource. Significant positive impacts will also enhance instream flows of the Yakima River. Negative impacts anticipated are those associated with construction activities, such as noise, dust, and the possible impacts to artificially sustained wetlands. The construction impacts are expected to be temporary in duration, and any artificially sustained wetlands lost, from the piping of open canals, will be replaced in kind by new habitat created by the new facilities, such as the edges of re-regulating reservoirs.

CHAPTER 6

Opportunities for Improvements in Water Supply and Distribution System Efficiencies

The following opportunities to conserve water and improve the efficiency of the existing KRD water delivery system have been identified:

Structural Improvements

Structural improvements are those types of improvements that are designed to increase system operating efficiencies and/or conservation of the water resource. They are designed to reduce or eliminate physical losses, and to measure and control canal flows and deliveries.

Reducing Physical Losses

Physical loss consists of both conveyance and operational losses. Conveyance loss consists of the water that is lost to seepage, evaporation, and transpiration by undesirable vegetation growing along the canal banks as the water travels from the point of diversion to the point of application. Operational loss consists of the water required to operate the system that is spilled back to the source stream or elsewhere. It consists of flows lost through regulating spills and water used to maintain proper water levels and turnout submergence in open channel systems. Operational losses also include spills necessary to return screened fish to the river, which the KRD does, but is credited for the water diverted for this purpose.

With over 90 percent of the length of the KRD canal system in unlined earthen ditch, conveyance losses make up a large portion of the physical losses within the system. When the system is considered as a whole, physical loss in the KRD at normal flow was estimated to be at least 30 percent of the flow diverted from the Yakima River, as discussed in Chapter 3. Although no precise records are available, experience with similar systems of the same construction and soil type indicates that approximately five percent of the physical losses are in the form of operational spills and approximately 25 percent of losses can be attributed to conveyance losses. One conservation measure that would eliminate these conveyance and operational losses is piping the laterals in the system that have been identified as high loss areas. Strategically placing re-regulation reservoirs in critical areas throughout the system would also reduce losses by allowing the supply to be better matched to the variable demand.

Seepage, and potential leaks, could also be controlled by lining the canals and laterals. Currently, about 10 percent of the KRD main canal system is concrete lined. Although concrete lining is effective in controlling losses, it is subject to frost heaving, cracking, and deterioration if provisions are not made for adequate underdrainage. Nevertheless, lining is still a cost-effective solution to a seepage problem, especially for larger canals in areas of highly permeable soils.

Because of the nature of the construction of the KRD system, operational spills represent a large portion of the losses within the KRD. Since the KRD is an open channel system, the water surface in the canal must be held at a certain level to allow water to be diverted to the turnouts. This is accomplished through the use of manually operated check structures with control gates or flashboards. The many spill and regulating points along the roughly 300 miles of canals and laterals require delicate manual adjustment throughout the irrigation season. The size and complexity of the system contributes to the operational losses in the system.

Operational losses could be controlled or eliminated by converting many of the open channel laterals in the system to enclosed conduit systems and placing reregulation reservoirs in strategic locations within the system. This would eliminate the need for many regulating spills and would simplify the operation of the check structures that would remain in the open channel portions of the system. The reregulation reservoirs would greatly reduce, or nearly eliminate, operational spills; a portion of which discharge directly to the Yakima River while the rest may be "used" by others before reaching the Yakima River. Pumps located at the reregulating reservoirs would pump temporarily stored water back into the canal system to meet short-term demands downstream. The reservoirs could be operated automatically to optimize water savings.

Flow Control and Measurement

Construction of pipeline systems on the designated laterals would be accompanied by the installation of new delivery structures. The new turnouts would be sized based on the number of acres served from each turnout, thereby limiting the maximum amount of water that could be delivered. Flowmeters would be installed to measure the rate of flow and volume of water delivered through each turnout for better management of the resource. Buried valves would be tamperproof to ensure that valve settings to turnouts remain undisturbed, thereby securing control of water delivery by the KRD.

Proposed Improvements

Five alternatives were evaluated for improving the KRD's water distribution facilities. These alternatives are technically sound from an engineering, operational, and environmental perspective and can be implemented. An additional "do nothing" alternative was added as well for comparative purposes. The five alternatives include:

- Retaining the existing system and constructing site-specific pipeline upgrades to the most inefficient laterals, constructing two re-regulation reservoirs with telemetry and automation in strategic sections of the North and South Branch Canals, and telemetry and automation of the Wippel Pumping Plant in conjunction with flow control structures downstream (Alternative 1).
- The same as Alternative 1 with the exception of using concrete lining instead of pipe for the lateral upgrades (Alternative 2).
- Retaining the existing system and constructing two re-regulation reservoirs with their associated telemetry as well as automation of the Wippel Pumping Plant and flow control structures downstream of it (Alternative 3).

- Retaining the existing system and constructing only site specific pipeline upgrades to inefficient laterals (Alternative 4).
- Installation of more efficient sprinkler type on-farm equipment (Alternative 5).

Alternative 1: Piping of High Loss Laterals, Construction of Re-regulation Reservoirs, and Automation of Wippel Pumping Plant

Alternative 1 rehabilitation projects would consist of piping specific open canal laterals and sub-laterals where high losses have been a problem. There are a total of 18 laterals and 2 sub-laterals within the system that would be replaced with piping. The pipelines would be constructed within the existing canal and lateral rights-of-way. Reregulation reservoirs will also be placed in two critical areas of the system. One reservoir would be placed near Page Canyon on the South Branch Canal and the other would be just up stream of Johnson Siphon on the North Branch Canal. Automation of the North and South Branch canals and the Wippel Pumping Plant would be constructed using flow control structures in conjunction with the reregulation reservoirs. Refer to Alternative 3 for a detailed description of the North and South Branch automation.

Alternative 1 would require approximately 70 miles of new PVC and concrete pipeline, two re-regulation reservoirs with booster pump stations at each, and a centrally located telemetry base station used as a central area to control all automation of flow control structures and equipment.

Advantages

The advantages of Alternative 1 are:

- An increase in system flexibility and response would be realized by this alternative by converting parts of the system to a type of "on-demand" system.
- It would achieve water conservation goals of the YRBWEP, DOE, Department of Fish and Wildlife (DFW), and other interested parties.
- System reliability would be measurably improved by replacing selected laterals that are currently high water loss.
- The new system would lend itself to easy installation of flow monitoring equipment, which would allow better record keeping of where the water is being used.
- Public safety would be improved. As with all open canal systems, the potential for accidents involving children, pets, or vehicles exists, especially in highly populated areas. Replacement of open canals with buried pipelines would eliminate the attractive nuisance and accident potential.

Disadvantages

The disadvantages of Alternative 1 are:

- There would be pumping costs associated with the new pump stations located at the reregulation reservoirs.

- Assessment rates would need to be increased to pay for the capital costs and electrical costs of the new system.
- Any artificial wetlands that may be hydraulically connected to, and/or dependent upon, the canal system may be affected by the abandonment of the open canals and elimination of spills.
- The Cascade Irrigation District, Ellensburg Water Company, Westside Canal Company, and individual users who obtain some of their water from operational spills within the KRD would need to find other alternatives for water supplies.

Alternative 2: Concrete Lining of High Loss Laterals, Construction of Reregulation Reservoirs, and Automation of Wippel Pumping Plant

This alternative is the same as Alternative 1 except that the open ditch canals will be replaced with concrete lining instead of piped.

Advantages

- An increase in system flexibility and response would be realized by this alternative.
- It would achieve some water conservation goals of the YRBWEP, DOE, DFW, and other interested parties although not to the same extent as Alternative 1.
- System reliability would be somewhat improved by replacing the selected laterals that are periodically limited in capacity by aquatic weeds and debris.

Disadvantages

- Additional energy costs would be incurred with a pump station at each of the re-regulation reservoirs.
- Assessment rates would need to be increased to pay for the capital costs of the new system.
- Concrete lining is subject to frost heaving, cracking, and breakage if provisions are not made for adequate underdrainage.
- Operational losses would be higher than with Alternative 1 because of the lack of an enclosed pipe system.
- Water conservation goals would not be achieved to the same extent as Alternative 1. Since the laterals and sub-laterals will still be open ditch, the water will still be subject to evaporation losses as well as end of lateral operational spills.

Alternative 3: Construction of Reregulation Reservoirs and Automation of the Wippel Pumping Plant

This alternative is an innovative method of reducing operational spills within the entire KRD, and if developed further could be coordinated with the automation of other USBR reservoirs as well. The alternative would consist of constructing two reregulation reservoirs and automating flow control structures on the North and South Branch canals, and at the Wippel pumping plant. The existing canal system would remain essentially unchanged. The

basic concept of the reregulation reservoirs is to minimize operational spills while maintaining an adequate supply for the downstream users. The KRD would automate three separate sections of their conveyance system. As a result of this automation, flow control at the Easton headworks to accurately match the system demand will also be achieved. The general concept for automation envisioned for the KRD is outlined below.

South Branch Canal: Instrumentation at the Manastash spillway, located at the downstream end of the South Branch Canal system, will monitor the level of water in the canal. Water levels in the canal at this point correspond to the amount of water being spilled. This instrumentation will control a pump station and a motorized spill structure at the Page Canyon reregulation reservoir. When the water level at Manastash spillway is low, the pump station will pump water up from the reservoir, discharging it to atmosphere (open air; unpressurized condition) into the South Branch canal. When the water level is high at the Manastash spillway, the instrumentation would send a signal to the motorized spillway at the reservoir, releasing water from the canal by gravity into the reservoir.

The optimum amount of water in the reservoir at any time is half of its capacity. Keeping the reservoir half full provides for extra capacity in the event that a large amount of water needs to be spilled from the canal, a condition that may be created by water users shutting off their turnouts suddenly, ending their demand on the system. Keeping the reservoir half full also provides for sudden increases in demand by the downstream water users.

A level sensor in the reservoir would monitor the reservoir level and control the headgates to the South Branch canal. The headgates are adjusted accordingly to keep the reservoir level relatively constant. When demands are reduced and the reregulating reservoir is at equilibrium, the headgates to the South Branch canal are turned down, and water that would have gone into the South Branch canal stays in the Main Canal, flowing down the North Branch canal as needed. This automation scenario provides for automatic control of the entire South Branch Canal.

Furthermore, when the reregulating reservoir is more than half full, water could be spilled down Page Canyon to the Taneum Ditch, providing water to their users—water that would be credited back to the KRD. This would mean that water saved by reregulation would be credited to the KRD, without the KRD having to pay for the electrical energy required to pump the reregulation water back up to their own canal. In the case of an emergency such as an equipment failure, reregulation water could be spilled down Page Canyon all the way to the Yakima River.

North Branch Canal/Wippel Pumping Plant: In automating the North Branch Canal, one of the primary goals would be to control and minimize the major spills on the lower end of the canal system, after the Wippel Pumping Plant. The turbine lateral spill, just after the Wippel Pumping Plant can be monitored with a level sensor that will send a signal to the wicket gates on the hydroturbine pumps. This telemetry and automatic control equipment will adjust the amount of water the hydroturbines receive by opening and closing the wicket gates using an electric control motor. The goal would be to maintain the excess hydroturbine tailwater flow measured at the turbine lateral spill at 70 cfs or less. The KRD receives a credit of up to 70 cfs for power water spilled at the turbine lateral spill which feeds into the Wippel Wasteway. By monitoring the water, and thereby the demand, in the turbine lateral, the hydroturbines can be operated at the maximum rate possible to conserve electrical energy while not spilling any non-credited water.

Currently the hydroturbines operate at maximum for approximately 95 percent of the irrigation season and the existing supplementary electric pumps operate approximately 60 percent of the season, to help meet the demand in the Pump Lateral. Even so, landowners along the Pump Lateral are still rationed at times. Under the above scenario, the wicket gates on the hydroturbines need to be adjusted frequently to match the Pump Lateral demand. Due to this manual operation, the flow in the Pump Lateral may not match the demand at all times. This results in shortages and spills. A level sensor at the Pump Lateral, near the outlet of the hydroturbines, will automatically determine if additional electric pumps at the Wippel pumping plant need to be turned on and allow optimization of the hydroturbine pumps. The existing electric pumps and a new electric pump controlled by a variable frequency drive will operate automatically as needed to match the demand in the Pump Lateral.

With all of the described improvements in place and with the telemetry system set points controlled by the Watermaster, the Wippel pumping plant and everything downstream of it would automatically receive a consistent supply of water.

The next element in automating the North Branch canal is to minimize the unnecessary spills at the intakes to the Wippel Pumping Plant forebay which feeds the penstocks. Water at this location is also diverted, or spilled, to meet the demands of the Gravity Lateral as well as the Turbine Lateral when power water volumes are insufficient to meet user demands. This can be achieved by using a level sensor at the Wippel forebay to send a signal upstream to the Johnson Siphon radial gate. The radial gate will adjust automatically to control the amount of flow to the penstock intakes, Gravity Lateral and Turbine Lateral diversions.

Just upstream of the Johnson Siphon is the location of the proposed Johnson Reregulation reservoir. A broadcrested weir that would feed the reregulating reservoir during times of high canal water could control water levels in the canal at this point. When the level in the canal is low, a new pump station will pump water from the reservoir back into the canal.

As in the case of the Page Canyon reregulation reservoir, the optimum level of water in the Johnson re-regulation reservoir is half full. To keep this level constant, a level sensor will send a signal to the Easton headgates to adjust water flow automatically. As part of the operation of the Johnson Reregulating Reservoir, the water needs of the CID must be considered. All water deliveries to the CID should be made from the new reregulating reservoir and piped at least a portion of the distance to the CID. Hydroelectric generation could be considered as a means to recover a small amount of energy. The KRD, the CID, the City of Ellensburg, and Kittitas County would need to collectively develop operational policies for the reregulating reservoir at Johnson to meet common and competing needs.

With all of the described improvements in place and with the telemetry system set points controlled by the Watermaster, the major elements of the KRD system can be monitored and controlled more efficiently.

Advantages

- An increase in system flexibility and response would be realized by this alternative.
- It would achieve the water conservation goals of the YRBWEP, DOE, DFW, and other interested parties, although not as significantly as Alternative 1.

- Additional automatic flow measuring locations will contribute to a more comprehensive monitoring of the KRD system.

Disadvantages

- Lateral losses due to seepage, leaks, and evaporation would still remain high.
- Assessment rates would to be increased to pay for the capital costs of the new system and the pumping costs of the new electric motors pumps.

Alternative 4: Piping High Loss Laterals

This alternative is similar to Alternative 1 except that the only improvements to the system would be piping the existing 20 open canal laterals that have high water losses.

This alternative has the same advantages and disadvantages as Alternative 1 except that the water savings realized would be smaller and no additional pumping costs for pump stations would be necessary.

Alternative 5: Installation of Efficient On-farm Application Equipment

This alternative would consist of upgrading existing irrigation equipment used by the water users of the KRD. Currently, the majority of the KRD's irrigated land is under surface or flood irrigation. Switching over to sprinkler irrigation systems where applicable would increase on-farm application efficiencies as much as 20 percent. This alternative considers using wheel line irrigation equipment for all the existing land within the KRD that is currently flood irrigated.

Advantages

- It would cost no more to operate and maintain the KRD system than it currently does.
- It would achieve the water conservation goals of the YRBWEP, DOE, DFW, and other interested parties.
- Surface run off from irrigated fields would be reduced, which would improve water quality of return flows to the Yakima River.

Disadvantages

- Conveyance and operational losses would still remain high.
- No increased system reliability would be realized by this alternative.
- No increase in system flexibility or responsiveness would be realized by this alternative.
- Electrical energy expenses for on-farm pumping equipment and pump operation and maintenance costs would be required to boost the pressure of the delivered water to sprinkler pressure.
- Farmers in the KRD prefer to irrigate their predominant crop of Timothy Hay with flood irrigation as opposed to overhead sprinkler irrigation.
- No increase in public safety would be gained by implementation of this alternative.

Alternative 6: "Do Nothing"

This alternative would involve no improvement work whatsoever. Its chief benefit is that it would cost no more to operate and maintain the KRD system than it currently does. Also, no detriment to wetlands or wildlife habitat would occur other than natural growth and decline cycles, and no adjustment to changes created by system improvements would be required by the KRD water users.

The cost of doing nothing is continued water waste; continued shortage of water for crop production; continued system inefficiencies. Also, no investment in infrastructure or increased regional employment as a result of a construction project would be realized by selecting this alternative.

There is no public benefit or improved safety of the public associated with this alternative.

Preferred Alternative

Alternative 1 is recommended as the Preferred Alternative. Alternative 1 is recommended because of its large benefits to the water users and other entities concerned with instream flows, reasonable cost and repayment burden, increase to the public safety and liability reduction to the KRD, system reliability and flexibility, and positive environmental effects.

Implementation of this alternative would replace approximately 70 miles of open ditch canal with pipeline, provide for the construction of two reservoirs and almost completely automate the major features of the KRD conveyance system. These benefits will facilitate better control and delivery of the KRD's water entitlement.

Refer to the General Map of Proposed Improvements, contained in Appendix I, for a graphic representation of the proposed improvements associated with the Preferred Alternative.

ADDENDUM NO. 1

Water Conservation Plan Supplemental Information

Introduction

The purpose of this addendum is to supplement the Kittitas Reclamation District's (KRD) recently completed Water Conservation Plan (WCP) by adding items suggested by the Feasibility Investigation Team. The information provided in this addendum includes potential use for conserved water to enhance fish habitat in tributary streams and the feasibility of increasing the diameter of piped irrigation laterals as described in the WCP to increase gravity pressure to turnouts.

Located in central Washington, KRD lies in the upper Yakima River Basin, along the eastern edge of the Cascade Mountains. Situated entirely within the boundaries of Kittitas County, the KRD borders on the cities of Ellensburg, Cle Elum and Kittitas.

KRD's Water Conservation Plan was completed in February 1999. In the fall of 2000, the U.S. Bureau of Reclamation led Feasibility Investigation Team recommended further evaluation be conducted to enhance specific aspects of the conservation plan. The team requested that the following information be included in this addendum to the *KRD Water Conservation Plan*:

- An evaluation to determine how the conserved water could be used to maximize fish benefits in four tributary streams within the KRD boundaries
- Identification of the feasibility and cost of further gravity pressurization of irrigation system laterals proposed for piping in the WCP
- Development of a schedule and budget to complete the conservation measures in the WCP and the Addendum

Maximize Benefits to Fish

The evaluation conducted under this addendum investigated the potential for eliminating private diversions of irrigation water from tributary streams within the KRD. Water to serve the individual water rights holders needs would be made available through implementation of the KRD's Water Conservation Plan. The Scope of Work developed by the Feasibility Investigation Team identified the priority tributaries as:

- Manastash Creek
- Taneum Creek
- Big Creek
- Little Creek

Through the investigation, it was determined that a number of water right holders utilize creek water as a source of irrigation. The first task of the Scope evaluated KRD's ability to

eliminate irrigation diversions from these creeks and supply water from KRD facilities. If KRD could reduce diversions from the creeks, in-stream flows would be increased, thereby enhancing fish habitat.

Water Rights Research

Investigations were conducted to determine the amount of water that has been appropriated through the grant of surface water rights from the creeks. This part of the task required a historical search of all existing surface water rights for creek users in the study areas. The investigation relied upon information from the ongoing water rights adjudication being conducted by the Yakima County Superior Court through Court Case No. 77-2-01484-5, defined as the "Washington State Department of Ecology v. James J. Acquavella, et. al." Available documents and maps related to this case were collected. These included Reports of Referee, Supplemental Reports of Referee, and Conditional Final Orders. The Reports of Referee and Conditional Final Orders collected were:

- Subbasin No. 2 Easton, (Big Creek and Little Creek) Volume 17 and Supplemental Report of Referee Volume 17A
- Subbasin No. 6 Taneum, (Taneum Creek) Volume 18 and Supplemental Report of Referee Volume 18A
- Subbasin No. 11 Manastash, (Manastash Creek) Volume 17 and Supplemental Report of Referee Volume 17A.
- Conditional Final Order – Subbasin No. 2- 1997
- Conditional Final Order – Subbasin No. 6 - 1998
- Conditional Final Order - Manastash Water Ditch Association's Exception to Lazy F Camp's Recommended Water Right – 1999

All reports were reviewed which relate to the maximum duty of water for various uses within each subbasin. The reports were also compared for uniformity.

Notations were made of standard review processes, such as limitations to the amount of water that can be used beneficially for application under irrigation, domestic supply, and stock watering. Additionally, each original document was compared to supplemental documents for changes and additions to each water right claim.

Once this data was collected, it was further tabulated for each creek (subbasin). The water right information that was tabulated included: Claim Number, Priority Year, Number of Acres Irrigated, Period of Use, Rate of Flow , Allowable annual consumption in Acre-feet per Year, Stock Water CFS, Stock Water Annual Consumption if Acre-feet, and Supplemental Water from KRD. The columns representing the number of acres irrigated, cubic feet per second (cfs), acre-feet per year, stock water cfs, and stock water acre-feet annually were then totaled for each creek (subbasin). By dividing the total irrigated acres for each creek by the total allotted annual acre-feet for each creek, an average annual water allotment per acre for each creek basin was determined. The average annual water allotment ranged from 3 to more than 9 acre-feet per acre allowed under the various adjudicated water rights. See Tables 4A through 7B.

Through the research, an anomaly was discovered. A number of claims in the adjudication documents appeared to be duplicated. Further conversations with the Department of Ecology determined that these "duplicates" were valid individual claims and not

duplications. Upon further investigation, it was found that these "duplicated" claims were part of water rights that covered different areas of land, i.e., four claims for 40 irrigated acres each having the same legal description were within an area of 160 acres or more.

Once the information was gathered and the total water right allotment calculated, each individual claim was located and identified on GIS maps supplied by KRD. Through this process, it was determined that a number of the water rights covered by the adjudication were located outside of KRD's service area. These claims were not included in the tabulations described earlier since KRD does not have facilities or authority to serve water outside of its boundaries. (see Figures 1 through 3)

Figures 1 through 3 were analyzed to determine the improvements to facilities that would be required to supply water through the KRD system to valid creek water right holders. Separating the water right holders that could currently receive supplemental water through KRD facilities from those that could not, determined where new irrigation infrastructure systems would be required. The goal of the proposed irrigation water conveyance facilities was to provide water to the creek water user's existing diversion points. This was accomplished in all the basins except Manastash Creek. In this particular basin, it was more efficient to serve lands directly than to deliver water to the existing diversion points.

Development of Alternatives

The amount of water used for development of alternatives in this addendum is the same amount produced by implementation of the preferred alternative (Alternative No. 1) in the *KRD Water Conservation Plan*. The total water conserved by Alternative No. 1 is 48,542 acre-feet per season (Table 6-2, *KRD Water Conservation Plan*). To be consistent with the current concept of reallocation of conserved water within the Yakima Basin, two-thirds of the water saved, or 32,361 acre-feet per season was determined to be available for use in serving the creek water rights holders. Table 1 presents a comparison between the water made available by construction of Alternative No. 1 and the water rights held by the creek water users.

Also shown in Table 1 is the *Washington State Irrigation Guide*'s recommended irrigation annual volume of water necessary to properly irrigate pasture /turf (31.46 inches), assuming one-hundred percent irrigation application efficiency. Assuming 65 percent irrigation efficiency, the annual irrigation system delivery requirement would be 48.40 inches per year. This data was confirmed by Mr. Robert Stevens of Washington State University Cooperative Extension Service, Prosser Research Station (WSU), who indicated the standard range of irrigation for Timothy hay is 30 to 36 inches in the Ellensburg area.

Soils in the Ellensburg area are primarily well drained alluvium that range from very deep to shallow. Due to the soil depth variations, the amount of water a Kittitas Valley farmer uses to irrigate his crops can vary without either damaging the soil through erosion, or wasting water. However, when standard irrigation practices are followed (30 to 36 inches, the recommended range), soil deterioration is prevented. Some areas of steeply sloping land or very permeable soils may require specialized irrigation equipment such as sprinkler systems to achieve the desired irrigation application efficiencies.

TABLE 1
Kittitas Reclamation District
Comparison of Conserved Water to Surface Water Rights

Basin	Creek Surface Water Right Allotment Ac-ft	Allotted Stock Water Rights Ac-ft	Required Irrigation Volume per Washington Irrigation Guide[1] Ac-ft	Two Thirds of Water Saved by Conservation Plan Ac-ft
Big Creek	1,464.00	19.62	1,235.82	
Little Creek	461.60	5.50	495.94	
Taneum Creek	11,834.40	68.00	16,018.33	
Manastash Creek	25,707.13	166.40	17,380.76	
Total	39,467.13	259.52	35,130.86	32,361

(1) Adjusted for on farm efficiencies of 65 percent

The totals in Table 1 show that two-thirds of the water conserved (32,361 ac-ft) by constructing Alternative 1 from KRD's Water Conservation Plan water is less than the total allocated surface water rights (39,467.13 ac-ft). The available conserved water is also less than recommended in the *Washington State Irrigation Guide* (35,130.86 ac-ft). Because the total surface water right and the irrigation guide amounts exceed the available amount of conserved water, a combination of the different creek basins was used to develop alternatives.

As a general starting point, it was determined that the total withdrawal from the two largest creeks, Taneum and Manastash Creeks (33,399.09 ac-ft), is greater than the two-thirds of the conserved water (32,361 ac-ft). Therefore, Taneum and Manastash cannot both be supplied with the available conserved water . Additional combinations are described below in the proposed alternatives of improvements.

Proposed Improvements

Three irrigation system improvement alternatives were evaluated that would increase in-stream flows potentially improving fish habitat. These alternatives are technically sound from an engineering, operational, and environmental perspective and can be implemented. The first two alternatives focus on supplying the creek water right holders directly from KRD canal and pipeline facilities, while the third alternative supplies conserved water directly from the KRD system to the existing creeks. The three alternatives are:

- Supply Big, Little, and Taneum Creeks with two-thirds of the District's conserved water. This would require that KRD construct systems to supply water by gravity to the existing creek diversion points. (Alternative 1A)

- Supply Big, Little, and Manastash Creeks with two-thirds of the District's conserved water. This would require that KRD construct systems to supply water by gravity to the existing diversion points for Big Creek and Little Creek and directly to farms on Manastash Creek. (Alternative 2A)
- A third alternative would divert two-thirds of the conserved water directly to all four of the creeks without removing the existing creek users' diversions. This would require diverting the conserved water from KRD directly into the creeks. (Alternative 3A)

It is assumed that all creek water right holders with KRD supplemental rights will not need new water conveyance facilities to obtain water since there are facilities currently in place for them to receive water from KRD. It is also assumed that the water requirements are based on the total acreage as shown on each water right for each basin within KRD's service boundaries.

Alternative 1A: New Laterals To The Diversion Points On Big, Little, and Taneum Creeks.

This alternative supplies water by gravity flow to 23 existing creek water right diversions on Big, Little, and Taneum Creeks. This alternative includes creating 10 new laterals. Approximately 13,350 feet of pipe would be installed (see attached Figures 1 and 2).

This alternative would benefit fish habitat in Big, Little, and Taneum Creeks, but not Manastash Creek.

Alternative 2A: New Laterals To The Diversion Points On Big, Little, and Manastash Creeks.

This alternative conveys water using gravity flow to 41 existing creek water right diversion points on Big, Little, and Manastash Creeks. The project will create 21 new laterals by installing approximately 28,850 feet of pipe (see Figures 1 and 3 at end of this addendum).

This alternative would increase in-stream flows to benefit fish habitat in Big, Little, and Manastash Creeks, but will not benefit Taneum Creek.

Alternative 3A: New Diversion Points To The Four Creeks.

This alternative requires very little construction. It will attempt to offset creek water diversions by returning conserved water to the all four creeks, and increasing in-stream flows for fish habitat. This would allow the existing creek diversions to continue as currently practiced.

Because this alternative would require KRD to only build diversion headworks to the creeks, some of which currently exist, construction costs would be less than for Alternative 1A and 2A.

Preferred Alternative

Alternative 2A is recommended as the preferred alternative. Alternative 2A is recommended because it will serve the most water rights holders and has the largest potential benefit to fish habitat.

This alternative requires approximately 28,850 feet of new pipe be constructed for 21 new laterals. Refer to Figures 1 and 3 to see the graphical presentation of the proposed improvements of this alternative.

Attachment E
Letters of Commitment and Project Support

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Central Regional Office - Office of Columbia River
1250 W. Alder Street • Union Gap, Washington 98903 • (509) 575-2490

January 14, 2016

Bureau of Reclamation
Acquisition Operations Branch
Attn: Ms. Janeen Koza
Mail Code: 84-27852
PO Box 25007
Denver, CO 80225

Subject: Bureau of Reclamation WaterSMART Program

Dear Ms. Koza:

I am writing on behalf of the Kittitas Reclamation District (KRD) to express support for the North Branch Canal Lining Project. This improvement to the canal system will reduce water seepage and losses, which will result in more efficient water distribution and usage. In addition, the KRD is committed to carrying the saved water to appropriate upper Yakima River tributaries, the exact location of supplemental tributary flows will be based on the KRD ability to get flows to tributaries and an annual recommendation to the USBR by the System Operations Advisory Committee.

The Department of Ecology (Ecology) is committed to providing $250,000 in funding through the Office of Columbia River for the first phase of the North Branch Canal Lining Project. Ecology has agreed to the allocation of $142,308 from the original $250,000 to match WaterSMART funding for the construction of the North Branch Canal Lining Project.

We applaud the KRD's commitment to conserve water, to help KRD water users, and to contribute to restoring Yakima River Basin fisheries consistent with the Yakima Basin Integrated Plan; and would encourage the Bureau of Reclamation assistance by providing project funding.

If you have any questions, I can be reached by phone at (509) 574-3989 or by email at: thomas.tebb@ecy.wa.gov .

Sincerely,

G. Thomas Tebb, L.Hg., L.E.G.
Director
Office of Columbia River

GT:CMR (160105)

Attachment F
Official Resolution

Kittitas Reclamation District
P.O. Box 276
Ellensburg, WA 98926
Phone: (509) 925-6158 Fax: (509) 925-7425

RESOLUTION 2016-1

WHEREAS, the Kittitas Reclamation District is in receipt of the U.S. Bureau of Reclamation Funding Opportunity Announcement No. R16-FOA-DO-004, WaterSMART Water and Energy Efficiency Grants for FY2016; and;

WHEREAS, the Kittitas Reclamation District has legal authority to enter into a grant with the Bureau of Reclamation; and;

WHEREAS, the Board of Directors of the Kittitas Reclamation District supports the application submitted; and;

WHEREAS, the Kittitas Reclamation District will work with the U.S. Bureau of Reclamation to meet established deadlines for entering into a cooperative agreement;

NOW, THEREFORE, IT IS HEREBY RESOLVED by the Board of Directors that the Kittitas Reclamation District is committed to the financial and legal obligations associated with receipt of WaterSMART Grant financial assistance.

DATED, this 2nd day of February 2016.

Fred Schnebly
CHAIRMAN

VICE CHAIRMAN

Ed Wahlquist
BOARD MEMBER

Mark Hansen
BOARD MEMBER

Larry Bland
BOARD MEMBER

SECRETARY-MANAGER