EXECUTIVE SUMMARY

SYSTEM IMPROVEMENT PLAN

2017

TUMALO IRRIGATION DISTRICT

COMMUNITY

Tumalo Irrigation District is a community of people with a shared concern and respect for the critical role sustainable agriculture plays in the region, the land and the water resources that nourish our land, and the fish and wildlife that depend on access to healthy native habitats.

Garlic harvest in Tumalo, 2016.

Tumalo Irrigation District

Last year, Tumalo Irrigation District (TID) and the City of Bend engaged Black Rock Consulting to conduct a comprehensive evaluation of the District's canal system. The goal in undertaking this detailed analysis was to determine the relative cost and benefits of piping all of the District's canals and laterals, and pressurizing deliveries to its members. The findings and recommendations in the System Improvement Plan (SIP) will improve the District's ability to responsibly manage its water supplies for the benefit of its members and the region's economy and environment.

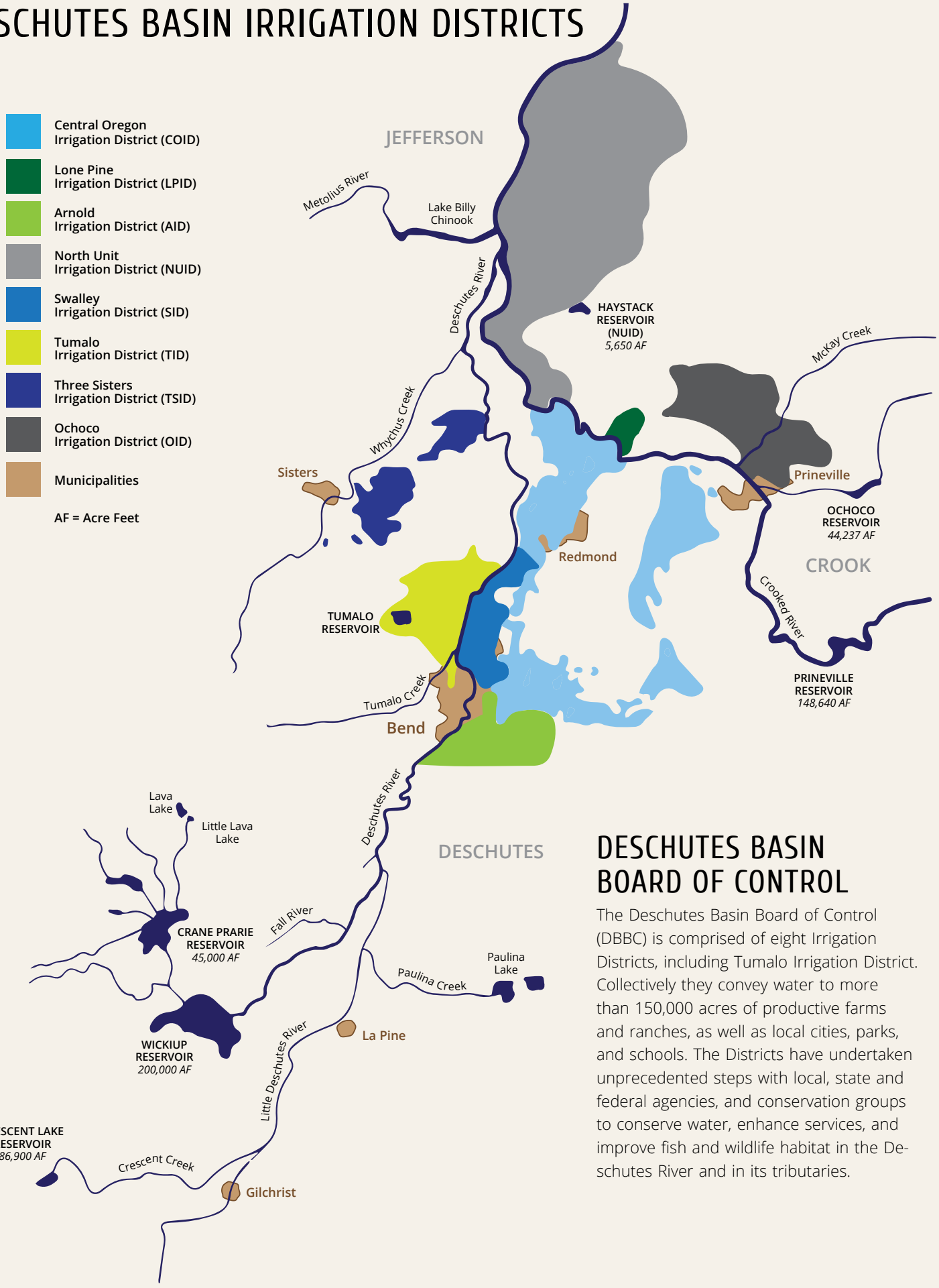
Ever since the early Oregon pioneers dug canals in the porous rock and dirt of Central Oregon, water managers have battled seepage and evaporation. Seepage is the natural result of the volcanic nature of the Central Oregon geology that presents fractured basalt, cinder, and varied substrates. As a result, earthen open canals in the District system have a high propensity for seepage losses, which is compounded by evaporation. These losses were considered with the original 100-year-old design of the open canal system and are reflected in the District's certificates.

Since the mid-1990s, Tumalo Irrigation District has aggressively pursued a water conservation program via piping to provide a permanent solution to system-wide water losses and to add drought tolerance to ensure the consistent delivery of irrigation water to District members. In addition, the District is committed to improving fish and wildlife habitat, including for the Oregon spotted frog, in the Deschutes River, Tumalo Creek and Crescent Creek.

We look forward to reporting on our progress and success in the future and invite you to learn more about Tumalo Irrigation District's System Improvement Plan. Please visit www.tumalo.org.

Kenneth B. Rieck
Manager and Secretary to the Board
Tumalo Irrigation District

DESCHUTES BASIN IRRIGATION DISTRICTS



DESCHUTES BASIN BOARD OF CONTROL

The Deschutes Basin Board of Control (DBBC) is comprised of eight Irrigation Districts, including Tumalo Irrigation District. Collectively they convey water to more than 150,000 acres of productive farms and ranches, as well as local cities, parks, and schools. The Districts have undertaken unprecedented steps with local, state and federal agencies, and conservation groups to conserve water, enhance services, and improve fish and wildlife habitat in the Deschutes River and in its tributaries.

Training the next generation of family farmers.

Tumalo Irrigation District

Tumalo Irrigation District has a long and storied history. In 1883, local citizens dug out the first documented canal to divert water from Tumalo Creek to surrounding farms and ranches. This system was formalized in 1902 when the Tumalo Project was organized as a state project under provisions of the federal Carey Act. In 1922, the project was reorganized as an irrigation district under Oregon state laws and renamed the Tumalo Irrigation District.

Today, the Tumalo Irrigation District manages water from two primary diversion sources: Tumalo Creek below Shevlin Park and the Deschutes River near Pioneer Park. It also manages water stored in Crescent Lake.

The District serves 676 small farms and ranches, manages more than 80 miles of piped and open canals, and irrigates more than 7,400 productive acres on which local citizens raise hay, alfalfa, garlic, lavender, and other cash crops. The District also conveys water supplies to District pasture for livestock and provides stock runs during winter months.

Tumalo Irrigation District is part of the Deschutes Basin Board of Control (DBBC). The DBBC and its member districts and municipalities are working collaboratively with conservation groups and local, state and federal agencies to increase instream flows in rivers and creeks, to improve fish passage through restored habitat, and to maintain ecologically important wetlands.

Since 2000, the districts have reduced annual irrigation diversions by more than 80,000 AF. In turn, this has increased flows in the Deschutes River, Little Deschutes River, Crooked River, Ochoco Creek, Whychus Creek, Tumalo Creek and Crescent Creek, benefitting salmon, steelhead, bull trout, Oregon spotted frog, and other species.

MISSION

Tumalo Irrigation District's mission is to manage water resources to meet the present and future needs of its members in ways that are economically and environmentally responsible. The District's priorities are improving water delivery efficiencies, conserving water, and preserving and restoring native fish and wildlife habitat in the Deschutes River Basin.

THE PROGRESS OF PIPING

In 1998, Tumalo Irrigation District chose to invest in piping canals as the preferred way to mitigate seepage losses (rather than lining them). In addition, piping canals is the single best way to improve canal safety, increase irrigation efficiencies, conserve water, and increase instream flows for fish and wildlife. Piping can also generate renewable hydroelectric power.

To date, TID has piped seven phases on the Bend Feed Canal and four phases on the Tumalo Feed Canal, which totals more than 39,640 feet or seven miles of piped canals.

BEND FEED CANAL

The Bend Feed Canal is completely piped along its approximate five-mile length. The materials used consist of a combination of 72-inch diameter reinforced concrete pipe and 84-inch diameter high-density polyethylene (HDPE) profile wall pipe. HDPE is a premier construction-grade material for piping canals.

TUMALO FEED CANAL

As of March 2017, four phases of the Tumalo Feed Canal piping project (totaling 13,240 feet) have been completed starting from the top near Tumalo Creek. The District has used HDPE in several sections of this canal; however, steel pipe and reinforced concrete dual-barrel pipe was used in certain sections, including at several siphon locations and downstream of the Tumalo Feed Canal intake.

The benefits of piping the two main canals are considerable. More than 11.3 cubic feet per second (cfs) of senior water rights have been restored to Tumalo Creek, and more than 2,843 AF of senior water rights have been returned to Crescent Lake. In addition, TID has dedicated more than 6,800 AF to the Endangered Species Act listed Oregon spotted frog.

SUMMARY OF TID PIPING TO DATE
BEND FEED CANAL AND TUMALO FEED CANAL

	Length of Canal Piped (ft)	Water Conserved	
		Tumalo Creek (cfs)	Crescent Lake (AF)
Bend Feed Canal	26,400	5.8 sr 11.2 jr	0
Tumalo Feed Canal	13,240	5.54	2,843

Local farmer using a combine to harvest grain.

CONSERVATION

Tumalo Irrigation District is dedicated to improving water flows in the Deschutes River, Tumalo Creek, and Crescent Creek; restoring and protecting native habitat; ensuring reliable water supply for agriculture and recreation; and supplying glacial water to cool the warming Deschutes River.

SYSTEM IMPROVEMENT PLAN SUMMARY

For every 50 AF of water TID conveys to a member, aproximately 25 AF is lost to seepage and evaporation. This is why Tumalo Irrigation District initiated a System Improvement Plan. The System Improvement Plan identifies TID's seepage losses throughout the canal system, the costs associated with piping remaining canals, and the benefits to District members of pressurization, which includes a more dependable water supply. It also proposes a systematic timeline in which to engineer and complete the upgrades.

The SIP recommends four distinct objectives, consistent with the District's broader goals:

- Reduce liability and improve the safety of the delivery system.
- Continue to mitigate seepage and minimize evaporation.
- Increase pressurization to benefit members and reduce costs.
- Enhance flows in Tumalo and Crescent creeks to ensure a viable and healthy ecosystem.

THE METHODOLOGY

Black Rock Consulting evaluated the open or "non-piped" sections of the main canal and laterals for seepage losses using state-of-the-art instrumentation. For the purposes of this SIP, 50 cfs was held as the total potential conservation attributed to piping projects and its analysis took into account the following:

- Approximately 50.4 cfs was being lost at the time of measurements.
- Approximately 53 cfs might be conserved if the system was completely piped and Tumalo Reservoir lined (assuming certificated peak flows of 7.48 gallon per minute per acres (GPM/Acre) delivered).

In addition, the SIP bundles these projects into $3 million to $5 million dollar project groups; however, these projects and how they are grouped can be adjusted as necessary. This approach allows for flexibility based on funding and will have the least negative impact on TID and member operations.

CONCLUSION

Significant savings can be realized when piping is completed. Nonetheless, there is a great deal of work ahead for the District. These improvements will take time, and there will be important choices to be evaluated.

The comprehensive analysis provided in the SIP will be invaluable in guiding the District to accomplish the stated objectives. It will support the District in securing the $44 million needed to implement SIP recommendations.

TUMALO FEED CANAL - PHASE V AND BEYOND

There are approximately 69 miles of main canal, laterals and ditches in the District remaining to be piped. TID will continue its phased approach to piping.

PHASE V

Phase V will continue to pipe the main Tumalo Feed Canal. This canal continues approximately 2.5 miles further downstream as an open channel canal to a junction known as the Division. At the Division, the Columbia Southern Lateral carries water into the District in a northeasterly direction. The primary District canal continues to the Tumalo Reservoir and supplies it with water for the purposes of re-regulation and supply to the Couch Lateral.

The District has already secured $2.4 million for a portion of the work planned for Phase V. Additional funds have been requested from the Oregon Watershed Enhancement Board, which is funded by Oregon Lottery dollars. The District plans to secure the remaining funds and will begin construction in Fall of 2017.

PHASE V OF THE TUMALO FEED CANAL

Length of Canal to be Piped (ft)	Estimated Cost	Estimated Water Conserved Tumalo Creek (cfs)	Crescent Lake (AF)
5,500	$3,475,267	1.80	660

PHASE VI AND BEYOND

The System Improvement Plan has been instrumental in identifying the remaining length and estimated costs to complete piping the Tumalo Feed Canal.

PHASE VI AND BEYOND OF THE TUMALO FEED CANAL

Length of Canal Remaining to be Piped (ft)	Estimated Cost	Estimated Water Conserved Tumalo Creek (cfs)	Crescent Lake (AF)
7,946	$8,196,203	3.66	1,148

The scope of piping TID's main canals is significant, but will generate considerable benefits to members, water resources, and native habitat and species when completed.

Constructing new water measurement structures.

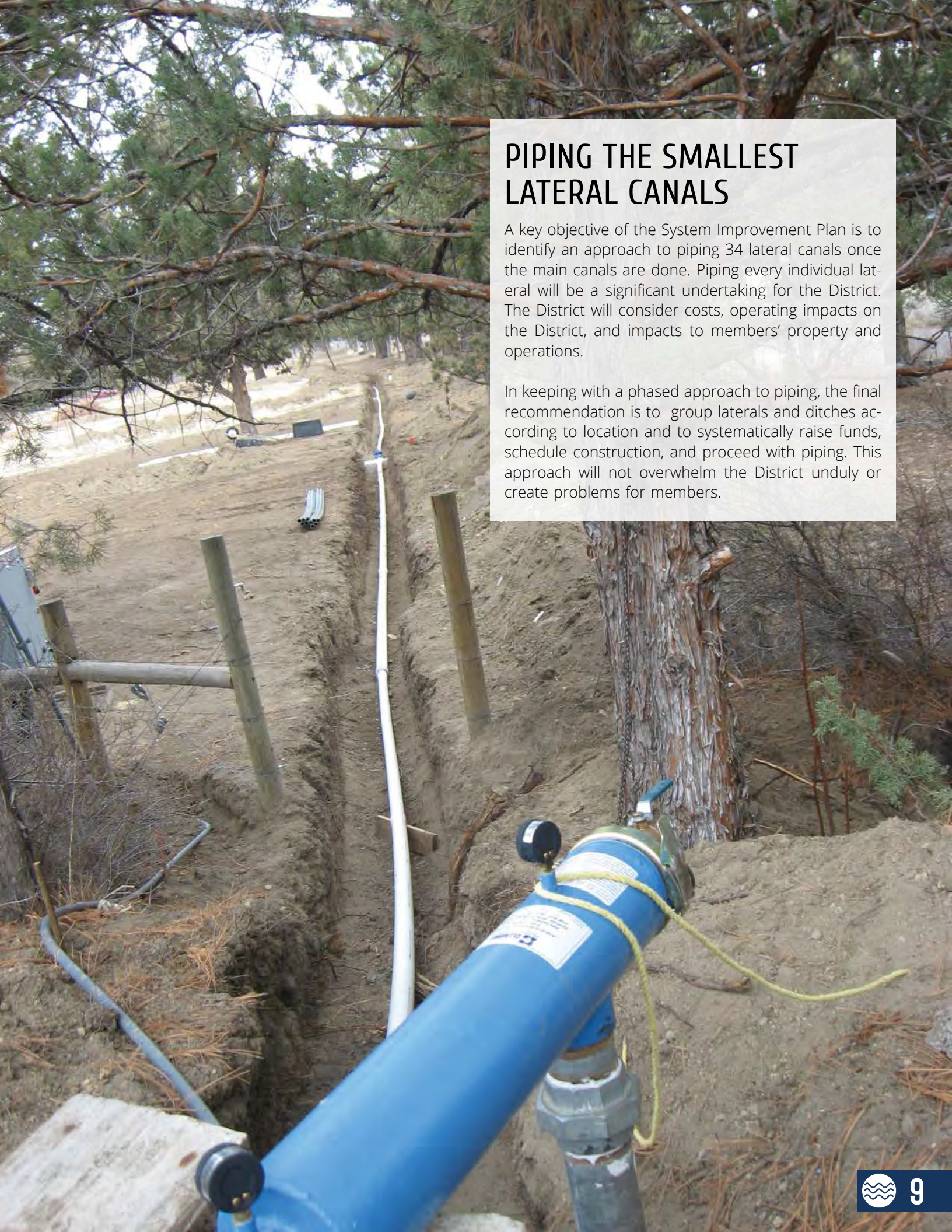
SUMMARY OF PIPING BEND FEED CANAL AND TUMALO FEED CANAL

Length of Canal to be Piped (miles)	Estimated Cost	Estimated Water Conserved Tumalo Creek (cfs)	Crescent Lake (AF)
11.9	$12,000,000	17.8	4,500

TUMALO IRRIGATION DISTRICT TOTAL PROJECT CONSERVATION ESTIMATES

Diverted Acreage	Maximum Diversion 2014-2016	Diversion Flow Rate at 7.48 GPM/Acre	Estimated Cons. At 7.48 GPM/Acre
7,417	177 cfs	124 cfs	53 cfs

When piping the main canals is completed, Tumalo Irrigation District will have achieved a significant milestone, but work will continue with piping of the smaller laterals and ditches.

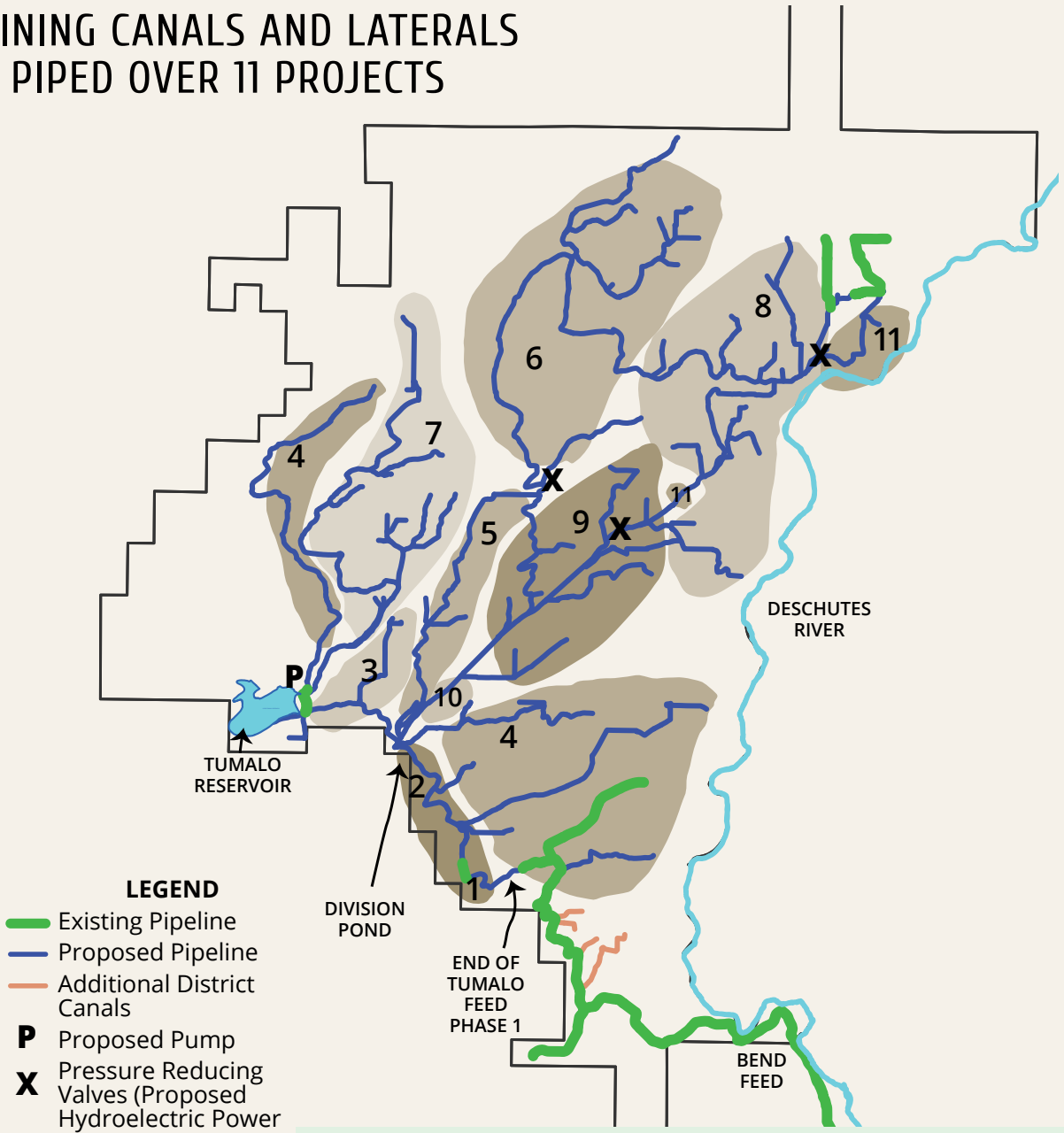


PIPING THE SMALLEST LATERAL CANALS

A key objective of the System Improvement Plan is to identify an approach to piping 34 lateral canals once the main canals are done. Piping every individual lateral will be a significant undertaking for the District. The District will consider costs, operating impacts on the District, and impacts to members' property and operations.

In keeping with a phased approach to piping, the final recommendation is to group laterals and ditches according to location and to systematically raise funds, schedule construction, and proceed with piping. This approach will not overwhelm the District unduly or create problems for members.

REMAINING CANALS AND LATERALS TO BE PIPED OVER 11 PROJECTS

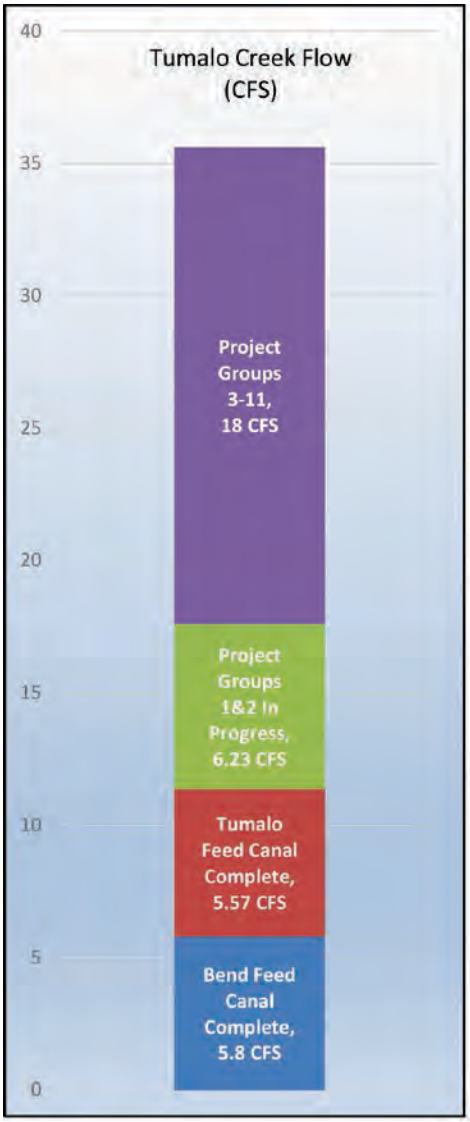


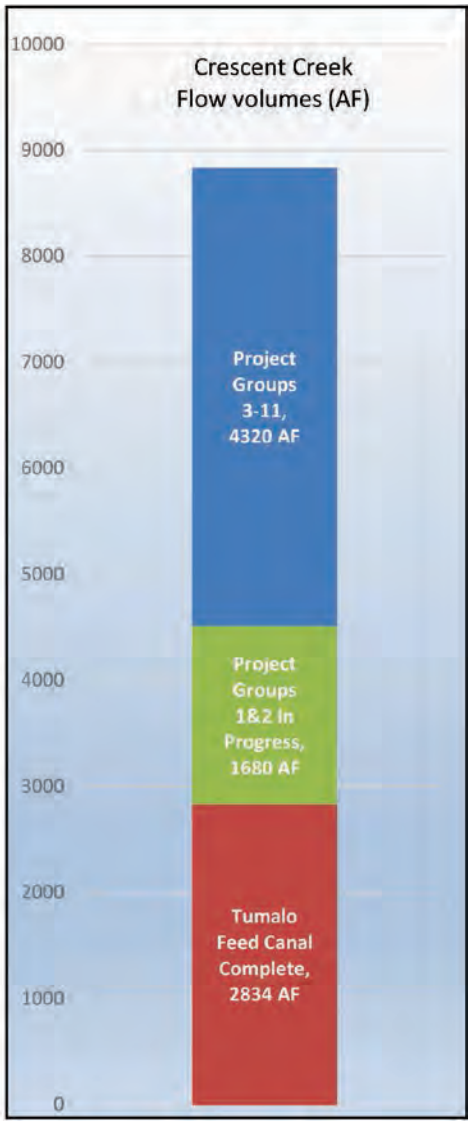
CANALS AND LATERALS TO BE COMPLETED OVER 11 PROJECTS

Project Group	Est Water Conservation (cfs)	Estimated Energy Conservation (kwh/yr)	Estimated Energy Production (kwh)	Length to be Piped (ft)	Recon. Estimated Cost
1&2	11.1	6,307		13,446	$11,671,470
3	0.2	56,214		17,308	$2,913,083
4	7.8	501,009		67,150	$3,079,404
5	4.2	294,751		25,518	$3,495,568
6	4.8	694,616	209,467	61,551	$3,868,267
7	3.5	383,475		55,950	$3,338,263
8	7.9	Included in Project 10		44,696	$2,547,536
9	4.1	Included in Project 11		35,650	$1,481,684
10	2.0	420,029	1,166,762	14,978	$5,468,931
11	4.5	1,646,550	162,263	30,491	$4,433,245
Total	**50**	**4,002,951**	**1,538,492**	**366,740**	**$42,297,451**

Piping the Tumalo Feed Canal, Phase IV 2016.

SECURED AND FUTURE INSTREAM FLOWS IN TUMALO AND CRESCENT CREEKS





STEWARDSHIP

For nearly 120 years, Tumalo Irrigation District has been a responsible steward of water resources in Central Oregon, serving 676 families, managing 80 miles of piped and open canals, and irrigating 7,400 acres of productive lands. This commitment will continue well into the future as Central Oregon continues to develop and thrive.

Tumalo Creek in 2016.

Pressurizing deliveries will improve efficiency and cut costs.

HYDROELECTRIC POWER AND PRESSURIZATION

While many irrigation districts consider hydroelectric power generation a priority, TID has instead chosen to combine generating hydroelectric power with pressurizing deliveries for its members.

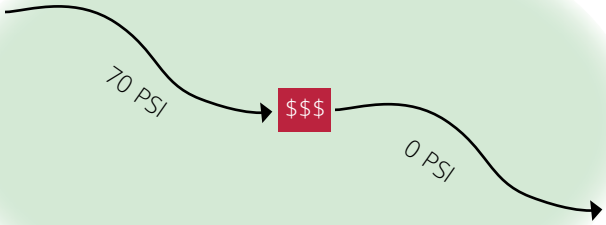
One natural advantage the District has in accomplishing its pressurization goal is that water diverted into the system falls approximately 370 feet as it travels from the diversion in Bend and Tumalo Creek to the northern limit of the system.

Because maintaining pressure downstream for irrigation is a priority, the SIP evaluated the potential for increasing water pressure and generating hydroelectric power.

Where pressure reduction is required, sustaining downstream pressure is incorporated into the analysis. This approach resulted in hydroelectric power potential estimated at 1.5 **Gi**gawatt hours (**G**wh) and an estimated reduction of 4.0 **G**wh in member pumping per season, for a net annual gain of nearly 5 **G**wh of energy. The SIP analyzed a total of three pressure reducing stations combined with hydroelectric power potential. The District's next step will be to estimate the cost to produce hydroelectric power.

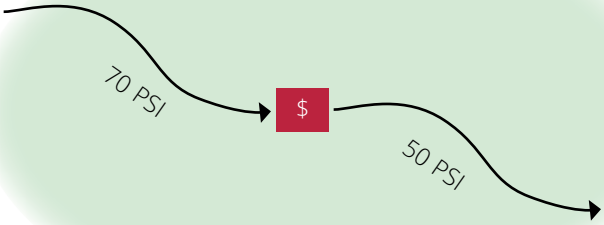
Pressurizing the remaining 7,012 irrigated acres to be piped in the District would save an estimated 4,002,051 Kilowatt hours per year (kwh/yr). Stated another way, enough hydroelectric power to serve 4,000 homes.

HYDROELECTRIC POWER GENERATION ONLY



Realizing full hydroelectric power revenue potential means no pressurized water deliveries.
PSI = Pounds per square inch

A COMBINATION OF HYDROELECTRIC POWER AND PRESSURIZATION WILL MAINTAIN IRRIGATION CAPACITY



Generating less revenue from hydroelectric power makes it possible to make pressurized deliveries. For TID, conserving water combined with pressurized deliveries and some hydroelectric power generation is the better option.

Kokanee swimming in restored Crescent Creek.

PARTNERSHIPS

Tumalo Irrigation District is grateful for the partnerships formed with local, state and federal agencies, conservation groups, irrigation districts, tribes and many others. Through these partnerships, TID has been part of a collaboration to responsibly and sustainably manage water supplies throughout the Deschutes Basin for the benefit of this region's economy and the environment.

Tumalo Irrigation District thanks the following partners:

Deschutes Basin Board of Control
- Arnold Irrigation District
- Central Oregon Irrigation District
- Lone Pine Irrigation District
- North Unit Irrigation District
- Ochoco Irrigation District
- Swalley Irrigation District
- Three Sisters Irrigation District

Bend Park and Recreation District
City of Bend
City of Redmond
City of Prineville
City of Sisters
Confederated Tribes of Warm Springs
Deschutes River Conservancy
Deschutes Water Alliance
Energy Trust of Oregon
Farmers Conservation Alliance
Oregon Department of Energy
Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife
Oregon Water Resources Department
Oregon Watershed Enhancement Board
Portland General Electric Company
Trout Unlimited
Upper Deschutes Watershed Council
U.S. Bureau of Reclamation
U.S. Department of Agriculture
U.S. Fish and Wildlife Service

Burying pipe on the Tumalo Feed Canal.

Tumalo Irrigation District

64697 Cook Ave
Bend, OR 97703
541-382-3053
staff@tumalo.org
www.tumalo.org

COVER PHOTO: The start of piping the Tumalo Feed Canal.