



Technical Report on the Enhanced Water Conservation Alternative for the Yakima River Basin Water Storage Feasibility Study

In support of the Yakima River Basin Water Storage Feasibility Study Draft Planning
Report/Environmental Impact Statement
Ecology Publication Number 07-11-044

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INTRODUCTION

This report describes the components of the Enhanced Water Conservation Alternative, an aggressive program implementing water conservation measures in the Yakima River basin to improve basin water supply without constructing additional large water storage reservoirs. The report will describe how the projects were determined, how the cost estimates for the projects were established, how much water savings is expected from the projects, and how the effects the projects have on Yakima River basin flow were calculated. The report will also discuss municipal projects not included in this alternative but that can be considered as possibilities for additional water conservation efforts. This report supplements the water conservation analyses performed in the Yakima River Basin Water Storage Feasibility Study Draft Planning Report/Environmental Impact Statement (Reclamation 2008).

DESCRIPTION OF MEASURES

Measures for the Enhanced Water Conservation Alternative are varied in cost and type. Measures are mostly agriculture-related projects that will be implemented by irrigation districts and individual landowners. These projects were established from irrigation districts' published water conservation plans and communication with conservation district representatives who have knowledge of planned conservation efforts within their district. Descriptions of projects from these sources follow. A summary table of the conservation projects is contained in Appendix A.

PROJECTS FROM WATER CONSERVATION PLANS

Projects to be implemented by irrigation districts improve basin water supply by reducing the amount of water required to be diverted from the Yakima River or one of its tributaries. Thirty projects included in the alternative were found in water conservation plans from seven irrigation districts in the Yakima River basin. The irrigation districts, the number of projects for each district, and their plan reference is shown in Table 1.

Table 1
Irrigation Districts with Projects in the Enhanced Water Conservation Alternative

Irrigation District	Number of Projects	Source
Wapato Irrigation Project	16	Natural Resources Consulting Engineers (NRCE). 1999. <i>Irrigation Water Conservation and Management Plan for the Wapato Irrigation Project</i> . May.
Sunnyside Valley Irrigation District	1	CH2M Hill. 1995. <i>Outlook Irrigation District Comprehensive Water Conservation Plan</i> .
Kiona Irrigation District	1	CH2M Hill. 1996. <i>Kiona Irrigation District Comprehensive Water Conservation Plan</i> . February.
Columbia Irrigation District	3	SCM Consultants. 2001. Facsimile; Subject: Yakima River Basin Watershed Plan. August 15.
Kennewick Irrigation District	1	SCM Consultants. 1999. <i>Kennewick Irrigation District Water Conservation Plan</i> . June.
Naches-Selah Irrigation District	7	CH2M Hill. 1995. <i>Naches-Selah Irrigation District Comprehensive Water Conservation Plan</i> . Harter, Justin. 2006. Personal correspondence. Naches-Selah Irrigation District.
South Naches Irrigation District	1	CH2M Hill. 1994. <i>South Naches Irrigation District Comprehensive Water Conservation Plan</i> . February.

These projects from the water conservation plans consist of several different types of projects that improve basin water supply. These types include lining projects, piping projects, re-regulation reservoir projects, on-farm conservation projects, pump exchange projects, and water management projects. A short description of each project type follows.

Lining Projects

Lining projects involve installing concrete or cement lining on major distribution canals that either do not currently have lining (earth ditch) or replacing lining that is leaking or in need of repair. These projects will save water by reducing losses through infiltration. Lining projects from conservation plans, along with their estimated water savings, are described in Table 2.

Table 2
Conservation Plan Lining Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Estimated Water Savings (acre-feet per year)	Description
17	Wapato Irrigation Project	4,600	Line Satus East and Satus West Canals with concrete
18	Wapato Irrigation Project	3,400	Concrete line Lateral 4 Extension and line or pipe corresponding sublaterals
19	Wapato Irrigation Project	5,100	Cement line Track Lateral and replace or repair water structures
21	Wapato Irrigation Project	5,900	Line Unit 1 Canal in Bench Unit with concrete
22	Wapato Irrigation Project	5,200	Line Unit 2 Pump Canal in Bench Unit with concrete
33	Columbia Irrigation District	26,000	Concrete line Main Canal (also includes pump exchange, see Table 6)
38	Naches-Selah Irrigation District	8,675	Line and rehabilitate Main Canal and tunnels from Mile 9 to Mile 15
41	Naches-Selah Irrigation District	a	Line existing unlined Main Canal from Mile 0 to Mile 9, replace failing wood flumes, rehabilitate structures, and automate canal

Note:

a = Water savings combined with Project No. 38

Sources:

NRCE 1999

SCM Consultants 2001

CH2M Hill 1995a

Harter, personal communication 2006

Piping Projects

Piping projects will install pipe to replace open ditches or currently piped systems that are leaking. These projects may also replace gravity-flow pipes to pipes that will operate as a pressurized system. These projects will reduce losses through infiltration and evaporation for water savings. In the case of pipe replacement to install a pressurized system, the projects will reduce diversions because of a more efficient conveyance system, which will reduce operational spills. Piping projects from conservation plans, along with their estimated water savings, are described in Table 3.

Table 3
Conservation Plan Piping Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Estimated Water Savings (acre-feet per year)	Description
20	Wapato Irrigation Project	1,300	Improve Spencer Lateral in Wapato Unit
23	Wapato Irrigation Project	700	Pipe or line East Highline Canal
24	Wapato Irrigation Project	7,200	Line Main Extension Canal with concrete and pipe associated laterals and sublaterals in Bench Unit
25	Wapato Irrigation Project	800	Pipe Island laterals and sublaterals in Bench Unit
26	Wapato Irrigation Project	1,600	Replace all piped laterals in Unit 1 in Bench Unit
27	Wapato Irrigation Project	1,000	Replace all piped laterals in Unit 2 in Bench Unit
30	Sunnyside Valley Irrigation District	4,265	Pipe former Outlook Irrigation District
31	Kiona Irrigation District	4,124	Convert to a complete pressurized system
32	Columbia Irrigation District	<i>a</i>	Pipe Lateral 1 and 2 canals and pressurize Lateral 1
39	Naches-Selah Irrigation District	<i>b</i>	Pipe first 1.4 miles of No. 1 Lateral
40	Naches-Selah Irrigation District	<i>b</i>	Replace and upgrade existing low head concrete pipe to handle higher pressures in Lower No. 2 Lateral
42	Naches-Selah Irrigation District	<i>b</i>	Pipe No. 1/North Pleasant Hill Lateral, replace failing wood pipe, and upgrade other existing distribution pipes
43	Naches-Selah Irrigation District	<i>b</i>	Pipe No. 3 Lateral, replace failing wood flumes and pipes, and upgrade other existing distribution pipes
44	South Naches Irrigation District	9,733	Pipe district-wide to convert to a pressurized distribution system

Notes:

a = Water savings combined with Project No. 33 (Table 2)

b = Water savings combined with Project No. 38 (Table 2)

Sources:

NRCE 1999

CH2M Hill 1995b

CH2M Hill 1996

SCM Consultants 2001

CH2M Hill 1995a

Harter, personal communication 2006

CH2M Hill 1994

Re-regulation Reservoir Projects

Re-regulation reservoir projects will construct small reservoirs to assist in water management. Re-regulation reservoirs are relatively small reservoirs that can store or release water when fluctuations in demand occur. Re-regulation reservoir installation results in water savings due to a reduction in operational spill. Re-regulation reservoir projects from conservation plans, along with their estimated water savings, are described in Table 4.

Table 4
Conservation Plan Re-regulation Reservoir Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Estimated Water Savings (acre-feet per year)	Description
15	Wapato Irrigation Project	700	Construct a 370 acre-foot capacity reservoir in Bench Unit
37	Naches-Selah Irrigation District	a	Construct a lined 55 acre-foot reservoir to buffer flows coming from Main Canal at Mile 15 into piped laterals

Note:

a = Water savings combined with Project No. 38 (Table 2)

Sources:

NRCE 1999

CH2M Hill 1995a

Harter, personal communication 2006

On-farm Conservation Projects

On-farm conservation projects in the water conservation plans are incentive-based programs that provide assistance to landowners to improve irrigation systems and land. Water savings is based on the amount of participation in the conservation effort. The typical on-farm conservation effort relies on converting less efficient watering methods (such as rill irrigation) into more efficient watering methods (such as sprinkler irrigation). On-farm conservation projects from conservation plans, along with their estimated water savings, are described in Table 5.

Table 5
Conservation Plan On-farm Conservation Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Estimated Water Savings (acre-feet per year)	Description
16	Wapato Irrigation Project	32,500	Voluntary incentive-based program to provide assistance to growers for improvements to irrigation systems and land

Source:

NRCE 1999

Pump Exchange Projects

Pump exchange projects involve constructing a revised conveyance system that pumps water from a different source as a replacement to diverting water from the current source. In the pump exchange projects reviewed, water would be pumped from the Columbia River to replace water that is originally diverted from the Yakima River. As a result, the Yakima River would have additional water downstream of the point of diversion. These projects do not conserve water on a whole but do reduce the amount of water being used in the Yakima River basin. Potential pump exchange projects, along with their estimated water savings, are described in Table 6.

Table 6
Conservation Plan Pump Exchange Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Estimated Water Savings (acre-feet per year)	Description
34	Columbia Irrigation District	26,000 (a)	Columbia River Pump Exchange Project
35	Kennewick Irrigation District	64,500	Columbia River Pump Exchange Project

Note:

a = Water savings combined with Project No. 33 (Table 2)

Sources:

Sandison, personal communication 2007

SCM Consultants 2001

SCM Consultants 1999

Water Management Projects

Water management projects in the water conservation plans include installing water measurement devices on canals and at turnouts, replacing manual check structures with mechanical gates, installing variable frequency drives on pumps, and installing SCADA systems for remote monitoring. These projects will provide the irrigation districts additional devices to determine the amount of water use and allow better control to the amount of water being diverted. Water management projects from conservation plans, along with their estimated water savings, are described in Table 7.

Table 7
Conservation Plan Water Management Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Estimated Water Savings (acre-feet per year)	Description
14	Wapato Irrigation Project	14,700	Equip all turnouts with adequate water measurement devices
28	Wapato Irrigation Project	Minor	Replace existing check structures with mechanical gates
29	Wapato Irrigation Project	Minor	Construct ramp flumes for water measurement at 23 different locations

Source:

NRCE 1999

CONSERVATION DISTRICT PROJECTS

Projects described by conservation districts are usually smaller projects that are typically implemented by individual landowners. The landowners implementing the projects often receive technical assistance from the local conservation district or the Natural Resources Conservation Service (NRCS). The projects included in the alternative are based on the knowledge of the conservation districts or communication between the conservation districts and local managers or property owners. These projects improve water supply by reducing the amount of water required

to be diverted from the Yakima River or one of its tributaries. Seventeen projects included in the alternative came from information obtained from one of two conservation districts, the Kittitas County Conservation District (12 projects) and the North Yakima Conservation District (five projects).

These projects from the conservation districts consist of several different types of projects that could improve basin water supply. These types include lining projects, piping projects, on-farm conservation projects, and other conservation projects. A short description of each project type follows.

Lining Projects

Lining projects involve replacing concrete lining in areas that are leaking. These projects will save water by reducing losses through infiltration. Lining projects from conservation districts, along with their estimated water savings, are described in Table 8.

Table 8
Conservation District Lining Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Conservation District	Estimated Water Savings (acre-feet per year)	Description
1	Kittitas Reclamation District	Kittitas County Conservation District	2,000	Replace leaking areas of Main Canal with new concrete liner

Source:

Crowley, personal communication 2006

Piping Projects

Piping projects will install pipe to replace open ditches or currently piped systems that are leaking. These projects will reduce losses through infiltration and evaporation for water savings. Lining projects from conservation districts, along with their estimated water savings, are described in Table 9.

Table 9
Conservation District Piping Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Conservation District	Estimated Water Savings (acre-feet per year)	Description
2	Westside Irrigation	KCCD	300	Pipe 5,280 feet of canal
3	Westside Irrigation	KCCD	300	Pipe 5,280 feet of canal
10	Bull Canal Company	KCCD	384	Pipe 1,800 feet of canal
11	Bull Canal Company	KCCD	255	Pipe 3,000 feet of canal
13	Union Gap Irrigation District	NYCD	200	Pipe ditches to the current points of use
36	Nile Valley Ditch Association	NYCD	395	Pipe the delivery for approximately 300 acres
45	Gleed Ditch Company	NYCD	100	Pipe ditches to the current points of use
46	Yakima Valley Canal Company	NYCD	500	Pipe ditches to the current points of use
47	Naches & Cowlitz Canal Company	NYCD	600	Pipe ditches to the current points of use

Notes:

KCCD = Kittitas County Conservation District

NYCD = North Yakima Conservation District

Sources:

Crowley, personal communication 2006

Tobin, personal communication 2006

On-farm Conservation Projects

On-farm conservation projects from the conservation districts are incentive-based programs that provide assistance to landowners to improve irrigation systems and land. Water savings is based on the amount of participation in the conservation effort. The typical on-farm conservation effort relies on converting less efficient watering methods (such as rill irrigation) into more efficient watering methods (such as sprinkler irrigation). On-farm conservation projects from conservation districts, along with their estimated water savings, are described in Table 10.

Table 10
Conservation District On-farm Conservation Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Conservation District	Estimated Water Savings (acre-feet per year)	Description
4	Westside Irrigation	KCCD	3,300	Conversion of rill irrigation to sprinkler irrigation
5	Ellensburg Water Company	KCCD	7,000	Conversion of rill irrigation to sprinkler irrigation
6	Ellensburg Water Company	KCCD	100	Conversion of rill irrigation to sprinkler irrigation
9	Cascade Irrigation District	KCCD	9,000	Conversion of rill irrigation to sprinkler irrigation
12	Bull Canal Company	KCCD	680	Conversion of rill irrigation to sprinkler irrigation

Note:

KCCD = Kittitas County Conservation District

Source:

Crowley, personal communication 2006

Other Conservation Projects

Other conservation projects from the conservation districts include installing a pump to return used water into the canal for reuse, installing variable frequency drives on pumps, or increasing local storage within an irrigation area. The projects will assist to give better control to the amount of water being diverted and reduce waste flows. These other projects from conservation districts, along with their estimated water savings, are described in Table 11.

Table 11
Conservation District Other Conservation Projects Included in the Enhanced Water Conservation Alternative

Alternative Project Number	Entity	Conservation District	Estimated Water Savings (acre-feet per year)	Description
7	Cascade Irrigation District	KCCD	2,088	Pump return flows from Johnson Drain back into the canal for reuse
8	Cascade Irrigation District	KCCD	<i>a</i>	Install a variable frequency drive on two pumps at the head end of the canal system

Notes:

KCCD = Kittitas County Conservation District

a = Water savings combined with Project No. 7

Source:

Crowley, personal communication 2006

COST ESTIMATES

Cost estimates for the projects included in the Enhanced Water Conservation Alternative were determined using estimates from the water conservation plans and from discussions with conservation district representatives.

Original cost estimates in water conservation plans were assumed to be in dollars of the same year that it was published. For example, cost estimates of projects from a water conservation plan with a 1999 report date were assumed to be in 1999 dollars. Cost estimates from conservation districts were assumed to be in 2006 dollars, which is the year the conservation districts were contacted and provided project information.

Cost estimates for all projects in the alternative were converted to 2007 dollars using the U.S. Bureau of Reclamation (USBR) Construction Cost Index (http://www.usbr.gov/pmts/estimate/cost_trend.html). The costs were converted using the composite trend construction indexes for April 2007 and April of the original year. The cost index used for each individual year is shown in Table 12.

Table 12
USBR Composite Trend Construction Cost Index, 1994 to 2007

Year	Cost Index
1994	196
1995	204
1996	208
1997	217
1998	218
1999	221
2000	231
2001	234
2002	237
2003	247
2004	259
2005	280
2006	298
2007	309

Source:
USBR 2007

As an example, if a project cost estimate was \$10 million in the original estimate in 1995, the 2007 cost estimate for the project was calculated to be \$15.1 million (10×309 [April 2007 index] $\div$ 204 [April 1995 index]).

Some projects included in the alternative had cost estimates that were itemized while some projects did not. These two types were approached differently to determine the project cost estimate, and a description of each type follows. A summary table of the cost estimates is contained in Appendix B.

ITEMIZED COST ESTIMATES

Projects that had an itemized cost estimate in their initial form had different values for items such as mobilization, contingencies, and noncontract costs. In order to maintain consistency for projects obtained from different sources, a specific formula was followed. The formula breaks the costs into itemized pay items, mobilization costs, unlisted items, contingencies, and noncontract costs. For these projects, the itemized pay items were placed in the formula and converted to 2007 dollars (described in Section 3). A description of each cost follows.

Itemized Pay Items

Itemized pay items are the major features of the project listed in the cost estimate. For consistency of projects from different sources, itemized pay items were the only values taken from the original estimate for those projects that had itemized cost estimates.

Mobilization Costs

Mobilization costs are incurred during assembly of contractor personnel and equipment to the project site during the initial project startup. These costs were assumed to be 5 percent of the itemized pay item total.

Unlisted Items

Unlisted items identify the confidence level in estimates and can be used for minor design changes or minor pay items that have not been itemized. These items were assumed to total 10 percent of the itemized pay item total.

Contingencies

Contingencies account for uncertainties in cost estimating and for funds to be used after construction starts. Those funds can pay contractors for overruns of quantities, changed site conditions, change orders, and other construction-related costs beyond the design costs. Contingencies were assumed to equal 25 percent of the sum of the itemized pay items, mobilization costs, and unlisted items.

Noncontract Costs

Noncontract costs include all costs that are not directly construction costs but are required for the project itself. These costs include final engineering design and specifications; regulatory compliance and permitting; environmental mitigation and monitoring; contract administration and management; and land acquisition, relocation, and right-of-way costs. Noncontract costs were assumed to be 35 percent of the sum of all previous costs (itemized pay items, mobilization costs, unlisted items, and contingencies).

Projects with itemized cost estimates, their original itemized cost and corresponding additional costs, and the updated total project cost in 2007 dollars are listed in Table 13.

Table 13
Cost Estimates of Projects in the Enhanced Water Conservation Alternative with Itemized Cost Estimates

Alternative Project Number	Itemized Pay Items (\$)	Total Project Cost (All Costs; \$)	Year of Cost Estimate	2007 Total Project Cost (\$)
15	209,513	408,400	1999	571,021
17	2,317,345	4,516,700	1999	6,315,205
18	2,264,473	4,413,600	1999	6,171,052
19	3,453,850	6,731,800	1999	9,412,236
20	958,397	1,868,000	1999	2,611,819
21	6,172,953	12,031,500	1999	16,822,324
22	5,967,078	11,630,200	1999	16,261,230
23	958,397	1,868,000	1999	2,611,819
24	15,000,163	29,236,300	1999	40,877,904
25	1,753,097	3,416,900	1999	4,777,476
26	3,818,262	7,442,000	1999	10,405,330
27	4,268,948	8,320,500	1999	11,633,640
28	581,800	1,134,000	1999	1,585,548
29	581,800	1,134,000	1999	1,585,548
30	474,526	924,900	1995	1,400,951
31	1,610,230	3,138,400	1995	4,753,753
32	5,878,171	11,456,900	2001	15,128,983
33	5,762,015	11,230,500	2001	14,830,019
34	2,648,700	5,162,500	2001	6,817,147
35	19,768,800	38,530,600	1999	53,873,101
44	3,264,000	6,361,700	1994	10,029,415

Sources:

NRCE 1999
CH2M Hill 1995b
CH2M Hill 1996
SCM Consultants 2001
SCM Consultants 1999
CH2M Hill 1994

NON-ITEMIZED COST ESTIMATES

Projects that did not have an itemized cost estimate were unable to follow this formula as the costs of the pay items were unknown. For these projects, the cost estimate given in the source was simply converted to 2007 dollars, as described in Section 3. Projects with non-itemized cost estimates, their original cost estimate, and the updated total project cost in 2007 dollars are listed in Table 14.

Table 14
Cost Estimates of Projects in the Enhanced Water Conservation Alternative with Non-itemized Cost Estimates

Alternative Project Number	Total Project Cost (\$)	Year of Cost Estimate	2007 Total Project Cost (\$)
1	3,000,000	2006	3,110,738
2	220,000	2006	228,121
3	220,000	2006	228,121
4	8,250,000	2006	8,554,530
5	17,500,000	2006	18,145,973
6	250,000	2006	259,228
7	200,000	2006	207,383
8	130,000	2006	134,799
9	22,500,000	2006	23,330,537
10	315,000	2006	326,628
11	225,000	2006	233,305
12	1,700,000	2006	1,762,752
13	500,000	2006	518,456
14	5,200,000	2006	7,270,588
16	16,730,000	1999	23,391,719
36	500,000	2006	518,456
37	3,000,000	2006	3,110,738
38	2,500,000	1995	3,786,765
39	1,960,000	2006	2,032,349
40	509,000	2006	527,789
41	13,700,000	2005	15,118,929
42	2,810,000	2006	2,913,725
43	4,710,000	2006	4,883,859
45	5,000,000	2006	5,184,564
46	25,000,000	2006	25,922,819
47	15,000,000	2006	15,553,691

Sources:

Crowley, personal communication 2006
Tobin, personal communication 2006
NRCE 1999
CH2M Hill 1995a
Harter, personal communication 2006

The total estimated costs for the two groups of projects listed in Tables 13 and 14 are \$405,700,000. A summary of the project costs is contained in Appendix B.

WATER SAVINGS

Water savings for the projects included in the Enhanced Water Conservation Alternative were determined using information available from water conservation plans and experience of representatives from the local conservation districts. The water conservation plans typically had a calculated value of water savings listed for each individual project; these values were used directly from the water conservation plan. For on-farm conservation projects that did not have a specific water savings published in a water conservation plan, a savings of 1 acre-foot of water was assumed for each acre that is to be converted from rill irrigation to sprinkler irrigation. Other water savings values supplied by water conservation representatives were unchanged. The water savings for each included project were shown in Tables 2 through 11. The total water savings in the Yakima River basin for all projects in the alternative is estimated to be 229,199 acre-feet per year. However those water savings do not result in a corresponding increase in water supply. The effects on water supply are discussed in the following section and in the Yakima River Basin Water Storage Feasibility Study Draft Planning Report/EIS (Reclamation 2008). With a total estimated cost in 2007 dollars of \$405.7 million, the cost per acre-foot saved is \$1,770.

EFFECTS ON FLOW

Water savings from the projects included in the Enhanced Water Conservation Alternative were used in the Yakima Project RiverWare (Yak-RW) model to determine the effects on flow and water supply in the Yakima River basin. Each project was categorized into one of three water savings categories (canal seepage, canal spill, or on-farm seepage) and placed in the Yak-RW model to assess the effect of reducing diversions and return flow. The model results are not repeated in this report; refer to the Yakima River Basin Water Storage Feasibility Study Draft Planning Report/EIS (Reclamation 2008) for detail on the modeling procedure and the results.

MUNICIPAL CONSERVATION

Municipal conservation projects involve improvements to infrastructure for delivering municipal water supplies and/or demand management to reduce household water consumption.

The Washington State Department of Health has water use efficiency requirements, which include water conservation, that are to be included in Water System Plans. These requirements are located in their Publication No. 331-375, Water Use Efficiency Guidebook (July 2007). These requirements include production (source) and consumption (service) meters, a plan to control leakage, and education programs for customers about water use efficiency practices (DOH 2007).

The purpose of this review of municipal conservation is to estimate the potential effect of conservation on the projected municipal needs for the Yakima River Basin. Those projected needs are described in Yakima River Basin Storage Alternatives Appraisal Assessment a component of Yakima River Basin Water Storage Feasibility Study, Washington Technical Series No TS-YSS-8 (Reclamation 2006). The projected additional municipal and domestic demand in that report for 2050 is 82,000 acre-feet per year. The demands are based upon projections without accounting for the effects of conservation. Since the water supply in the Yakima River basin is fully appropriated, future water supplies will need to be derived from either new storage, conservation or buying water from existing water right holders. A significant cost will be incurred for any of those alternatives, potentially increasing the price of water obtained for new growth. Those increased costs will increase the desire for conserving water that is already used to allow growth to occur at lower costs.

WATER SYSTEM PLANS

Water system plans from four of the largest municipal suppliers of water in the Yakima River basin (Cities of Yakima, Ellensburg, Grandview, and Sunnyside) were reviewed to determine current water use, conservation efforts, and future water use with the conservation efforts in place. Details for each municipality follow.

City of Yakima

The City of Yakima is the largest municipal supplier of water in the Yakima River basin, serving a population of more than 65,000. Their main source of water is surface water diversion from the Naches River. During non-drought years, the City of Yakima can divert up to 25 million gallons per day (MGD). During drought years, their allowed diversion is based on proratable rationing. In 2001, their worst case on record, the diversion allowed was 10 cubic feet per second (cfs) plus 29 percent of 29 cfs, which equals 11.9 MGD. Groundwater wells are also a source for the City of Yakima; however, the wells are currently used in emergencies only (Thomas E. Coleman, P.E. Consulting Services 2004).

Water Use Estimates

Water use estimates are based on previous (1994 to 2000) average water use and current and future projections for land use, customer class (single family, multi-family, commercial, industrial, and irrigation), and population. The intermediate series from the Office of Financial

Management Yakima County projections was assumed for the population trend. Table 15 presents the estimates for the current and future population, total water use, and water use per capita. Water use estimates assume that the average use will not significantly change (Thomas E. Coleman, P.E. Consulting Services 2004). It is assumed the estimates do not include any conservation measures described in Section 6.1.1.2.

Table 15
City of Yakima Water Use Estimates

Year	Total Population	Total Average Daily Demand (MGD)	Estimated Number of Residential Connections	Estimated Residential Average Daily Use (MGD)	ERU Demand (gpd/ERU)	Per Capita Demand (gpd/person)
2000	65,038	13.06	17,088	4.87	285	201
2010	69,378	13.80	18,246	5.20	285	199
2025	82,951	16.10	21,825	6.22	285	194

Notes:

ERU = Equivalent residential units

gpd = gallons per day

Source:

Thomas E. Coleman, P.E. Consulting Services 2004

The estimated demands are lower than the forecast contained in the Yakima River Basin Storage Alternatives Appraisal Assessment (Reclamation 2006). Reclamation's forecast for the City of Yakima in 2020 is 17.4 MGD, compared to 16.1 MGD in Table 15 for 2025.

Conservation Measures

In 1995, a list of potential conservation measures was developed for consideration. Many of these measures were not determined to be cost-effective and were not recommended for implementation (Thomas E. Coleman, P.E. Consulting Services 2004). From the list, five conservation measures were recommended for the City of Yakima. Table 16 lists the project, its cost, and the expected water savings of the recommended measures implemented by the City of Yakima.

Table 16
City of Yakima Water Conservation Measures

Measure	Cost (\$)	Water Savings
Program promotion/public education	22,000 per year	1 percent reduction in residential water use
Meter replacement program	35,000 per year	Not listed
Leak detection program	32,000 every 4 years	Not listed
New plumbing code	None	1.4 MGD by 2008 4.5 MGD by 2022
Irrigation efficiency measures	6,000 per year	0.2 to 0.5 MGD by 2008

Source:

Thomas E. Coleman, P.E. Consulting Services 2004

Conservation Effects on Future Water Use

The conservation measures will result in water savings that can allow for additional service using the same amount of water. Table 17 compares the estimated future water use and equivalent residential unit (ERU) demand with and without conservation.

Table 17
City of Yakima Future Water Use Comparison

Year	Average Demand		ERU Demand		Per Capita Demand	
	No Conservation (MGD)	With Conservation (MGD)	No Conservation (gpd/ERU)	With Conservation (gpd/ERU)	No Conservation (gpd/person)	With Conservation (gpd/person)
2010	13.80	12.15	285	251	199	175
2025	16.10	11.04	285	195	194	133

Note:

gpd = gallons per day

The estimated reduction in water use with conservation measures is 5 MGD, or approximately 5,600 acre-feet/year (31% reduction). The difference between the estimate in Table 17 and the Reclamation forecast is greater (6.3 MGD or 7,100 acre-feet/year for 2025).

City of Ellensburg

The City of Ellensburg is the third-largest municipal supplier of water in the Yakima River basin, serving a population of approximately 16,700. They also have two major users of water: Central Washington University (207 million gallons per year) and Twin City Foods (112 million gallons per year). Their source of water comes from groundwater wells (Gray & Osborne 2007).

Water Use Estimates

Water use estimates are based on previous average water use (2000 to 2005) and population. The projected population is assumed to equal 45 percent of the Office of Financial Management projections for Kittitas County. Table 18 presents the estimates for the current and future population, total water use, and water use per capita. Water use estimates assume that the per capita usages will not significantly change (Gray & Osborne 2007). It is assumed the estimates do not include any conservation measures described in Section 6.1.2.2.

Table 18
City of Ellensburg Water Use Estimates

Year	Total Population	Total Average Daily Demand (MGD)	Estimated Number of Total ERUs	ERU Demand (gpd/ERU)	Per Capita Demand (gpd/person)
2005	16,700	3.61	8,535	423	216
2010	18,466	4.92	11,631	423	266
2025	23,765	6.33	14,965	423	266

Note:

gpd = gallons per day

Source:

Gray & Osborne 2007

The estimated demands are slightly lower than the forecast contained in the Yakima River Basin Storage Alternatives Appraisal Assessment (Reclamation 2006). Their forecast for the City of Ellensburg in 2020 is 6.32 MGD, compared to 6.33 MGD in Table 18 for 2025 (5 years later than the Reclamation forecast).

Conservation Measures

The City of Ellensburg has 15 improvements listed on their capital improvement schedule. These improvements are listed as the current water conservation plan. Improvements will conserve water by reducing leaks and unaccounted for water. Water savings and cost estimates are not provided for individual measures; instead, the conservation measures have an overall estimated water savings of 1 percent per year over 10 years (Gray & Osborne 2007). Table 19 presents each improvement, the estimated cost, and the year the project is planned to be implemented.

Table 19
City of Ellensburg Capital Improvement Plan

Project	Cost (\$)	Year of Implementation
New well no. 1	1,000,000	2007
New well no. 2	1,000,000	2008
New well no. 3	1,000,000	2008
New well no. 4	1,000,000	2009
Phenning Road water main construction	650,000	2007
Walnut Street water main replacement	254,000	2010
Seattle/Manitoba Avenue water main replacement	306,000	2011
John Wayne Trail water main construction	65,000	2008
Wenas Road water main replacement	110,000	2012 or later
Bull/Berry Road water main construction	1,000,000	2012 or later
Transmission main inspection	25,000	2007
Transmission main valve rehabilitation	100,000	2009
Oversizing pipe fund	50,000 per year	Every year
Pipe replacement program	100,000 per year	Every year
Bulk water fill stations (4)	30,000 each	2008 to 2011 (1 each year)

Source:

Gray & Osborne 2007

Conservation Effects on Future Water Use

The conservation measures will result in water savings that can allow for additional service using the same amount of water. Table 20 compares the estimated future water use and ERU demand with and without conservation.

Table 20
City of Ellensburg Future Water Use Comparison

Year	Average Demand		ERU Demand		Per Capita Demand	
	No Conservation (MGD)	With Conservation (MGD)	No Conservation (gpd/ERU)	With Conservation (gpd/ERU)	No Conservation (gpd/person)	With Conservation (gpd/person)
2010	4.92	4.72	423	406	266	256
2025	6.33	5.79	423	387	266	244

Note:

gpd = gallons per day

The estimated reduction in water use with conservation measures is 0.54 MGD, or approximately 600 acre-feet/year (8.5% reduction).

City of Sunnyside

The City of Sunnyside is the fifth-largest municipal supplier of water in the Yakima River basin, serving a population of approximately 15,000. They also have two major users of water: Westfarm Foods (96 million gallons per year) and Independent Food Processors (43 million gallons per year). Their source of water comes from groundwater wells (HDR-EES 2005).

Water Use Estimates

Water use estimates are based on previous average water use (1997 to 2002) and population. The projected population is assumed to grow at a rate of 2.5 percent annually. ERUs were calculated based on meter counts and the Washington State Department of Health Water System Design Manual. The ERUs were assumed to increase by 2.5 percent annually. Table 21 presents the estimates for the current and future population, total water use, and water use per capita. Water use estimates assume that the per capita usages will not significantly change (HDR-EES 2005). It is assumed the estimates do not include any conservation measures described in Section 6.1.3.2.

Table 21
City of Sunnyside Water Use Estimates

Year	Total Population	Total Average Daily Demand (MGD)	Estimated Number of Total ERUs	ERU Demand (gpd/ERU)	Per Capita Demand (gpd/person)
2005	15,024	3.00	4,966	604	200
2010	16,998	3.40	5,618	605	200
2024	24,018	4.80	7,938	605	200

Note:

gpd = gallons per day

Source:

HDR-EES 2005

The estimated demands are higher than the forecast contained in the Yakima River Basin Storage Alternatives Appraisal Assessment (Reclamation 2006). Reclamation's forecast for the City of Sunnyside in 2020 is 3.8 MGD, compared to 4.8 MGD in Table 21 for 2024 (4 years later than the Reclamation forecast).

Conservation Measures

The City of Sunnyside has six planned water conservation measures. Water savings and cost estimates are not provided for individual measures; instead, the conservation measures have an overall estimated water savings of 2.5 percent by 2010 and 5 percent by 2024. The annual budget for water conservation measures is \$10,000 (HDR-EES 2005). Table 22 presents the planned projects with a description of each project.

Table 22
City of Sunnyside Planned Water Conservation Measures

Project	Description
Program promotion	Use cost-effective forms of education and outreach, including targeting messages to specific target audiences
Customer assistance	Give a set amount of training time to billing staff and water operations crew
Single family and multi-family kits	Relatively inexpensive (\$1 each) kits that include conservation equipment and tools such as toilet tank displacement bags, faucet aerators, and informational booklets
Public water system audit	Improvement of water tracking methods to help track water losses and determining corrective actions
Conservation water rates	Cost of service analysis in considering adopting a conservation or flat rate structure
Large customer technical assistance	Focus conservation efforts on largest water users, including partial to full funding of water audits and incentives for implementation of recommended changes

Source:
HDR-EES 2005

Conservation Effects on Future Water Use

The conservation measures will result in water savings that can allow for additional service using the same amount of water. Table 23 compares the estimated future water use and ERU demand with and without conservation.

Table 23
City of Sunnyside Future Water Use Comparison

Year	Average Demand		ERU Demand		Per Capita Demand	
	No Conservation (MGD)	With Conservation (MGD)	No Conservation (gpd/ERU)	With Conservation (gpd/ERU)	No Conservation (gpd/person)	With Conservation (gpd/person)
2010	3.40	3.31	605	589	200	195
2024	4.80	4.56	605	574	200	190

Note:
gpd = gallons per day

The estimated reduction in water use with conservation measures is 0.24 MGD, or approximately 270 acre-feet/year (5% reduction).

City of Grandview

The City of Grandview is the sixth-largest municipal supplier of water in the Yakima River basin, serving a population of approximately 8,100. They also have several major industrial users of water, including J.M. Smucker Co.; Stimson Lane; Shonan (USA), Inc.; Snokist Growers; and Welch Foods. The City of Grandview's source of water comes from groundwater wells (HLA 2002).

Water Use Estimates

Water use estimates are based on previous average water use (1995 to 1999), the number of services, and population. The projected population is assumed to grow at a rate of 2.5 percent annually. Table 24 presents the estimates for the current and future population, total water use, and water use per capita. Water use estimates assume that the usages per service will not significantly change (HLA 2002). It is assumed the estimates do not include any conservation measures described in Section 6.1.4.2.

Table 24
City of Grandview Water Use Estimates

Year	Total Population	Total Average Daily Demand (MGD)	Estimated Number of Total ERUs	ERU Demand (gpd/ERU)	Per Capita Demand (gpd/person)
1998	8,120	1.77	5,068	349	218
2011	10,241	2.61	7,484	349	255
2024	12,314	3.08	8,820	349	250

Note:

gpd = gallons per day

Source:

HLA 2002

The estimated demands are lower than the forecast contained in the Yakima River Basin Storage Alternatives Appraisal Assessment (Reclamation 2006). Reclamation's forecast for the City of Grandview in 2020 is 4.8 MGD, compared to 3.1 MGD in Table 24 for 2024 (4 years later than the Reclamation forecast).

Conservation Measures

The City of Grandview has eight planned water conservation measures. Water savings and cost estimates are not provided for individual measures; instead, the conservation measures have an estimated water savings in residential use of 5 percent (HLA 2002). Table 25 presents the planned projects with a description of each project.

Table 25
City of Grandview Planned Water Conservation Measures

Project	Description
Program promotion	Publicize the need for water conservation through public service announcements, news articles, and city newsletter inserts
Source meters	Calibrate source meters every 3 years
Purveyor/customer assistance	Provide assistance to water users regarding the development and implementation of water conservation measures
Service meter replacement	Replace 300 residential meters annually throughout the city
Leak detection program	Fire hydrant maintenance program and mainline valve exercise program to ensure proper operation and reduce water leakage
Development of nurseries/agricultural conservation program	Encourage incoming nurseries or agricultural users to implement water conservation practices such as moisture sensors, flow timers, low volume sprinklers, and drip irrigation
Development of landscape management/xeriscape program	Expand pressurized irrigation water system (currently at 500 residences); continue City of Grandview code measure that requires all residents to water lawns and gardens on an even-odd schedule (even addresses on even numbered days of the month, odd addresses on odd numbered days of the month)
Conservation pricing	Revise water rate structure to conservation pricing

Source:
HLA 2002

Conservation Effects on Future Water Use

The conservation measures will result in water savings that can allow for additional service using the same amount of water. Table 26 compares the estimated future water use and ERU demand with and without conservation.

Table 26
City of Grandview Future Water Use Comparison

Year	Average Demand		ERU Demand		Per Capita Demand	
	No Conservation (MGD)	With Conservation (MGD)	No Conservation (gpd/ERU)	With Conservation (gpd/ERU)	No Conservation (gpd/person)	With Conservation (gpd/person)
2011	2.61	2.56	349	342	255	250
2021	3.08	3.01	349	341	250	244

Note:
gpd = gallons per day

The estimated overall reduction in water use with conservation measures is 0.07 MGD, or approximately 80 acre-feet/year (2.3% reduction). The reduction in residential use was estimated to be 5% but less so when including industrial use.

OTHER WATER CONSERVATION PROGRAMS

Additional water conservation programs have been implemented in other areas, successfully reducing the amount of water used per capita. A review of other municipal water conservation plans was performed for areas outside of the Yakima River basin to help determine what water

savings may be possible. Several water districts in California and Nevada were reviewed because of their similar climates to the Yakima River basin.

Southern Nevada Water Authority

The Southern Nevada Water Authority (SNWA) is an entity formed by an agreement between seven water and wastewater agencies in Southern Nevada. Combined, they provide water and wastewater services to approximately 1.6 million people. Several water conservation efforts were implemented in order to achieve a goal of 25 percent conservation by 2010 compared to a baseline usage in 1990 (SNWA 2004).

Annual Water Use

Water use in a given year is most significantly related to population, weather, and economic indicators in the Southern Nevada valley. From 1999 to 2003, the actual annual water use in the SNWA was found (with conservation). The corresponding conservation percentage and estimated use without conservation was then determined. The results are presented in Table 27.

Table 27
SNWA Water Use Comparison

Year	Average Demand		Water Savings (%)	Estimated Per Capita Demand (1990 Baseline: 375 gpd/person)
	With Conservation (MGD)	No Conservation (MGD)		
1999	383	460	16.8	312
2000	410	490	16.5	313
2001	428	495	13.5	324
2002	446	534	16.4	314
2003	426	554	23.1	288

Note:

gpd = gallons per day

Source:

SNWA 2004

Conservation Measures

The *Five-year Conservation Plan 2004-2009* (SNWA 2004) listed several conservation programs that were implemented to achieve this level of water savings and will continue. The goal of the SNWA is an additional 13% decrease in water use by 2010 and a per capita water demand reduction to 250 gpd/person. A description of each measure follows.

Water Rate Setting

Purveyors in SNWA all use a multi-tier increasing block rate structure. These structures give the heaviest water users incentive to reduce water use.

Water Smart Landscapes Program

This program offers a rebate to residents that convert turf grass to xeric and/or drought-tolerant plant material. A water smart landscape is expected to save 55.8 gallons per square foot annually compared with a turf lawn. The current rebate offered is \$1.00 per square foot of conversion. In 2004, \$21 million was available for the program. In 2005, the appropriation for this program

was \$31.93 million. Overall, the program's estimated savings is 3.8 billion gallons per year (average 10.4 MGD).

Irrigation Clock Rebate Program

This program offers a rebate to residents that upgrade landscape irrigation controllers to models that can increase water efficiency. These technologies are found to have the potential of reducing water use by 10 to 20 percent through efficient scheduling with minimal user oversight. Specific costs and water savings are not described.

Water Efficient Technologies Program

This program pays incentives to fund capital improvement projects that permanently increase water efficiency. In order to be cost effective, a minimum of 1 million gallons of use annually has to be reduced. This program can be used for consumptive or non-consumptive use; double the incentive is paid for consumptive use to promote this type of use reduction. Since its inception, the program has paid \$258,000 for projects estimated to conserve 130 million gallons per year (0.36 MGD).

Water Waste Regulations

This policy prohibits the waste of water by setting a fee structure that increases depending on meter size, number of violations, and drought conditions. Watering days are also assigned depending on the season and customer location. In the winter, only one watering day is allowed per week. In the spring and fall, three watering days are allowed weekly. In the summer, people are allowed to water any day, but watering is not allowed from 11 a.m. to 7 p.m.

Water Budgets

Large water use customers (currently only golf courses) are given water budgets instead of watering days. Currently golf courses are given a budget of 6.5 acre-feet per irrigated acre (average 5,800 gallons per day per irrigated acre). If they exceed the budget, the rate jumps to 300 to 900 percent of the highest cost of water used within the budget. This policy expects to conserve approximately 10 percent of the total golf industry's water use.

Development Codes and Policies

Additional policies are set for new developments in order to limit landscape water demand. Some examples include not allowing ornamental turfgrass for any new commercial, industrial, or institutional landscape; limiting size and placement of turf at new residential homes; and requiring a water efficiency plan for all new resorts for approval.

Education and Public Outreach

This program is a campaign to educate water users on the need for conservation, provide tips on how to conserve, and give customers access to experts that can help with water reduction at the customers' properties. Some efforts include water-efficient demonstration gardens, conservation publications sent to all customers, youth education programs, conservation videos, and descriptions of sample water-efficient landscape designs.

Seattle Public Utilities

Seattle Public Utilities (SPU) serves more than 1 million customers in their retail and wholesale service area and has installed several conservation measures. They have also done detailed studies on individual measures relating to cost and savings. SPU currently has the 1 Percent Program, a water conservation program implemented in 2000 that strives to reduce per capita demand by 1 percent each year through 2010. This goal, in combination with new codes, price impacts, and system savings, will result in a decrease in total water demand despite having a projected population increase of 10 percent through 2010 (SPU 2006). A description of water use compared with population, as well as conservation measures, follows.

Annual Water Use

Table 28 presents the estimated population served, water use, single family demand, and average use per capita and per ERU for SPU.

Table 28
SPU Water Use

Year	Estimated Population Served (Assumed 71 percent of King County population)	Total Average Daily Demand** (MGD)	Single Family Household Connections (Retail Area)	Single Family ADD (MGD)	ERU Demand (gpd/ERU)	Per Capita Demand (gpd/person)
2000	1,233,300	148.2	151,070	26.9	178	120.2
2005	1,284,100	126.7	151,363	22.6	149	98.7
2010*	1,327,300	134.3	151,746	21.6	142	101.2
2030*	1,563,700	129.2	157,758	19.9	126	82.6

Notes:

* = Forecasted

** = Including conservation programs

gpd = gallons per day

Source:

SPU 2006

Since inception of the 1 Percent Program in 2000, the ERU demand has decreased by 16.3 percent in the retail area of SPU (178 gallons per day [gpd] per ERU in 2000 to 149 gpd per ERU in 2005).

Conservation Program Savings and Measures

SPU is currently in the middle of their 1 Percent Program, a program that has a goal of reducing the per capita demand by 1 percent each year from 2000 to 2010. In 2004, this program had a budget of \$3.6 million (SPU 2006). Table 29 lists the program's sectors, estimated water savings by 2010, types of measures, and types of strategies used to implement the measures.

Table 29
SPU 1 Percent Program Sectors, Savings, Measures, and Strategies

Sector	Annual Average Savings by 2010 (MGD)	Types of Measures	Types of Strategies
Residential indoor	6.90	Replace toilets, faucets, and showers; fix leaks; and change behaviors	Incentives and promotion to accelerate replacement; and behavior messaging
Residential landscape	0.93	Reduce lawn watering; improve irrigation performance; and change lawn and garden practices	Media outreach; technical materials; irrigation efficiency incentives; and landscape industry partnerships
Commercial/ Process/ Domestic	3.04	Upgrade toilets and equipment for cooling; and improve cooling performance	Technical assistance and financial incentives
Commercial landscape	0.13	Upgrade equipment and improve scheduling and maintenance	Assessments and technical assistance; and financial incentives

Source:
SPU 2006

Conservation Potential Assessment Analysis

In 2006, SPU had a water conservation potential assessment (CPA) completed for water conservation commitments made through their 1 Percent Program. The CPA estimated the cost to the utility and the annual savings for individual measures through 2010. For this analysis, it was assumed that the SPU would pay 50 percent of the total cost, since the 1 Percent Program generally pays a portion of the direct cost. The other portion is expected to be paid by the customer (SPU 2006). Table 30 is a summarized list of measure names, the number of measures, annual savings, and the utility average annual cost.

Table 30
Summary of CPA Measure Names, Savings, and Utility Cost

Measure Name	Number of Measures	Annual Savings (MGD)	Utility Average Annual Cost (\$)
Air cooling	1	0.1083	58,400
Car wash	3	0.0565	45,781
Clothes washers	7	1.0273	830,285
Cooling tower	1	0.0117	12,000
Dishwashers	4	0.2957	179,916
Disposal use	3	0.3076	49,000
Faucet aerator	3	0.2747	91,688
Faucet flow	1	0.0300	15,900
Faucet use	7	0.2721	71,711
Food preparation	1	0.2770	10,833
Laundry wash	1	0.0122	20,500
Lawn dormant	5	0.6552	117,499
Leak reduction	4	0.4329	165,703
Process water	2	0.0432	45,000
Shower use	2	0.4936	57,500
Showerheads	6	0.4319	184,565
Sidewalk cleaning	1	0.0081	13,500
Swimming pool use	2	0.0696	28,500
Toilet	5	1.9477	2,043,676
Urinal	3	0.1063	108,345

Source:
SPU 2006

The total water savings for these 62 measures is estimated to be 6.81 MGD by 2010. At a 50 percent cost-share by SPU, these measures are expected to cost \$4,150,303 annually. Utility costs include overhead, marketing, and rebates. When comparing indoor and outdoor water savings, 88 percent of the water savings realized from the measures listed is from a reduction in indoor use. When comparing residential and non-residential water savings, 77 percent of the water savings from the listed measures are due to a reduction in residential use (SPU 2006).

In addition, the CPA presented additional savings measures for when the 1 Percent Program ends in 2010. The CPA listed a total of 115 potential measures. These measures that run from 2011 to 2030 have an estimated annual water savings of 34.17 MGD by 2030. The measures have an estimated average cost of \$16,315,798 annually. This cost assumed all of the costs (overhead, marketing, and rebates) are paid by SPU (SPU 2006).

Contra Costa Water District

The Contra Costa Water District (CCWD) serves water to approximately 510,000 people; 46 industries; and 50 agricultural users in north, central, and east Contra Costa County, California. Climate within the CCWD usually has hot, dry summers and cool, wet winters. Average precipitation ranges from 13 to 22 inches. CCWD has implemented water conservation programs since 1988. Even though the population has increased by 37 percent since 1985, the total current water use within the district is below mid-1980s (pre-drought) levels (CCWD 2005). This district is presented as an example of successful past conservation efforts. A description of past and current water use, conservation projects, and cost estimates follows.

Annual Water Use

Table 31 presents the annual water use, total number of equivalent residential units, and average demand per ERU for past and present years for the CCWD.

Table 31
Annual Water Demand for CCWD

Year	Estimated Population	Total Daily Average Deliveries (MGD)	Single Family Average Demand (MGD)	Single Family Household Connections	Per Capita Demand (gpd/person)
1990	367,131	125.31	17.42	48,360	341
1995	403,776	101.52	15.23	49,722	251
2000	429,760	119.33	17.41	50,400	278
2004	500,000	128.33	20.03	52,313	257

Sources:

CCWD 2005

CCWD 2000

CCWD 1995

Conservation Program and Costs

Eighteen programs have been implemented by CCWD since 1988. Table 32 lists these programs and their 2004 savings in million gallons per day. The programs have helped the district reduce per capita

Table 32
CCWD Water Conservation Programs and 2004 Estimated Savings

Program Name	2004 Estimated Savings (MGD)
Single family (SF) surveys	0.19
Multi-family (MF) surveys	0.22
Commercial and institutional (CII) surveys	0.41
Landscape surveys	0.35
SF showerheads	0.05
MF showerheads	0.02
Residential free ultra low flow toilets (ULFTs)	0.89
CII ULFTs	0.05
SF washers	0.15
CII washers	0.02
Pre-rinse nozzles	0.09
CII low flow urinals	0.002
CII low flow faucets	0.001
"Smart" sprinkler timers	0.02
Standard sprinkler timers	0.01
Drip retrofit	0.004
Rain sensors	0.002
Sprinklers replaced	0.002
Total	2.49

Source:
 CCWD 2005

Budgets for water conservation for the CCWD from 1999-2003 are presented in Table 33.

Table 33
CCWD Water Conservation Budget

Year	Budget (\$)
1999	1,021,134
2000	1,034,247
2001	1,096,302
2002	1,090,453
2003	1,094,568

Sources:
 CCWD 2000
 CCWD 2002
 CCWD 2003

West Basin Municipal Water District

The West Basin Municipal Water District (West Basin) serves over 850,000 people in 17 cities and several unincorporated areas of Los Angeles County, California. This area has an average rainfall of 12.13 inches. In the past 25 years, the population has increased by 21 percent, but the water demand has only increased by 13.1 percent (West Basin 2005b). A description of past and current water use and conservation projects follows.

Annual Water Use

Table 34 presents the annual water use, total number of equivalent residential units, and average demand per ERU for past and present years for West Basin.

Table 34
West Basin Annual Water Use

Year	Estimated Population	Total Average Demand (MGD)	Per Capita Demand (gpd/person)
1980	707,500	145.1	205
2005	852,800	164.1	192

Source:

West Basin 2005b

Conservation Program and Costs

Since 1990, West Basin has implemented 14 programs for water conservation. These programs and estimated annual water savings (if stated) are presented in Table 35.

Table 35
West Basin Water Conservation Programs and Estimated Annual Savings

Program Name	Estimated Annual Savings (MGD)
Water survey programs	Not stated
Residential plumbing retrofit	0.939
System water audits	Not stated
Metering with commodity rates	Not stated
Large landscape conservation	Not stated
High-efficiency washing machine rebates	0.010
Public information programs	Not stated
School education programs	Not stated
CII conservation programs	Not stated
Wholesale agency programs	Not stated
Conservation pricing	Not stated
Water conservation coordinator	Not stated
Water waste prohibition	Not stated
Residential ULFT replacement	0.410

Source:

West Basin 2005b

Although many of the programs do not have specific savings stated, the overall annual savings due to conservation is estimated to be 12.9 MGD in 2005 (West Basin 2005b).

Water conservation is combined with groundwater monitoring in the expense list of West Basin (West Basin 2005a). These expenditures for 1996-2005 are listed in Table 36.

Table 36
West Basin Water Conservation and Groundwater Monitoring Expenditures

Year	Budget (\$)
1996	330,000
1997	266,000
1998	666,000
1999	841,000
2000	1,072,000
2001	960,000
2002	1,367,000
2003	1,743,000
2004	1,794,000
2005	2,145,000

Source:
West Basin 2005a

SUMMARY OF MUNICIPAL CONSERVATION POTENTIAL AND COSTS

Potential water savings from current municipal water conservation activities for the cities of Yakima, Ellensburg, Sunnyside, and Grandview in the Yakima River basin were reviewed. The estimates of potential water savings range from 2.3% to 31% of total demand and average over 10% of total demand. Those potential water savings were not accounted for in Reclamation's estimate of future municipal and domestic water needs. It was also found that the future demand estimates for the cities of Yakima, Ellensburg and Grandview is less than shown in Reclamation's estimates, most likely because the Water System Plans the demands were obtained from were more up-to-date than the information used to develop Reclamation's estimates. However, the estimate of future demand for the City of Sunnyside was greater than Reclamation's estimate. The difference between the estimates for all four cities (including future conservation savings) and Reclamation's estimate is approximately 7,400 acre-feet/year for 2020. Reclamation's estimate of increased demand in 2020 for the Yakima River basin is 38,000 acre-feet/year, the revised estimates of demands for the four cities would reduce that to 30,600 acre-feet/year.

Additional water conservation savings is possible within other community water systems and for single-family domestic water users. Experience with conservation plans from Washington State (City of Seattle) and from other water systems in the arid Southwest U.S. show that significant water savings can result with investments in conservation activities. The water conservation programs reviewed have achieved a 10-20% reduction in water use and have plans to save more. The costs of the programs vary, with the more expensive and aggressive programs replacing lawns and plumbing fixtures. The City of Seattle's water conservation program that has a goal of achieving a 1% reduction in water use every year costs about \$3 per person served per year. That cost covers one-half of the costs of the program. A second program that will start in 2011 also has a goal of achieving a 1% reduction in water use but will be paid in total by the City. The estimated costs for that program are about \$10 per person served per year.

An aggressive program of water conservation would reduce the municipal and domestic demands in the Yakima River basin. It is our opinion that overall water savings of 20% is possible. If a 20% water savings were applied to both the existing and future estimated demands published by Reclamation, the total additional demand for the year 2050 would be reduced to from 82,000

acre-feet/year to 45,300 acre-feet/year. That estimate was obtained by taking 80% of Reclamation's estimated 2050 demand (186,000 acre-feet/year) and subtracting the 2000 demands of 103,465 acre-feet/year.

The estimated costs for that program, using a range of \$6-10 per person/year, would be \$3-5 million/year. That estimate is based upon an estimated 2050 population of over 500,000 people in the Yakima River basin. A comprehensive and coordinated program on the scale of the City of Seattle's would be needed to reach all water users in the basin and effect the large savings described above.

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APPENDIX A

YAKIMA RIVER BASIN WATER CONSERVATION PROJECTS

Yakima River Basin Water Conservation Projects

Project Number	Entity	Project Type	River or Creek	Yakima or Naches River Mile Diversion	Estimated Water Savings (ac-ft/yr)	Total Project Cost (2007 \$)	Cost per Acre-foot Saved	Project Description	Source
1	Kittitas Reclamation District	Lining/Piping	Yakima	202.5		\$ 3,110,738	\$ 1,555	Replace leaking areas of Main Canal with new concrete liner.	Crowley, Mark. 2006. Personal correspondence. Kittitas County Conservation District.
2	Westside Irrigation	Lining/Piping	Yakima	166.1		\$ 228,121	\$ 760	Project will pipe 5,280 feet of canal.	Crowley, personal correspondence 2006
3	Westside Irrigation	Lining/Piping	Yakima	166.1	2,000	\$ 228,121	\$ 760	Project will pipe 5,280 feet of canal.	Crowley, personal correspondence 2006
4	Westside Irrigation	On-farm Conservation	Yakima	166.1	300	\$ 8,554,530	\$ 2,592	Conversion of 3,300 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
5	Ellensburg Water Company	On-farm Conservation	Yakima	161.3	300	\$ 18,145,973	\$ 2,592	Conversion of 7,000 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
6	Ellensburg Water Company	On-farm Conservation	Yakima	161.3	3,300	\$ 259,228	\$ 2,592	This project would convert 100 acres of rill irrigated hay and crop land to sprinkler irrigation.	Crowley, personal correspondence 2006
7	Cascade Irrigation District	Tailwater Reuse	Yakima	160.3	7,000	\$ 207,383	\$ 164	Project would pump return flows from Johnson Drain back into the canal for reuse.	Crowley, personal correspondence 2006
8	Cascade Irrigation District	Other	Yakima	160.3	combined with 100 Project #7	\$ 134,799		Project would install a VFD on two of the eight pumps at the head end of the canal system.	Crowley, personal correspondence 2006
9	Cascade Irrigation District	On-farm Conservation	Yakima	160.3	2,088	\$ 23,330,537	\$ 2,592	Conversion of 9,000 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
10	Bull Canal Company	Lining/Piping	Yakima	153		\$ 326,628	\$ 851	Project will pipe 1,800 feet of canal.	Crowley, personal correspondence 2006
11	Bull Canal Company	Lining/Piping	Yakima	153	9,000	\$ 233,305	\$ 915	Project will pipe 3,000 feet of canal.	Crowley, personal correspondence 2006
12	Bull Canal Company	On-farm Conservation	Yakima	153	384	\$ 1,762,752	\$ 2,592	Conversion of 680 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
13	Union Gap Irrigation District	Lining/Piping	Yakima	105	255	\$ 518,456	\$ 2,592	Piping a ditch Co to the current points of use (approx 4 miles).	Tobin, Mike. 2006. Personal correspondence. North Yakima Conservation District.
14	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	Yakima	106.7	680 200	\$ 7,270,588	\$ 495	Equip all turnouts with adequate water measurement devices; water savings due to reduced deliveries; approximately 3,500 water measuring devices to be installed.	Natural Resources Consulting Engineers (NRCE). 1999. Irrigation Water Conservation and Management Plan for the Wapato Irrigation Project. May.
15	Wapato Irrigation Project	Storage/Re-reg Reservoirs	Yakima	106.7	14,700	\$ 571,021	\$ 816	Construct 370 ac-ft capacity reservoir in Bench Unit; water savings due to water recapture.	NRCE 1999
16	Wapato Irrigation Project	On-farm Conservation	Yakima	106.7		\$ 23,391,719	\$ 720	Voluntary incentive-based program to provide assistance to growers for improvements to irrigation systems and land.	NRCE 1999
17	Wapato Irrigation Project	Lining/Piping	Yakima	66.7	700 32,500	\$ 6,315,205	\$ 1,373	Line Satus East and Satus West Canals with concrete; water savings due to decrease in seepage.	NRCE 1999
18	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	4,600	\$ 6,171,052	\$ 1,815	Concrete line Lateral 4 Extension and line or pipe corresponding sub-laterals; water savings due to decrease in seepage.	NRCE 1999
19	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	3,400	\$ 9,412,336	\$ 1,846	Cement line Track Lateral and replace or repair water structures; water savings due to decrease in seepage.	NRCE 1999
20	Wapato Irrigation Project	Lining/Piping	Yakima	106.7		\$ 2,611,819	\$ 2,009	Improve Spencer Lateral in Wapato Unit; 10.5 miles.	NRCE 1999
21	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	5,100 1,300	\$ 16,822,324	\$ 2,851	Line Unit 1 (West Highline) Canal in Bench Unit with concrete; water savings due to reduction in seepage; 24.5 miles of lining.	NRCE 1999
22	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	5,900	\$ 16,261,230	\$ 3,127	Line Unit 2 Pump Canal in Bench Unit with concrete; water savings due to reduction in seepage; approximately 15 miles of lining.	NRCE 1999
23	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	5,200	\$ 2,611,819	\$ 3,731	Pipe or line East Highline (Unit 1) Canal; water savings due to decrease in seepage and spills; estimated 12,000 feet of pipe.	NRCE 1999
24	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	700	\$ 40,877,904	\$ 5,677	Line Main Extension Canal with concrete and pipe associated laterals and sublaterals in Bench Unit; water savings due to reduction in seepage; 73 miles of lining/piping.	NRCE 1999
25	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	7,200	\$ 4,777,476	\$ 5,972	Pipe Island laterals and sub-laterals in Bench Unit; water savings due to reduction in seepage; approximately 10 miles of piping.	NRCE 1999
26	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	800	\$ 10,405,330	\$ 6,503	Replace all piped laterals in Unit 1 in Bench Unit; laterals and concrete pipe that are leaking after 50 years of operation; replace with PVC pipe; water savings due to reduction in spills and seepage; approximately 32 miles of piping.	NRCE 1999

Yakima River Basin Water Conservation Projects

Project Number	Entity	Project Type	River or Creek	Yakima or Naches River Mile Diversion	Estimated Water Savings (ac-ft/yr)	Total Project Cost (2007 \$)	Cost per Acre-foot Saved	Project Description	Source
27	Wapato Irrigation Project	Lining/Piping	Yakima	106.7		\$ 11,633,640	\$ 11,634	Replace all piped laterals in Unit 2 in Bench Unit; laterals are concrete pipe that are leaking after 40 years of operation; replace with PVC pipe; water savings due to reduction in spills and seepage; approximately 32 miles of piping.	NRCE 1999
28	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	Yakima	106.7	1,000 minor	\$ 1,585,548		Replace existing check structures with mechanical gates.	NRCE 1999
29	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	Yakima	106.7	minor	\$ 1,585,548		Construct water measurement structures at several locations; 23 ramp flumes to be constructed.	NRCE 1999
30	Sunnyside Valley Irrigation District	Lining/Piping	Yakima	103.8		\$ 1,400,951	\$ 328	Piping of former Outlook Irrigation District; various sub-laterals; water savings due to decrease in seepage; approximately 5 miles of sub-laterals to be piped.	CH2M Hill. 1995b. Outlook Irrigation District Comprehensive Water Conservation Plan. November.
31	Kiona Irrigation District	Lining/Piping	Yakima	34.9		\$ 4,753,753	\$ 1,153	Complete pressurized system conversion.	CH2M Hill. 1996. Kiona Irrigation District Comprehensive Water Conservation Plan. February.
32	Columbia Irrigation District	Lining/Piping	Yakima	18	4,265	\$ 15,128,983	\$ 1,414	Piping Lateral 1 and 2 canals and pressurizing Lateral 1; water savings due to decreasing seepage, evaporation, and operational spill.	SCM Consultants. 2001. Facsimile; Subject: Yakima River basin Watershed Plan. August 15.
33	Columbia Irrigation District	Lining/Piping	Yakima	18	4,124 combined with 26 Project #32	\$ 14,830,019		Concrete line Main Canal; water savings due to decrease in seepage losses; approximately 16 miles of lining.	SCM Consultants 2001
34	Columbia Irrigation District	Lining/Piping	Yakima	18	combined with Project #32	\$ 6,817,147		Columbia River Pump Exchange Project	SCM Consultants 2001
35	Kennewick Irrigation District	Lining/Piping	Yakima	47.1		\$ 53,873,101	\$ 835	Columbia River Pump Exchange Project	SCM Consultants. 1999. Kennewick Irrigation District Water Conservation Plan. June.
36	Nile Valley Ditch Association	Lining/Piping	Naches	27.8		\$ 518,456	\$ 1,313	This Project would pipe the delivery for apprx 300 acres.	Tobin, personal correspondence 2006
37	Naches-Selah Irrigation District	Storage/Re-reg Reservoirs	Naches	18	64,500 395	\$ 3,110,738	\$ 3,732	Re-Regulation Reservoir. Lined 55 Ac-Ft reservoir to buffer flows coming from the Main Canal at Mile 15 into the piped laterals. Reservoir required to eliminate spills from the ends of the laterals. On demand service would be possible for all district	CH2M Hill. 1995a. Naches-Selah Irrigation District Comprehensive Water Conservation Plan. Harter, Justin. 2006. Personal correspondence. Naches-Selah Irrigation District.
38	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with 8,675 Project #37	\$ 3,786,765		Main Canal Mile 9 to Mile 15. Line and rehabilitate canal and tunnels.	CH2M Hill 1995a
39	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 2,032,349		No. 1 Lateral. Pipe first 1.4 miles of No.1 Lateral that serves 4500 acres.	CH2M Hill 1995a; Harter, personal correspondence 2006
40	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 527,789		Lower No. 2 Lateral. Replace and upgrade 9,000ft of existing low head concrete pipe to handle gravity head of 40-100 PSI. 1500 acres would benefit from 40 PSI or greater at delivery points.	CH2M Hill 1995a; Harter, personal correspondence 2006
41	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 15,118,929		Main Canal Mile 0 to Mile 9. Replace 2 miles of failing wood flumes with large diameter low head pipe. Line 3 miles of existing unlined main canal. Rehabilitation of structures and canal automation.	CH2M Hill 1995a; Harter, personal correspondence 2006
42	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 2,913,725		No. 1/NPH Lateral. Pipe 5 miles of open canal. Replace 2 miles of failing wood pipe. Upgrade other existing distribution pipes.	CH2M Hill 1995a; Harter, personal correspondence 2006
43	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 4,883,859		No. 3 Lateral. Replace 1.1 miles of failing wood flumes with pipe. Pipe 1.7 miles of open canal. Replace 1.1 miles of failing wood pipes. Upgrade other existing distribution pipes.	CH2M Hill 1995a; Harter, personal correspondence 2006
44	South Naches Irrigation District	Lining/Piping	Naches	14.5		\$ 10,029,415	\$ 1,030	Piping district-wide in conversion to pressurized distribution system; includes installation of pump station.	CH2M Hill. 1994. South Naches Irrigation District Comprehensive Water Conservation Plan. February.
45	Gleed Ditch Company	Lining/Piping	Naches	9		\$ 5,184,564	\$ 51,846	Piping a ditch Co to the current points of use (1280 acres, approx. 6.5 miles of ditch).	Tobin, personal correspondence 2006
46	Yakima Valley Canal Company	Lining/Piping	Naches	9	9,733	\$ 25,922,819	\$ 51,846	Piping a ditch Co to the current points of use (4300 acres approx 15 miles of ditch).	Tobin, personal correspondence 2006
47	Naches and Cowiche Canal Company	Lining/Piping	Naches	3.6	100	\$ 15,553,691	\$ 25,923	Piping a ditch Co to the current points of use (serving 2400 acres 5.5 mile of ditch).	Tobin, personal correspondence 2006
Total					500	\$ 405,732,181	\$ 1,770		

590
228,199

APPENDIX B

CONSERVATION PROJECT COST DETAILS

Conservation Project Costs

Project Number	Entity	Project Type	Itemized Pay Items	Mobilization	Unlisted Items	Construction Contract Cost	Contingencies	Field Cost	Noncontract Costs	Total Project Cost	Year of Cost Estimate	USBR Construction Cost Index	2007 Total Project Cost
				5% of Pay Items	10% of Pay + Mobilization	Pay + Mobilization + Unlisted	25% of Construction	Construction + Contingencies	35% of Field Cost	Field + Noncontract		April of Composite Trend (http://www.usbr.gov/pmts/estiamte/cost_trend.html)	USBR Construction Cost Index = 309
1	Kittitas Reclamation District	Lining/Piping								\$ 3,000,000	2006	298	\$ 3,110,738
2	Westside Irrigation	Lining/Piping								\$ 220,000	2006	298	\$ 228,121
3	Westside Irrigation	Lining/Piping								\$ 220,000	2006	298	\$ 228,121
4	Westside Irrigation	On-farm Conservation								\$ 8,250,000	2006	298	\$ 8,554,530
5	Ellensburg Water Company	On-farm Conservation								\$17,500,000	2006	298	\$ 18,145,973
6	Ellensburg Water Company	On-farm Conservation								\$ 250,000	2006	298	\$ 259,228
7	Cascade Irrigation District	Tailwater Reuse								\$ 200,000	2006	298	\$ 207,383
8	Cascade Irrigation District	Other								\$ 130,000	2006	298	\$ 134,799
9	Cascade Irrigation District	On-farm Conservation								\$22,500,000	2006	298	\$ 23,330,537
10	Bull Canal Company	Lining/Piping								\$ 315,000	2006	298	\$ 326,628
11	Bull Canal Company	Lining/Piping								\$ 225,000	2006	298	\$ 233,305
12	Bull Canal Company	On-farm Conservation								\$ 1,700,000	2006	298	\$ 1,762,752
13	Union Gap Irrigation District	Lining/Piping								\$ 500,000	2006	298	\$ 518,456
14	Wapato Irrigation Project	Automation/Irrigation Water Mgmt								\$ 5,200,000	1999	221	\$ 7,270,588
15	Wapato Irrigation Project	Storage/Re-reg Reservoirs	\$ 209,513	\$ 10,480	\$ 22,000	\$ 241,990	\$ 60,500	\$ 302,490	\$ 105,870	\$ 408,400	1999	221	\$ 571,021
16	Wapato Irrigation Project	On-farm Conservation								\$16,730,000	1999	221	\$ 23,391,719
17	Wapato Irrigation Project	Lining/Piping	\$ 2,317,345	\$ 115,870	\$ 243,320	\$ 2,676,540	\$ 669,140	\$ 3,345,680	\$ 1,170,990	\$ 4,516,700	1999	221	\$ 6,315,205
18	Wapato Irrigation Project	Lining/Piping	\$ 2,264,473	\$ 113,220	\$ 237,770	\$ 2,615,460	\$ 653,870	\$ 3,269,330	\$ 1,144,270	\$ 4,413,600	1999	221	\$ 6,171,052
19	Wapato Irrigation Project	Lining/Piping	\$ 3,453,850	\$ 172,690	\$ 362,650	\$ 3,989,190	\$ 997,300	\$ 4,986,490	\$ 1,745,270	\$ 6,731,800	1999	221	\$ 9,412,336
20	Wapato Irrigation Project	Lining/Piping	\$ 958,397	\$ 47,920	\$ 100,630	\$ 1,106,950	\$ 276,740	\$ 1,383,690	\$ 484,290	\$ 1,868,000	1999	221	\$ 2,611,819
21	Wapato Irrigation Project	Lining/Piping	\$ 6,172,953	\$ 308,650	\$ 648,160	\$ 7,129,760	\$ 1,782,440	\$ 8,912,200	\$ 3,119,270	\$12,031,500	1999	221	\$ 16,822,324
22	Wapato Irrigation Project	Lining/Piping	\$ 5,967,078	\$ 298,350	\$ 626,540	\$ 6,891,970	\$ 1,722,990	\$ 8,614,960	\$ 3,015,240	\$11,630,200	1999	221	\$ 16,261,230
23	Wapato Irrigation Project	Lining/Piping	\$ 958,397	\$ 47,920	\$ 100,630	\$ 1,106,950	\$ 276,740	\$ 1,383,690	\$ 484,290	\$ 1,868,000	1999	221	\$ 2,611,819

Conservation Project Costs

Project Number	Entity	Project Type	Itemized Pay Items	Mobilization	Unlisted Items	Construction Contract Cost	Contingencies	Field Cost	Noncontract Costs	Total Project Cost	Year of Cost Estimate	USBR Construction Cost Index	2007 Total Project Cost
				5% of Pay Items	10% of Pay + Mobilization	Pay + Mobilization + Unlisted	25% of Construction	Construction + Contingencies	35% of Field Cost	Field + Noncontract		April of Composite Trend (http://www.usbr.gov/pmts/estiamte/cost_trend.html)	USBR Construction Cost Index = 309
24	Wapato Irrigation Project	Lining/Piping	\$ 15,000,163	\$ 750,010	\$ 1,575,020	\$ 17,325,190	\$ 4,331,300	\$ 21,656,490	\$ 7,579,770	\$29,236,300	1999	221	\$ 40,877,904
25	Wapato Irrigation Project	Lining/Piping	\$ 1,753,097	\$ 87,650	\$ 184,070	\$ 2,024,820	\$ 506,210	\$ 2,531,030	\$ 885,860	\$ 3,416,900	1999	221	\$ 4,777,476
26	Wapato Irrigation Project	Lining/Piping	\$ 3,818,262	\$ 190,910	\$ 400,920	\$ 4,410,090	\$ 1,102,520	\$ 5,512,610	\$ 1,929,410	\$ 7,442,000	1999	221	\$ 10,405,330
27	Wapato Irrigation Project	Lining/Piping	\$ 4,268,948	\$ 213,450	\$ 448,240	\$ 4,930,640	\$ 1,232,660	\$ 6,163,300	\$ 2,157,160	\$ 8,320,500	1999	221	\$ 11,633,640
28	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	\$ 581,800	\$ 29,090	\$ 61,090	\$ 671,980	\$ 168,000	\$ 839,980	\$ 293,990	\$ 1,134,000	1999	221	\$ 1,585,548
29	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	\$ 581,800	\$ 29,090	\$ 61,090	\$ 671,980	\$ 168,000	\$ 839,980	\$ 293,990	\$ 1,134,000	1999	221	\$ 1,585,548
30	Sunnyside Valley Irrigation District	Lining/Piping	\$ 474,526	\$ 23,730	\$ 49,830	\$ 548,090	\$ 137,020	\$ 685,110	\$ 239,790	\$ 924,900	1995	204	\$ 1,400,951
31	Kiona Irrigation District	Lining/Piping	\$ 1,610,230	\$ 80,510	\$ 169,070	\$ 1,859,810	\$ 464,950	\$ 2,324,760	\$ 813,670	\$ 3,138,400	1995	204	\$ 4,753,753
32	Columbia Irrigation District	Lining/Piping	\$ 5,878,171	\$ 293,910	\$ 617,210	\$ 6,789,290	\$ 1,697,320	\$ 8,486,610	\$ 2,970,310	\$11,456,900	2001	234	\$ 15,128,983
33	Columbia Irrigation District	Lining/Piping	\$ 5,762,015	\$ 288,100	\$ 605,010	\$ 6,655,130	\$ 1,663,780	\$ 8,318,910	\$ 2,911,620	\$11,230,500	2001	234	\$ 14,830,019
34	Columbia Irrigation District	Lining/Piping	\$ 2,648,700	\$ 132,440	\$ 278,110	\$ 3,059,250	\$ 764,810	\$ 3,824,060	\$ 1,338,420	\$ 5,162,500	2001	234	\$ 6,817,147
35	Kennewick Irrigation District	Lining/Piping	\$ 19,768,800	\$ 988,440	\$ 2,075,720	\$ 22,832,960	\$ 5,708,240	\$ 28,541,200	\$ 9,989,420	\$38,530,600	1999	221	\$ 53,873,101
36	Nile Valley Ditch Association	Lining/Piping								\$ 500,000	2006	298	\$ 518,456
37	Naches-Selah Irrigation District	Storage/Re-reg Reservoirs								\$ 3,000,000	2006	298	\$ 3,110,738
38	Naches-Selah Irrigation District	Lining/Piping								\$ 2,500,000	1995	204	\$ 3,786,765
39	Naches-Selah Irrigation District	Lining/Piping								\$ 1,960,000	2006	298	\$ 2,032,349
40	Naches-Selah Irrigation District	Lining/Piping								\$ 509,000	2006	298	\$ 527,789
41	Naches-Selah Irrigation District	Lining/Piping								\$13,700,000	2005	280	\$ 15,118,929
42	Naches-Selah Irrigation District	Lining/Piping								\$ 2,810,000	2006	298	\$ 2,913,725
43	Naches-Selah Irrigation District	Lining/Piping								\$ 4,710,000	2006	298	\$ 4,883,859
44	South Naches Irrigation District	Lining/Piping	\$ 3,264,000	\$ 163,200	\$ 342,720	\$ 3,769,920	\$ 942,480	\$ 4,712,400	\$ 1,649,340	\$ 6,361,700	1994	196	\$ 10,029,415
45	Gleed Ditch Company	Lining/Piping								\$ 5,000,000	2006	298	\$ 5,184,564

Conservation Project Costs

Project Number	Entity	Project Type	Itemized Pay Items	Mobilization	Unlisted Items	Construction Contract Cost	Contingencies	Field Cost	Noncontract Costs	Total Project Cost	Year of Cost Estimate	USBR Construction Cost Index	2007 Total Project Cost
				5% of Pay Items	10% of Pay + Mobilization	Pay + Mobilization + Unlisted	25% of Construction	Construction + Contingencies	35% of Field Cost	Field + Noncontract		April of Composite Trend (http://www.usbr.gov/pmts/estiamte/cost_trend.html)	USBR Construction Cost Index = 309
46	Yakima Valley Canal Company	Lining/Piping								\$25,000,000	2006	298	\$ 25,922,819
47	Naches and Cowiche Canal Company	Lining/Piping								\$15,000,000	2006	298	\$ 15,553,691
Total													\$ 405,732,181

Yakima River Basin Water Conservation Projects

Project Number	Entity	Project Type	River or Creek	Yakima or Naches River Mile Diversion	Estimated Water Savings (ac-ft/yr)	Total Project Cost (2007 \$)	Cost per Acre-foot Saved	Project Description	Source
1	Kittitas Reclamation District	Lining/Piping	Yakima	202.5		\$ 3,110,738	\$ 1,555	Replace leaking areas of Main Canal with new concrete liner.	Crowley, Mark. 2006. Personal correspondence. Kittitas County Conservation District.
2	Westside Irrigation	Lining/Piping	Yakima	166.1		\$ 228,121	\$ 760	Project will pipe 5,280 feet of canal.	Crowley, personal correspondence 2006
3	Westside Irrigation	Lining/Piping	Yakima	166.1	2,000	\$ 228,121	\$ 760	Project will pipe 5,280 feet of canal.	Crowley, personal correspondence 2006
4	Westside Irrigation	On-farm Conservation	Yakima	166.1	300	\$ 8,554,530	\$ 2,592	Conversion of 3,300 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
5	Ellensburg Water Company	On-farm Conservation	Yakima	161.3	300	\$ 18,145,973	\$ 2,592	Conversion of 7,000 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
6	Ellensburg Water Company	On-farm Conservation	Yakima	161.3	3,300	\$ 259,228	\$ 2,592	This project would convert 100 acres of rill irrigated hay and crop land to sprinkler irrigation.	Crowley, personal correspondence 2006
7	Cascade Irrigation District	Tailwater Reuse	Yakima	160.3	7,000	\$ 207,383	\$ 164	Project would pump return flows from Johnson Drain back into the canal for reuse.	Crowley, personal correspondence 2006
8	Cascade Irrigation District	Other	Yakima	160.3	combined with 100 Project #7	\$ 134,799		Project would install a VFD on two of the eight pumps at the head end of the canal system.	Crowley, personal correspondence 2006
9	Cascade Irrigation District	On-farm Conservation	Yakima	160.3	2,088	\$ 23,330,537	\$ 2,592	Conversion of 9,000 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
10	Bull Canal Company	Lining/Piping	Yakima	153		\$ 326,628	\$ 851	Project will pipe 1,800 feet of canal.	Crowley, personal correspondence 2006
11	Bull Canal Company	Lining/Piping	Yakima	153	9,000	\$ 233,305	\$ 915	Project will pipe 3,000 feet of canal.	Crowley, personal correspondence 2006
12	Bull Canal Company	On-farm Conservation	Yakima	153	384	\$ 1,762,752	\$ 2,592	Conversion of 680 acres of rill irrigation to sprinkler irrigation.	Crowley, personal correspondence 2006
13	Union Gap Irrigation District	Lining/Piping	Yakima	105	255	\$ 518,456	\$ 2,592	Piping a ditch Co to the current points of use (approx 4 miles).	Tobin, Mike. 2006. Personal correspondence. North Yakima Conservation District.
14	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	Yakima	106.7	680 200	\$ 7,270,588	\$ 495	Equip all turnouts with adequate water measurement devices; water savings due to reduced deliveries; approximately 3,500 water measuring devices to be installed.	Natural Resources Consulting Engineers (NRCE). 1999. Irrigation Water Conservation and Management Plan for the Wapato Irrigation Project. May.
15	Wapato Irrigation Project	Storage/Re-reg Reservoirs	Yakima	106.7	14,700	\$ 571,021	\$ 816	Construct 370 ac-ft capacity reservoir in Bench Unit; water savings due to water recapture.	NRCE 1999
16	Wapato Irrigation Project	On-farm Conservation	Yakima	106.7		\$ 23,391,719	\$ 720	Voluntary incentive-based program to provide assistance to growers for improvements to irrigation systems and land.	NRCE 1999
17	Wapato Irrigation Project	Lining/Piping	Yakima	66.7	700 32,500	\$ 6,315,205	\$ 1,373	Line Satus East and Satus West Canals with concrete; water savings due to decrease in seepage.	NRCE 1999
18	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	4,600	\$ 6,171,052	\$ 1,815	Concrete line Lateral 4 Extension and line or pipe corresponding sub-laterals; water savings due to decrease in seepage.	NRCE 1999
19	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	3,400	\$ 9,412,336	\$ 1,846	Cement line Track Lateral and replace or repair water structures; water savings due to decrease in seepage.	NRCE 1999
20	Wapato Irrigation Project	Lining/Piping	Yakima	106.7		\$ 2,611,819	\$ 2,009	Improve Spencer Lateral in Wapato Unit; 10.5 miles.	NRCE 1999
21	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	5,100 1,300	\$ 16,822,324	\$ 2,851	Line Unit 1 (West Highline) Canal in Bench Unit with concrete; water savings due to reduction in seepage; 24.5 miles of lining.	NRCE 1999
22	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	5,900	\$ 16,261,230	\$ 3,127	Line Unit 2 Pump Canal in Bench Unit with concrete; water savings due to reduction in seepage; approximately 15 miles of lining.	NRCE 1999
23	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	5,200	\$ 2,611,819	\$ 3,731	Pipe or line East Highline (Unit 1) Canal; water savings due to decrease in seepage and spills; estimated 12,000 feet of pipe.	NRCE 1999
24	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	700	\$ 40,877,904	\$ 5,677	Line Main Extension Canal with concrete and pipe associated laterals and sublaterals in Bench Unit; water savings due to reduction in seepage; 73 miles of lining/piping.	NRCE 1999
25	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	7,200	\$ 4,777,476	\$ 5,972	Pipe Island laterals and sub-laterals in Bench Unit; water savings due to reduction in seepage; approximately 10 miles of piping.	NRCE 1999
26	Wapato Irrigation Project	Lining/Piping	Yakima	106.7	800	\$ 10,405,330	\$ 6,503	Replace all piped laterals in Unit 1 in Bench Unit; laterals and concrete pipe that are leaking after 50 years of operation; replace with PVC pipe; water savings due to reduction in spills and seepage; approximately 32 miles of piping.	NRCE 1999

Yakima River Basin Water Conservation Projects

Project Number	Entity	Project Type	River or Creek	Yakima or Naches River Mile Diversion	Estimated Water Savings (ac-ft/yr)	Total Project Cost (2007 \$)	Cost per Acre-foot Saved	Project Description	Source
27	Wapato Irrigation Project	Lining/Piping	Yakima	106.7		\$ 11,633,640	\$ 11,634	Replace all piped laterals in Unit 2 in Bench Unit; laterals are concrete pipe that are leaking after 40 years of operation; replace with PVC pipe; water savings due to reduction in spills and seepage; approximately 32 miles of piping.	NRCE 1999
28	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	Yakima	106.7	1,000 minor	\$ 1,585,548		Replace existing check structures with mechanical gates.	NRCE 1999
29	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	Yakima	106.7	minor	\$ 1,585,548		Construct water measurement structures at several locations; 23 ramp flumes to be constructed.	NRCE 1999
30	Sunnyside Valley Irrigation District	Lining/Piping	Yakima	103.8		\$ 1,400,951	\$ 328	Piping of former Outlook Irrigation District; various sub-laterals; water savings due to decrease in seepage; approximately 5 miles of sub-laterals to be piped.	CH2M Hill. 1995b. Outlook Irrigation District Comprehensive Water Conservation Plan. November.
31	Kiona Irrigation District	Lining/Piping	Yakima	34.9		\$ 4,753,753	\$ 1,153	Complete pressurized system conversion.	CH2M Hill. 1996. Kiona Irrigation District Comprehensive Water Conservation Plan. February.
32	Columbia Irrigation District	Lining/Piping	Yakima	18	4,265	\$ 15,128,983	\$ 1,414	Piping Lateral 1 and 2 canals and pressurizing Lateral 1; water savings due to decreasing seepage, evaporation, and operational spill.	SCM Consultants. 2001. Facsimile; Subject: Yakima River basin Watershed Plan. August 15.
33	Columbia Irrigation District	Lining/Piping	Yakima	18	4,124 combined with 26 Project #32	\$ 14,830,019		Concrete line Main Canal; water savings due to decrease in seepage losses; approximately 16 miles of lining.	SCM Consultants 2001
34	Columbia Irrigation District	Lining/Piping	Yakima	18	combined with Project #32	\$ 6,817,147		Columbia River Pump Exchange Project	SCM Consultants 2001
35	Kennewick Irrigation District	Lining/Piping	Yakima	47.1		\$ 53,873,101	\$ 835	Columbia River Pump Exchange Project	SCM Consultants. 1999. Kennewick Irrigation District Water Conservation Plan. June.
36	Nile Valley Ditch Association	Lining/Piping	Naches	27.8		\$ 518,456	\$ 1,313	This Project would pipe the delivery for apprx 300 acres.	Tobin, personal correspondence 2006
37	Naches-Selah Irrigation District	Storage/Re-reg Reservoirs	Naches	18	64,500 395	\$ 3,110,738	\$ 3,732	Re-Regulation Reservoir. Lined 55 Ac-Ft reservoir to buffer flows coming from the Main Canal at Mile 15 into the piped laterals. Reservoir required to eliminate spills from the ends of the laterals. On demand service would be possible for all district	CH2M Hill. 1995a. Naches-Selah Irrigation District Comprehensive Water Conservation Plan. Harter, Justin. 2006. Personal correspondence. Naches-Selah Irrigation District.
38	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with 8,675 Project #37	\$ 3,786,765		Main Canal Mile 9 to Mile 15. Line and rehabilitate canal and tunnels.	CH2M Hill 1995a
39	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 2,032,349		No. 1 Lateral. Pipe first 1.4 miles of No.1 Lateral that serves 4500 acres.	CH2M Hill 1995a; Harter, personal correspondence 2006
40	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 527,789		Lower No. 2 Lateral. Replace and upgrade 9,000ft of existing low head concrete pipe to handle gravity head of 40-100 PSI. 1500 acres would benefit from 40 PSI or greater at delivery points.	CH2M Hill 1995a; Harter, personal correspondence 2006
41	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 15,118,929		Main Canal Mile 0 to Mile 9. Replace 2 miles of failing wood flumes with large diameter low head pipe. Line 3 miles of existing unlined main canal. Rehabilitation of structures and canal automation.	CH2M Hill 1995a; Harter, personal correspondence 2006
42	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 2,913,725		No. 1/NPH Lateral. Pipe 5 miles of open canal. Replace 2 miles of failing wood pipe. Upgrade other existing distribution pipes.	CH2M Hill 1995a; Harter, personal correspondence 2006
43	Naches-Selah Irrigation District	Lining/Piping	Naches	18	Combined with Project #37	\$ 4,883,859		No. 3 Lateral. Replace 1.1 miles of failing wood flumes with pipe. Pipe 1.7 miles of open canal. Replace 1.1 miles of failing wood pipes. Upgrade other existing distribution pipes.	CH2M Hill 1995a; Harter, personal correspondence 2006
44	South Naches Irrigation District	Lining/Piping	Naches	14.5		\$ 10,029,415	\$ 1,030	Piping district-wide in conversion to pressurized distribution system; includes installation of pump station.	CH2M Hill. 1994. South Naches Irrigation District Comprehensive Water Conservation Plan. February.
45	Gleed Ditch Company	Lining/Piping	Naches	9		\$ 5,184,564	\$ 51,846	Piping a ditch Co to the current points of use (1280 acres, approx. 6.5 miles of ditch).	Tobin, personal correspondence 2006
46	Yakima Valley Canal Company	Lining/Piping	Naches	9	9,733	\$ 25,922,819	\$ 51,846	Piping a ditch Co to the current points of use (4300 acres approx 15 miles of ditch).	Tobin, personal correspondence 2006
47	Naches and Cowiche Canal Company	Lining/Piping	Naches	3.6	100	\$ 15,553,691	\$ 25,923	Piping a ditch Co to the current points of use (serving 2400 acres 5.5 mile of ditch).	Tobin, personal correspondence 2006
Total					500	\$ 405,732,181	\$ 1,770		

590
228,199

Conservation Project Costs

Project Number	Entity	Project Type	Itemized Pay Items	Mobilization	Unlisted Items	Construction Contract Cost	Contingencies	Field Cost	Noncontract Costs	Total Project Cost	Year of Cost Estimate	USBR Construction Cost Index	2007 Total Project Cost
				5% of Pay Items	10% of Pay + Mobilization	Pay + Mobilization + Unlisted	25% of Construction	Construction + Contingencies	35% of Field Cost	Field + Noncontract		April of Composite Trend (http://www.usbr.gov/pmts/estiamte/cost_trend.html)	USBR Construction Cost Index = 309
1	Kittitas Reclamation District	Lining/Piping								\$ 3,000,000	2006	298	\$ 3,110,738
2	Westside Irrigation	Lining/Piping								\$ 220,000	2006	298	\$ 228,121
3	Westside Irrigation	Lining/Piping								\$ 220,000	2006	298	\$ 228,121
4	Westside Irrigation	On-farm Conservation								\$ 8,250,000	2006	298	\$ 8,554,530
5	Ellensburg Water Company	On-farm Conservation								\$17,500,000	2006	298	\$ 18,145,973
6	Ellensburg Water Company	On-farm Conservation								\$ 250,000	2006	298	\$ 259,228
7	Cascade Irrigation District	Tailwater Reuse								\$ 200,000	2006	298	\$ 207,383
8	Cascade Irrigation District	Other								\$ 130,000	2006	298	\$ 134,799
9	Cascade Irrigation District	On-farm Conservation								\$22,500,000	2006	298	\$ 23,330,537
10	Bull Canal Company	Lining/Piping								\$ 315,000	2006	298	\$ 326,628
11	Bull Canal Company	Lining/Piping								\$ 225,000	2006	298	\$ 233,305
12	Bull Canal Company	On-farm Conservation								\$ 1,700,000	2006	298	\$ 1,762,752
13	Union Gap Irrigation District	Lining/Piping								\$ 500,000	2006	298	\$ 518,456
14	Wapato Irrigation Project	Automation/Irrigation Water Mgmt								\$ 5,200,000	1999	221	\$ 7,270,588
15	Wapato Irrigation Project	Storage/Re-reg Reservoirs	\$ 209,513	\$ 10,480	\$ 22,000	\$ 241,990	\$ 60,500	\$ 302,490	\$ 105,870	\$ 408,400	1999	221	\$ 571,021
16	Wapato Irrigation Project	On-farm Conservation								\$16,730,000	1999	221	\$ 23,391,719
17	Wapato Irrigation Project	Lining/Piping	\$ 2,317,345	\$ 115,870	\$ 243,320	\$ 2,676,540	\$ 669,140	\$ 3,345,680	\$ 1,170,990	\$ 4,516,700	1999	221	\$ 6,315,205
18	Wapato Irrigation Project	Lining/Piping	\$ 2,264,473	\$ 113,220	\$ 237,770	\$ 2,615,460	\$ 653,870	\$ 3,269,330	\$ 1,144,270	\$ 4,413,600	1999	221	\$ 6,171,052
19	Wapato Irrigation Project	Lining/Piping	\$ 3,453,850	\$ 172,690	\$ 362,650	\$ 3,989,190	\$ 997,300	\$ 4,986,490	\$ 1,745,270	\$ 6,731,800	1999	221	\$ 9,412,336
20	Wapato Irrigation Project	Lining/Piping	\$ 958,397	\$ 47,920	\$ 100,630	\$ 1,106,950	\$ 276,740	\$ 1,383,690	\$ 484,290	\$ 1,868,000	1999	221	\$ 2,611,819
21	Wapato Irrigation Project	Lining/Piping	\$ 6,172,953	\$ 308,650	\$ 648,160	\$ 7,129,760	\$ 1,782,440	\$ 8,912,200	\$ 3,119,270	\$12,031,500	1999	221	\$ 16,822,324
22	Wapato Irrigation Project	Lining/Piping	\$ 5,967,078	\$ 298,350	\$ 626,540	\$ 6,891,970	\$ 1,722,990	\$ 8,614,960	\$ 3,015,240	\$11,630,200	1999	221	\$ 16,261,230
23	Wapato Irrigation Project	Lining/Piping	\$ 958,397	\$ 47,920	\$ 100,630	\$ 1,106,950	\$ 276,740	\$ 1,383,690	\$ 484,290	\$ 1,868,000	1999	221	\$ 2,611,819

Conservation Project Costs

Project Number	Entity	Project Type	Itemized Pay Items	Mobilization	Unlisted Items	Construction Contract Cost	Contingencies	Field Cost	Noncontract Costs	Total Project Cost	Year of Cost Estimate	USBR Construction Cost Index	2007 Total Project Cost
				5% of Pay Items	10% of Pay + Mobilization	Pay + Mobilization + Unlisted	25% of Construction	Construction + Contingencies	35% of Field Cost	Field + Noncontract		April of Composite Trend (http://www.usbr.gov/pmts/estiamte/cost_trend.html)	USBR Construction Cost Index = 309
24	Wapato Irrigation Project	Lining/Piping	\$ 15,000,163	\$ 750,010	\$ 1,575,020	\$ 17,325,190	\$ 4,331,300	\$ 21,656,490	\$ 7,579,770	\$29,236,300	1999	221	\$ 40,877,904
25	Wapato Irrigation Project	Lining/Piping	\$ 1,753,097	\$ 87,650	\$ 184,070	\$ 2,024,820	\$ 506,210	\$ 2,531,030	\$ 885,860	\$ 3,416,900	1999	221	\$ 4,777,476
26	Wapato Irrigation Project	Lining/Piping	\$ 3,818,262	\$ 190,910	\$ 400,920	\$ 4,410,090	\$ 1,102,520	\$ 5,512,610	\$ 1,929,410	\$ 7,442,000	1999	221	\$ 10,405,330
27	Wapato Irrigation Project	Lining/Piping	\$ 4,268,948	\$ 213,450	\$ 448,240	\$ 4,930,640	\$ 1,232,660	\$ 6,163,300	\$ 2,157,160	\$ 8,320,500	1999	221	\$ 11,633,640
28	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	\$ 581,800	\$ 29,090	\$ 61,090	\$ 671,980	\$ 168,000	\$ 839,980	\$ 293,990	\$ 1,134,000	1999	221	\$ 1,585,548
29	Wapato Irrigation Project	Automation/Irrigation Water Mgmt	\$ 581,800	\$ 29,090	\$ 61,090	\$ 671,980	\$ 168,000	\$ 839,980	\$ 293,990	\$ 1,134,000	1999	221	\$ 1,585,548
30	Sunnyside Valley Irrigation District	Lining/Piping	\$ 474,526	\$ 23,730	\$ 49,830	\$ 548,090	\$ 137,020	\$ 685,110	\$ 239,790	\$ 924,900	1995	204	\$ 1,400,951
31	Kiona Irrigation District	Lining/Piping	\$ 1,610,230	\$ 80,510	\$ 169,070	\$ 1,859,810	\$ 464,950	\$ 2,324,760	\$ 813,670	\$ 3,138,400	1995	204	\$ 4,753,753
32	Columbia Irrigation District	Lining/Piping	\$ 5,878,171	\$ 293,910	\$ 617,210	\$ 6,789,290	\$ 1,697,320	\$ 8,486,610	\$ 2,970,310	\$11,456,900	2001	234	\$ 15,128,983
33	Columbia Irrigation District	Lining/Piping	\$ 5,762,015	\$ 288,100	\$ 605,010	\$ 6,655,130	\$ 1,663,780	\$ 8,318,910	\$ 2,911,620	\$11,230,500	2001	234	\$ 14,830,019
34	Columbia Irrigation District	Lining/Piping	\$ 2,648,700	\$ 132,440	\$ 278,110	\$ 3,059,250	\$ 764,810	\$ 3,824,060	\$ 1,338,420	\$ 5,162,500	2001	234	\$ 6,817,147
35	Kennewick Irrigation District	Lining/Piping	\$ 19,768,800	\$ 988,440	\$ 2,075,720	\$ 22,832,960	\$ 5,708,240	\$ 28,541,200	\$ 9,989,420	\$38,530,600	1999	221	\$ 53,873,101
36	Nile Valley Ditch Association	Lining/Piping								\$ 500,000	2006	298	\$ 518,456
37	Naches-Selah Irrigation District	Storage/Re-reg Reservoirs								\$ 3,000,000	2006	298	\$ 3,110,738
38	Naches-Selah Irrigation District	Lining/Piping								\$ 2,500,000	1995	204	\$ 3,786,765
39	Naches-Selah Irrigation District	Lining/Piping								\$ 1,960,000	2006	298	\$ 2,032,349
40	Naches-Selah Irrigation District	Lining/Piping								\$ 509,000	2006	298	\$ 527,789
41	Naches-Selah Irrigation District	Lining/Piping								\$13,700,000	2005	280	\$ 15,118,929
42	Naches-Selah Irrigation District	Lining/Piping								\$ 2,810,000	2006	298	\$ 2,913,725
43	Naches-Selah Irrigation District	Lining/Piping								\$ 4,710,000	2006	298	\$ 4,883,859
44	South Naches Irrigation District	Lining/Piping	\$ 3,264,000	\$ 163,200	\$ 342,720	\$ 3,769,920	\$ 942,480	\$ 4,712,400	\$ 1,649,340	\$ 6,361,700	1994	196	\$ 10,029,415
45	Gleed Ditch Company	Lining/Piping								\$ 5,000,000	2006	298	\$ 5,184,564

Conservation Project Costs

Project Number	Entity	Project Type	Itemized Pay Items	Mobilization	Unlisted Items	Construction Contract Cost	Contingencies	Field Cost	Noncontract Costs	Total Project Cost	Year of Cost Estimate	USBR Construction Cost Index	2007 Total Project Cost
				5% of Pay Items	10% of Pay + Mobilization	Pay + Mobilization + Unlisted	25% of Construction	Construction + Contingencies	35% of Field Cost	Field + Noncontract		April of Composite Trend (http://www.usbr.gov/pmts/estiamte/cost_trend.html)	USBR Construction Cost Index = 309
46	Yakima Valley Canal Company	Lining/Piping								\$25,000,000	2006	298	\$ 25,922,819
47	Naches and Cowiche Canal Company	Lining/Piping								\$15,000,000	2006	298	\$ 15,553,691
Total													\$ 405,732,181