Twin Falls Canal Company

High Line Canal Lining Project No. 1

Reclamation WaterSMART Grants:

Water and Energy Efficiency Grants for Fiscal Year 2019

Funding Opportunity Announcement No. BOR-DO-19-F004

Prepared By

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Contents

Attachments

Acronyms & Abbreviations

ADCP	acoustic Doppler current profiler
AF	acre-feet
Cfs	cubic foot/feet per second
FOA	Funding Opportunity Announcement
LF	linear feet
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
Reclamation	Bureau of Reclamation

1. Technical Proposal and Evaluation Criteria

1.1 Executive Summary

Date: March 19, 2019

Applicant: Twin Falls Canal Company

City/County/State: Twin Falls, Twin Falls County, Idaho

This application is submitted to the Bureau of Reclamation (Reclamation) for consideration of funding approval through the Reclamation WaterSMART Grants: Water and Energy Efficiency Grants for Fiscal Year 2019 Funding Opportunity Announcement (FOA) No. BOR-DO-19-F004. Twin Falls Canal Company (TFCC) seeks $239,000 in Federal funding assistance within Funding Group I for smaller, on-the-ground projects. The funding will be used to line 4,200 linear feet (LF) of earthen canal in the High Line Canal portion of the TFCC irrigation water delivery system to significantly reduce the amount of water lost each year due to seepage. The proposed project will conserve over 9,400 acre-feet (AF) of water per year. The requested $239,000 in Federal funding comprises 49 percent of the total estimated project costs of $489,400. The requested Federal funds will provide TFCC with the necessary financial assistance to implement the proposed water conservation and system efficiency improvement project. TFCC is prepared to initiate final planning, procurement, and construction in August 2019 to achieve project completion in November 2019.

1.2 Background Data

TFCC was established in 1909 and is located in south central Idaho in Twin Falls County with its headquarters located in the City of Twin Falls. TFCC serves water users in Murtaugh, Kimberly, Hansen, Filer, Buhl, Castleford, and Twin Falls, with a total project service area of approximately 50 miles long by 15 miles wide.

1.2.1 Sources of Water Supply

The primary source of water supply available to TFCC is natural flow from the Snake River. Water is diverted at Milner Dam on the Snake River, regulated at Murtaugh Dam, and split between the High Line Canal and the Low Line Canal at the Forks Diversion. Murtaugh Lake, which is formed by Murtaugh Dam, is located approximately 8 miles downstream of Milner Dam. Murtaugh Lake is a man-made lake that was developed as part of the Southside Irrigation Project and is used to regulate flows for both the TFCC and the Southside Irrigation District.

To supplement natural flow rights, TFCC has water storage rights in Reclamation's Minidoka Project at American Falls Reservoir and Jackson Lake. Table 1 summarizes TFCC storage rights and these two Reclamation facilities.

Table 1. TFCC Storage Rights at Reclamation Facilities

Storage Facility	TFCC Storage Rights (acre-feet)	Total Facility Storage Capacity (acre-feet)
American Falls Reservoir	151,185	1,672,590
Jackson Lake	97,183	847,000

Additionally, TFCC recaptures over 400 cubic feet per second (cfs) of return water that seeps into the shallow aquifer on farmland west of Rock Creek Canyon and then comes back to the surface for re-use in the west end of the tract from Filer to the Buhl area. Irrigation water applied to farmland in the eastern half of the TFCC system (including the proposed project area) seeps into the ground, flows through the aquifer, and discharges into the deep Snake River and Rock Creek canyons preventing the potential for recovery for reuse in the TFCC surface water irrigation delivery system.

1.2.2 Water Rights

TFCC has water rights for and delivers up to 3/4 miner's-inch per share. TFCC delivers a proportionate share of the water supply for each share of stock. TFCC water rights are summarized in Table 2.

Table 2. TFCC Water Rights and Entitlements

Type	Source	Flow Rate or Volume	Priority Date
Natural flow	Snake River	3,000 cfs	October 11, 1900
Natural flow	Snake River	600 cfs	December 22, 1915
Natural flow	Snake River	180 cfs	April 1, 1939
Reservoir storage	American Falls Reservoir	151,185 acre-feet	February 21, 1911
Reservoir storage	Jackson Lake	97,183 acre-feet	February 21, 1911

1.2.3 Current Water Uses, System Summary, and Water Delivery Summary

The TFCC system provides water for irrigation uses only to a total irrigated land area of 202,691 acres of highly fertile and productive agricultural land. TFCC's service area has not changed since the mid-1980s. TFCC has not expanded beyond its historical service area boundaries and has no plans to expand. Figure 1 shows the service area for the TFCC.

The main crops produced on the farmland served by the TFCC are corn, wheat, barley, alfalfa hay, potatoes, sugar beets, dry beans, and peas.

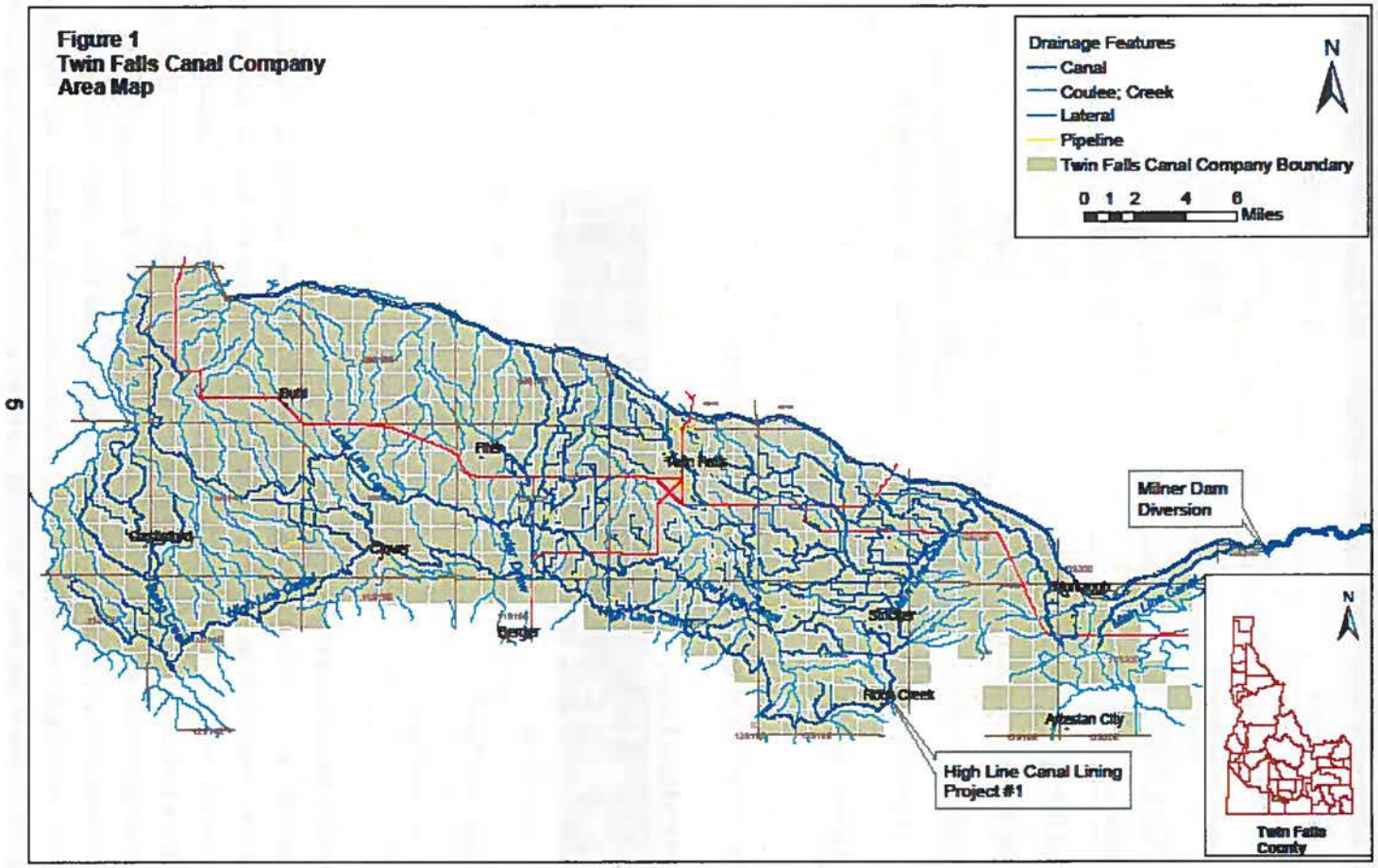


Figure 1. Twin Falls Canal Company Area Map

Table 3 provides a summary of the TFCC system.

Table 3. Summary of TFCC System

Category	Value
Area Irrigated	202,691 acres
Length of major canals	110 miles
Length of laterals*	1,000 miles
Number of laterals*	450
Number of water users	over 4,600
Number of shares	202,691
Number of service gates*	5,300
Irrigation Season	April 1-October 31
Diversion	Per demand up to 3,800 cfs

*Note: Approximations

Table 4 summarizes the major TFCC conveyance facilities.

Table 4. TFCC Major Canals

Name of Facility	Approximate Capacity (cfs)
Main Canal	3,400
High Line Canal	1,500
Low Line Canal	1,300

1.2.4 Potential Shortfalls in Water Supply

TFCC has relatively junior priority to Snake River water, therefore TFCC has historically suffered numerous water years with late summer water shortages prior to the construction of Jackson Lake Dam (1915) and American Falls Dam (1927). To alleviate shortages TFCC purchased 250,000 AF of storage in these two reservoirs when they were completed. Since that time, TFCC experienced very few water shortages until about the 1970s. From about 1960 to the present, about 1 million acres of groundwater pumping was developed on the Eastern Snake River Plain and this groundwater use began steadily lowering groundwater levels, and consequently also reduced tributary spring flows and reach gains to the Snake River that supply a large part of TFCC's water supply. This reduction in spring flows and reach gains has resulted in TFCC using nearly all of its storage in recent years, and in reduced allocations to TFCC farmers many times over the past 25 years. Allocations were reduced in 1992, 1994, 2001, 2002, 2003, 2004, 2005, 2007, and 2013. In 2005, a Water Call was filed against Groundwater Users on the Snake River Plain by TFCC and six other canal companies and irrigation

districts below American Falls. After several court decisions, mostly favorable to TFCC, a Settlement Agreement was signed that required Groundwater Users to reduce pumping by 240,000 AF per year and to supply 50,000 AF per year for direct storage use. TFCC used 30,000 AF of this water to avoid a severe late season shortage in 2015.

Table 5 provides a summary of the reduced water allocations for the record period of 1990 to 2008.

Table 5. Summary of Recent Historical Water Supply Shortfalls

Water Year	Total Annual Water Delivery	Percent of Annual Water Rights Allocation	Historical Water Supply Shortfall	Percent Historical Water Supply Shortfall
1990	1,613,159	100%	-	0%
1991	1,613,159	100%	-	0%
1992	899,550	56%	713,609	44%
1993	1,613,159	100%	-	0%
1994	1,392,041	86%	221,118	14%
1995	1,613,159	100%	-	0%
1996	1,613,159	100%	-	0%
1997	1,613,159	100%	-	0%
1998	1,613,159	100%	-	0%
1999	1,613,159	100%	-	0%
2000	1,613,159	100%	-	0%
2001	1,278,969	79%	334,190	21%
2002	1,344,299	83%	268,860	17%
2003	1,344,299	83%	268,860	17%
2004	1,177,204	73%	435,955	27%
2005	1,344,299	83%	268,860	17%
2006	1,613,159	100%	-	0%
2007	1,344,299	83%	268,860	17%
2008	1,613,159	100%	-	0%

As can be seen in Table 5, eight of the nineteen years in this record period were reduced water supply years. 42 percent of the years in this nineteen-year period of records were short water supply years.

1.2.5 Current and Past Working Relationships with Reclamation

TFCC has a long, successful partnership record with Reclamation. Current ongoing partnerships with Reclamation include TFCC's storage rights in American Falls Reservoir and Jackson Reservoir.

Historically, TFCC partnered with Reclamation through their Water Conservation Program, beginning in 1996, to complete numerous automation upgrades. Through this program, projects with a total cost of up to $50,000 qualified for a 50 percent federal cost share. Through 2007, TFCC completed approximately 30 projects for a total cost of over $1,000,000, with a federal match of over $500,000. Additionally, TFCC was awarded a $300,000 grant through the WaterSMART: Water and Energy Efficiency Grants for Fiscal Year (FY) 2013 (Reclamation Funding Opportunity Number R13SF80003) for the Kinyon Pond Reregulating Reservoir.

1.3 Project Location

The proposed project is located on the High Line Canal portion of the TFCC canal conveyance system upstream of the road crossing of route N 3800 E (Rock Creek Road) just north of the E 2950 N. Figure 2 identifies the location of the proposed project. The project start latitude is 42°26'52.32"N and longitude is 114°17'56.91"W.

1.4 Basis for Project Selection

The TFCC High Line Canal typically conveys 1,000 to 1,300 cfs through the proposed project reach during irrigation season. Gravels present in this reach are so extensive that several large gravel and paving companies operate pits adjacent to the canal. These gravel pits fill with water each year, very soon after irrigation water is released into the canal system. Figure 3 provides an aerial view of the project area and the adjacent gravel pits.

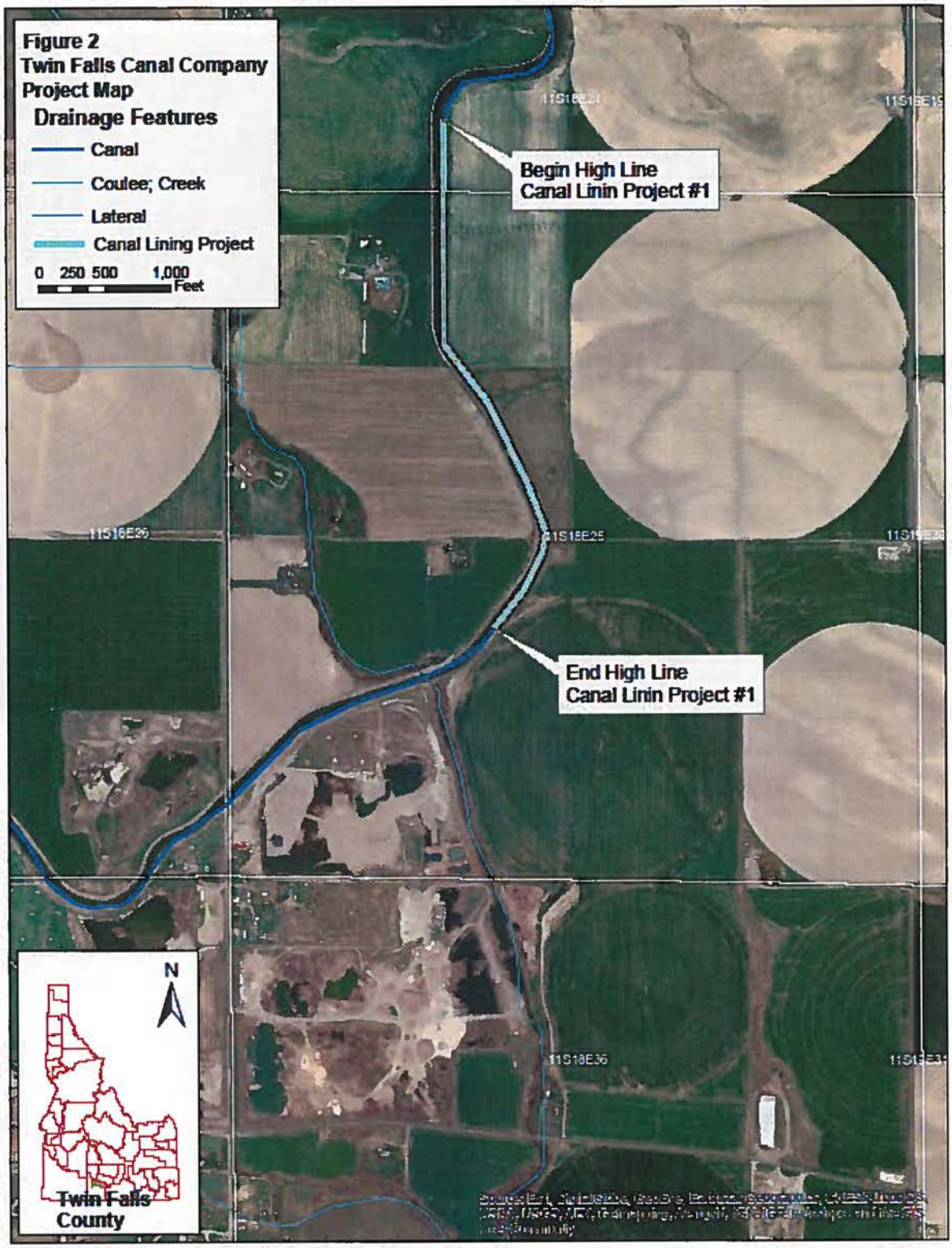


Figure 2. Twin Falls Canal Company Project Map

Figure 3. Aerial Image of Project Area Showing Adjacent Gravel Mining Pits

When the Highline Canal was first constructed through the Rock Creek reach and water delivery began in 1906, seepage damage to farms became immediately apparent. Within two years farms below the canal were severely damaged and a series of lawsuits were filed against TFCC. After years of denial and then attempts to drain the land, the Brose farm was the first of these lawsuits settled in 1916. The Brose farm settlement paid for the loss of 45 acres of land and for 4 years of lost crops. Numerous other settlements followed as drainage systems were designed and installed, and farmers in this reach were at least partially able to farm their ground and get compensation for lost crops. Figure 4 shows a map of the drainage tiles that were installed on the Brose farm, which are still currently maintained to keep the water table below the root zone on the farms adjacent to the canal.

Figure 4. Aerial Image of Project Area Showing Existing Drain Tiles Installed Adjacent to the Canal to Control Groundwater Elevation Due to Canal Seepage Loss

The 1917 annual report to the stockholders, describes how this reach was the most porous on the entire system and that the only permanent remedy would be to concrete line the canal in this area. The TFCC Board voted to line 1.5-miles of the High Line in this reach and approximately ½-mile of concrete lining was accomplished. That project cost much more than was estimated and lining was halted after this first project. The Board decided at that point that purchasing storage water in Jackson Lake and the soon to be built American Falls Reservoir would be a better alternative than lining miles of canal. Currently, that ½-mile is the only lined stretch of TFCC canal.

TFCC has continued considering additional concrete lining without installing any beyond the 1917 stretch, which now looks like concrete cobble. Recently, TFCC has observed the improvement in geotextile liners and the positive results that many other canal companies are getting from this type of liner. TFCC believes it is time to pursue canal lining projects, as they are now a viable, effective, and affordable solution to a long-standing issue.

1.5 Technical Project Description

TFCC plans to install 4,200 LF of prefabricated geomembrane liner in the High Line Canal at the project location, as described in Section 1.3. This canal lining project requires 3,200 LF of geomembrane liner with a width of 100-feet and 1,000 LF of geomembrane liner with a width of 90-feet, resulting in 410,000 square feet of total geomembrane liner required. The geomembrane liner will be provided in multiple rolls up to 12,000 square feet each.

The liner installation project will be performed in three main steps: (1) excavation, (2) liner placement, and (3) backfill. Each of these construction steps will be performed in succession for each liner panel section and construction will advance incrementally through the canal reach. Excavation will consist of removing 2 feet of existing canal material from the bottom and side slopes. 2-foot by 2-foot keyways will be excavated along the top of the canal banks to anchor the liner. The liner will be unrolled along the canal bottom and then unfolded to allow for placement of the liner panel across the entire width of the canal. The liner will be temporarily held in place using sand bags. The edges of the liner will be placed in the keyway and backfill material placed in the keyway to anchor the liner. Keyways will also be excavated at the upstream and downstream ends of the liner project extents. Backfill material will be placed on top of the liner along the bottom and sides. The material initially excavated will be used as backfill. The canal bottom and sides will be re-established to pre-project widths and slopes. Approximately 10 feet will be left exposed at the end of each panel section to allow welding of the adjoining section seam. Once the liner joint seams are welded, the backfilling process will advance, and the final grade of the canal bottom will be re-established.

Based on outcomes from similar liner installation projects by other irrigation districts, approximately 24 field days will be required to complete this proposed High Line Canal Lining Project #1, once the prefabricated geomembrane liner has been delivered to the site and the equipment and ancillary materials are staged for construction. Approximately twelve field construction staff (four operators and eight laborers) will be required throughout the liner installation period and the following list of equipment will be utilized: (1) three excavators, (2) two dozers, (3) one front-end loader, and (4) one grader. The year, make, and model information for the equipment is provided on the detailed budget proposal in Attachment A.

1.6 Evaluation Criteria

1.6.1 Evaluation Criterion A – Quantifiable Water Savings

TFCC's long-term goal is to ensure adequate deliveries while minimizing return flows by operating and maintaining a safe, efficient water storage and delivery system.

Describe the amount of estimated water savings

This liner installation project will conserve over 9,400 AF of water per year.

Describe current losses

Current water losses within this reach of the High Line Canal are attributable to seepage into the ground through the canal sides and bottom during irrigation season. This canal reach was constructed through coarse alluvium. Numerous large gravel and paving companies operate pits adjacent to the

canal. These adjacent gravel pits fill with water each year when irrigation water starts flowing through the High Line Canal.

Additionally, in 2018, a farmer located adjacent the proposed project canal reach damaged one of the existing drain tiles, which resulted in immediate seepage of water into his field. Refer to the following figures showing the canal seepage resultant from the existing drain tile damage.

Figure 5. 2018 Canal Seepage Resultant from Damage to an Existing Drain Tile

Figure 6. Flow Measurement Weir Installed to Quantify 2018 Canal Seepage Resultant from Damage to an Existing Drain Tile

Describe the support/documentation of estimated water savings

The project canal reach has an existing seepage rate of approximately 25 cfs. TFCC conveys irrigation water through this canal reach for 190 days on average. The resultant annual water loss is 9,420 AF per year. The supporting calculation is:

$$\frac{25\ ft^3}{1\ sec} * \frac{1\ acre}{43{,}506\ ft^2} * \frac{60\ sec}{1\ minute} * \frac{60\ minutes}{1\ hour} * \frac{24\ hours}{1\ day} * \frac{190\ days}{1\ irrigation\ season}$$

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

The estimated average annual water savings resulting from the proposed canal lining project have been determined based on an existing seepage rate of 25 cfs and a 190-day irrigation season per the calculation shown above.

How have average annual canal seepage losses been determined?

TFCC has conservatively estimated the seepage losses in the project canal reach based on seepage loss study findings for canals with similar bed material, flowrates, and volumes. Furthermore, impacts to adjacent properties to the project canal reach described above support the seepage loss estimation.

What are the expected post-project seepage/leakage losses and how were these estimates determined?

Per the product performance properties report by the manufacturer of the geomembrane identified for installation on this project shown in Figure 7, the liner has a hydraulic conductivity of 7.73×10^{-12} centimeters per second as measured on non-laminated liner. Applying a similar calculation for the 410,000 square feet of liner to be installed and a 190-day irrigation season results in a seepage loss of 3.92×10^{-5} AF of seepage loss per year. Therefore, the post-project seepage losses will be negligible.

Hydraulic Conductivity (Permeability) Calculated from MVTR	**7.73×10^{-12} cm/s (measured on non-laminated liner)**

Figure 7. Geomembrane Product Performance Properties
Manufacturer Product Data for AquaMasters® AmorPad™3NWLD

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

The anticipated annual transit loss reduction is 11,775 AF per mile. However, the proposed project consists of lining 4,200 feet of canal, thereby resulting in a total project annual transit loss reduction of 9,420 AF.

How will actual canal loss seepage reductions be verified?

TFCC is prepared to hire an independent contractor to measure water velocities at the upstream and downstream ends of the project reach using an acoustic Doppler current profiler (ADCP) to determine the change in flowrate through the project reach to quantify the actual post-project canal seepage.

Include a detailed description of the materials being used

TFCC has researched the available geomembranes available on the market and has consulted with manufacturer representatives. TFCC intends on using the AquaMaster® ArmorPad™ 3NWLD geomembrane, with a 24-mil (0.60 mm) nominal thickness. According to the manufacturer's literature, the selected liner material is "a heavyweight fabric incorporating a special weave pattern to enhance thickness, flatness, and tear properties. This product has a top and bottom coat of laminated non-woven geotextile to reduce slip risks in dry and wet conditions and to increase puncture resistance."

1.6.2 Evaluation Criterion B – Water Supply Reliability

The proposed project will reduce the amount of system water loss due to seepage and increase the resiliency of the system, allowing TFCC to provide irrigation water to its users on a more consistent basis in dry water years.

TFCC's primary natural flow water right was decreed with a priority of October 11, 1900 for 3,000 cfs of water from the Snake River. Later natural flow water rights brought TFCC up to 3750 cfs of maximum diversion at Milner Dam on the Snake River. This natural flow water right is junior to most natural flow water rights above Blackfoot, as almost all of the canals above Blackfoot have water rights prior to 1900. Because of this relatively junior priority to Snake River water TFCC has historically

suffered numerous water years with late summer water shortages prior to the construction of Jackson Lake Dam (1915) and American Falls Dam (1927). To alleviate shortages TFCC purchased 250,000 AF of storage in these two reservoirs when they were completed. Since that time TFCC annually diverts roughly 1.1 million AF and experienced very few water shortages until about the 1970s. From about 1960 to the present, about 1 million acres of groundwater pumping was developed on the Eastern Snake River Plain and this groundwater use began steadily lowering groundwater levels, and consequently also reduced tributary spring flows and reach gains to the Snake River that supply a large part of TFCC's water supply. This reduction in spring flows and reach gains has resulted in TFCC using nearly all of its storage in recent years, and in reduced allocations to TFCC farmers many times over the past 25 years. Allocations were reduced in 1992, 1994, 2001, 2002, 2003, 2004, 2005, 2007, and 2013. In 2005, a Water Call was filed against Groundwater Users on the Snake River Plain by TFCC and six other canal companies and irrigation districts below American Falls. After several court decisions, mostly favorable to TFCC, a Settlement Agreement was signed that required Groundwater Users to reduce pumping by 240,000 AF per year and to supply 50,000 AF per year for direct storage use. TFCC used 30,000 AF of this water to avoid a severe late season shortage in 2015.

In addition to the legal fight to protect their water rights, TFCC has also spent millions of dollars in conservation and efficiency improvements to their system. These include numerous automated structures improved with cost-share help from the Reclamation Water Conservation Program, and a $1.5 million re-regulating reservoir TFCC built in 2013 with the help of a Reclamation Water Smart Grant. TFCC understands that they must do their part to help conserve water as its value for all purposes continues to increase.

The following provides responses to the questions specifically listed in the FOA.

1.6.2.1 Will the project address a specific water reliability concern?

Explain and provide detail of the specific issue(s) in the area that is impacting water reliability.

In addition to the TFCC system-wide water reliability issues described in Section 1.6.2, the proposed 4,200 LF project reach within the High Line Canal has demonstrated high seepage rates since original construction. Existing gravel pits located adjacent to this canal reach fill with water each spring at the onset of the irrigation water season, when water flows through this canal reach. Prior to the installation of subsurface drain tiles under the farmland adjacent to this canal reach in the mid-1910s, high groundwater, crop area oversaturation, and flooding were common occurrences that resulted in litigation against TFCC. While the drain tiles have addressed the cropland flooding issues, the seepage in this canal reach is still prevalent and results in significant system losses, thereby negatively impacting the system reliability.

The proposed lining project will improve the water reliability for this canal reach by significantly reducing the current seepage losses and improving water delivery.

Describe how the project will address the water reliability concern.

The proposed canal lining project will essentially eliminate the current seepage losses through the canal reach and allow the irrigation water within the canal to be put to beneficial use rather than be lost to seepage. The system will be more resilient and allow for more reliable water deliveries to TFCC water users, especially during lower water years.

This proposed project will allow TFCC to continue to improve their overall system reliability and meet their ongoing goal to conserve water and be good stewards of this precious resource.

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

Water will no longer be lost to seepage through this canal reach and will instead be available for the intended purpose of providing irrigation water to TFCC water users.

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

Approximately 9,400 AF of conserved water will be available annually for the intended purpose following the completion of this canal lining project.

1.6.2.2 Will the project make water available to achieve multiple benefits or to benefit multiple water users?

Will the project benefit multiple sectors and/or users?

TFCC provides irrigation water for both farmland and urban water users. The service area has and continues to experience population growth and urbanization. Lots with an area of 0.5-acre and larger are kept in the assessment. The Idaho Department of Water Resources allow the use of wells to irrigate up to 0.5-acre, so lots less than 0.5-acre are not assessed.

Will the project benefit species?

TFCC irrigation water is utilized by livestock producers and crop production that benefits livestock. In addition, wildlife (for example, deer and migratory birds) benefits from the irrigation water that flows through the TFCC system.

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

This project will help TFCC achieve two of its core objectives: (1) to operate and maintain a safe, efficient water storage and delivery system and (2) to be wise stewards and to encourage practices that promote water conservation of natural resources.

Will the project benefit Indian tribes?

This project will not provide any direct benefit to Indian tribes.

Will the project benefit rural or economically disadvantaged communities?

Yes, this project will enhance the water reliability of the TFCC system, which serves water users located in the following rurally and economically disadvantaged communities: Murtaugh, Kimberly, Hansen, Filer, Buhl, and Castleford.

Describe how the project will help to achieve these multiple benefits.

As previously stated, the proposed canal lining project will essentially eliminate the current seepage losses through the canal reach and allow the irrigation water within the canal to be put to beneficial use rather than be lost to seepage.

Water will no longer be lost to seepage through this canal reach and will instead be available for the intended purpose of providing irrigation water to TFCC water users.

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

Is there widespread support for the project?

The TFCC Board and its members, consisting of over 4,600 water users, support this project. Water conservation and water efficiency projects, for which this canal lining project represents, are valued by all throughout the TFCC service area.

What is the significance of the collaboration/support?

The broad support for water conservation projects of this nature by the TFCC Board, its water users, and the community as a whole ensures the success of this project. If this funding request is successful, the project supporters will endorse the project and be fully vested to see it through to completion.

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

Yes, implementation of this canal lining project will reduce the amount of seepage in the High Line Canal system and allow for farmers to pursue installation of more efficient irrigation systems that have previously not been necessary and/or feasible.

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

As described in previous sections, there have been many litigation proceedings that TFCC has been involved in relating to production losses and crop damage in the early 1900's, due to high canal seepage losses and conflicts with groundwater pumpers. These proceedings culminated in the 2000's due to a series of back-to-back drought years and decreased reach gains. Water shortages in the system will be partially mitigated through the implementation of this proposed canal lining project by keeping the water in the canal and rather than being lost to seepage. The water shortages will likely be reduced to a degree for TFCC water users as a result of this project.

Describe roles of any partners in the process.

TFCC will not partner with outside entities for this canal lining project.

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

The water reliability improvements resultant from this project have been characterized in the content provided throughout this grant application.

1.6.3 Evaluation Criterion E – Department of the Interior Priorities

1.6.3.1 Creating a conservation stewardship legacy second only to Teddy Roosevelt

The proposed canal lining project is a water conservation project that allows the irrigation water to be put to beneficial use rather than lost to seepage. The project results in a more efficient overall water delivery system and allows TFCC to adhere to one of its core objectives, which is to be wise stewards and to encourage practices that promote water conservation of natural resources.

1.6.3.2 Utilizing our natural resources.
This canal lining project will allow TFCC to more effectively and efficiently manage water through their canal system which aligns directly with this U.S. Department of the Interior priority.

1.6.3.3 Restoring trust with local communities.
The agricultural and urban communities look to TFCC to be responsible managers of this natural resource and to find opportunities to enhance the canal system to develop a more reliable and efficient system. This canal lining project allows TFCC to demonstrate to the local community that they are taking a proactive role to fulfill this expectation and mission.

1.6.3.4 Striking a regulatory balance.
The project canal reach is not located on federal or state lands. There are no known environmental or cultural resources of significance within the TFCC service area. Therefore, there isn't a need for environmental compliance. No permits are required to perform the liner installation work.

1.6.3.5 Modernizing infrastructure.

The proposed canal lining project will allow TFCC to improve and modernized this stretch of canal that was originally constructed over 100 years ago and has undergone very few changes since other than routine maintenance.

1.6.4 Evaluation Criterion F – Implementation and Results

1.6.4.1 Project Planning

Does the applicant have a Water Conversation Plan and/or System Optimization Review (SOR) in place?

Yes. TFCC prepared a Water Management and Conservation Plan (February 2007), which is included in Attachment D.

Section 6 of the 2007 Water Management and Conservation Plan identifies the Water Management Issues and Goals. The first problem described is "long distribution system creates challenges in water management" and one of the goals identified is to "improve delivery system efficiency" by lining problem areas. The canal reach identified for this proposed High Line Canal Lining Project No. 1 is a high priority problem area for TFCC to address through the implementation of this lining project to reduce or eliminate seepage for this stretch.

1.6.4.2 Performance Measures

TFCC is prepared to perform a seepage study for this canal reach upon completion of the lining project by hiring an independent contractor to use ADCP to measure the inflow and outflow rates to determine the change in flowrate due to seepage.

1.6.4.3 Readiness to Proceed

TFCC has performed planning efforts to support this project and is prepared to implement it in Fall 2019, following the end of the irrigation season, if this WaterSMART grant application is selected for funding.

TFCC has received material quotes from vendors and is prepared to purchase the necessary materials to construct the project. Furthermore, TFCC either owns or has preliminary arrangements in place to provide the necessary construction equipment and personnel to perform the installation work.

Describe the implementation plan of the proposed project.

TFCC plans to procure the material and self-perform the installation work, and owns the heavy equipment needed to perform the work. TFCC staff will be utilized for operating the equipment and as laborers.

The procured material and construction equipment will be transported to the site during the mobilization stage.

TFCC will be responsible for construction planning, oversight, and management prior to and during installation.

Table 6 provides the preliminary schedule for implementing this canal lining project:

Table 6. Preliminary Schedule for Canal Lining Project

Activity	Date
Material Procurement	August 15, 2019
Mobilization	October 14, 2019
Liner Installation	October 15, 2019 through November 15, 2019
Project Completion	November 15, 2019

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

No permits are required to perform the work.

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

No engineering or design work is needed to support the proposed project.

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

No new policies and/or administrative actions are required to implement the project.

Describe how the environmental compliance estimate was developed.

There are no known environmental resources of special value, including rivers, streams, lakes, fisheries, threatened plant and animal communities, spawning grounds, or flyways that are present at the proposed project location. Natural vegetation adjacent to the canal is characterized with sagebrush and various arid grasses.

There are no identified or known cultural resources of significance within the TFCC service area.

Therefore, there isn't a need for environmental compliance and no budget needed for the estimate.

1.6.5 Evaluation Criterion G – Nexus to Reclamation Project Activities

1.6.5.1 Is the proposed project connected to Reclamation project activities?

Does the applicant receive Reclamation project water?

Yes. TFCC water is diverted from the Snake River at Milner Dam, regulated at Murtaugh Lake, and split between the Low and High Line Canals at Forks.

TFCC has storage rights in American Falls Reservoir and Jackson Lake, which are both considered Reclamation project water part of the Minidoka Project.

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

The proposed canal lining project is not located on Reclamation project lands. However, the project does indirectly involve Reclamation facilities in that it will conserve water that is provided from Reclamation facilities.

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

Yes, the project is located within the Snake River basin, which contains multiple Reclamation projects and facilities including the Minidoka and Palisades Projects.

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

Yes, the proposed project will conserve water and increase water efficiency for water provided by Reclamation projects within the Snake River basin.

1.6.5.2 Will the project benefit any tribe(s)?

This project will not provide direct benefit to any tribes.

1.6.6 Evaluation Criterion H – Additional Non-Federal Funding

The non-Federal funding portion of the proposed project costs constitute 51 percent of the total costs per the following calculation:

$$\frac{\text{Non-Federal Funding} = \$250{,}400}{\text{Total Project Cost} = \$489{,}400}$$

2. Project Budget

2.1 Funding Plan and Letters of Commitment

This project will be funded through use of $239,000 of Federal grant money obtained through this WaterSMART FOA and $250,400 of non-Federal investments. No federal funds will be applied outside of the Reclamation WaterSMART FOA. The non-Federal investment money will be fully funded by TFCC through operating accounts, which are immediately available. There are no additional outside funding sources, therefore no letters of commitment are necessary.

Table 7 provides a summary of funding for this proposed project.

Table 7. Summary of Project Funding

Funding Source	Funding Amount
Non-Federal Twin Falls Canal Company	$250,400
Federal Reclamation WaterSMART	$239,000
Other n/a	$0
Total Project Funding	**$489,400**

2.2 Budget Proposal

The total estimated project cost is $489,400 The project cost estimate was prepared based on projected labor and equipment requirements using historical records from previous similar projects completed by other irrigation districts, material quotes from suppliers, input from engineering professionals, TFCC labor rates, and the November 2016 US Army Corps of Engineers Construction Equipment Ownership and Operating Expense Schedule, Region VIII (EP 1110-1-8). Table 8 provides a summary of the estimated project costs.

Table 8. Project Cost Summary

Source	Amount	Percent of Total Project Cost
Costs to be reimbursed with the requested Federal funding	$239,000	49
Costs to be paid by the applicant	$250,400	51
Value of third-party contributions	$0	0
Total Project Cost	**$489,400**	**100**

A detailed budget proposal is provided in Attachment A.

2.3 Budget Narrative

2.3.1 Salaries and Wages

As shown in the detailed budget proposal in Attachment A, TFCC expects to make an in-kind investment of $61,918 in salaries and wages. These investments support grant and project management specific to this project, as follows:

- Project Planning and Procurement in Fall 2019
    - TFCC estimates that a combined total of 4 work days will be required by staff for pre-construction planning and coordination, and for procurement.
- Construction and Construction Management in Fall 2019
    - TFCC estimates that onsite construction activities will require 24 field days, based on a daily average liner installation completion rate of 200 LF per day and a total of 3 days for mobilization and demobilization.
    - The TFCC project superintendent in the field 8 hours per day and the project manager and office administrator providing 2 hours of project support each day on average.
    - TFCC equipment operators (four) and laborers (8) are anticipated to be onsite for the entire duration of field work with an 8-hour workday.

In-kind investments exclude general administration outside the project.

2.3.2 Fringe Benefits

As shown in the detailed budget proposal in Attachment A, TFCC expects to make an in-kind investment of $26,560 in fringe benefits. These investments provide for Federal Insurance Contributions Act taxes, retirement, health insurance, unemployment tax, workers compensation, personal time off, and sick leave. Fringe benefits are applied to management, staff, operators, and laborers.

2.3.3 Travel

As shown in the detailed budget proposal in Attachment A, TFCC expects to make an in-kind investment of $818 in travel expenses related to this project. This cost is based on 30 site visits to and from TFCC's headquarters in Twin Falls at $0.545 per mile. These investments pay for vehicle mileage for staff conducting site visits, providing construction oversight, and inspections.

2.3.4 Equipment

TFCC owns the equipment needed for construction of this project. The project budget includes Canal Company-owned equipment in excess of $5,000 and having a useful life of more than 1 year. Hourly rates were established using the November 2016 US Army Corps of Engineers Construction Equipment Ownership and Operating Expense Schedule, Region VIII (EP 1110-1-8). The following is a projected list of the equipment that will be furnished and used by TFCC for completion of this project: (1) three excavators, (2) two dozers, (3) one front-end loader, and (4) one grader.

It is anticipated that the equipment will be required onsite for the entire duration of field work.

2.3.5 Materials and Supplies

The materials needed to complete this project are the geomembrane liner, sandbags, and incidental tools.

This canal lining project requires 3,200 LF of geomembrane liner with a width of 100 feet and 1,000 LF of geomembrane liner with a width of 90 feet, resulting in 410,000 square feet of total geomembrane liner required. The geomembrane liner will be provided in multiple rolls up to 12,000 square feet each. A quotation was obtained from a reputable supplier with a total delivered cost of $258,160, including freight and an installation crew to unroll the liner panels and perform the necessary field seam welding.

An estimated total of 100 sandbags are required to temporarily hold down edges of the liner panels, at a cost of $4 per filled sandbag.

Refer to the detailed budget proposal in Attachment A.

2.3.6 Contractual

There are no contractual costs anticipated to complete this project.

2.3.7 Environmental and Regulatory Compliance Costs

For purposes of this budget proposal, environmental and regulatory compliance costs are estimated at 1 percent of the total project cost. TFCC anticipates minimal environmental and regulatory compliance costs. The total budgeted amount for environmental and regulatory compliance costs for the project is $4,199.

It is anticipated that any environmental costs incurred would be related to time spent by TFCC and Reclamation required to determine level of environmental compliance required for the project, prepare any necessary environmental compliance documents or reports, review any environmental compliance documents, and time required for approvals or permits.

2.3.8 Other

This line item includes costs to be incurred while reporting to federal funders. In accordance with the FOA requirements, TFCC will prepare and submit post-award reporting to Reclamation an SF-425 Federal Financial Report.

A contingency cost of 10 percent of the project subtotal has been applied. While TFCC has performed its due diligence and project pre-planning, the potential exists for unanticipated events and unforeseen challenges to occur prior to or during project execution that could impact cost.

2.3.9 Indirect Costs

For this project, the recipient will not have any indirect costs. All costs associated with the project are direct and can be documented as such.

2.3.10 Total Costs

The estimated total project cost is $489,400. The requested federal share is $239,000, and the total non-federal share is $250,400. A copy of the completed SF 424C, Budget Information-Construction Programs is provided in Attachment B.

3. Environmental and Cultural Resources Compliance

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

TFCC will excavate 2 feet of existing canal material within the proposed canal reach, place the liner, and then redistribute the canal material. Potential environmental impacts are minimal and consist of excessive dust and equipment leakage spills. These potential impacts will be mitigated through good housekeeping practices (e.g proper equipment maintenance) and use of best management practices (e.g. watering surfaces to control dust, spill containment).

Access to the work site will be via existing TFCC right-of-way access roads, therefore no impact to wildlife is anticipated.

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

There are no known environmental resources of special value including rivers, streams, lakes, fisheries, threatened plant and animal communities, spawning grounds, or flyways that are present at the proposed project location.

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

No wetlands or other surface waters that could fall under Clean Water Act jurisdiction exist in the project area.

When was the water delivery system constructed?

The High Line Canal was first constructed through the Rock Creek reach and water delivery began in 1906

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

Aside from the proposed canal lining project, no other modifications will be made to the system as part of this project.

Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places?

There are no structures present with the limits of the proposed project and all immediately adjacent land is cultivated farmland.

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

There are no known cultural resources of significance within the TFCC service area.

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

No, there are no low income or minority populations in the immediate vicinity of the proposed project.

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

No, the proposed project will not limit access to and ceremonial use of Indian sacred sites or result in other impacts on tribal lands.

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

No, the proposed project will contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species.

4. Required Permits of Approvals

4.1 Federal Permitting

TFCC will comply with the National Environmental Policy Act (NEPA) and all applicable state, federal, and local environmental, cultural, and paleontological resource protection laws and regulations including, but not limited to, the Clean Water Act, the Endangered Species Act, the National Historic Preservation Act (NHPA), consultation with potentially affected tribes, and consultation with the State Historic Preservation Office.

As lead agency for NEPA compliance, Reclamation will be responsible for determining the appropriate level of NEPA compliance. TFCC will coordinate with Reclamation through this process. Based on the location and nature of the proposed canal lining project, no significant environmental impacts are anticipated. TFCC believes this project fits with a recognized Categorical Exclusion to NEPA.

TFCC is prepared to work with Reclamation to complete the Section 106 process of the NHPA. There are no identified or known cultural resources of significance within the TFCC service area. Therefore, TFCC anticipates that Reclamation will determine that the proposed project does not have the potential to cause effects to the historic properties.

There are no known environmental resources of special value including rivers, streams, lakes, fisheries, threatened plant and animal communities, spawning grounds, or flyways that are present at the proposed project location. Therefore, TFCC anticipates that Reclamation's consultation with U.S. Fish and Wildlife Service and/or the National Oceanic and Atmospheric Administration Fisheries Service will result in the finding that this project does not jeopardize the continued existing of any endangered or threatened species or destroy or adversely modify any designated critical habitat.

TFCC anticipates minimal environmental and other resource compliance costs will be incurred by TFCC and Reclamation. For this reason, environmental and regulatory compliance costs are estimated at 1 percent of the total project cost.

4.2 State Permitting

There are no state permitting requirements.

4.3 Local Permitting

There are no local permitting requirements.

5.0 Letters of Project Support

The TFCC plans to fully fund the non-Federal portion of the project costs and there are no other direct stakeholders involved in the project. Therefore, no letters of support are included.

6.0 Official Resolution

An official resolution was adopted and approved by the TFCC Board. Refer to Attachment C for the signed official resolution.

Attachment A
Detailed Budget Proposal

FY 2019 WaterSMART Grant
TFCC High Line Canal Lining Project #1

Detailed Budget Proposal

Budget Item Description	Computation $/Unit	Quantity	Unit	Extended Cost	Notes
Salaries and Wages					
Planning and Procurement					
Louis Zamora (2019) - TFCC Project Manager	$ 35.28	32	Hour	$ 1,128.96	4 work days combined total
Clay Robinson (2019) - TFCC Superintendent	$ 35.28	32	Hour	$ 1,128.96	4 work days combined total
Office Administrator (2019)	$ 24.74	32	Hour	$ 791.68	4 work days combined total
Construction and Construction Management					
Louis Zamora (2019) - TFCC Project Manager	$ 35.28	48	Hour	$ 1,693.44	24 days, 2 hours per day
Clay Robinson (2019) - TFCC Superintendent	$ 35.28	192	Hour	$ 6,773.76	24 days, 8 hours per day
Office Administrator (2019)	$ 24.74	48	Hour	$ 1,187.52	24 days, 2 hours per day
Equipment Operators (2019)	$ 26.90	768	Hour	$ 20,659.20	4 equipment operators, 24 days, 8 hours per day
Laborers (2019)	$ 18.59	1536	Hour	$ 28,554.24	8 laborers, 24 days, 8 hours per day
		Extended Cost Subtotal		**$ 61,917.76**	
Fringe Benefits					
Planning and Procurement					
Louis Zamora (2019) - TFCC Project Manager	$ 14.36	32	Hour	$ 459.37	4 work days combined total
Clay Robinson (2019) - TFCC Superintendent	$ 14.36	32	Hour	$ 459.37	4 work days combined total
Office Manager (2019)	$ 9.90	32	Hour	$ 316.80	4 work days combined total
Construction and Construction Management					
Louis Zamora (2019) - TFCC Project Manager	$ 14.36	48	Hour	$ 689.06	24 days, 2 hours per day
Clay Robinson (2019) - TFCC Superintendent	$ 14.36	192	Hour	$ 2,756.24	24 days, 8 hours per day
Office Manager (2019)	$ 9.90	48	Hour	$ 475.20	24 days, 2 hours per day
Equipment Operators (2019)	9.81	768	Hour	$ 7,534.08	4 equipment operators, 24 days, 8 hours per day
Laborers (2019)	9.03	1536	Hour	$ 13,870.08	8 laborers, 24 days, 8 hours per day
		Extended Cost Subtotal		**$ 26,560.21**	
Travel					
Site Visits	$ 0.545	1500	Mile	$ 817.50	30 visits @ 50 mile ea.
		Extended Cost Subtotal		**$ 817.50**	
Equipment					
Excavator 1 (2018 Case CX 250 D Long Reach)	$ 63.74	192	Hour	$ 12,238.08	
Excavator 2 (2018 Cat 316 F Excavator)	$ 47.83	192	Hour	$ 9,183.36	
Excavator 3 (2018 Cat 323 Excavator)	$ 48.66	192	Hour	$ 9,342.72	
Dozer 1 (1999 Cat D 6 RXL Dozer)	$ 39.33	192	Hour	$ 7,551.36	
Dozer 2 (2000 Cat D 5 MXL Dozer)	$ 92.95	192	Hour	$ 17,846.40	
Front-End Loader (2013 Cat 966K Rubber Tired Loader)	$ 81.89	192	Hour	$ 15,722.88	
Grader (2012 John Deere 872G Grader)	$ 60.54	192	Hour	$ 11,623.68	
		Extended Cost Subtotal		**$ 83,508.48**	
Supplies and Materials					
Geomembrane Liner	$ 258,160.00	1	Lump Sum	$ 258,160.00	Cost includes supplier crew to weld seams
Pit Run Gravel	$ 9.00	400	Cubic Yards	$ 3,600.00	
Sandbags	$ 4.00	100	Each	$ 400.00	
		Extended Cost Subtotal		**$ 262,160.00**	
Environmental and Regulatory Compliance					
Reclamation Cost Share		0.5%	Percentage	$ 2,174.82	Percentage of total project cost (line items above)
Recipient Cost Share		0.5%	Percentage	$ 2,174.82	Percentage of total project cost (line items above)
		Extended Cost Subtotal		**$ 4,349.64**	
Other					
Post-construction Seepage Loss Measurement	$ 5,000.00	1	Lump Sum	$ 5,000.00	
Post-Award Reclamation Reporting (SF-425)	$ 49.64	12	Hours	$ 595.63	
		Extended Cost Subtotal		**$ 5,595.63**	
Other - Contingency					
Contingency		10%	Percentage	$ 44,490.92	
Total Direct Costs				**$ 489,400.14**	
Indirect Costs		**0.0%**	**Percentage**	$ -	
TOTAL ESTIMATED PROJECT COSTS				**$ 489,400.14**	

Attachment B
SF-424C

OMB Number: 4040-0008
Expiration Date: 01/31/2019

BUDGET INFORMATION - Construction Programs

NOTE: Certain Federal assistance programs require additional computations to arrive at the Federal share of project costs eligible for participation. If such is the case, you will be notified.

COST CLASSIFICATION	a. Total Cost	b. Costs Not Allowable for Participation	c. Total Allowable Costs (Columns a-b)
1. Administrative and legal expenses	$ 6,742.04	$	$ 6,742.04
2. Land, structures, rights-of-way, appraisals, etc.	$ 0.00	$	$ 0.00
3. Relocation expenses and payments	$ 0.00	$	$ 0.00
4. Architectural and engineering fees	$ 0.00	$	$ 0.00
5. Other architectural and engineering fees	$ 0.00	$	$ 0.00
6. Project inspection fees	$ 0.00	$	$ 0.00
7. Site work	$ 0.00	$	$ 0.00
8. Demolition and removal	$ 0.00	$	$ 0.00
9. Construction	$ 343,895.94	$	$ 343,895.94
10. Equipment	$ 83,508.48	$	$ 83,508.48
11. Miscellaneous	$ 10,762.76	$	$ 10,762.76
12. SUBTOTAL *(sum of lines 1-11)*	$ 444,909.22	$	$ 444,909.22
13. Contingencies	$ 44,490.92	$	$ 44,490.92
14. SUBTOTAL	$ 489,400.14	$	$ 489,400.14
15. Project (program) income	$	$	$
16. TOTAL PROJECT COSTS *(subtract #15 from #14)*	$ 489,400.14	$	$ 489,400.14
FEDERAL FUNDING			
17. Federal assistance requested, calculate as follows: (Consult Federal agency for Federal percentage share.) Enter the resulting Federal share.	Enter eligible costs from line 16c Multiply X 49 %		$ 239,806.07

Attachment C
Official Resolution

OFFICIAL RESOLUTION
OF THE
TWIN FALLS CANAL COMPANY

RESOLUTION NO. 2019 - 02

WHEREAS, the United States Department of the Interior, Bureau of Reclamation has announced the *WaterSMART Water and Energy Efficiency Grants for FY 2019* in order to provide assistance to undertake projects that result in quantifiable and sustained water savings, and has requested proposals from eligible entities to be included in the WaterSMART Program; and

WHEREAS, the Twin Falls Canal Company (TFCC) has a present need for funding to implement the proposed Rock Creek Lining Project; and

WHEREAS, the project is intended to eliminate canal losses in an area of the High Line Canal near Rock Creek and will result in water savings and higher efficiency in TFCC's water delivery to certain lands.

NOW, THEREFORE, BE IT RESOLVED that the TFCC Board of Directors agrees and authorizes that:

1. The Board has reviewed and supports the proposal submitted;

2. The District is capable of providing the amount of funding and/or in-kind contributions, specified in the funding plan; and

3. If selected for a WaterSMART Grant, TFCC will work with Reclamation to meet established deadlines by entering into a cooperative agreement.

DATED: March 12, 2019

~~Phil Blick~~ Roger Bless
President, Twin Falls Canal Company

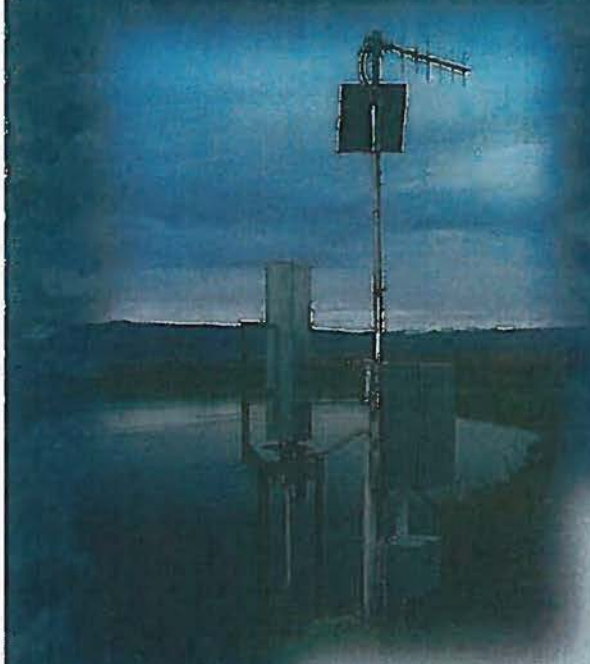
ATTEST:

Rick Pearson, Secretary

Attachment D
TFCC Water Mgmt-Conserve Plan Feb2007

Twin Falls Canal Company

Water Management and Conservation Plan



Prepared by

Twin Falls Canal Company

with assistance from

Idaho Water Users Association, Inc.

CH2MHILL

February 2007

Twin Falls Canal Company

Water Management and Conservation Plan

Jennie Kennedy
Gonia Beattie

Prepared by
Twin Falls Canal Company

with assistance from

Idaho Water Users Association, Inc.
CH2MHILL

February 2007

Table of Contents

Contents, Continued

Contents, Continued

Tables

Figures

Contents, Continued

1.0 Description of the Canal Company

The Twin Falls Canal Company (TFCC) is located in Twin Falls County in south central Idaho. The TFCC is comprised of two divisions: the East Division and the West Division. The East Division serves water users in Murtaugh, Kimberly, Hansen, and Twin Falls from the main office building in Twin Falls. The West Division serves water users located near Filer, Buhl, and Castleford from an office located in Buhl. Water is diverted at Milner Dam, regulated at Murtaugh Dam, and split between the Low and High Line Canals at Forks.

The Company's mission is to deliver water to the land and distribute it equitably to the water users. Objectives of the TFCC include:

- To operate and maintain a safe, efficient water storage and delivery system
- To be wise stewards and to encourage practices that promotes water conservation of natural resources
- To be progressive in meeting changing demands and regulations
- To attract and maintain capable employees to accomplish this mission

The following is general information about the TFCC system:

Area Irrigated	202,691 acres
Length of major canals	110 miles
Length of laterals	1,000 miles
Number of laterals	450
Number of turnouts	5,300
Number of waterusers	4,355
Number of shares	202,691
Number of service gates	5,300
Number of watermasters	2
Number of ditchriders	27
Irrigation Season	April 1-October 31
Diversion	Per demand up to 3,800 cubic feet per second (cfs)

Note: Some values are approximations

1.1 History and Background Information

In 1894 the United States Congress passed the Carey Act which allowed states to request that large tracts of Federal land be set aside for private investors. Irrigation systems were to be developed in accordance with approved plans for an irrigation system. This prompted the interest of I.B. Perrine and other investors, which led to the construction and development of the TFCC. The entrymen paid the Twin Falls Land and Water Company for the water, developed 20 acres with irrigation water, paid the state fifty cents ($0.50) per acre, and obtained patents to the land. The TFCC has operated the canal system since 1909.

Canal Company Organization

The TFCC is controlled and operated by a Board of five directors. Each director's term is 3 years. Cumulative voting (shares times the number of directors being elected) is used to determine the number of votes that a stockholder casts in director elections. Terms of service are staggered so that no more than two directors are elected in any 1 year. Any stockholder can run for election as a director when the seat in the district in which the stockholder resides is up for election.

The Board of Directors hires a General Manager to administer policy and take care of day-to-day activities. The General Manager hires all other employees.

Each division has a watermaster and a maintenance supervisor. The watermasters supervise the ditchriders in their division and are responsible for delivering water to the water users. The maintenance supervisors are responsible for keeping the canal system in good repair and supervising all equipment operators and general crew members.

Canal Company facilities include:

- Office at 357 6th Avenue West, Twin Falls, Idaho
- Office at 1310 Burley Avenue, Buhl, Idaho

1.2 Location

The project is located in south central Idaho in Twin Falls County with the headquarters located in Twin Falls. Irrigated lands are bounded to the north by the Snake River. TFCC lands begin at the Milner Dam diversion and extend east just upstream of the confluence with Salmon Falls Creek. The total project service area is approximately 50 miles long by 15 miles wide.

Figure 1 depicts shows the service area for TFCC and the major facilities. The following is a list of the types of facilities and features shown:

- **Automated diversion** is used for a lateral or conveyance canal and has been automated to regulate and measure flows. The flow measurements and gate settings can be monitored and adjusted from a remote computer. Some of the diversions are run manually for operational purposes.
- A **flow gaging station** is used for measuring flow and may be monitored remotely.
- A **stage gaging station** is used for measuring stage and may be monitored remotely.
- **Spills** are points in the system at which flows are released for operational purposes.
- **Automated spills** are spill points that have been automated to regulate and measure flows. The flow measurements and gate settings can be monitored and adjusted from a remote computer. Some of the diversions are run manually for operational purposes.
- **Return flows** are flows measured by TFCC that are either drainage, excess, or irrigation flows that return to the Snake River.
- **USGS return flows** are flows measured by the U.S. Geological Survey (USGS) that are either drainage, excess, or irrigation flows that return to the Snake River.
- **Measured seeps** are locations of subterranean seepage flows that are recaptured in the system and that TFCC is measuring.
- **Sediment ponds** are locations at which TFCC has built a pond for treating water and capturing sediment before the water returns to the Snake River.

1.3 Size

TFCC serves approximately 202,691 irrigated acres. The acreage has not changed since the mid-1980s. The service area has experienced population growth and urbanization. Lots with area 0.5 acre or larger are currently kept in the assessment. The Idaho Department of Water Resources allows the use of wells to irrigate up to 0.5 acre so lots less than 0.5 acre are not assessed. Transfers have been executed carefully to ensure equity.

TFCC has not expanded beyond historical service area boundaries and has no intentions to expand. Geographic and economic constraints have limited the feasibility for expansions.

1.4 Population and Industry Trends

As with most of the West, the service area is growing in population. The average annual growth for Twin Falls County has been approximately 1.5 percent.

Table 1-1

County Agricultural Trends

	County	1987	1992	1997
Number Irrigated Farms	Twin Falls	1,351	1,243	1,223
Number Irrigated Acres	Twin Falls	272,367	231,351	276,307

Note: These are county-wide statistics and include acres beyond the TFCC service area.

1.5 Topography

The area's topography is characterized with flat to gently rolling land making the general topography well-suited for irrigation farming. The topography of the project service area is diverse, given the large area of land. Surface elevations of the irrigable area vary from 3,700 to 4,100 feet.

1.6 Soils

There are no significant soil problems or limitations within the project service area. Most of these soils have been described as well-drained soils that have intermediate water-holding capacity. The predominant hydrologic soil group designation is B, indicating moderate infiltration rates.

Twelve soil associations (mapping units used on general soil maps) have been delineated within the project service area. As shown in the table, the soils are primarily silt loam, loam, or silty clay loam. All soils are classified with a mesic temperature regime (average annual soil temperature between 46 and 59 degrees Fahrenheit).

Soil orders are broad groupings of soils based on which soil-formation factor has the greatest influence in determining soil properties. Soil orders present within the project service area include:

- Aridisol – Soils of arid regions that show limited change because of a low effective precipitation, typically used for production of cultivated crops when irrigated.
- Mollisol – Soils of the semiarid grasslands with deep, dark, friable surface horizons, typically very fertile except where dry climates have limited the accumulation of organic matter and nitrogen.
- Entisol – Soils of very limited development, typically shifting sand dunes and soils forming from alluvial or glacial deposits that have been in place for only a short time.

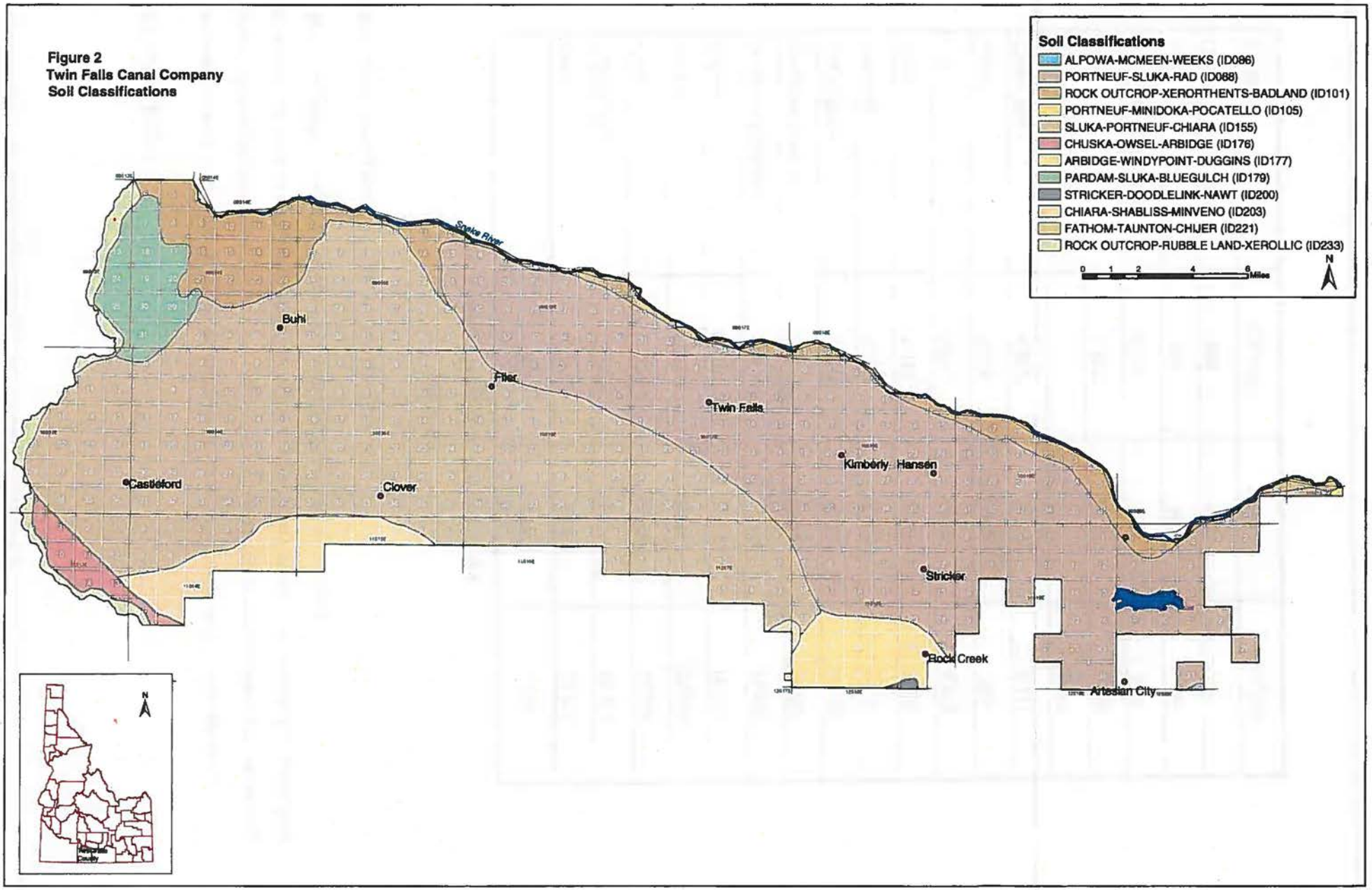
Figure 2 shows the distribution of various soils and Table 1-2 summarizes the area distribution of these soils.

Table 1-2

Types of Soils Found within the Project Service Area

Soil Association	Acres	Soil Texture	Drainage	Hydrologic Soil Group	Soil Order
ALPOWA-MCMEEN-WEEKS (ID086)	67	Loam, Silt Loam	Well Drained	B	Mollisol, Aridisol
PORTNEUF-SLUKA-RAD (ID088)	100,786	Silt Loam	Well Drained	C and B	Aridisol
ROCK OUTCROP-XERORTHENTS-BADLANDS (ID101)	21,774	Bedrock/Variable	Well Drained	D and B	Aridisol, Entisol
PORTNEUF-MINIDOKA-POCATELLO (ID105)	68	Silt Loam	Well Drained	B	Aridisol
SLUKA-PORTNEUF-CHIARA (ID155)	123,862	Silt Loam	Well Drained	B and C	Aridisol
CHUSKA-OWSEL-ARBIDGE (ID176)	3,630	Gravelly Loam/Sandy Loam	Well Drained	D and B	Aridisol
ARBIDGE-WINDYPOINT-DUGGINS (ID177)	7,726	Loam, Silt Loam	Well Drained	C	Aridisol, Entisol
PARDAM-SLUKA-BLUEGULCH (ID179)	8,556	Silt Loam	Well Drained	C and B	Aridisol
STRICKER-DOODLELINK-NAWT (ID200)	181	Gravelly Loam/Cobbles	Well Drained	D and B	Mollisol
CHIARA-SHABLISS-MINVENO (ID203)	9,271	Silt Loam, Stony	Well Drained	D	Aridisol
FATHOM-TAUNTON-CHIJER (ID221)	9	Loamy Fine Sand, Fine Sand	Well Drained	B	Aridisol
ROCK OUTCROP-RUBBLE LAND-XEROLLIC HAPLARGIDS (ID233)	3,995	Silty Clay Loam, Stony	Mixed	B and D	Mollisol, Aridisol, Entisol

Figure 2
Twin Falls Canal Company
Soil Classifications



1.7 Crops Grown

A crop report is prepared each year to estimate the crop production within the service area. Ditchriders estimate crop acres on their ride or lateral by talking to stockholders and observing crop type planted in each field. The crop report is a summary of these estimates. The years 1997, 1998, and 2001 are used for a water budget described in a later section.

The major crops grown are summarized in Table 1-3.

Table 1-3

Agricultural Water Use – Major Crops

Crop	1997	1998	2001
Beans	40,970	40,107	26,416
Alfalfa Hay	35,022	34,792	39,453
Corn	22,676	22,960	23,606
Barley	21,380	20,197	25,468
Wheat	21,015	22,165	18,305
Silage or Ensilage	13,570	11,446	15,892
Irrigated Pasture	12,761	12,685	14,426
Sugar Beets	9,498	9,682	11,483
Potatoes	9,328	8,991	5,237
Oats	1,440	1,290	1,600
Peas	5,803	6,006	4,874
Grain	5,038	3,522	733
Other Hay	4,400	3,029	3,411
Other Vegetable			2,778
Seeds	1,191	2,282	1,449
Gardens & Orchards	1,700	819	429
Sod	415	941	6,642
Onions	180	199	307
TOTAL	206,387	201,113	202,509

Secondary crops grown are summarized in Table 1-4.

Table 1-4

Agricultural Water Use – Secondary Crops

Crop	1997	1998	2001
Beet Tops	2,125	1,720	2,000
Stubble, Stalks, etc	1,850	1,516	2,000
Straw, All Kinds	32,621	32,838	40,000
TOTAL	36,596	36,074	44,000

1.8 Major Irrigation Methods

The majority of crops in the service area are flood irrigated. There has been an increasing trend toward converting to sprinkler irrigation. Table 1-5 presents the irrigation method as a percentage of the 202,691 irrigated acres. The acres with sprinkler irrigation are an inventory of sprinkler agreements registered with TFCC. TFCC requires that sprinkler irrigation and pump agreements be registered to receive water from TFCC's distribution system.

Table 1-5

Approximate Historical Irrigation Practices

Irrigation Application Method (Estimated Efficiency)	Estimated Percentage of Service Area		
	1992	1998	2006
Gravity (50% efficient)	94%	84%	68%
Sprinkler Pivots (90% efficient)	4%	12%	30%
Sprinkler Siderolls (65% efficient)	1%	3%	1%
Sprinkler Handlines (65% efficient)	1%	1%	1%
Weighted Average Irrigation Application Efficiency	52%	55%	62%

The efficiency of an irrigation method is a percentage of the delivered water that is beneficially used to meet the crop water requirement. Table 1-5 shows accepted efficiencies for various irrigation application methods and summarizes historical irrigation practices. The weighted average irrigation application efficiency illustrates the net impacts of the increase in sprinkler irrigation.

As the service area continues to convert to sprinkler irrigation there are some changes in operation within the TFCC. For example, depending on crop patterns some sprinklers may only need to run 5 days a week to efficiently irrigate crops that previously required 7 days to water with gravity irrigation. In some cases water is spilled for the remaining 2 days. Spills at the tail ends of the laterals can also occur during power outages when sprinklers are off-line. These changes in operation have been well managed by the TFCC and the current automation system and spills at the tail end of the system as a result of sprinkler irrigation are minimal.

Another operational change that has occurred as a result of the conversion to sprinkler irrigation is the management of return flows. Sprinkler irrigated land has little or no wastewater or runoff, compared to that previously resulting from gravity irrigation. The wastewater that used to drain from gravity irrigated fields was historically recaptured and redelivered to other downstream water users. To adjust for these changes, the TFCC needs to deliver more water at the heads of the laterals and coulees than in the past to ensure that there are no shortages at the tail end of the system.

1.9 Natural Environment

There are no known environmental resources of special value including rivers, streams, lakes, fisheries, threatened plant and animal communities, spawning grounds, or flyways. Natural vegetation is characterized with sagebrush and various arid grasses.

1.10 Cultural Resources

There are no identified or known cultural resources of significance within the TFCC service area.

1.11 Climate

The project service area is located in a semi-arid western climate typical of the Snake River Plain and southwest Idaho. Climate summaries from Twin Falls, ID (cooperative ID no. 109303) were used to represent the service area climate conditions. Average annual precipitation is approximately 10.7 inches, predominately during the winter months in the form of rain and snow. Average annual snowfall is 27.0 inches. The maximum recorded annual precipitation was 18.3 inches, which occurred in 1995, and the minimum was 4.6 inches in 1966.

Temperatures are typically moderate in winter and high in summer. The mean annual temperature is 47.6 degrees. Temperature extremes range from a minimum of –23 degrees and a maximum of 104 degrees. Average winter maximum and minimum temperatures are approximately 38.2 and 20.9 degrees, respectively. Subzero temperatures occur occasionally in each of the winter months. During the summer season, daily maximum temperatures average about 81.8 degrees but often reach 100 degrees. High summer temperatures are accompanied by low humidity.

The average frost-free season is about 137 days and extends from mid-May to mid-October. Length of the frost-free season fluctuates with a minimum duration of about 107 days and a maximum around 183 days.

The service area is relatively windy when compared to the rest of Idaho. Average annual wind velocity in the service area is 11 miles per hour. Average monthly wind velocities during March, April, and May are approximately 12 miles per hour. Winds increase the rate of water loss from soils and plants, particularly if the air is dry. As mentioned above, high summer temperatures are accompanied by low humidity. The rate of water loss is increased in part because of the high capacity of moving air to supply energy for evaporation and in part from the removal of water vapor as rapidly as it is released by evaporation.

1.12 Diversion and Storage Facilities

Water is diverted from the Snake River at Milner Dam, regulated at Murtaugh Dam, and split between the Low and High Line Canals at Forks.

Milner Dam

The initial construction of Milner Dam was completed in October 1906 as part of the United States Bureau of Reclamation's (USBR) Minidoka Project. The dam was formed by three earth and rock-filled embankments abutting against the river banks and two islands. In 1910, a powerplant and three pumping plants were added to allow water delivery to lands which could not be supplied by gravity irrigation. Milner Dam is approximately 30 miles downstream of Minidoka Dam which forms Lake Walcott.

In December 1988, the Federal Energy Regulatory Commission's Division of Dam Safety and Inspection determined there was a high risk of failure unless it was rebuilt. To pay for reconstruction, the TFCC and the North Side Canal Company (NSCC) entered into an agreement with the USBR and Idaho Power to rehabilitate the dam and build a new 57.5 megawatt power plant. Reconstruction of Milner Dam and the new power plant was completed in 1997.

Murtaugh Lake

Murtaugh Lake, which is formed by Murtaugh Dam, is located approximately 8 miles downstream of Milner Dam. Murtaugh Lake is a man-made lake that was developed as part of the Southside Irrigation Project and is used to regulate flows for both the TFCC and the Southside Irrigation District.

To supplement natural flow rights, the TFCC has storage rights in American Falls Reservoir and Jackson Reservoir. Table 1-6 summarizes TFCC storage facilities. The water rights and priority dates for the storage facilities are provided in Section 2.0 Inventory of Water Resources.

Table 1-6

Storage Facilities

Storage Facility	Storage Rights (acre-feet)	Total Storage Capacity (acre-feet)
American Falls Reservoir	151,185	1,672,590
Jackson Reservoir	97,183	847,000

American Falls Reservoir Storage

American Falls Reservoir is located on the Snake River in southeastern Idaho just upstream of the town of American Falls. There have been two American Falls Dams. The first dam was built from 1925-1927. A second dam was built from 1974-1978 to replace the first dam and is located immediately downstream from the original dam. American Falls Reservoir currently has an active storage capacity of 1,672,590. The TFCC is entitled to 151,185 acre-feet of storage in American Falls Reservoir.

Jackson Reservoir

Jackson Reservoir Dam, located on the South Fork Snake River, is located within Grand Teton National Park near Moron, Wyoming. Jackson Reservoir Dam was first constructed in 1906 by installing a log dam at the outlet of the natural lake. The dam failed in 1910 and was replaced by an earthen dam that through a series of dam improvements increased the reservoir to its current active capacity of 847,000 acre-feet. The TFCC is entitled to 97,183 acre-feet of storage in Jackson Reservoir.

1.13 Conveyance and Distribution Facilities

TFCC conveyance and distribution facilities include approximately 1,110 miles of major canals and laterals. Table 1-7 summarizes information relative to major conveyance facilities.

Table 1-7

Canal Company Conveyance and Distribution Facilities

Name of Facility	Length (miles)	Approximate Capacity (cfs)
Main Canal	31	3,400
High Line Canal	104	1,500
Low Line Canal	52	1,300

2.0 Inventory of Water Resources

2.1 Water Supplies

Explanation of Water Right

TFCC has water rights for and delivers up to 3/4 miner's-inch (m-in) per share. This is an obligation to deliver 1/80 cubic foot per second (cfs) of water for each share of stock when the water is available. TFCC delivers a proportionate share of the water supply for each share of stock. TFCC water rights are summarized in Table 2-2.

Table 2-2

Water Rights or Entitlements

Type	Source	Flow Rate or Volume	Priority Date
Natural flow	Snake River	3,000 cfs	October 11, 1900
Natural flow	Snake River	600 cfs	December 22, 1915
Natural flow	Snake River	180 cfs	April 1, 1939
Reservoir storage	American Falls Reservoir	151,185 acre-feet	February 21, 1911
Reservoir storage	Jackson Reservoir	97,183 acre-feet	February 21, 1911

History of Water Right

Following passage of the Carey Act, described in the 'History and Background Information' section of this report, the State of Idaho authorized the Twin Falls Land and Water Company, by contract dated January 2, 1903, to sell water rights to entrymen within the Twin Falls project. The system was planned and constructed to offer one (1) cfs of water for each 80 acres the entrymen purchased. The State Reclamation Engineer was required to approve a plan for construction of the project. He approved a project of about 240,000 acres (shares) based upon a 1900 water right for 3,000 cfs spreading the water right equally per acre if all 240,000 acres were developed. Even distribution of 3,000 cfs (150,000 m-in) on 240,000 acres provides 5/8 m-in per

acre. TFCC has operated on the premise that the Company must deliver 5/8 m-in per acre constant flow so long as that supply is available.

As the project was developed, it was determined that inadequate water was available. Consequently, after the Company sold rights for about 198,000 acres, sales were stopped. After the allocation of 5,000 shares to the High Line Canal Company (Clover Tract), sales were halted. This action was eventually validated by Court decree, State and Rice vs. Twin Falls Land and Water Company, 37 Idaho 73, 217 p.252 (1922). A final legal action Twin Falls Land and Water Company vs. Twin Falls Canal Company, 79 F.2d 431, 1935, limited the water right to 203,569 shares at one share per acre. The amount has been since reduced to 202,691 by acquisition of treasury stock and through foreclosures.

Acquisition of Additional Water Rights Since 1900

To increase the water supply of the project, the TFCC (as the Carey Act Operating Company, which succeeded the Construction Company) continued to acquire additional water rights. Storage rights were acquired in Jackson and American Falls reservoirs as "Warren Act" contractors (Act of February 21, 1911, 43 USC 523), for approximately 250,000 acre feet. In average years reservoir storage supplements declining natural flows in late summer. During drought years reservoir storage supplements natural flows throughout the season.

In years in which TFCC receives its full 3,000 cfs of natural flow well into the summer because reservoirs are full and spring runoff is still available, TFCC has traditionally delivered at least 3/4 m-in per acre/share, and sometimes up to an inch in critical periods. (202,691 acres x 3/4 m-in per acre/share = 3,040 cfs).

Since 1905, TFCC has improved and enlarged the system carrying capacity and water deliveries. Additional natural flow rights of 780 cfs of natural flow were acquired in 1915 and 1939. However, these rights are valid only during flood stage.

About 1918, subsurface water began seeping to the surface on the west end of the tract. A multi-million dollar effort resulted in the recapture and reuse of this water, which was reclaimed to preclude losing cropland to alkali processes. With reuse and better management of the system, TFCC has more often been able to deliver 3/4 inch per acre/share, succeeding in most average and above average water years. The estimated diversion requirements that are needed to

supply 3/4 m-in to all shares plus an additional 10 percent at the turnout for peak 10- to 14-day needs are 3,750 cfs at the Milner Headworks and 3,400 cfs at the Murtaugh Headworks.

The TFCC water rights are perfected both by water right filings and adjudication decrees. No challenge has ever been made alleging TFCC's diversion and use of up to 1 inch per acre is not a beneficial use of water.

2.2 Quality of Water Sources

Relative to water quality, there are no known limitations on the agricultural use of water diverted from Lake Walcott.

The Idaho Water Resources Research Institute (IWRRI) group at the University of Idaho's Kimberly Research and Extension Center has been involved with water quality studies on the Snake River between Milner and King Hill, (commonly known as the Mid Snake) since 1990. The focus of the research has been the collection of water quality data in the reach related to sediment and nutrients and their sources. The studies have been funded by, the Idaho Department of Health and Welfare, Division of Environmental Quality, local canal companies (TFCC and NSCC), with assistance by USBR. Water quality monitoring data can be obtained at the following URL: http://www.kimberly.uidaho.edu/midsnake/monitor.html.

Water quality data for the various monitoring locations include the following:

- Canal system water quality data locations
    - R Lateral at 4000 N (Part of the LQ Drain at 4000 N)
    - TFCC Division 3 Lateral 10 above Hydroplant
    - Twin Falls Highline Canal at Bridge southeast of Buhl
    - Twin Falls Lowline Canal at Bridge southeast of Buhl
    - Twin Falls Main Canal at Bridge near Milner
    - Twin Falls Main Canal at split south of Hansen
- Irrigation return flow water quality data locations
    - Main Perrine Coulee at Poleline Road near Twin Falls
    - Q2 Lateral at 2600E 4720N
    - TFCC Lateral 3
    - TFCC Lateral 4C

- TFCC Lateral 5A2/5A Complex
- LQ Drain at 4000 N Crossing
- LQ Drain at 2400 E and 4340 N
- LQ Drain at MP 4200 N

- Inflow/outflow monitoring of various water quality improvement facilities (i.e., constructed wetlands, and/or sediment ponds)
  - Cedar Draw
  - College of Southern Idaho
  - Kasel Pond
  - Norris Sediment Pond

3.0 Canal Company Water Budget

The water budget depicts where and when the TFCC gets its water and how water is used and lost throughout the service area. The evaluations help to identify water supply and timing opportunities. A water budget was prepared for years that represent a dry, average, and dry year of available water. Available water is the amount of surface water or stream flows. The amount of stream flows, usually associated with the amount of precipitation, is typically snow during the previous winter. It is not associated with the amount of precipitation during the growing season. Years with extreme high or low precipitation were also avoided. The selection was also limited to the period for which better data are available. The years chosen are:

- 1997 to represent a wet year (Upper Snake River regional flow records 151 to 181 percent of average)
- 1998 to represent an average year (Upper Snake River regional flow records 111 to 130 percent of average)
- 2001 to represent a dry year (Upper Snake River regional flow records 50 to 65 percent of average)

The following sections include general definitions to assist in understanding specific terms and a summary of the water budgets. The calculated and measured quantities used in the water budgets for all years (1997, 1998, and 2001) are included in the Appendix.

3.1 General Definitions

Some general definitions are presented below. Some of the terms and their use are specific to the TFCC.

- ***Crop requirement or evapotranspiration (ET)*** is the depth of water transpired by plants or evaporated from adjacent soil surfaces in a specific time period. The crop requirement was determined using the USBR AgriMet daily ET values for the years 1997, 1998, and 2001. The AgriMet station at Kimberly, Idaho, was used. AgriMet stations monitor climatic parameters representative of the evaporative demand on irrigated crops. Crop water-use models are run daily to translate local climatic data into daily ET information for crops. The published ET values assume optimum conditions, that is, water not limited, crops adequately fertilized, and no disease.

In addition to ET, there are other water requirements included in the water budget that are not in the AgriMet ET values. The additional water requirements include pre-plant, irrigation of crop stubble or straw prior to cultivating, and irrigation of potatoes prior to harvesting. The pre-plant water requirement for pre-plant irrigation and bare ground ET was estimated by using 30 percent of the ET value for "alfalfa peak." The ending date assumed for using alfalfa peak ET values to estimate pre-plant irrigation is May 5 for spring grain. The corresponding crop ET values are used after these dates. A typical practice in the fall is to irrigate grains prior to cultivating and potatoes prior to harvesting. It was assumed to facilitate cultivating of grains that there are 2.5 inches of irrigation on acres with straw and crop stubble over a period of 10 days, from August 26 to September 4. It was assumed to facilitate harvesting of potatoes that there are 2.0 inches of irrigation, respectively, over a period of 10 days, from October 1 to October 10.

- ***Total crop requirement*** is the total volume or quantity of water determined using the individual crop requirements and crop acreage. Canal Company crop reports were used to estimate the acreage. Most of the crop types in the Canal Company crop reports and AgriMet aligned. Some assumptions were made in the conversion. For example, the crop description of "other hay" was assumed to be an oat-hay mix.
- ***Conveyance and distribution losses*** include seepage and evaporation within canals and laterals. These losses are not quantified.
- ***Spills*** include water that is spilled at different locations in the system to meet farm deliveries. Spills are often reused within the drainage system.
- The ***drainage system*** collects diverted, waste, and surface or subsurface water from the service area. For example, the runoff of excess water from gravity irrigation systems is collected in the drainage system.
- ***Return flows*** include drain flows in excess of the sediment pond storage that are returned to the Snake River.
- ***Ground water recharge*** is the flow to ground water storage from infiltration.
- The different types of efficiencies used in the report are as follows:

- ***Irrigation application efficiency*** is the ratio of the average depth of irrigation water that is beneficially used to the average depth of irrigation water applied, expressed as a percent. Beneficial uses include satisfying the soil water deficit and any leaching requirement to remove salts from the root zone.

- ***Overall efficiency*** is a measure of the diverted volume of water that is not returned by ground water recharge that is beneficially used by the crop. It indicates how efficiently the Canal Company and water users put the water to beneficial use.
  Overall efficiency = total crop requirement/total supply

- ***System efficiency*** is a measure of the diverted volume of water that is not returned by ground water recharge that is beneficially used by the crop. It indicates how efficiently the Canal Company delivers the water to the water users.
  System efficiency = total volume delivered /total supply

3.2 Summary

The level and accuracy of a water budget is dependent on the amount and reliability of flow measurements within the system. The water balance is complicated by wastewater and seepage water being recaptured and put into the delivery system to serve water users downstream. This recapture of wastewater and other subterranean seepage flows further increases the efficiency of the system, but makes it difficult to perform a water budget within the system.

The water budgets were prepared using records of the measured diversions and the calculated crop requirement. The crop requirement is calculated using recorded USBR data and the land use is determined from the annual crop report.

The overall efficiency is presented for the overall service area water budget; the system efficiency is not presented for the overall service area. The TFCC measures all farm deliveries as it is their obligation to deliver water users their water right. The TFCC focuses their analysis of system efficiencies on individual laterals which can be more efficiently evaluated to identify localized problem areas. The localized water budgets presented in Section 3.3 evaluate lateral system efficiencies.

Figure 3 shows the temporal distribution of the water budgets used for determining the overall efficiencies. Table 3-1 is a summary of overall efficiencies estimated for each year. Tables that quantify irrigation efficiency estimates for each water budget are included in the Appendix.

Table 3-1

Overall Irrigation Efficiencies

	Percent Efficiency		
	Wet (1997)	Average (1998)	Dry (2001)
March	-	-	-
April	26%	43%	26%
May	32%	31%	40%
June	49%	48%	56%
July	57%	66%	66%
August	54%	52%	62%
September	30%	28%	37%
October	9%	8%	34%
Total	42%	44%	50%

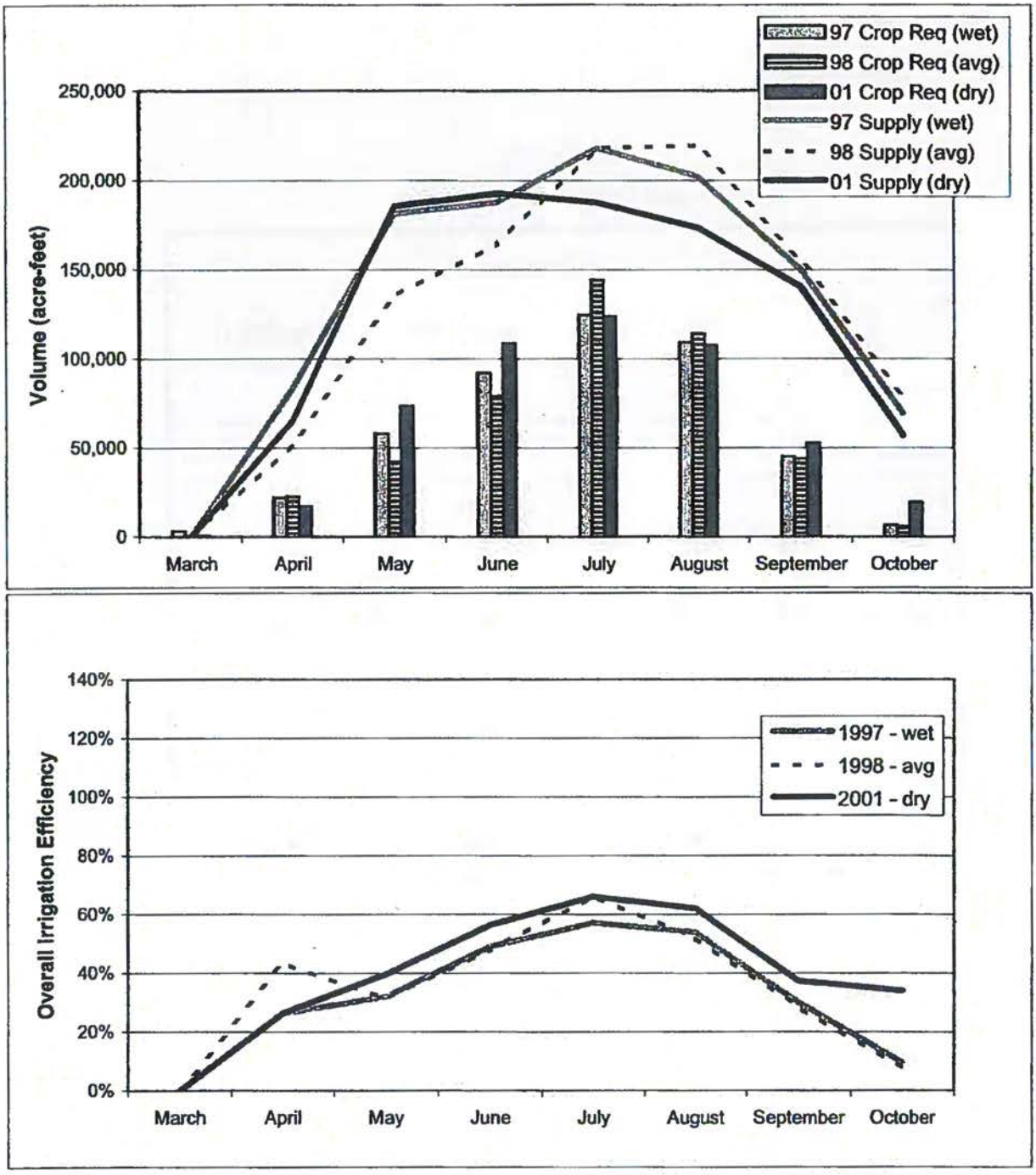


Figure 3. Overall Irrigation Efficiency Estimates with Volumes

Table 3-2 summarizes total annual volumes used in each water budget.

Table 3-2

Water Budget Annual Volume Summary

	Wet - 1997	Average - 1998	Dry - 2001
Total Supply (acre-feet)	1,092,477	1,023,540	1,002,466
Crop Requirement (acre-feet)	460,315	452,252	503,214
Overall Efficiency	42%	44%	50%

A review of the water budget analysis identified the following items for consideration in the water conservation plan:

- The calculated annual overall efficiencies range from 42 percent to 50 percent.
- Spring and fall efficiencies are low, suggesting there that there are losses and waste in these periods. Several factors could be contributing to these low efficiencies. One factor is that the delivery system is unable to adjust to changes in demands. Another factor that is not within the control of TFCC is excessive or over-irrigation by water users. It is TFCC's obligation to deliver water users their water right. One reason for over-irrigation in the spring is that although the ET values are low, the same amount of water application for a gravity system is required to get adequate coverage. Low efficiencies in the spring and fall could also result from the desire of water users to irrigate new stands of alfalfa or winter wheat, or poor rotation of irrigation.
- The Canal Company continues to upgrade and improve water measurements to better track water usage. Operation of the distribution system to assure the maximum delivery rate of 3/4 miner's inch per share has been established by historic practice and precedent.

3.3 Localized Water Budgets

Additional water budgets were prepared to evaluate lateral system efficiencies. Since 1999, the TFCC has developed several small-scale water budgets to identify localized problem areas. Daily supply, farm delivery, and spill measurements were used to develop localized water budgets. Examples of localized water budgets prepared during 2004 for Laterals #28/#29, Lateral 16, and Lateral #44 are shown in the Appendix. The average system efficiencies range from 47 percent to 80 percent. As calculated, the system efficiencies are understated. The localized water budget does not credit the Canal Company for re-use of spills. Considering that the re-use of spills is not accounted for, these efficiencies are relatively high, indicating that conveyance and distribution losses are minimal.

4.0 Legal, Institutional, and Environmental Considerations

4.1 Legal and Institutional Considerations

The TFCC is regulated by the Idaho Code. The TFCC has its own set of by-laws and operates and maintains the distribution system used to deliver water to the project service area.

4.2 Environmental Considerations

TFCC has been actively implementing Best Management Practices (BMPs) to improve water quality of flows returning to the Snake River. Water quality is improved by removing nonpoint source pollutants. Wetlands, sediment ponds, and other treatment facilities are part of the water quality improvement program.

The program was initiated in October 1991. The University of Idaho (U of I) Pond, College of Southern Idaho (CSI) Pond, and Cedar Draw Pond were primary projects that established the groundwork for the program.

Cedar Draw Pond served as a pioneer project combining cooperative efforts from TFCC, Idaho Fish and Game, Idaho Power Company, Coors Brewing Company, U of I, U.S. Department of Agriculture Plant Materials Center, and U.S. Fish and Wildlife Service. The project utilizes an old fish hatchery for the construction of a wetland. The wetland treats flows from Cedar Draw. The facility was primarily monitored during 1997 with some spot monitoring in 1995 and 1996. Estimates for removal efficiencies at that time were approximately 50 to 60 percent for sediment, and 15 to 30 percent for phosphorous. After establishment of the wetland vegetation, the sediment removal efficiency ranges between 50 and 90 percent and the total phosphorous removal ranges between 20 and 70 percent.

The CSI Pond is a wetland constructed to improve water quality in the Perrine Coulee. The wetland was modeled after a constructed wetlands system developed in Maine by Wengrzynek and Terrell. Their work indicates removal efficiencies of 65 to 100 percent for nitrogen and total phosphorous.

In addition to these initial projects, the TFCC now maintains over 100 sediment ponds. Since 2000 the TFCC has constructed the following major wetland projects:

- Malone Pond and Wetland (completed in 2000) – 17-acre wetland site built by TFCC in partnership with the Idaho Power Company, Idaho Fish and Game and Idaho Department of Environmental Quality (IDEQ)
- Main Perrine Coulee Wetland 319 Project (completed in 2003) – 15-acre facility built by the TFCC in partnership with the Snake River Soil Conservation District (SRSCD)
- F-Coulee Wetland 319 Project (completed in 2003) - 15-acre facility built by the TFCC in partnership with the Balanced Rock Soil Conservation District
- East Perrine Wetland 319 Project (completed in 2004) - 7-acre facility built by the TFCC in partnership with the SRSCD
- Lower Perrine Wetland 319 Project (completed in 2005) - 5-acre facility built by the TFCC in partnership with the SRSCD
- LS-LQ Wetland 319 Project (completed in 2006) – 29-acre facility built by the TFCC in partnership with the SRSCD, the Idaho Power Company, and IDEQ.

Figure 1 shows the locations of the projects. The focus during the past 2 years has been to locate the ponds close to the Snake River. Maintenance of these ponds led to the purchase of an excavator in the fall of 1997 for the sole purpose of pond maintenance. The TFCC continues to work with the U of I for water quality monitoring on 11 major irrigation drains returning from the service area to the Snake River (see additional discussion in Section 2.2). Monitoring has shown dramatic improvements in reducing the amount of sediment, nutrients, and other pollutants that are returned to the Snake River. It is estimated that the ponds and wetlands maintained by the TFCC remove 100,000 tons of sediment annually from return flows.

In addition to pond and wetland construction, the TFCC remains very active in educational programs to help landowners retain soil on their farms. The TFCC promotes the use of PAM (polyacrylamide) on all furrow irrigated crops in conjunction with filter strips and sediment basins. All TFCC ditchriders have Imhoff cones available which can be borrowed for sampling.

5.0 Existing Water Management Measures and Programs

TFCC has been actively implementing programs to improve water management and delivery service to its shareholders, and to provide data to verify future water savings. In 1995 the TFCC implemented a Quality Assurance Program in which they hired an additional staff member to check ditchrider measurements and to verify that headgates are locked.

5.1 Water Measurement and Accounting Procedures

Canal Automation

The TFCC canal automation system typically includes flow measurement devices, gate controllers, and remote computers for monitoring and control. Computer controls of major water control and diversion structures allow TFCC to schedule increases and decreases in flow without requiring that system operators be present. Remote access allows for faster response to demand changes. The automation also provides more consistent control because the automation can compensate for fluctuations in the system, such as changes in water level.

Figure 1 shows the location of facilities with automation. The diversions at Milner, Murtaugh, and the Forks are automated. Changing the desired flows can be performed at a computer located in the main office.

The gate for controlling diversions and spills into Cedar Draw on the High Line Canal and Low Line Canal is automated to regulate discharge. The wasteway at Point Spill is also configured for automation. The function of Point Spill is to quickly spill flows back to the Snake River during an emergency. An additional 40 laterals have also been automated.

Canal Measurements

Remote flow monitoring assists system operators in making decisions to "tune" portions of the canal under their control. The electronic flow monitoring equipment also provides an unbiased and continuous view of flows where operators are not available. There are currently four gaging stations for the major canals. The locations of these gaging stations are also shown in Figure 1.

Return Flow Measurements

Thirty-four locations are currently being measured using a weir. Six of the locations have a continuous data recorder. The remaining locations are measured and recorded two to three times each week throughout the irrigation season.

To separate the base or natural flows from irrigation flows, flow measurements were recorded during the non-irrigation season in late November 1996. Measurements were taken at locations where the return flows were previously measured during the irrigation season.

The TFCC built two portable automation units that are used to measure return flows. These units are mounted on a portable frame and are used for the following purposes in addition to monitoring return flows:

- Monitoring lateral heads
- Monitoring canal reaches
- Monitoring seeps

The ability to monitor various areas using the portable unit is a benefit for water users and allows the TFCC to operate safely and more efficiently.

Lateral Inventory and Measurements

Approximately 450 laterals flow from the major canals, all of which have some type of flow measuring device. TFCC has upgraded all measuring devices that were in need of maintenance with broad-crested weirs.

Farm Turnouts and Measurements

The irrigation system includes approximately 5,300 farm turnouts. Each turnout is equipped with a discharge measuring device. Individual landowners are responsible for maintenance of turnout structures and on-farm discharge measurements.

5.2 Water Pricing and Billing Practices

TFCC revenues are based on per-share assessments. Stockholders pay a flat rate of $21 per share. TFCC uses these assessments to fund operations and capital improvements.

5.3 Operation and Maintenance Program

The goal is to protect and maintain operating infrastructure and to deliver water as economically as possible while maintaining the integrity of TFCC facilities. Day-to-day operations are coordinated from the main office located in Twin Falls; the West Division is coordinated from the Buhl office. Ditchriders are responsible for water distribution.

Routine operation and maintenance responsibilities include:

- Operation of the canal and lateral structures including the diversion of water through headgates to private pumps and ditches
- Concrete work, trenching, and installation of gates and weirs for accurate delivery and measurement of water
- Application of aquatic and terrestrial chemicals to control vegetation
- Mechanical control of noxious weeds
- Mechanical removal of aquatic weeds
- Removal of sediment accumulation from drainage ways and ponds
- Physical maintenance of delivery systems including removing rocks from conveyance channels to reduce water losses
- Preventative maintenance of heavy equipment and light vehicles
- Maintenance of lateral and drainage road right of ways by grading and hauling gravel
- Installation of pipelines
- Routine repair of all system components

- Repair and replacement of concrete structures
- Office and clerical work
- Assign new water certificate for lands sold to new owners

5.4 Water Shortage Allocation Policies

Water shortages may result from limited water supply as a result of prolonged periods of drought that deplete reservoir storage. When demand exceeds the delivery capacity of the TFCC, water is allocated on an equal-share basis according to the number of irrigable acres.

5.5 Wasteful Use of Water Policies

Ditchriders monitor water use and communicate with land owners when they observe wasteful practices. Ditchriders point out problems that result in wasted water and suggest practices that promote water conservation. Since the TFCC is obligated to deliver each land owner his water right, implementation of water-conservation practices is voluntary.

5.6 Water Transfer Policies

Stockholders can request permanent transfers which legally change the location where water rights are appurtenant and possibly the point of diversion. Transfer requests must be made at least seven working days before the Board meeting and a transfer fee is collected to offset recording and research costs. Following Board approval, transfer applications are sent to the American Falls Reservoir District for final approval by their Board.

Stockholders can also request seasonal transfers which are effective for one irrigation season. Upon approval by the Board, designated transfers are allowed by notifying the ditchrider prior to delivery changes. Transfer requests are made from 7:00 a.m. to 7:30 a.m. for water transfers for the next day. In addition, transfer requests for equal amounts of water, which do not change

the original amount ordered and include transfers from one headgate to another on the same canal or lateral, may be completed during a ditchrider's scheduled stop.

5.7 Flooding

Floods occur when flows exceed the capacity of canals and laterals and other natural waterways. During the non-irrigation season, flooding can occur due to runoff water that infiltrates the system. The TFCC will reasonably assist in efforts to control flood waters and minimize flood damage to stockholders and is not be responsible for any damages. The TFCC will not divert water from coulees or natural drainage channels into the distribution system as a means of reducing the flow in the coulee or natural drainage channel.

6.0 Water Management Issues and Goals

TFCC's long-term goal is to minimize return flows. Two basic problems have been identified that inhibit TFCC from accomplishing this long-term goal:

- Long distribution system creates challenges in water management.
- Delivery system adjusts too slowly to changing weather conditions and demands.

Each problem is listed below. Symptoms follow each problem. Corresponding goals and a discussion of their projected result follow. Each goal has clear and precise objectives to be implemented for the current 5-year plan. The objectives represent the "What" and the "How" of accomplishing the goals.

Some of the problems have common symptoms and thus share common goals and objectives. Goals and objectives are aligned with the problem that they best remedy.

Problem 1: Long Distribution System Creates Challenges in Water Management

Goal: Develop Localized Water Budgets

TFCC believes that by focusing on a small area, such as a lateral, problems can be identified. A water budget could be developed on a small scale. A baseline for lateral efficiency would be established and tracked to identify trends. The efficiencies for laterals could be assessed to determine if they seemed reasonable. Laterals with unreasonably high or low efficiencies would be evaluated to determine both the cause and whether a remedy is warranted. In addition, ditchriders have developed a better understanding of their laterals to manage more efficiently. Since 1999 the TFCC has developed localized water budgets for approximately 85 and 20 percent of the laterals on the east and west sides of the project service area, respectively.

Objectives

- Continue to collect data and prepare and evaluate lateral water budgets.

Goal: Improve Delivery System Efficiency

Conveyance and distribution system losses due to seepage comprise a significant portion of the total diverted volume of irrigation water. The reduction of these seepage losses will improve delivery system efficiency and facilitate water conservation. The TFCC has identified high seepage zones and has evaluated various lining alternatives.

Canal Company Objectives:

- Continue to line problem areas within the canal with bentonite.

Problem 2: Delivery System Does Not Adjust to Changing Demands

Symptoms:

- Canal runs full and cannot track closely to on-farm demands.
- Flows are spilled or returned to the Snake River.

Goal: Identify Locations for Water Reuse Systems

Return flows at locations may be decreased by the proposed improvements. The TFCC identified the LS/LQ Drain as a possible reuse location. The following criteria were developed for selecting pump back locations:

- Reliable water supply
- Location near the Snake River
- Land availability
- Water users downstream are not negatively impacted (irrigators, hydropower, etc.)
- Power availability

Objectives

- TFCC will work with the City of Twin Falls to develop a cooperative agreement for pump backs.

7.0 Implementation of Objectives

7.1 Schedule

Many water management improvements take time to develop and will not be realized immediately. Commitment of both time and budget are required to accomplish these improvements. Table 7-1 presents a schedule template for implementation of the objectives. It is TFCC's desire to meet these objectives, although some objectives may be deemed undesirable if, after evaluation, it is found that they are not cost-effective or are not contributing to the success of the goal.

7.2 Budget

A budget template for the water management plan is also summarized in Table 7-1. The TFCC will evaluate the budget for the proposed schedule periodically based on available funds and costs associated with the specific improvements.

7.3 Monitoring and Evaluation

An assessment of each objective will be performed annually. The TFCC will provide a progress report that reflects the successes and failures. The progress report shall also include a comparison with projected results.

Table 7-1

Schedule and Budget for Objectives

Goals and Objectives	2007	2008	2009	2010	2011
Augmentation of Current Water Measurements					
Continue program for inventorying and replacing farm turnouts (25 per year)					
Upgrade flow measurement of laterals (two per year)					
Continue monitoring and measuring return flows at key locations.					
Develop Localized Water Budgets					
Prepare and evaluate a lateral water budget for each lateral					
Develop Water Reuse Systems					
LS/LQ Drain as a pump backs facility for reuse.					
Continue to Maintain Water Quality					
Sediment Pond Maintenance					
Develop Sediment Pond Site (two per year)					

APPENDIX

Water Budget Tables

Wet Year 1997

Table A-1 Monthly Crop Irrigation Requirements Summary—1997

Table A-2 Canal Company Agricultural Water Budget —1997

Average Year 1998

Table B-1 Monthly Crop Irrigation Requirements Summary—1998

Table B-2 Canal Company Agricultural Water Budget —1998

Dry Year 2001

Table C-1 Monthly Crop Irrigation Requirement Summary—2001

Table C-2 Canal Company Agricultural Water Budget—2001

Localized Water Budgets

Table D-1 Lateral #44

Table D-2 Laterals #28, #29, #29A, #29A1, and #29B

Table D-3 Laterals #16, #16A, #16B, and #16C

Table A-1

Monthly Crop Irrigation Requirement Summary - 1997 (Wet)

		Irrigation Required (inch)								Irrigation Required (acre-feet)							
Crop	Acres	March	April	May	June	July	August	Sept.	Oct.	March	April	May	June	July	August	Sept.	Oct.
Sugar Beets	9,498	0.1	1.0	2.5	5.5	8.8	8.4	4.7	0.5	95	755	1961	4322	6934	6672	3680	396
Wheat	21,015	0.1	1.0	3.6	8.0	7.9	0.5	0.0	0.0	210	1671	6229	14063	13905	823	0	0
Mixed Grain	5,038	0.1	1.0	3.6	8.0	7.9	0.5	0.0	0.0	50	401	1493	3371	3333	197	0	0
Potatoes	9,328	0.0	0.0	1.9	5.7	8.2	7.6	2.6	0.0	0	0	1446	4439	6390	5877	2037	0
Alfalfa Hay	35,022	0.4	3.1	6.5	6.9	7.6	7.5	4.8	1.2	1167	9047	18824	20138	22093	21860	14126	3473
Barley	21,380	0.1	1.0	3.6	8.0	7.9	0.5	0.0	0.0	214	1700	6337	14307	14146	837	0	0
Beans	40,970	0.1	1.0	2.3	2.6	6.9	7.5	0.4	0.0	410	3257	7723	8778	23489	25572	1229	0
Silage/ Corn	13,570	0.0	0.5	2.7	4.9	7.9	8.5	3.3	0.0	0	565	2997	5485	8945	9646	3687	0
Corn	11,365	0.0	0.0	0.0	2.3	5.9	8.7	4.9	0.0	0	0	0	2216	5607	8211	4631	0
Pasture	12,761	0.8	2.6	5.1	5.5	6.0	5.9	3.6	0.7	808	2797	5466	5828	6412	6306	3807	691
Alfalfa Seed	235	0.4	3.1	6.5	6.9	7.6	7.5	4.8	1.2	8	61	126	135	148	147	95	23
Other Hay	4,400	0.1	1.0	6.8	8.1	8.9	8.8	5.7	1.4	44	350	2511	2959	3260	3216	2086	513
Oats	1,440	0.1	1.0	3.6	8.0	7.9	0.5	0.0	0.0	14	114	427	964	953	56	0	0
Onion Seed	180	0.0	0.0	0.0	2.1	6.9	7.5	0.4	0.0	0	0	0	32	103	112	5	0
Peas	5,803	0.1	1.0	0.3	0.0	0.0	0.0	0.0	0.0	58	461	144	0	0	0	0	0
Gardens & Orchards	1,700	0.8	2.6	5.1	5.5	6.0	5.9	3.6	0.7	108	373	728	776	854	840	507	92
Sod Farm	295	0.9	3.4	6.1	6.4	7.1	7.0	4.5	1.1	23	83	149	158	175	172	112	28
Urban or Commercial	120	0.9	3.4	6.1	6.4	7.1	7.0	4.5	1.1	9	34	61	64	71	70	45	11
Straw, All kinds	32,621	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0	0	0	0	0	4078	2718	0
Corn, sweet	11,311	0.0	0.0	0.8	3.6	7.5	8.1	0.0	0.0	0	0	754	3412	7051	7625	0	0
Grass Seed	956	0.4	3.1	6.5	6.9	7.6	7.5	4.8	1.2	32	247	514	550	603	597	386	95
Stubble	49,283	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0	0	0	0	0	6160	4107	0
Harvest	18,826	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.8	0	0	0	0	0	0	1883	1255
									Monthly Total (Acre Feet):	3,250	21,915	57,889	91,995	124,472	109,075	45,141	6,578

Table A-2
Agricultural Water Budget - 1997 (Wet)

Time Period	Volume (acre-feet)		Efficiency
	Total Supply	Total Crop Requirement	Overall
March	0	3,250	-
April	83,540	21,915	26%
May	181,335	57,889	32%
June	187,665	91,995	49%
July	218,072	124,472	57%
August	202,321	109,075	54%
September	150,223	45,141	30%
October	69,321	6,578	9%
Total	1,092,477	460,315	42%

Table B-1

Monthly Crop Irrigation Requirement Summary - 1998 (Average)

		Irrigation Required (inch)								Irrigation Required (acre-feet)							
Crop	Acres	March	April	May	June	July	August	Sept.	Oct.	March	April	May	June	July	August	Sept.	Oct.
Sugar Beets	9,682	0.0	1.1	1.9	4.8	10.1	8.4	4.4	0.4	0	854	1497	3881	8149	6777	3510	323
Wheat	22,165	0.0	1.1	3.1	7.1	10.2	2.6	0.0	0.0	0	1956	5719	13040	18859	4858	0	0
Mixed Grain	3,522	0.0	1.1	3.1	7.1	10.2	2.6	0.0	0.0	0	311	909	2072	2997	772	0	0
Potatoes	8,991	0.0	0.0	0.4	3.7	9.1	7.8	3.3	0.0	0	0	322	2742	6803	5852	2435	0
Alfalfa Hay	34,792	0.0	3.2	4.8	6.1	8.7	7.4	4.5	1.1	0	9220	13801	17686	25195	21513	13134	3102
Barley	20,197	0.0	1.1	3.1	7.1	10.2	2.6	0.0	0.0	0	1782	5211	11883	17184	4427	0	0
Beans	40,107	0.0	1.1	1.7	2.2	8.0	7.5	0.4	0.0	0	3539	5585	7490	26738	24967	1370	0
Silage/ Corn	11,446	0.0	0.0	0.7	3.2	8.7	8.5	3.2	0.0	0	0	668	3014	8327	8079	3090	0
Corn	13,915	0.0	0.0	0.0	1.7	5.6	8.2	4.7	0.0	0	0	0	1994	6517	9532	5496	0
Pasture	12,685	0.5	2.7	3.8	4.9	6.9	5.9	3.4	0.6	529	2696	4017	5159	7326	6237	3552	624
Alfalfa Seed	1,260	0.0	3.2	4.8	6.1	8.7	7.4	4.5	1.1	0	334	500	641	912	779	476	112
Clover Seed	365	0.0	3.2	4.8	6.1	8.7	7.4	4.5	1.1	0	97	145	186	264	226	138	33
Other Hay	3,029	0.0	1.1	4.8	7.2	10.2	8.7	5.3	1.3	0	267	1208	1805	2582	2196	1348	316
Oats	1,290	0.0	1.1	3.1	7.1	10.2	2.6	0.0	0.0	0	114	333	759	1098	283	0	0
Onion Seed	199	0.0	0.0	0.0	1.9	8.0	7.5	0.4	0.0	0	0	0	32	133	124	7	0
Peas	2,160	0.0	1.1	1.7	6.2	5.6	0.0	0.0	0.0	0	191	311	1120	1012	0	0	0
Gardens & Orchards	819	0.5	2.7	3.8	4.9	6.9	5.9	3.4	0.6	34	187	259	333	473	403	229	40
Field Corn	300	0.0	0.0	0.7	3.2	8.7	8.5	3.2	0.0	0	0	18	79	218	212	81	0
Sod Farm	741	0.5	3.5	4.5	5.7	8.2	6.9	4.3	1.0	33	215	276	351	507	429	265	62
Urban or Commercial	200	0.5	3.5	4.5	5.7	8.2	6.9	4.3	1.0	9	58	75	95	137	116	72	17
Straw, All kinds	32,838	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0	0	0	0	0	4105	2737	0
Corn, sweet	8,745	0.0	0.0	0.7	3.2	8.7	8.1	0.0	0.0	0	0	510	2303	6362	5661	0	0
Pea Seed	3,846	0.0	1.1	1.7	6.2	5.6	0.0	0.0	0.0	0	339	547	1994	1801	0	0	0
Grass Seed	657	0.0	3.2	4.8	6.1	8.7	7.4	4.5	1.1	0	174	261	334	476	406	248	59
Stubble	46,690	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0	0	0	0	0	5836	3891	0
Harvest	18,673	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.8	0	0	0	0	0	0	1867	1245
									Monthly Total (Acre Feet):	604	22,535	42,169	78,991	144,069	114,007	43,945	5,931

Table B-2
Agricultural Water Budget - 1998 (Average)

Time Period	Volume (acre-feet)		Efficiency
	Total Supply	Total Crop Requirement	Overall
March	0	604	-
April	52,047	22,535	43%
May	135,307	42,169	31%
June	164,426	78,991	48%
July	218,261	144,069	66%
August	219,460	114,007	52%
September	155,192	43,945	28%
October	78,847	5,931	8%
Total	1,023,540	452,252	44%

Table C-1

Monthly Crop Irrigation Requirement Summary - 2001 (Dry)

		Irrigation Required (inch)								Irrigation Required (acre-feet)							
Crop	Acres	March	April	May	June	July	August	Sept.	Oct.	March	April	May	June	July	August	Sept.	Oct.
Sugar Beets	11,483	0.0	0.6	3.0	6.7	9.1	8.5	3.0	0.0	0	614	2837	6402	8718	8115	2880	0
Wheat	18,305	0.0	0.6	6.4	9.0	6.4	0.0	0.0	0.0	0	979	9816	13744	9778	0	0	0
Mixed Grain	733	0.0	0.6	6.4	9.0	6.4	0.0	0.0	0.0	0	39	393	550	392	0	0	0
Potatoes	5,237	0.0	0.0	1.5	6.0	8.5	8.0	2.7	0.0	0	0	663	2619	3688	3500	1174	0
Alfalfa Hay	39,453	0.0	2.1	6.9	7.7	7.8	7.9	5.2	3.5	0	7038	22521	25184	25546	25842	17195	11408
Barley	25,468	0.0	0.6	6.4	9.0	6.4	0.0	0.0	0.0	0	1363	13657	19122	13604	0	0	0
Beans	26,416	0.0	0.6	2.4	3.3	7.9	5.6	0.0	0.0	0	1413	5184	7341	17280	12283	0	0
Silage/ Corn	15,892	0.0	0.0	1.4	4.5	8.3	9.0	4.2	0.0	0	0	1841	5986	10992	11906	5602	0
Corn	9,805	0.0	0.0	0.0	3.2	6.8	9.2	5.5	0.7	0	0	0	2582	5556	7517	4510	584
Pasture	14,426	0.3	2.5	5.5	6.1	6.2	6.3	4.1	2.3	313	2945	6588	7345	7441	7550	4965	2753
Alfalfa Seed	638	0.0	2.1	6.9	7.7	7.8	7.9	5.2	3.5	0	113	363	406	412	417	277	184
Other Hay	3,411	0.0	0.6	7.2	9.0	9.1	9.3	6.2	4.3	0	182	2042	2561	2598	2629	1757	1211
Oats	1,600	0.0	0.6	6.4	9.0	6.4	0.0	0.0	0.0	0	86	858	1201	855	0	0	0
Peas	4,874	0.0	0.6	3.5	8.0	1.5	0.0	0.0	0.0	0	261	1440	3266	601	0	0	0
Gardens & Orchards	429	0.3	2.5	5.5	6.1	6.2	6.3	4.1	2.3	9	88	196	218	221	225	148	82
Field Corn	3,085	0.0	0.0	1.4	4.5	8.3	9.0	4.2	0.0	0	0	357	1162	2134	2311	1087	0
Sod Farm	507	0.5	3.4	6.4	7.2	7.3	7.4	5.0	3.3	21	145	272	304	310	313	209	138
Urban or Commercial	6,135	0.5	3.4	6.4	7.2	7.3	7.4	5.0	3.3	256	1759	3292	3681	3753	3788	2531	1672
Straw, All kinds	40,000	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0	0	0	0	0	5000	3333	0
Corn, sweet	13,801	0.0	0.0	0.6	3.9	8.1	8.6	0.8	0.0	0	0	702	4531	9362	9891	920	0
Grass Seed	813	0.0	2.1	6.9	7.7	7.8	7.9	5.2	3.5	0	145	464	519	526	533	354	235
Stubble	46,426	0.0	0.0	0.0	0.0	0.0	1.5	1.0	0.0	0	0	0	0	0	5803	3869	0
Harvest	16,720	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.8	0	0	0	0	0	0	1672	1115
								Monthly Total (Acre Feet):		599	17,169	73,488	108,726	123,766	107,622	52,484	19,362

Table C-2
Agricultural Water Budget - 2001 (Dry)

Time Period	Volume (acre-feet)		Efficiency
	Total Supply	Total Crop Requirement	Overall
March	0	599	-
April	65,274	17,169	26%
May	185,725	73,488	40%
June	192,925	108,726	56%
July	187,524	123,766	66%
August	173,417	107,622	62%
September	140,614	52,484	37%
October	56,987	19,362	34%
Total	1,002,466	503,214	50%

Table D-1
Agricultural Water Budget - 2004

Time Period	Average Daily Flow (acre-feet/day)			
	Total Supply	Delivered to Patrons	Spills	System Efficiency
	Lat #44	Lat #44	Lat #44	
May	7	5	2	69%
June	7	5	2	72%
July	9	7	1	82%
August	8	6	1	77%
September	5	3	1	58%
Average	7	5	2	73%

NOTE: Schematic shows the average daily flow values

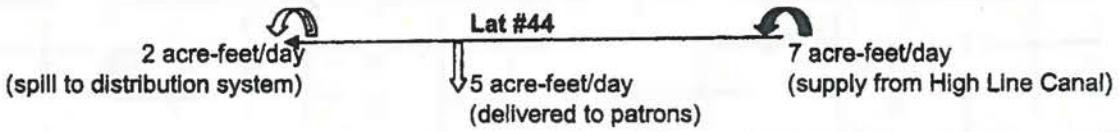


Table D-2
Agricultural Water Budget - 2004

Time Period	Average Daily Flow (acre-feet/day)										
	Total Supply	Delivered to Patrons					Spills				System Efficiency
	Lat #28	Lat #28	Lat #29	Lat #29A	Lat #29A1	Lat #29B	Lat #29	Lat #29A	Lat #29A1	Lat #29B	
May	72	7	6	13	2	8	3	25	3	4	50%
June	75	9	4	10	7	7	2	21	2	3	50%
July	80	6	5	12	7	6	2	25	4	2	46%
August	84	7	5	13	7	4	2	25	2	3	43%
September	63	6	3	12	6	3	2	23	2	2	46%
Average	75	7	5	12	6	5	2	24	3	3	47%

NOTE: Schematic shows the average daily flow values

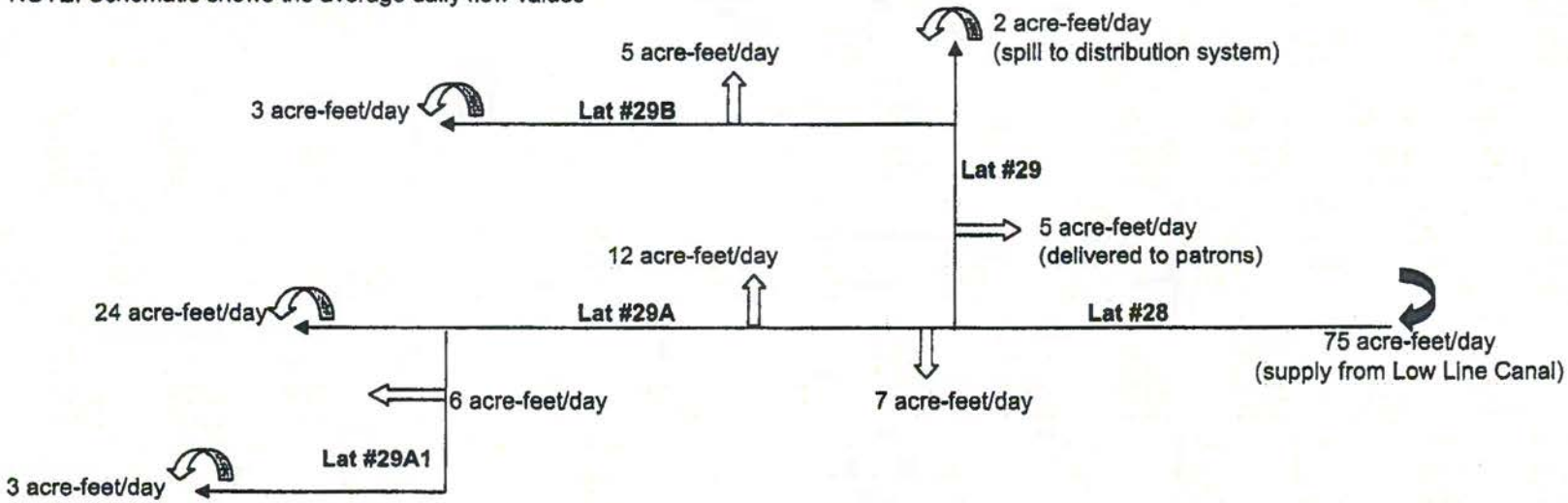
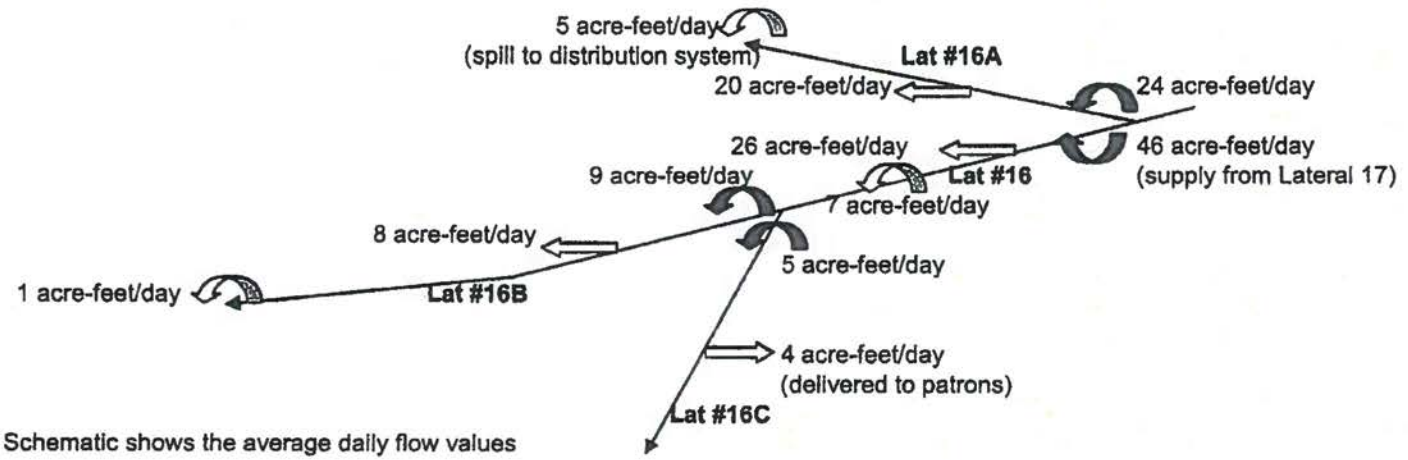


Table D-3
Agricultural Water Budget - 2004

Time Period	Average Daily Flow (acre-feet/day)												
	Total Supply				Delivered to Patrons				Spills				System Efficiency
	Lat #16	Lat #16A	Lat #16B[1]	Lat #16C[1]	Lat #16	Lat #16A	Lat #16B	Lat #16C	Lat #16	Lat #16A	Lat #16B	Lat #16C	
May	51	28	10	5	25	23	9	4	8	5	2	-	77%
June	50	26	9	5	27	20	8	4	6	5	1	-	77%
July	48	25	8	4	28	20	7	3	6	6	1	-	79%
August	46	24	9	4	30	23	8	4	7	4	1	-	93%
September	37	18	7	4	18	13	6	4	10	5	1	-	74%
Average	46	24	9	5	26	20	8	4	7	5	1	-	80%

[1]Supply from Lat #16B and #16C were not included in the overall system efficiency calculations as they are included in the supply from Lat #16.



NOTES: Schematic shows the average daily flow values