UNITED States Department of Agriculture
Forest Service

ENVIRONMENTAL ASSESSMENT

Special Use Permit
City of Bend
Bridge Creek Water Supply System

Bend–Fort Rock Ranger District, Deschutes National Forest
Deschutes County, Oregon

For information, contact:

Rod Bonacker
Bend–Fort Rock Ranger District
63095 Deschutes Market Road
Bend, Oregon 97701
541-480-3915

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
ACS	Aquatic Conservation Strategy
APE	area of potential effects
AUC	Area Under the Curve
BA	Biological Assessment
BCC	Birds of Conservation Concern
BE	Biological Evaluation
BI	Beneficial Impact
BMP	Best Management Practices
BO	Biological Opinion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CWM	Coarse Woody Material
CWPP	Community Wildland Protection Plan
DEIS	Draft Environmental Impact Statement
dbh	Diameter at Breast Height
DNF	Deschutes National Forest
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
et al.	and other authors
FEIS	Final Environmental Impact Statement
FS	Forest Service
FSH	Forest Service Handbook
FSM	Forest Service Manual
ft	feet
ft/s	feet per second
ft^2	square feet
FVS	Forest Vegetation Simulator
FWS	United States Fish and Wildlife Service
GIS	geographic information system
GTR	Green Tree Replacement
HABS/HAER	Historic American Building Survey/Historic American Engineering Record
HDA	Habitat Duration Analysis
HRV	Historic Range of Variability
HSA	Highway Safety Act
IDT	Interdisciplinary Team
INFISH	Inland Native Fish Strategy
LAA	Likely to Adversely Affect
LFR	Ladder Fuels Reduction
LMZ	Lower Management Zone
LOS	Late and Old Structure
LRMP	Deschutes National Forest Land and Resource Management Plan (1990)

MA	Management Area
MCR	Middle Columbia River
mgd	million gallons per day
MIIH	May Impact Individuals or Habitat but Will Not Likely Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species
MIS	Management Indicator Species
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPP	Maximum Population Potential
MST	Mechanical Shrub Treatment
MVUM	Motor Vehicle Use Map
N/m^2	Newtons per square meter (a measure of pressure)
NA	not applicable
NE	No Effect
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NF	North Fork
NGO	non-governmental organization
NHPA	National Historic Preservation Act
NI	No Impact
No.	number
NRF	nesting, roosting, and foraging
NRHP	National Register of Historic Places
NSO	northern spotted owl
NW	northwest
NWFP	Northwest Forest Plan
NWI	National Wetland Inventory
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OGMA	Old Growth Management Area
OHV	Off-Highway Vehicle
OSHA	Occupational Safety and Health Administration
OWRD	Oregon Water Resources Department
PAG	Plant Association Group
PDC	Project Design Criteria from the Programmatic Biological Assessment
PFA	Post Fledgling Area
PHABSIM	Physical Habitat Simulation Model
PM	Particulate Matter
RHCA	Riparian Habitat Conservation Area
RMO	Riparian Management Objective
ROD	Record of Decision
S&G	Standards and Guidelines
SDI	Stand Density Index
SEIS	Supplemental Environmental Impact Statement
SF	South Fork
SHPO	State Historic Preservation Officer
SMS	Scenery Management System

SOC	Species of Concern
spp.	various subspecies
SUP	Special Use Permit
TES	Threatened, Endangered, Sensitive
TID	Tumalo Irrigation District
TMDL	Total Maximum Daily Load
UMZ	Upper Management Zone
USDA	United States Department of Agriculture
USFS	United States Forest Service
VQS	Visual Quality System
WSAS	Water Supply Alternatives Study
WUA	Weighted Usable Area

REVISIONS

Revisions to July 24, 2013 Environmental Assessment
Special Use Permit
City of Bend Bridge Creek Water Supply System
October 20, 2013

Section 1.1.1, Construction Schedule has been updated.

Section 1.2, a new figure is added – Bridge creek Water Supply Schematic.

Section 1.9.16, Oregon State Scenic Waterways Program, was added to 1.9, Pertinent Plans, Laws, and Regulations.

Section 1.9, Pertinent Plans, Laws, and Regulations, has been revised to include a discussion of the Federal Land Policy and Management Act (FLPMA), now section 1.9.6.

Section 1.9.17, State Scenic Waterways Act, has been revised to include a discussion of ORS 39.835, which defines highest and best uses of waters within State Scenic Waterways.

Section 2.1.2.6, Costs, was revised to remove a financial analysis based on the Brown and Caldwell Feasibility Study (2009).

Section 2.2.2.2, Table 5: The following edits were made to the Design Criteria for Flow Control:

- The City will monitor water diversion rates continuously using either an ultrasonic or magnetic type flow meter located at the Outback site. Under normal operations, the system will be designed to check flow at least every 15 minutes and adjust the diversion gate to maintain the desired flow. Reporting will include the peak hour flow rate and the daily volume of water diverted. This will allow the City to control water diversions, within the ability of the available technology, so as to not exceed the instantaneous diversion rate of 18.2 cubic feet per second. The flow rate diverted from Bridge Creek is the same as the flow rate at the Outback site since there will be no gain or loss of flow along the proposed pipeline.
- The City shall be limited to an instantaneous rate of diversion no greater than the demand for municipal use, up to a maximum of 18.2 cfs.
- The City will work with the USFS to develop a seasonal ramping rate that is operationally sound and protective of fish.
- The City will eliminate their use of returning diverted flows in excess of municipal demand.

Section 3.1.2, Cumulative Effects was revised to include a table of Past Actions and Events that Contribute to the Current Conditions in the Project Area and Cumulative Effects Area, Ongoing or Reasonably Foreseeable Future Actions, in the Project Area and the Tumalo Watershed that may contribute to Cumulative Effects**,** and a discussion of potential effects of future increases in water conveyed by the new waterline.

Chapter 5 – Added **ODFW 2012 Middle Deschutes Monitoring Project (Carrasco, Harington, and Hodgson, 2012)** to references.

SUMMARY

What is the Proposed Action that is triggering NEPA?

The Deschutes National Forest proposes to issue a Special Use Permit to the City of Bend (City) for planned improvements to the Bridge Creek Water Supply System. The issuance of the Special Use Permit is a federal action that triggers the National Environmental Protection Act (NEPA).

The City's planned improvements include installation of a 10-mile-long replacement water supply pipeline in a new alignment and upgrades to an existing intake facility. The pipeline and the intake facility are located on National Forest System lands and are subject to a Special Use Permit.

Why is the Forest Service proposing to issue a Special Use Permit?

The Deschutes National Forest Service, in accordance with 36 Code of Federal Regulations (CFR) Part 251, Subpart B, has identified a **need** to respond to an application from the City of Bend for issuance of a Forest Service Special Use Permit. The **purpose** of the Special Use Permit is to allow the use of National Forest System lands for planned upgrades to the City's existing Bridge Creek intake facility and replacement of the City's aging Bridge Creek water supply pipelines. Implementation of these upgrades cannot proceed until after both parties have signed a Special Use Permit.

What alternatives were considered?

The Forest Service is evaluating two alternatives in this Environmental Assessment (EA): the proposal from the City (Proposed Action), and the No Action Alternative. Alternatives considered but not studied in detail included replacement of the water supply pipelines within existing pipeline alignments and two alternatives for moving the City's water intake facility downstream and closer to the City's water storage site.

Prior to initiating the Special Use Permit process with the Forest Service, the City assessed replacing the surface water supply with groundwater or with Deschutes River water. The City's decision to reinvest in their surface water supply system is discussed in Section 1.3 of this EA.

What would happen if the Forest Service did not issue the City a Special Use Permit?

If the Forest Service did not issue the proposed Special Use Permit, the City's Surface water supply system, which currently provides about half of Bend's drinking water, would be at risk of failure. The City would:

- Continue to maintain and operate the existing water supply pipelines and intake facility under the City's current Special Use Permit until they irreparably fail or the permit expires. Failure of one of the operating pipelines would result in the uncontrolled discharge of pipeline water overland, potentially causing damage to private properties, sediment loading into nearby surface waters, and damage to roadways.
- Continue to grow into their water right to the extent allowed, taking into account limitations of water rights: available flow, municipal demand, demands of other water right holders, and limitations of the current system.
- Repair severely damaged sections of the existing pipeline as needed and where feasible, as allowed under their existing Special Use Permit.

What are the potential adverse environmental effects of the Proposed Action?

The Proposed Action will result in equal or more stream flow in upper Tumalo Creek relative to the No Action Alternative.

The Proposed Action will not change stream flows in Tumalo Creek Reaches A2 or B, or the Middle

Deschutes River relative to the NO Action Alternative.

Anticipated short-term (construction) effects resulting from the Proposed Action include but are not limited to:

- In-water work resulting in temporary increases in suspended sediments (turbidity) in Bridge and Tumalo Creeks and stream diversions that could temporarily affect upstream fish passage
- Temporary impacts to wetlands and riparian areas and long-term (until the tree grow back large enough to provide canopy cover) conversion of a small portion of wetland from forested to pre-emergent wetland. There is no permanent loss of wetlands as a result of the project.
- Temporary road closures on Forest Service Road 4603 and intermittent lane closures along Skyliners Road to facilitate pipe installation within these road rights of way.
- Temporary increased noise levels in project area due to construction-related truck traffic, rock crushing, excavation work, and construction activities.

Anticipated long-term (operational) effects resulting from the Proposed Action include but are not limited to:

- There will be a beneficial impact resulting from decreased Bridge/Tumalo Creek diversion rates during certain times of the year, consistent with City demand, which would result in higher instream flows between the Bridge Creek diversion and the TID diversion, improving stream temperatures and in-stream habitat.
- The existing continuous diversion of 18.2 cfs of water by the City would be replaced by a diversion control that would allow the City to match the amount diverted to the amount in demand.
- The overland return of water in excess of demand from the Outback Site to Tumalo Creek would be eliminated, resulting in a beneficial impact of reducing turbidity and warm water input from the return flow.
- Removal and replacement of the above-grade portions of the Bridge Creek intake building, resulting in visual changes and impacts to a historic structure that is eligible for listing in the National Register of Historic Places.

How will adverse effects be mitigated?

The Forest Service Special Use Permit will include Design Criteria and resource protection measures to avoid adverse effects, minimize unavoidable effects, and provide compensatory mitigation for effects as appropriate. These Design Criteria and resource protection measures are described in Section 2.2.2.1 of this EA.

When would construction begin?

The Forest Service could issue the Special Use Permit in July 2013. The City is planning to begin installation of the replacement pipeline in the summer or early fall of 2013 and to begin construction of the intake building upgrades in the fall of 2013.

CHAPTER 1.0 INTRODUCTION

When the City of Bend was founded in the early 1900s, its primary source of drinking water was the Deschutes River. However, water quality problems in the river developed in the 1920s and forced the City to purchase the existing private water company and investigate alternative water supply sources. That investigation led to the identification of Bridge Creek as a high-quality and reliable source of drinking water. In 1926, the Bridge Creek intake facility and the first pipeline from Bridge Creek into town were constructed. In the 1950s, a second pipeline was constructed. Water storage and treatment facilities were added at the City's Outback site (approximately 3 miles west of town) starting in the 1980s. The original two water supply pipelines now terminate at the Outback site.

The City's existing Bridge Creek intake facility is in very poor condition and does not comply with current state and county standards for building codes, or meet new operational requirements for fish screening. The City's existing surface water supply pipelines are also in poor condition and are at risk of failure.

1.1 Proposed Action

The Forest Service received notice of the City's intent to seek a new Special Use Permit on December 6, 2012. The Forest proceeded with the initial and second level screening process and accepted the initial proposal for environmental analysis on December 12, 2012. At this time, the Forest reviewed previous feasibility studies completed by the City and the alternatives evaluated by the City for delivery of water to Bend.

The Deschutes National Forest proposes to issue a Special Use Permit to the City of Bend that would authorize:

- Construction of a single, approximately 10-mile-long replacement water supply pipeline that would be installed primarily within the Forest Service Road 4603, Skyliners Road, and Forest Service Road 4606-100 corridors (Figure 1 and Figure 2)
- Replacement of the above-grade portions of the Bridge Creek intake building with a new, remotely controllable intake and installation of new fish screens that are compliant with current Oregon Department of Fish and Wildlife fish screening regulations (Figure 3).
- Rehabilitation and revegetation of areas disturbed by construction, including the restoration of wetlands, staging areas, and stream crossings.
- Limiting conveyance of water through the pipe to a maximum of 18.2 cfs.
- Monitoring of flows, temperatures, and fish population trends to validate modeling predictions and effects of climate change on aquatic habitats to direct future modifications of the Permit if necessary to protect resources.

1.1.1 Construction Schedule

The City is planning to begin installation of the replacement pipeline in the fall of 2013 and to begin construction of the intake building upgrades in the fall of 2014. The City's schedule for pipeline replacement is being closely coordinated with Western Federal Lands Highway Division Skyliners Road Improvement Project that is scheduled to begin in the spring or summer of 2015. The County has stated that once the road is reconstructed they would not permit the City to place the pipe in the road until the next anticipated road rebuild, which is estimated by the County Road Engineer to not be necessary for 35 to 40 years after the current reconstruction. The County has required that all of the City's pipeline work must be complete prior to the County beginning the road reconstruction in the spring of 2015. In order to meet this schedule, the City needs to begin work no later than the spring of 2014.

Another schedule-driver for the City is new drinking water regulations issued by the U.S. Environmental Protection Agency (EPA) that require the City to build a new treatment facility for its surface water supply. The compliance deadline for this new regulation is October 2012, but the City has negotiated an extension of this deadline to October 2014 in order to streamline construction of all proposed surface water improvements in the most cost-effective manner.

1.1.2 Project Area

The project area encompases the area where actual ground disturbance will occur. The project is located west of Bend, Oregon, between the City's Bridge Creek Water Intake and Outback Reservoir Site (Figure 1). The proposed new pipeline route is primarily following Forest Service Roads 4601 (Skyliners Road) and 4603. The proposed pipeline would originate at the City's intake facility located on Bridge Creek approximately 13 miles west of the city near the Tumalo Falls Overlook parking area and would terminate at the City's Outback Reservoir Site located approximately 1.5 miles west of Bend off of Skyliners Road (Figure 1-2).

A majority of the proposed project is within existing developed areas (City of Bend's water supply Intake Facility, gravel U.S. Forest Service [USFS] roads, Skyliners Road, a Deschutes County road, and the City's Outback Reservoir Site). One section (approximately 700 feet) of the new pipeline would run through a forested area previously disturbed by the existing pipeline from the intake facility to the western terminus of Forest Service Road 4603.

The project area is in unincorporated Deschutes County in Township 17S, Range 11E, Section 34; Township 18S, Range 10E, Sections 1, 2, 7, 8, 9, 10, and 11; and Township 18S, Range 11E, Sections 3, 4, 5, 6, 7, and 8. The majority of the project area is within the Bend–Fort Rock Ranger District of the Deschutes National Forest. The project lies within two 6^{th} field watersheds: Upper and Lower Tumalo. The actual area of project disturbance is a corridor approximately 10 miles long by 100 feet wide, or approximately 121 acres.

Figure 1. Project Vicinity

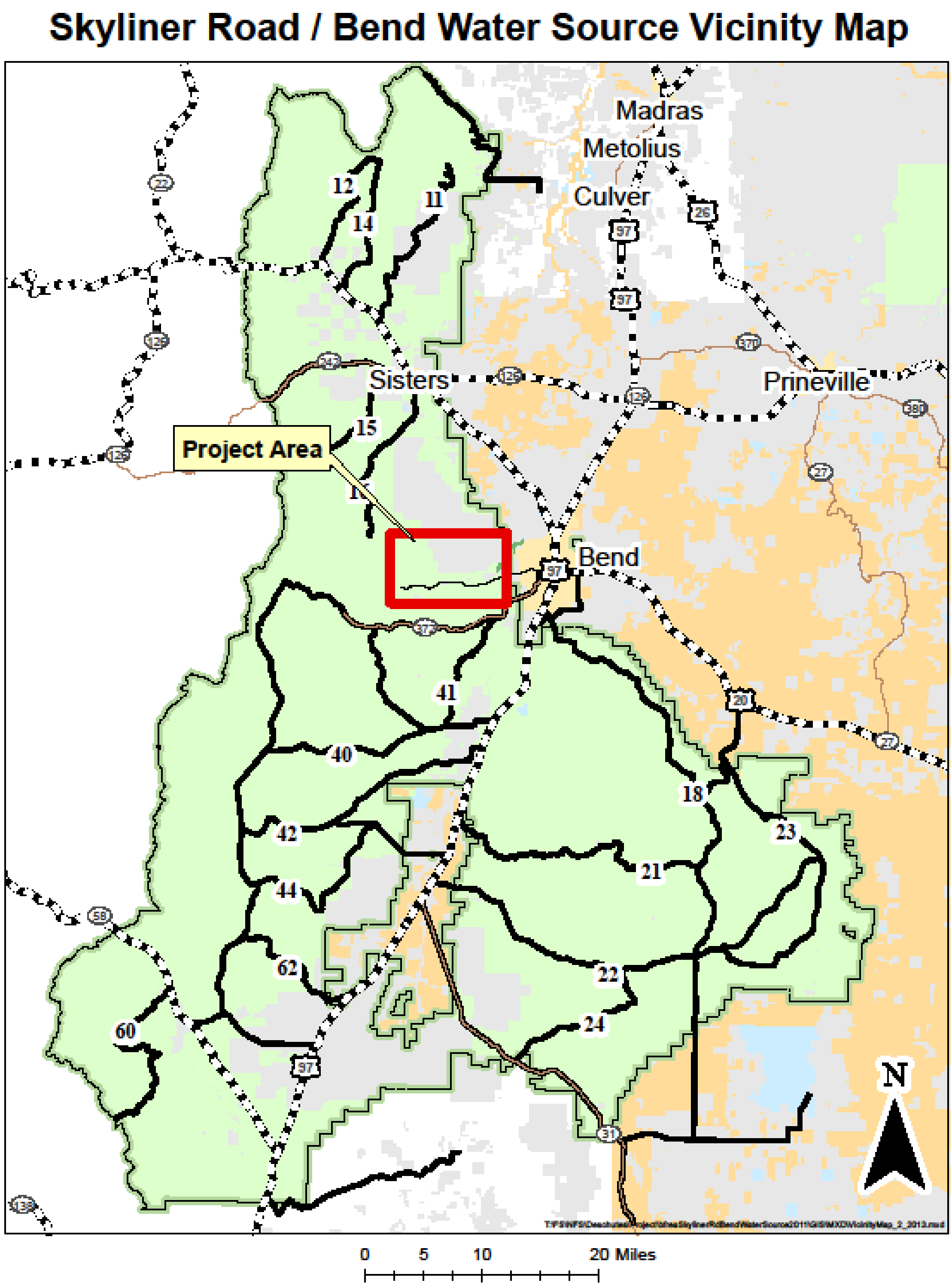

Figure 2. Project Area

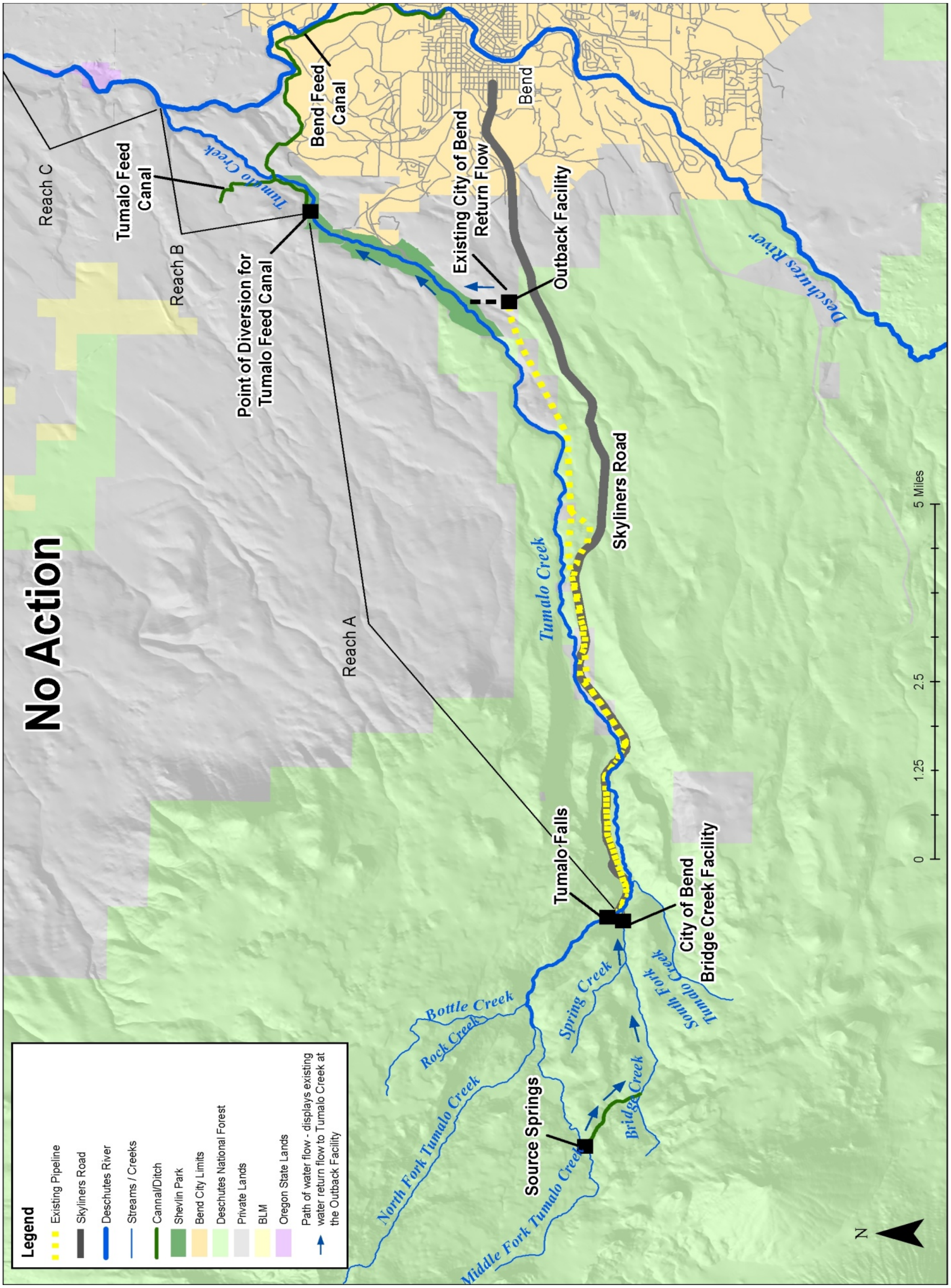

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Figure 3. Existing Bridge Creek intake building (left) and conceptual rendering of proposed upgrades (right)

The new intake building is still in the design phase. Surface treatments, materials, and number and placement of windows are subject to change.

1.2 Purpose of and Need for Action

The Deschutes National Forest Service, in accordance with 36 CFR Part 251, Subpart B, has identified a **need** for action on an application from the City of Bend for issuance of a Forest Service Special Use Permit. The **purpose** of the Special Use Permit is to authorize use of National Forest System lands for planned upgrades to the City's existing Bridge Creek intake facility and replacement of the City's aging Bridge Creek water supply pipelines.

The City relies on a dual-source water supply that is comprised of groundwater from the Deschutes Regional Aquifer and surface water from Tumalo and Bridge Creeks. Each of these water sources provide about one-half of the City's annual water supply, and the City holds secured, senior water rights for both. The dual-source water supply satisfies the City's obligation to provide a safe and reliable water supply that meets current and future demands as well as maximizes the long-term energy efficiency, cost-effectiveness, and operational flexibility of the City's water supply system.

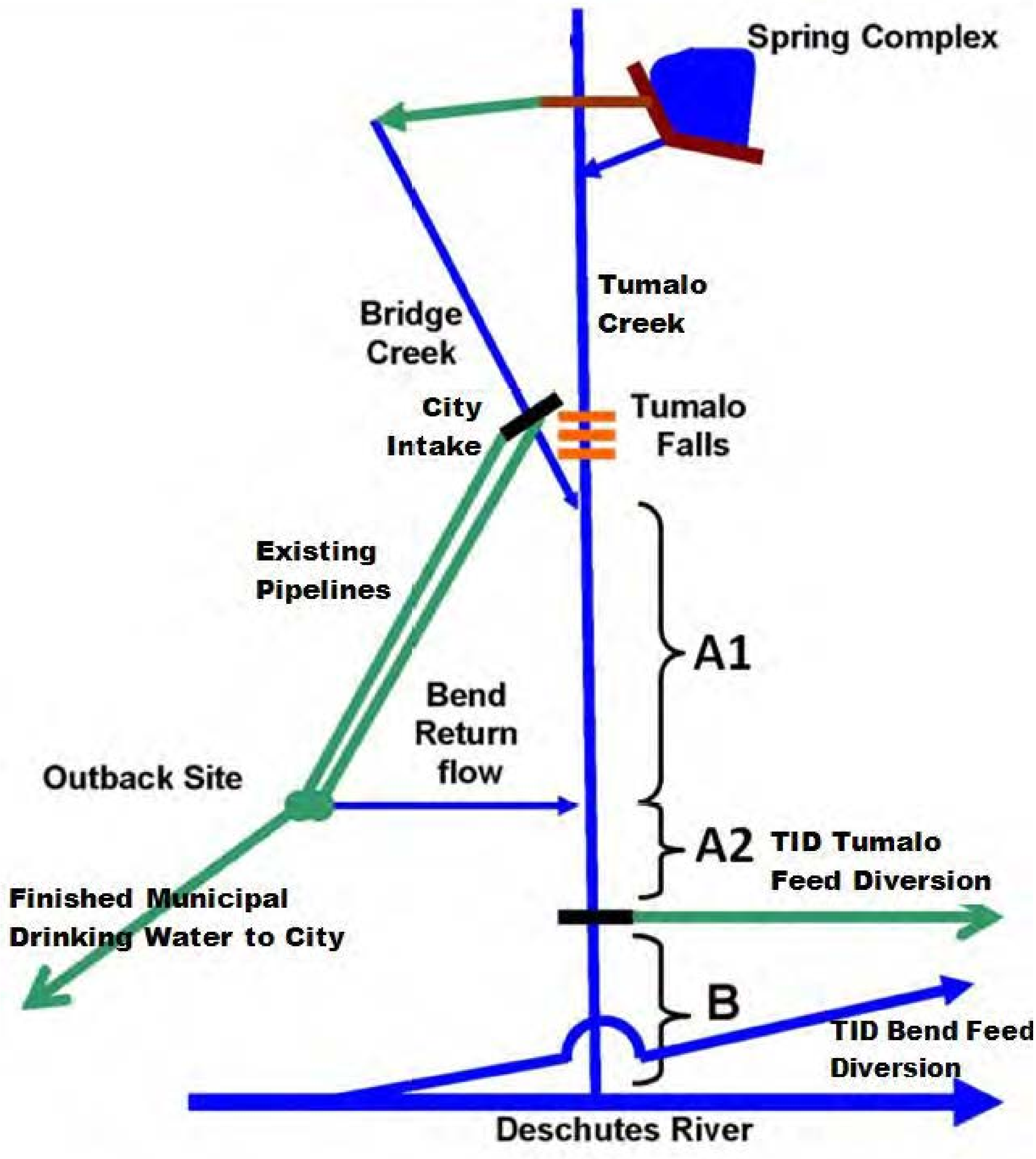
The Bridge Creek surface water supply is a critical component of the City's dual-source supply, and the planned upgrades that are subject to a Forest Service Special Use Permit respond to the City's need to:

- Address the deteriorating condition of the water supply pipelines that carry approximately 50% of the City's annual municipal water supply from Bridge Creek to a storage and disinfection facility at the City Outback site.
- Comply with Forest Service Manual Guidance to locate utilities within developed corridors or easements and reduce the vulnerability of the City's surface water supply pipelines to substantial damage by wildfire or windstorms.
- Address regulatory and structural deficiencies identified at the City's Bridge Creek intake building.

The City proposes to maintain the Bridge Creek intake facility at its existing location in order to:

- Maintain cost-effective gravity-fed conveyance of its surface water supply.
- Minimize risk of contamination by keeping the intake immediately adjacent to a protected watershed.
- Operate the surface water system under existing, secured water rights.
- Avoid environmental impacts associated with development of a new point of diversion.

Figure 4. Bridge Creek Water Supply System Schematic



1.3 City's Decision to Reinvest in Surface Water

In November 2010, the Bend City Council passed a resolution (Resolution No. 2867) committing to proceeding with the surface water pipeline replacement project and thereby preserving the dual-source water supply system for the City of Bend. The City Council reaffirmed this with a vote on a revised version of the resolution on February 20, 2013.

Over the last 30 years, the City has studied the possibility of developing new systems to enhance Bend's public water supply. Most recently, the City completed a Water Supply Alternatives Study (WSAS) in 2009 that analyzed three alternatives for water delivery to Bend residents, and also completed a Water System Master Plan Optimization Study in 2011. These studies are available on the City of Bend's website at www.bendoregon.gov/surfacewater, under Master Plans and Analyses; and on the Deschutes NF website. The alternatives studied in the WSAS included reinvesting in the surface water system, replacing the Bridge Creek/Tumalo Creek supply with groundwater, and replacing the Bridge Creek/Tumalo Creek supply with water from the Deschutes River.

After analyzing multiple variables—including water rights, existing water delivery infrastructure, and long-term energy, construction, and operational costs—the City identified reinvestment in the Bridge Creek/Tumalo Creek water supply and preservation of the dual- source water supply as the lowest-risk, and most economical, sustainable, and reliable long-term water supply option. A discussion of the alternatives to reinvesting in the surface water supply that were studied in the WSAS is summarized in the following sections.

1.3.1 Replacing the Bridge Creek Supply with Groundwater

The City could proceed with a groundwater-only option without the involvement or permission of the Forest Service. The viability of replacing the Bridge Creek supply with groundwater was studied and documented in one report and two technical memorandums commissioned by the City: *Surface Water Improvements Alternatives Study* (Brown and Caldwell 2009), *Surface Water / Groundwater Cost Comparison Memorandum* (Bryan Black, HDR 2010), and *Surface Water Rights Memorandum* (Glick 2010). These reports evaluated the costs, benefits, and risks associated with relying on groundwater as the sole water supply for the City of Bend.

After reviewing these reports, the City concluded that transitioning from a dual- source to a single-source (groundwater-only) water supply would compromise the City's ability to provide a safe and reliable water supply that meets current and future demands and maximizes long-term energy efficiency, cost-effectiveness, and operational flexibility. In addition, transitioning to an all-groundwater supply system would require substantial infrastructure upgrades and would require the City to apply for new water rights to meet future demands. An all groundwater system would also make the City's water supply completely dependent on energy for pumping water. This would increase the City's carbon footprint.

Based on these reports, the City dismissed replacing the Bridge Creek water supply with an all-groundwater supply from further consideration. The findings are discussed in more detail in the following sections.

1.3.1.1 Additional Development Costs

The City currently operates nine groundwater facilities throughout its service area, consisting of 25 wells that pump Deschutes Aquifer water to the City's system. The total groundwater well capacity (as of September 2011) is 30.4 million gallons per day (mgd). The City's current reliable "firm" well capacity based on dedicated power backup at a well site, redundancy of wells at a well facility, and supervisory control and data acquisition (SCADA) controls for remote operation and monitoring of a well was determined to be 9.0 mgd (Optimatics 2011, Appendix E). The 2008 maximum-day water demand was 29.2 mgd (Optimatics 2011). If the City did not have its surface water system, the City would need to make substantial reliability and expansion investments in its groundwater production facilities to make sure that facilities are operational during power outages, earthquakes, fires, or other events when water is needed in the City.

All of the current surface water capacity and all of the groundwater capacity is needed to meet current and future projected demands with desired redundancy and reliability. Since all sources are needed, if the City did not did not have a surface water system, it would need to be replaced by an equivalent amount of additional groundwater production capacity. Therefore, replacing the capacity of the current dual-source water system with an all-groundwater supply would require development of an additional 11.6 mgd (18.2 cfs) in groundwater well capacity.

Several actions and facilities would be needed to integrate a new 11.76-mgd groundwater supply into the City's water system, beyond the additional groundwater facilities already planned, to replace the surface water supply. These actions and facilities would be costly for the City and are described below:

Water Master Planning. The City's water supply and distribution system has been developed to effectively receive and distribute surface water. If the City decides to consider replacing its surface water supply with additional groundwater and wells, it would need to complete a thorough water master planning effort to determine the additional facilities that would be required. Water master planning efforts of this scale typically require a period of 7 to 12 months and a budget in the range of $400,000 to $500,000.

Land Acquisition for Wells. If the City were to rely solely on a groundwater system, additional land would need to be acquired to site new well fields to replace surface water. Per the groundwater cost memorandum presented in the Surface Water / Groundwater Cost Comparison (HDR 2010), 10 additional wells would be needed to provide the 11.6-mgd firm capacity. The analysis estimated that approximately $250,000 would need to be budgeted for land acquisition.

Well Transmission Piping to Water Storage Reservoirs. The development of new well fields would require water transmission pipelines from the well fields to finished water storage reservoirs prior to water distribution within the City. The total estimated cost for the transmission pipelines is $22 million including engineering and contingencies.

New Terminal Storage Reservoirs for Well-produced Water. New terminal storage reservoirs would need to be constructed to equalize the flow rate produced from the new wells fields to match the rate at which water is consumed by customers. The total estimated cost for the transmission pipelines is $8.5 million including engineering and contingencies.

Booster Pumping for Water Distribution. Additional booster pumping capacity may be needed with installation of the anticipated volumes of terminal storage, and this is not included in the cost analysis. The additional power costs for booster pumping to higher water pressure zones have not been evaluated and could be substantial.

Additional Storage in the Distribution System. It is currently not known whether additional distribution storage would be needed with the installation of the anticipated volumes of terminal storage. However, additional distribution system storage may actually be required for emergency water storage or fire flows. This would need to be further investigated in a new water master plan.

Estimated costs for additional actions and facilities to support integration of new groundwater into the City's water system are presented in Table 1.

Table 1. Additional costs required to develop groundwater supply to replace surface water

Action or Facility	Anticipated Cost
Water Master Plan	$200,000
Land acquisition	$250,000
10 additional wells (see companion memo, *Surface Water / Groundwater Cost Comparison*)	$28,500,000
Well field transmission piping	$22,010,000
New terminal storage reservoirs	$8,510,000
Booster pumping capital costs	None anticipated – needs review
Additional storage in the distribution system	None anticipated – needs review
TOTAL	$59,470,000

Energy Efficiency

Groundwater must be pumped up to the various pressure zones throughout the city. The power consumption of pumping groundwater from 300 feet to 750 feet below the city is substantially greater than using surface water that flows by gravity without power consumption from 1,320 feet above the city. While wholesale power costs dropped through 2009, they are at risk of doubling or more over the next 20 years (Sixth Northwest Conservation and Electric Power Plan, Appendix D: Wholesale Electricity Price Forecast, Draft December 2012, Northwest Power and Conservation Council - www.nwcouncil.org). This makes surface water the more energy-efficient and cost-effective source to use compared to groundwater. The pumping required to supply groundwater makes the groundwater system more costly for the City to operate than the surface water source that requires less energy for pumping.

Risk Associated with a Single Water Source

A single-source system is less reliable for residents in the event of power outages, contamination, or quantity issues. With a single-source system, there is no flexibility or backup option when water quality or operational issues arise. A single source system also puts the City at greater risk if a legal or other action limited the use of the source or its availability. The City's current dual- source system—gravity-flow surface water and pumped groundwater—is designed to ensure reliable water service in the face of power failures, system failures, and natural disasters. The dual-source system is an extremely important aspect of protection for public health and safety. Having a gravity system for fire prevention in the event of power outages is a benefit to public safety.

Water Rights

A shift from surface water to groundwater would move the City from a position of holding secure water rights that require no further government approval to use to a highly uncertain regulatory environment in which to obtain new groundwater rights (Glick 2010). The majority of the City's water rights are in the "certificate" stage. These municipal-use water right certificates are afforded numerous protections under state law and are generally not subject to third-party challenges.

In contrast, securing new groundwater rights in the Deschutes Basin under the Deschutes Basin Groundwater Mitigation Program (Program) would expose the City to substantial risk because (1) applications for new water rights are subject to challenge based on a broad standard of review; (2) the Program to obtain permits and provide mitigation is controversial and is currently set to expire in 2029; (3) the 200-cfs "cap" (limit) on permits that can be issued under the Program has almost been reached based on permits issued to date and applications already in the queue at the Oregon Water Resources Department; and (4) according to the U.S. Geological Survey (USGS) Report No. 03-4195 (*Simulation of Regional Groundwater Flow in the Upper Deschutes Basin, Oregon*), increased groundwater pumping may lead to streamflow impacts, thus triggering future unknown regulatory actions and risk to the City. By way of contrast, the surface water rights held by the City require no further water rights development process and do not present ready opportunity for parties to challenge further development of the water rights (Glick 2010).

Long-term Cost

The all-groundwater alternative is anticipated to cost about 75% more than the dual-source alternative over the 50-year period, and this differential gets even larger if viewed on an 80-year timeframe. If the City decides to abandon surface water, it can expect to pay an additional $50 million on a present-worth basis over the course of the 50-year planning period (HDR 2010).

Environmental Impacts of a groundwater-only system

Surface water supplied by gravity is the City's primary base supply and is operated year-round. Currently, the City is limited on much surface water it can use (18.2 cfs) due to the capacity of the two existing pipelines. If the City did not use the Bridge/Tumalo Creek source, the City would have to pump an additional 2 billion to 4.3 billion gallons per year from the groundwater aquifer.

USGS studied the groundwater and surface water hydrology of the Deschutes Basin (USGS 2001) and found that groundwater discharges to surface water through springs, seeps, and diffuse discharges. The groundwater discharge to area streams provides an important base flow of cold water to area streams that is particularly critical during late summer or droughts.

USGS modeled the environmental impacts of additional groundwater withdrawal of 10 cfs (6.46 mgd) in the Bend area (USGS 2004). 10 cfs is roughly half of what the City would need to make up to replace the surface water supply. USGS found that withdrawing additional groundwater would reduce the amount of groundwater discharging to area streams by a similar amount. Withdrawing an additional 10 cfs from groundwater from the Bend area was found to reduce flows in the Deschutes River both upstream and downstream from Bend, including the cold springs in the Lower Bridge area of the Deschutes River, and in Tumalo Creek, Whychus Creek, Alder Springs, the Crooked River, and the Metolius River.

1.3.2 Replacing the Bridge Creek Supply with Deschutes River Water

The City considered options to replace the Bridge Creek water supply with water from the Deschutes River. The City could proceed with a Deschutes River option without the involvement or permission of the Forest Service. Replacing the Bridge Creek supply with Deschutes River water was dismissed from further study because:

- The City does not hold water rights on the Deschutes River, and obtaining these rights would be difficult and/or expensive.
- These options would compromise the City's ability to provide high-quality water in an energy-efficient and cost-effective manner. Deschutes River water would require a much higher level of treatment than Bridge Creek water.
- The City does not have infrastructure to support use of Deschutes River water, and developing this infrastructure would be logistically difficult and costly.

One option to use Deschutes River water that was studied in the 2009 WSAS would require installation of a new intake and water treatment plant on the Deschutes River near Drake Park. This option would require a more expensive and sophisticated treatment plant than what is currently proposed at the Outback Site to remove organic matter, taste, and odor and to control disinfection byproduct formation resulting from higher temperature/organic content waters of the Deschutes River. The Deschutes River supply would also require a new additional storage tank and pump station after the treatment plant to pressurize the water for the distribution system. The supply location would make mixing with the local groundwater supply more problematic unless the supply had a direct pipeline to the Outback site.

Another option assessed in the 2009 WSAS would involve the construction of a new intake and water treatment plant at the inlet to an existing canal that carries water from the Deschutes River. This option would have avoided a direct intake on the Deschutes River but would still require a more sophisticated filtration plant than what is currently proposed at the Outback Site. This option would also have required extensive and energy-intensive pumping, since the treatment plant would have been located at a much lower elevation than the Outback Site. In addition, this option would have required a new, major river pipeline crossing.

1.4 City of Bend Surface Water Rights

The City has sufficient proven water rights on Bridge and Tumalo Creeks to make surface water a viable source for Bend into the future. The City's surface water rights are complex, and many of these rights have season of use and annual water use limitations because they were obtained in the early 1900s from irrigation rights that are limited traditionally to the growing season. In addition, several of the surface water rights are subject to regulation at some time during the irrigation season under the Oregon Watermaster's distribution schedule. The City holds surface water rights from Bridge Creek and Tumalo Creeks as shown in Table 2.

Table 2. City of Bend Water Rights by Seniority, Season of Use

Priority date	Irrigation Season (cfs)	Non-Irrigation Season (cfs)	Notes
Senior to all other rights	6	6	Most senior, year round right Certificate 85526
8/5/1900	2	0	Certificate 31411
9/30/1900	4.5	0	Certificate 31411
6/1/1907	0.02	0	Certificate 31411
9/30/1900	1.314 1.62	0	Certificate 31665 Transfer B-112
4/28/1905	0.186	0	Certificate 31665
6/1/1907	1.103 0.39	0	Certificate 31665 Transfer B-112
10/29/1913	3.98	0	Transfer B-112 Depending on creek flows, portions of this priority date amount may not be available during periods of distribution
12/12/1983	12.2*	12.2	Certificate 85713 *Very Junior and frequently not available during irrigation season
12/12/1983	2.8*	2.8	Permit S-49823 *Very Junior and frequently not available during irrigation season
Senior Water Right *Available* by season of use	**21.113**	**21**	
TOTAL Water Rights	**36.113**	**21**	

(green)	Most senior water rights, available year-round
(blue)	Senior Irrigation Season Only water rights
(orange)	Junior Irrigation Season Only water rights
(purple)	Year-round right, junior during irrigation season

Revised 12-14-12 (Transfer B-112, 5.99 cfs, now broken out by priority dates)

The City's ability to use these water rights for municipal supply is limited by the water rights' seasons of use and dates of priority, available streamflows, and demands of other Tumalo Creek water users. For example, the City's Certificates 31411 and 31665 and Transfer B-112 allow the use of water only during the irrigation season (generally April 15 to October 15). Further, Tumalo Irrigation District (TID) holds water rights that authorize the use of up to 210 cfs during irrigation season, which can be a large portion of Tumalo Creek flows.

During periods of low flow, usually in the summer and early fall, when there is not sufficient water in Tumalo Creek to satisfy all of the existing water rights, the State of Oregon Watermaster distributes the flow in Tumalo Creek between TID, the City, and in-stream water rights according to a predetermined proportional- share formula based on the rights' priority dates and flow rates (Table 3). During these periods, the City does not receive water under its 1983 water right, due to its junior priority date, and generally receives less than the maximum authorized rate for its other water rights (except Certificate 85526).

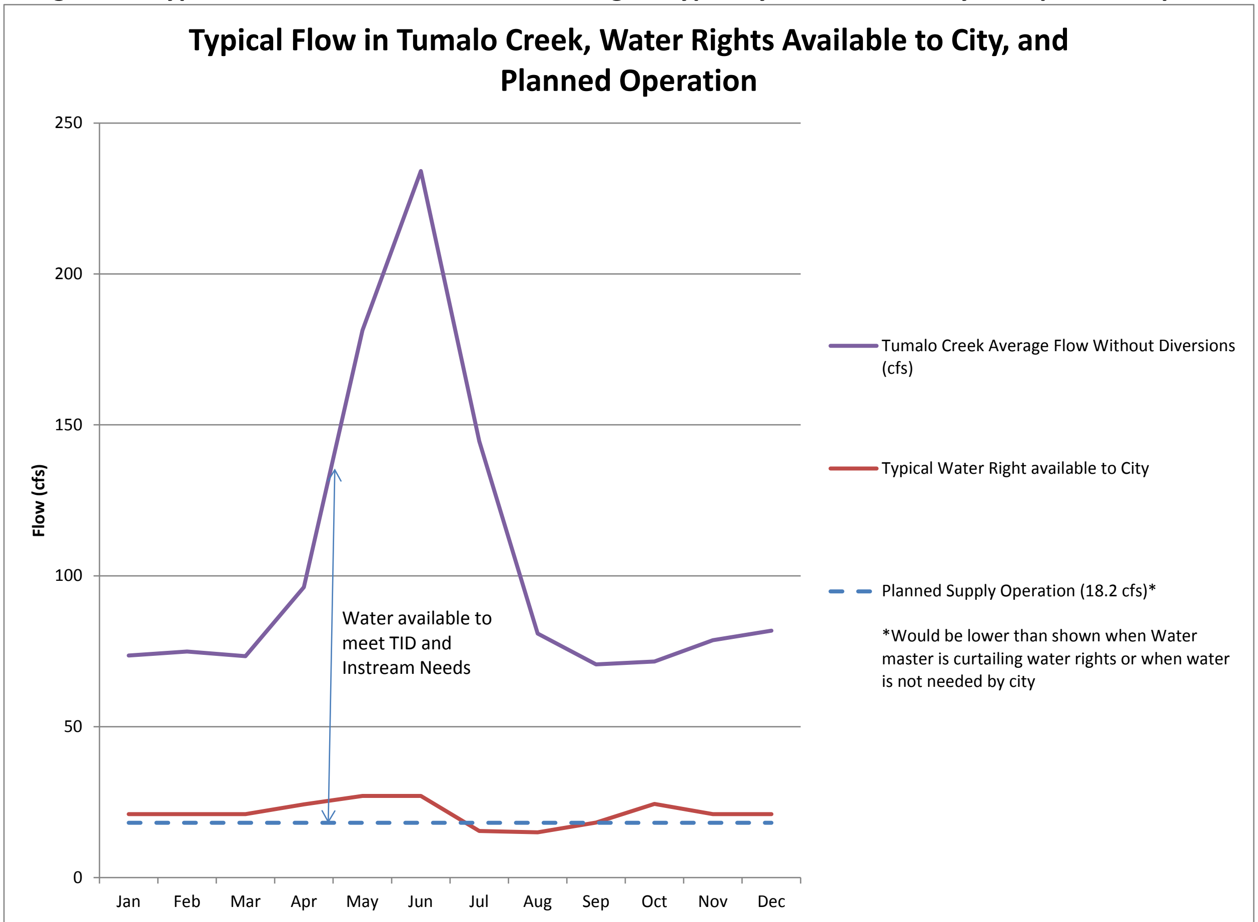
Table 3. All Tumalo Creek water rights by seniority

Priority Date	Maximum Water Right (cfs)		
	City of Bend	Tumalo Irrigation District	In-stream
"Senior to all other rights"	6.000	—	—
AUG 5, 1900	2.000	5.572	0.251
SUPERIOR SEPT 1900	—	—	5.820
SEPT 1900	7.434	39.084	1.751
APR 28, 1905	0.186	4.124	0.185
MAY 27, 1907	0.000	0.577	0.026
JUNE 1, 1907	1.513	13.573	0.608
OCT 29, 1913	3.981	136.000	0.000
DEC 8, 1961	0.000	11.300	7.800
DEC 12, 1983	15.000	0.000	0.000
OCT 11, 1990	0.000	0.000	32.000
Total	**36.114**	**210.230**	**48.441**

Source: Oregon Water Resource Department, December 2012. Includes CW-37 through Increment 2.

As a result, even though the City's surface water rights have a total combined maximum authorized rate of 36.1 cfs, this rate of diversion is typically not available to the City during periods of high water demand, usually in the summer. Figure 5 illustrates the average natural flow in Tumalo Creek, the typical water right available to the City, and the planned supply operation of 18.2 cfs. The water right available to the City varies with creek flow as discussed above and typical values are illustrated in the figure. Actual operation would not exceed 18.2 cfs and may be less if the water is not needed or if constrained by water rights distribution. The difference between the creek flow and the City's actual use is the amount of water available to meet TID and in-stream water needs. Currently in winter, the City uses much less than 18.2 cfs.

Figure 5. Typical flow in Tumalo Creek, water rights typically available to City, and planned operation.



1.5 Historic Use and Future Demands

The City has used the gravity-fed surface water supply as the base foundation for water supply source since 1926 due to its high quality and low operating costs. Currently, the surface water system supplies approximately 50% of the annual supply (Figure 6).

Though total City water demand during the summer irrigation season exceeds 21 cfs, limitations within the new Special Use Permit for the project will limit the maximum diversion to 18.2 cfs:

Other factors limiting the City's ability to divert their full water rights include:

- Stream flow varies in the creek by time of day, daily, monthly, and seasonally.
- Water rights are managed by Oregon Water Resources Department (OWRD) using the system of "prior appropriation". City water rights include a mix of seniority which, at times, limits availability.
- The City's diversion is limited by actual demand up to 18.2 cfs. Currently, during portions of the year, City demand is less than 18.2 cfs.

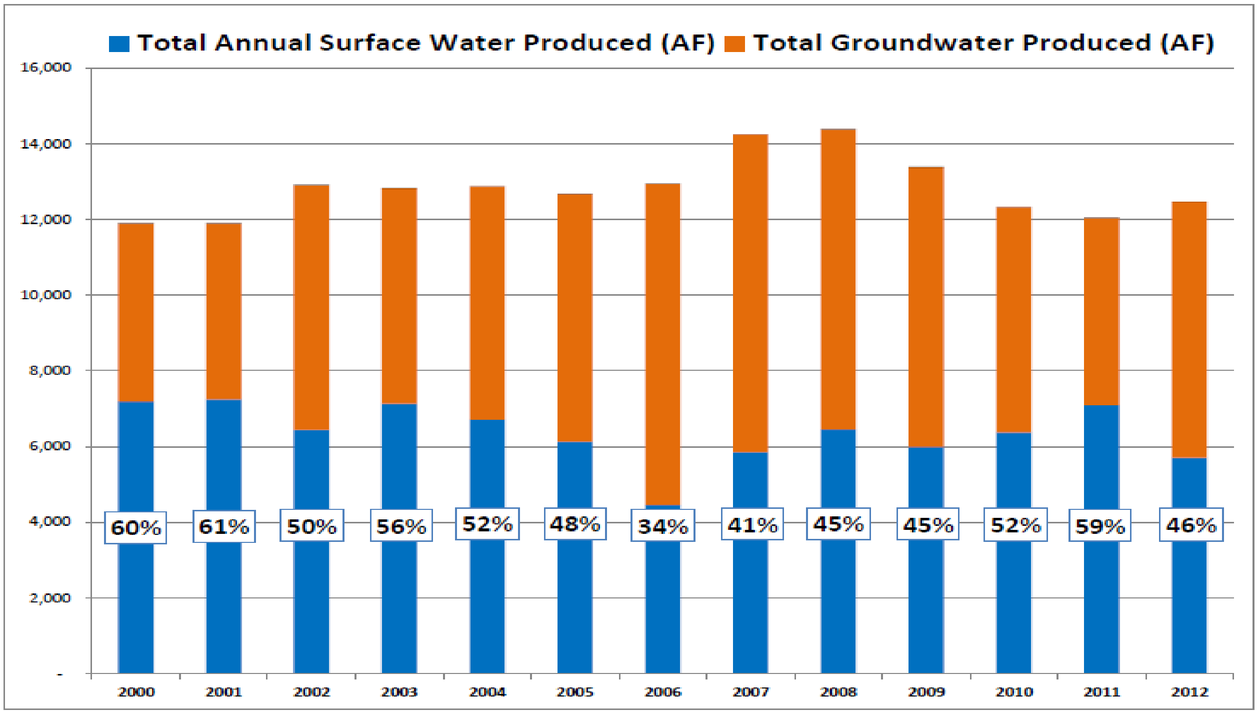


Figure 6. Annual production of surface water and groundwater

Source: City of Bend Water Production Records 2000-2012. Comparison of surface water and groundwater from 2000-2012. Variations are generally weather related; 2006 had major construction at Outback, and surface water was shut off over 100 days.

1.6 Coordination with Skyliners Road Project

The Western Federal Lands Highway Division and Deschutes County plan to reconstruct 8.4 miles of Skyliners Road from the western city limits of Bend to the junction with Forest Service Road 4603. The primary purpose for the road reconstruction is to repair the deteriorating roadway surface and to more safely accommodate existing bicycle and motorist use. The City proposes to install their new water supply pipeline within this same section of Skyliners Road and is working closely with Western Federal Lands Highway Division to support coordinated:

- Design, permitting, and construction activities
- Construction schedules
- Environmental processes to minimize construction and operational impacts to either facility
- Studies and permitting activities to satisfy NEPA requirements common to both projects

Although these projects are being closely coordinated, they have independent utility. The construction of one is not a prerequisite for construction of the other, therefor, they are not considered to be connected actions under NEPA.

Reconstruction of Skyliners Road is currently scheduled to begin no later than the spring of 2015, with completion potentially extending through two consecutive construction seasons. The City's pipeline construction is scheduled to begin in the late summer of 2013 and to be completed in the late fall of 2014.

To stay ahead of the County road reconstruction schedule, the City must begin construction of the pipeline no later than spring of 2014. The City will patch Skyliners Road following pipeline installation and will maintain the roadway until Western Federal Lands begins construction on the Skyliners Road reconstruction project. Separating the construction of the two projects will avoid construction conflicts and the potential for delay, lessen the risks for additional costs to the public on each project, and minimize full road closures and traffic delays.

The Skyliners Road Improvement project is also subject to NEPA, and Western Federal Lands completed a Documented Categorical Exclusion for that project, issued July 31, 2012.

1.7 Decision to be made

The Deciding Officer is the Forest Supervisor, Deschutes National Forest. The decision is whether to issue a Special Use Permit authorizing the City's proposed Bridge Creek Surface Water System Improvement Project (Project) studied in this Environmental Assessment, and, if so, under what conditions and with what mitigation measures. All actions discussed in this EA will be incorporated into the SUP which is the written authorization that will approve the construction and all mitigation.

1.8 Public and Agency Involvement

The Forest Service first published their intent to analyze this project in the Schedule of Proposed Actions (SOPA) in May, 2010.

The Forest Service originally issued a decision on this project on July 10, 2012. The project was appealed, the Decision was upheld by the Reviewing Officer, and subsequently a complaint and request for a Temporary Restraining Order was filed in District Court. A Preliminary Injunction was granted, which stopped implementation of the project on October 11, 2012. The decision was subsequently withdrawn on December 17, 2012.

The Forest Service's proposal to issue a Special Use Permit allowing the City's revised planned upgrades to their surface water supply system was provided to the public and other agencies for comment during the NEPA scoping period held between December 18, 2012, and January 22, 2013.

A summary of the comments received during scoping and the Forest Service response to these comments is provided in Table 4.

Table 4. Issues raised during NEPA scoping.

Comment	Response and Relevant Section of EA
Forest Service should prepare an EIS.	The Forest Service has not concluded that the Proposed Action would result in significant adverse effects to the human environment. Therefore, at this time, preparation of an Environmental Impact Statement (EIS) is not anticipated.
The EA should include a detailed description of the City's water rights (permitted vs. certificated) and the reliability of these rights.	A detailed discussion of the City's water rights is included in Section 1.4.
The EA should fully describe the City's full surface water system.	Discussion of the City's existing system and its condition is presented in Section 2.2.2.2.
The Forest Service should confirm Bull Trout use (or non-use) in Tumalo Creek via thorough and impartial studies.	Bull trout surveys were conducted during 2011, and no bull trout or signs of bull trout were observed in Tumalo Creek. Potential impacts of the Proposed Action to fisheries are presented in Section 3.7.
The EA should explain how pipe size was determined.	A discussion of the City's proposed pipeline and rationale for pipe diameter is presented in Section 2.2.2.2.
The City conducted inadequate study of options to use existing pipe.	The City conducted extensive studies on the condition of the existing pipes and implications of their continued use (Brown and Caldwell 2009). Use of the existing pipelines is considered in this EA as the No Action Alternative.
The Forest Service should fully evaluate replacing pipelines with single new pipeline of similar size and diameter.	This alternative was reviewed by the City's independent Value Engineering team following the pre-design phase and was found to be unacceptable, mainly because it does not meet the city's future capacity needs and is, therefore, not a reasonable action alternative.
Replacing surface water with groundwater should be fully evaluated in the EA.	It is not appropriate for the Forest Service to fully evaluate replacing surface water with groundwater. This option would not be subject to a Forest Service decision or Special Use Permit and is outside the scope of this EA. The City did evaluate replacing their surface water supply with groundwater, and this option was dismissed prior to the City's request for a Special Use Permit from the Forest Service. Those findings are presented in Section 1.3.1.
The Forest Service should fully evaluate continued use of the existing pipelines.	This is the No Action Alternative and is assessed as such in this EA.
The EA should evaluate moving the point of diversion downstream and closer to the Outback Site.	This alternative was considered and dismissed from detailed study due to water quality, water rights, impacts to undeveloped forest lands, operational costs, and engineering constraints and concerns. The rationale for dismissal is presented in Section 2.1.2.
The EA should evaluate how the Action Alternative could affect Tumalo Creek temperatures, flows and aquatic habitat.	A discussion of the effects of the Proposed Action on Tumalo Creek streamflow, habitat, and water temperature is provided in Section 3.7.

The EA should evaluate the effect of increased diversions to restoration goals for Tumalo Creek and Deschutes.	A discussion of the effects of the Proposed Action on Tumalo Creek streamflow, habitat, and water temperature, including the Deschutes River, is provided in Section 3.7.
The EA should evaluate the effect of increased diversions to downstream scenic waterway flows.	A discussion of the effects of the Proposed Action on Tumalo Creek streamflow, habitat, and water temperature is provided in Section 3.7.
The EA should evaluate how the proposed hydropower facility could provide incentive for the City to use more surface water (than groundwater) to maximize revenues.	At this time, the City has not committed to the development of a hydropower facility as part of their currently proposed project. Regardless, the City always has and will continue to use surface water as its primary water supply source and groundwater as a secondary source based on operating costs. The City will continue to use surface water preferentially with or without hydropower.
The EA should evaluate the increased pipe size leading to larger winter diversions.	Anticipated effects to water resources due to increased pipe capacity are evaluated in Section 3.7.
The EA should evaluate how the City's potential expansion of consumptive use to 36 cfs may preclude future water conservation projects.	The City is seeking a Special Use Permit to construct a new pipeline and is proposing to divert no more than 18.2 cfs through this pipeline. In the future, if the City decides to pursue increased diversion beyond 18.2 cfs, that would trigger a new NEPA analysis, and the effects of such consumptive use would be evaluated at that time.
EA should evaluate effects of two pipeline stream crossings.	The potential effects of pipeline stream crossings are presented in Section 3.7.
EA should evaluate effects of increased diversions to past restoration efforts on Tumalo Creek.	The potential project effects on Tumalo Creek temperature, flow, riparian areas, and habitat are assessed in Section 3.7.
Proposed flow control could result in rapidly changing streamflows, leading to forced redistribution of available habitat.	A discussion of the effects of the Proposed Action on Tumalo Creek streamflow, habitat, and water temperature is provided in Section 3.7.
EA should evaluate effects of cross-forest installation of pipe between the Bridge Creek intake and the upper Tumalo Creek crossing.	The effects of the cross-forest installation of pipe between the Bridge Creek intake and the upper Tumalo Creek crossing are assessed in Section 3.7.
EA should evaluate effects of increased diversion on bull trout and steelhead.	No significant adverse effects to bull trout or steelhead are currently anticipated, since these species are not present within the area of potential effects. The closest bull trout critical habitat is downstream of Big Falls. Steelhead is an experimental population and is not protected under the Endangered Species Act. Further, the Proposed Action will not affect temperatures in the Deschutes River. Project effects to fisheries are presented in Section 3.7.
The EA should evaluate effects of greenhouse gas emissions during construction.	Project-related emissions and climate change are discussed in Section 3.10.

The EA should evaluate the benefits of the proposed project against the costs, including cost of the potential hydropower facility and retrofitting and operating the water treatment plant in the event of a fire.	Evaluating cost or the City's decision to reinvest in its surface water supply system is beyond the scope of the Forest Service action and jurisdiction. The decision to reinvest the surface water was a City decision that was made prior to the City applying to the Forest Service for a Special Use Permit. The City's decision to reinvest in surface water is discussed in Section 1.3.
The need for OWRD permits for impoundments could jeopardize the City's continued use of their current point of diversion.	After review of the size, purpose, and operations of the City's Bridge Creek impoundments, OWRD concluded that storage water rights are not necessary (Aug. 2, 2011, letter from Kyle Gorman).
Implement the project prior to Thanksgiving 2013 above Milepost 4.	Construction schedule is discussed in Sections 2.2.2.1 and Section 3.5..
Preserve all roadside trees except Lodgepole.	Tree removal is discussed in Section 2.2.2.1.
Add hydroelectric plant and a biofuels plant to the project.	These actions have not been proposed to the Forest Service and are outside the scope of this analysis.
Place fire hydrants along the entire route.	The City has proposed to construct at least three fire hydrants in the upper end of the pipeline near the subdivision.
Put gravel on all staging areas to later serve as off road parking.	Staging areas are discussed in Section 2.2.2.1, and will be restored to their pre-construction condition.
EA needs to address buildup of debris downstream due to construction thus inhibiting flow.	In-stream construction is addressed in Section 2.2.2.1.
EA needs to address the risk of fire during construction.	As a condition of their permit, the City will be required to follow all standard fire prevention regulations for industrial use and construction projects.
EA needs to address the effects of the surface water project to the bikers and other recreationists in the area.	Effects to Recreation and access are addressed in Section 3.5.
The EA must correct misleading statements with respect to "firm capacity" of wells and correctly state peak day demand and how groundwater plays a role.	Firm capacity of wells is discussed in detail in the Water System Master Plan Update Optimization Study, Final Report, February, 2011, Optimatics. Peak day demand and role of groundwater is discussed here in Section 1.5.
EA should include a review of instream leasing options for the City.	Instream leasing of the City's water rights is outside the purview of the Forest Service and the scope of this analysis.
EA must consider the likelihood of catastrophic fire in the Bridge Creek Basin.	Risk of wildfire in the watershed is discussed in Section 2.1.2.2.
EA should explain the measuring device that will record instantaneous diversions at the diversion point.	Raw water controls and gauging are discussed in Section 2.2.2.2.
EA should consider a full range of ecological restoration actions to fully realize the desired future condition of the riparian land allocation and standards and guidelines even if it requires substantially modifying the project.	A discussion of the effects of the Proposed Action on Tumalo Creek streamflow, habitat, and water temperature, including the Deschutes River, is provided in Section 3.7.

EA should include a detailed description of the fish salvage plan for the lower Tumalo Creek crossing.	The fish salvage plan is not a written plan. It is routinely done by ODFW and USFWS, most recently at Camp Polk in Whychus Creek. Once barriers are in place, fish are electro-shocked and captured in nets, and moved to open water above or below the work area.
EA should include a description of the existing fish screen and intake structure including the fish bypass structure and the projected screening plan for the proposed project.	The current and proposed fish screens are described in Section 2.2.2.2. There is currently no fish bypass structure in the existing Intake Facility, nor is one proposed in the new improvements to the existing Intake Facility.

1.8.1 Outreach Efforts

Outreach efforts conducted by the City in support of the planned upgrades to the Bridge Creek water supply system are summarized below.

Outreach to non-governmental organizations (NGOs). Between May and September 2010, the City held one-one-one meetings with the following NGOs to discuss the elements of the project and solicit input on potential effects and concerns. The City has engaged in ongoing coordination with several of these NGOs:

- Upper Deschutes Water Council
- Deschutes River Conservancy
- Tumalo Irrigation District
- Trout Unlimited
- Native Fish Society
- Central Oregon Land Watch

Ongoing coordination with regulatory agencies. Since May 2010, the City has been regularly coordinating with the following agencies on permitting and compliance for the proposed surface water project:

- U.S. Forest Service, Bend–Fort Rock District
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Oregon Department of Fish and Wildlife
- Oregon Water Resources Department
- Oregon Department of Environmental Quality
- Oregon Division of State Lands
- Oregon Health Authority

Public open houses. The City hosted two public open houses (October 12, 2010, and September 27, 2011) to provide information and answer questions about the proposed Project and its potential effects. The Forest Service was represented at both of these open houses to discuss the NEPA process and the Environmental Assessment for the proposed project.

Bend Summer Festival. The City staffed an informational booth at the July 2010 Bend Summer Festival to discuss the Project with the public and to allow the public to sign up for the Project e-mail list to receive further project information and updates.

Website. The City has maintained a project website that includes reference documents, general monthly project updates, notifications of all project-related comment periods, and project schedule updates.

1.9 Pertinent Plans, Laws, and Regulations

Analysis and documentation for this EA has been performed according to direction contained in the Federal Land Policy and Management Act (FLPMA), National Forest Management Act, the Deschutes National Forest Land and Resource Management Plan (LRMP), as amended, the National Environmental Policy Act, the Council on Environmental Quality regulations, Forest Service NEPA regulations, the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act of 2000, the National Historic Preservation Act, the Clean Air Act, and the Clean Water Act.

The following is a brief explanation of each of these laws and other applicable state and federal environmental regulations.

1.9.1 Deschutes National Forest Land and Resource Management Plan, 1990

This EA is tiered to the Final Environmental Impact Statement (FEIS) for the Deschutes National Forest Land and Resource Management Plan, 1990, as amended.

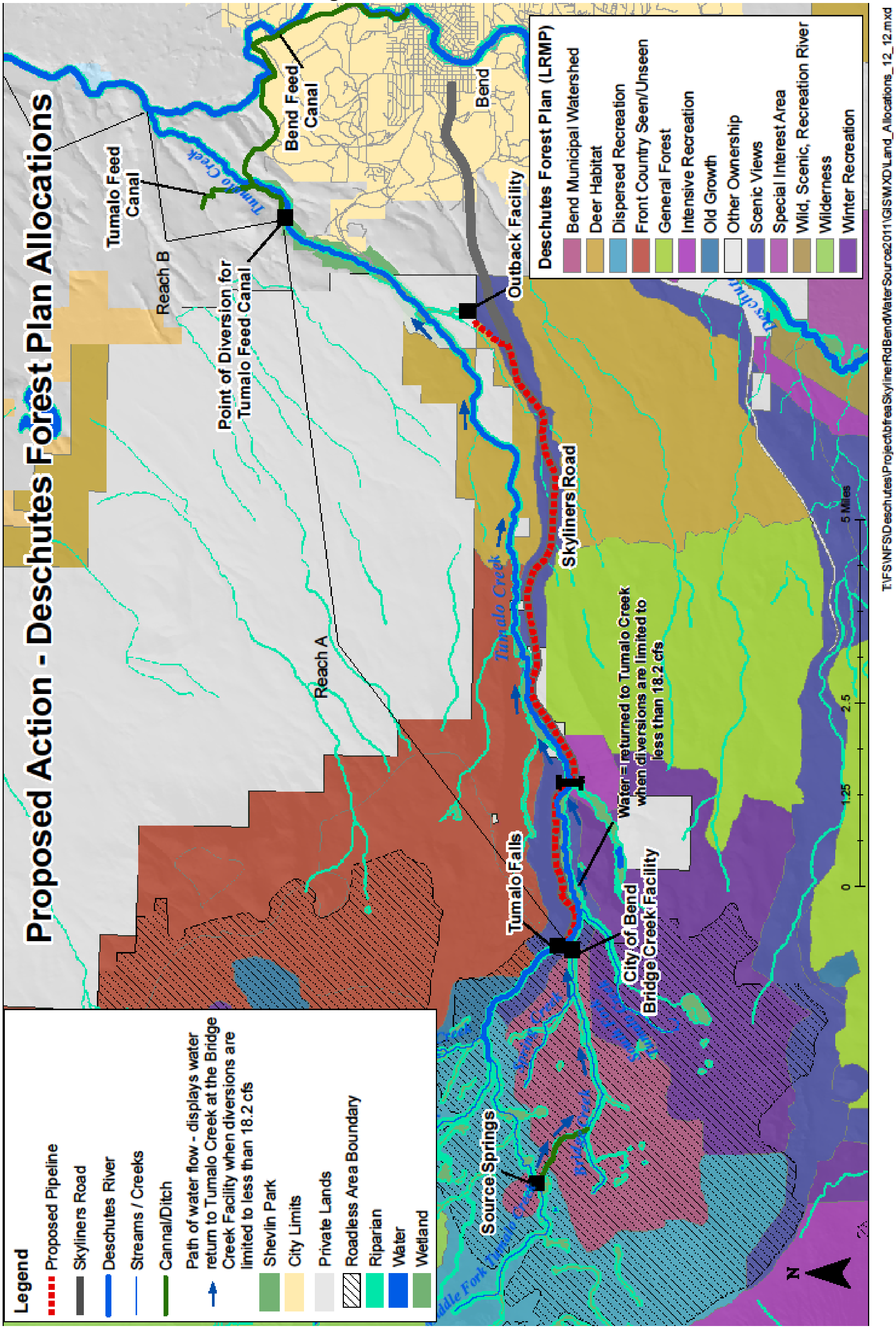
The Forest Plan provides management direction for the Forest. It includes management goals and objectives, standards, and guidelines, both forest-wide and specific to land allocations. The project area (road corridor) is entirely within the Scenic Views Management Area (MA), except where the County Road transects private lands. See Figure 7.

Scenic Views, MA 9. The primary goal of this management area is to provide high-quality scenery representing the natural character of central Oregon.

Landscapes seen from selected travel routes and use areas will be managed to maintain or enhance their appearance. To the casual observer, the results of activities either will not be evident or will be visually subordinate to the natural landscape (LRMP, 1990). A small amount of foreground and middle-ground scenic views are present within this project area. Landscapes will be enhanced by opening views; programmed timber harvest is permitted to improve the visual quality of the stands. Timber stands, which have remained unmanaged in the past because of their visual sensitivity, will begin receiving treatments to avoid loss of stands to natural causes. Negative visual impacts such as skid roads or activity residue will be rehabilitated.

Bend Municipal Watershed, MA 10. None of the project area is actually within this MA, but, because of the nature of the project, the goals of the MA apply. The primary goals of this management area are (1) to provide water at a level of quantity and quality that will, with adequate treatment, result in a satisfactory and safe domestic water supply and (2) to balance present and future resource use with domestic water supply needs.

Figure 7. Deschutes LRMP Allocations



1.9.1.1 Inland Native Fish Strategy (INFISH)

The riparian management guidelines of the Forest Plan were amended by the Inland Native Fish Strategy (INFISH 1995). INFISH was intended to be interim direction to protect habitat and populations of resident native fish and to provide for options for management. INFISH delineated Riparian Habitat Conservation Areas (RHCAs) where riparian-dependent resources receive primary emphasis. These RHCAs include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems. These areas will be managed to maintain or restore water quality, stream channel integrity and channel processes, sediment regimes, in-stream flows, diversity and productivity of plant communities in riparian zones, and riparian and aquatic habitats to foster unique genetic fish stocks that evolved within the specific region. RHCAs run through and are overlaid on other allocations.

This direction applies to National Forest System lands east of the NWFP “owl line” on portions of the RHCA for Tumalo Creek and the Deschutes River that are adjacent to the project area, or to areas outside the RHCA that could potentially degrade the RHCAs. This project does not involve priority watersheds under INFISH.

1.9.1.2 Northwest Forest Plan (NWFP)

In 1994, the Record of Decision for Amendments to the Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (USDA 1994) amended the LRMP. Standards and guidelines from the Deschutes LRMP (USDA 1990) apply where they are more restrictive or provide greater benefits to late-successional-forest-related species than other provisions of the NWFP S&Gs (NWFP, C-2).

There are seven land allocations under the NWFP. The Bend Water Supply project area falls within three of these allocations: Matrix, Administratively Withdrawn, and Riparian Reserves. Part of the project, down to approximately 1.25 miles below Skyliners Bridge, is within the Upper Tumalo Creek Tier 2 Key Watershed, which was designated to preserve water quality.

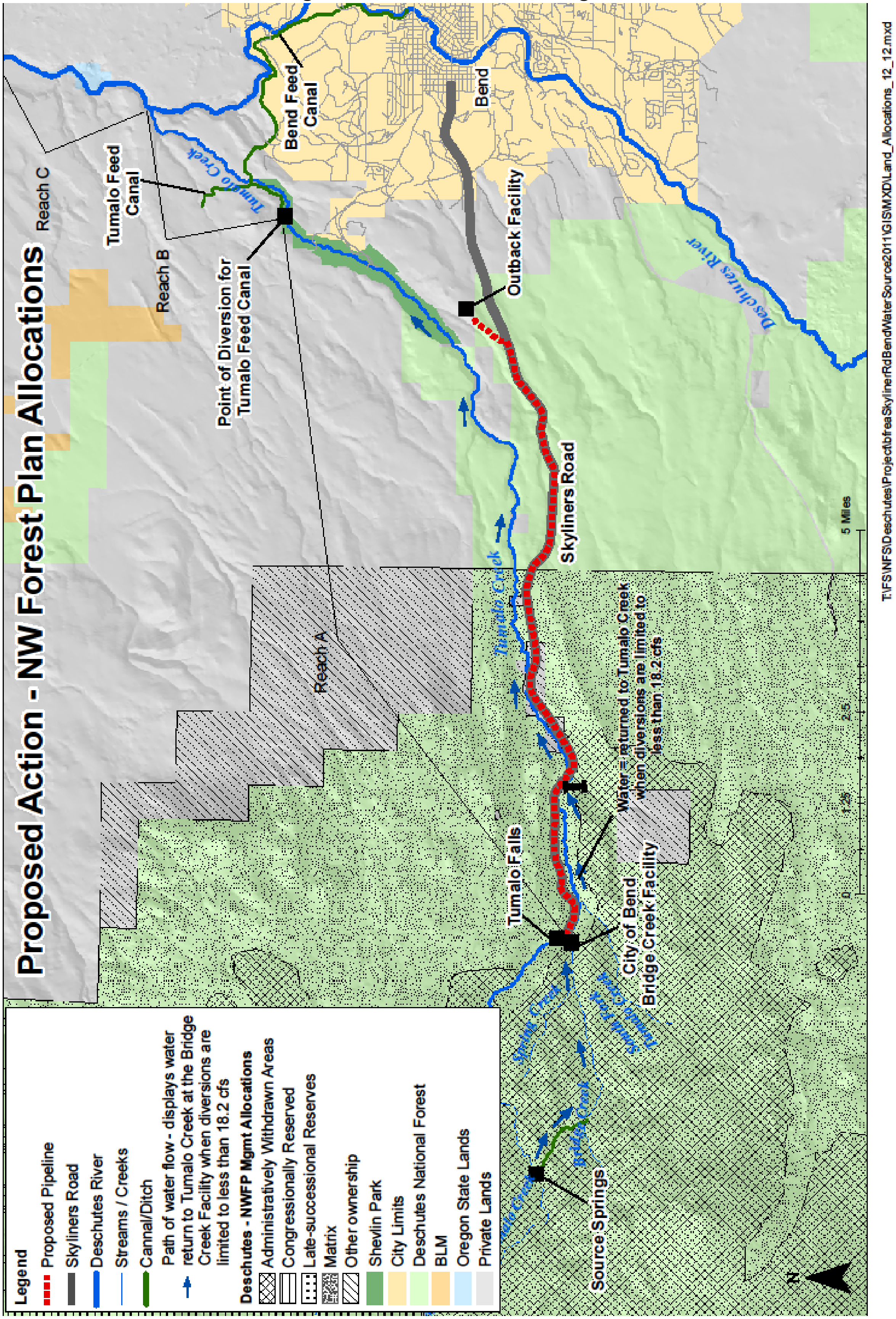
Matrix

The matrix consists of federal lands not falling within one of the other six land allocation categories (Congressionally Reserved Areas, Late-Successional Reserves, Managed Late-Successional Reserves, Adaptive Management Areas, Administratively Withdrawn Areas, and Riparian Reserves). There are no Matrix S&Gs that apply to the Proposed Action.

Administratively Withdrawn

Administratively Withdrawn Areas (AWAs) are areas where existing Forest Plan direction would preclude scheduled timber harvest (that is, that portion of the land base was not used to develop the Forest Plan’s allowable/probable timber sale quantity; it does not prohibit timber harvest). In this case, the AWA is the same as the Scenic View allocation (MA-9) of the Deschutes LRMP, and those S&Gs apply.

Figure 8. NW Forest Plan Management Areas



Riparian Reserves

This allocation emphasizes riparian resources and values. This includes lands generally within 300 feet of perennial and intermittent streams and other water bodies. Management activities are permitted where they do not prevent or impede the attainment of Aquatic Conservation Strategy (ACS) objectives.

Compliance with the Aquatic Conservation Strategy

An essential piece of the NWFP is the Aquatic Conservation Strategy (ACS) which “was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands” (USFS 1994, B-9). Management activities proposed for watersheds must meet, or not retard or prevent the attainment of, the nine ACS objectives as specified in the NWFP (pages C31–C38). The analysis in this EA discusses how the Proposed Action meets the intent of the Aquatic Conservation Strategy Objectives of the NWFP and analyzes effects of the alternative and compliance with the ACS for hydrologic functions and fisheries habitat.

Compliance with Survey and Manage Standards and Guidelines

Project Consistency: The Bridge Creek Water Supply System Project applies the Survey and Manage species list in the 2001 ROD (Table 1-1, Standards and Guidelines, pages 41-51) and thus meets the provisions of the 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines.*

1.9.1.3 Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales (Eastside Screens)

The eastern portion of the project lies east of known spotted owl range, and is subject to management direction known as the Eastside Screens. The Eastside Screens were the result of a large-scale planning effort to determine the best approach for maintaining future options concerning wildlife habitat associated with late and old structural stages, fish habitat, and old forest abundance. The Eastside Screens contain guidelines for management of timber sales in Late and Old Structure (LOS) forests relative to the Historic Range of Variability (HRV), wildlife corridors, snags, coarse woody debris, and goshawk management. The Eastside Screens were intended as interim direction in 1995, and it remains an applicable amendment to the Deschutes LRMP (also referred to as the Forest Plan). In this project, trees are being removed to make way for construction, not as part of a timber sale, so the Screens do not apply.

1.9.2 American Antiquities Act of 1906

The American Antiquities Act makes it illegal to appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned by the Government of the United States, without permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated.

1.9.3 National Historic Preservation Act of 1966, as Amended

The National Historic Preservation Act (NHPA) requires federal agencies to consult with American Indian tribes and state and local groups before nonrenewable cultural resources, such as archaeological and historic structures, are damaged or destroyed. Section 106 of this Act requires federal agencies to review the effects that project proposals may have on the cultural resources in the analysis area.

Cultural resource surveys have been conducted following inventory protocols approved by the State Historic Preservation Officer (SHPO). The final Cultural Resources Inventory Report for the City of Bend Surface Water Project was submitted to the SHPO in January 2012. The SHPO has been consulted on this project, and a letter of concurrence for an adverse effect to an eligible historic property (the

Bridge Creek Intake Building) was received in February 2012. A Memorandum of Agreement between the SHPO and the Forest Service was included as an attachment to the concurrence letter and outlines mitigation for the demolition of the intake building. Native American communities have been contacted and public comments encouraged.

Cultural (Heritage) resources are evaluated in Section 3.6 of this EA, and the Cultural Resources Inventory Report is found in the project record.

1.9.4 Endangered Species Act of 1973, as Amended

The intent of the Endangered Species Act is “to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such tests as may be appropriate to achieve the purpose of the treaties and conventions set forth in subsection (a) of this section.” The Act also states, “It is further declared to be the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act.”

Threatened and endangered fish, plant, and wildlife species and their habitat are evaluated in Chapter 3 of this EA and in the Biological Assessments found in the project record.

1.9.5 National Environmental Policy Act (NEPA) of 1969, as Amended

The intent of the National Environmental Policy Act is “to declare a national policy which will encourage productive and enjoyable harmony between man and his environment, to promote efforts which will prevent or eliminate damaged to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nations; and to establish a Council on Environmental Quality” (42 United States Code [U.S.C.], Section 4321). The law further states, “It is the continuing policy of the Federal Government, in cooperation, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the present and future generations of Americans.” This law essentially pertains to public participation, environmental analysis, and documentation.

The Council on Environmental Quality (CEQ) promulgated the regulations for implementing NEPA (40 CFR 1500–1508). CEQ has recently provided guidance on considering past actions in cumulative effects analysis (Memo to Heads of Federal Agencies, June 24, 2005). NEPA direction for the Forest Service is codified in 36 CFR 220.

1.9.6 Federal Land Policy and Management Act (FLPMA) of 1976, (43 U.S.C. 1761-1771).

Title V of the Federal Land Policy and Management Act (FLPMA) authorizes the Secretary of Agriculture to issue permits, leases, or easements to occupy, use, or traverse National Forest System lands. FLPMA directs the United States to receive fair market value unless otherwise provided for by statute and provides for reimbursement of administrative costs in addition to the collection of land use fees (43 U.S.C. 1764(g)).

1.9.7 National Forest Management Act (NFMA) of 1976

The National Forest Management Act guides development and revision of National Forest Land Management Plans. There are several sections of the Act pertinent to this project, including Section 1 (purpose and principles), Section 19 (fish and wildlife resources), Section 23 (water and soil resources), and Section 27 (management requirements).

1.9.8 Multiple-Use Sustained-Yield Act of 1960

The Multiple Use–Sustained Yield Act of 1960 requires the Forest Service to manage National Forest System lands for multiple uses (including timber, recreation, fish and wildlife, range, and watershed). All renewable resources are to be managed in such a way that they are available for future generations.

1.9.9 Executive Order on Migratory Birds (No. 13186)

On January 10, 2001, President William Clinton signed an Executive Order titled “Responsibilities of Federal Agencies to Protect Migratory Birds.” This executive order requires each federal agency to “ensure that the environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern.” It is the responsibility of federal agencies to protect migratory birds. Implementation of the Proposed Action is not expected to have a negative effect on migratory birds or their habitat, as described in Section 3.8, Wildlife.

1.9.10 Executive Order on Invasive Species (No. 13112, signed February 3, 1999)

This order requires federal agencies, whose actions may affect the status of invasive species, to identify those actions and, within budgetary limits,

> *(i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species… (iii) monitor invasive species populations… (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded;…(vi) promote public education on invasive species… and (3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species… unless, pursuant to guidelines that it has prescribed, the agency had determined and made public… that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.*

Implementation of the Proposed Action with mitigation is not anticipated to cause or promote the introduction or spread of invasive species, as described in Section 3.4, Noxious Weeds and Unwanted Vegetation.

1.9.11 Executive Order on Protection of Wetlands (No. 11990)

This executive order directs federal agencies to “minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands….” As described in Section 3.7, Fisheries and Watershed, the Proposed Action is expected to meet all applicable standards.

1.9.12 Clean Water Act, as Amended in 1977, 1982, and 1987

The primary objective of this Act is to restore and maintain the integrity of the nation’s waters. This objective translates into two fundamental national goals: (1) eliminate the discharge of pollutants into the nation’s waters and (2) achieve water quality levels that are fishable and swimmable. This Act establishes a non-degradation policy for all federally proposed projects. The Proposed Action meets anti-degradation standards agreed to by the State of Oregon and the Forest Service, Region 6, in a Memorandum of Understanding (Forest Service Manual 1561.5).

The City’s project would result in impacts to federally protected wetlands and waters of the state and is subject to regulations under Section 404 and Section 401 of the Clean Water Act, which is promulgated by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency (EPA), respectively. EPA has delegated Section 401 authority to the Oregon Department of Environmental Quality. The following permits will be required prior to the City implementing this project:

1. **U.S. Army Corps of Engineers Section 404 Permit**
2. **Oregon Department of State Lands Removal Fill Permit**
3. **Oregon Department of Environmental Quality Section 401 Water Quality Certification**
4. **Oregon Department of Environmental Quality NPDES 1200-C Permit**
5. **Oregon Department of Environmental Quality Water Pollution Control Facility (WPCF) Permit**

Monitoring and evaluation of the implementation and effectiveness of Forest Plan standards and guidelines and Best Management Practices (BMP) will occur as described in Section 3.7, Fisheries and Watershed. The Proposed Action is expected to meet all applicable State of Oregon water quality standards.

In Oregon, The Clean Water Act is administered by the Department of Environmental Quality. The standards applicable to this project are defined in the Oregon Administrative Rules at Oregon Department of Environmental Quality: Division 041 – Chapter 45 – Water Quality Standards
Effective July 2nd, 2007. ODEQ does not consider water diversions to meet the definition of point-source pollutants as defined by the Clean Water Act.

OAR 340-041-0028 Temperature

(11) Protecting Cold Water.

(a) Except as described in subsection (c) of this rule, waters of the State that have summer seven-day-average maximum ambient temperatures that are colder than the biologically based criteria in section (4) of this rule, may not be warmed by more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) above the colder water ambient temperature. This provision applies to all sources taken together at the point of maximum impact where salmon, steelhead, or bull trout are present.

(c) The cold water protection narrative criteria in subsection (a) do not apply if:

(A) There are no threatened or endangered salmonids currently inhabiting the water body;

(B) The water body has not been designated as critical habitat; and,

(C) The colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria.

1.9.13 Executive Order on Environmental Justice (No. 12898)

Forest Service Departmental Regulation 5600-2 directs the agency to integrate environmental justice considerations into federal programs and activities, and address environmental justice in minority and low-income populations. *Environmental justice* means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by government programs and activities affecting human health or the environment.

1.9.14 Clean Air Act, as Amended in 1977 and 1990

The Clean Air Act requires the Forest Service to protect air-quality-related values in Class I Areas (for example, the city of Bend). The primary purposes of this act are to (1) protect human health and welfare with national air quality standards, (2) establish major air quality goals, and (3) provide means and measures to attain goals by addressing existing and potential air pollution problems. All Forest Service–proposed activities must follow the federal Clean Air Act, as amended. EPA has the responsibility and authority to establish regulations and standards for carrying out the provisions of the Act. EPA Region 10 covers Oregon, Washington, and Idaho.

1.9.15 Oregon Land Use Regulations

By Order dated 11/29/12, the Oregon Land Use Board of Appeals (LUBA) remanded the City's final decision on the Water Public Facilities Plan (PFP), adopted pursuant to Statewide Planning Goal 11 (Public Facilities and Services) and OAR 660-011-0000 et. seq. While some appeal issues were denied, the remand was on a total of four assignments and subassignments of error, and there are essentially two issues to be addressed on remand. One issue is to sufficiently describe the surface water project by describing its components and costs, and list the surface water project on the short -term or long-term project list. The other set of issues relates to the provision of water service to the Tetherow destination resort. The City has prepared the revised Water PFP, plan amendment, staff report, issue summary and necessary supporting documents. The City believes that the revised Water PFP and supporting documents contain the required information regarding the surface water project, and provide a legally and factually supportable justification regarding the service to Tetherow.

1.9.16 Oregon Water Law

The Water Code (from OWRD, 2009)

Under Oregon law, all water is publicly owned. With some exceptions, cities, farmers, factory owners, and other water users must obtain a permit or water right from the Water Resources Department to use water from any source— whether it is underground, or from lakes or streams.

Oregon’s water laws are based on the principle of prior appropriation. This means the first person to obtain a water right on a stream is the last to be shut off in times of low streamflows. In water-short times, the water right holder with the oldest date of priority can demand the water specified in their water right regardless of the needs of junior users. If there is a surplus beyond the needs of the senior right holder, the water right holder with the next oldest priority date can take as much as necessary to satisfy needs under their right and so on down the line until there is no surplus or until all rights are satisfied. The date of application for a permit to use water usually becomes the priority date of the right.

The use of water under a water right is restricted to the terms and conditions described in the water right certificate: place of use, point of diversion, and type of use. For example, if a water right holder establishes the right to irrigate a particular 20-acre tract of land, the water cannot be diverted from a different point or source, nor can it be used to irrigate other land. It cannot be used for any other purpose than the type of use indicated in the water right.

The water right holder must file a transfer application with the Department to change a point of diversion, point of appropriation, type of use, place of use, or any combination of these.

Watermasters respond to complaints from water users and determine in times of water shortage, which generally occurs every year, who has the right to use water. Each summer as streamflows drop, they regulate junior users to provide water to more senior users. Watermasters work with all of the water users on a given water system to ensure that the users voluntarily comply with the needs of more senior users. Occasionally, watermasters take more formal actions to obtain the compliance of unlawful water users or those who are engaged in practices that “waste” water. The waste of water means the continued diversion of more water than is needed to satisfy the specific beneficial use for which the right was granted.

The rules governing the water Rights Program are found at:

- Water Rights Act, Appropriation of Water Generally, Oregon Revised Statutes ORS 537.505 - 537.795 (See "Oregon Administrative Rules and Oregon Revised Statutes");
- Water Resources Department Rules, Oregon Administrative Rules, Chapter 690, Division 8 (See "Oregon Administrative Rules and Oregon Revised Statutes");

1.9.17 Oregon Scenic Waterways Program

The people of Oregon established the Oregon Scenic Waterways Program in 1970, recognizing that wise individual and public use of these special rivers and adjacent lands is necessary. It strives to achieve a balance between protecting the rivers´ natural resources and the equally valuable lives and plans of the people who live along them.

The Oregon Parks and Recreation Department must be notified of certain activities proposed within a 1/4 mile of the bank of Oregon's designated scenic waterways. Such activities include cutting of trees, mining, construction of roads, railroads, utilities, buildings, or other structures.

The rules governing the Scenic Waterways Program are found at:

- Scenic Waterways Act, Oregon Revised Statutes 390.805 to 390.940 (See "Oregon Administrative Rules and Oregon Revised Statutes");
- Scenic Waterways Rules, Oregon Administrative Rules, Chapter 736, Division 40 (See "Oregon Administrative Rules and Oregon Revised Statutes");

There are two segments of the Middle Deschutes Scenic Waterway adjacent to and downstream of the mouth of Tumalo Creek:

From the northern Urban Growth Boundary of the City of Bend at approximately river mile 161 downstream to Tumalo State Park at approximately river mile 158, the river is classified Recreational River Area;

From Deschutes Market Road at approximately river mile 157 downstream to the south boundary of the Wilderness Study Area at approximately river mile 131, excluding the Cline Falls Dam and powerhouse section between the State Highway 126 Bridge and river mile 144 and the Crooked River Ranch River Community Area, the river is classified Scenic River Area;

Within these areas, all new structures, improvements and development must comply with the Land Management rules as described in OAR 736-040-0035 and 736-040-0040(1)(c)(B), and be consistent with applicable Deschutes County land use and development regulations.

Diversion of waters for human consuption within and above State Scenic Waterways are regulated under ORS 390.835 (Highest and best use of waters within scenic waterways).

1.10 Project Record

This EA hereby incorporates by reference the project record (40 CFR 1502.21) The project record contains specialist reports and other technical documentation used to support the analysis and conclusions in this EA. Chapter 3 provides a summary of the specialist reports in adequate detail to support the decision rationale; specialist reports and appendices provide supporting documentation.

Incorporating these specialist reports and the project record help implement the provision of the CEQ regulations that agencies should reduce NEPA paperwork (40 CFR 1500.4), that the document shall be “analytic rather than encyclopedic,” and that the document “shall be kept concise and no longer than absolutely necessary” (40 CFR 1502.0). The objective is to furnish adequate site-specific information to demonstrate a reasoned consideration of the environment impacts of the alternative and how these impacts can be mitigated, without repeating detailed analysis and background information available elsewhere. The project record is available for review at the Bend–Fort Rock District Office, 63095 Deschutes Market Road, Bend, Oregon, Monday through Friday, 7:45 a.m. to 4:30 p.m.

CHAPTER 2.0 ALTERNATIVES

This chapter describes the alternatives considered for the Bridge Creek Water Supply System project, including the No Action Alternative and those alternatives that were dismissed from detailed study. Additional alternatives that were considered by the City prior to proposing the action for this environmental assessment are described in Section 1.3. The potential effects of the alternatives that were advanced for full study are presented in Chapter 3.

2.1 Alternatives Considered and Dismissed from Detailed Study

Federal agencies are required by NEPA to study, develop, and describe appropriate alternatives to recommended courses of action in any proposal that involves unresolved conflicts concerning alternative uses of available resources (NEPA Section 102 (2)(E); 40 CFR 1507.2(d)). Public comments received in response to the Proposed Action expressed concerns with the proposal and provided suggestions for different courses of action. The alternatives that were considered by the Forest Service but not analyzed in detail are summarized below.

2.1.1 Replacing the City's Water Supply Pipelines within Existing Alignments

The City and the Forest Service considered the option of replacing both of the existing pipelines in their current alignments with two 20-inch water supply pipelines and also considered replacing the existing pipelines with a single 30-inch pipeline in one of the existing alignments. The existing pipelines are located within a 15 to 30 foot right-of way (depending on how close the two pipes are to each other), which they share with a Pacific Power and Light (PPL) transmission line. The 20 foot wide PPL right-of-way centerline is located 10 feet south of the pipeline ROW centerline. This corridor is located on primarily on otherwise undeveloped forest lands, and access is constrained – there is no road along the corridor. Large trees and dense vegetation are well established on top of or adjacent to the existing pipelines because these corridors, other than that portion associated with the PPL ROW, have not been routinely cleared in recent years. Although these existing-alignment alternatives could meet the capacity needs of the City, they were not studied in detail for reasons presented in the following sections.

2.1.1.1 Disturbance in Undeveloped Forest Lands

Replacing pipelines in one or both of their existing alignments would result in landscape and habitat disturbance from access and construction in undeveloped forest lands and would require substantial tree removal and construction noise in undeveloped, ecologically sensitive areas.

2.1.1.2 Access and New Roads

Construction of new temporary and permanent roads through undeveloped forest lands would be required for construction access as well as long-term access for maintenance and inspection. These roads further increase the environmental footprint of the project.

2.1.1.3 Corridor Maintenance

A new pipeline in one or both of the existing alignments would require ongoing tree and vegetation clearing activities along the pipeline alignment(s) in order to protect the pipe from encroaching roots and to maintain access to the pipe. Ongoing corridor clearing activities would result in visual impacts and ongoing ground and noise disturbance in undeveloped forested areas and would be costly.

2.1.1.4 Private Property

Existing-alignment alternatives would require maintaining pipeline easements on private property where structures, parking areas, driveways, and buildings have been built on top of the pipeline. Paved driveways and parking areas would need to be removed and replaced, and several auxiliary structures on private properties would need to be removed in order to replace portions of the existing pipelines that are on private properties.

2.1.1.5 Cost

Replacing the pipelines in one or both of the existing alignments would be more expensive to build and maintain than the proposed in-road alignments due to:

- Higher construction costs to install pipe in forested areas without road access
- Cost of removing the existing pipeline(s)
- Costs associated with temporary and permanent access roads required to install, maintain, and inspect the pipeline
- Cost of ongoing corridor maintenance (clearing) to maintain pipe integrity

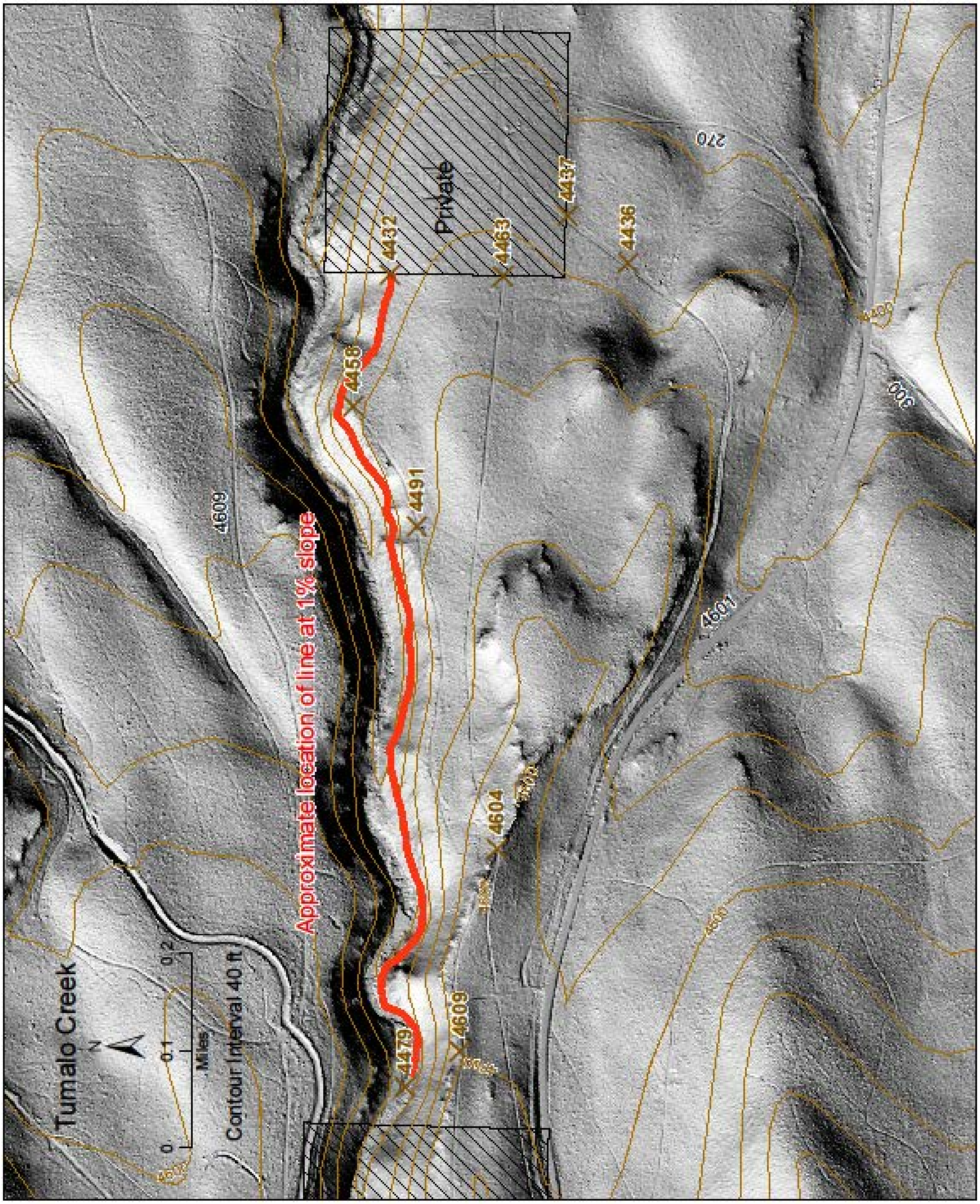
2.1.2 Moving the Point of Diversion East to a Location on Tumalo Creek

See Figure 10.

In the Brown and Caldwell Feasibility Study (Brown and Caldwell, 2009) the City considered moving its point of diversion to a river intake pump station near the Outback site ***(pump station alternative)***. The location was not specified, but for the purposes of this analysis the potential sites to be considered on NFS lands are limited to the area in T18S, R11E, southeast corner of section 33, where FS Road 4606 crosses Tumalo Creek just upstream of the west end of Shevlin Park. There is no other NFS land along the creek within about 2 miles of this site, except that upstream of this site the north side is NFS lands and the south side is private. From the pumping station, pipe could be run under the road for approximately one mile.

During public review and comment, a number of commenters suggested that the diversion and intake be moved from Bridge Creek east to a downstream location on Tumalo Creek, again to an unspecified location ***(short pipe alternative)***. For the purposes of this analysis, the location for a conceptual short pipe alternative needed to meet the purpose and need for a dual water system dependent on gravity for flow to the Outback Site. Also any diversion site must be at a high enough elevation on the creek to allow for gravity flow of water down to the Outback Site. A pipe running from this conceptual new diversion must traverse the canyon slope at slightly less downhill grade than the creek, until it can exit the canyon at a point with sufficient elevation to provide downstream drop to the Outback site. This limits the potential diversion location to approximately T18S, R11E, east quarter of section 6 and west half of section 5 (See Figure 8).

Figure 9. Potential pipeline route necessary to exit the canyon from an alternative diversion site



Locations below this point are too low in elevation to allow water to flow to the Outback site without pumping assistance. Other sites upstream of this location may be feasible, but are either on private lands, or in locations on NFS lands where the Tumalo Creek floodplain becomes much broader, greatly increasing the complexity and environmental impacts of a diversion. The analysis assumed that pipeline would be run from this diversion point along the south side of Tumalo canyon until it would exit the canyon rim and follow either the existing pipeline corridor or intersect Skyliners Road at approximately Station 780+00, and remain under the south side of the roadbed down to Outback. The Rd 4601/4606 intersection is at Station 935+95, and Outback is at Station 967+33. Pipeline length would be approximately 4.3 miles.

Moving the diversion downstream to any point beyond approximately T18S, R11E, east quarter of section 6 and west half of section in the “canyon” reach of Tumalo Creek would require a pumping facility to add between 110 and 130 feet of lift to move water from the creek to the Outback Site. This would also likely require a negotiated easement with private landowners between the diversion site and Outback for the transmission line for power to the pump and for the pipeline.

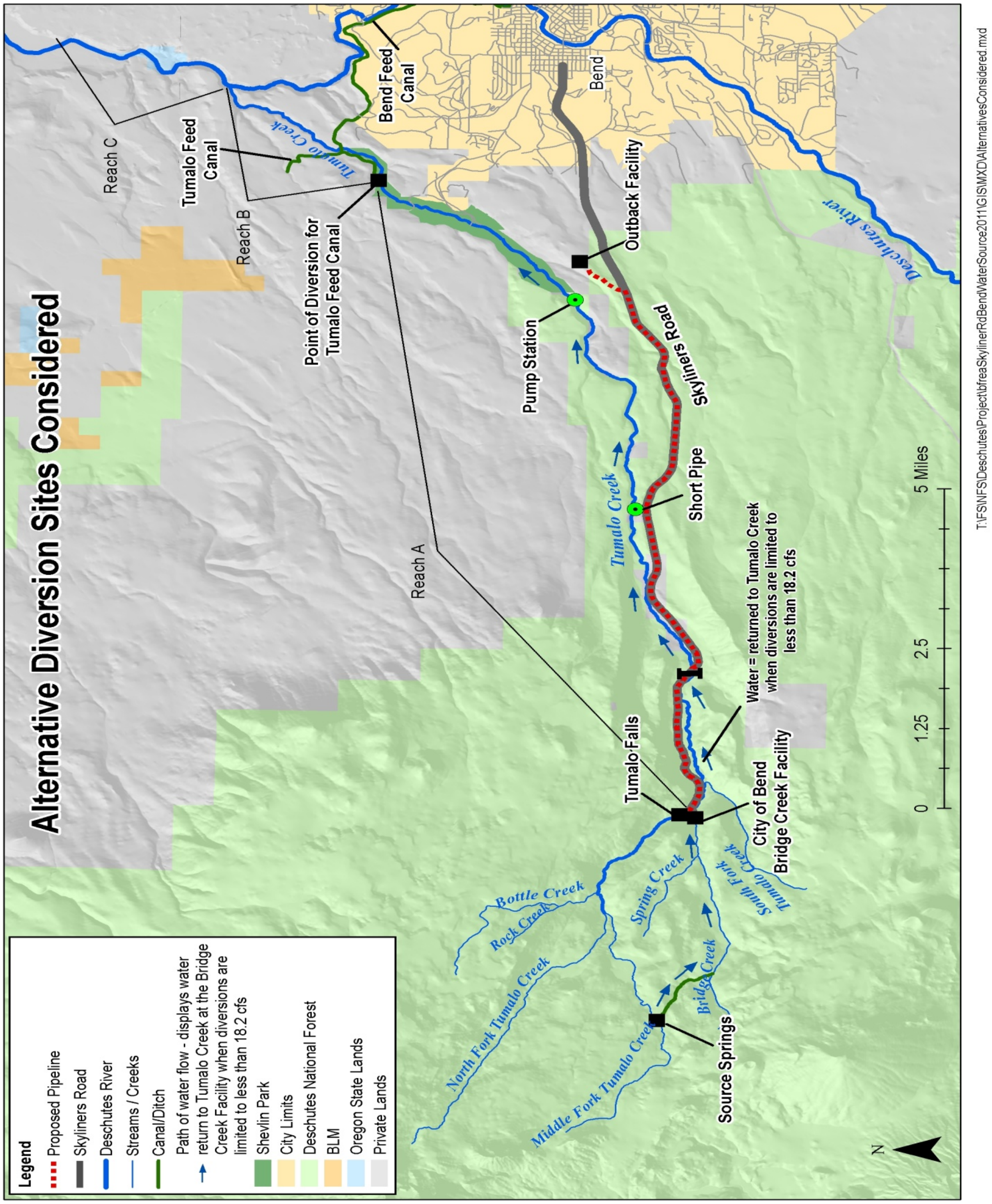
These alternatives have been suggested because they would reduce the length of the pipeline, reduce pipe material costs, allow water to remain in a longer reach of Tumalo Creek, and present higher opportunity for the City to approach their full water rights due to higher flows that would be available at a lower point of diversion. Because no specific sites have been suggested for either alternative, the Forest Service has not conducted surveys in these areas or along prospective routes for cultural resources, threatened, endangered, or sensitive (TES) species of plants or wildlife. Absent surveys, this analysis assumes the presence of cultural resources anywhere that is affected by construction; and presence of TES plants and animals anywhere there is potential habitat. If one of these alternatives were to be further considered, surveys would need to be completed, and/or mitigation measures would need to be specified to avoid or minimize impact to these resources. Also, the soils and geology are fairly complex in these areas due to the canyon topography, so geologic and soil stability studies could further limit the available sites.

2.1.2.1.1 Benefits

For the short pipe alternative, moving the diversion downstream to roughly River Mile 10.0 would allow approximately 2.3 miles of the Middle Fork and 2.5 miles of the mainstem of Tumalo Creek to be unaffected by diversions. An additional 18.2 cfs would remain in the creek down to the new diversion. Increased flows could maintain or improve water temperatures in Reach A. If the City were able to protect their existing water rights or move all of their water rights downstream, they could eliminate the Springs diversion from the Middle Fork, and flows could increase over Tumalo Falls by approximately 16-19 cfs.

The lower diversion would eliminate the need for approximately 5.7 miles of new pipeline construction. Two stream crossings would be eliminated. Tree removal and impacts to the wetlands affected by the Proposed Action would be avoided except as caused by removal of the old pipelines and site restoration. New pipeline construction disturbance to residents, visitors, and wildlife would be avoided except as caused by removal of the old pipelines and site restoration.

Figure 10. Alternative Diversion Sites Considered



Moving the diversion point to a pump station at roughly River Mile 6.8 would allow approximately 2.3 miles of the Middle Fork and 11.7 miles of the mainstem of Tumalo Creek to be unaffected by diversions. An additional 18.2 cfs would remain in the creek down to the new diversion.

The pump station alternative would eliminate the need for 10 miles of pipeline as in the Proposed Action. It would require construction of approximately one mile of pipeline to access the Outback Site. A new transmission line would need to be constructed to service the pump station. Both pipe and transmission line could be mostly located on or under Road 4606. Two stream crossings would be eliminated. Tree removal and impacts to the wetlands affected by the Proposed Action would be avoided except as caused by removal of the old pipelines and site restoration. New pipeline construction disturbance to residents, visitors, and wildlife would be avoided except as caused by removal of the old pipelines and site restoration.

Reasons for dismissing these alternatives from detailed study are discussed in the following sections.

2.1.2.2.1. Water Quality and Public Health

Moving the City's point of diversion out of a protected watershed to a location downstream of developed areas accessible by road, private properties, and potential point and non-point sources of water contamination presents public health risks and could require higher-level and more-expensive water treatment than what is currently proposed. Moving the point of diversion out of the protected watershed also presents risk to the aesthetics (taste and odor) of the current surface water supply. At the current diversion point on Bridge Creek, approximately 4136 acres, all National Forest, comprise the protected Bend Municipal Watershed where pollution from private land development or accidental spill is highly unlikely.

A fire risk analysis conducted by USFS shows that there is a higher risk of fires from approximately the floodplains affected by the 1979 Bridge Creek Fire just below the Bridge Creek intake all the way east (downstream) to Bend (see Tumalo Creek Watershed Analysis, 2008, Page 105, Exhibit 16). This is a substantial increase in water quality risk for a lower point of diversion alternative.

The risk of large fires is moderate to high because of the large amounts of dead fuels resulting from past fire suppression, stand age, and increasing insect and disease mortality, and difficulty of access (Tumalo Watershed Analysis, 2008). This risk is moderated somewhat by the restricted levels of human use in the watershed. Fires history for the entire watershed averages about 3 reported starts per year (1980-2007).

In the case of the short pipe alternative, the amount of acres that drain the area above the potential diversion point increases to 23,012 acres. Residential development exists on approximately 694 acres directly along the creek, with potential to increase density or add some limited commercial lodging development. None of these additional acres are protected with the same kinds of restrictions as in the Bend Municipal Watershed. Sewage treatment associated with development on these lands is all via individual septic systems. Much of this area was burned in the 1979 Bridge Creek Fire, a human-caused fire which started above the intake and burned 3364 acres, mostly downstream along the north side of Tumalo Creek. Stand structure and fuel loading within the Bridge Creek Fire boundary are just now again reaching a point where burn probability and potential flame lengths are likely to contribute to future large fires. Most of the area outside of the Bridge Creek Fire would have high to very high burn probability except that it has received considerable fuels treatment and stand modifications due to the proximity to private lands.

In the case of the pump station alternative, the amount of acres that drain the area above the potential diversion point increases slightly again to 24,701 acres. Residential development also increases to approximately 1014 acres adjacent to the creek, with little additional potential to increase residential density or add some limited commercial lodging development. Again, none of these additional acres are protected with the same kinds of restrictions as in the Bend Municipal Watershed. Private timber lands to the north and west of this area have very high fire probabilities because of extensive areas of very high loadings of brush and minimally treated logging slash. Two large fires in the recent past, Rooster Rock in 2010, and

Pole Creek in 2012, came within a mile or two of entering this area after burning several miles from north to south along the eastern Cascade slope.

The Oregon Health Authority requires that the City suspend using surface water when natural turbidity reaches a level greater than 5.49 NTU (nephelometric turbidity units) more than two times in a 12 month period. Samples must be collected for Fecal Coliforms on days when turbidity is greater than 1.49 NTU. The City, as a Best Management Practice for controlling high water quality, maintaining required chlorine residuals in the water distribution system, and controlling debris accumulation in reservoirs, valves, and pipelines, voluntarily suspends surface water into the distribution system when turbidimeter data shows an elevation trend of greater than 1.49 NTU.

Because the current source is primarily from the Springs diversion, suspension is rarely necessary, occurring during 20 episodes, lasting 1 to 15 days, in the past 3 years, probably associated with thunderstorms or rain-on-snow events(personal communication, Steve Prazak, City Water Quality Manager, 1/8/2013). If the diversion is moved downstream in either of these alternatives, that risk is greatly increased as the mainstem of Tumalo Creek is much more prone to natural turbidity, and a greater length of the water course is exposed above a new diversion.

2.1.2.3 Disturbance in Undeveloped Forest Lands

With the exception of some private land development, Tumalo Creek runs primarily through undeveloped forest lands between Bridge Creek and Bend. Moving the point of diversion downstream and east to a location on Tumalo Creek (short pipe alternative) would require construction of a new intake facility and installation of a new water supply pipeline and power facilities in undeveloped forested lands in a relatively pristine canyon. Pipeline and other facility construction and maintenance would require road building, and pipeline corridor maintenance would require ongoing vegetation and tree removal, which would result in habitat and visual impacts.

The short pipe alternative would require approximately .5 to .75 miles of road construction to provide access for diversion and pipeline construction, and regular maintenance. The approximately 1.6 to 1.8 miles of new pipeline would result in a range of 7.75 to 8.7 acres of disturbance (estimated at 40 feet wide construction need) and permanent removal of forested area on 3.87 to 4.35 acres (estimated 20 foot permanent clearing width) depending on if and where the pipeline intersected Skyliners Road. Also, power would need to be provided to the diversion for gaging and flow control, so a new transmission line would need to disturb approximately 14.5 forested acres (aerial line, approximately 2 miles long, with a permanent clearing width of 60 feet).

Loss of this amount of forest habitats would impact wildlife through loss of hiding and foraging cover, loss of nesting habitat, and human disturbance because of the increased ease of access to the area via roads, transmission lines, and pipeline clearing.

The pump station alternative would require very little new road construction for construction and maintenance if the site were located on the south side of Tumalo Creek, close to the 4606 bridge in section 33, just upstream of the west end of Shevlin Park. Another possibility would be the already disturbed route of the return flow canal. This is slightly longer and is on private land. Power transmission lines cannot be located in the same trench as the waterline, but could be located within the road ROW underground, or on poles with roadside tree clearing to accommodate the aerial transmission line along approximately one mile of Road 4606. A powered pump station in this location would create noise at approximately 80-90 decibels, and could be heard from Shevlin Park and by neighboring residences.

If the springs diversion were out of service, 16-19 cfs would no longer flow into Bridge Creek, and approximately 2.0 miles of Bridge Creek would have substantially lower flows, as well as the 0.5 mile canal that carries water from the Springs to Bridge Creek, albeit at “natural” pre-development levels, resulting in a loss of riparian and wetland habitat that has established over the last 50-plus years.

Impacts to the creek below either of the new lower diversion point and in Reach C (Middle Deschutes River) would be the same as in the Proposed Action.

2.1.2.4 Riparian Areas, Channel Morphology and in-stream impacts.

Because of its size, Tumalo Creek is subject to much more bedload and woody debris transport than is Bridge Creek. Both lower diversion alternatives would likely have continuous need for removal of material that would otherwise fill up the diversion pools.

Because both diversion alternatives are potentially located in areas with much higher potential for fish movement than what exists in Bridge Creek, a more sophisticated and expensive barriers structure would be necessary and required by ODFW.

2.1.2.5 Feasibility

The short pipe alternative presents engineering challenges to find a suitable site in the canyon, and to construct a pipeline along the steep canyon wall.

A non-gravity pump station would require a sophisticated, wild-river intake and would have to be installed in an environmentally sensitive area.

For both alternatives, permitting new structures in the creek and riparian zones would require review under state and county riparian protection regulations. If private land access was necessary, obtaining the necessary easements would be a lengthy process with no guaranteed outcome.

2.1.2.6 Cost

Costs are difficult to estimate for either of these potential alternatives because they are necessarily site-specific. The short pipe alternative would require a new diversion dam and intake structure, road construction and maintenance, and transmission line construction and maintenance. Because of fish presence in this portion of Tumalo Creek, a fish screen would have to be constructed that meets ODFW screen criteria. Approximately one mile of the new pipeline would have to be constructed between the creek and the south canyon rim, which, because of difficult access and rocky terrain, would be much more expensive than the overland portion or a pipeline installed in the road way. The existing diversions at Bridge Creek and the Springs could be removed and the sites restored to native function. Savings may occur because this alternative would require approximately 5 miles less pipe and the cost of 5 miles less construction (Intake at Station 464.00 to where the pipe would join Road 4601 at Station 780.00, minus the new overland). But those savings might be off-set by increased design and construction costs.

The pump station alternative would require a construction and maintenance of a sophisticated wild river intake station and partial stream diversion, minimal temporary road construction, and transmission line construction and maintenance. An ODFW criteria fish screen would be required. The existing diversions at Bridge Creek and the Springs could be removed and the sites restored to native function. There would be more or less continuous costs to run the pumping station. Savings could occur because this alternative would require approximately 9 miles less pipe and the cost of 9 miles less construction.

2.1.2.7. Water Rights

The City holds surface water rights of record that equal 21 cfs in the non-irrigation season and 36 cfs in the irrigation season. The City's water rights are a compilation of rights that have been acquired over time and vary with respect to seniority and permit status. As a result, the City's water rights are not readily replaceable or easily adjusted (transferred downstream or upstream). To move the point of diversion (POD) from the existing location on Bridge Creek to a new point of diversion lower on Tumalo Creek, the City would be required to enter into a complex series of regulatory processes and transactions with OWRD. These include water right transfers, development of claims of beneficial use, and requests for new water right certificates. These processes are all subject to review by the public and other Tumalo Creek water right holders, and potentially "protests" (challenges to the proposed changes that can result in trial-like administrative hearings and petitions for judicial review) (Gorman, 2/2013).

While a proposed downstream POD transfer is typically straight-forward, the City cannot be certain that OWRD would ultimately approve the applications. Further, the water rights process supporting a new downstream POD could result in only a portion of the City's water rights being successfully transferred downstream, leaving the City with two different points of diversion corresponding to different water rights, or at risk of losing any portion of their rights not immediately put to use at the new POD. This would require ongoing maintenance of the City's existing Bridge Creek intake to meet water demands and would compromise the efficiency of the City's system as well as further complicating measurement and management of Tumalo Creek flows (Gorman, 12/2012).

Point of Diversion Transfer process

The point of diversion transfer process is governed by Oregon Statute, ORS Chapter 540.505 et seq., and described in OAR Chapter 690 Division 380.

- Application is made according to the description in OAR 690-380-3000
- After receipt and review of the application, the Department publishes a 30 day notice for comment.
- At the end of the comment period, the Department issues a Preliminary Determination to the applicant. The applicant has 30 days to comment or provide additional information.

The Department then publically issues the Preliminary Determination. Anyone can protest a transfer application; the standard for review is whether or not the proposed transfer can be made without injury to any other existing water rights.

- Interested parties have 30 days to file a protest.
- If a protest is filed, the Department will hold a hearing.

Some water rights and water rights in permit status cannot be transferred to a new point of diversion because they have not been certificated.

- The City holds approximately 5.99 cfs of inchoate transferred water rights acquired from TID and a 1983 permitted water right not fully perfected.

A simple transfer can take up to a year to complete. A challenge or "protest" can extend that time frame up to 5 years possibly but is not predictable. Water rights can also be diminished as a result of a transfer if the holder is not "ready, willing, and able" to make full beneficial use of those rights at the new point of diversion.

- This situation could apply to water rights that the City holds in excess of the 18.2 cfs if they were limited to 18.2 cfs to a new downstream POD.

Priority dates do not change with the change in point of diversion.

TID could be economically impacted by a proposal by the City to move the point of diversion because the City could lose the inchoate rights for which they currently pay an annual fee to TID. This is also potentially true for any proposed transfer to instream, or a temporary transfer or a lease (Gorman, 2/2013).

2.2 Description of Alternatives Studied in Detail

2.2.1 Alternative 1 – No Action

See Figure 11.

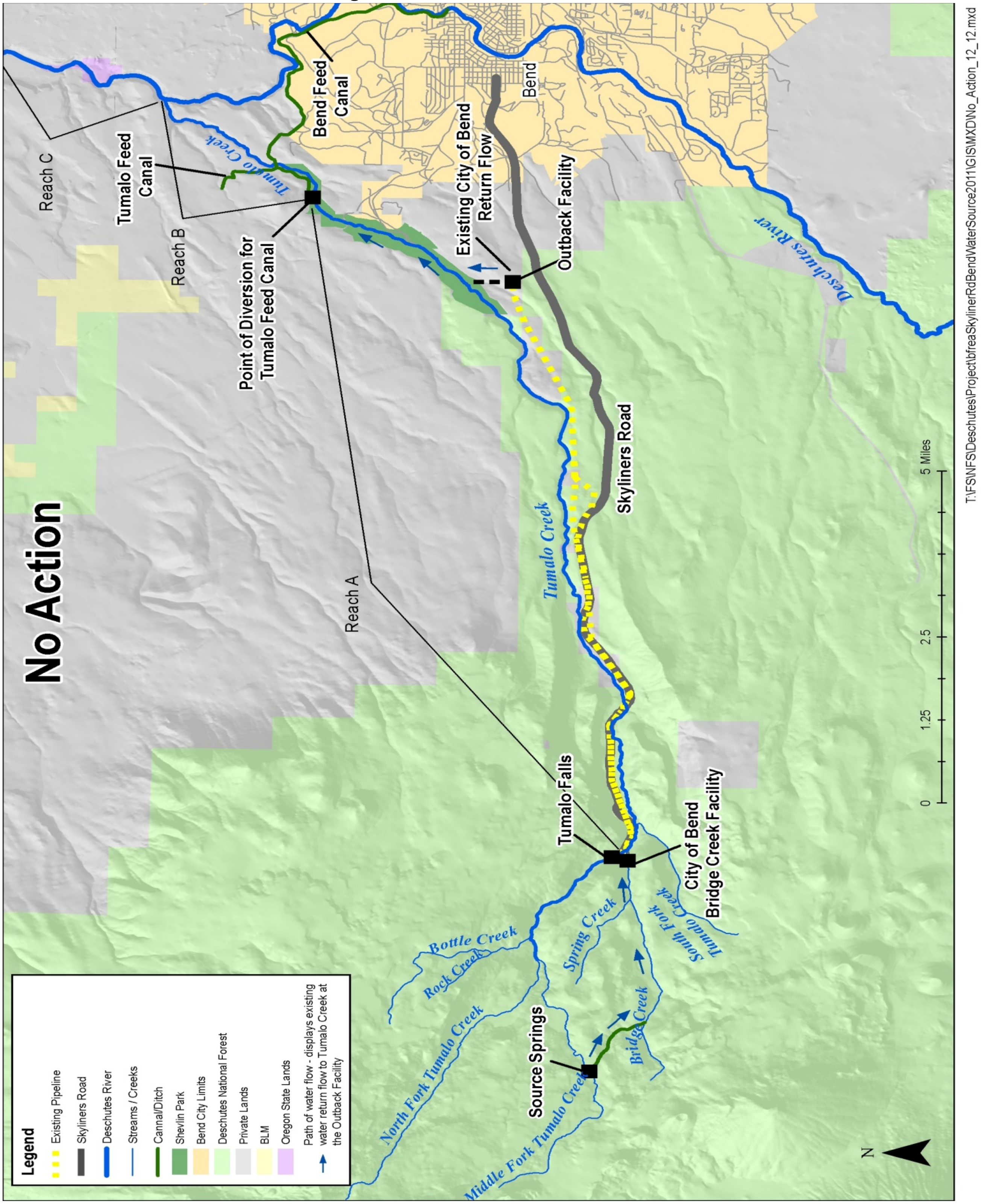
Under the No Action Alternative, the Forest Service would not issue a Special Use Permit authorizing the City's proposed intake improvements and pipeline replacement, and the City would:

- Continue to maintain and operate the existing water supply pipelines and intake facility under the City's current Special Use Permit until they irreparably fail. The City's current Special Use Permit authorizing City surface water facilities located on National Forest System lands expires in December 2019, at which time the City would apply to the Forest Service to renew the permit.
- Continue to grow into their water right to the extent allowed, taking into account limitations of those rights: available flow, municipal demand, the demands of other water right holders, and the limitations of the current system. The City's water rights are limited to beneficial municipal use, many of their water rights are junior to those of other Tumalo Creek users, and their current system has a maximum capacity of 18.2 cfs.
- Repair severely damaged sections of the existing pipeline as needed, as allowed under their existing Special Use Permit and to the extent technically possible from an engineering standpoint given the age and condition of the existing pipelines.
- Proceed with construction of water treatment to meet compliance with federal safe drinking water regulations. Water treatment facilities would be located on the City-owned portion of the Outback Site and would not be subject to Forest Service approval.
- Continue to operate the existing return-flow system to convey water from the Outback Site back to Tumalo Creek when City demand is less than the continuous diversion amount of 18.2 cfs. The existing pipelines lack flow control and must be operated continuously at full capacity to avoid potential failure and to automatically fill the existing reservoirs due to existing hydraulic grade lines which are part of the original design.

The two existing pipelines, constructed in 1926 and from 1954 through 1957, convey water approximately 10 miles from the Bridge Creek Intake Facility to the discharge at the Outback Facility. Most of the existing pipeline alignments lie within heavily forested areas on National Forest System lands. The pipelines also cross several private properties on City of Bend easements.
Both pipelines are mostly welded steel with coal tar linings and coverings. They are similar in diameter with approximately 28,000 feet of 14-inch-diameter pipe that comprises the upper section and 21,000 feet of 12-inch-diameter pipe that comprises the lower section, which terminates at the City's Outback Facility. Several sections (approximately 8% of the total length) of the 1926 pipe have been replaced with 20-inch-diameter ductile iron pipe. Almost all of the replaced sections are in the upper 14-inch-diameter section of the 1926 pipeline. The existing pipelines are in poor condition and at risk of failure. The operational condition of the existing pipelines and intake facility were assessed in 2009, and detailed findings are presented in the Water Supply Alternatives Study (WSAS) prepared by Brown and Caldwell (2009). The following is a very brief summary of those findings.

Failure of the coal tar lining and coating. The terminal reservoirs at the Outback Facility routinely receive pieces of the lining and tree roots, which indicates that the pipe has been penetrated by trees and the lining is detaching from the steel in some sections.

Figure 11. No Action Alternative



Damage from trees. There are many trees growing directly over and adjacent to the pipelines that have the potential to cause damage. Tree roots will follow any minor leak back into the pipeline and penetrate and pry open any minor crack or opening in the pipeline. Once in the pipeline, the tree root will continue to pry open the pipe and buckle its wall, weakening the pipe and often increasing the leakage of water.

Steep slopes. Sections of the pipelines are located in steep, potentially unstable terrain, presenting reliability and maintenance issues.

Structures. Structures have been built in the sections of the old, shallow 1926 pipeline easements that cross developed private properties. These include private wells, paved driveways, sheds, and formally landscaped areas. Such intrusions put the pipeline at risk of localized corrosion due to stray current from power lines to buildings and wells, damage to pipeline from further construction, and crushing of pipeline from wheel loads and building foundation pressures.

Hydraulic condition. The hydraulic conditions in the existing pipelines are stable during flowing full-operational mode but, due to the age and manual configuration of the existing air valves, the hydraulics within the pipelines cannot respond to any type of changed pressure fluctuation that might result from any type of pipe rupture. All existing pipeline valves must be operated manually. As a result, the current pipelines are at high risk should any event cause a pressure change within either pipe line. Both of the existing pipelines were designed to operate continuously at full capacity. In the past, a single pipe was operated in the winter when lower demands could be met with a single pipe. Current winter demands now fluctuate at times above what a single pipeline can supply. Due to the operational requirements to shut down, completely drain, and restart a pipeline, current City operation leaves both pipes running full all year. Draining the pipeline carries some risk of pipe collapse on private property during the drainage operation as well as risk to the pipe because of the age and fragility of the old drain valves. Full-time operation of the pipes also is believed to decrease the risk of further degradation to the existing pipe lining.

On February 20, 2013, Robert Willis, a professional engineer for RH2 and one of the authors of the 2009 Brown and Caldwell Feasibility testified before the Bend City Council on the subject of the condition of the existing pipes. In part, he said *“The two pipelines are in terrible shape, they were in terrible shape when I first reviewed those pipelines 20 years ago, they were in more terrible shape 4 years ago when I wrote this report and they are in still more terrible shape now….They are now showing signs of imminent failure, imminent catastrophic failure, and that is something you simply cannot continue with. Those pipelines need to be replaced, and they need to be replaced as soon as you can reasonably do that.”*

The pipeline experienced two serious failures in October 2012, both pipe failures took place on the 1920's pipe line. One failure was discovered while the pipelines were being shut down. An 8 foot section of the steel pipe split open along the original longitudinal welded pipe seam. The pipe was uncovered, and the seam was re-welded. The location of the failure was less than 1 mile upstream of the Outback facility within the existing powerline easement. The repair and down time for this failure was about three days. The cost for the repair was roughly $7000. The second failure was discovered while the pipelines were being put back into use. This failure was located on pipe within the boundaries of the Outback facility. The failure was a hole approximately one inch in diameter. The hole was repaired by a welder using a welded plug and patch. Down time included a day to drain the lines again, one day to repair the pipe, and two more days to start up the surface water pipes again. The cost for this repair was approximately $1500.

The pipes are currently operating at a continuous capacity of approximately 18.2 cfs as measured with actual flow during a Claim of Beneficial Use submitted to the State in 2009, and used to certificate the City’s surface water rights.

Under the No Action Alternative, the existing pipelines will eventually fail, although how and when such a failure would occur is speculative. In the event of pipeline failure, the City would decide to replace or repair sections of a pipeline or an entire pipeline based on the nature and extent of the resulting damage, alternative infrastructure capacity, demand levels, the schedule for repair or replacement, and the City's financial constraints. The current permit requires that City prepare and submit to the Forest Service any plans for reconstruction or alteration of the existing pipelines. In the event of an emergency, the City must notify the Forest Service within 48 hours of taking any remedial action.

If either of the existing pipelines ruptured or collapsed while the pipeline was in operation, water would be discharged freely to the environment at an approximate rate of 9 cfs (about 4,100 gpm). The City's operation staff has estimated that it would take approximately 3 to 7 hours to shut down and drain either pipe, depending on where a break occurred. The shutdown sequence would generally be as follows:

1. Operations staff detects a rupture: 90 minutes to 2 hours.
2. Staff travels to the intake to begin shutdown process: about 45 minutes.
3. Staff closes main valves to stop flow through the pipes. These valves must be closed slowly to prevent collapsing of the mains: 1 to 3 hours.
4. Once shut down, the pipeline could take up to 90 minutes to drain.

Given this estimated timeline, pipeline failure could result in the release of water at the approximate rate of 9 cfs (4,100 gpm) for a period of 3 to 7 hours. This is anywhere from about 738,000 gallons to 1,722,000 gallons total volume of water. For perspective, there are about 600,000 gallons of water in an Olympic-sized swimming pool.

If the rupture occurred along Road 4603, in particular the steep fill bank section just below the upper Tumalo Creek Road 4603 crossing, the consequence could be complete loss of sections of Road 4603 and long-term closure to vehicle traffic. Further, a rupture in this steep fill bank section could result in the release of at least tens of cubic yards of sediment into Tumalo Creek. There are some locations of the pipelines, maybe 1,000 feet in total, where a major rupture could create a risk of a landslide that would reach Tumalo Creek from steep hill slopes above the pipe.

Following pipeline failure, construction activities to repair the failure would be required, which could possibly require new access, extensive clearing, and environmental impacts in the forest.

2.2.2 Alternative 2 – Proposed Action

Under the Proposed Action (See Figure 12), the Deschutes National Forest would issue a Special Use Permit to the City authorizing construction and operation of a replacement water supply pipeline and upgrades to the City's Bridge Creek intake building. Intake building upgrades include installation of new fish screens that would be compliant with current Oregon Department of Fish and Wildlife requirements.

The Special Use Permit will limit the amount of water conveyed by the pipe to an average of 18.2 cfs, measured over a 60 minute period.

The Special Use Permit will require the City to install three new flow and temperature gauges in Tumalo Creek to monitor compliance and validate assumptions made about flows and water temperatures. Additional monitoring will be required to determine population size and age-class trends for redband trout.

The Proposed Action allows the City to meet their obligation to provide a safe and reliable water supply that meets current and future demands as well as maximizes the long-term energy efficiency, cost-effectiveness, and operational flexibility of the City's water supply system.

The Bridge Creek surface water supply is a critical component of the City's dual-source supply. Planned pipeline replacement and intake building upgrades that are subject to a Forest Service Special Use Permit respond to the City's need to:

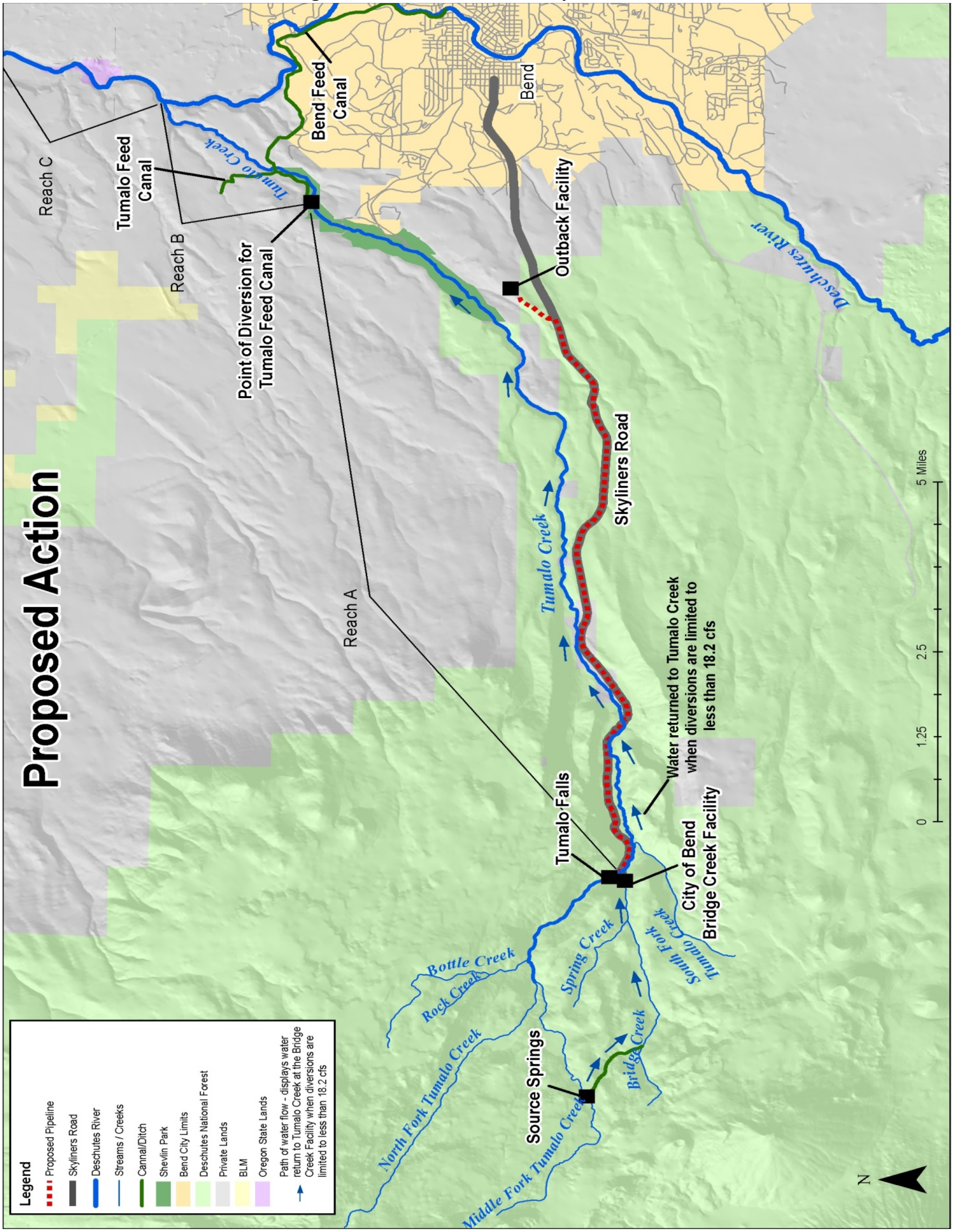
- Address deteriorating water supply pipelines that carry approximately 50% of the annual municipal water supply by replacing these pipelines with single new water pipeline

- Comply with Forest Service Manual Guidance to locate utilities within developed corridors or easements by moving the new pipeline primarily into existing roadway corridors

- Reduce the vulnerability of the City's surface water supply pipelines to substantial damage by wildfire or windstorms that could uproot trees that entangle the existing pipeline by abandoning the existing pipeline located on forested lands and constructing a replacement pipeline primarily in existing roadway corridors

- Address regulatory and structural deficiencies identified at the City's Bridge Creek intake building by constructing upgrades including a remotely controlled intake and ODFW-compliant fish screens.

Figure 12. Alternative 2 - Proposed Action



2.2.2.1 Design Criteria for the Proposed Action

The Proposed Action (issuance of a Special Use Permit) includes Design Criteria in order to avoid, minimize, and mitigate environmental impacts (Table 5). The Design Criteria are generally presented in the Special Use Permit as conditions of the permit. Design Criteria include:

- **Design approaches** that avoid or minimize project-related impacts to resources
- **Best Management Practices** that avoid or minimize construction impacts
- **Restoration activities** to return disturbed areas to pre-construction conditions
- **Monitoring activities** to determine the success of restoration activities or to inform future management decisions.

Table 5. Design Criteria for the Proposed Action

Discipline	Design Criteria/Resource Protection Measure
Scenic Resources	• The proposed upgrades to the City's Bridge Creek intake building will reflect a rustic-style Cascadian design as presented in the Forest Service Built Environment Image Guide. This is a traditional and crafted form of architecture that uses native materials such as timber posts, a lava rock or stone base, and a steeper roof pitch, especially in areas with heavy snow. The City's intake building modifications will incorporate the following elements: ➢ Exterior veneer shall be comprised of (or very closely resemble) Montana Black Diamond natural stone ➢ Exterior light over main entrance door to intake building must be placed symmetrically over the door ➢ Windows are to be aluminum-clad with a rustic exterior finish, with a style that responds to direction in the Forest Service Built Environment Guide (Cascadian Style) ➢ Roof girders and outrigger will be wood or steel that is painted in a wood-toned color ➢ All exterior wall panels will be cementations fiber panel, and they will be painted brown • The City will minimize tree removal and incorporate large vegetation into the final site design to the extent possible. Where stumps must remain, they will be flush-cut to be removed from view. • Slash generated from construction activities will be removed from the site as soon as possible given chosen method (chip, burn or removal) or burning if conditions are safe.
Noxious Weeds and Unwanted Vegetation	• All project-related equipment will be cleaned before entering National Forest System lands to remove mud, dirt, and plant parts before entering National Forest System lands. • Weeds located within or immediately adjacent to the project will be treated prior to project initiation. • All fill material brought into the project area will be examined by the District Botanist or her designee for the presence of invasive plants. • The City of Bend will be responsible for monitoring and treatment of weeds within the project area for a period of 3 years after project construction is completed. The monitoring and treatment period will commence the first growing season after completion of work. The City will consult with the Bend–Fort Rock Ranger District Weed Coordinator as to where the known weed sites are, what treatment method is appropriate for each site, what herbicides are approved for use, and proper reporting of herbicide use. • The City will send monitoring/treatment reports to the District Weed Coordinator by August 31 of each year that the City is responsible for weed monitoring and treatment.

Discipline	Design Criteria/Resource Protection Measure
Historic Structures	• Under the Proposed Action, there would be substantial alterations to the above-grade portions of the Bridge Creek intake building, which is eligible for nomination to the National Register of Historic Places (NRHP). Resolution of adverse effects under Section 106 will be advanced under the Proposed Action. Resolution of these effects is included in a Memorandum of Agreement (MOA) with the SHPO and includes Historic American Building Survey/Historic American Engineering Record (HABS/HAER) surveys and documentation and the Cultural Report prepared for the intake building to be submitted to the University of Oregon Libraries, the State Historical Society, and the Deschutes County Historical Society. This documentation must also be made accessible to the public on the City's project website throughout project construction.
Recreation Resources, Access, and Public Safety	• The City will sign the area 1 month prior to project implementation to alert the public of construction start dates. Warning signs and public notices will be posted during project activities to alert the public in advance about expected road delays and closures and trail access changes. • The City will schedule construction activities to provide access to the Tumalo Falls Recreation Area and all major trailheads along Skyliners Road and Forest Service Road 4603 during the peak visitor period. The peak visitor period for the project area starts on Memorial Day and ends on Labor Day. • The City will maintain proper trailhead directional and approach signage along Skyliners Road and Forest Road 4603 throughout pipeline installation work. • Pipeline installation along Forest Road 4603 will require full road closure. This segment of the project will be completed in the shortest timeframe possible and will be conducted outside the peak visitor period. During the peak visitor period, parking will be maintained at the Tumalo Falls Trailhead, and access along the full length of Forest Service Road 4603 will be maintained. • The City will reconstruct and restore the Farewell Trailhead to pre-construction condition at a minimum in a manner agreed upon in advance with the Forest Service. • As pipeline and intake building construction is completed, the City will restore pre-construction contours and grades wherever possible and will stabilize soils in a manner and on a schedule that is agreed upon in advance with the Forest Service. The Forest Service will revegetate disturbed areas. • The City will coordinate construction activities to maintain access to Skyliners Lodge, Skyliners Trailhead, and all other trailheads accessed from Skyliners Lodge. Trailhead parking that is displaced from Skyliners Trailhead may be relocated between the trailhead and Road 430, but parking near Skyliners Trailhead will be made available during construction. • The City will install signage during Forest Road 4603 closures to make it clear to the public that the road is temporarily closed to all access and uses. • Access to Skyliners Subdivision will be maintained throughout all phases of construction. The City will set up a communication protocol with Skyliners residents so that they are effectively kept apprised of anticipated delays and are aware of when construction might affect driveway access. The communication protocol will include a contact at the city to report speeding or other safety issues related to construction. • If Western Federal Land's Skyliners Road Improvement project construction occurs during pipeline installation along Skyliners Road, the City will work closely with Western Federal Lands and the County to minimize delays and lane closures along Skyliners Road.

Discipline	Design Criteria/Resource Protection Measure
Wildlife	• To assure that suitable NRF habitat is remaining vacant, or becomes occupied by a pair of northern spotted owls, yearly monitoring for northern spotted owls will occur in NRF habitat every year within ¼ mile of Skyliners Road (starting in 2013) until construction in this area is complete. If spotted owls are discovered nesting within any of these particular stands, pipeline construction and road construction would be seasonally restricted beginning from March 1 to September 30. • Any sizeable downed log that must be removed during construction will be placed back as close as possible to its original position. • Historic nest sites for goshawk, Cooper's and Sharp-shinned hawks will be surveyed during the breeding season prior to construction to determine if nests are active. • Disturbing activities (such as tree removal, grubbing, rock crushing, blasting, etc.) shall not be conducted within ¼ mile and/or line of sight from any active nest of the following species during the listed periods. Distance increases to 1 mile for blasting. ➢ Northern goshawk March 1 – August 31 ➢ Cooper's hawk April 15 – August 31 ➢ Sharp-shinned hawk April 15 – August 31. • The City will immediately coordinate with the District Wildlife Biologist if any of these accipiter species are detected during project activities. • If, for presently unanticipated constraints or construction delays, restriction periods specified above must be compromised, conduct project activity at the end of the period (the last month) as least likely to cause nest abandonment. • Construction of the pipeline between the water intake building and the lower bridge crossing should not begin until after September 1 to reduce impacts to potential nesting birds and potentially after September 15 for roosting bats. • Conduct summer surveys for roosting bats to determine the potential use of the upper and lower Tumalo Creek bridges and the water intake building. If necessary, restrict project activities to occur at these sites after September 15 when bats may be proceeding to winter hibernacula sites. Also if necessary, utilize appropriate exclusion techniques at the water intake building to be assured that no bats are still roosting at the site. If bats are discovered during dismantling of the building, work must stop immediately. • Conduct pre-activity surveys during the spring and summer to determine if western bumblebees are present within the project area. If it is found that this species does occur, potential loss of individual western bumblebees would be reduced if project activities associated with pipe construction between the water intake facility and the first bridge crossing occurred in late September to mid-October when the bumblebees may be dying off and the queens have not found a place to hibernate yet. • While working in the pipeline corridor adjacent to the Tumalo Falls Trailhead parking area, limit tree-clearing activities to within construction clearing limits as agreed upon by the Forest Service. The City will, to the extent possible, work around trees >20 inches dbh to minimize impacts to Williamson's sapsucker, brown creeper, and hermit thrush nesting and foraging habitat. • The City will minimize clearing limits for pipeline installation along Skyliners Road to reduce the number of trees and shrubs removed and retain these habitat constituents for chipping sparrows and other birds. • The City will implement Best Management Practices for all ground-disturbing activities.

Discipline	Design Criteria/Resource Protection Measure
	• To the extent possible, the City will maintain riparian vegetation excavated for pipeline placement on site and will place it back on disturbed areas post-construction. • The City will restore original grade and contours to disturbed areas wherever possible. The City will stabilize disturbed areas as work is completed in a manner agreed upon by the Forest Service. • The Forest Service will re-vegetate disturbed areas with native vegetation sourced from on site. • The Forest Service will monitor re-vegetated areas for survival of wetland vegetation for 2 years and continue re-vegetation if needed. • The Forest Service will revegetate disturbed areas with native vegetation sourced from onsite. • To avoid potential nest abandonment, nest destruction, and loss of broods for focal bird species, within or immediately adjacent to the project area, limit felling of trees and removing brush during the period April 15 – July 15. Implement activities where possible during the late summer, fall, winter, and early spring (August through March). *If the specified restriction period **must** be compromised, project activity at the beginning of the period (within the first month) or the end of the period (within the last month) is preferred.* If these activities could be done during these time periods, impacts such as disturbance and abandonment of nests or even nest destruction would be reduced.
Soil Resources	• The City will implement appropriate design elements for avoiding or reducing the disturbance footprint to only that which is needed. • The City will minimize the extent of new soil disturbance from mechanical treatment. • The City will prepare an erosion-control plan prior to construction and will apply appropriate erosion-control measures to all ground-disturbing activities associated with the construction and development of new facilities. • The City will, to the extent possible, refrain from excavation work during major rain events, periods of high surface runoff, or rain-on-snow events. Exceptions would be made to accommodate completing work in sensitive areas as expeditiously as possible. The City will use appropriate Best Management Practices when working in sensitive areas (slopes, wetlands, and riparian areas) to minimize soil erosion and disturbance. • The City will, where appropriate, use swales and vegetated filtering structures placed at key drainage pathways to dissipate runoff from project construction areas. • The City will maintain road and parking surfaces and drainage structures so that they remain functional at dispersing runoff adequately. • For non-paved road and parking areas, the City will treat surfaces during construction to minimize the generation of dust, particularly during the dry season. • The City will restore areas to their original elevation and contours wherever possible and will stabilize soils immediately after construction in a manner agreed upon by the Forest Service. The Forest Service will revegetate disturbed areas with native vegetation. • The City will use mulch, top soil, or another type of top cover that will help retain soil moisture and support the re-establishment of vegetation. • If using off-site mulch or topsoil, the City will use weed-free/seed-free products. • The City will design new facilities and place natural materials from within the project area in a manner that discourages the creation of new trails by users.

Discipline	Design Criteria/Resource Protection Measure
Tumalo Creek Monitoring	• Additional Tumalo Creek monitoring will be implemented as part of the Proposed Action to improve the understanding of its hydrology and fisheries. The monitoring program will focus on flow, temperature, and fisheries. • Within 6 months of the issuance of the SUP, the City will establish flow and temperature monitoring at two new gauging sites on Tumalo Creek. One of these gauges would be located on Tumalo Creek between Bridge Creek and South Fork Tumalo Creek at approximately river mile 16. Another would be located on Tumalo Creek approximately ¼ mile downstream of Skyliners Bridge in a location that can be readily accessed. An additional continuous temperature monitoring station will be established between the FS Road 4606 crossing and the TID diversion at approximately rm 3.0 This station would fill a data gap in the temperature monitoring. These gauges are to be run concurrently to collect data at the three locations. This data would provide the basis for comparison with, and supplement the flow and temperature monitoring that is ongoing at the existing OWRD gauge below TID's diversion. They also serve to validate the assumptions and outputs of the Heat Source modeling and ensure compliance with ODEQ cold water standards. • In addition, redband trout populations are to be monitored in Tumalo Creek to determine trends in population size and age class structure. The methodology will be night snorkeling in late summer in Sub-reach A1 and an area above Tumalo Falls using stations that were established during a 2011 fisheries survey conducted by the Forest Service. This data will supplement the fisheries data collected during the 2011 survey. The snorkeling frequency will be annual for the first 3 years, then every other year for the next 6 years. • For the duration of the Special Use Permit, the City and the Forest Service will hold a meeting at the end of each monitoring season to review results, identify trends and concerns, and possibly refine the monitoring program. If temperature values are found that exceed ODEQ standards for Tumalo Creek, and can be determined to be the result of the City's activities authorized by the SUP, the Forest Service, after consultation with ODEQ and OWRD, may amend the SUP to ensure flows that maintain the cold water temperature standards. After 9 years of monitoring, a committee comprised of City and Forest Service representatives will determine if monitoring should continue, or what changes, if any, need to occur within the monitoring program.

Discipline	Design Criteria/Resource Protection Measure
Flow Control and ramping rates	• The City will monitor water diversion rates continuously using either an ultrasonic or magnetic type flow meter located at the Outback site. Under normal operations, the system will be designed to check flow at least every 15 minutes and adjust the diversion gate to maintain the desired flow. Reporting will include the peak hour flow rate and the daily volume of water diverted. This will allow the City to control water diversions, within the ability of the available technology, so as to not exceed the instantaneous diversion rate of 18.2 cubic feet per second. The flow rate diverted from Bridge Creek is the same as the flow rate at the Outback site since there will be no gain or loss of flow along the proposed pipeline. • The City shall be limited to an instantaneous rate of diversion no greater than the demand for municipal use, up to a maximum of 18.2 cfs. • The City will work with the USFS to develop a seasonal ramping rate that is operationally sound and protects fish. • The City will eliminate their use of returning diverted flows in excess of municipal demand.
Water Quality, Aquatic Species, and Riparian Areas	• To the extent possible, the City will service and refuel equipment on developed roads in areas that are at least 200 feet from streams. When equipment must be serviced in off-road areas or near surface waters, the City will exercise Best Management Practices to prevent pollutants from entering natural bodies of water. • Prior to construction, the City will develop a general Erosion-Control Plan shall that sets erosion- control measures to be used and identifies all mitigation measures to be employed to limit erosion and sedimentation. • The City will plan construction to ensure that pipeline placement under Tumalo Creek occurs in the fall when streamflows are low and shall conduct this work within periods allowed by the Oregon Department of Fish and Wildlife. • The City will store or stockpile excavated materials from pipeline placement activities away from streams and outside of wetlands. • The City will use silt fences or other erosion-control structures near streams during construction to limit sedimentation of streams. • During pipeline placement under Tumalo Creek, the City will minimize downstream sedimentation and restore the channel to natural grade, condition, and alignment as soon as possible post- construction. • The City will minimize impacts to wetlands from pipeline placement. To the extent possible, wetland vegetation that is excavated for pipeline placement shall be maintained on site and placed back on disturbed areas post-construction. The Forest Service will revegetate disturbed areas as needed with native vegetation sourced from on-site. The Forest Service will monitor re- vegetated areas for survival of wetland vegetation for 2 years and will continue revegetation if needed. • To prevent contamination of waters in the event of accidental spills, a predetermined organization and action plan will be prepared by the City. A Spill Prevention, Control, and Countermeasure (SPCC) Plan will be prepared if the total oil products on-site exceed 1,320 gallons or if a single container exceeds 660 gallons capacity. The plans will identify coordination responsibilities and names and phone numbers of agencies for spill reporting and cleanup.

2.2.2.2 City's Existing Surface Water Supply Facilities and Planned Upgrades

The City's surface water supply system is comprised of an intake facility located on Bridge Creek and two approximately 10-mile-long pipelines that carry water to a storage and disinfection facility referred to as the Outback Reservoir Site. The City's intake facility accepts water from Bridge Creek. The flow in Bridge Creek at the diversion point includes water diverted from source springs located along the Middle Fork of Tumalo Creek. The source springs diversion system has been operated by the City since the 1950s and diverts a portion of the water from the source springs that naturally flow into the Middle Fork of Tumalo Creek and over Tumalo Falls.

The City is planning to upgrade the Bridge Creek intake facility and replace the aging water supply pipelines with a single pipeline to be installed primarily within the existing roadway corridors. No physical or operational changes to the source spring (Tumalo Creek) diversion system are proposed as part of the City's currently proposed Surface Water Improvement Project. This source spring diversion system currently operates—and will continue to operate— at a constant rate, and that rate will not increase as a result of the Proposed Action. Diversions at Bridge Creek could decrease when demand for surface water does not require 18.2 cfs. This will increase flows in Bridge Creek and Tumalo Creek below the diversion. The City's planned pipeline replacement and intake building upgrades are mostly on National Forest System lands and are subject to a new Forest Service Special Use Permit and NEPA.

The City plans to construct a new water treatment plant on the City-owned portion of the Outback Site and is considering the potential for an in-conduit hydropower facility to be located at the Outback Site. This element of the City's project is not on National Forest System lands and is not subject to a Forest Service Special Use Permit. These are not connected actions under NEPA because the treatment plant is not dependent on the new pipeline being constructed; and, while the hydro plant is dependent on construction of the new pipeline, the decision to construct a hydro plant is speculative at this time. The hydro plant will not be on federal lands, so there will be no Forest Service NEPA decision related to the hydro plant if it occurs in the future, unless the City requested to alter the terms of the Special Use Permit.

Bridge Creek Intake Facility

The City's Bridge Creek Intake Facility was constructed in 1926 and includes a diversion dam, intake screens, and an intake building located on Bridge Creek approximately 800 feet west of its confluence with Tumalo Creek. The basic functions of the intake building include providing a covered, internal area to screen debris from inlet flow, monitor water quality, monitor security around the intake pool and facility, and house supervisory control and data acquisition equipment. The existing facility is currently functional for today's operational needs but is in very poor condition and does not comply with current standards.

The Bridge Creek Intake Building was constructed in 1926 for the purpose of monitoring the City's water supply. The building structure is constructed over the water intake channels and shares existing foundation elements with the dam and intake channels. The basic function of this building is to provide a covered internal area to screen debris from inlet flow, monitor water quality, and house supervisory control and data acquisition (SCADA) equipment. In previous years the structure provided quarters for a resident caretaker. The structure is accessed by City of Bend (City) staff at least weekly and less frequently by visitors during tours of the intake facility on an invitation only basis. The structural system for the Intake Building consists of a wood-frame superstructure supported by a reinforced concrete basin/intake structure on the south portion and a conventional continuous footing system on the north portion. The superstructure walls are nominally 2-inch by 4-inch wood studs spaced at approximately 16 inches. Horizontal boards line the interior face of the walls and corrugated metal panels are attached to the exterior face of walls and roof.

An evaluation of the Bridge Creek Intake structure was conducted on March 20, 2009. The evaluation consists of visual observations of accessible areas such as the living quarters of the residential portion, the intake screen room, the attic areas above the quarters, and the crawlspace/basement portion at the northwest corner of the building. In general, the structure was found to be in good condition, considering its age and location.

The Bridge Creek Intake structure does not comply with current building codes, which is to be expected considering the building's age and type of construction. This lack of compliance does not necessarily indicate an unsafe structural condition but represents a deficiency when compared with contemporary codes and standards of construction. The structure falls under the requirements of the Oregon Structural Specialty Code (OSSC), based upon the International Building Code (IBC) which was last updated in 2007. Specific items that do not meet the requirements of the current code are as follows:

- There are no defined load path to transfer lateral loads (wind and seismic) from the structure into the foundation, such as shear walls, roof diaphragms, hold-downs or bracing.
- There is no (apparent) positive attachment of the building structure to the foundation, such as anchor bolts.
- There is no apparent redundancy in load-carrying members for lateral loading.

Intake Facility Fish Screen

(Reference Chapter 3 of the WSAS, pages 3-6 through 3-12, Brown and Caldwell, November 2009)

The intake structure is located on the north bank of the diversion pond with its face parallel to stream flow and generally in line with the stream bank. Referencing original construction drawings, the finish floor elevation of hydraulic elements of the structure are constructed at 4,997.00 feet. The original design was developed for a diversion flow of approximately 10 cfs. Raw water is drawn from the diversion pond at right angle to the stream flow. The intake opening is approximately 14.33 feet long and 2.5 feet high with an invert elevation of 4,987.50 feet. Using an assumed design flow of 10 cfs for the existing intake facility, the approach velocity at the face of the intake is approximately 0.28 fps.

The existing intake facility debris screening process currently includes both a trash rack and a wire screen. The trash rack is an inclined flat bar rack at the face of the intake structure using ¼-inch by 3-inch steel flat bars on 2-inch spacing. The front side of the trash rack can be accessed for cleaning through floor hatches located inside the intake structure building above the trash rack. The back side of the trash rack can be flushed manually by opening a sluice gate at one end of a narrow channel between the trash rack and screening bays. Following the trash rack are two screening bays in a parallel configuration. Inlet flow to each screening bay can be controlled by a sluice gate. Each screening bay utilizes a horizontally-oriented brass wire mesh (#3 mesh, 16 gauge) to screen fine debris. The resulting mesh provides about a ¼-inch square opening. The area of each bay is approximately 15 feet long by 6 feet wide. Water flows up through the screen with debris caught below. Using an assumed design flow of 10 cfs for the existing intake, the approach velocity at the face of the debris screens is approximately 0.1 fps. Each debris screen is constructed from six discrete panels such that each panel can be rotated upward about a hinged edge and made accessible for cleaning.

Sediment in diversion flow that is dense enough to settle in the screening bay is collected in the hopper-shaped bottom of the screening bay. At an assumed design flow of 10 cfs for existing facilities, the detention time in each screen bay is approximately 1 minute with both screening bays in operation. Each screening bay is provided with a sluice gate outlet for manually flushing sediment and debris.

Subsequent to screening, water flows over broad crested weirs at the end of each screening bay and into a common channel with a 36-inch outlet connected to conveyance pipelines serving the Outback Facility site.

Notes on the original construction drawings indicate the weir elevation is 4,991.90 feet and weir length is 6.0 feet. At the assumed design flow of 10 cfs in the existing intake facility, the required head over each weir is approximately 0.4 foot. Bend WTP operations staff indicate that existing debris screens are cleaned on a weekly basis during routine operation and twice weekly during periods of higher turbidity and debris flow. Screen capture material generally consists of sticks, bark, needles, and cones from drainage basin vegetation. Silt deposition and algal growth is observed on the screens between cleaning cycles. Sediment capture below the screens consists of sand and silt. It should be noted that Bend WTP operations staff report a significant accumulation of sand and silt in the Contact Basin and subsequent reservoir tanks at the Outback Facility site. The origin of this sediment load is presumed to be at the diversion structure.

Existing trash rack, sluicing gates, and screens are generally in good condition and comprised essentially of the equipment installed circa 1926. The age of the equipment elements raises concern for continued operation without failure, although no elements appear to be significantly weakened by corrosion or physical damage.

As part of the new improvements proposed for the existing 1926 intake Facility, new horizontal drum screens will be installed. For redundancy and optimal operability two identical screens will be installed, one in each flow channel. Each screen will have automatic cleaning cycle equipment and an automatic frazzle ice de-icing system. Both screens will be able to operate in an automatic mode. A warm water system heated by propane will be used for the frazzle ice system. Screen design has been reviewed by Oregon Department of Fish and Wildlife.

The improved structure will accommodate upgrades to meet new operational requirements and safeguards related to the changed hydraulic operations of the new pipeline, including controls for monitoring and adjusting flow into the intake end of the new pipeline. The City is planning to replace above-grade portions of the intake building to address accessibility, safety, fire protection, current fish-screening requirements, thermal performance, energy efficiency, seismic risk, and obsolete mechanical and electrical systems. Selective demolition and modification of the existing intake facility will require mitigation under Section 106 of the National Historic Preservation Act. No structural changes to the diversion dam or modifications to the adjacent waterway are currently proposed.

The proposed new intake facility would:

- Include drum fish screens that are compliant with current Oregon Department of Fish and Wildlife requirements
- Be designed in a manner consistent with the Forest Service's Built Environment Image Guide for the Pacific Northwest
- Include provisions to remotely shutdown flow at the intake

Water Supply Pipeline

The City is planning to replace the existing pipelines with a single 30-inch pipeline approximately 10 miles long, which would be located almost entirely within existing roadways. The new pipeline would include a flow-control system that would allow the City to adjust diversion rates according to municipal demand, available stream flow/water rights, and limited to 18.2 cfs on average over a 60 minute period. Flow controls will be located at the downstream end of the pipe at the Outback Site. The City will monitor water diversion rates continuously using either an ultrasonic or magnetic type flow meter located at both the intake and the Outback site. Reporting will include the peak hour flow rate and the daily volume of water diverted. This will allow the City to control water diversions not to exceed the 18.2 cubic feet per second (11.6 million gallons per day). The flow rate diverted from Bridge Creek is the same as the flow rate at the Outback site since there will be no gain or loss of flow along the proposed pipeline.

The new pipeline would be:

- Comprised of different sections of materials including high-density polyethylene, ductile iron, and steel
- Installed approximately 3 to 5 feet beneath the surface, and deeper in areas where the pipeline is installed under Tumalo Creek or adjacent tributaries
- Aligned to cross Tumalo Creek at two locations ("upper crossing" being the most western crossing and "lower crossing" being the most eastern crossing). Both are existing road/bridge crossings
- Installed aerially at the upper Tumalo Creek crossing
- Installed under the creek at the lower Tumalo Creek crossing
- Designed to minimize impacts to wetlands and other sensitive areas
- Built with flow control to eliminate return flows from the Outback Site to Tumalo Creek, and leave more water in the creek downstream from the Intake down to the TID diversion (approximately 10 miles) when the City's use is less than 18.2 cfs
- Designed and constructed in close coordination with the Federal Highway Administration's Deschutes County Skyliners Road Project to maximize effective use of public dollars and minimize impacts of construction activities

The new pipeline size (30-inch outside diameter, 28.5 inch internal diameter) is based on the City's assessment of cost-effectiveness, access to allow internal welding, inspections, as well as operational and maintenance considerations. Water velocity is a primary design driver. Earlier in the design process, the City considered a 36-inch- diameter pipe, but, given projected demands and available water, the City determined that this pipe size was not warranted. The City's decision to construct a 30-inch-diameter pipeline is independent of any potential plans to develop a hydropower facility on the surface water supply system. The City is planning to build a 30-inch-diameter pipeline whether or not the hydropower facility is carried forward. At the time of this writing the City has withdrawn their application to FERC for a hydro facility.

At the original new pipeline design flow of 21 cfs, the design velocity is in the range of 4.7 ft/sec. At 18.2 cfs the design velocity is approximately 4.1 ft/sec. The risk of hydraulic surge due to sudden valve closure or failure is reduced at this lower velocity of water flow, thus extending the life of the pipe, and providing overall reduced operational risk through the life of the facility. Water flow control in the proposed design is achieved with a set of automatic control valves located at the Outback Facility, at the bottom end of the new pipeline. Successful flow control may be achieved at the design flow rate of 21 CFS or at a lower flow rates as demanded by City water use.

Storage and Disinfection Facilities

The City's Bridge Creek water supply storage and disinfection facilities have been added since the 1980s and are located on an approximately 10.6-acre City-owned parcel now known as the Outback Reservoir Site. Facilities on the property include three water storage reservoirs, a chlorine contact reservoir, chlorine storage and dosing systems, seven drinking water wells that supply water to the city of Bend, and multiple and miscellaneous accessory structures used for operating and maintaining the utility facility. As previously mentioned, the City is planning to construct a new water treatment plant on the City-owned portion of the Outback Site. However, it is not certain at this time what treatment will be selected, or when that facility would be constructed. The City has also assessed the potential for a hydroelectric facility at the Outback Site, but the timing for construction of this potential facility has not been determined. These potential future actions are not on National Forest System lands and are not subject to a Forest Service Special Use Permit. Any facility that requires a flow greater than 18.2 cfs would require an amendment to the Special Use Permit with a new NEPA analysis for that amendment.

Staging Areas

The Forest Service considered several areas to be used for staging areas. These are sites where contractors for both the Waterline project and the Skyliners Road Project could locate equipment and materials during the construction process. The Forest Service initially evaluated 14 sites. The sites were all surveyed for cultural resources, sensitive wildlife habitat, sensitive plant habitat, and presence of noxious weeds. The criteria used were:

- Use previously disturbed sites
- Avoid sensitive wildlife habitats and/or cultural resources
- Avoid or pretreat noxious weeds
- Provide as much distance as feasible to residential developments
- Avoid for extensive tree removal
- Restore site to an equal or improved condition

The sites selected and approved for potential use were: (see Figure 13):

Site A - the 14.1 acre site adjacent to the City-owned Outback Site. This site is already under Special Use Permit and most staging will occur here.

Site D – This is a large abandoned gravel pit. Spoils from pipeline trenching that is to be used as fill for the road project will be stored here. The site will be treated for weeds prior to use, recontoured, road access removed, and vegetation restored after use.

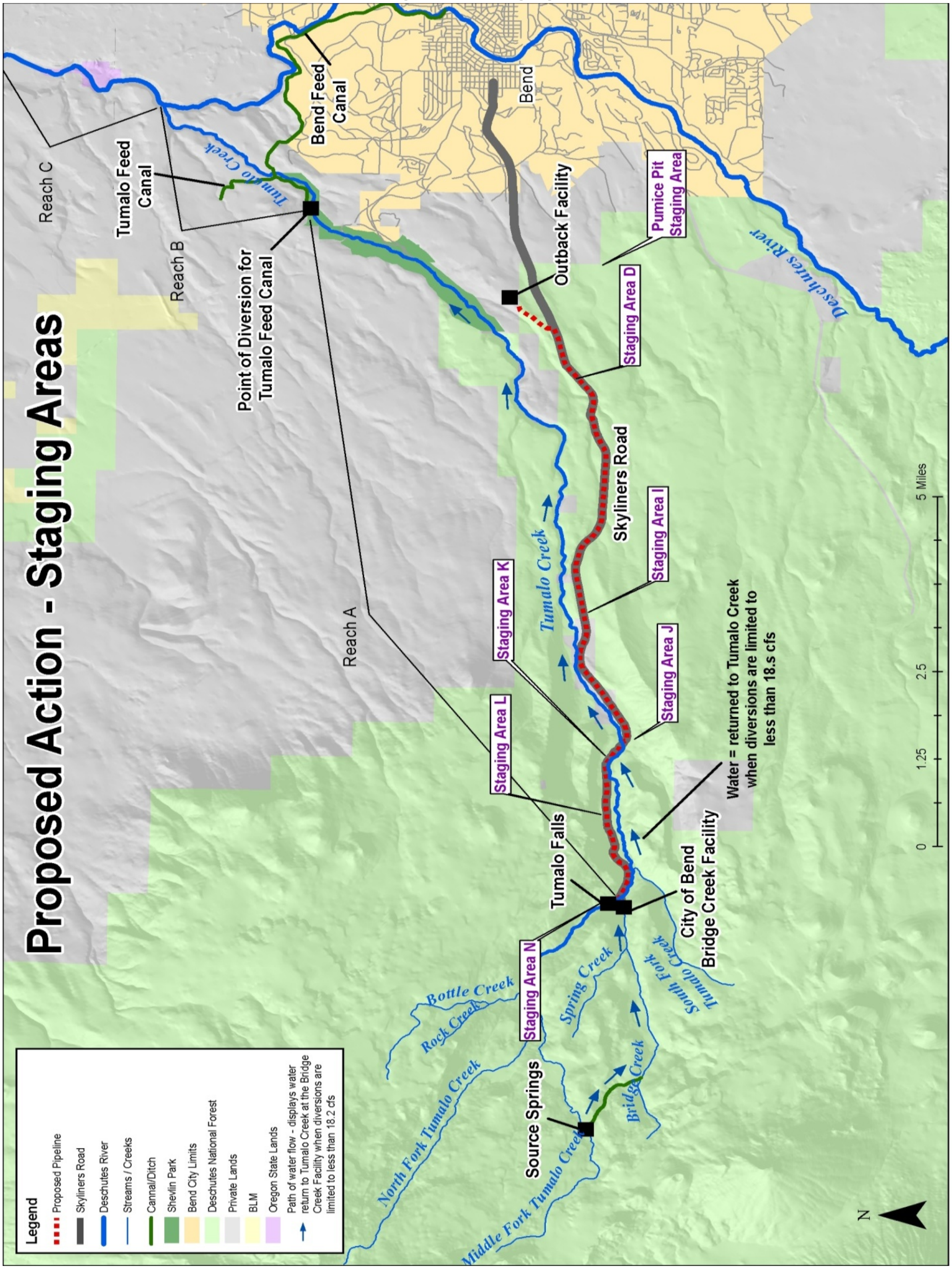
Site I – The existing road and an existing landing will be used to turn equipment around during construction of the eastern portion of the pipeline and road. This will reduce traffic impacts on the residential area. The road and landing will be restored.

Site J – Skyliners Lodge parking lot. An office trailer and porta-potty will be staged here. Access and capacity of the Lodge parking lot will not be affected.

Sites K and L – Existing old landings on Road 4603 for storing pipe and equipment to be used during the construction of the upper section of waterline and the two creek crossings. Both sites will have soil compaction rehabilitated and be restored with native vegetation

In addition to these sites, the project will use the Ski Hill parking lot for an equipment turn-around during construction of the upper phases of construction in Skyliners Road. And, an abandoned pumice pit adjacent to Phils Trailhead will be used to deck the trees removed during both projects. Any logs will be used for site restoration, stockpiled for future instream habitat improvement projects, or sold from decks at this site. The slash remaining will be chipped for use during site rehabilitation on the waterline project.

Figure 13. Staging Areas



CHAPTER 3.0 ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This section summarizes the physical, biological, social, and economic environments of the affected project area and the potential changes to those environments due to implementation of the Proposed Action. It also presents the scientific and analytical basis for comparison of the alternatives. For the cumulative effects analysis, consideration of past actions followed guidance provided by CEQ (June 24, 2005, Memorandum from James L. Connaughton, Project Record). Where pertinent, analysis is tiered to the FEIS of the LRMP. Probable effects are discussed in terms of environmental changes from the existing condition and include qualitative and quantitative assessments of direct, indirect, and cumulative effects.

3.1.1 Summary of Effects Resulting from the Proposed Action

Table 6. Environmental Effects Summary

Impact	Size of Impact (Intensity)	Why Not Significant
Noxious Weeds		
It is possible that the heavy equipment used in the project will carry in noxious weed seeds or parts and introduce them to currently weed-free portions of the project area.	Approximately 120 acres at risk; low risk due to Design Criteria and mitigation.	Construction occurs in a well-used transportation corridor already subject to weed introduction; Forest has a noxious weed program; not a new problem or one that is likely to change the Forest ecosystem. Equipment will be inspected and washed prior to entering the project.
Maintenance and operations carries same risk of noxious weed introduction.	Same as above.	Same as above.
Recreation and Access		
During construction, effects include restricted access to Tumalo Falls, dispersed recreation sites, and trails.	The project will disrupt the recreation use in the area for approximately 1 year; access will be restricted only during period of lowest visitor use.	Visitors will have multiple options for alternative recreation; no adverse effect on overall recreation experience Forest-wide.
Heritage Resources		
Under the Proposed Action, the NRHP-eligible Intake Facility would be demolished.	The project requires loss of one NRHP-eligible structure.	Compliance with NHPA Section 106; mitigation includes HABS/HAER surveys and documentation and providing public access to documentation and history; no loss of historic data.

Impact	Size of Impact (Intensity)	Why Not Significant
Stream Flows		
The implementation of the Proposed Action would temporarily increase flows in Tumalo Creek at two different periods: installation and operation.	During construction of the new intake sections of the pipeline and facilities at the Bridge Creek intake, diversion of flow would partially or completely cease for 2 to 6 months anticipated to begin in September or October 2012, increasing flow over the spillway and Tumalo Creek by approximately 9 to 18.2 cfs.	This increase would augment flow volumes in Tumalo Creek to a level closer to natural hydrologic conditions through at least Reach A.
Summer Stream Flows: The Proposed Action, after construction and operation, will permanently increase stream flow in Tumalo Creek in the Summer.	Once completed and operational, the proposed action will result in an equal or greater amount of flow in Tumalo Creek at all times and in all locations. Specifically, under summer low flow conditions when the City's use is restricted due to water rights limitations, the proposed system with flow control will leave more water in about 10 miles of the creek than would occur with the existing system. For example, at the 5th percentile low watershed yield of 53 cfs, the proposed action would result in an additional 5 cfs left in stream. This is a permanent condition that cannot change due to increasing demands since use is limited by water rights enforced by Oregon Department of Water Resources.	The Proposed Action to implement pipeline flow control will increase flows in Tumalo Creek, changing the creek hydrology closer to natural conditions. This would beneficially improve flows in the creek for 10 miles of stream upstream from river mile 5.5. During the summer low flow periods, this beneficial impact is permanent.
Winter Stream Flows: Although not an adverse impact, the Proposed Action, after construction and operation, will result in a long-term but potentially temporary increase stream flow in Tumalo Creek in the Winter.	The City's Winter time water use (Nov through April) is in the range of 10 cfs. Immediately following implementation of the Proposed Action of pipeline flow control, Winter time flows in 10 miles of Tumalo Creek will increase by 8.2 cfs. This is a benefit since the watershed yields on average about 73 cfs during this season. As the City's winter time demand grows, this beneficial impact will gradually decline and could disappear. The duration and magnitude of this benefit depends on the City's rate of growth in water needs during Winter.	Increasing flows in Tumalo Creek will change the hydrology closer to a natural condition. Following project completion and operation, this would beneficially improve flows in the creek. for 10 miles of stream upstream from river mile 5.5. During Winter, this beneficial impact is long-term, but could be temporary.
	Implementation of the Proposed Action will result in an equal or greater flow rate in Tumalo Creek for over 10 miles (upstream from river mile 5). Downstream from river mile 5 (the location of the existing system return flow), stream flows will not be affected by the Proposed Action.	Base flows (lowest flows of late summer to winter) are critical to the quality of trout habitat. An increase in base flow with the Proposed Action improves the quality of aquatic habitat

Impact	Size of Impact (Intensity)	Why Not Significant
Fisheries		
Direct and indirect effects to fisheries are dependent on changes in aquatic habitat, water temperatures, and other environmental factors and vary by sub-reach. The implementation of theProposed Action would affect fisheries in Tumalo Creek at two different periods: installation and operation.	Pipeline construction would have short-term (<4 weeks) effect to native redband trout habitat in the vicinity of the stream crossing of Tumalo Creek by dewatering of 80– 100 feet of the channel. This section would be isolated with upstream and downstream coffer dams, and fish trapped and relocated before and during de-watering.	Redband trout would move or be relocated to areas up- or downstream of the project site and would return shortly to the crossing site post-construction. The crossing construction is targeted to occur within the ODFW in-stream work period of July 1 – October 15 to protect redband trout and brown trout (ODFW 2008), but may occur later if the work period is extended by ODFW.
	Increase in flows could result in increased habitat for adult trout. Increased adult habitat could increase the abundance of spawners and the resultant abundance of juveniles. Increased abundance of juveniles could then result in more adult fish, so that in the end the population abundance is increased. In the Proposed Action, additional instream flow due to flow control at the diversion would provide some ecological and biological benefits at most flows. Adult redband habitat would be increased in 10 miles of stream downstream from the City's Intake. Water temperatures may be cooled minimally.	As described above, the Proposed Action will result in a permanent increase in stream flows in Summer and a long-term but potentially temporary increase in streamflows in Winter. These stream flow increases are anticipated to increase the abundance of fish populations. In-stream and other water rights would limit the City's use below the 18.2 cfs cap from July through September under low flow conditions, protecting stream flow and providing additional water in 10 miles of stream downstream from the City's Intake due to the addition of diversion flow control.
	Benefits in the winter would be on a diminishing trend as demand increases. However, summer benefits would be permanent due to water rights curtailment by OWRD.	Benefits would be minimal as wetted perimeter would increase less than 1% within Sub-reach A1 when at or near median flow. However, during a low flow summer condition of 5th percentile watershed yield of 53 cfs, the Proposed Action is anticipated to increase streamflow by approximately 5 cfs.
Water Quality		
During installation, diversion of flow would partially or completely cease.	Increased flow to Tumalo Creek by approximately 9 to 18.2 cfs for 2 to 6 months.	Increased flow would likely provide no change or would temporarily decrease temperatures during installation. During fall construction, base temperatures are not a great concern. Effects of sediment would be minimized through BMPs and monitoring. No long-term effect on stream productivity; no change to fishery composition or productivity.

Impact	Size of Impact (Intensity)	Why Not Significant
Building demolition and construction at the intake has potential to impair water quality through overland flow of sediments and on-site location of toxicants.	Short term, limited to intake area less than 1 acre.	No change to quality of municipal water supply; no change to stream productivity Best Management Practices and integrated design features would reduce the likelihood of overland flow of sediments entering Bridge Creek and nearby springs during building and construction. Materials and spill management planning is required to reduce risk of spills into the waterway.
Construction of the pipeline has the potential to impair water quality through the delivery of sediments from overland flow.	There is potential to affect turbidity and sedimentation of Bridge Creek, Tumalo Creek, and the small springs crossing under Road 4603 in the short term during pipeline installation. These areas of potential disturbance to water quality are limited to the first 3.1 miles of pipeline replacement below the Bridge Creek intake facilities. Once past the Tumalo Creek crossing below Skyliners Bridge, the pipeline alignment to the Outback site is located within uplands with no potential for water quality disturbance.	Same as above.
Proposed system will divert equal or less flow volumes, leaving more water in-stream for over 10 miles as described above. Increased streamflow will result in decreased stream temperatures.	Increased in-stream flow and decreased water temperatures during critical times of the year – low flow summer months.	Critical low-flow periods for fish are between July and September. The City of Bend commitment to not increasing its maximum diversion rate combined with installation of flow control to leave more water in stream will decrease water temperatures in the 10 miles of Tumalo Creek downstream from the City's Intake (down to river mile 5). Modeling indicates temperature reductions in the over 10-mile reach to range from 0.8 degrees C at lower diversion/stream flow rates to 0 degree C at higher diversion/streamflow rates.
Aquatic Habitat		
During pipeline construction at the crossing below Skyliners Bridge, channel morphology would be temporarily affected by trenching the streambed.	Approximately 80–100 feet of stream channel would be dewatered and unavailable to fish and other aquatic life for less than 4 weeks, planned to occur in September or October 2012.	Downstream fish passage would be maintained but upstream passage would be eliminated during this time. After construction is completed, the channel morphology would be returned to pre-construction conditions per BMP R-13. There would be no long-term effects to the channel and associated habitat.

Impact	Size of Impact (Intensity)	Why Not Significant
Demand for municipal water is projected to increase over time with both the No Action and Proposed Action alternatives, as shown in Section 3.7.5, Environmental Consequences – Streamflow. Effects to aquatic habitat and channel morphology are dependent on the magnitude and timing of changes in stream flow and vary by reach..	***Tumalo Creek from Bridge Creek downstream to the existing system return flow:*** As described above, stream flow in Reach A1 will increase permanently in the summer, and increase temporarily in the winter, but once demand at full capacity then winter flows will be the same as existing system. The stream flow increase will improve fish habitat. ***Reach A2 and B Tumalo Creek downstream from existing system return flow and TID Diversion.*** The Proposed Action will result in no change to stream flows in Reaches A2 or B, and will therefore not impact aquatic habitat.	Persistent benefits to stream ecology and redband habitat within Sub-Reach A1due to flow control. With increased demand there will be changes, but no difference between the alternatives for Sub-reach A2 and Reach B since demand increases with both.
	Reach C Middle Deschutes River downstream from Tumalo Creek The Proposed Action will not impact flows from Tumalo Creek into the Deschutes River.	There will be no impact to aquatic habitat in the Deschutes River.
Riparian Habitat		
There are two areas containing 6 small wetlandsn where riparian areas would be disturbed during construction.	Near the Tumalo Falls Trailhead parking area, the new pipeline will follow the existing pipeline alignment, crossing under two small springs that have associated riparian vegetation of sedges, grasses, cottonwood, and mountain alder. Approximately 0.08 acres of riparian vegetation would be disturbed at this site, including 0.03 acres of conversion from forested to pre-emergent wetland because of the removal of 4 trees. Construction of the crossing underneath Tumalo Creek below Skyliners Bridge would result in disturbance to approximately 0.019 acres of riparian vegetation, including 0.04 acres of conversion from forested to pre-emergent wetland because of the removal of 5 trees. A total of approximately 0.27 acres of riparian vegetation would be disturbed in the short term.	Riparian vegetation would be excavated and stored on site for replacement. At both sites, impacts to riparian vegetation are expected to be short term (<2 years), except that up to 9 large trees (>6”dbh) may be removed, resulting in a portion of the wetland being converted from a forested wetland to a pre-emergent wetland because of the loss of canopy cover. Riparian vegetation disturbed during construction will be restored to pre-construction conditions to avoid compensatory mitigation; no change to streamside ecology.

Impact	Size of Impact (Intensity)	Why Not Significant
Project operations increase flows, which can affect health and viability of riparian vegetation. Effects vary by reach. The Proposed Action will not change stream flows in Reach A2 or Reaches B and C.	***Sub-Reach A1 Tumalo Creek upstream from Existing System Return :*** There would be minimal benefits to riparian vegetation as stream flow would be increased during the growing season, but benefits would diminish over time. Some minimal benefit would persist long term July through September. ***Sub-Reach A2 and Reach B Tumalo Creek downstream from Existing System Return Flow and TID Diversion:*** The Proposed Action will not impact Stream Flows or riparian habitat. ***Reach C Middle Deschutes River downstream from Tumalo Creek:*** The Proposed Action will not impact Stream Flows or riparian habitat.	These additional effects as a result of implementing the Proposed Action would be minimal because of the small change in flows and associated small change in water elevation. No change to streamside ecology; no loss of species diversity or persistence.
Forest Habitat		
Loss of forested habitat including live trees, snags, logs, and shrubs.	Disturbance of 0.3–0.5 acre; less than 1% of forest habitat.	No change to forest ecology; no loss of species or degradation of species persistence.
Construction of the Bend Pipeline is expected to remove nesting and foraging habitat for Williamson's sapsucker, red-naped sapsucker, and downy woodpecker	Loss of small snags on 0.3 acre out of a 6-acre stand.	Less than 1% of habitat affected. No adverse effect on nesting success. No decline in woodpecker population expected.
May impact brown creeper and hermit thrush.	Loss of small snags on 0.3 acre out of a 6-acre stand.	Less than 1% of habitat affected. No adverse effect on nesting success.
The proposed project is expected to minimally impact future snags, down wood, and green tree replacements.	Loss of small snags on 0.3 acre out of a 6-acre stand.	Would not contribute to any changes in viability on the Deschutes National Forest for any species dependent on this habitat. No long-term habitat disturbance.
Crater Lake Tightcoil		
The Bridge Creek Water Supply project may impact Crater Lake tightcoil, but the impact is not expected to be significant or lead towards a downward trend to federal listing. This minimal impact is also not expected to add incrementally to ongoing and reasonably foreseeable actions; therefore, cumulative impacts to this species or its habitat are not expected.	Approximately 1,750 ft² of habitat disturbed in four sites. Unknown number of individuals potentially disturbed. Less than 0.0001% of the available habitat within the area bounded by the four sites would be impacted, and only short term.	Project would not impact known sites. Habitat elements would be replaced at disturbed sites within 2 years (riparian mitigation). Any potential loss of individuals would not lead to a trend towards federal listing.

Impact	Size of Impact (Intensity)	Why Not Significant
Noise Disturbance to Wildlife		
Noise disturbance from construction activities if they are occurring during the breeding season for accipiters. The timing of the activities could negatively impact nesting pairs within ¼ mile of Skyliners Road and within 1 mile of blasting areas.	If the projects occur during the breeding season, project activities could have direct, negative impacts to nesting accipiters. Disturbance during this time could result in nest failure (noise disturbance) or direct loss of individuals (adults away from the nest for too long).	Disturbance is expected outside the sensitive breeding season when there will be no adverse effect on nesting success. Activities restricted during nesting seasons. No adverse effect on nesting success.
The project may impact chipping sparrows, brown creepers, and hermit thrush if project activities are conducted during the nesting season.	Area within 200 feet of activities.	Although the project may impact individuals, it is not expected to contribute to a downward trend in populations.

3.1.2 Cumulative Effects

The environmental consequences disclosures in this EA include discussions of cumulative effects. Where there is an overlapping zone of influence, or an additive effect, this information is disclosed. In order to understand the contribution of past actions to the cumulative effects of the Proposed Action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analysis in this EA does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach. First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the Proposed Action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one cannot reasonably identify each and every action over the last century that has contributed to current conditions. Additionally, focusing on the impacts of past human actions risks ignores the important residual effects of past natural events, which may contribute to cumulative effects as much as human actions.

By looking at current conditions, this EA captures all the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects. Finally, CEQ issued an interpretive memorandum on June 24, 2005, regarding analysis of past actions, which states, “Agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.”

The cumulative effects analysis in this EA is also consistent with Forest Service NEPA Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

> *CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7)*

The following table lists the groups of actions that have contributed to the existing conditions within the project area. The effects analysis throughout this Chapter considers these past actions as contributing to the current condition. Note that throughout this chapter, the boundary of the cumulative effects analyses varies by resource. For some resources, the boundary for cumulative effects will be the project area because the effects of the proposed actions are limited (for example, cultural resources), while for others, the entire Tumalo Watershed is considered.

Table 7. Past Actions and Events that Contribute to the Current Conditions in the Project Area and Cumulative Effects Area

	Timing	Description	Residual Effects
Transportation System	Present	Road system developed. Approximately 12.6 miles of open road in Highway Safety Act (HSA) roads (Skyliners and Road 4603), and approximately 4.0 miles in non HSA roads FS Road 4606-100 and 4609). Current transportation system, road density, access, habitat fragmentation.	
Industrial Timber Operations	1920s-1930s	Extensive railroad logging across project area, primarily clearcutting. Most of the Bend Watershed and the project area received from Shevlin-Hixon in 1944. .	
Large Wildfire	1900s	Bridge Creek Fire (1979) burned 3,364 acres in upper project area, subsequent salvage activities. Pole Creek Fire (2012) burned 26,580 acres, approximately 10 miles north in an adjacent watershed.	
Travel Management Rule	Ongoing	Across project area and Forest. Motorized travel in Central Oregon restricted to designated roads and trails only. Access to dispersed camping has special provisions to limit access to sensitive areas.	
Tumalo irrigation District	1900s to present, and ongoing	Has greatest impact to stream flows in Reach B and the Middle Deschutes River, Currently providing some additional instream flow due to operational requirements of their fish ladder.	
Recreational Game Fish harvest	ongoing	Managed by ODFW, light pressure and limited harvest of redband trout.	
Vegetation Management / Fuels Reduction Projects			
Fry timber sale and fuels treatment	2011-2012	North of project area. Commercial thinning, understory thinning, fuels treatments (pile, mow, burn) on 70 acres around private land.	Tree harvest and understory treatments completed, Fuels treatments remaining.
Tumalo Creek Fish Habitat Restoration	2004-2007, and ongoing	Reduced channel erosion and sedimentation, and increased aquatic habitat complexity.	
Tumalo Creek Instream Flow leasing	Ongoing since 2001.	Contribution of 8.08 cfs to date	
Recreation			
Development of Summer Trail Systems	Ongoing	Recreation use by hikers, mountain bikers and equestrians primarily during the spring, summer and fall seasons.	For the entire Tumalo Watershed: Miles of Hike/Pedestrian, Mtn. Bike, and Trail: 78.3 miles
Development of Winter Trail Systems	Ongoing	Recreation use by cross country skiers, snowshoers and snowmobilers during the winter season.	For the entire Tumalo Watershed Miles of motorized trail: 16.8 miles Miles of Cross Country ski and Snowshoe Trail: 19.5 miles

Table 8. Ongoing or Reasonably Foreseeable Future Actions, in the Project Area and the Tumalo Watershed that may contribute to Cumulative Effects.

Project Name / Activity	Status/Timing	General Description of Activities
Miscellaneous / Special Uses		
Bearwallow Mastication	Ongoing (second year)	Along the 4603 road. Fuels reduction.
Recreation		
Phil's Trailhead Enhancement	Implementation 2014	Providing paved parking area, toilets, and trailhead kiosks. Approximately 1.4 acres impacted.
Snowmobiling	Ongoing in winter	Within and around project area. Motorized recreation and grooming of trails. Some tree cutting for trails and safety.
Cross-Country Skiing	Ongoing in winter	Within and around project area. Bipedal recreation and grooming of trails. Some cutting of trees for trails and safety.
Mountain Biking	Ongoing	Within and around project area. Wheeled and bipedal recreation of trails. Some cutting of trees for trails and safety.
Roads		
Road Maintenance	Ongoing	Grading, ditching, and brushing out of roads
Skyliner Road reconstruction / realignment	Implementation in 2014	FHWA categorical exclusion. Within northern portion of project area. Road to be resurfaced and realigned in some locations.
Vegetation Management/Other		
West Tumbull HFRA Project	Implementation	North of project area. Commercial thinning, understory thinning, fuels treatments (pile, mow, burn). Tree harvest understory thinning completed. Fuels treatments remaining
Jet Timber Sale part of West Tumbull project	Ongoing	Skyliners Road upper community. Commercial thinning, understory thinning, fuels treatments (pile, mow, burn). Tree harvest continuing Understory treatments and fuels treatments remaining.
East Tumbull HFRA Project (Net T.S., Set T.S., NT7)	Ongoing	Within project east 1/3 of West Bend Project. Commercial thinning, understory thinning, fuels treatments (pile, mow, burn). Tree harvest finished, understory treatments for fuels remaining.
Invasive Plant Control EIS	Planned	Within project area and across Forest. Herbicide and manual treatment of invasive plant populations
West Bend Vegetation Management Project	Planning	Mostly south, but overlaps lower portion of project area. Approximately 3700 acres of pre-commercial and commercial thinning, and fuels treatments, all outside of Riparian Reserves and RHCAs.
Bend Watershed Fuelbreak Project	Planning	Fuels treatment along roads west of the Watershed to reduce likelihood of fire entering the watershed.
Activities on adjacent private land	Ongoing/Periodic	Fuels treatments, new housing structures (Section 16, Skyliner, Adjacent to east boundary
TID water conservation Project (CW-37)	Beginning 2014	Will restore approximately 11.8 cfs to Reach B and Middle Deschutes River.
Continued diversion of water for the City of Bend	Ongoing	Continued diversion of water from Tumalo Springs; continued operation of the Bridge Creek and Outback facilities. The effects of these activities are captured in the description of the existing condition.

Reasonably Foreseeable Actions: During the objection resolution meeting, much discussion occurred regarding the cumulative effects analysis and what projects/actions should be considered. In considering which actions are reasonably foreseeable, the agency is given guidance by regulation in determining what to consider for cumulative effects.

The regulation at 36 CFR 220.3 states that reasonably foreseeable future actions are those Federal or non-Federal activities not yet undertaken, for which there are existing decisions, funding, or identified proposals. Identified proposals for Forest Service actions are described at 36 CFR 220.4(a)(1) which states the Forest Service has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated.

In accordance with the regulations at 36 CFR 220.3 and 220.4(a)(1), the Forest Service considers that those projects with decisions, those that are being actively planned, or those that are in scoping constitute identified proposals that should be considered during a cumulative effects analysis. If Forest Service is not actively preparing to make a decision on a proposal, and the effects of the proposal cannot be evaluated (i.e., the project has not yet been proposed), the project is typically not considered during a cumulative effects analysis.

In the Revised EA of June 30, 2012, the Forest Service analyzed the effects of a previous proposed action that would have set an upper limit of flows conveyed by the pipeline at 21 cfs. The Forest Service withdrew the Decision Notice and Finding of No Signficant Impact for this original proposal on December 17, 2012 (see Section 1.8 of Chapter 1 of this EA). The City submitted a revised proposal to convey 18.2 cfs in December of 2012. Thus, pursuant to the regulations, the City's potential conveyance of 21 cfs is not reasonably foreseeable as it is not yet proposed. To address the concerns raised by the objectors, however, this EA incorporates by reference the 2012 EA, which documented the potential cumulative effects of diverting 21 cfs on stream flows, water quality, fisheries, and aquatic and riparian habitats. The 2012 EA determined that the increased withdrawal had no direct, indirect, or cumulative effects on any other resources. The following section summarizes the direct, indirect, and cumulative effects of diverting 21 cfs, as documented in the 2012 EA.

Stream Flows

Flows in Tumalo Creek would vary between reaches and time of year, depending on the City of Bend's demand for water, its restricted ability to divert water because of the seniority of water rights and demand for irrigation water owned by TID, and in-stream flows. Operating at full capacity, the system could divert approximately 21 cfs, or 2.8 cfs more than the No Action Alternative or the Proposed Action.
Maximum changes in flows between Proposed Action and 21 cfs are in the 3–4% range during winter months. Changes in flow during summer base-flow periods will still be limited by senior water rights holders.

Fisheries

A decrease in flows if 21 cfs were diverted could coincide with decreased habitat for adult trout. Decreased adult habitat could reduce the abundance of spawners and the resultant abundance of juveniles. Reduced juveniles could then result in less adult fish, so that in the end the population abundance is decreased.

The small increase in system diversion capacity (maximum 2.8 cfs) is approximately 4% of the average off-peak stream flow. In-stream and other water rights would still limit diversion rate increases from July through September, protecting stream flow and providing additional water in 10 miles of stream downstream from the City's Intake due to the additional of diversion flow control

Water Quality

Decreased in-stream flow and increased water temperatures during critical times of the year could potentially occur if 21 cfs were diverted. The distribution of those effects will vary as a result of operational differences and increased demand for surface water from Tumalo Creek.

Critical low-flow periods for fish are between July and September. The potential for the City of Bend to divert additional water is held to existing levels or lower by other existing water rights. Therefore, temperatures are expected to remain the same or decrease.

Aquatic Habitat

Effects to aquatic habitat and channel morphology from diverting 21 cfs are dependent on the magnitude and timing of changes in stream flow and vary by reach.

Reach A Tumalo Creek upstream from TID Diversion

Reach A is 13.2 stream miles, or 82.5% of the total project area. For the entirety of Reach A, on a monthly basis, a 1% increase in spawning habitat, a maximum of 1% decrease in juvenile habitat, and a maximum of a 2% decrease in adult habitat is predicted with an additional 2.8 cfs of diversion.

Reach B Tumalo Creek downstream from TID Diversion

This sub-reach is 2.8 stream miles in length, or 17.5% of the project area length. Redband trout spawning habitat would be improved slightly early in the season over the Proposed Action by an increase to 21 cfs due to reduced velocities but may be decreased thereafter, up to 8% in May. Juvenile habitat would be improved up to 2% during the non-irrigation season but may be decreased up to 8% during short periods within the irrigation season. Adult habitat would not change during the non-irrigation season but may be decreased up to 9% during short periods within the irrigation season.

No change to stream ecology; no change to fishery productivity. Redband trout persist; no loss to redband trout viability.

Reach C Middle Deschutes River downstream from Tumalo Creek

Short term: Increased municipal water demand would most affect flow during the non-irrigation winter months when flows are highest (600–800 cfs). Increasing demand may occasionally slightly reduce stream flow (1–2 cfs) through Reach B into Reach C during the irrigation season.

Long term: The occasional 1–2 cfs reduction in stream flow through Reach B would be carried forward to the Middle Deschutes River.

The 1.5–2% decrease in flow would minimally affect redband habitat and stream ecological functions such as primary production and secondary production.

Riparian Habitat

Reach A Tumalo Creek upstream from TID Diversion

Effects to riparian areas from an additional 2.8 cfs would initially be essentially the same as the No Action Alternative or the Proposed Action, since excess water beyond demand is returned to Tumalo Creek under the existing system. As demand increases, effects to riparian vegetation would occur but would be minimized by the small change in water elevation observed at lower flows. Effects above the No Action Alternative or the Proposed Action would start to be realized once diversion at the intake exceeds 18.2 cfs, which would frequently occur by 2025 July through September when diversions are already curtailed to below system capacity.

Reach B Tumalo Creek downstream from TID Diversion

The small change in flows within this reach would have immeasurable impacts to riparian vegetation.

Reach C Middle Deschutes River downstream from Tumalo Creek

The small change in flows within Reach B from an additional 2.8 cfs diversion would carry downstream to the Deschutes River but would have immeasurable impacts to riparian vegetation.

All Reaches – Long Term

Flow control with 21 cfs diverted results in minimal benefits to riparian areas, compared to the No Action Alternative or the Proposed Action that diminish until approximately 2025. The benefits would be slightly less than the Proposed Action with an additional 2.8 cfs diverted. Beyond 2025, there would be a trend of increasing minimal detrimental impacts until demand meets system capacity with the exception of July through September, during which there would be long-term minimal benefits as diversion rates are restricted by water rights.

These additional effects at 21 cfs would be minimal because of the small change in flows and associated small change in water elevation.

No change to streamside ecology; no loss of species diversity or persistence.

3.2 Scenic Resources

The source document for the following sections is the *Bend Water Source and Skyliners Road Improvements Project Scenic Resource Analysis* (prepared by Robin Gyorgyfalvy, Landscape Architect, May 28, 2013; incorporated by reference, and on file at the Bend–Fort Rock Ranger District).

3.2.1 Existing Condition – Scenic Resources

The City's Bridge Creek water supply system was originally constructed in 1926 and currently provides approximately 50% of the city of Bend's municipal water. The existing system includes a diversion dam impoundment structure, a canal that carries water from the diversion to the headwaters of Bridge Creek, an intake facility including a dam, two 11-mile-long water supply pipes, and a water storage and disinfection facility. The current water supply pipes are underground, supported by piers, and under the stream.

The western portion of the project area (from the eastern terminus of Forest Road 4603 to the City's intake facility) is within the Tumalo Recreation Area. This area is highly valued for its scenery and close proximity to Bend by bicyclists, hikers, Nordic skiers, and families wanting to recreate nearby. The availability of water for viewing and recreation makes this a popular spot for residents and visitors. This area is the gateway to Tumalo Falls, which is considered to be one of the main features for tourism in central Oregon because it is easily accessible and not too far a distance for driving and biking in the summer and Nordic skiing and snowshoeing in the winter. The Tumalo Creek Bridge at the western terminus of Skyliners Road provides access to the Tumalo Recreation Area.

The entire Proposed Action is within a *Scenic Views – Foreground management area classified as High Scenic Integrity – SMS (Retention – VMS)* area, which refers to landscapes where the valued landscape character "appears" intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.

Approximately 5 miles west of Bend, Skyliners Road is within a *Scenic Views – Foreground management area which is classified as Moderate Scenic Integrity – SMS (Partial Retention – VMS)* area, which refers to landscapes where the valued landscape character "appears slightly altered." Noticeable deviations must remain visually subordinate to the landscape character being viewed (*Landscape Aesthetics, A Handbook for Scenery Management*).

Scenic views along Road 4603 are mostly dense forested areas with openings to meadows adjacent to Tumalo Creek and scattered aspen stands on the valley slopes and on the north side of the road close to Tumalo Falls. Other views are to riparian vegetation areas surrounding and forming islands within the creek. The views along the creek and at the falls are popular during summer as well as winter for cross-country skiers. Skyliners Lodge, a historic Forest Service structure from the Civilian Conservation Corps era, is located at the end of Road 4601 overlooking Tumalo Creek.

Scenic views from Road 4603 are to the surrounding upland geologic features and include aspen stands along upper valley drainage areas. Other views throughout the project area are from hiking and mountain biking trails overlooking the Tumalo Creek drainage. The City of Bend maintains a caretaker's house located above the trailhead parking area that leads to the falls.

3.2.2 Management Direction – Scenic Views

The Forest Plan for the Deschutes National Forest provides standards and guidelines for an array of land uses referred to as management areas. The management areas for Scenic Views and Front Country are described in terms of desired future conditions for various settings and how these are to be met by specified activities or actions. The Scenery Management System (SMS) is the methodology used by Forest Service landscape architects since 1996 to provide a visual impact assessment of effects to scenic resources which integrates social impacts to recreation visitors with physical impacts to the visitor experience.

This current and more holistic system includes the human element as an integral part of the ecosystem and has been the methodology used in place of the previous outdated Visual Quality System (VQS) of 1974 which continues to be referenced in Forest Plans that have not yet been updated to reference the current SMS instead. To facilitate this change in methodology, both systems have been referenced by applying SMS and including the VQS in parentheses such as High Scenic Integrity - SMS (Retention – VQS).

The Forest Service implementing regulations currently establish a variety of Scenic Integrity Levels for Scenic Views – MA9 (LMRP page 4-121). These standards and guidelines include:

- High Scenic Integrity Level – SMS - Natural Appearing Landscape
  (Retention – VMS) - MA 9, SV-1 Foreground, SV-3 Middleground

- Moderate Scenic Integrity Level - SMS - Slightly Altered Landscape
  (Partial Retention – VMS) - MA 9, SV-2 Foreground, SV-4 Middleground

- Low Scenic Integrity Level – SMS - Altered Landscape
  (Modification – VMS or General Forest) - MA 8, GFO within Foreground as well as Middleground

The distance zones for Scenic Views management areas for an observer are as follows:

- Immediate Foreground 0 - 300 feet
- Foreground 0 - ½ mile
- Middleground ½ mile - 4 miles
- Background 4 miles – horizon

Scenery Management Objectives are defined in terms of Scenic Integrity Levels which describe existing conditions and whether the landscape is visually perceived to be “complete” or not. A rating of ***High Scenic Integrity*** means having little or no deviation from the landscape character that makes it appealing and attractive to visitors and local residents. In addition to describing existing conditions, Scenic Integrity Levels also describe the level of development allowed and ways to mitigate deviations from the area’s landscape character.

Usually the most effective way to meet Scenic Integrity Levels is to repeat visual form, line, color, texture, pattern, and scale common to the scenic values of the landscape character being viewed. For example, in natural and natural appearing landscapes, deviations such as created openings can sometimes be visually enhanced through repetition of size, shape, spacing, surface color, edge effect, and pattern of natural openings common to the existing landscape character.

Adding structures or additions to existing structures in the landscape can often be accomplished by repeating architectural form, line, color, texture, pattern, and scale that visually relates to the surrounding site features. When repetition is designed to be accurate and well placed, the deviation may blend so well that change is not evident.

3.2.2.1 Scenic Views

The goal of the Scenic Views management area is to provide high quality scenery representing the natural character of Central Oregon. The general theme and objectives of Scenic Views is for landscapes seen from selected travel routes and use areas to be managed to maintain or enhance the appearance of the areas being viewed. To the casual observer, results of activities will either not be evident or will be visually subordinate to the natural landscape.

3.2.2.2 Minerals and Special Uses (M9-83)

Mineral developments, utilities, and electronic sites may be located in these areas if the facilities and associated improvements are located, designed, and maintained to blend with the characteristic landscape. Visual quality objectives may not always be met when the viewer is within the special use site itself, due to the usual large scale of these facilities. However, when viewed from travel routes, recreation areas, and other sensitive viewer locations, Scenery Management Objectives (Visual Quality Objectives) should be met.

3.2.2.3 Built Environment Image Guide

The Built Environment Image Guide (BEIG, 2001) shall be used as a reference when designing new structures or new facilities on Forest Service lands. Building facilities within the project area need to reflect the character of the Pacific Northwest east of the Cascades and the central Oregon area. A rustic-style Cascadian design is a more traditional and crafted form of architecture that uses native materials such as timber posts and lava rock or a stone base and a steeper roof pitch, especially in areas with heavy snow.

3.2.3 Analysis Methods – Scenic Resources

Methodology used for analyzing impacts to scenic resources is the Scenery Management System (SMS) which uses “Landscape Aesthetics: A Handbook for Scenery Management.” Issued in 1996, this new handbook replaces “Agriculture Handbook 462 – The Visual Management System (VMS)” which was issued in 1974. While many of the basic inventory elements of the Visual Management System are retained, the Scenery Management System incorporates both the natural and human processes into the ideas of managing for ecosystems and is the current methodology used by the Forest Service to inventory and evaluate impacts to scenic resources.

3.2.4 Environmental Consequences – Scenic Resources

3.2.4.1 No Action Alternative

Under the No Action Alternative, the project area would remain as it exists today. There would be no direct, indirect, or cumulative effects on scenic views. However, the No Action Alternative could result in pipeline failure, which could affect the surrounding landscape through direct damage caused by released water and damage caused by construction activities required to repair the failed pipeline. Impacts could include temporary loss of vegetation, property damage, erosion, stream turbidity, substantial damage to roads that could prohibit access to scenic areas, and removal of trees to facilitate access to damaged sections of pipe.

3.2.4.2 Proposed Action

In following the Design Criteria specified in this document, the proposed design for the intake facility uses some native materials such as a lava rock veneer and has a steep roof pitch. Paint colors, metal treatments, and window designs reflect a traditional or rustic-style Cascadian design as presented in the Built Environment Image Guide.

Nearly all of the City's proposed pipeline would be buried and would have no long-term adverse effects to scenic resources. The proposed pipeline would be located almost entirely within road corridors with the exception of a short section (less than 700 linear feet) between the intake facility and the western-most Tumalo Creek crossing. Tree clearing in this area would be required to facilitate pipe installation and would have a short-term effect on the scenic environment and views from within the Tumalo Recreation Area. The western-most Tumalo Creek pipeline crossing is currently an aerial crossing, as is the new pipeline. The crossing is and would continue to be visible from Forest Service Road 4603 and the surrounding area. However, the new pipe would be a larger structure than the current pipeline. A buried crossing is not reasonable here due to engineering constraints associated with a steeply incised creek bed and surrounding topography.

In consideration of scenic views from the Tumalo Falls parking area, there would be a noticeable ground disturbance change that would occur in the corridor clearing that is approximately 40 feet wide by 300 feet long. This would be visible from the trailhead parking area. To recreate a more natural appearing setting, at least 20 fallen trees would need to be randomly placed throughout an area that is 60 feet wide (so there is overlap into the forested areas by 10 feet on each side of the corridor clearing) by 300 feet long. To further mitigate this change to scenic views, planting of native shrubs between the parking area and the view to the ground disturbance would provide some additional screening. The combination of the fallen trees and screening with native shrubs will visually break up the appearance of an unnatural corridor clearing in a forested setting. In addition to aesthetics, it will also be beneficial by helping restore the area's wildlife habitat capabilities.

3.2.5 Cumulative Effects – Scenic Resources

Table 9. Cumulative effects to scenic resources

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	The Proposed Action will result in the replacement of the above-grade portion of the existing intake building with a more modern structure. In following the Design Criteria specified in this document, the proposed design for the intake facility uses some native materials such as a lava rock veneer and has a steep roof pitch. Paint colors, metal treatments, and window designs reflect a traditional or rustic-style Cascadian design as presented in the Built Environment Image Guide.
Affected Environment	The scenic quality of the landscape within the project area has been affected over the last 100 years by development of roads and trails, logging, and the 1979 Bridge Creek Fire. Restoration efforts along Tumalo Creek have included major replanting efforts, but the landscape along Road 4603 is still recovering from a major fire and is dominated by smaller trees and shrubs.
Effects of Reasonably Foreseeable Future Actions	Planned and future timber sales and fuelbreak projects will continue to alter the landscape within the project area. Skyliners Road improvements in 2013 will have short term impacts to scenic quality along Skyliners Road. Visitors and residents will note construction activities and changes to the immediate foreground along the road for up to two years.
Mitigation not included in the Proposed Action	None.
Sum of impacts (cumulative Impact)	Replacement of the above-grade portions of the intake building with a new structure with a more modern-looking structure that reflects elements of a traditional or rustic-style Cascadian design as presented in the Built Environment Image Guide. Project effects to the landscape are temporary and will not add to the other modifications that have occurred within the project area (trails, roads, logging, major fire, existing City water utilities).
Regulatory cap (if applicable)	NA

3.3 Botany

The source documents for the following sections are the Bend Water Source and Skyliners Road Improvements Project Survey and Manage Plant Species Report, the Biological Evaluation – Threatened, Endangered, and Sensitive Plants Report, and Noxious Weed Risk Assessment prepared by Charmane Powers, Botanist, June4, 2013. These reports are incorporated by reference, and on file at the Bend–Fort Rock Ranger District.

3.3.1 Management Direction – Threatened, Endangered, and Sensitive Plants

Effects of this activity are evaluated for those TES plant species on the current Regional Forester's Sensitive Species List (FSM 2670.44, December, 2011) that are documented or suspected to occur on the Deschutes National Forest.

3.3.1.1 Prefield Review

The pipeline spans numerous plant associations, listed here from east to west: Ponderosa/bitterbrush-snowbrush/Idaho fescue; ponderosa/bitterbrush-snowbrush/needlegrass; mixed conifer/snowbrush-chinkapin/pinegrass; mixed conifer/snowbrush-manzanita; mixed conifer/snowbrush-manzanita/sedge- penstemon; and mountain alder in the Tumalo Creek floodplain. The elevation lies between 3600' – 5200'. The average annual precipitation spans a wide gradient measuring between 20-40".

Roughly 90% of the proposed disturbance area or in similar habitat immediately adjacent to it has been surveyed over the past 15 years or so by Forest Service botanists, with TES plant sites only found within the Tumalo Creek floodplain above Skyliners Lodge (see following paragraph). Outside of the floodplain, much of the remainder of the habitat where the pipeline crosses contains abundant manzanita and/or ceanothus, which do not offer good quality TES plant habitat. Because of these things, no further TES plant survey is required.

There are two known TES plant sites near the City of Bridge Creek Water Supply project, although none occur within the zone of proposed disturbance. These sites are:

- *Gentiana newberryi* var. *newberryi* (Newberry's gentian): 2 sites
- Formerly there had been a small population of *Tritomeria exsectiformis*, a liverwort, in an atypical habitat along Bridge Creek, but no longer occurs in that location (Rick Dewey, pers. comm., October 2011).

3.3.1.2 Field Reconnaissance

As mentioned in the previous section, no further TES plant survey is required. Botanical visits to the area in 2011 involved weed treatments and seed collection only.

3.3.1.3 Project Effects and Findings

Direct and Indirect Effects:
There are no anticipated effects to TES plants at the project site, because none have been located during surveys.

Cumulative Effects:
There are no anticipated cumulative effects because no TES plants have been located during surveys.

Deschutes National Forest Land and Resource Management Plan (LRMP) Consistency

The City of Bridge Creek Water Supply project as regards TES plant species is consistent with the Deschutes LRMP (1990). Records were checked for previously known TES plant populations (TE-1); and suitable habitat was located (TE-2). The suitable habitat has been surveyed. The remaining standards and guidelines for TES plant species do not apply to the City of Bridge Creek Water Supply project.

Finding

The proposed action will have no impact on Proposed, Endangered, Threatened, or Sensitive plant species.

3.3.2 Management Direction – Survey and Manage Plants

The City of Bridge Creek Water Supply project is consistent with the Deschutes National Forest Land and Resource Management Plan as amended by the 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (2001 ROD).

Project Consistency:
The City of Bend Pipeline project applies the Survey and Manage species list in the 2001 ROD (Table 1-1, Standards and Guidelines, pages 41-51) and thus meets the provisions of the 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines.*

See Appendix A of the Sensitive Plant Report, June 4, 2013, for the Survey and Manage categories into which species are grouped; see Appendix B in the same report for a list and brief habitat description of the potential Deschutes National Forest species for which pre-disturbance surveys are required and for which any known sites are required to be managed; see Appendix C in the same report for Definitions of “Equivalent Effort Surveys in Old Growth” and “Habitat Disturbing”.

One way the NWFP requires the Forest Service to address late-successional forest ecosystem function is through consideration of “Survey and Manage” species associated with this ecosystem. These are selected species of fungi, lichens, bryophytes, vascular plants, and invertebrate animals whose viability are of concern within this broad ecosystem type.

The 2001 ROD identifies six categories into which species are grouped. In order to fall into one of these categories, the species must meet three basic criteria:

1. The species must occur within the Northwest Forest Plan area, or occur close to the NWFP area and have potentially suitable habitat within the NWFP area.
2. The species must be closely associated with late-successional or old-growth forest.
3. The reserve system and other Standards and Guidelines of the NWFP do not appear to provide for a reasonable assurance of species persistence.

All six categories contain a requirement to conduct landscape-scale “strategic surveys”, which cover the range of the species and are conducted through the USFS Region 6 office. This is something separate from project-level surveys and is not required to be addressed in this document.

Specific habitat information on Survey and Manage species is becoming better understood as species-specific surveys are conducted and data is compiled and compared. However, many habitat descriptions are based on relatively few records and will continue to be scrutinized and refined as new sites are discovered. The following discussion is an effort to assess and apply existing information as it relates to the City of Bridge Creek Water Supply project.

3.3.3 Existing Condition – Survey and Manage Plants

The proposed pipeline alignment spans numerous plant associations, listed here from east to west where the project falls within the NWFP: Ponderosa/bitterbrush-snowbrush/needlegrass; mixed conifer/snowbrush-chinkapin/pinegrass; mixed conifer/snowbrush-manzanita; mixed conifer/snowbrush-manzanita/sedge-penstemon; and mountain alder in the Tumalo Creek floodplain. The elevation lies between 4,400 feet and 5,200 feet. The average annual precipitation spans a gradient measuring between 30–40 inches.

3.3.3.1 Vascular Plants

There is no habitat present within the project area for *Cypripedium montanum;* this species would require pre-disturbance surveys if habitat is present. Additionally, there are no known sites present within the project area for this species that would, according to FEIS direction, require management of those sites.

3.3.3.2 Bryophytes

Suitable habitats in the Bridge Creek/Tumalo Creek floodplain have received bryophyte surveys within the past 15 years or so. Only a small population of *Tritomaria exsectiformis* is located on Bridge Creek in atypical habitat near the project, but it has since vanished (Dr. Rick Dewey, pers. comm., October 2011).

Of the bryophytes requiring a pre-disturbance survey if habitat is present, there is no habitat present within the project area for *Schistostega pennata*.

There are no sites present for *Rhizomnium nudum* or *Tritomaria exsectiformis.* These species would require protection if sites were present.

3.3.3.3 Lichens

Suitable habitat in the Bridge Creek/Tumalo Creek floodplain has received lichen surveys within the past 15 years or so, with no Survey and Manage lichens being located.

There are no known sites of *Leptogium teretiusculum*, which would require protection if present.

3.3.3.4 Fungi

Category B fungi are now required (as of Fiscal Year 2011) to have “equivalent effort” surveys conducted if the project proposes to disturb old-growth habitat.

Surveys for Category B fungi are not warranted in the City of Bridge Creek Water Supply project, because there is no old growth habitat present within proposed habitat-disturbing areas. This determination was made using the 1993 Region 6 Interim Old Growth definitions, and using the Gradient Nearest Neighbor (GNN) dataset in the GIS layer of the Deschutes National Forest. This has ben validated by field visits to the project area by the project botanists.

Additionally, there are no known sites present within the project area for fungi species that would, according to 2001 ROD direction, require management of those sites.

3.3.4 Environmental Consequences – Survey and Manage Plants

3.3.4.1 No Action Alternative

Under this alternative, the project area would remain as it exists today. There would be no direct, indirect, or cumulative effects on Survey and Manage plants. However, the No Action Alternative could result in pipeline failure, which could affect Survey and Manage species located along the existing pipeline. Impacts of pipeline failure could include temporary loss of vegetation and removal of trees to facilitate access to damaged sections of pipe.

3.3.4.2 Proposed Action

There are no expected direct, indirect, or cumulative effects to Survey and Manage species in the proposed project area because there are no known Survey and Manage sites present. There would be short-term disturbance to habitat from the intake area to where the pipeline leaves the Tumalo Creek floodplain, but this area can be expected to recover within 2 years.

3.4 Noxious Weeds and Unwanted Vegetation

There are numerous and prodigious known weed sites in or adjacent to the project area. They have been treated with hand-pulling and herbicides. Herbicide treatment has occurred mostly along Skyliners Road where it is adjacent to Forest Service land, although some areas on Road 4603 are also treated where they do not lie within 100 feet of the creek. Hand-pulling has occurred mostly along Road 4603. Known noxious weeds are located in these general areas:

- Road 4603, west of lower Tumalo Creek Bridge: eight populations (seven are spotted knapweed, one is dalmatian toadflax)
- At north end of lower Tumalo Creek bridge: one expansive population of spotted knapweed
- At Skyliners Lodge parking lot: one population of spotted knapweed
- Skyliners Road between Skyliners Lodge and Road 4606: three populations of spotted knapweed

3.4.1 Environmental Consequences – Noxious Weeds and Unwanted Vegetation

3.4.1.1 No Action Alternative

Under this alternative, the project area would remain as it exists today. There would be no direct, indirect, or cumulative effects on unwanted vegetation. However, the No Action Alternative could result in pipeline failure, which could lead to introduction of noxious weeds along the existing pipeline alignments. Heavy equipment would be required to repair impaired sections of pipe and would be a potential vector for the introduction of weeds into forested areas.

3.4.1.2 Proposed Action

The Proposed Action has a HIGH risk of introducing noxious weeds into the project area. A risk ranking of HIGH is appropriate for this project because heavy equipment, soils, and gravels will be brought into the area (which brings a risk of importing weed seeds or parts with it), and there are known weed populations at and near the project area. The proposed Special Use Permit will require that the City ensures that equipment is cleaned prior to project entry, and this mitigation reduces this concern but does not eliminate the risk. The risk is considered LOW due to prevention, monitoring and treatment requirements in the design criteria.

3.4.2 Prevention Strategy – Noxious Weeds and Unwanted Vegetation

A Record of Decision for Preventing and Managing Invasive Plants was signed in October 2005, and its standards are incorporated into the Forest Plan of the Deschutes National Forest. Three of those standards specifically address prevention of weed introductions (1, 2, and 7) into projects of the type that the City of Bridge Creek Water Supply project represents. These standards obligate the Forest Service to incorporate weed prevention into its planning documents and implementation phase.

3.4.3 Cumulative Effects – Noxious Weeds and Unwanted Vegetation

Years of increasing recreational use in this popular area adjacent to Bend have brought many weeds into the project area. It is likely that this trend will continue. In addition to recreation use, there have been and will be woodcutters, timber sales, fire operations, and special use permittees working here, all creating areas of disturbance and potential for weed introductions.

Table 10. Cumulative effects to noxious weeds and unwanted vegetation

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	Project construction could result in introduction or increases of noxious weeds within the 121-acre project area. Best Management Practices during construction and monitoring and treatment of disturbed acres will be included as conditions of the Special Use Permit to minimize the introduction and spread of noxious weeds.
Affected Environment	Noxious weeds already occur in the project area.
Effects of Reasonably Foreseeable Future Actions	Multiple Special Use permittees working in the same area, all creating areas of disturbance and potential for weed introductions and proliferation. Skyliners Road reconstruction, West Bend TS, fuelbreak projects.
Mitigation not included in the Proposed Action	None. Central Oregon has a serious weed problem. Weeds are transported by many vectors not associated with this project.
Sum of impacts (cumulative Impact)	Net increase on 121 acres. Likely decrease over time due to ongoing treatment.
Regulatory cap (if applicable)	LRMP, Executive Order, County Weed Ordinance.

3.5 Recreation and Access

The primary source document for the following sections is the *Bend Water Source and Skyliners Road Improvements Project Recreation Report* prepared by Marv Lang, Recreation Planner, February 6, 2013. This report is incorporated by reference, and on file at the Bend–Fort Rock Ranger District.

The analysis boundary includes the Forest Service Road 4601 (Skyliners Road), Forest Road 4603, and FSR 4606-100 corridors. The analysis corridors include access points to facilities or recreation opportunities stemming from the road corridors.

3.5.1 Forest Plan Direction – Recreation and Access

The Deschutes National Forest Land and Resource Management Plan (LRMP), as amended, establishes broad direction for the Forest. The project includes Forest Plan Management Area 9, (Scenic Views

100%). This project is within the parameters provided in this management area M9-3. The Recreation Opportunity Spectrum standard in the Scenic Views Management Area for this project is Roaded Natural - “Conventional motorized use is provided for in construction standards and design of facilities.”

3.5.2 Existing Condition – Recreation and Access

The Tumalo/Skyliners area in the Deschutes National Forest is approximately thirteen miles from Bend, OR, a Central Oregon urban center, (Forest Plan pp. 2-3) known for its year-round recreational opportunities and its consistently favorable weather. Increases in tourist traffic and in resident population between 1985 and 1995 (Economic Fact Book, Bend Chamber of Commerce) have increased the recreation pressure on the area. Bend and the surrounding area is a very popular winter and summer destination and it is reasonable to assume that the project area would be visited more as the population of Bend increases.

The Bend-Fort Rock (BFR) Ranger District on the Deschutes National Forest (DNF) is a destination recreation area for all kinds of motorized and non-motorized recreation. More specifically, mountain bike use has increased exponentially in the last ten years. The Tumalo/Skyliners Road area has especially been a popular spot for mountain bike trails as it is close to town and hosts a considerable amount of forested area that is gentle, rolling terrain, suitable for trail building. As a result, the area has become a destination for recreationists from all over the United States.

Tumalo Falls itself draws thousands of visitors each year. In addition, 4 trails use this as a trailhead parking area.

There are approximately 50-60 homes within the Skyliners area, which are mostly within a contiguous block of private land. Access to the homes is via the 4601 road (Skyliners Rd.) The proposed pipeline will be buried under the 4601 road. There is also an access route to the Tumalo Lake area where there are three vacation rentals.

Recreation Activities:
Parking occurs at various points along the corridors to access the Tumalo Trail system. Recreational acitvities occuring along the road corridors include, but are not limited to, mountain biking, road biking, walking, motorized recreational travel and cross country skiing .

Mountain biking in the Bend area is growing rapidly due to the following reasons: 1) mountain biking as a sport is growing, 2) the population of Bend is growing, and 3) the popularity of the Bend area as a mountain bike destination is becoming more popular.

Tumalo Falls Trailhead draws thousands of people each year to view the falls, use the trails stemming from the trailhead for hiking or mountain biking primarily, and in winter as a ski or snow shoe destination. When conditions are cold enough, ice climbing on the falls can be popular. The gate at the junction of the 4601 and 4603 is closed when snow makes it dangerous for vehicles, usually December through March.

Access:
Access to the project area is primarily from Bend via Skyliners Road. Other access points are primarily from other roads (4609 rd.), or trails which enter the project area.
Another access issue pertains to the Tumalo Winter Range Cooperative Road Closure, which overlaps with the Deer Winter Range Management Allocation. This closure occurs from December 1st to March 31st each year and restricts motorized access to the area to protect big game.

Tumalo Trail system is accessed from Forest roads stemming from the project corridors.

The project area contains three types of system roads: Forest Service Highway Safety Act (HSA) arterial roads, Forest Service non-HSA collector roads, and Forest Service non-HSA local system roads.

Skyliners Road is the only HSA arterial road in the project area. It is maintained by Deschutes County and extends from the intersection of NW 14th Street and NW Galveston Avenue in Bend approximately 10 miles west to the junction with Road 4603. Road 4603 is an approximately 2.6-mile HSA collector road that provides access to Tumalo Falls and the trailhead. The Forest Service has maintenance responsibility for this road, which is a maintenance level 3 road.

There are two non-HSA collector roads within the project area: Forest Service Roads 4606-100 and 4609. Both are maintained by the Deschutes National Forest for high-clearance vehicles only. The junction of Road 4606-100 with Skyliners Road is located approximately 3 miles east of the project area. It provides ingress and egress to the north side of Tumalo Creek via Road 4609. Road 4609 parallels Tumalo Creek on the north side between Road 4606 and Skyliners Road.

Developed Recreation Sites:
Phil's Trailhead is located on the east end of the project area. Although parking capacity is not clearly defined, the high end average of vehicle counts in 2011 is 43 at one time. The parking area and serves the mountain bike trails system. Phil's Trailhead is scheduled for reconstruction in 2014 or 2015 in conjunction with the Skyliners Road reconstruction.
Skyliners Trailhead is located on the western side of the project area and serves hikers and bikers in the summer and snowshoers and Nordic skiers in the winter. A historic snow play area has been closed due to safety concerns. The site serves approximately 20 vehicles.

Tumalo Falls Day Use Area/Trailhead provides standard amenities such as interpretation, restroom, trash service, picnic sites and security. The site also provides access to non-motorized trails in the Tumalo and Bridge Creek areas and holds approximately 20 vehicles.

Dispersed Recreation:
Dispersed camping areas which may be accessed by corridors in this project area are few. The adjacent open forest has few natural recreation attractions such as water and mountain scenery, which usually draw dispersed camping. Dispersed use tends to be associated with parties, shooting and camping. The area from the 4601/4603 road junction to Tumalo Falls TH on the 4603 road is closed to dispersed camping.

Special Uses:
Skyliners Lodge is a historic structure that is currently under special use permit to the High Desert Education Service Department for outdoor education opportunities for local students. Numerous outings, especially during the school year take place here. It is also used for occasional events.
Two road easements stem from the project corridor to serve private lands. Pacific Power and Century Link operate a combination of overhead and buried utilities within and paralleling the project area.

There are numerous recreation events that use this area, mostly during the summer months. These are races or rides which are permitted through the special use permitting process. In addition, there are a number of Outfitter/Guides which use trails or road in this area.

3.5.3 Environmental Consequences – Recreation and Access

No Action Alternative

Under this alternative, the project area would remain as it is today, and there would be no direct, indirect, or cumulative effects to recreational resources. If the pipeline is not replaced and continues to degrade over time, it will increasingly develop leaks. These leaks would cause saturation of soils, including road surfaces on the 4603 road to Tumalo Falls as well the paved 4601 road. The water from leaks could surface and become a surface flow as well, especially impacting Tumalo Falls Day Use area as well as the 4603 road providing access to the site. This could preclude access to the Tumalo Falls Trailhead, including the

City of Bend Water facilities, the falls overlook, and numerous trail opportunities. These effects may be short term, until the problem is remedied, but could happen repeatedly in different places given the age of the pipeline. Water quality in Tumalo Creek could be affected as well, ultimately changing recreation opportunities in the area. If problems arise on the 4601 road from the road bridge over Tumalo Creek to town, other sites or access to them could be limited at least in the short term. Skyliners Lodge, Skyliners Trailhead, Skyliners subdivision, and Phils Trailhead Tumalo Lake are sites potentially affected.

Following pipeline failure, construction activities to repair the failure would be required, which could possibly require new access, extensive clearing, and environmental impacts in the forest.

These activities could affect recreational access and opportunities in the short term.

Proposed Action

During construction, effects include restricted access to developed, dispersed recreation sites and trails. Access may be closed during the construction (the 4603 road). Access may be limited or intermittent for local residents requiring access (the 4601 road from the Tumalo Creek Bridge east toward Bend). Access to Tumalo Creek itself will be limited by construction and timing. Access points would be more available from the north side of the creek.

The pipeline replacement project will have short term impacts during construction but no anticipated long term effects. The project will disrupt the recreation use in the area for approximately one year, but will be constructed in phases which tier to the road access. In turn, the access to key recreation areas (developed sites mentioned above) will be affected during those construction phases. The phases/areas affected are:

Road 4603 from Tumalo Falls trailhead to its junction with Road 4601 road at the road bridge over Tumalo Creek. Pipeline installation along Road 4603 would require full closure of this road and there would be no access to recreation sites or trails. Construction in this zone will affect access to the City Intake facilities, the trailhead parking and use of numerous trails coming into this trailhead, and use of the road (mostly used in the winter as a ski trail). The Farewell Trail intersects with the 4603 road and will need to be reconstructed after disturbance from the pipeline construction is completed. Recreation events or Outfitter /Guides as well as general recreation use would be precluded or re-routed during the actual time of construction at the facilities being affected by the construction. The trails entering this area would not be closed, but the immediate construction area in and surrounding Tumalo Falls Trailhead, including the trails for a short distance would be closed. The area surrounding the trailhead, including the trails may open up after the immediate construction work is completed and the pipeline burial process has moved on. This would only occur when rehab work has been completed and the area and trails are safe.

This work would be scheduled to occur in the fall/winter months, after Labor Day, to avoid the higher recreation user numbers in the spring and summer months. Therefore, fall /winter users, including general recreation, as well as special use permittees would be affected for at least a short time. If construction moves as planned, the area around the trailhead could be closed to public use for approximately a month at least. For the entire season of construction along the 4603 road, all users would have to access the Falls Trailhead area via cross country or other trails, primarily the Tumalo Creek trail from Skyliners Lodge and Trailhead.

The 4603 road would be closed to public use during the construction anywhere along the road and gated at the junction with the 4601 road near the road bridge.

Noise would be fairly consistent and heard by all users in the Tumalo Creek valley along the 4603 road. Noise levels would not be in unsafe ranges but could be annoying to users.

Road 4601 (Skyliners Road) from its junction with Road 4603 to the Skyliners Trailhead. Construction along Skyliners Road would impact only one lane of traffic and would be staged to allow traffic to flow in the remaining lane. Access to Skyliners Lodge and to the Skyliners Trailhead would be maintained during pipeline construction, but construction activities in this area could result in delays for those accessing these facilities. The alternate route to Forest Road 4603 is Road 4606 (near the Outback Site), Road 4609, and Road 4601 to Road 4603 on the north side of Tumalo Creek; however, the need to use this alternate route during construction is not anticipated because one lane of Skyliners Road will remain open.

In the event that Skyliners Trailhead parking is displaced due to construction activities, an alternate parking area could be designated between the trailhead and Road 430. Skyliners Trailhead would be used as a truck turnaround for the bulk for the project work on the west end of the Skyliners Road, and this could affect the point of access to the Skyliners Trailhead.

Construction noise and related disturbance would be heard and seen by those related to Skyliners Lodge, Trailhead or Subdivision. The impacts in this phase could be two months or less and in the early to mid-spring.

Road 4601 (Skyliners Road) from the Skyliners trailhead to the Outback Reservoir Site. This section includes Forest Road 4606-100, which links Skyliners Road and the Outback Reservoir Site. Construction along Skyliners Road would impact only one lane of traffic and would be staged to allow traffic to flow in the remaining lane. Access on Road 4606-100 may be limited or closed for short periods during pipeline installation, and this could affect access to recreational resources in this area for intermittent and short periods. Phil's Trailhead and the trails accessed would continue to be available by bike or foot via Marvin's Garden trail from the Forest Boundary paralleling Skyliners Road. Events planned at Phil's Trailhead should be coordinated to avoid coincidence with construction timing through that area (likely late summer).

The biggest inconvenience would be temporary closures and delays for the residences of Skyliners Subdivision. For those that live on the north side of the Creek, access may have to be maintained from the 4609 road or the Thunder Bridge. Short term delays on the 4601 road should be expected.

Noise and sight of construction effects would be most noticeable for the residents who live adjacent to Skyliners Road.

3.5.4 Cumulative Effects – Recreation and Access

Table 11. Cumulative effects to recreation and access

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	Project construction will intermittently disrupt recreation use in the area for approximately 1 to 1.5 years. During construction, effects would include restricted access to Tumalo Falls, dispersed recreation sites, and trails. Access restrictions on Forest Service Road 4603 (to Tumalo Falls). Controlled access would be provided to most of the project area during construction.
Affected Environment	The project area is used for cross-county skiing, hiking, off-road and on-road bicycling, hiking, and water recreation. Recreational resources and access in the project area have been continuously improved over the last century.
Effects of Reasonably Foreseeable Future Actions	The Forest Service is continuing to improve recreational access and maintain access and safety through trail-clearing activities. Skyliners Road improvements in 2013 will have short term impacts to visitors and residents. Visitors and residents will be impacted by traffic delays and construction disturbance through completion of the road project scheduled for 2014. West Bend TS and fuelbreak projects may cause temporary noise or access impacts on trail systems.
Mitigation not included in the Proposed Action	Limit closure of Road 4603 during peak visitor season.
Sum of impacts (cumulative Impact)	There would be access restrictions on Forest Service Road 4603 (to Tumalo Falls). The temporary closure of Road 4603 is required for pipe installation and cannot be avoided.
Regulatory cap (if applicable)	NA

3.6 Heritage Resources

This section of the EA discloses the affected environment and environmental consequences for cultural resources (historic properties) located within the area of potential effects (APE). The analysis compares the effects by alternative to cultural resources. Adverse effects to historic properties that are eligible for listing in the National Register of Historic Places (NRHP) will be mitigated as required under 36 CFR 800. The mitigation will be incorporated into the Proposed Action.

The primary source document for the following sections is the *Cultural Resource Inventory of the Bend Water System Improvement Project, Brian O'Neill, University of Oregon, Museum of Natural and Cultural History*, *February, 2012.* This report is incorporated by reference, and on file at the Bend–Fort Rock Ranger District.

3.6.1 Regulatory Framework – Heritage Resources

Forest Service management direction for heritage resources is found in the Deschutes National Forest Resource Management Plan, in Forest Service Manual Section 2360, in federal regulations 36 CFR 64 and 36 CFR 800 (amended December 2000), and in various federal laws including the National

Historic Preservation Act (NHPA) of 1966 (as amended), the National Environmental Policy Act, and the National Forest Management Act. In addition, the 2004 Programmatic Agreement among the United States Forest Service Region 6, the Advisory Council on Historic Preservation, and the Oregon State Historic Preservation Office provides a regulatory framework for project review.

In the LRMP, the goal for managing cultural resources is “to provide for the protection and preservation of prehistoric and historic sites, buildings, objects, and antiquities of local, regional, or national significance” (LRMP, Cultural Resources, page 4-34). The desired condition is protecting cultural resources to the reasonable extent possible.

3.6.2 Analysis Methods – Heritage Resources

A review of documents on file at the Bend–Fort Rock District, Deschutes National Forest Office, and the Oregon State Historic Preservation Office in Salem was conducted in preparation for pedestrian field inventories of the APE. Field inventories were conducted within and surrounding the proposed pipeline corridor, construction corridor, staging areas and ancillary facilities and in areas where geotechnical borings were scheduled to occur.

3.6.3 Existing Condition – Heritage Resources

Field inventories identified seven historic properties. Only one, the Bridge Creek Intake Facility, is considered to be eligible for listing in the National Register of Historic Places (NRHP).

Archaeological field investigations within the APE included a pedestrian survey, a subsurface reconnaissance of high-probability areas, and an evaluation of select archaeological sites. Six archaeological sites and one historic structure were identified within the APE as a result of the investigations. Two of the six archaeological sites are prehistoric sites that appear to have been associated with brief episodes of stone tool manufacture. A NRHP determination of eligibility was undertaken for both sites. Neither site was found to be eligible for listing in the NRHP.

In addition to the two prehistoric sites, four historic sites were identified and recorded as a result of the investigations. Two of the sites are segments of an abandoned railroad grade that were associated with the industrial logging activity of Shevlin-Hixon Company and were in use from about 1915 until 1930. The infrastructure of both segments has been removed and little evidence remains of the grade. Both sites were evaluated for their eligibility for listing in the NRHP; both were found to be ineligible. The two remaining historic sites are small, isolated dumps, one dating between 1922 and 1945 and the other probably prior to the 1920s. Both sites appear to be single episodes of dumping of household debris. Both sites were evaluated for their eligibility for listing in the NRHP and were found to be ineligible.

The historic Bridge Creek Intake Facility, which was constructed in 1926, consists of the intake building, the intake screening equipment, a retaining wall/afterbay, and a dam. The facility was evaluated for its eligibility for listing in the NRHP. The evaluation found that the facility had not been substantially modified and retains its integrity. The building was determined to be eligible for listing in the NRHP under the following criteria:

- Criteria A - Buildings or structures associated with events that have made a significant contribution to the broad patterns of our history.

- Criteria C - Buildings or structures that embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.

3.6.4 Environmental Consequences – Heritage Resources

3.6.4.1 No Action Alternative

Under the No Action Alternative, the Intake Facility would not be altered. Therefore, there would be no direct or indirect effects to historic properties under the No Action Alternative.

3.6.4.2 Proposed Action

Under the Proposed Action, the NRHP-eligible intake building would be substantially modified and the historic property would be affected. However, per the Memorandum of Agreement between the Forest Service and the SHPO, effects to the structure would be mitigated through documentation of the structure using the Historic American Building Survey/Historic American Engineering Record (HABS/HAER) forms. The cultural report prepared for the intake building will be available on the City's project website and will also be provided to the University of Oregon Libraries, the State Historical Society, and the Deschutes County Historic Society, where it will be made available to the public.

3.6.5 Cumulative Effects – Heritage Resources

The scale of analysis for cumulative effects is limited to the Bend Water System Improvement project APE. Cumulative effects under current management from actions or activities by agencies or entities other than the Forest Service could affect cultural resources.

Ground-disturbing activities and activities and actions that alter settings might affect the significance of potentially eligible cultural resources. Cumulative loss of significant resources might affect the eligibility of resources for listing in the NRHP. Looting sometimes occurs, but inadvertent actions from recreation, rock hounding, wood cutting, off-road activities, and vegetation management affect cultural resources as well. The Proposed Action could contribute to cumulative impacts to cultural resources. However, implementation of the proposed mitigation measures would reduce or eliminate these effects. Therefore, the Proposed Action and mitigation measures, when combined with impacts from other sources, would not contribute to any measurable effects to cultural resources.

Table 12. Cumulative effects to heritage resources - prehistoric resources

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	The Proposed Action will result in no effects to prehistoric resources within the APE. There is potential for disturbance of undetected (unknown) subsurface resources on 121 acres of project area. If there are unanticipated discoveries of cultural resources during construction, the protocol presented in the programmatic agreement between the SHPO and the Forest Service will be followed.
Affected Environment	No NRHP-eligible prehistoric sites are located within the APE surveyed for heritage resources.
Effects of Reasonably Foreseeable Future Actions	No effect to known resources since they are protected, subject to survey and monitoring.
Mitigation not included in the Proposed Action	None beyond the SHPO plan incorporated into the proposal. Some subsurface resources are not detectable until disturbed by project activities.
Sum of impacts (cumulative Impact)	No net increase in adverse effect to surface resources due to mitigation.
Regulatory cap (if applicable)	Compliance with Section 106 of the NHPA.

Table 13. Cumulative effects to heritage resources - historic structures

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	Under the Proposed Action, there would be substantial alterations to the above-grade portions of the Bridge Creek intake building, which is eligible for listing in the NRHP. Resolution of adverse effects under Section 106 will be advanced under the Proposed Action. Resolution of these effects includes HABS/HAER surveys and documentation and an MOA with the SHPO. In addition to the HABS/HAER documentation, the MOA requires that the cultural report prepared for the intake building be submitted to the University of Oregon Libraries, the State Historical Society, and the Deschutes County Historical Society. This documentation must also be made accessible to the public on the City's project website through project construction.
Affected Environment	Intake structure is eligible for the NRHP but is not suitable for new project and must be modified.
Effects of Reasonably Foreseeable Future Actions	None.
Mitigation not included in the Proposed Action	None. Altering or preserving the existing intake building was analyzed and found not feasible due to cost, new project needs, and modern building code restrictions.
Sum of impacts (cumulative Impact)	Loss of an eligible resource. Resolution of "adverse affect" to "no effect" to be achieved
Regulatory cap (if applicable)	Compliance with Section 106 of the NHPA.

3.7 Watershed and Fisheries

The primary source document for the following sections is the *Specialist Report for the Bend Surface Water Improvement Project, Watershed and Fisheries Specialists Report and Biological Evaluation* prepared by Tom Walker, District Fisheries Biologist, and Jason Gritzner, Forest Hydrologist, March 15, 2013. This report is incorporated by reference, and on file at the Bend–Fort Rock Ranger District.

3.7.1 Introduction

The project area is located west of Bend within the 38,004 acre Tumalo Creek Watershed (HUC 170703010501), and includes the city of Bend's municipal watershed. Streams affected by the existing water supply system include Bridge Creek, Middle Fork of Tumalo Creek, and Tumalo Creek. Streams in the Tumalo Creek watershed are coldwater systems fed by both springs and snowmelt. Tumalo Creek is the main collector stream for the watershed and discharges to the middle Deschutes River north of Bend.

Overview of Tumalo Creek Watershed

The Tumalo Creek watershed is a source of high quality water originating in the cool clear springs in the Happy Valley Area and snowmelt of nearby Broken Top. Streams drain the higher elevations of Broken Top and Tumalo Mountain where the heavy snow pack melts and generally flows in an easterly direction through glaciated valleys. The water collects in Tumalo Creek and eventually enters the Deschutes River approximately 8 miles north of Bend. The watershed is composed of two sub-watersheds, Upper Tumalo (20,766) and Lower Tumalo (17,238 acres). Upper Tumalo was designated in the Northwest Forest Plan (NWFP) a Tier 2 Key watershed because of its high water quality (USDA/USDI 1994).

Annual precipitation ranges from approximately 40 inches in the western portion of the watershed to 15 inches at the eastern edge. Very little surface water exists in the eastern portion of the watershed, except in Tumalo Creek itself. Runoff from the upper 59 square miles of the watershed is monitored at a gauging station in Shevlin Park at river mile 2.8. Tumalo Creek fluctuates between about 50-75 cubic feet per second (cfs) in the winter months to a normal peak flow of 250 to 350 cfs in May and June, with an average annual mean flow of around 105 cfs.

Tumalo Creek and many of its tributaries are unusual for Upper Deschutes River Basin streams in that they respond quickly to rain on snow events with large increases in flow. While the dynamics of high antecedent moisture levels in soils, frozen ground, and/or layers of ice in the snowpack contribute to rapid runoff during these precipitation events, the somewhat impermeable glaciated soils underlying a relatively thin layer of Mazama ash also contribute to the runoff behavior of the watershed during rain on snow events. Another contributing factor is the steep slopes, which exceed 60 degrees in some areas. Still, most precipitation in the watershed percolates into the subsurface, and is considered to be an area of groundwater recharge.

During the past 100 years, the natural hydrology within the watershed has been greatly altered. Water from Crater Creek, a tributary to Soda Creek, which is within an adjoining watershed, is diverted through a small canal to the Middle Fork of Tumalo Creek to provide irrigation water to the Tumalo Irrigation District (TID). A portion of flows from springs destined for the Middle Fork of Tumalo Creek are diverted into Bridge Creek for the city of Bend municipal drinking water supply. The abandoned Columbia Southern Canal, owned and operated by TID with a diversion point downstream of Skyliners Bridge at river mile 11.5, had historically withdrawn on average 40 cfs from Tumalo Creek during the irrigation season, reducing in stream flows (ODFW, 1996). This canal has not been used since 1998, as the entire Tumalo Creek TID water right allotment is now withdrawn downstream off-forest at river mile 2.8, augmenting instream flows an additional 8.7 miles during the irrigation season.

Streams Reaches in the Project Area

The affected environment includes Bridge Creek from the confluence with the canal carrying Middle Fork of Tumalo springwater to the mouth at Tumalo Creek, the Middle Fork of Tumalo Creek from the springwater diversion to the confluence with Tumalo Creek, Tumalo Creek from the confluence with Middle Fork to the mouth at the confluence with the Deschutes River, and the Deschutes River below the confluence with Tumalo Creek, known as the Middle Deschutes. For the purposes of discussion for this project, three reaches were delineated:

- **Reach A** is from the confluence of Tumalo and Bridge Creeks (river mile (rm) 16.0) downstream 13.2 miles to the TID diversion at rm 2.8. Reach A also includes 0.2 miles of Bridge Creek from the intake facility to the mouth at Tumalo Creek.

- **Reach B** is from the TID Feed Canal diversion at rm 2.8 to the mouth of Tumalo Creek.

- **Reach C** is an undetermined length of the Middle Deschutes River below the mouth of Tumalo Creek.

Reach A was further broken down into two sub-reaches; A1 and A2:

Sub-reach A1

This sub-reach begins at the diversion dam on Bridge Creek and ends10.6 miles downstream of the confluence with Tumalo Creek where the return flow from the Outback site re-enters the stream at rm 5.4. The Bridge Creek section within this sub-reach is 0.2 miles in length.

Sub-reach A1 is further broken down into Sub-reach A1-RR and Sub-reach A1-B due to differing channel morphology and habitat conditions:

Sub-reach A1-RR

Sub-reach A-1-RR, referred to as the restoration reach, is 5.6 miles in length (5.8 miles including Bridge Creek section) and includes the Tumalo Creek restoration area where nearly 3 river miles were damaged from the Bridge Creek Fire. Bridge Creek, South Fork of Tumalo Creek, Tumalo Lake Creek, and several small unnamed springs are all tributaries to Tumalo Creek within this area. Because of the stream flow input of the South Fork and other tributaries that form the accretion zone, this sub-reach was further split into an upper and lower area. The accretion zone is between river miles 12.9 and 15.7 - the upper area is above the South Fork at rm 15.0 and is above nearly all the accreted flows. The upper area accounts for a total distance in this zone of 1.0 mile. The lower area includes the remaining 4.6 miles of Tumalo Creek within Sub-reach A1-RR.

Sub-reach A1B

In Sub-reach A1-B, which runs for a length of 5.0 miles, the valley floor gradually narrows as the stream transitions into a higher gradient area with a narrow valley floor and steep sideslopes. An ephemeral stream channel is the only potential surface source of accretion in this sub-reach.

Sub-reach A2

This sub-reach begins at the return flow from the Outback site at rm 5.4 and ends at the TID diversion 2.6 miles downstream. The return flow from the Outback facility enters at the head of this sub-reach, which is located primarily within Shevlin Park, and is similar to Sub-reach A1-RR in gradient, floodplain width, and habitat types.

Reach B

Reach B begins below the TID Feed Canal diversion and continues 2.8 miles to the mouth of Tumalo Creek without receiving any tributary stream flow. The valley width again decreases moving downstream to the Middle Deschutes River, transforming into a rimrock canyon with steep to moderately steep sideslopes. The Bend Feed Canal passes underneath Tumalo Creek within this reach.

Reach C

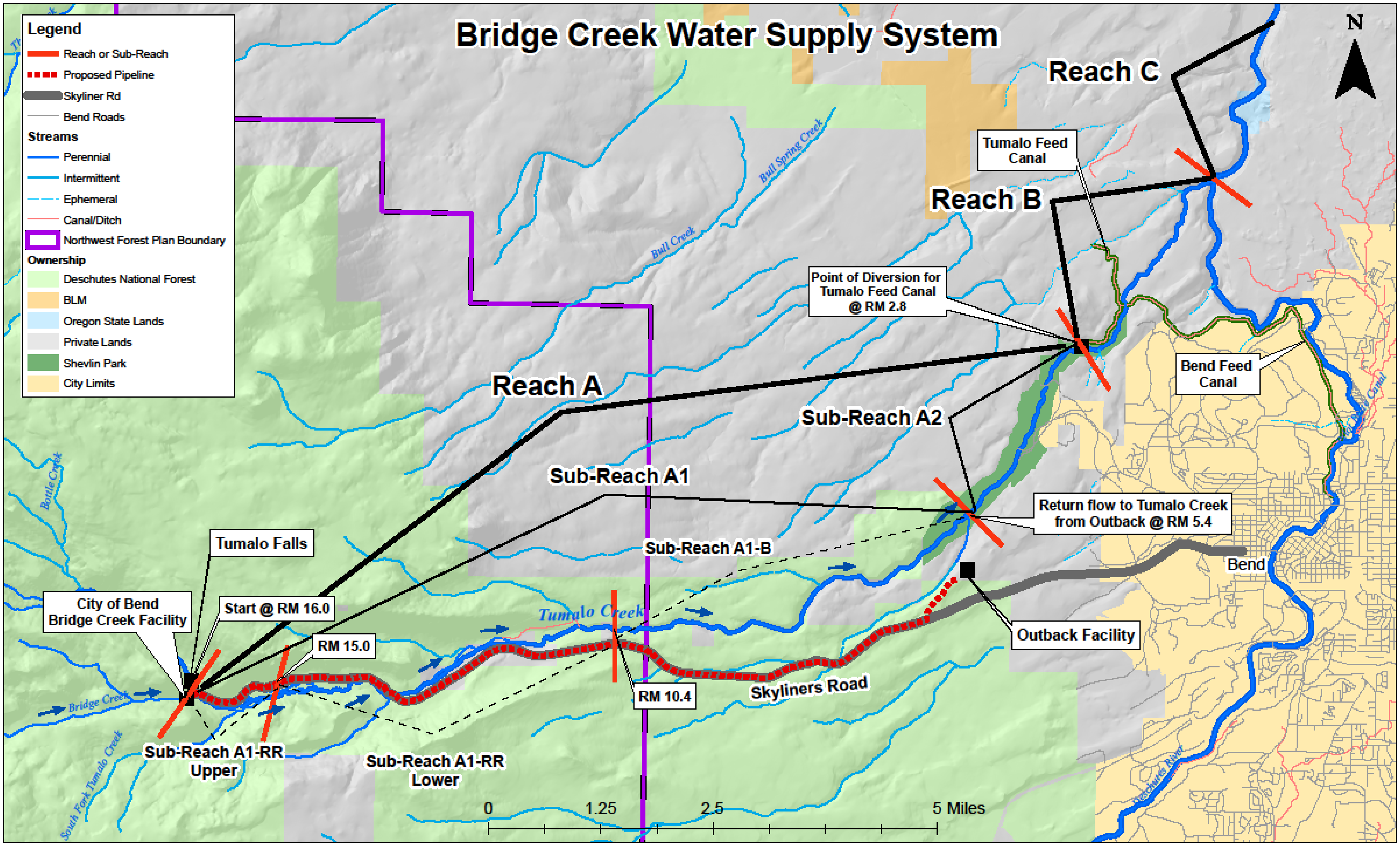
Reach C is the Middle Deschutes River beginning at the mouth of Tumalo Creek. The river is low gradient and flows through a rimrock canyon.

Table 14. Summary of reaches and sub-reaches.

Reach or Sub-reach	Reach or Sub-Reach Description	Sub-reaches located within	River miles (begin-end)	Total length (miles)	Rosgen channel type	Channel slope	% of Total Project Area
Reach A	Bridge Creek to Tumalo Feed Canal diversion	A1,A2	*16.0 – 2.8	13.2	C,B	-	82.5
Sub-reach A1	Bridge Creek to Outback return flow	A1-RR, A1-B	16.0 – 5.4	10.6	C	-	66.3
Sub-reach A1-RR	Bridge Creek to channel gradient increase	A1-RR Upper A1-RR Lower	16.0 – 10.4	5.6	C	1.2	35
Sub-reach A1-RR Upper	Bridge Creek to South Fork Tumalo	-	16.0 – 15.0	1.0	C	-	6.3
Sub-reach A1-RR Lower	Below South Fork to gradient increase	-	15.0 – 10.4	4.6	C	-	28.8
Sub-reach A1-B	Near confluence of Jack Pine Spring to City of Bend return flow.	-	10.4 – 5.4	5.0	B	3.2	31.3
Sub-reach A2	Outback return flow to Tumalo Feed Canal	-	5.4 – 2.8	2.6	C	1.1	16.3
Reach B	Tumalo Feed Canal diversion to confluence with Deschutes River	-	2.8 - 0	2.8	B, C	2.5	17.5
Reach C	Mouth of Tumalo Creek and downriver	-	-	**	C, B	0.3	-

*Reach A also includes 0.2 miles of Bridge Creek.

Figure 14. Reaches and sub-reaches within the Bridge Creek Water Supply Project



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Hydrology of Streams in Project Area

Bridge Creek

The summer natural flow is normally 5 to 15 cfs but is augmented with the diversion from the springs via the Bridge Creek Canal near the headwaters. Examination of 25% through 75% exceedance values throughout the year indicates a natural flow range between 4 cfs and 80 cfs. The portion of the discharge from the source springs impounded by the existing diversion structure ranges from 25 to 35 cfs, of which approximately 16-19 cfs ends up diverted into the canal and to Bridge Creek and the rest flows to Middle Fork of Tumalo Creek. The diversion rate to Bridge Creek is uniform (constant), to prevent erosion and sedimentation issues in the canal. The earthen canal, completed in 1955, is approximately 0.5 mile long and for the most part occupies a natural draw. Bridge Creek is generally a high energy, Rosgen A/B-type stream channel system. There are numerous falls and a predominance of riffles. In general, stream gradients in Bridge Creek are approximately 7 to 8 percent. There is one 1.2-mile reach that is lower in gradient (2 percent) where pools are more numerous. The 0.2 mile section below the intake to the mouth is a Rosgen A/B-type channel dominated by riffle habitat, with a stable riparian area and abundant instream large woody material.

While fish are found in the system, there are barriers that impede their migration throughout the length of the stream system. The municipal water diversion dam at approximately river mile 0.2 is one of these barriers. Another likely barrier is a waterfall found approximately 800 feet upstream of the dam, and a large vertical falls is located at river mile 0.7.

Middle Fork of Tumalo Creek

Runoff in the Middle Fork of Tumalo Creek is influenced heavily by the rerouting of surface flows in the area to satisfy water needs for irrigation and municipal beneficial uses. The Middle Fork of Tumalo Creek receives additional flow from the Crater Creek Canal but loses flow by the diversion of water by the City of Bend from the source springs into the Bridge Creek canal. This water would otherwise be discharged into the Middle Fork. The Crater Creek canal has been in operation since 1914, and is owned by the Tumalo Irrigation District. It supplements the flow of the Middle Fork. The maximum flow of the canal is 20 cfs and it generally runs from July to October, providing approximately 4,000 acre feet of water annually. The volume of water diverted from the Middle Fork source springs to the Bridge Creek Canal generally runs 16 to 19 cfs throughout the year. Due to the design of the City of Bend facility that diverts spring water before it discharges into the Middle Fork, it is not possible for the City to divert water directly from the Middle Fork, including that water contributed by Crater Ditch.

The first 0.7 mile of the stream above the confluence with the North Fork of Tumalo Creek is characterized by a high gradient channel with numerous falls. The stream then changes dramatically to a low gradient (<1.0%) system with abundant in-stream wood, then again increasing in gradient to the headwaters.

Tumalo Creek

Below the confluence of the North and Middle Forks of Tumalo Creek, the stream flows through an entrenched channel with numerous scenic waterfalls until descending into a wide, glaciated valley composed of underlying glacial tills for nearly 3 miles down to Skyliners Bridge. The Bridge Creek Fire of 1979 burned nearly 3.0 miles of floodplain vegetation along Tumalo Creek within this glaciated valley and has since undergone stream and riparian restoration. Through this section, Tumalo Creek increases flow as it accretes water from South Fork Tumalo Creek, Tumalo Lake Creek, and a number of springs.

Below Skyliners Bridge, the valley narrows and valley sideslopes remain steep. Tumalo Creek is primarily a Rosgen stream type B above the confluence with Bridge Creek, but below the confluence, the stream fluctuates between B and C channel type to the mouth, but retains B-type channel characteristics over most of its length. B-type channels in this area tend to have moderately steep gradients, narrow floodplains, low sinuosity, and dominated by rapids. C-type channels exhibit lower gradients, have broader floodplains, are more sinuous, and have a riffle/pool bedform morphology (Rosgen, 1996).

Discharge in Tumalo Creek fluctuates from 5th percentile low of about 50 cfs during late summer to a calculated bankfull discharge of 300-345 cfs calculated at Skyliners Bridge (rm 13.4) during the spring snowmelt period (Wasniewski, 2004). Occasional rain-on-snow events in the spring and fall exceed bankfull discharge (Figure 14). The mean annual flow (between 1923-1987 - the period of record for gauge 14073001) was 102 cfs with a maximum of 677 cfs and a minimum of 21 cfs. However, the City was diverting water upstream from the gauge during its operation, so the natural production of the watershed is greater than reported by the gauge results. Outside of this period of record, two recent rain-on-snow events that occurred in the fall of 2007 both produced flows that exceeded 700 cfs.

In-stream flows in the main stem of Tumalo Creek vary along its length depending on a number of variables that include climatic variable, hyporheic/groundwater exchange, diurnal fluctuations, and anthropogenic controls. Diversions and return flows from the city's water system, and diversion for irrigation at the Tumalo Irrigation District Diversion are the dominant anthropogenic controls. Figure 13 illustrates where flows are diverted from and return to the channel. The City of Bend diverts 18.2 cfs around Sub-reach A1 on an almost continuous basis. Diverted water flows to the Outback facility where it is treated and distributed to the city. Unused and untreated water is returned to the creek and varies based on actual demand into the City system. The return flow at the beginning of Sub-reach A2 at rm 5.4 (western end of Shevlin Park) varied between 1 and 10.1 cfs in 2011. At rm 2.8, the TID diversion defines the beginning of Reach B and reduces in-stream flow to the mouth during the irrigation season of mid-April to mid-October. Flows can drop as low as 6 cfs for periods during irrigation season when TID is operating on its Tumalo Creek source. Prior to 1992, Tumalo Creek could run dry during irrigation season before leased and donated water totaling 2.5 cfs was left in-stream (ODFW 1996). Tumalo Irrigation District is continuing to build piping projects to conserve and protect additional water instream. CW Project 37 is on phase 3 with approximately 3 cfs of the projects total 20 cfs in process to be protected instream. Annual instream leases of 300-500 acres have averaged over 8 cfs over the last decade with plans to continue in addition to the permanent instream flow restoration and conservation.

Middle Deschutes

Tumalo Creek joins the Deschutes River at river mile 160.2 within Tumalo State Park. During the irrigation season, much of the in-stream flow of the Deschutes is diverted upriver near Bend by irrigation districts and others for irrigation use. Until recent years, the flow was only about 30 cfs below Bend to the confluence with Tumalo Creek. During the last 5 years, flow below Bend has been increased to approximately 140 cfs due to the Deschutes Groundwater Mitigation Program, water conservation projects, and purchases and leases of water rights designated for in-stream flow (Jacobsen and Jacobs, 2010). Below Bend, the Deschutes River flows through rimrock canyon for much of its path to Lake Billy Chinook at river mile 120. Along the way, springs and tributaries supplement flows. Whychus Creek is a major tributary to the Deschutes at rm 123.1.

3.7.2 Regulatory Framework

The principal regulatory framework governing management of watershed and fisheries resources on the Deschutes National Forests (DNF) for this analysis includes:

- National Forest Management Act of 1976 (NFMA)
- National Best Management Practices for Water Quality Management on National Forest System Lands
- Deschutes National Forest Land and Resource Management Plan (USDA 1990)
- Northwest Forest Plan (USDA/USDI 1994) NWFP
- Inland Native Fish Strategy (USDA 1995) INFISH
- Federal Water Pollution Act (Clean Water Act) as amended
- State of Oregon's Implementation of the Clean Water Act
- Executive Order 11988 - Management of Floodplains

- Executive Order 11990 – Management of Wetlands
- Executive Order 13084 – Consultation and Coordination with Indian Tribal Governments
- Safe Drinking Water Act

The National Forest Management Act of 1976 (NFMA) requires that the Forest Service manage for a diversity of fish habitat to support viable fish populations (36 CFR 219.19). Direction is also included in the Deschutes National Forest Land and Resource Management Plan (Forest Plan), which was amended by the Inland Native Fish Strategy (INFISH) and the Northwest Forest Plan (NWFP). The amendments include direction regarding stream and fish habitat protections measures.

National Best Management Practices (BMP) Program was developed to improve agency performance and accountability in managing water quality consistent with the Federal Clean Water Act (CWA) and State water quality programs. Current Forest Service policy directs compliance with required CWA permits and State regulations and requires the use of BMPs to control nonpoint source pollution to meet applicable water quality standards and other CWA requirements (USDA, 2012). The relevant BMPs in this technical guide are referenced in Facilities-9: Pipelines, Transmission Facilities, and Rights-of-Way, AqEco-2: Operations in Aquatic Ecosystems, Road -3: Road Construction and Reconstruction, and Fac-6: Hazardous Materials.

The Deschutes National Forest Land and Resource Management Plan includes Standards and Guidelines (S&Gs) relevant to the aquatic and riparian resources. S&Gs related to the proposed project include RP 1 – RP 4, RP 6 –RP 10, RP 47, and WT 1-2, WT-5, and are incorporated by reference. In general, they provide for maintenance or enhancement of floodplains, riparian areas and riparian-dependent resources, water quality, fish habitat, and require Water Quality Best Management Practices.

Northwest Forest Plan

The intake facility at Bridge Creek, 5.6 miles of the new pipeline alignment, and 6 miles of Tumalo Creek within the project area (including private inholdings) are located within the boundaries of lands managed under the NWFP. Management direction of the NWFP requires delineation of Riparian Reserves, where riparian-dependent resources receive primary emphasis, and management activities are subject to specific S&Gs. NWFP S&Gs from within Riparian Reserves include LH-1, LH-2, RA-1, and are described later in this document in Other Findings. In summary, these S&Gs give priority emphasis to instream flows and habitat conditions that maintain or restore riparian resources, channel integrity, and aquatic habitat. The Upper Tumalo sub-watershed is a Tier 2 Key Watershed in the NWFP. The boundary between the Upper Tumalo sub-watershed and the Lower Tumalo sub-watershed is downstream of Skyliners Bridge at approximately river mile 12.2 on Tumalo Creek.

INFISH

National Forest System Lands within the project area east of the NWFP are managed under INFISH, with the break at river mile 10.0 on Tumalo Creek. Deschutes National Forest land ownership ends at river mile 6.2, resulting in 3.8 river miles of Tumalo Creek (including private inholdings) within the boundaries of lands managed under INFISH. Management direction within INFISH requires Riparian Habitat Conservation Areas (RHCAs) to be delineated for watersheds. They are similar in function to Riparian Reserves as described above. Nearly 3.1 miles of the pipeline alignment are on lands managed under INFISH but in areas completely outside of RHCAs. Standards and Guidelines (S&Gs) from INFISH within RHCA's include LH-1, LH-3, RA-1, RA-4, and are described later in this document under Other Findings. In summary, these S&Gs give priority emphasis to instream flows and habitat conditions that maintain or restore riparian resources, channel integrity, and aquatic habitat. There are no INFISH Priority Watersheds within the project area.

Federal Water Pollution Act (Clean Water Act) and Oregon State Water Quality Standards

The Clean Water Act stipulates that states are to adopt water quality standards. Included in these standards are provisions for identifying beneficial uses, establishing the statutes of beneficial uses, setting water quality criteria, and establishing BMPS to control non-point sources of pollution. The "no net increase" criterion is a provision in the Oregon Water Quality Standards for high priority water bodies prior to approval of a Total Maximum Daily Load (TMDL). Oregon Water Quality Standards designate beneficial uses for Tumalo Creek. They are as follows*:

- Fish and Aquatic Life
- Fishing
- Public Domestic Water Supply
- Private Domestic Water Supply
- Water Contact Recreation
- Industrial Water Supply
- Irrigation
- Wildlife and Hunting
- Boating
- Livestock Watering
- Aesthetic Quality

*From Oregon Department of Environmental Quality - Table 130A, Designated Beneficial Uses, Deschutes Basin

Tumalo Creek is listed (303(d)) as being water quality impaired for temperature from rm 0 (mouth) to rm13.5 (downstream of confluence with Tumalo Lake Creek) based on salmon and trout rearing and migration (18.0 degrees C 7 day average maximum, 303(d) list, ODEQ Water Quality Assessment – Oregon Integrated Database, http//www.deq.or.us/wq/assessment/rpt2010/search.asp). The ODEQ database lists the confluence with Tumalo Lake Creek as rm 12.5, differing from rm13.5 designated on the map provided by HDR and used throughout the analysis of effects to Watershed and Fisheries Resources. The discrepancy is due to differing techniques of calculating river miles. The remaining stream reaches and other tributaries within the watershed are either attaining water quality standards, or there is insufficient data to determine attainment.

Executive Order 11988 – Protection and Management of Floodplains

Federal Executive Order 11988 provides for the protection and management of floodplains. The rules are also incorporated as BMPS in Oregon Water Quality Standards

Executive Order 11990 – Protection and Management of Wetlands

Federal Executive Order 11990 provides for the protection and management of wetlands. The rules are also incorporated as BMPS in the Oregon Water Quality Standards.

3.7.3 Analysis Methods

The analysis of aquatic resources is driven by issues that were identified during public scoping and internal review related to the components of the project that would take place on National Forest System Lands. These issues are listed below. Public concerns were focused on protection of flows and water quality in Tumalo Creek and the middle Deschutes River; potential effects to fisheries habitat in Tumalo Creek and the middle Deschutes River below the confluence with Tumalo Creek; the potential impact to bull trout and redband trout populations; and the protection of riparian areas.

Issue #1 Stream Flow:

Effects to stream flow was assessed through a comparative analysis of annual stream flow fluctuations as they exist with the current water system (No Action alternative) and as they would be affected through the operations of the proposed system (proposed action alternative). A comparative analysis was conducted for existing (2011 maximum daily use records) and projected demand. The data used for this analysis is provided by the Oregon Water Resources Department (OWRD), the City of Bend, and HDR Consulting. Stream flow scenarios were compared to existing flow conditions as well as reconstructed native flow estimations. Native flow estimations provide a surrogate analysis for a municipal water system that relies solely on groundwater.

Data for the flow analysis was taken from OWRD station 14073001 – TUMALO CR + COLUMBIA SOUTHERN CN NR TUMALO, OR. The period of record for this analysis is 10/1/23 to 9/30/87. This flow record provides the longest period of data that most closely represents native flow in Tumalo Creek as it includes measurements below the City's return and includes water diverted for irrigation. More recent flow records following this period are not reliable because of issues with gauge operations and location.

Flow values in this record do not include water that was actually used by the City. Native flow estimations are made by adding existing use data to historical hydrologic record provided by station #14073001. Flow augmentation from TID's Crater Ditch was considered as part of Tumalo Creek's native flow estimations since it is included in the hydrologic record. It should be noted that the City's No action and Proposed Action alternatives cannot divert any water out of the flowing channel of Middle Fork Tumalo Creek or water that originated in Crater Ditch.

Natural in-stream flow levels will vary over the length of the stream based on accreted flows from tributary drainages and spring flow (Table 15) as well as hyporheic exchange of surface water being lost to the subsurface and gained from groundwater upwelling. The values in Table 13 are estimates using assumed drainage areas and precipitation patterns; these estimates have not been verified with measurements and would be expected to fluctuate seasonally and annually in a similar manner to the total watershed discharge. It was assumed that flow levels along the length of Tumalo Creek below the accretion zone (river mile 15.7 -12.9) are relatively constant, and that changes in flow beyond seasonal discharge fluctuations, weather events, and diurnal fluctuations are a product of anthropogenic manipulations. Measurements for flow were made in cubic feet per second (cfs).

Table 15. Location and estimated volume of flow accreted through the accretion zone of Tumalo Creek

	Sub-reach A1-RR_ Top	Spring	SF Tumalo	Spring	Tumalo Lake Creek	Spring	Sub-reach A1-RR_ Bottom	Total
River mile:	***16.0***	15.7	15.0	14.3	13.3	12.9	***10.4***	5.6
Estimated Median Discharge (cfs):		1.80	8.30	3.67	2.59	0.37		16.7
Percent Contribution		10.8%	49.6%	21.9%	15.5%	2.2%		100%

Issue #2 Water Quality:

Effects to water quality considered sediment and water temperature. While sediment is the water quality parameter that is primarily focused on during construction of the project, there was discussion of potential effects to the sediment regime of Tumalo Creek due to operational differences between the two systems. Temperature is the water quality parameter that was focused on during operations of the proposed system.

The temperature analysis takes place in two parts. The first is a qualitative analysis that discusses potential temperature trends as a function of flow for each reach. The second is a quantitative comparison of the model predicted water temperatures between the No Action and Proposed Action alternatives using the Oregon Department of Environmental Quality's (DEQ) Heat Source Model (HDR, 2013b).

The Heat Source Model is a peer reviewed model that is known to be the most accurate model for predicting in-stream temperature. It was also identified as the best model suited to analyzing temperature differences as a function of changes in stream flow in Tumalo Creek as it was rigorously calibrated in an analysis in Tumalo Creek (Watershed Sciences, 2008) and updated by DEQ for the TMDL effort in the Deschutes Basin.

The approach to the analysis was to simulate diversion scenarios with the maximum impact. These periods are defined as the maximum diversion at the minimum creek flow that provided for full diversion at the distribution rates regulated by OWRD, as well as at the low flow value for which the model was calibrated. The "distribution scenarios" provide the most realistic management scenarios at given stream flows for the proportional allocation of water based on water rights. The "baseline scenario" models stream temperatures at the indicated locations as the model was calibrated, but adds the flow from the Outback Station modeled for the existing system to Bridge Creek for the proposed system.

Because the proposed project could only affect water temperatures through changes in flow, stream flow and diversion rates were the only model attributes adjusted in the calibrated model in order to evaluate the operation differences of the proposed and existing system. All other model attributes were held at the values to which they were calibrated.

Model selection, parameterization, flow increments, locations, and time frame for model runs were decided by resource experts from the US Forest Service and ODEQ. ODEQ provided the most up-to-date version of the model for Tumalo Creek to HDR technical staff, which ran the model scenarios. Model outputs were thoroughly reviewed by Forest Service and ODEQ specialists.

Water temperatures were measured in degrees Celsius (C). Fluctuations in temperature were compared to State standards for water quality and effects to fisheries. The details and assumptions related to temperature modeling in Tumalo Creek can be found in HDR Technical Memorandum, 2013b.

Issue #3 Aquatic Habitat and Channel Morphology:

Effects to aquatic habitat and channel morphology were assessed through a combination of stream cross-section surveys and a review of historical Forest Service and ODFW stream survey data. The stream cross-section surveys were performed for the calibration of redband trout simulation and channel response modeling utilizing the Physical Habitat Simulation Model (PHABSIM) and Habitat Duration Analysis (HDA). Stream cross-section transect sites were selected cooperatively between the Forest Service and HDR Consultants. Stream cross-section surveys were performed by HDR. Cross-section survey and modeling methodologies, and redband trout habitat indices used in the modeling were reviewed by Forest Service and ODFW specialists. The details of this methodology can be found in the HDR Instream Flow Study Technical Memorandum (2012). Historical stream channel and fisheries habitat data were provided by the Forest Service and were used to describe channel form and function.

PHABSIM combines physical measurements of the stream (velocity, depth, and substrate) with redband trout habitat preference curves to estimate the amount of spawning, juvenile rearing, and adult habitat available to fish at different flows in Tumalo Creek. The HDA methodology integrated available habitat calculated in PHABSIM with hydrology and project operations, providing a dynamic analysis of flow versus total habitat over time under different operational scenarios. A quantitative measurement of habitat was then developed for each sub-reach comparing the No Action and Proposed Action alternatives. Because potential changes to flow are so small during periods when channel forming events typically occur, channel morphology is discussed in qualitative terms.

Changes in trout habitat under the Proposed Action using the PHABSIM/HDA methodologies were modeled at 3 hypothetical stream flow scenarios within Sub-reach A1. Results were compared to modeled habitat values under the existing system. Downstream of Sub-reach A1, stream flow would not change under the Proposed Action compared to the existing system as return flow is returned at Sub-reach A2.

Issue #4 Effects to Fisheries:

Analysis of fisheries focused on effects to the Region 6 sensitive species redband trout, and was tied closely to the analysis of #2 and #3 above. PHABSIM and HDA model physical habitat but do not account for ecological changes within a stream that would influence redband trout. A literature review was used to assess potential impacts to fisheries beyond changes in physical habitat as described under Issue # 3 above.

An assessment of potential effects to primary production (algae) and secondary production (benthic invertebrates) was made based on differences in wetted perimeter between the alternatives. A review of literature was used to determine a possible optimal temperature range for redband trout and compared to modeled temperatures generated from the ODEQs Heat Source model as described above. A literature review was used to assess impacts of competition from non-native fish species and potential impacts from implementing the Proposed Action. Fish community structure and relative abundance information was gathered from a thorough fisheries survey of Tumalo Creek completed in 2011 by Deschutes National Forest Staff assisted by ODFW staff.

Issue #5 Effects to Riparian Areas:

Effects to riparian areas from pipeline installation activities were assessed by acres disturbed and duration of effects. A quantitative analysis will be performed comparing acres of disturbance between the existing condition and the Proposed Action. Variations in stream flow and the possible effects to floodplain inundation and channel morphology were be used to assess potential effects to riparian areas from changes in stream flows. The results of these analyses were used to assess effects in terms of the NWFP Aquatic Conservation Strategy Objectives (ACS) for the area.

Other Information Used in the Analysis

The analysis considered riparian area data attained from multiple Deschutes National Forest and ODFW stream surveys of Tumalo Creek, Middle Fork of Tumalo Creek, Bridge Creek, and the Deschutes River, numerous fish population surveys conducted by the Deschutes National Forest and ODFW, GIS generated data, aerial photography, water temperature data for Tumalo Creek and the Deschutes River, and stream flow data from a Oregon Water Resources Department operated gaging station on Tumalo Creek. Numerous publications were researched and used in determining effects.

Past activities in the watershed were included in the analysis of the existing conditions for stream flow, water quality, aquatic habitat and channel morphology, fisheries populations, and riparian areas. The analysis also considered the effects to Essential Fish Habitat of the Magnuson-Stevens Fishery Conservation Act, Riparian Management Objectives of INFISH, Wetlands and Floodplains, the Endangered Species Act, and the Aquatic Conservation Strategy Objectives of the NWFP. Cumulative Effects considered past, present, and reasonably foreseeable activities.

The analysis of the potential effects to the above resource issues were used to drive integrated design features and mitigation measures for the project. They will also be used to set parameters to the City of Bend's special use permit.

3.7.4 Stream flow

3.7.4.1 Existing Condition

Baseline stream flow conditions in the Tumalo Creek watershed are driven by a combination of spring flow and snowmelt. Minimum, maximum, and mean flow values over the period of record at ODWR's gauging station below Shevlin Park are illustrated in the hydrograph in Figure 15. Highest flows generally occur in June during the seasonal snowmelt period with gauged mean high flow values of approximately 227 cfs. Native flows during this period are calculated at approximately 234 cfs (Figure 16). Occasional peak flows also occur through the fall to spring months during rain on snow events (Figure 15). Record peak flows for Tumalo Creek during the period of record were 677 cfs, recorded in December 1964.

Figure 15. Maximum, minimum, and mean flow values for Tumalo Creek.
Flow includes a compilation of in-stream flow and flow from the Columbia Southern canal. Data do not include water use by the City of Bend

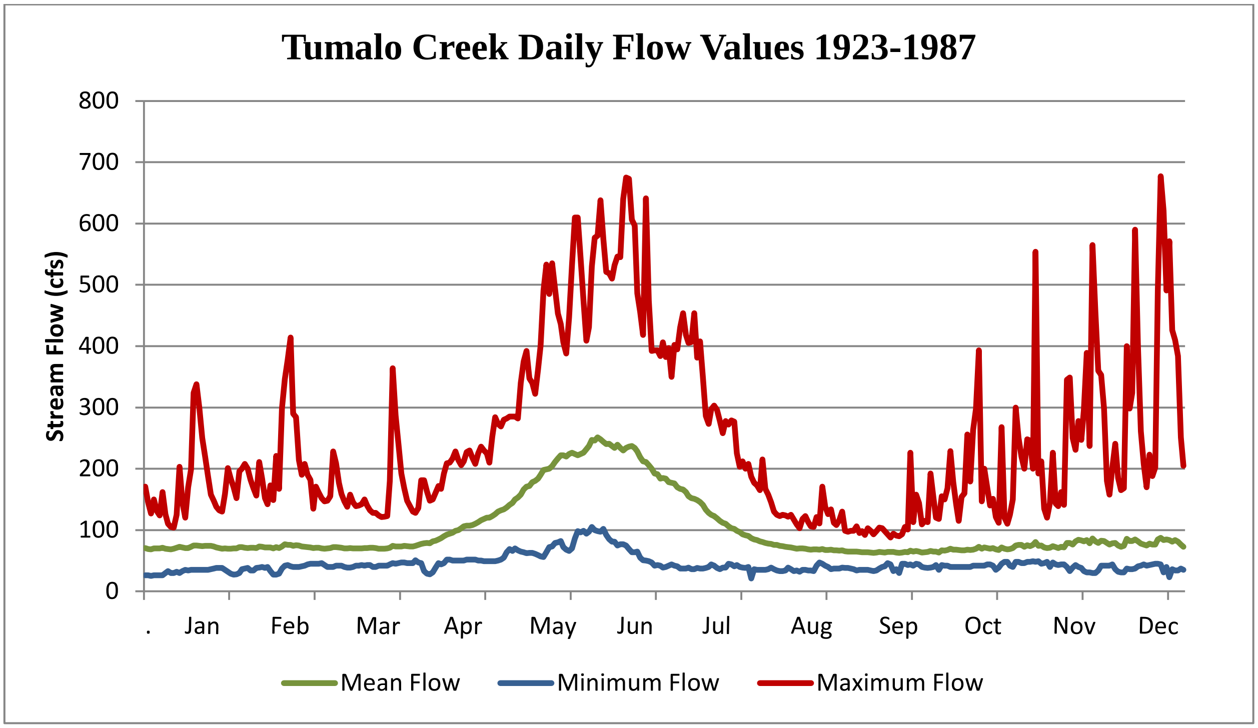
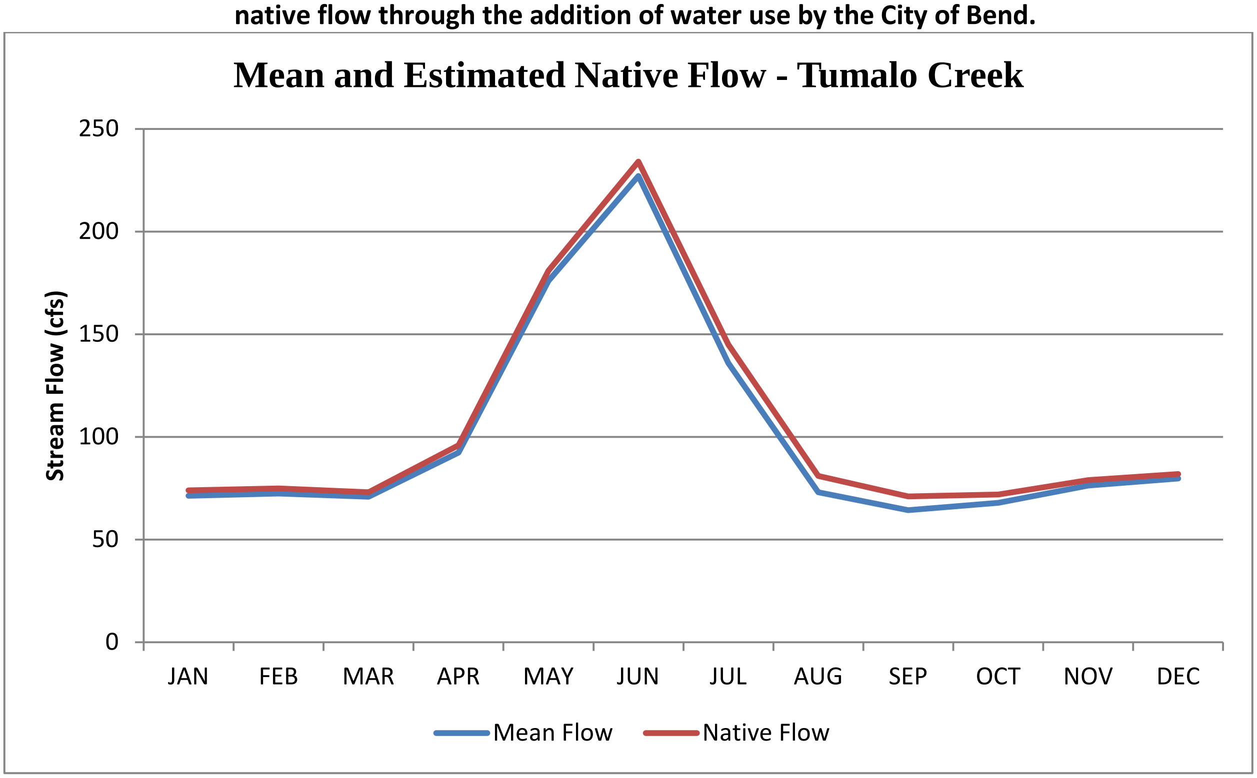


Figure 16. Comparison of mean monthly flows at OWRD station #14073001 and an estimation of native flow through the addition of water use by the City of Bend.



Low flows generally occur in late summer and winter (Figure 16), with mean monthly low flows records of 64.4 cfs recorded at OWRD station #14073001 in September. Native low flows are calculated to be approximately 71 cfs (Figure 16) for the same month. Record low flows in Tumalo Creek for the period of record were recorded at 21 cfs (Figure 15) in August 1971.

Downstream of the Crater Ditch and Middle Fork spring flow diversions (discussed above), flow dynamics in the Tumalo Creek watershed are affected by the diversion of water for two primary beneficial uses of water supported by water rights. These include municipal water rights owned by the City of Bend and water rights for irrigation owned by the Tumalo Irrigation District (TID). General flow diagrams that illustrate stream flow as it relates to seasonality, anthropogenic influences and where they occur within the cumulative effects area can be found in Appendix O of the Fish and Hydrology Report. These diagrams also compare and contrast the proposed and existing systems.

Sub-reach A1

At the Bridge Creek Intake Facility, the City of Bend's water system diverts 18.2 cfs on a continuous basis through the two pipelines to the City's Outback facility, where water is treated and distributed to the users. Water that is not used for municipal purposes is returned to Tumalo Creek at the bottom of Sub-reach A1.This creates a flow condition in Sub-reach A1 that is almost perpetually 18.2 cfs lower than native baseline conditions.

The City's surface water supply from Bridge Creek may be shut down occasionally for maintenance or bypassed to return flow due to excessive turbidity that makes the water unsuitable for municipal supply due to lack of filtration. Complete shutdowns for maintenance typically occur in late fall and usually last 3 to 5 days. The pipes are closed during maintenance shut downs so that no water is withdrawn from Bridge Creek (and there is no return flow).

When turbidity increases to levels that make the water unusable for municipal drinking supply, all 18.2 cfs diverted from Bridge Creek is returned to Tumalo Creek through the Outback return flow system that discharges within Shevlin Park. The frequency and duration of this turbidity bypass varies by year and can range from about 14 days to 60 days per annum. The most typical turbidity bypasses occur during snow melt runoff in June /July but they can also occur during summer thunderstorms or warm rain-on-snow events in the late fall or spring.

With the existing system design, it is not possible to control the volume of water diverted at the Bridge Creek intake to vary with actual demand. Each pipe in the system is either on or off. During periods when the system is shut down, the 18.2 cfs that is usually diverted for municipal use remains in Tumalo Creek to TID's point of diversion or beyond. During periods of operation, water that is not put to use by the City of Bend either because of limited demand or when Bend's rate is reduced by the Watermaster when distributing limited water to other senior water uses such as those of TID and senior in-stream water rights, it is returned to Tumalo Creek within Shevlin Park at the bottom of Sub-reach A1 (Figure 13).

Sub-reach A1 is further subdivided into two sub-reaches (A1-RR and A1-B) based on morphological differences as discussed above. Within Sub-reach A1-RR, flow accretion from springs and tributaries could provide a mean annual flow estimated to be 21cfs (HDR, 2012) – approximately 20% of Tumalo Creek's mean annual native flow of 105 cfs. Table 16 shows current mean monthly flow values in Sub-reach A1 with the existing water system in operation. Accreted flow represents approximately 24% current mean annual flow levels below the accretion zone.

Table 16. Mean monthly flows in accretion zone under existing system operation with continuous 18.2 cfs discharge and corresponding mean monthly flows above and below accretion zone

	Jan	Feb	Mar	Arp	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Below Accretion	55.8	56.8	54.8	77.8	162.8	218.8	126.8	62.8	52.8	53.8	60.8	63.8
Accretion	15	14.9	17.3	18	35.2	48	25.4	16.2	14.6	14.7	15.3	15.1
Above Accretion	40.8	41.9	37.5	59.8	127.6	167.8	101.4	46.6	38.2	39.1	45.5	48.7

Native flow conditions can be calculated by adding 18.2 cfs to monthly flow values above and below the accretion zone.

Sub-reach A2

The amount of return flow discharged back to Tumalo Creek at the bottom of Sub-reach A1 from the Outback facility can range widely depending on use (Table 17). Surface water use varies with demand, in-stream flow, and water rights distribution. The unused flow volume is added back to Tumalo Creek, helping to partly restore the 18.2 cfs flow deficit, and remains in-stream through Sub-reach A2 (2.6 miles) to the point of diversion for TID's Tumalo Feed Canal.

Table 17. City of Bend Surface Water Use in cfs (Maximum day based on 2011)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10.2	8.2	8.1	11.1	16.5	16.5	17.1	17.2	17.2	16.5	8.1	8.3

A continual flow of 18.2 cfs is diverted to the Outback facility. Return flows are calculated by subtracting these values from 18.2. Current infrastructure and operational restrictions result in less than 100% use of the 18.2 cfs, even when City demand exceeds 18.2 cfs.

Reach B

Reach B begins where TID diverts water through the Tumalo Feed Canal for distribution to its users. Outside of the irrigation season, in-stream flow through Reach B of Tumalo Creek would correspond with the flow rates of Sub-reach A2 that reflect total water yield minus the water used by the City of Bend. During the irrigation season, the existing water rights owned by TID support a maximum diversion of 211 cfs. While TID does not divert this quantity on a perpetual basis, the combined use of water by TID and the City of Bend often substantially depletes stream flow in Tumalo Creek through Reach B. During the irrigation season, flows in Reach B range from an upper value that is dependent on flow during peak flow events minus municipal and agricultural use, down to the minimum in-stream flow guaranteed by current in-stream water rights during low flow periods (Figure 17). The in-stream water right increases as the Tumalo Creek natural flow increases as shown in Figure 17.

Minimum in-stream flow values have recently been revised upward through the permanent transfer of 2.82 cfs of conserved water by TID to Tumalo Creek through the completion of the first two phases of their CW37 project, bringing the minimum in-stream flow up to approximately 7.2 cfs at a total flow rate of 50 cfs (a drought condition with an approximate 95% exceedance probability). Although the current minimum in-stream flows that are now documented in distribution tables are the in-stream flows protected by water rights, the more common in-stream flows in Tumalo Creek reflect the water requirements to operate the new fish screen and ladder that was installed on TID's diversion, as well as water left in-stream through the in-stream flow lease program. The operation of this fish ladder requires TID to pass a minimum of 10 cfs downstream. In-stream flow leases vary annually, and further increase flows beyond the 10 cfs required to operate the fish screen and ladder. Future scheduled water conservation projects will further change this baseline condition upward. While minimum in-stream flows have the potential to increase further, the established minimum of in-stream flows that are documented in the current distribution tables will be used for this discussion as it represents the worst case scenario for flow.

Reach C – Middle Deschutes River

Most of the flow of the Deschutes River is diverted at Bend by irrigation districts during the summer for irrigation. Until recently, summer flows would frequently drop to near 30 cfs for extended periods. A combination of favorable snowpack and reservoir carry-over conditions, successful implementation of conservation projects by various irrigation districts and the implementation of the Groundwater Mitigation Program in 2002 have resulted in more in-stream flows approaching 150 cfs in recent years, . Since 2002, water leases and transfers from the in-stream water leasing program became large enough to make a difference in summer flows. Figure 18 below demonstrates mean monthly flows for the periods of 1955-1995 and 1996-2010.

Figure 17. Proportional availability of water for diversion and in-stream flows during the irrigation season by water right

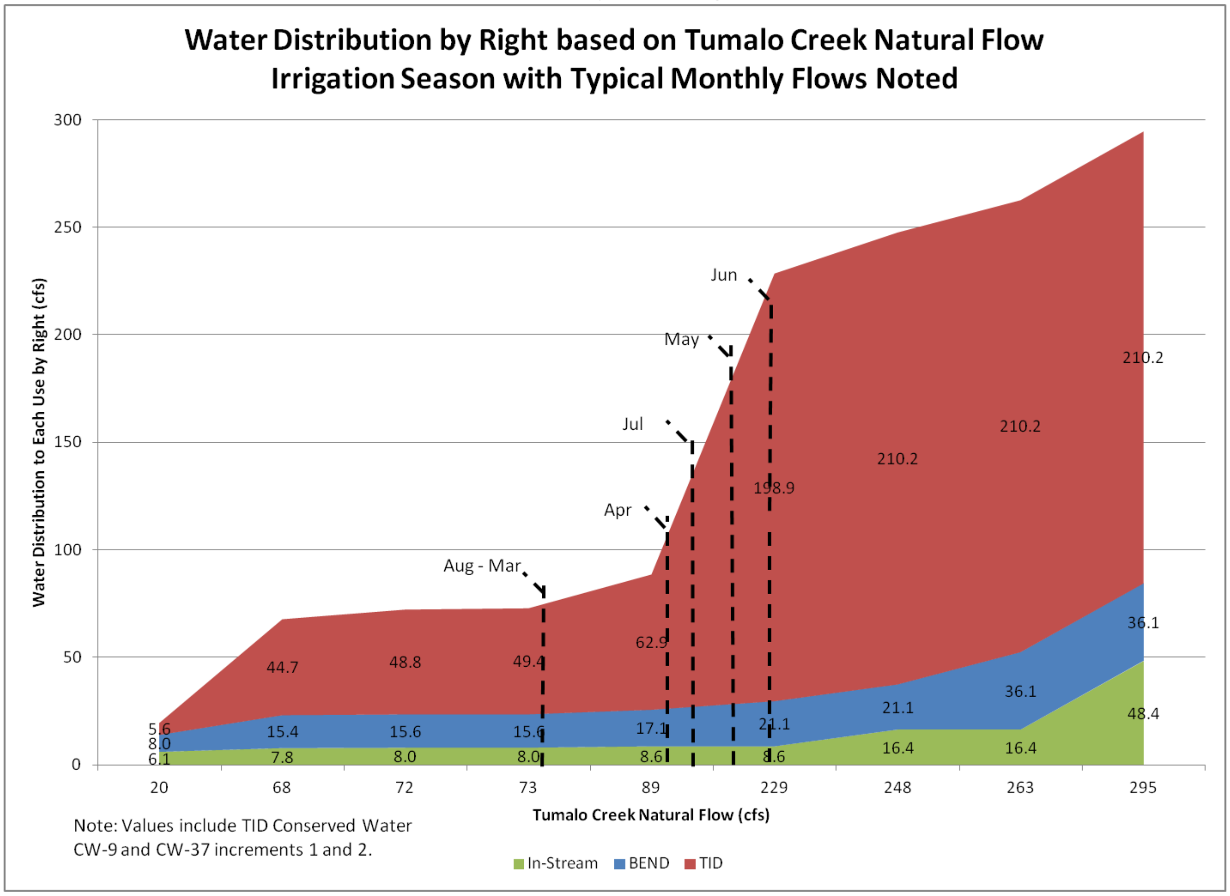
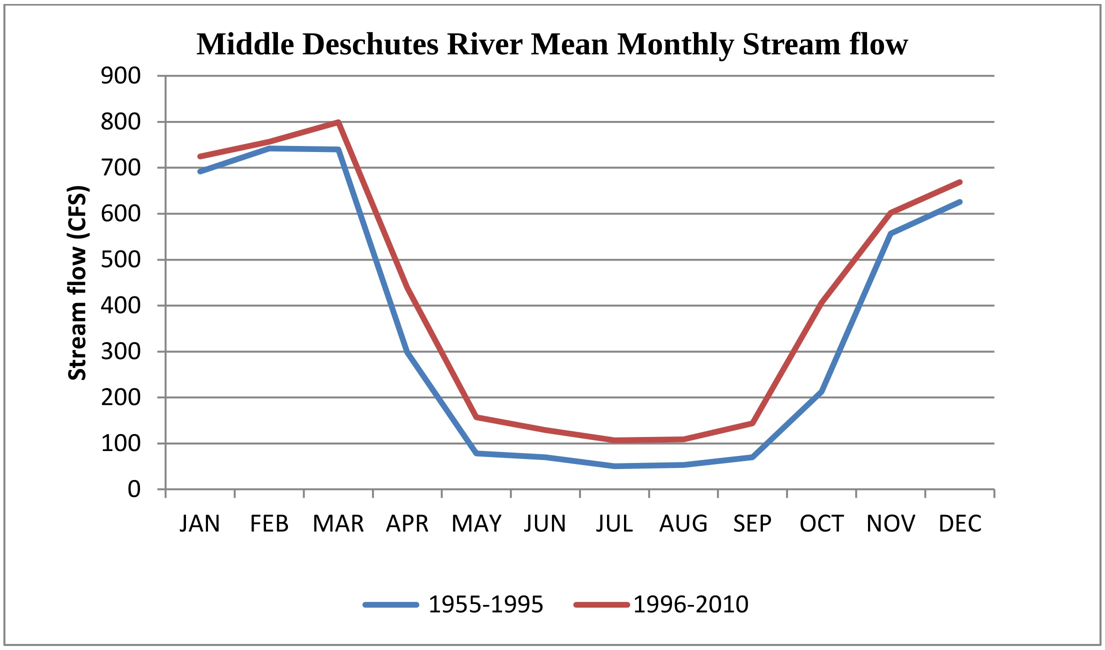


Figure 18. Comparison of mean monthly stream flow in Middle Deschutes River for periods of 1955-1995 and 1996-2010 OWRD Station 1407500



3.7.4.2 Environmental Effects – Stream Flow

Summary of Effects to Stream Flow

- **Sub-reach A1**: Any municipal use below 18.2 cfs (the existing diversion rate and maximum proposed diversion rate) will result in an increase in stream flow through 10.6 miles of Sub-reach A1with the operation of the Proposed Action. At current use levels, stream flow would increase through all months of the year.
- **Sub-reach A2**: There would be no change in stream flow as a result of the Proposed Action.
- **Reach B**: There would be no change in stream flow as a result of the Proposed Action.
- **Reach C:** There would be no change in stream flow as a result of the Proposed Action.

Direct and Indirect Effects – Stream flow – No Action

Under the No Action alternative, the current management of water within Bridge Creek, the Middle Fork, and Tumalo Creek would continue. However, with projected increases in population and other urban growth variables municipal water use will increase (HDR, 2011). Table 18 below shows hypothetical projected growth in surface water use that the City of Bend used for planning purposes. Base water demand forecast methodologies are described in an HDR memorandum. The numbers and dates used in this analysis should not be used verbatim as forecasts for population growth were developed in 2004 (City of Bend) and actual growth in the City of Bend has not occurred as projected at that time. This projection analysis for increased consumption should be viewed as a water use/in-stream flow relationship analysis under a potential growth scenario in the future.

During the months of October to June, municipal water use is driven primarily by demand. Although the irrigation season starts in April, in-stream flows are normally sufficient for all water rights holders until July. Between the months of July and September as natural in-channel flows decrease toward base flow conditions, potential surface water use rates may be curtailed, and are driven by the proportional distribution of available water to senior water rights holder including the City of Bend, TID, and Tumalo Creek itself (Figure 16). This projected use rate would vary depending on available in-stream flows - increasing during wet years and decreasing during dry years. Water use rates projected for September in Table 18 are a maximum for the month. When it occurs, distribution typically extends until September 22 and would remain near 15 cfs during that time.

Table 18. Projected Surface Water Use with Existing and Proposed Systems

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current use (2011)	10.2	8.2	8.1	11.1	16.5	16.5	17.1	17.2	17.2	16.5	8.1	8.3
2015	13.5	12.1	12.1	18.2	18.2	18.2	15.5	15	18.2	18.2	12.2	12.6
2020	16.3	14.6	14.6	18.2	18.2	18.2	15.5	15	18.2	18.2	14.7	15
2025	18.2	17.2	17.2	18.2	18.2	18.2	15.5	15	18.2	18.2	17.2	17.7
2030	18.2	18.2	18.2	18.2	18.2	18.2	15.5	15	18.2	18.2	18.2	18.2
2033 and later	18.2	18.2	18.2	18.2	18.2	18.2	15.5	15	18.2	18.2	18.2	18.2

Projected municipal use of surface water in Tumalo Creek (City of Bend, 2011- Appendix I). Current use figures based on maximum daily use.

Sub-reach A1

If no modification of the current water system was made by the City of Bend, flows in Tumalo Creek through Sub-reach A1 would continue to be depleted by 18.2 cfs on a continual basis except for isolated periods when the system is shut down for maintenance (Table 19).

Table 19. In-Stream Flow with Existing System – Reach A1

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Native Flow	74	75	73	96	181	234	145	81	71	72	79	82
With 18.2 cfs Diversion	55.8	56.8	54.8	77.8	162.8	215.8	126.8	62.8	52.8	53.8	60.8	63.8

In-stream flow values based on the perpetual diversion of 18.2 cfs around Sub-reach A1.

Sub-reach A2

With projected increase in use, flows downstream of the return in Sub-reach A2 would vary depending on use and how much water is returned from the Outback facility to the stream. With increased projected use for the colder months of the year, return flows to Tumalo Creek and therefore stream flow in Sub-reach A2 would be on a decreasing trend (Table 20). Because the existing system only has a capacity to divert 18.2 cfs, meeting increased demand for surface water would only be possible up to 18.2 cfs. During these periods, there would be no return flow to Tumalo Creek below the Outback facility. The 18.2 cfs flow deficit that occurs through Sub-reach A1 would be maintained through Sub-reach A2 during periods of no return flow. Predicted demand in excess of this amount would have to be met through alternative means.

Projected increased use during peak flow months of May and June are relatively small (<2 cfs) and represent a very small proportion of the overall hydrograph. City of Bend use projections during the lower flow months of July through September are based on water rights distribution patterns during water years that correspond with median monthly flows. Water distribution during this time is controlled by OWRD, and do not relate directly to demand. Current (2011) use rates during that period exceed projected use rates because higher than normal stream flows during that time of year allowed for greater distribution of water to the City of Bend, TID, and to in-stream flow demands.

Table 20. Projected In-Stream Flow with Existing System

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Native Flow	74	75	73	96	181	234	145	81	71	72	79	82
2015	60.5	62.9	60.9	77.8	162.8	215.8	129.5	66	52.8	53.8	66.8	69.4
2020	57.7	60.4	58.4	77.8	162.8	215.8	129.5	66	52.8	53.8	64.3	67
2025	55.8	57.8	55.8	77.8	162.8	215.8	129.5	66	52.8	53.8	61.8	64.3
2030	55.8	56.8	54.8	77.8	162.8	215.8	129.5	66	52.8	53.8	60.8	63.8

Projected in-stream flow as a function of projected increases in use with the existing system through Reach A2. Flow values are based on mean monthly values. Native flows are estimated by adding City of Bend historic use to mean monthly flow values provided at ODWR station #140730001 (HDR, 2011). Data for 2033 and later does not change from 2030 with the existing system.

Given projected increases in use, maximum withdrawals of water would first be predicted to occur during the high flow periods of April to June, as well as the low flow period of September and October following the irrigation season. During the peak flow periods of May and June, this demand potential would result in an approximate decrease of in-stream flow through Sub-reach A2 by 8.8% of the average of mean monthly native flows for May and June. This level of use would decrease in-stream flow by up to 1.7 cfs beyond the existing condition. In September and October, this demand potential would result in an approximate decrease of in-stream flows of 25.5% of the average of mean monthly native flows during that period, and up to a 1.7 cfs decrease beyond existing condition. Given 2011 use rates and available in-stream flows that can be diverted to the City of Bend during periods outside of the irrigation season, the projected amount of increased use is possible.

Because stream flow from July through the end of September is may be in OWRD-controlled distribution between the City of Bend, TID, and in-stream flows, the amount of water that the City of Bend can use will depend on the amount of water available in the stream to distribute to senior water rights holders. The maximum use rates of 15 to 15.5 cfs that are projected here are based on approximate mean monthly flow rates and current distribution patterns. The projected use of 18.2 cfs in September (Table 19) could only be available for use after September 22, when the distribution period ends, or if total water yield is high enough to support that level of municipal use during the distribution period.

While October use rates could increase over current conditions by approximately 1.7 cfs, as demand grows over time, in-stream flows in Reach A2 from November through March will be on an incrementally decreasing trend of up to 10.1 cfs over current use rates. Maximum increases in winter use and lowest mean monthly winter flows occur in March. This level of decreased flow represents 25% of the mean monthly native flows in March, and 15.5% of the current mean monthly flow. Because this projected increase in use would occur outside of the irrigation season, there would be no conflict with other water rights holders or in-stream water rights.

In this analysis, no further decrease in stream flow is forecasted beyond 2030 based on forecasted increased use of surface water with the existing system. The ability of the City of Bend to actually use water consistent with the full projected use rates will depend upon demand growth in the winter months and availability during the irrigation season. Again, this projection analysis for increased consumption should be viewed as a water demand/in-stream flow relationship analysis under a potential growth/demand scenario in the future, and not as a specific forecast for water demand in any specific year.

Reach B

The effects to in-stream flow in Reach B as a result of increased demand by the City of Bend will vary greatly depending on time of year and irrigation withdrawals. During the non-irrigation season (October to April) when TID is not diverting water, a corresponding magnitude and timing of decreased in-stream flows that was discussed in Sub-reach A2 of up to 10.1 cfs would translate directly to Reach B below TID's point of diversion.

Through the irrigation season (April through September), potential effects will vary with water yield.

During peak flow periods in May and June, flows in Reach B would vary depending on stream flows above exercised municipal and irrigation water rights (Figure 16). Increasing municipal demand to maximum operational capacity during these months would deplete in-stream flow approximately 2 cfs. This increase is less than 1% of the flow diverted by TID during high flow periods.

During lower flow periods, particularly the middle to latter part of the irrigation season when low flows become a concern below TID's diversion, there is little to no potential for effects to occur to in-stream flows from changes in municipal consumption. Because water management during this time in lower Tumalo Creek (Reach B) is based on the available stream flow (regardless of increased demand), at any given time during the irrigation season, maximum potential water distribution to the City would only be granted to the degree that the proportional minimum in-stream flow requirements identified in the distribution tables are maintained. Base flow through Reach B illustrated in Figure 16 would be maintained to the mouth of Tumalo Creek as a worst case scenario. At the 95% exceedance flow of 50 cfs during this period in 2012, minimum flows through Reach B would be 7.2 cfs. As discussed earlier and in the Cumulative Effects section, in-stream flows are generally higher than the minimum flow guaranteed by water rights.

Reach C – Middle Deschutes River

As discussed above in Reach B, the potential for effects to stream flow with increased demand vary by season. In the non-irrigation season when the potential for additional municipal diversion increases the most, flows delivered to the Middle Deschutes River may decrease by up to 10.1 cfs. Flows in the middle Deschutes during this time currently average 600 – 800 cfs, and represent this section of the river's higher flows. This level of potential decrease in winter flows in the Middle Deschutes represents a maximum of 1.7% decrease in flow – a level of decrease that would be undetectable.

During the irrigation season, increased municipal use of surface water based purely on demand could only occur during peak flow period in May and June. With the existing system this may constitute a maximum of 2 cfs decrease in summer flows under existing condition as discussed above in relation to Reach B. However, because of current water distribution practices and management of Tumalo Creek water for municipal and agricultural purposes, as well as in-stream flows, flow levels through Reach B, and therefore Reach C would not be affected by changes in demand during lower flow distribution periods. Any flow benefits that occur through TID operations, water conservation projects, and in-stream leasing would translate to the Middle Deschutes River.

Existing System Failure Scenario

The no action alternative, would maintain use of the existing water system. This 2-pipe system (as described earlier) was installed in two phases. One pipe was installed and became operational in 1926; the other became operational in 1957. Both pipes are steel, and have had maintenance problems as they have aged. As these pipes age the risk of a failure increases. In this scenario, a failure would entail the full volume of one or both pipes discharging aerially and/or overland.

With the existing system, each pipe carries a nominal flow of approximately 9 cfs (~4100 gal/min). In a complete rupture scenario, freely discharged flow rates could equal or exceed the nominal flow rate of each pipe. The City of Bend's operation staff have indicated that it could take 3 to 8 hours to get a main break shut down in either pipe depending on where a break occurred after a major leak or rupture were detected. This could equate from approximately 738,000 gallons to 1,968,000 gallons total volume of water lost per pipe.

If a pipe ruptured, the effect to in-stream flow would depend on the location of the rupture. Depending on proximity to Tumalo Creek and local topography, the entirety of that flow could return to Tumalo Creek. In the event of a rupture, the potential for adverse effects to Tumalo Creek would not come directly from the volume of water added back to the creek, but from the quantity of sediment associated with the return of the flow as it emerges from the ground and travels overland back to the channel, as well as damage to stream banks and riparian areas. In some locations (~1000 feet total) a major rupture could create a risk of a landslide that reaches Tumalo Creek from steep hill slopes above the pipe. This could introduce large quantities of sediment to the channel.

Direct and Indirect Effects – Stream flow – Proposed Action

The implementation of the Proposed Action alternative could affect flows in Tumalo Creek at two different periods – installation and operation. The magnitude and duration of the effects would be different, and will be discussed separately

System Installation:

Under the current proposed plan of operations, during installation of the new intake, pipeline, and facilities at the Bridge Creek intake, diversion of flow would partially or completely cease, increasing flow over the spillway and Tumalo Creek by approximately 9 to 18.2 cfs for a brief period in fall of 2013 or 2014 potentially continuing for several months. This increase would augment flow volumes throughout Tumalo Creek to a level that would partially or fully restore native flows. True native flows for October may be exceeded if water is being diverted through the Crater Creek ditch to Tumalo Creek. Diversion through the Crater Creek ditch generally ceases in September. However, this would occur during a low flow period and any flow from the Crater Creek ditch would be minimal. Flows in Tumalo Creek in Reach B below TID's diversion and the middle Deschutes would also increase since installation would occur outside of the irrigation season. If the entire 18.2 cfs remained in-stream, even through Reach B, flow levels would still be below bankfull levels and would not create any adverse effects to physical and ecological processes as discussed below.

System Operations:

Following installation of the proposed new pipeline and facilities at the Bridge Creek intake, flows in Tumalo Creek would vary depending on the City of Bend's demand for water, and its restricted ability to divert water because of the seniority of water rights and demand for irrigation water owned by TID and in-stream flows. Operating at its full permitted capacity, the system will accommodate a maximum sustainable diversion rate of 18.2 cfs. During periods of operation at full capacity, in-stream flows in Tumalo Creek through Sub-reaches A1 and A2 would not change in comparison to the full use scenario with the existing system. At all other operational levels less than full capacity, stream flow in Tumalo Creek would increase.

Under current conditions, during the colder months of the year, the municipal demand for surface water is relatively low, currently averaging approximately 8-11cfs. During the warmer months when in-stream flows are low the potential for the City of Bend to divert water is limited by availability and senior water rights designated to irrigation and in-stream flows. During these higher demand periods, the City of Bend has traditionally relied on ground water to supplement the supply that cannot be provided by surface water alone.

Because of operational differences between the proposed system and the existing, even under existing demand/availability patterns, stream flow through Tumalo Creek would be increased by the system conversion. Currently, the system diverts 18.2 cfs around Sub Reach A1 on a continuous basis. Unused water is returned to the creek at the top of Sub-reach A2. It is in Sub-reach A2 that in-stream flows reflect the actual municipal use of surface waters from Tumalo Creek by the City of Bend. This perpetual diversion of 18.2 cfs around Sub-reach A1 reduces stream flow during critical low flow periods in September to 74.4% of the stream's native flow below the accretion zone. Above the accretion zone in Sub-reach A1-RR where flow volumes are smaller, the existing system reduces low flow to 67.7% of native flows.

In contrast, the new system would allow control over the volume diverted from Bridge Creek to occur at the intake. Under current use scenarios, the unused flow (less than 18.2 cfs) that would normally be returned to the stream at the top of Sub-reach A2 would persist through Sub-reach A1, increasing flows through Sub-reach A1 – a distance of 10.6 miles, and continue through A2. Based on current surface water use records, we would expect to see increased flows in Tumalo Creek between 1 and 10.1 cfs under the 2011 City of Bend use scenario. During critical low flow periods when stream flow is in distribution, this flow augmentation in Sub-reach A1 would provide improvement to stream flow that would vary depending on water distribution to water rights holders. In drier years when the City of Bend's water use is curtailed to a greater degree, the amount of water left in-stream would be greater. At the 95th exceedance probability flow drought condition could generate a watershed yield of ~53 cfs in August. Using flow control, the Proposed Action would result in 5 cfs additional flow left in Reach A1 for 10.6 miles. It is important to note that the summer instream flow benefits with the Proposed Action are permanent since they are limited by water rights and administered by the State Water Master.

The largest benefit to in-stream flow would be realized during the winter when existing use patterns would return flows to approximately 90% of native flow (Table 21). However, this benefit would diminish as municipal demand increases in the winter.

Table 21. Current City of Bend Use and Return Flow

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current use (2011)	10.2	8.2	8.1	11.1	16.5	16.5	17.1	17.2	17.2	16.5	8.1	8.3
Augmentation flow	8	10	10.1	7.1	1.7	1.7	1.1	1	1	1.7	10.1	9.9

Current" use is based on maximum daily use (cfs) from 2011. Augmentation flow is the difference in use from 18.2 that would remain in-stream through Sub-reach A1 and A2 with the proposed system that would otherwise be piped around Reach A1 and returned to the stream at the top of Sub-reach A2.

Projected consumption patterns create a different set of in-stream flow scenarios with the proposed municipal water system (Table 22). With the proposed surface water system, in-stream flow patterns in Sub-reaches A1 below the accretion zone and A2 will be approximately the same. Again, because of operational differences, the return flow from the Outback facility that defines the beginning of Sub-reach

A2 will be eliminated. From a comparative standpoint this creates some differences in how various reaches will be affected by the contrasting function of the two systems.

Table 22. Projected In-Stream Flow with Proposed System

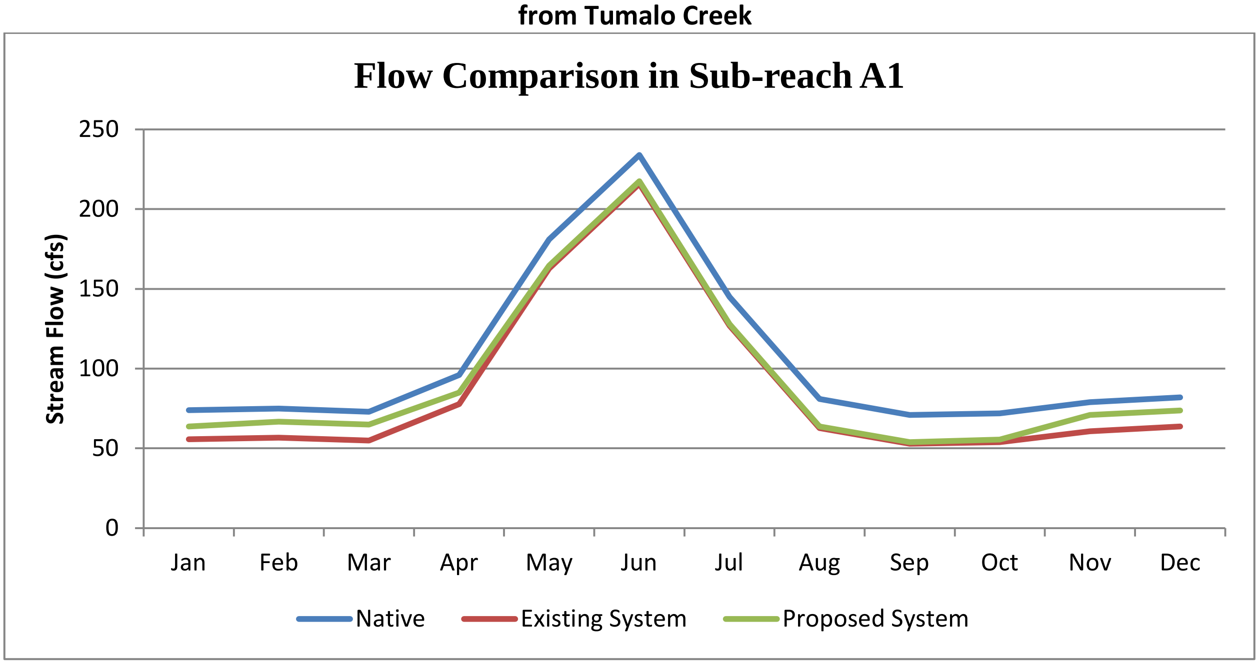
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Native Flow	74	75	73	96	181	234	145	81	71	72	79	82
2015	60.5	62.9	60.9	77.8	162.8	215.8	129.5	66	52.8	53.8	66.8	69.4
2020	57.7	60.4	58.4	77.8	162.8	215.8	129.5	66	52.8	53.8	64.3	67
2025	55.8	57.8	55.8	77.8	162.8	215.8	129.5	66	52.8	53.8	61.8	64.3
2030	55.8	56.8	54.8	77.8	162.8	215.8	129.5	66	52.8	53.8	60.8	63.8
2033 and later	55.8	56.8	54.8	77.8	162.8	215.8	129.5	66	52.8	53.8	60.8	63.8

Projected in-stream flow for Sub-reach A1/A2 as a function of projected increases in use with the proposed system. Flow values are based on mean monthly native flow values. Native flows are estimated by adding historic City of Bend use data to current flow values provided at ODWR station #140730001 (HDR Tech Memo, 2012). Corresponding in-stream flow values for 2011 use were not included since distribution rates that year were based on a wetter than average year.

Sub-reach A1

Sub Reach A1 will see the greatest relative increases in flow with the proposed municipal surface water system. With the proposed system and current water use patterns, flows through Sub-reach A1 would increase between 1 and 10.1 cfs depending on variations in demand and the distribution of water rights throughout the year (Figure 19). Because there was more stream flow in 2011, the City of Bend was able to fulfill more of their water rights during the summer period than they would have if under tighter distribution by OWRD. During more average runoff years, the City of Bend could be distributed less water, resulting in more water through Sub-reach A1 than with the existing system.

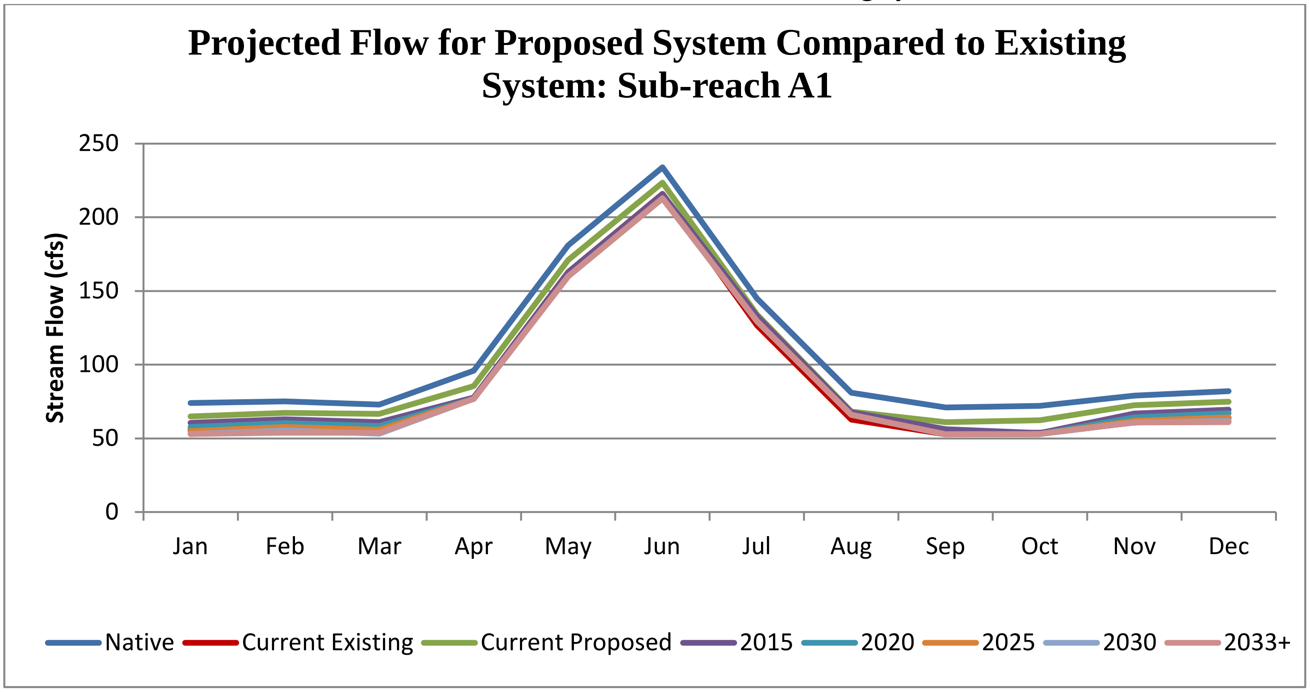
Figure 19. Flow comparison for Sub-reach A1 under current/recent municipal surface water use (2011) from Tumalo Creek



With projected increases in use of surface water, in-stream flow increases achieved with the proposed system are expected to be maintained for most of the year. In certain projected growth scenarios, in-stream flow benefits would first cease in April, May, June, end of September, and October when City demand is projected to increase to 18.2 cfs. At that point, in-stream flow through Sub-reach A1 would return to its existing condition. Beyond the 2015 scenario, as projected demand continues to increase, most months of the year would also eventually arrive at a demand rate that is equal to the existing year-round diversion rate, and in-stream flow benefits realized through the operation of proposed system would taper off to the in-stream flow conditions we have today.

However, even though the furthest forecasted increase in demand, the City's water rights would continue to be curtailed in some years by OWRD during the months of July, August, and into September (Figure 20). At mean monthly flow values for this period, this would result in approximately a 3 cfs increase in stream flow through Sub-reach A1during critical low flow periods through the operation of the proposed system.

Figure 20. Projected flow comparisons of the proposed system to flow conditions through Sub-reach A1 below the accretion zone with the existing system



"Current Proposed" refers to in-stream flows under 2008-2010 consumption levels with the proposed system.

Sub-reach A2

The effects to Sub-reach A2 from the operation of the proposed system are parallel to the Sub-reach A2 discussion in the No Action alternative as flow levels in Sub-reach A2 reflect most directly in-stream flows for Tumalo Creek as they are affected by demand for municipal water diversions with the existing system. In certain projected growth scenarios, diversion rates first reach the 18.2 cfs level in April, May, June, September and October. Beyond 2015, projected use rates continue to increase in other months as well until maximum diversion rates of 18.2 cfs occur.

As previously discussed projected water use rates during low flow periods are likely to remain below the maximum 18.2 cfs diversion potential while water rights are in distribution. Higher allowed diversion rates during this time would only be possible if general stream flows supported proportional increases of water to TID, and in-stream flow. In-stream flow rates in Sub-reach A2 will not change as a result of operations of the proposed water system.

Reach B

The effects to Reach B are also parallel to the previous discussion of effects under No Action as a function of projected increased demand. During low flow periods of the irrigation season, Tumalo Creek water is distributed proportionately to municipal and agricultural water rights holders, as well as in-stream uses. Flow rates in Reach B would not change as a function of the proposed water system.

During the non-irrigation season (October to March), a corresponding magnitude and timing of decreased in-stream flows as a result of increased demand discussed for Sub Reach A2 would translate directly to

Reach B below TID's point of diversion. In further projected urban growth scenarios, maximum diversion rates of 18.2 cfs may occur in the months of December – February. Average mean monthly flows for Tumalo Creek for these winter months are 77 cfs. Maximum diversion rates during these months would constitute 23.6% of the average native mean monthly in-stream flow. This condition would not change between the existing and proposed alternatives. Other management activities unrelated to municipal diversions in the watershed can affect stream flow through Reach B. During the winter months, in-stream flows are occasionally impacted by water diversions for stock runs through TID's irrigation system. During these times OWRD would coordinate with TID and the City of Bend to adjust water withdrawals to guarantee that a minimum level of flow through Reach B is maintained or exceeded.

Reach C – Middle Deschutes River

Effects to in-stream flows in the Middle Deschutes River as a result of operations of the proposed water system would be to the same as No Action. There would be no effect to flows in the Middle Deschutes River from the implementation of the proposed project. Flows in the Middle Deschutes, as they are related to flows from Tumalo Creek, will only vary as a function of municipal demand, conservation efforts by TID, and flow augmentation through the in-stream lease program.

Cumulative Effects - Stream flow

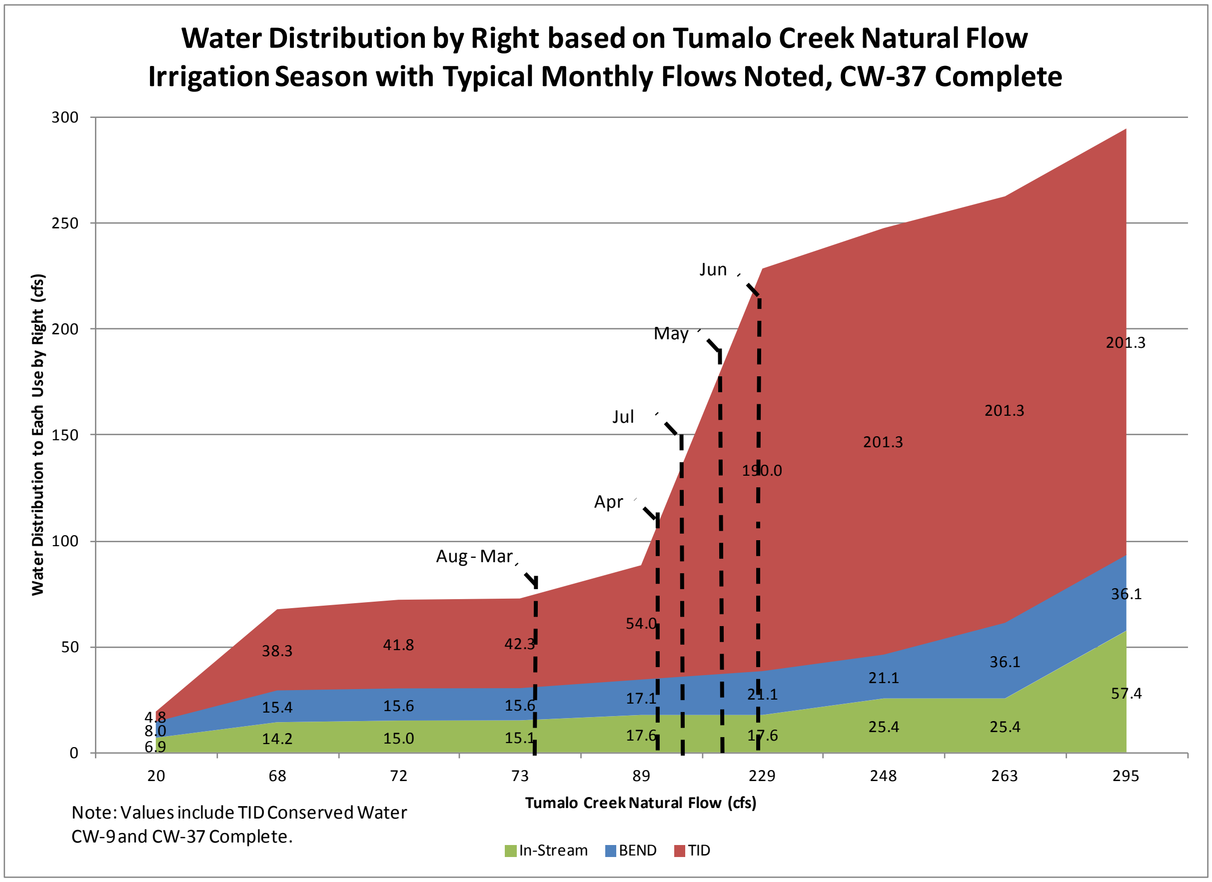
The cumulative effects of the implementation of the proposed project on stream flow would vary over time and by reach. Sub-reach A1 and Bridge Creek below the intake facility would see an improvement in in-stream flow under all municipal use scenarios until demand reaches the current diversion level of 18.2 cfs with the Proposed Action. At this time in-stream flow levels will return to existing conditions. It cannot be predicted exactly when municipal use rates will reach 18.2, but in-stream flow benefits are expected to endure for some time from fall through early spring. At the lowest summer flows (July through September) when the City's water use is curtailed to below 18.2 cfs during distribution, Sub-reach A1 would see a flow improvement with the proposed system, regardless of City demand. These benefits are expected to endure indefinitely.

The cumulative effects to in-stream flow through Sub-reach A2 would be insignificant at current use levels. This is because current in-stream flows in Sub-reach A2 with the existing system benefit from the return flow of water that is diverted by the City of Bend but not put to use. Any increase in demand for surface water from Tumalo Creek beyond current levels would decrease flows through Sub-reach A2 regardless of which system is in place. With either the existing system, or the proposed system, potential increases in municipal use would be capped at 18.2 cfs and subject to distribution rates managed by OWRD during low flow months.

No cumulative effects to in-stream flow through Reach B would occur as a result of the operation of the proposed municipal water system. During the irrigation season, flows would continue to be regulated by OWRD to assure that minimum in-stream flows are maintained or exceeded through the period of distribution. During the non-irrigation season in-stream flow rates through Reach B, like Sub-reach A2, would only vary with changes in demand, and not as a result of any operational differences between the proposed and existing systems.

Because flows in Reach B during the irrigation season are largely controlled by TID's use of water, it is the management and practices of TID that will result in the greatest potential for cumulative effect to flows through Reach B and into the Middle Deschutes. Currently, TID is operating a fish screen and ladder as a component of their diversion facilities that requires a minimum of 10 cfs to be functional. This 10 cfs is in excess of the minimum in-stream flows that have been calculated in distribution tables by OWRD. The incremental difference between minimum in-stream flows and the 10 cfs left in-stream for operation of the fish screen and ladder is left there voluntarily by TID, and is anticipated to be fully transferred to in-stream use upon completion of the CW-37 water conservation project (Figure 20). Phases 1&2 of the project have been completed, with 2.8 cfs of conserved water applied in-stream. The District is preparing to send a completion notice for Phases 3 of the project, and is the process of seeking funding for Phase 4. These phases will provide an additional 8.98 cfs of conserved water will be permanently transferred to Tumalo Creek. Upon completion, this project will result in total of 11.8 cfs of water saved and returned to Tumalo Creek, as well as 2732 acre-feet of conserved water in Crescent Lake and a permanent transfer of 5 cfs to Crescent Creek – another source of irrigation water for TID.

Figure 21. Water rights distribution upon completion of water conservation projects by TID



This does not include additional in-stream flows that would be gained through the in-stream lease program.

Other past, present, and reasonably foreseeable activities within the Tumalo Watershed that have the potential to affect flows in Tumalo Creek are leases of water rights for in-stream flow. These activities are ongoing and have resulted in increased flow within Tumalo Creek. TID has reported a 10-year average (2001-2011) 8.08 cfs leased for in-stream flows. Leasing and water conservation projects are expected to continue into the future and will result in improved flows through Reach B and the Middle Deschutes River. Future transfers of Deschutes River water for Tumalo water could also be explored to improve in-stream flow in Tumalo Creek.

3.7.5 Water Quality

3.7.5.1 Existing Condition

Water in the Tumalo Creek watershed is generally known to be cold and clean. The high quality water that is diverted into Bend's municipal water system comes mostly from spring systems at the headwaters of the watershed. The lack of recent disturbance and restricted land use within the municipal watershed has helped to maintain the quality and beneficial uses of these waters. Below the Bridge Creek intake, water quality has been somewhat compromised by disturbance through wildfire (Bridge Creek Fire – 1979), road building, timber harvest, residential development, recreational developments and activities (see Past, Present, Reasonably Foreseeable Activities section). This has contributed to variable levels of channel disturbance, increased sediment, and increases in temperature. Although restoration activities in the upper three miles of Tumalo Creek have substantially contributed to improved channel, floodplain, and riparian vegetation conditions, ODEQ has listed Tumalo Creek as being water quality impaired for temperature below River Mile 12.5 (13.5 in this analysis)- downstream of Tumalo Lake Creek (2010 Integrated Report – 303(d) list).

Another factor influencing water quality in lower Tumalo Creek is the City of Bend's return flow from the Outback facility. Water returning to Tumalo Creek passes overland through a channel, providing a chronic sediment contribution to the stream at the top of Sub-reach A2. During high return periods large quantities of sediment have been observed entering Tumalo Creek. Although this segment of stream has not been listed for sediment/turbidity, ODEQ has discussed the need for a National Pollution Discharge Elimination System (NPDES) permit to address point source sediment issues associated with the existing municipal water system.

3.7.5.2 Environmental Effects – Water Quality

Summary of Effects to Water Quality

- **Sub-reach A1**: With the Proposed Action, stream temperatures will decrease for all flow regimes associated with municipal diversion rates of less than the existing 18.2 cfs. Any effects to sedimentation and turbidity through the implementation of the Proposed Action would be very small to non-existent in magnitude and duration during system installation.
- **Sub-reach A2**: Effects to stream temperature are expected to be very small (if measurable) with the implementation of the Proposed Action. Effects to sedimentation and turbidity will improve with the abandonment of return flows through the channel from the Outback facility.
- **Reach B**: Effects to stream temperature are expected to be very small (nearly immeasurable) with the implementation of the Proposed Action. There are no expected effects to sedimentation and turbidity.
- **Reach C:** There will be no effects to temperature, sediment, or turbidity with implementation of the Proposed Action.

Direct and Indirect Effects – Water Quality – No Action

In the No Action alternative, water temperature would not be affected under current use conditions. In the future, with potential increased urban growth and projected increases in demand for surface water, associated decreases in in-stream flow in the lower reaches of Tumalo Creek could result in increased summer water temperatures. However, because of the impacts of various water management details by TID and OWRD discussed below, effects to water temperature as a result of changes in flow from increased municipal demand would largely occur outside of the low-flow distribution period when high in-stream temperatures are a concern.

Sub-reach A1

Because stream flow of 18.2 cfs from Bridge Creek is diverted on a continuous basis regardless of municipal demand and distribution to other water rights holders, there would be no effect to water temperature in Sub reach A1 with the No Action alternative.

Sub-reach A2

Effects to water temperature in Sub-reach A2 in the No Action alternative could occur under certain projected urban growth scenarios. This is the sub reach of Tumalo Creek that is most directly affected by changes in municipal diversion rates. As discussed in the stream flow section of this report, maximum diversions of up to18.2 cfs would decrease in-stream flows through Sub-reach A2. During the non-irrigation season, outside of the distribution period, this diversion rate could occur at relatively low flows since water is not shared with TID, and in-stream flows are satisfied. However, because of colder ambient air and stream temperatures during this period of time, infringement on water quality standards for cold water criteria is not an issue.

During the irrigation season, there is only a limited possibility that a maximum diversion rate could occur when in-stream temperatures are at their highest for the year. Because the net in-stream flow during periods that allow a diversion rate of 18.2 cfs is greater than periods when flows are low and municipal diversions are more curtailed, in-stream temperatures are relatively low.

In the No Action alternative, modeled stream temperatures are highest during the lowest in-stream flow scenarios when the City of Bend's potential to divert water is more heavily curtailed. Therefore, it is reasoned that the relationship of stream temperature to flow in Sub-reach A2 is governed more by total water yield and water distribution by OWRD than it is by the potential for the City of Bend to divert more water during summer months when stream temperatures are their highest.

In the No Action alternative, sediment contribution from the Outback return channel would continue at variable rates depending on return flow under the current operating scenario.

Reach B

Water temperature changes in Reach B are not anticipated to change with the No Action alternative. Even with projected increases in demand, OWRD will continue to govern the distribution of water to water rights holders so that minimum in-stream flows are maintained or exceeded through Reach B during the irrigation season. This season corresponds with the warmest months of the year. Potential changes to water temperature in Reach B as a result of other management activities are discussed in the cumulative effects section below.

Reach C – Middle Deschutes River

Water temperature changes in Reach C are also not anticipated to change with the no-action alternative. Because flows through Reach B to the mouth of the Deschutes River will be managed consistently despite potential growth scenarios, changes to flow regime and therefore temperature would not occur in Reach C with the No Action alternative.

Existing System Failure Scenario

As discussed previously, because the No Action alternative would maintain the aged system of pipes, the risk of failure, including failure, is higher than it would be with new pipes under the action alternative. Were a failure to occur, the effects to water quality would depend on the location of the rupture.

If a failure were to occur in an area where the full discharge of ~4100 gal/min (per pipe) could reenter Tumalo Creek, the effects to water quality could be substantial. Given the reaction time of 3-8 hours that is estimated for the City of Bend's operation staff to get a main break shut down, 738,000 to 1,968,000 gallons of water could return to Tumalo Creek. Depending on overland travel distances, soil depth, slope, and soil cover from rock and vegetation, such a failure could deliver tens to hundreds of cubic yards of sediment to the stream system – causing severe erosion in the process. As noted earlier, in some locations, a major rupture could create a risk of a landslide that reaches Tumalo Creek from steep hill slopes above the pipe. This would likely be considered a worst case scenario and could produce very large quantities of sediment.

Direct and Indirect Effects – Water Quality – Proposed Action

The potential for water quality effects to take place as a result of project implementation could occur during the installation/construction phase and/or the operations phase of the project. The realm of effects, as well as their magnitude and duration would be different, and will be discussed separately.

Installation:

Under the current plan of operations, during installation of the new pipeline and facilities at the Bridge Creek intake, diversion of municipal water would partially or fully cease, increasing flow over the spillway and Tumalo Creek by approximately 18.2 cfs for a brief period in the fall of 2013 or 2014. This increase would augment flow volumes through the entire length of the stream to a level that would restore native flows. Although October is not considered to be a critical time of year for temperature issues, the effects of increased flow would likely decrease temperatures during the period of installation. Because increases in flow would occur during a low flow period, there is no potential for adverse effects of bank erosion and sediment delivery from increased flow during the period of installation.

During construction, National Core Best Management Practices (BMP) (USDA, 2012) will be implemented to preserve the integrity of soil and water resources. The relevant BMPs in this technical guide are referenced in *Fac-9: Pipelines, Transmission Facilities, and Rights-of-Way, AqEco-2: Operations in Aquatic Ecosystems, and Road -3: Road Construction and Reconstruction*. Erosion control plans, timing of construction activities, control of construction in streamside management areas, and other site specific integrated design features will be incorporated to reduce the likelihood of overland flow of sediments entering Bridge Creek, nearby springs, and Tumalo Creek during building and construction. BMPs have been shown to be effective in reducing sediment delivery to background levels if properly applied (USDA, date unknown; Ice et al., 1999; Megahan et al., 1992). BMP implementation and effectiveness monitoring will follow project implementation to ensure that conservation objectives were met, or require that corrective actions and/or adaptive management is implemented to achieve the desired results.

During the partial demolition and reconstruction of the intake facility, in addition to implementing BMPs, the proposed design will reuse the existing below grade concrete foundation and flow channels with some modifications. This will further minimize the potential for soil disturbance and sediment delivery from areas adjacent to Bridge Creek and the likelihood of impaired water quality from these disturbances.

During pipeline installation there are a few key areas where certain integrated design features will further decrease the potential for adverse effects to water quality. One of these is at the upper crossing of Tumalo Creek where the pipeline will cross the creek aerially, eliminating the need to trench the creek and reducing the disturbance to the bed and banks of Tumalo Creek.

Another of these locations is along FS Road 4603 where several small springs cross under the road. Here, most culverts conducting spring flow would be left in place while the trench and new water line would be installed under the existing culverts. In one case a damaged culvert would be replaced. This would eliminate the potential for the adverse effects of turbidity or sedimentation to water quality.

The new pipeline alignment and lower crossing of Tumalo Creek would require trenching of the streambed to a depth of 12 feet to bury the new 30” diameter pipeline. At this depth, and because the pipeline would be encased in concrete at the crossing, there are no anticipated adverse effects to the pipe that could lead to rupture and related water quality issues. To reduce turbidity and sedimentation during installation, the project design includes placement of coffer dams upstream and downstream of the trench, diverting stream flow through temporary culverts, and utilization of filter cloths. Approximately 80-100 feet of Tumalo Creek would be de-watered during the construction period. National BMP *AqEco-2: Operations in Aquatic Ecosystems* describes and references practices that would minimize the short term and long term potential for turbidity and sedimentation of Tumalo Creek related to this portion of project implementation. These activities are also required to meet mitigations of the Division of State Lands and Army Corps of Engineers fill/removal permits.

Operations:

Following installation, the potential for effects to water quality would be related to changes in flow from the operation of the proposed water system. Because there are no significant anticipated effects to channel morphology (see fish habitat/channel morphology analysis), potential water quality issues associated with sediment in the main channel are not predicted. There are some anticipated changes to sediment regime associated with the Outback return channel that will be discussed below.

However, because the proposed system will divert and transmit water, there is a potential for changes in in-stream flow and therefore water temperatures during critical times of the year. The distribution of those effects throughout the year and over the length of the analysis area will vary as a result of operational differences between the two systems and increased demand for surface water from Tumalo Creek given different urban growth scenarios.

Because changes in flow can be inversely related to changes in temperature, this analysis will begin with a brief qualitative discussion of potential trends in temperature as it relates to changes in flow for each reach with the operation of the new system. Then the analysis will present the numeric results of modeling efforts using the Heat Sources Model (DEQ, 2011a) for nine discrete points along Tumalo Creek and will discuss their significance. The period of greatest concern for water temperatures are July through September when in-stream water temperatures have the potential to infringe on State water quality standards for cold water and biological criteria.

Sub-reach A1

As discussed in the flow analysis, Sub-reach A1 will see the greatest range of effects to temperature from the construction and operation of the City of Bend's proposed water system. Given the operational limitations of the existing system, 18.2 cfs is constantly diverted around Sub-reach A1. The proposed system will be able to respond directly to variable demand and water rights constraints by regulating the rate of diversion at the intake, thereby increasing the amount of water flowing through Reach A1 when the City uses less than 18.2 cfs. Recent (2011) water use rates by the City of Bend show actual use to be below 18.2 cfs for all months of the year. With increased flows through Sub-reach A1, water temperatures could decrease below current levels. This would be the case even with increased demand for surface water until demand returns the diversion rate to 18.2 cfs, and temperatures would return to current conditions.

However, given constraints of in-stream flow and other priority water rights on Tumalo Creek, the potential for diverting 18.2 cfs does not readily occur throughout the year. During critical low flow periods from July through September, the potential for the City of Bend to divert water is constrained at times by a limited amount of water distributed proportionately to senior water right holders for municipal, irrigation and in-stream uses by OWRD. Therefore, water temperatures in Sub Reach A1 are expected to decrease indefinitely below existing levels with the operation of the proposed system.

Sub-reach A2

Currently, Sub-reach A2 most closely reflects in-stream flows as they are affected by municipal demand. This is because water that is diverted with the existing system, but not used by the City of Bend is returned to Tumalo Creek, augmenting its flow through Sub-reach A2. Installation and operation of the proposed system at current use rates would not change in-stream flows through Sub-reach A2. Increased demand above current levels will begin to decrease in-stream flow through Sub-reach A2 with either system. With decreased flow, temperatures would be expected to trend in an upward direction. However, as discussed earlier, this simple relationship is true during limited periods outside of the irrigation season (late September/early October) when there is no conflicting need for a limited quantity of water, and minimal concern for infringement on water quality standards. During the irrigation season when temperatures are higher, maximum municipal diversions are only possible at higher flows, resulting in a greater net flow in-stream in Sub-reach A2 (despite higher diversion rates), and lower water temperatures. This would be the case with the operation of both the existing and proposed system.

There is potential for some minimum effect to temperature to occur as a result of operational differences and the unused portion stream flow entering Sub-reach A2 through the return flow channel with the existing system, and the mainstem channel with the proposed system. The temperature of return flows from the Outback Station have not been measured, but may be somewhat cooler than in-stream at the point of return. Although flow in the existing pipe would be protected from solar radiation as it travels to the

Outback Station, it would be expected to heat to some degree in the pipe from friction (as discussed below). Return flow would heat further as it travels overland to the point of confluence with Tumalo Creek and would be somewhat dependent on the flow volumes in the return channel. With the proposed system, overall stream temperatures are expected to be colder as water enters the top of Sub-reach A2, also providing a cooling effect. The relative differences in effects to temperature related to return flows versus cooler upstream flows are too small to be measurable with the technology in place.

Again, the period of greatest concern for stream temperature is between July and September. During this period of time, the projected municipal proportional share available for use would be limited to around 15 cfs during an average runoff year, when in distribution as governed by OWRD, and would not create a concern for temperature.

There would be an expected change in water quality related to sediment/turbidity between the two systems. With the proposed system, return flows from the Outback Station would cease. This would eliminate sediment being delivered to Tumalo Creek through the return channel.

Reach B

Stream temperatures in Reach B are not expected to change during the critical low-flow periods as a result of the operation of the proposed water system. Because OWRD distributes the waters of Tumalo Creek to various water rights holders during the irrigation season, minimum in-stream flows set for various distribution scenarios are maintained or exceeded (outside of peak flow periods in May and June when flows are sufficient to meet all water rights). In-stream flow through Reach B during distribution is predominantly controlled by TID's water management and would be maintained and managed accordingly regardless of municipal demand or the operational differences between the existing and proposed water systems. Insofar as there are no groundwater or tributary factors affecting stream temperatures in this reach, temperatures will be predominantly linked to flow and will fluctuate based on water management during summer low flow periods.

If any changes to stream temperatures were to occur to Reach B as a result of the operation of the proposed system it is anticipated that a slight residual cooling effect may occur from increased in-stream flows upstream in Reach A1. Other factors of water management by TID and the in-stream water leasing program to return water to lower Tumalo Creek will also serve to decrease temperatures.

Reach C – Middle Deschutes River

Like Reach B, stream temperatures are not expected to change during low flow periods. Because flows through Reach B would largely be regulated as they are today through the irrigation season there would be no effect to temperature expected in Reach C as a result of the operational difference of the proposed water system by the City of Bend. The only potential for changes in water temperature to occur in the Middle Deschutes River would be a slight cooling for the reasons discussed above in Reach B.

Heat Source Analysis

The DEQ's Heat Source model was used to analyze potential thermal regimes at nine different points along Tumalo Creek given variable intake and stream flow scenarios. The analysis compares the proposed and existing systems at various diversion rates and corresponding in-stream flow scenarios. The nine points on Tumalo Creek include:

- Middle Fork Tumalo Below Tumalo Falls (rm 16.3)
- Above South Fork Tumalo (rm 15.4)
- Downstream of Skyliners Bridge (rm 13.4)
- Upstream of Road 4606 Bridge (rm 6.8)
- Upstream of Outback Return Flow (rm 5.5)
- Downstream of Outback Return Flow (rm 5.0)
- Above TID Diversion (rm 2.9)

- Gage Downstream of TID Diversion (rm 2.7)
- Mouth of Tumalo Creek Upstream of Deschutes River (rm 0.0)

A complete description of modeling parameters, assumptions, limitations, and key understanding is described in HDR Technical Memorandum (2013b).

The results of the modeling simulations were a 7-day average of maximum stream temperatures over the period of July 19th to August 7th, 2001- the period for which the model was calibrated. Stream flow parameters for this modeling period were adjusted to accommodate the various diversion scenarios during the distribution period. All other parameters were held constant.

The scenarios that were chosen to model represent the flow parameters during the time the model was calibrated, as well as an array of distribution scenarios for this period of time. Scenarios were developed with the assumption that the hydrologic and distribution systems were being managed exactly to the level that is supported by senior water rights. The analysis is designed to portray a worst case scenario for minimum in-stream flow, and does not account for various operational and water conservation considerations that have and will continue to increase in-stream flow.

The 61.5 cfs scenario developed for this modeling effort corresponds with the baseline flow for which the model was calibrated. The 53 cfs scenario represents a low-flow/drought scenario when the City of Bend would be distributed 13.1 cfs for municipal use. The 66 cfs scenario represents an approximate mean monthly flow for this period and corresponds with the anticipated use rate of 15 cfs that would be distributed to the City of Bend during this period. The 92 cfs scenario represents the stream flow that would be required to support the 17.2 cfs diversion/distribution rate that was used to analyze the current (2011) municipal water use rate, and demonstrates a relatively wet year. The 128 cfs scenario represents the stream flow that would support the maximum diversion of 18.2 cfs.

The maximum 7-day average maximum water temperature for model simulations at the nine locations are shown for the proposed and existing water systems in Table 23. The maximum change of the 7-day average maximums between the proposed and existing water system model simulations at the nine locations are shown in Table 24.

Table 23. Heat Source Output Using 2001 Calibrated Version Revised for TMDL (degrees C)

Heat Source Output Using 2001 Calibrated Version Revised for TMDL (degrees C)

Maximum 7-Day Maximum Temperatures During 3 Week Simulation Period for Existing and Proposed Systems

		Middle Fork Tumalo Below Falls (rm 16.3)		City of Bend Diversion (A1)	Above South Fork Tumalo (rm 15.4)		Downstream Skyliners Bridge (rm 13.4)		Upstream Road 4606 Bridge (rm 6.8)		Upstream of Outback Return Flow (rm 5.5)		Outback Return (A2)	Downstream of Outback Return Flow (rm 5.0)**		Above TID Diversion (rm 2.9)		TID Diversion (B)	Gauge Downstream of TID Diversion* (rm 2.7)		Mouth of Tumalo Creek* (rm 0.0)		
Total Yield	**Water Use Rates**	**Existing System**	**Proposed System**		**Existing System**	**Proposed System**	**Existing System**	**Proposed System**	**Existing System**	**Proposed System**	**Existing System**	**Proposed System**		**Existing System****	**Proposed System**	**Existing System****	**Proposed System**		**Existing System****	**Proposed System**	**Existing System****	**Proposed System**	**Minimum Instream Flow*****
61.5	**DEQ**	13.2	13.2		12.5	12.1	14.4	14.1	15.4	15.2	15.9	15.5		15.6	15.9	17.3	17.3		17.8	17.8	19.9	18.1	**DEQ**
53	**13.1**	13.7	13.7		13.0	12.2	15.1	14.3	16.1	15.4	16.8	16.0		16.0	16.5	17.6	18.0		17.8	18.2	18.0	18.1	**7.0**
65.5	**15**	13.0	13.0		12.3	12.0	14.1	13.7	15.1	14.8	15.4	15.1		15.3	15.5	16.6	16.7		16.8	17.0	17.3	17.4	**7.4**
92	**17.2**	12.2	12.3		11.7	11. 6	13.0	13.0	13.9	13.8	14.1	14.0		14.1	14.1	14.9	15.0		15.1	15.2	16.1	16.1	**8.3**
126	**18.2**	12.2	12.2		11.4	11.4	12.4	12.4	13.0	13.0	13.2	13.2		13.2	13.2	13.6	13.6		13.8	13.8	15.0	15.0	**8.6**

*Flow, and therefore temperatures in Tumalo Creek below TID's diversion are highly dependent on water use by TID and what is distributed to the City and in-stream flow by OWRD. Modeled values here cannot be directly attributed to surface water diversion for municipal use.

**Stream temperatures modeled for the existing system downstream of the Outback return flow are colder than what would be expected. This is due to an assumption made in the calibration of the model that water temperatures returning to Tumalo Creek are the same temperature as where it was diverted in Bridge Creek. Recent data gathered by the City of Bend shows an average of 0.55ºC warming between the intake and outlet of the pipe at the Outback Station.

***Minimum in-stream flows are the proportionately distributed flows that correspond with in-stream water rights during low flow periods when natural flows are not sufficient to fulfill all certificated water rights. These flows are distributed and managed by OWRD. These are the minimum flows that would be in-stream below TID's diversion.

Note: In the DEQ model (line 1), baseline water use rate averages 14.3 cfs and baseline Reach B instream flow averages 8.3 cfs.

Maximum predicted 7-day average maximum water temperature for the proposed system (HDR, 2013b). The locations Above South Fork Tumalo and Above TID Diversion were added later in the analysis so only select models were re-simulated to obtain the output.

Table 24. Modeled Change in Temperature Between Existing System and Proposed System (degrees C)

Modeled Change in Temperature Between Existing System and Proposed System (degrees C)

Maximum 7-Day Maximum Temperature Differences During 3 Week Simulation Period: Proposed minus Existing Systems

Total Yield	Water Use Rates	Middle Fork Tumalo Below Falls (rm 16.3) Temp Change	City of Bend Diversion (A1)	Above South Fork Tumalo (rm 15.4) Temp Change	Downstream Skyliners Bridge (rm 13.4) Temp Change	Upstream Road 4606 Bridge (rm 6.8) Temp Change	Upstream of Outback Return Flow (rm 5.5) Temp Change	Outback Return (A2)	Downstream of Outback Return Flow (rm 5.0)** Temp Change**	Above TID Diversion (rm 2.9) Temp Change**	TID Diversion (B)	Gauge Downstream of TID Diversion* (rm 2.7) Temp Change**	Mouth of Tumalo Creek* (rm 0.0) Temp Change**	Minimum In-stream Flow***
61.5	**DEQ**	0		-0.4	-0.3	-0.2	-0.4		0.3	0		0	-1.8	**DEQ**
53	**13.1**	0		-0.8	-0.8	-0.7	-0.8		0.5	0.4		0.4	0.1	**7.0**
65.5	**15**	0		-0.3	-0.4	-0.3	-0.3		0.2	0.1		0.2	0.1	**7.4**
92	**17.2**	0		-0.1	0	-0.1	-0.1		0	0.1		0.1	0	**8.3**
126	**18.2**	0		0	0	0	0		0	0		0	0	**8.6**

*Flow, and therefore temperatures at the mouth of Tumalo Creek are highly dependent on water use by TID and what is distributed to the City and in-stream flow by OWRD. Modeled values here cannot be directly attributed to surface water diversion for municipal use.

**Stream temperatures modeled for the existing system downstream of the Outback return flow are colder than what would be expected. This is due to an assumption made in the calibration of the model that water temperatures returning to Tumalo Creek are the same temperature as where it was diverted in Bridge Creek. Recent data gathered by the City of Bend shows an average of 0.55ºC warming between the intake and outlet of the pipe at the Outback Station. Modeled increases in stream temperature downstream of the Outback return flow are an overestimation of the differences in stream temperature between the existing and proposed system.

***Minimum in-stream flows are the proportionately distributed flows that correspond with in-stream water rights during low flow periods when natural flows are not sufficient to fulfill all certificated water rights. These flows are distributed and managed by OWRD. These are the flows that would be in-stream below TID's diversion.

Note: In the DEQ model (line 1), baseline water use rate averages 14.3 cfs and baseline Reach B instream flow averages 8.3 cfs.

The difference between the proposed and existing systems during maximum predicted increase in 7-day average maximum water temperature (HDR, 2013b).

In general, with a few exceptions explained below, the model results show that through the operation of the proposed system water temperatures decrease or remain approximately the same. Factors influencing some of the dynamics in model outputs are discussed below.

Sub-reach A1

Temperatures in Sub-reach A1 decrease overall with maximum relative differences occurring at low stream flow scenarios when municipal diversion is most curtailed. During these periods, water that would otherwise be piped around Sub-reach A1 and return to Tumalo Creek at the top of Sub-reach A2 for downstream use with the existing system would be left in stream at the diversion – increasing stream flow and decreasing temperatures throughout Sub-reach A1 (10.6 miles). As stream flow increases to the point that the maximum diversion of 18.2 cfs could occur with the proposed system, stream temperature differences trend toward zero as stream flow and diversion rates become the same as what occurs with the existing system. Although there is no relative temperature difference between the existing and proposed systems at the maximum diversion rate, absolute stream temperatures at this higher flow are lower than at lower flows.

Modeled stream temperatures meet or exceed State criteria (Table 25) except for *Middle Fork Tumalo Below Falls*, and the lowest flow scenario *Above South Fork Tumalo*. Here, State criteria are set for bull trout, which is known not to occur in the watershed, and is currently not listed for temperature impairment. The model location *Middle Fork Tumalo Below Falls* is not affected differently by the proposed action as it is above the confluence of Bridge Creek and the location of the diversion point for the proposed and existing systems. The model location *Above South Fork Tumalo Creek* is affected by the proposed project, and helps to trend temperatures at low flow toward the attainment of State standards by lowering temperatures by approximately 0.8^{o}C. Below river mile 13.5 in Sub-reach A1, State standards for water temperature are 18^{o}C, and are attained at all flow/diversion rates.

Table 25. Water temperature criteria by designated beneficial use

Beneficial Use	Applicable Criteria	OAR 340-041-0028	When Criterion Applies	Where Criterion Applies
Bull trout spawning and juvenile rearing	12^{o}C 7-day average maximum Spawning narrative Cold water protection, summer	(4)(f) (4)(f) (11)(a)&(c)	Year round Aug 15 to May 15 Summer (Jun 1 to Sept 30)	Above confluence of Tumalo Lake Creek
Salmon and trout rearing and migration	18^{o}C 7-day average maximum Cold water protection, summer	(4)(c) (11)(a)&(c) (12)(b)&(d)	Year round Summer (Jun 1 to Sept 30)	Mouth of Tumalo Creek to confluence of Tumalo Lake Creek

Sub Reach A2

Modeled temperatures in Sub-reach A2 at average or higher stream flows show very little difference between the proposed and existing systems. Most temperature differences were less than 0.1^{o}C and do not exceed State temperature standards. This was expected as in-stream flow rates through Sub-reach A2 are equivalent for the proposed and existing systems in that they both represent in-stream flow minus municipal use.

However, at the lower flow value for which the model was calibrated at the *Downstream of Outback Return Flow* point, temperatures were modeled to increase approximately 0.3^{o}C with the proposed system. Drought simulations show as much as a 0.5^{o}C temperature increase.

These temperature values are an artifact of the limitations of the model. During the original calibration process for 2001, water temperatures reentering Tumalo Creek through the Outback return channel were assumed to be the same as they were at the point of diversion in Bridge Creek and did not account for any potential warming in the pipe, or the return channel to Tumalo Creek. Since this modeling site is the closest point to the return flow channel, Tumalo Creek temperatures are more influenced in the model by the temperature and magnitude of water entering the creek at that point. Because of these assumed low temperatures and the relatively high quantity of return flow being added to in-stream flows in the low flow scenarios, modeled temperatures for the existing system are relatively cold. In high flow scenarios, return flows are relatively small, and do not affect temperatures in the main stem of Tumalo Creek.

Although there is no documentation of water temperature in the return channel at the point of return to Tumalo Creek, it is assumed that during summer months there would be some warming of the water as it travels overland for 0.5 miles. In-stream warming is documented in other parts of the watershed in the model and in stream temperature monitoring for reaches where water temperature is not influenced by the accretion of springs or cooler water from tributaries. It is also assumed that water temperature would increase from friction as it travels through the pipes. This phenomenon is documented with data that the City of Bend collected at the inlet and outlet of their pipes in 2011-2012, showing an average of approximately 0.55°C warming through the pipe (Figure 22). Temperature changes range from between 0.35 – 0.40°C when intake water temperatures are their warmest, to 0.72 °C when intake temperatures are coldest.

Therefore, the modeled Tumalo Creek water temperatures below the return flow from the Outback Station are artificially low for the existing system. On average, water returning to Tumalo Creek through the return channel from the Outback Station would be in excess of 0.55°C warmer when considering additional heating that would occur in the return channel with the existing system. This modeling effect is especially exaggerated at lower modeled flow scenarios, when return flows are relatively high and contribute a larger portion of the overall volume of water modeled in the stream at that point. The expected temperature difference between the proposed and existing systems for these lower flow scenarios is substantially less than what was modeled. The relative differences in effects to temperature are too small to be measurable with the technology in place.

Although the modeled temperature increase of up to 0.5°C is an overestimation of the difference between the existing and proposed systems in this particular case, it is acknowledged that temperatures may show somewhat of a relative increase at low flows in extreme cases. OAR 340-41-0028 (11) defines a 0.3°C maximum warming rule for the protection of cold water. Because Tumalo Creek (A) does not have threatened or endangered salmonids currently inhabiting the creek; (B) has not been designated as critical habitat; and (C) colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria (OAR 340-41-0028 (11)(c)), Tumalo Creek is not subject to or in violation of this State water quality standard. This rule applies to waters that currently remain colder than the biologically based numeric criteria throughout the summer; where salmon, steelhead or bull trout are present; and waters not designated for salmon and steelhead spawning use (ODEQ, 2008).

OAR 340-41-0028 (12)(b)(A) describes acceptable temperature increases for human use allowance prior to the completion of a temperature TMDL as being no more than 0.3°C above the applicable temperature criteria. In this part of Tumalo Creek, modeled stream temperatures below the return flow through Sub-reach A2 do not exceed State temperature criteria of 18°C.

Modeled temperatures do reach 18°C in Sub-reach A2 and rise to a maximum of 18.2°C in Reach B, however, this occurs only in the drought scenario run for the 95% exceedence flows. OAR 340-41-0028 (12)(d) acknowledge that extremely low flows conditions can adversely affect temperatures and does not consider temperature violations that relate to flows that are less than the 7Q10 (7-day 90% exceedence flow) low flow condition for that water body.

Figure 22. Water warming in pipe

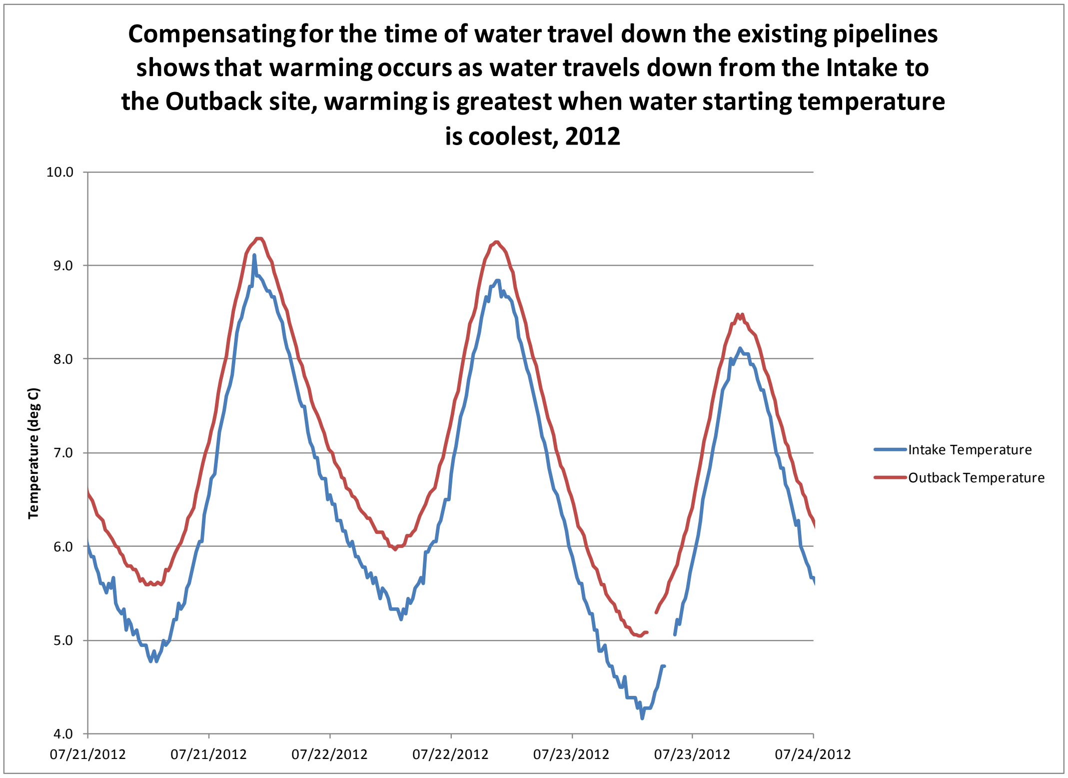
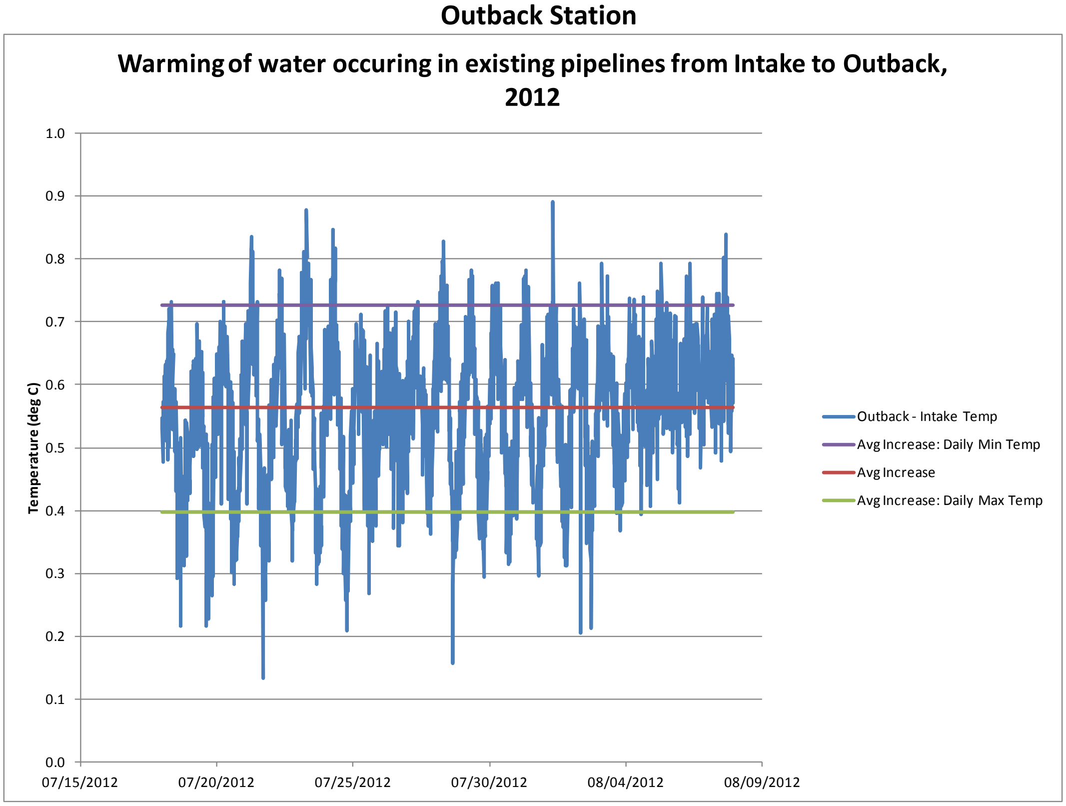


Figure 23. Water temperature differences between the intake on Bridge Creek and pipe outlet at the Outback Station



Reach B

Stream temperatures modeled for Reach B in general show very little difference between the proposed and existing systems. This is expected as there are no in-stream flow differences as a result of the operation of the two systems, and because stream flow below TID's diversion is controlled equally for both systems.

As discussed in context of modeling results for Sub Reach A2, there is some lingering effect in Reach B of the artificially cold water contribution from the return flow from Outback to Tumalo Creek. This is more evident at the lowest flow (53 cfs) scenario, but dissipates at the mouth of Tumalo Creek.

Another temperature modeling anomaly occurs at the mouth of Tumalo Creek for the 61.5 cfs, DEQ model calibrated run. The 1.8°C decrease in temperature between the proposed and existing system for the baseline, model calibrated condition is caused by the relative timing of low flow at the mouth Tumalo Creek in the model. This is because the Outback Return flow with the existing system added to the stream near river mile 5.4 arrives at the mouth sooner than water that is be left in-stream at the intake near river mile 16.2 with the proposed system. Because lowest flows with the existing system occur at a time of day with the greatest heat flux there is relatively greater thermal gain. With the proposed system, low flows occur later in the day and are subject to lower heat flux and thermal gains. Thus maximum water temperatures for the existing system are greater. Also, during the 2001 calibrated year, the water system was operated manually to provide a combination of surface water and groundwater. Water going to the city from the Outback storage tanks was turned on and off, creating somewhat erratic flows through the return channel to Tumalo Creek. For this reason the amplitude and timing of flows, and therefore temperature, below the return channel can be quite variable. Contemporary operation of the water system is automated so that surface water use and return rates are more constant. The effect of these operational differences is seen in the modeling as a more consistent temperature regime in the non-2001 baseline scenarios.

In Reach B, although there are some modeled temperatures above 18°C, flow and temperature are controlled primarily by the operation of TID's irrigation diversions – not the municipal use of water. Modeling in this reach used flow parameters that correspond with minimum in-stream flow supported by water rights (a worst case scenario). Maximum temperatures with the proposed action were modeled to be 18.2°C. As described earlier, actual flows in Reach B exceed these minimum in-stream flows considerably and therefore would produce colder than modeled temperatures. Recent temperature monitoring has shown that flow augmentation through Reach B has been effective in bringing temperatures below the 18°C standard (Fish and Hydrology Report, Appendix R).

Reach C

Because of the very small differences in temperature modeled at the mouth of Tumalo Creek, there would be no effect to stream temperatures in the Deschutes River from the operation of the proposed system. While Tumalo Creek can influence Deschutes River temperatures, the relative contribution of flow is small, and does not contribute enough cold water to the main stem of the Deschutes River to attain temperature standards on its own. Differences in temperature between the existing and proposed system at the mouth of Tumalo Creek are < 0.1°C. Because of this, there is no meaningful contribution of Tumalo Creek to lower water temperatures or compliance with State standards in the middle Deschutes River through the retention of the existing water system. In the middle Deschutes River, temperatures are most affected by the upstream diversion of water for irrigation, reservoir storage and release, and degraded riparian conditions. For the middle Deschutes River to achieve compliance with temperature standards, the restoration of flow and channel characteristics on the main stem of the Deschutes River upstream of the confluence of Tumalo Creek would be a critical step in trending toward attainment of applicable temperature standards.

Other than specific cases discussed above, the range of temperature predictions obtained through the modeling is effective for analyzing the relative temperature differences between alternatives. Modeled temperature differences do not fall within the range of what would be an expected measured temperature change in the field at given flow scenarios as the model's accuracy is approximately plus/minus 1°C (Watershed Sciences, 2008). Modeled maximum temperatures predictions downstream of Skyliners Bridge using the Heat Source model for both the existing and proposed water systems do generally fall into the range of temperature data collected in the field between 1997 and 2000. Because of relatively low modeled flow scenarios, some slightly higher modeled maximum values are expected.

The accuracy of the thermistors themselves also affects the potential to accurately account for small temperature differences in the field. To be accepted by ODEQ as Level A Data Quality (fully meets Quality Control Limits), thermographs have an allowable error of up to 0.5°C accuracy for both the pre-deployment lab test and post-deployment field test, when checked against a calibrated thermometer of high accuracy (National Institute of Science and Technology (NIST) approved). To meet ODEQ Level B Data Quality (the minimum acceptance criteria), the allowable error increases to 1°C for the lab test and 2°C for the field check. Detecting small changes in temperature in Tumalo Creek between the two alternatives would be difficult with the allowable level of error in thermographs. ODEQ Data Validation Criteria is listed at: http://www.deq.state.or.us/lab/techrpts/docs/DEQ04-LAB-0003-QAG.pdf

Cumulative Effects – Water Quality

The potential for cumulative effects to water quality occurring as a result of the implementation of the proposed action in conjunction with the ongoing effects of past activities and reasonably foreseeable future activities have the potential to occur in the realm of turbidity/sedimentation, and effects to temperature. As discussed earlier, the potential for adverse effects to occur either directly or indirectly as a result of the implementation of this project with the implementation of BMPs and integrated design features are very low in magnitude or duration.

The greatest effect to sedimentation from disturbance in Tumalo Creek occurred with the Bridge Creek Fire and subsequent salvage activities that removed wood from the riparian area and stream channel from 1979 to 1981. Since then, there have been a number of stream restoration efforts to stabilize the stream channel and reduce sedimentation from bank erosion. Between 2004 and 2007, a comprehensive restoration effort of 3 miles of Tumalo Creek (Sub Reach A1-RR – above Skyliners Bridge) was implemented that restored stream-floodplain connectivity, vertical and lateral structural stability through the installation of large woody debris and rock structures, and riparian planting of native vegetation.

The stream restoration project greatly reduced active channel erosion and creates a net decrease in sedimentation when considering all past, present and reasonably foreseeable activities. Ongoing and future efforts to improve riparian conditions through planting native species and hand thinning overstocked and undesirable conifer species will benefit riparian species composition and continue to improve conditions in the upper reaches of Tumalo Creek in terms of improved stream bank stability and buffering the stream from potential upland sources of sediment. The restoration also helps to maintain desirable channel dimensions and improve riparian shade which will continue to maintain and improve stream temperatures.

West Bend DEIS, Section 3.16.1: The project area was extensively logged 70-90 years ago. Past major vegetation management projects within the watershed that are documented in the database date back to the late 1960s. Much of the past activity removed large volumes of ponderosa pine, fir, and lodgepole pine. These projects each implemented various activities including salvage of dead and dying timber, commercial harvest, commercial and non-commercial thinning, prescribed underburning, closing and decommissioning of roads, and mechanical treatment of shrubs.

Minor vegetation management projects have included day use area and roadside hazard tree removals, and campground and snow-park construction. Recent planned projects include bend Municipal Watershed Fuelbreaks (scoping February, 2013) and Bear Wallow Mastication Project (draft Decision memo, July 2013). These minor projects have had or will have no to minimal effect on the hydrology of Deschutes River, Tumalo Creek and tributaries, and intermittent channels. They have not affected peak flows or water temperature. An Equivalent Clearcut Acreage (ECA) value for the existing conditions for the West Bend Project was not generated but likely falls below a threshold where hydrologic effects have resulted because of the groundwater-driven nature of the watershed. Past fires in the Tumalo Creek watershed, such as the 1979 Bridge Creek Fire, may have had short term effects by increasing stream flow but vegetation recovery since that time has increased ground cover and water retention so effects are presently diminished.

There will be a beneficial effect to sedimentation below the Outback return flow to Tumalo Creek through the implementation of the proposed project. Because of operational differences with the proposed system, there will be no return flows, and therefore no potential for sediment contribution through the return channel.

The cumulative effects to temperature that may occur from the implementation and operation of the proposed water system will vary along the length of Tumalo Creek below the diversion on Bridge Creek and will be influenced by several anthropogenic factors that accumulate downstream. In consideration of past, present, and reasonably foreseeable activities, the restoration activities described above have addressed issues of natural and anthropogenic disturbance, and has initiated and will continue a trend toward cooler water temperatures.

The modeling of stream temperatures using the Heat Source Model demonstrates a cooling effect taking place in Tumalo Creek through Sub Reach A1 (10.6 miles), where the operation of the proposed water system would return flow to the stream until demand meets maximum allowable diversion rates. In Sub-reach A2 and Reach B, flows will not change as a result of the operation of the proposed system, and contrary to anomalous model readings of temperature discussed above, temperatures are not expected to change substantially with the proposed action.

The greatest period of concern for temperature affecting the beneficial uses of water in Tumalo Creek is during the summer when atmospheric temperatures are high and water levels are low. As discussed, the City of Bend is restricted in its ability to divert water for municipal use as limited water yield is distributed to senior water rights associated with the municipality, TID, and protected in-stream flows. As a result, the management and distribution of flows during this time by OWRD in combination with the operational differences of the proposed system protect and improve flows and therefore temperatures through the majority of Tumalo Creek during this critical period.

Other ongoing and foreseeable activities occurring in the watershed that will improve flow through Reach B of Tumalo Creek will also continue to have a cooling effect on stream temperatures. As discussed earlier, TID has installed a fish screen and ladder on their diversion structure that requires 10 cfs to operate. This is above the protected minimum in-stream flow guaranteed through water rights. TID is also in the process of implementing a water conservation project (CW-37) that will restore an additional 11.8 cfs to lower Tumalo Creek, further reducing temperatures.

The continuation of the in-stream leasing program will also continue to benefit stream flow and water temperatures in lower Tumalo Creek. The 10-year average for this program from 2001 to 2011 has contributed 8.08 cfs to in-stream flow.

Recent temperature monitoring (2012) by the City of Bend shows the combined effects of TIDs operational changes, water conservation projects, and in-stream flow leases on improving flow and decreasing temperatures. All stream temperature data in 2012 was cooler than the 18^{o}C State standards for cold water protection.

Improving riparian conditions will also continue to increase shade to the channel and improve temperature conditions. This is particularly true in the Sub-reach A1-RR where restoration efforts and ongoing riparian improvement efforts continue to improve protection from solar radiation, regulate temperatures, and protect beneficial uses of water in Tumalo Creek.

3.7.6 Aquatic Habitat and Channel Morphology

3.7.6.1 Existing Condition

The stream reaches of Tumalo Creek in the project area that occur on National Forest System lands are generally adequate in large woody material, gravels, cobbles, and boulders for trout spawning, rearing, and aquatic macroinvertebrate habitat. The riparian zones are relatively intact with mature stands of mixed conifer (exception is the Bridge Creek Fire area where stands are only 32 years old) and shrubs providing shade, overhead cover, and instream large wood recruitment. The numerous falls and the paucity of pool habitat are natural habitat features limiting fish populations. Stream sub-reaches are generally riffle dominated (80% - 85%), having only 15-20 percent pool habitat. Approximately 8.5 miles of the 16.0 miles of Tumalo Creek within the project area flows through private land, where instream large wood, shade trees, and riparian vegetation have been removed or otherwise adversely impacted at isolated sites. The area analyzed focuses on from the confluence of Tumalo Creek with Bridge Creek downstream to the junction of Tumalo Creek with the Deschutes River. Also included in the discussion are 0.2 miles of Bridge Creek from the diversion dam to the junction with Tumalo Creek and an undefined length of the Deschutes River below the junction with Tumalo Creek.

Sub-reach A1-RR

Sub-reach A-1-RR includes the Bridge Creek Fire area, where past restoration work has occurred. Whole trees were placed and anchored into the Tumalo Creek channel with instream work beginning in the early 1990's. Willow, cottonwood, and Engelmann spruce were planted along the banks. The early attempts at restoration had limited success in providing long-term benefits to fisheries habitat. The Bridge to Bridge Restoration Project was implemented during 2004-2007 on Tumalo Creek within the Bridge Creek Fire area, restoring bank and channel stability, riparian vegetation, pool habitat, and large woody debris instream and on the floodplain. Over 2100 whole trees were used to create numerous log jams and pools, several hundred boulders were used for structures and grade control, side channels and off-channel ponds were created, and over 72,000 trees and shrubs were planted. Downstream of the restoration area, Sub-reach A1-RR remains relatively low gradient for nearly 3 miles, with a mature forested canopy and abundant in-stream large wood. In this lower section of the sub-reach, the stream flows through several tracts of private property where some instream large wood and shade has been removed.

Sub-reach A1-RR is predominantly a C-type channel within a glaciated valley of wide floodplains, gentle gradient and fairly abundant side channels and off-channel rearing areas. Because this part of Tumalo Creek is an alluvial (depositional) sub-reach of stream, a certain degree of vertical and lateral channel adjustment is expected to occur as the stream reacts to a variable flow and sediment regime. Channel stability in C-type channels is largely dependent on bank stability and upper watershed conditions that affect discharge and sediment (Rosgen, 1996).

The 0.2 mile section of Bridge Creek below the intake facility is within the Bridge Creek Fire area, and is a Rosgen A/B-type channel dominated by riffle habitat with a stable riparian area and abundant instream large woody material.

Through Sub-reach A1-RR channel conditions are currently considered to be in a "stable" condition of dynamic equilibrium. One notable exception to this is on private land where the deposition of wood and subsequent bedload pushed a portion Tumalo Creek flow into the relict Columbia Southern canal for a length of ~1000 feet before re-entering the main stem of the channel. Options for restoration of this section of the stream are being considered by the land owner.

Sub-reach A1-B

In Sub-reach A1-B, the stream transitions into a higher gradient area with a narrow valley floor and steep sideslopes. High gradient riffles, cascades, plunge pools, and pocket water behind boulders characterize the habitat types.

Sub-reach A1-B is classified as a B-type channel. These channel types are generally stable. Streambank erosion rates are low as are channel aggradation/degradation processes (Rosgen, 1996). These characteristics apply to Tumalo Creek throughout Sub-reach A1-B. Near the end of the sub-reach, the valley floor once again opens up and the channel gradient decreases, transitioning again into a Rosgen C-type channel.

Sub-reach A-2

This sub-reach is primarily within Shevlin Park and is similar to Sub-reach A1-RR in gradient, floodplain width, and habitat types. Approximately 2 miles of Tumalo Creek within Shevlin Park were treated with large woody material structures during 1991-1994 to improve habitat conditions. During a 2009 blow-down event numerous large trees within the park added additional in-stream structure. There are no perennial tributary streams to Tumalo Creek through Sub-reach A-2. Minor stream flow (< 2 cfs) is diverted into the Shevlin fishing pond, which in turn drains back into Tumalo Creek.

Sub-reach A-2 is also a C-type channel and exhibits similar geomorphic processes as Sub-reach A-1-RR. Channel conditions through this sub-reach are in dynamic equilibrium. Stream banks are well vegetated and are predominantly stable, with isolated impacts from recreational users. There are no excessive aggradation or degradation processes occurring through this sub-reach.

Reach B

The valley width again decreases moving downstream through this 2.8 mile sub-reach to the Middle Deschutes River, transforming into a rimrock canyon with steep to moderately steep sideslopes. Stream gradient and substrate size increases toward the mouth, with large boulders forming pocket water. Large woody material is generally lacking. There are no perennial tributary streams through this part of Tumalo Creek.

Reach B of the project area contains both B and C channel types. While flows are limited to this reach because of upstream water diversions, stream banks are well vegetated and predominantly stable. The stream also exhibits vertical stability despite the departure from native flow regime. While Reach B does not receive the same bankfull flow volumes the rest of Tumalo Creek does during spring snowmelt periods, it does periodically receive high flow volumes outside of the irrigation season during rain on snow events.

Reach C –Middle Deschutes River

The Middle Deschutes River habitat conditions are most affected by low flow from upriver irrigation diversions and the resultant high water temperatures. ODFW surveyed the Middle Deschutes in 1993 during the low flow summer period (ODFW, 1996) from the North Canal Dam in Bend at rm 164.8 downriver to Steelhead Falls at rm 128. Stream types are generally Rosgen C types with some stretches of B-type channel confined within steep canyon walls. Sub-reach 4 of the survey included the confluence with Tumalo Creek and stretched from the town of Tumalo upriver 3.5 miles to the upper end of Tumalo State Park. In this sub-reach, gradient was low (0.3%) and habitat types were glides (49%), riffles (38%) and pools (12%). Riverbanks were stable.

There is concern that as legally permitted groundwater pumping increases over time, it may substantially reduce the amount of cold groundwater recharging the Deschutes River (Jacobsen and Jacobs 2010). The Groundwater Mitigation Program was developed to help mitigate this problem, and is partly responsible for increased summer flows in the middle Deschutes River in recent years. This program has been extended through 2029 (Giffin, OWRD, personal communication, 2011).

Existing Redband Trout Habitat Conditions Using PHABSIM and HDA

Instream Flow Study

Trout select various habitats based on water velocity, water depth, substrate size, and cover availability. As stream discharge changes, all of these variables change. The in-stream flow study method selected was the Physical Habitat Simulation model (PHABSIM), the most widely accepted and applied fish habitat model in Oregon and the USA (HDR 2012). PHABSIM combines physical measurements of the stream (velocity, depth, and substrate) with habitat preference curves to estimate the amount of habitat available to fish at different flows.

The goal of the in-stream flow study, completed in the fall of 2011, was to quantify or characterize fisheries habitat as a function of flow within the Project-affected area of Tumalo Creek. The study modeled simulated ranges of in-stream flow values. The study area was from the confluence of Bridge Creek and Tumalo Creek at rm 16.0 to the mouth of Tumalo Creek. From the point of the return flow (start of Sub-reach A2) down through Reach B to the mouth at the confluence with the Middle Deschutes River (Reach C), the stream flow would be the same between the two alternatives. The study compared habitat conditions in Sub-reach A1 for redband trout between the existing system (No Action Alternative) and the Proposed Action as a function of flow, using 3 different hypothetical flow scenarios. The study analyzed effects on flow and redband trout habitat based on municipal water use rates, water rights, and in-stream flow requirements, as they currently exist.

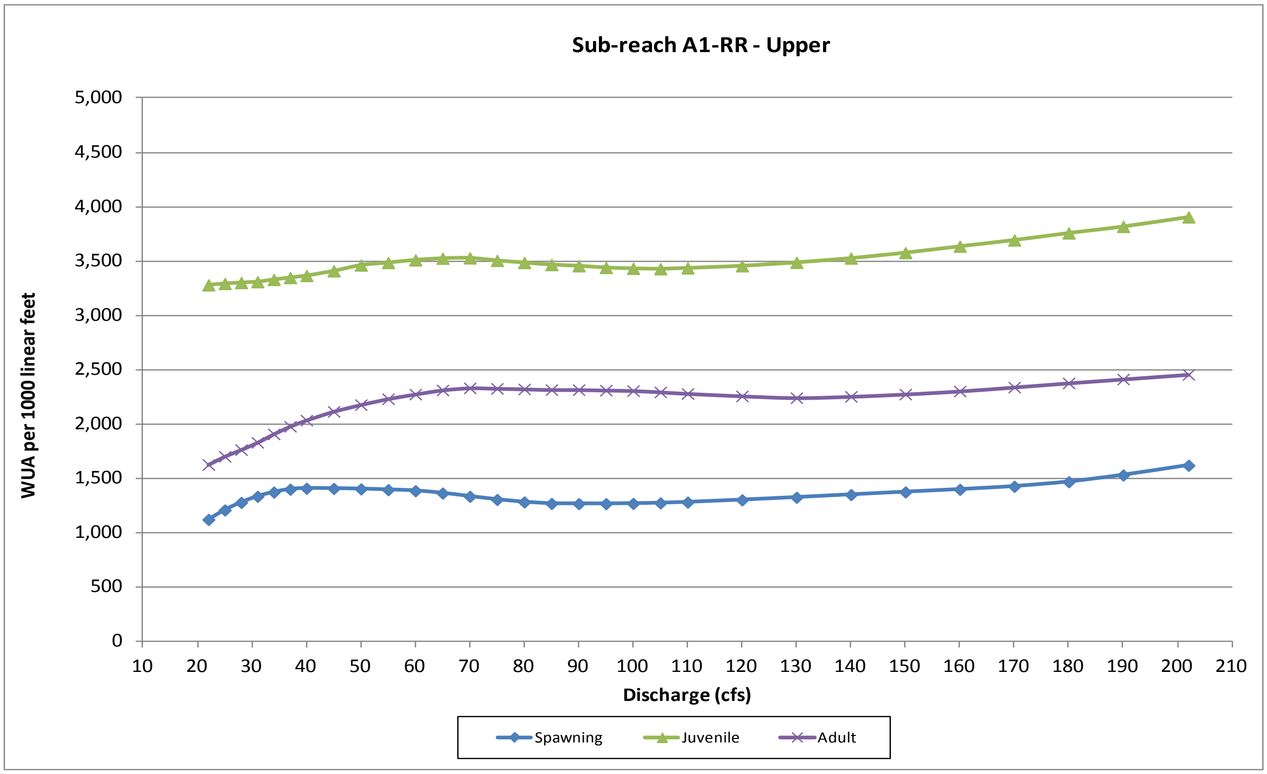
The Instream Flow Study only modeled to a maximum discharge of 202 cfs although bankfull flows are 300 cfs or greater. Above the upper modeled flow, the model becomes less accurate due to increased flow interaction with near stream vegetation. Stream flows above the modeled flows are typically of short duration during the rise and fall of the hydrograph. More information on the instream flow study methodology can be found in the In-stream Flow Technical Memorandum (HDR, 2012).

Besides the PHABSIM and associated HDA methodologies for assessing the quality of trout habitat, an evaluation of base flows was also used in the analysis. Base flows (lowest flows of late summer to winter) are critical to the quality of trout habitat. A base flow of ≥ 50% of the mean annual daily flow is considered excellent for maintaining quality habitat, 25-50% fair, and < 25% poor (Binns and Eiserman 1979, Wesche 1980, in Raleigh, et al 1984).

Sub-reach A1-RR Upper

Figure 23 below displays available redband trout habitat available for each life stage at different stream flows for Sub-reach A1-RR Upper, derived from the instream flow study. Habitat is expressed as Weighted Usable Area.

Figure 24. Graphical WUA results for Sub-reach A-1-RR (upper) for three life stages of redband trout (HDR, 2012a)



Spawning habitat: This section had a relatively low WUA for spawning habitat meaning a relatively low amount of spawning habitat per 1000 lineal feet of stream. The instream flow study modeled spawning habitat is maximized at two periods – when stream flow is at 40 cfs and again when the stream flow is at about 202 cfs (Figure 24 above), although changes in WUA are small over a wide range of discharge. Spawning WUA is likely higher near 40 cfs because of favorable velocities. Near 200 cfs, gravel deposits along margins are likely being accessed by the higher flows. Should spawning occur on the gravel deposits along the margins accessed at these flows, developing eggs may desiccate as flows naturally drop. Stream flow of 200 cfs is met or exceeded between 25-50% of the time from early May to early July.

Juvenile habitat: This section had a relatively low overall WUA for juvenile habitat, but comparable to the lower section of this sub-reach, meaning less available habitat per 1000 lineal feet of stream. Juvenile habitat changes with changing stream flow track what was observed with spawning habitat. Similar to spawning habitat, the maximum available habitat occurred at the highest stream flow modeled, at about 202 cfs, with another smaller peak at 70 cfs (Figure 24 above). Juvenile trout would be able to access more habitat along the margins when flows are at or near 202 cfs, then navigate out as flows naturally drop.

Adult habitat: This area is generally lower in WUA for adult habitat than any other sub-reach or reach, but is comparable to the lower area of Sub-reach A1-RR. There is less available habitat per 1000 lineal feet of stream. The modeled maximum habitat is the same as juvenile habitat, with peaks at 70 cfs and 202 cfs.

<u>Base Flow Habitat Assessment:</u> Under existing conditions with the 18.2 cfs diversion, the 50% or greater base flow resulting in excellent habitat rating is met in 7 of the 12 months for Sub-reach A1-RR Upper. For the months where this criteria is not met, there is a slight reduction in spawning habitat for one month (0.3%), and slight reductions in juvenile and adult habitat during all 5 months (up to 3.8%).

<u>Sub-reach A1-RR Lower</u>

Spawning: This lower area of Sub-reach A1-RR has considerably more spawning habitat than the upper area. Spawning habitat is maximized at 45 cfs but falls off sharply at stream flows above 55 cfs and below

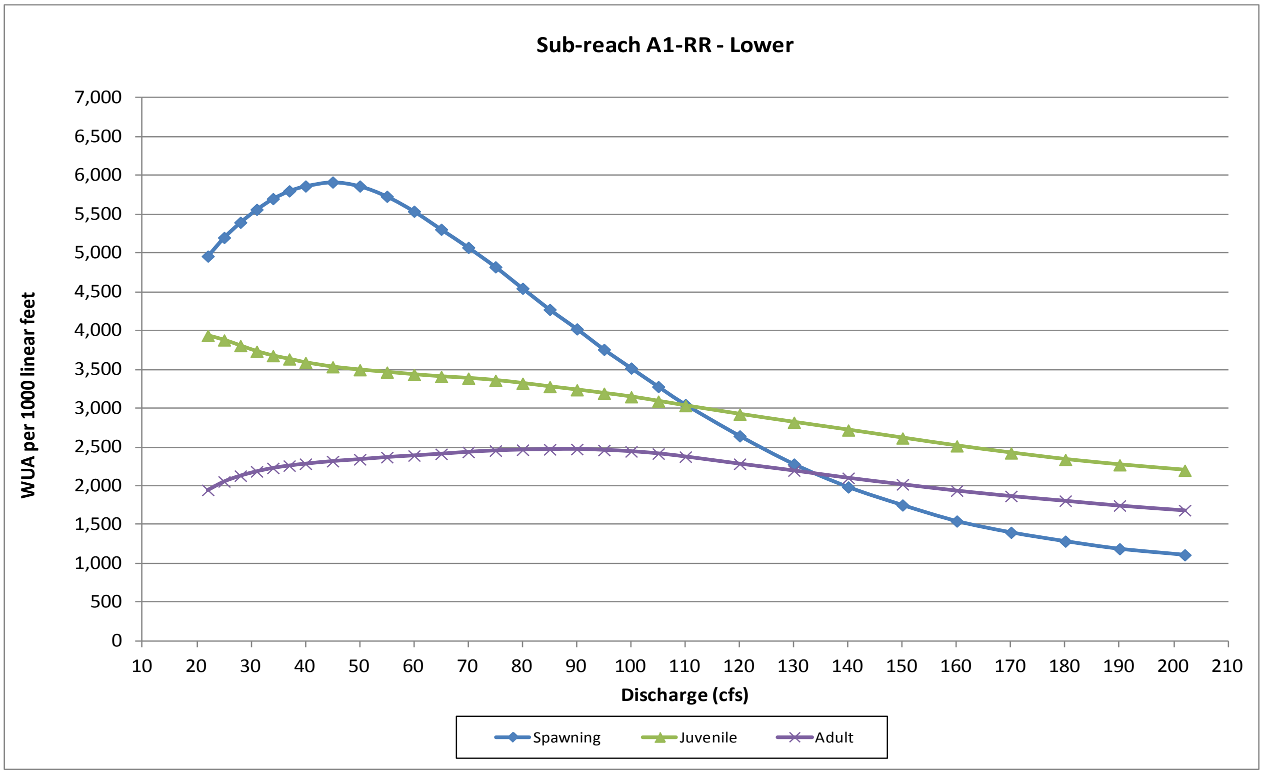
34 cfs. The stream flow is usually above 45 cfs during the spawning period.

Juvenile: The maximum juvenile habitat is at 22 cfs, a very atypical stream flow. Any stream flow above this decreases juvenile habitat.

Adult: The peak habitat is at 90 cfs but there is very little change in habitat with changes in stream flows except at the very lowest and highest stream flows. Stream flow is typically below 90 cfs most of the year except the snowmelt period of late spring and early summer.

<u>Base Flow Habitat Assessment:</u> Under existing conditions with the 18.2 cfs diversion, the 50% or greater base flow resulting in excellent habitat rating is met in all 12 months for Sub-reach A1-RR Upper.

Figure 25. Graphical WUA results for Sub-reach A1-RR (lower) for three life stages of redband trout (HDR, 2012).



Spawning: This lower area of Sub-reach A1-RR has considerably more spawning habitat than the upper area. Spawning habitat is maximized at 45 cfs but falls off sharply at stream flows above 55 cfs and below 34 cfs. The stream flow is usually above 45 cfs during the spawning period.

Juvenile: The maximum juvenile habitat is at 22 cfs, a very atypical stream flow. Any stream flow above this decreases juvenile habitat.

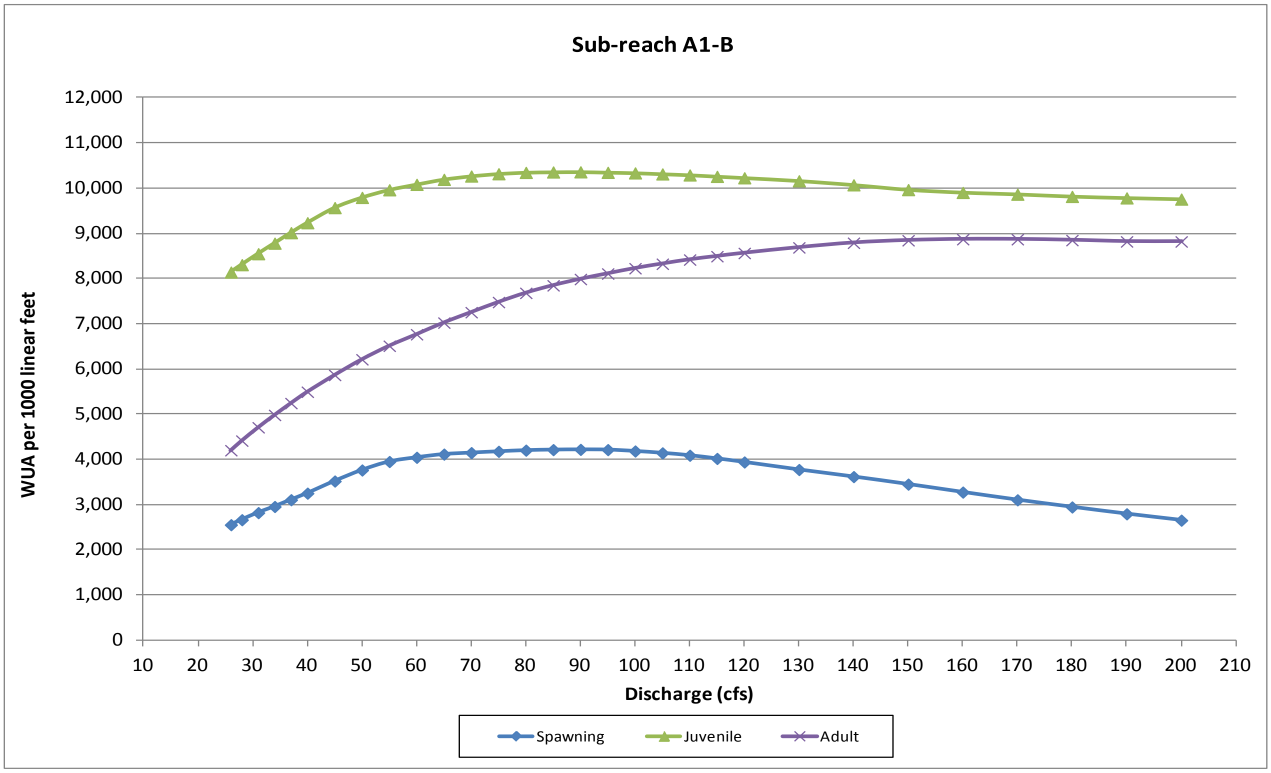
Adult: The peak habitat is at 90 cfs but there is very little change in habitat with changes in stream flows except at the very lowest and highest stream flows. Stream flow is typically below 90 cfs most of the year except the snowmelt period of late spring and early summer.

<u>Base Flow Habitat Assessment:</u> Under existing conditions with the 18.2 cfs diversion, the 50% or greater base flow resulting in excellent habitat rating is met in all 12 months for Sub-reach A1-RR Upper.

<u>Sub-reach A1-B</u>

Figure 26 below displays the available redband trout habitat for Sub-reach A1-B derived from the instream flow study.

Figure 26. Graphical WUA results for Sub-reach A1-B for three life stages of redband trout (HDR, 2012a)



Spawning habitat: This sub-reach had a lower WUA for spawning habitat than the other sub-reaches at most stream flows, with the exception of Sub-reach A1-RR Upper. Spawning habitat is maximized when stream flows are at about 90 cfs but there is little change between 60 and 115 cfs (Figure 26 above). Stream flows are typically above 60 cfs during the spawning period and 115 cfs is usually exceeded during the rise, peak, and fall of the hydrograph from May to July.

Juvenile habitat: This sub-reach had the highest overall WUA for juvenile habitat of all sub-reaches and reaches. The modeled maximum habitat occurs at a stream flow of 90 cfs, similar to spawning habitat. There is little change in habitat across a broad range of flows above 60 cfs. Although velocity preferences may be exceeded at higher flows, additional wetted channel maintains juvenile habitat across a broad range of flows.

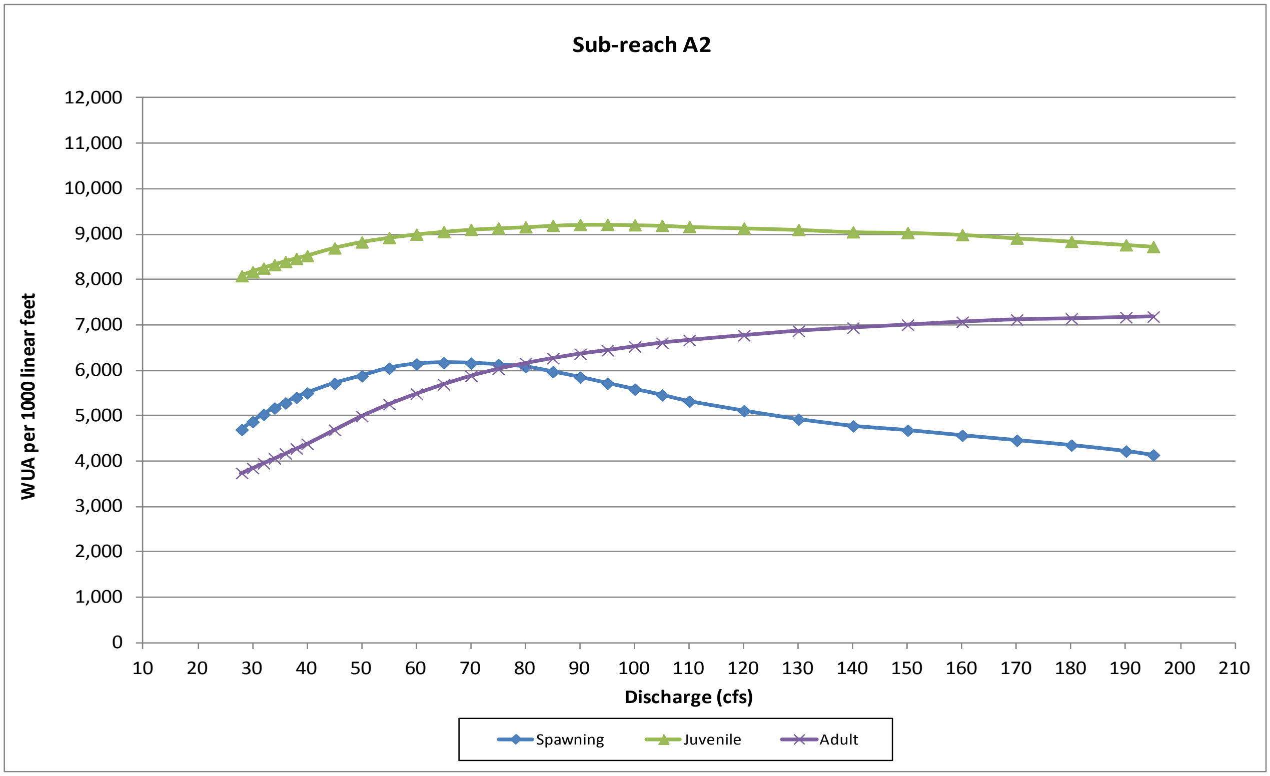
Adult habitat: This sub-reach had a higher WUA for adult habitat than any other sub-reach or reach. The modeled maximum habitat occurs at 160 to 170 cfs, but is fairly constant between 130 and 200 cfs. Habitat decreases at a higher rate after flows drop below 90 cfs. The stream flow is at or below 90 cfs approximately 75% of the year. Increases in stream flow when below about 90 cfs are especially beneficial to adult habitat.

Base Flow Habitat Assessment: Sub-reach A1-B would have the same stream flow as Sub-reach A1-RR Lower, therefore the existing conditions for the base flow evaluation would be identical to Sub-reach A1-RR Lower. Base flows provide excellent habitat rating during all months within Sub-reach A1-B.

Sub-reach A2

Under existing conditions, Sub-reach A2 receives variable return flow from the Outback site. Figure 27 below displays the available redband trout habitat for Sub-reach A2 derived from the instream flow study.

Figure 27. Graphical WUA results for Sub-reach A2 for three life stages of redband trout (HDR, 2012)



Spawning habitat: This sub-reach had a relatively high WUA for spawning habitat for most stream flows, comparable to Sub-reach A1-RR and Reach B. Spawning habitat is maximized when stream flows are at about 65 cfs (Figure 27).

Juvenile habitat: This sub-reach had a relatively high WUA for juvenile habitat, with maximum habitat predicted at 95 cfs. Very little changes in habitat occur across a wide range of flows above 55 cfs. Stream flow is typically above 55 cfs but occasionally drops below in the fall and winter months.

Adult habitat: Sub-reach A-2 had a relatively high WUA, with habitat maximized at 195 cfs, the highest flow modeled. The increase in depths with increased flow benefits adult habitat.

<u>Base Flow Habitat Assessment:</u> For the purposes of trout habitat using base flow evaluation, it was assumed stream flow in Sub-reach A2 was identical to Sub-reach A1-B, i.e., that all 18.2 cfs diverted water is used by the City for all months (no return flow to Tumalo Creek into Sub-reach A2). This does not occur under existing conditions. Any return flow in Sub-reach A2 would boost base flow and maintain excellent habitat rating. Under existing conditions, the 50% or greater base flow resulting in excellent habitat rating is met in all 12 months.

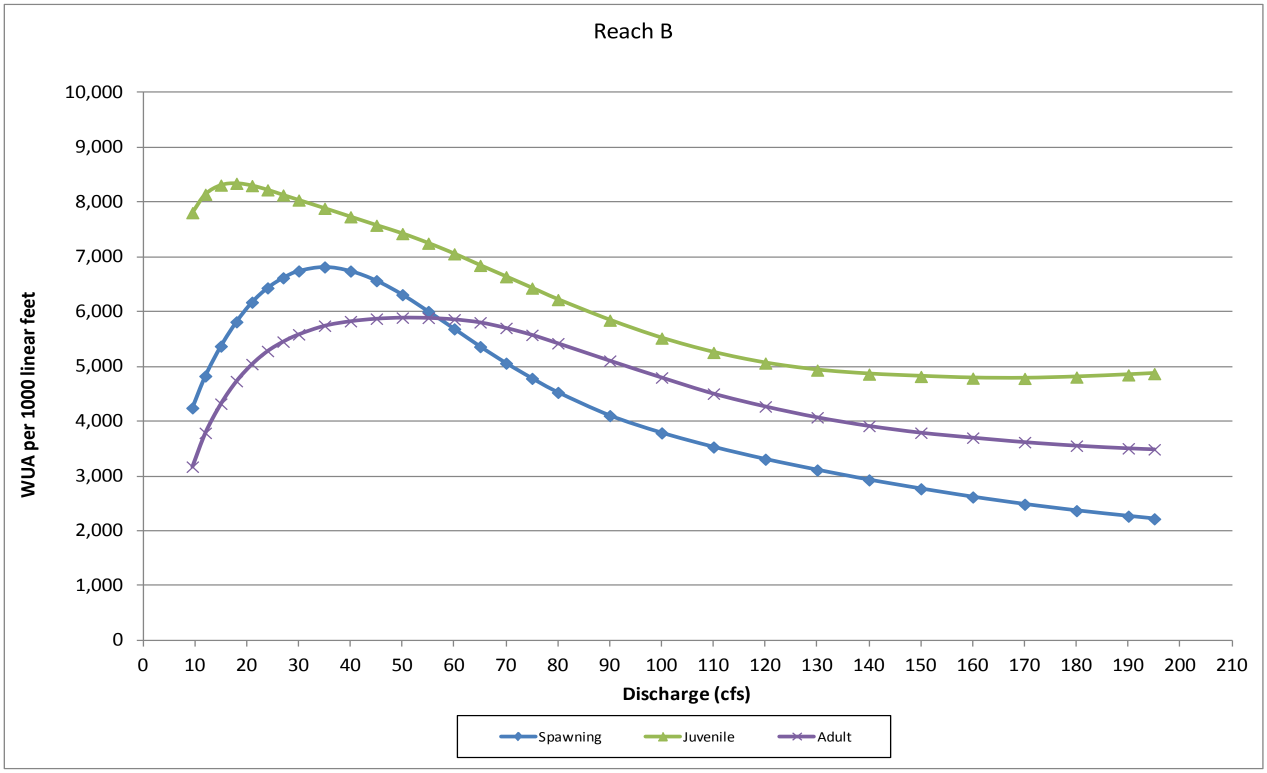
<u>Summary of Habitat Values in Reach A:</u>

WUA values in Reach A for adult and juvenile life stages indicate that habitat is generally suitable over a wide range of stream flows. However as discharge increases, velocity preferences are increasingly exceeded, driving suitability down. But at the same time, habitat suitability based on depth alone, increases with increasing stream flow, suggesting that preferred habitat is lost due to increased velocities at a rate that is slightly higher than habitat is gained due to increasing depths. The spawning WUA functions generally show a narrower band of flows that provide optimal habitat availability, compared to that of the juvenile and adult life stages. Both Sub-reach A1-RR Lower and Sub-reach A2 show a similar amount of suitable spawning habitat, both exceeding what was calculated for Sub-reach A1-B, owing to the greater availability of suitable spawning gravels observed. Suitable spawning gravels observed in Sub-reach A1-B were limited and found mostly along channel margins and in depositional areas behind boulders and upstream obstructions (HDR 2012).

Reach B

Under existing conditions, large diversions of stream flow occur during the irrigation season in Reach B. Figure 28 below displays the available redband trout habitat for Reach B derived from the instream flow study.

Figure 28. Graphical WUA results for Reach B for three life stages of redband trout (HDR, 2012)



Spawning habitat: Reach B had a relatively high WUA for spawning habitat, and is comparable to Sub-reaches A1-RR and A-2. Maximum spawning habitat is at 35 cfs (Figure 28), but drops off sharply below this flow. Flows below 35 cfs are experienced much of the spawning season as it largely coincides with irrigation season.

Juvenile Habitat: Overall, Reach B had a lower WUA for juvenile habitat, but at lower flows (<60 cfs) Reach B has a comparable WUA to Sub-reach A1-RR. The maximum WUA is at 18 cfs_– this low value being the result of decreased velocities within this higher gradient reach. Stream flow is reduced to as low as near 10 cfs during the irrigation season under existing conditions.

Adult habitat: Overall, this reach has a lower WUA for adult habitat, but at flows between 30 and 80 cfs the available habitat is comparable to conditions seen in the other reaches and sub-reaches. The maximum habitat is at 50 cfs. Flows are often above 50 cfs during the non-irrigation season, but often well below this value during the irrigation season.

WUA functions for all three redband trout life stages indicate that habitat is generally more suitable when stream discharge is between approximately 27 and 60 cfs. Channel morphology and gradient play an important factor in the observed habitat functions in this reach. The channel is generally narrower and higher gradient than found in Reach A, thereby resulting in higher velocities per unit discharge. As a result, the WUA functions slope downward at a higher rate than found in Reach A (HDR, 2012).

Base Flow Habitat Assessment: Under existing conditions, the excellent trout habitat rating ($\geq$ 50% mean native annual flow) is maintained during the non-irrigation season, but is only met during June during the irrigation season. A fair habitat rating is achieved during two months and a poor rating in 4 months. However, even during these "fair" and "poor" rated months, the habitat modeling demonstrated an increase at times in juvenile and spawning habitat compared to the $\geq$ 50% mean native annual stream flow criteria, as the Weighted Usable Area increased, due to a decrease in velocity with reduced stream flows.

3.7.6.2 Environmental Effects- Aquatic Habitat and Channel Morphology

Summary of Effects to Aquatic Habitat and Channel Morphology

- Sub-reach A1: The Proposed Action would eliminate potential adverse impacts to redband trout habitat and channel morphology in the case of pipeline failure. During operations of the system, the Proposed Action would have predominantly neutral effects or improved redband trout habitat conditions compared to the No Action alternative. When diversion rates are less than 18.2 cfs, the additional stream flow would benefit habitat for redband trout most of the time, with the adult life stage having the greatest benefit. During operations, no measurable effects are expected in channel morphology with the Proposed Action.
- Sub-reach A2, Reaches B and C: The Proposed Action would eliminate potential adverse impacts to redband trout habitat and channel morphology in the case of pipeline failure. During operations, there would be no difference between the Proposed Action and the No Action as stream flow would be identical.

Direct and Indirect Effects – Aquatic Habitat and Channel Morphology – No Action

In the No Action alternative, the current management of water within the existing system would continue. Operation of the existing water system would result in a continual decrease of 18.2 cfs in Tumalo Creek below native flows within the 10.6 mile Sub-reach A1 except for short periods of system shut down. The water supply from Bridge Creek may be shut down occasionally for maintenance or bypassed to return flow due to excessive turbidity that makes the water unsuitable for municipal supply due to lack of filtration. Complete shutdowns for maintenance typically occur in late fall and usually last 3 to 5 days. The pipes are closed during maintenance shut downs so that no water is withdrawn from Bridge Creek (and there is no return flow to Sub-reach A2).

When turbidity increases to levels that make the water unusable for municipal drinking supply, all 18.2 cfs diverted from Bridge Creek is returned to Tumalo Creek through the Outback return flow system that discharges within Shevlin Park at the head of Sub-reach A2. The frequency and duration of this turbidity bypass varies by year and can range from about 14 days to 60 days. In the last 3 years, high turbidity events have warranted bypass 20 times, with episodes lasting 1-15 days each. The most typical turbidity bypasses occur during snow melt runoff in June/July but they can also occur during summer thunderstorms or warm rain-on-snow events in the late fall or spring.

Although current system operations would continue, demand for municipal water is projected to increase over time as discussed in the stream flow section. Effects to aquatic habitat and channel morphology are dependent on changes in stream flow, and vary by sub-reach. For aquatic habitat, potential effects for this alternative focused on redband trout habitat as this was the selected species for the in-stream flow study (HDR, 2012a). Redband trout are the only native fish species in the project area and are a Region 6 U.S. Forest Service and State of Oregon sensitive species.

Stream flow regime is a major factor in determining stream patterns, channel dimensions, bedload transport, and the distribution of geomorphic features and habitat types. Changes in the magnitude and duration of flows can influence these channel forming processes. The bankfull stage and its attendant discharge can be related to the formation, maintenance and dimensions of the channel as it exists under the modern climatic regime (Rosgen, 2009). For this reason, changes in bankfull stage were used to assess the potential for effects to channel function and conditions.

Pipeline Failure Scenario

Sub-reach A1-RR is the most susceptible of all sub-reaches to incur adverse impacts to aquatic habitat and channel morphology under the scenario of a pipeline failure due to the proximity of the pipeline to Tumalo Creek. The pipeline alignment includes an area of steep sideslopes that could potentially generate dozens of cubic yards of sediment release to Tumalo Creek. Up to nearly 4 million gallons of water could flow overland into Tumalo Creek over a period of several hours until flow in the pipes could be completely shut down. Effects would be dependent on volume of overland flow and sediment, stream flow, and time of year. Short term (<1/2 day) there could be increased stream flow that may detrimentally impact spawning habitat should it coincide with the spawning season. Aquatic habitat and channel morphology would be most affected though by the input of sediment that could alter microhabitats and reduce pool depths. The area most affected would be at and near where overland flow enters Tumalo Creek. Depending on the volume of sediment delivered, these affects may only last one or two seasons until sediment is transported downstream during higher flow events.

Sub-reaches A1-B, A2, Reach B, and Reach C would experience similar but continually diminishing short term impacts to aquatic habitat and channel morphology as sediment moves downstream and is temporarily deposited in streambed features. Effects from sediment would be dissipated but chronic for a year or two as sediment is transported downstream during high flow events.

Repairs to the pipeline could take several days to several weeks depending on the nature and extent of the repair. During this time of system shutdown, 18.2 cfs more stream flow would enter Bridge Creek over the dam at the intake facility and flow through the entire system to the mouth of Tumalo Creek. If repairs occur during the irrigation season, a portion of this additional instream flow may be utilized by TID and not enter Reaches B and C. The additional instream flow during temporary shutdown could have beneficial or detrimental impacts to aquatic habitat depending on life stage considered, sub-reach or reach, time of year, and existing stream flow. Redband adult habitat would benefit under most situations of increased stream flow.

Bridge Creek Intake and Operations

Streams above the Project Area

Approximately 16-19 cfs would continue to be diverted at the spring complex into Bridge Creek rather than flow into the Middle Fork of Tumalo Creek and eventually Tumalo Creek down to the start of the project area. The effects to aquatic habitat conditions and channel morphology would remain the same as existing conditions.

Sub-reach A1 (A1-RR and A1-B)

Under No Action, no short or long term trends or changes from existing conditions are anticipated for aquatic habitat and channel morphology throughout Sub-reach A1. Because 18.2 cfs is diverted around this sub-reach of Tumalo Creek on a perpetual basis, regardless of demand and including during periods of high turbidity, there are no changes in flow through Sub-reach A1as long as the existing system is operational. The one exception is short duration maintenance operations of 3-5 days annually where the system is bypassed at the Bridge Creek intake increasing flows 18.2 cfs.

Sub-reach A2

In the No Action alternative, any potential for effects to aquatic habitat and channel morphology from changes in water diversion would be the result of increased municipal water demand. With the City's projected increase in municipal water demand, return flows to Tumalo Creek and subsequently stream flow within Sub-reach A2 would have a decreasing trend. Stream flow would decrease over time up to the point that system capacity of 18.2 cfs is met. When demand meets capacity, then no return flow would enter Tumalo Creek. The exception would be July through most of September when in-stream water rights limit water use requiring return flow to Tumalo Creek under average or below average water years. In addition, during short term maintenance operations at the intake and when turbidity levels are high allowing full return flow then 18.2 cfs more stream flow would be left instream.

Redband trout habitat under current conditions (frequently some return flow) was compared to conditions when the demand meets the system capacity of 18.2 cfs (no return flow), using the Instream Flow Study methodology described earlier. Water Year 2011 was used to represent current conditions of municipal water use, although use was higher during the summer months than previous years, attributable to higher stream flows. In Table 26 below, habitat available under current conditions are expressed as a percentage of habitat when the system is at capacity, diverting 18.2 cfs. For example, in January under existing conditions (withdrawal of 10 cfs), adult trout habitat is 107% of what habitat is under system capacity of 18.2 cfs.

Table 26. Sub-reach A2. Monthly percent difference in AUC (available habitat) between the Current Conditions and Maximum Diversion Rate scenario (18.2 cfs) for redband trout (HDR, 2012)

AUC Tumalo Creek - Bend Oregon - Sub-reach A2												
All Water Year Types - Sum of AUC 1% to 100%												
	Current Conditions As % of Maximum Diversion Rate											
Current Conditions Withdrawal (cfs)>	**-10**	**-8**	**-8**	**-11**	**-16**	**-16**	**-17**	**-17**	**-17**	**-16**	**-8**	**-8**
Species/Lifestage	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Trout Spawning			103	100	99	99	100					
Trout Juvenile	102	102	102	101	100	100	100	100	100	101	102	102
Trout Adult	107	109	109	104	100	100	100	101	101	102	108	108
			=>100%				=>90%					

Table 26 displays that habitat conditions for current conditions are of equal or higher quality under the current conditions than when the demand meets the system capacity of 18.2 cfs, with the exception of spawning habitat during the rise and fall of the hydrograph in May and June. Reduced velocities as a result of decreased stream flow from increased demand would minimally benefit spawning during this time. For the most part, habitat conditions would have a trend of decreased quality as demand increases and stream flow decreases, with the greatest effect on adult redband trout habitat.

In most years, some return flow would still occur in late summer under No Action because of restrictions on the City's ability to withdraw water, augmenting stream flow and decreasing differences in available habitat. This was not accounted for in the modeling in Table 24 above as the full 18.2 cfs diversion was assumed.

At some future date, the demand will be at the system capacity for the months of April through June and late September through October and there would be no return flow into Sub-reach A2. The impacts to redband trout habitat would continue to increase (but at a diminishing rate) for the winter months until system capacity is realized. System capacity for the winter months is not expected until later, 2030 or beyond.

Channel Response

Reductions in stream flow with increasing municipal water demand may affect habitat for other aquatic species differently than redband trout, but effects to other species, including non-native fish species, were not modeled in the in-stream flow study. Decreased stream flow would reduce primary and secondary production by reducing available habitat for algae, aquatic macroinvertebrates, and other aquatic species due to less wetted area. A decrease in stream flow from the median stream flow of 58 cfs to 55 cfs was shown to correlate to a mean reduction in wetted width of 0.25 feet within Sub-reach A2 (Table 27 below), a change of 0.6%. Impacts to biological production and stream ecology would be minimal at this change.

Table 27. Sub-reach A2. Channel Response with reduction in stream flow of 3cfs from median discharge of 58 cfs to 55 cfs. Decrease in stream flow due to projected future increased municipal water demand. Values calculated using Cross-Section Tool provided by HDR

Transect	Habitat Type	Change in Water Elevation (ft)	Change in Wetted Perimeter (ft)	Change in Mean Velocity (ft/s)	Change in Mean Depth (ft)
1	Riffle	-0.02	0	0.06	-0.03
2	Pool	-0.03	-0.54	-0.03	-0.02
3	Riffle	-0.03	0	-0.05	-0.03
4	Riffle	-0.02	0	-0.05	-0.02
5	Riffle	-0.03	-0.95	-0.04	-0.02
6	Pool	-0.04	0	-0.02	-0.03
Average change		**-0.03**	**-0.25**	**-0.02**	**-0.025**

Bankfull flows, which can occur at any time of year in response to rain on snow, or intense thunderstorm events, typically occur in May or June in response to snowmelt. Increased demand during this period would incrementally decrease in-stream flows until demand reaches system capacity of 18.2 cfs. However, because the change in current (2011 data) and projected use during this period would only amount to a 1.7 cfs change in stream flow, the stream stage during a bankfull discharge event would not change appreciably. Because there is so much linear variation in landform throughout the sub-reach, as well as flow on a year to year and diurnal basis, such a small change in stage would not manifest measurable changes in channel form, dimensions, or ability to transport sediment.

Summary Sub-reach A2: There would be a trend of diminishing benefit to adult redband trout habitat and biological productivity compared to existing conditions as municipal water demand increases and subsequent stream flow decreases. Decreased stream flow could have either a beneficial or detrimental impact to redband juvenile or spawning habitat, but would generally be detrimental when stream flow is below about 65 cfs. In the long term (approximately 2030 and beyond), July, August, and most of September are the only months when Tumalo Creek would continue to receive any return flow, with expected returns of 2.5 to 3 cfs.

<u>Reach B</u>

Stream flow in Reach B is identical to that of Sub-reach A2 with the exception of the irrigation season of April to October when TID diverts water. Water returned at Sub-reach A2 during high turbidity events or system maintenance would carry forward to Reach B. Depending on the timing of these events and the current stream flow, this additional flow may be left instream or partially or completely captured by TID.

Diminishing return flows as municipal water demand increases has different effects to redband trout habitat than observed in Sub-reach A2 for the non-irrigation season despite identical flows, owing to differing stream morphology. Overall, this reach is narrower, higher gradient, and has larger substrate than Sub-reach A2. A reduction in stream flow during the non-irrigation season, as a function of increased municipal water demand, could have either a beneficial or detrimental impact on redband trout aquatic habitat, depending on the magnitude of discharge, the month, and life stage considered. During the non-irrigation season, redband habitat would be improved over time as demand increases as a function of decreased velocities associated with decreased stream flow. During the irrigation season, when TID withdrawals constitute a large portion of the available stream flow, habitat for all life stages could be decreased as municipal water demand increases, if additional water is available to meet the increased demands.

Similar to the process described above under Sub-reach A2, redband trout habitat under current conditions (some return flow occurring upstream in Sub-reach A2) was compared to conditions when the demand meets the system capacity of 18.2 cfs (no return flow), using the Instream Flow Study methodology. Again, water Year 2011 was used to represent current conditions of municipal water use. In Table 28 below, habitat available under current conditions are expressed as a percentage of habitat when the system is at capacity, diverting 18.2 cfs. For example, in April under existing conditions (withdrawal of 11 cfs), juvenile trout habitat is 121% of what habitat is under system capacity of 18.2 cfs diversion.

Table 28. Reach B. Monthly percent difference in AUC (available habitat) between the Current Conditions and Maximum Diversion Rate scenario for redband trout (HDR, 2012)

AUC Tumalo Creek - Bend Oregon - Reach B												
All Water Year Types - Sum of AUC 1% to 100%												
	Current Conditions As % of Max Div Rate											
Current Conditions Withdrawal (cfs)>	-10	-8	-8	-11	-16	-16	-17	-17	-17	-16	-8	-8
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			91	139	111	107	105					
Trout Juvenile	97	96	96	121	107	104	104	103	101	103	97	96
Trout Adult	99	99	99	146	112	107	106	104	101	104	100	99
			=>100%				=>90%					

During the irrigation season, projected rising demand for municipal water may increase the frequency that stream flow is reduced 1-2 cfs from existing conditions, but not lower than, the protected minimum in-stream requirement. Recently, lowest flows have been near 10 cfs. Primary and secondary production, and habitat for all life stages of redband trout are detrimentally impacted when flows are at 10 cfs or lower. Increasing the frequency that flows are reduced to near 10 cfs results in detrimental impacts to redband trout habitat and primary and secondary production.

Channel Response

In Reach B, increased municipal demand is a relatively small influencing factor on stream flow - the greatest controlling factor being water diversion for irrigation. When stream flow is reduced due to increased municipal water demand, habitat for algae, macroinvertebrates and other aquatic species would be slightly decreased due to less wetted environment. Reach B is less responsive than Sub-reach A2 to a change in wetted perimeter with a decrease in stream flow from the median stream flow. Only one transect of eight showed any measurable change in wetted perimeter when comparing the median stream flow of 58 cfs to 55 cfs (Table 29 below).

Table 29. Reach B. Channel response with reduction in stream flow of 3cfs from median discharge of 58 cfs to 55 cfs. Decrease in stream flow due to projected future increased municipal water demand

Transect	Habitat Type	Change in Water Elevation (ft)	Change in Wetted Perimeter (ft)	Change in Mean Velocity (ft/s)	Change in Mean Depth (ft)
1	Pool	-0.03	0	-0.01	-0.03
2	Riffle	-0.04	0	-0.06	-0.03
3	Riffle	-0.02	0	-0.06	-0.03
4	Riffle	-0.03	0	-0.07	-0.03
5	Riffle	-0.02	0	-0.07	-0.02
6	Glide	-0.03	0	-0.05	-0.03
7	Riffle	-0.03	0	-0.07	-0.03
8	Pool	-0.03	-0.23	-0.04	-0.03
Average Change		**-0.03**	**-0.03**	**-0.05**	**-0.03**

Channel Morphology

Because irrigation withdrawals correspond to the timing of the peak flows, this sub-reach typically does not experience bankfull flows during May and June of the magnitude experienced upstream. While increased demand could result in decreased in-stream flows during this period, the proportion of decrease in stage during a high flow event would be very small (hundredths of a foot), and would not result in measureable changes. Reach B, like other sub-reaches in Tumalo Creek can also experience high flow events at or above bankfull levels outside of the irrigation season. These events may occur at any time as a result rain-on-snow. These events are extremely variable in nature and would produce flows similar to what would be experienced in sub-reach A2 upstream. A trend of diminishing stream flow with increasing municipal water demand, including during high flow events, would minimally affect channel processes and features such as sediment routing, aggradation, degradation, and pool and riffle depths.

Summary Reach B: Under the No Action alternative, there would be a trend of increasing impacts to aquatic habitat compared to existing conditions as municipal water demand increases. Impacts to redband trout may be either beneficial or detrimental, depending on the time of year and the life stage considered. Generally beneficial impacts would occur to all redband trout life stages during the non-irrigation season due primarily to a reduction in velocities. Detrimental impacts to juvenile and adult redband habitat would occur in late summer and early fall when stream flow is low, if water is available under the City's existing water rights to meet increased demand. Effects to aquatic habitat during low flow months have been reduced in recent years by water conservation measures that increase minimum flows.

The degree of flow reduction that would occur between current and maximum use rates during the high flow months of May and June are not of the magnitude that would impair the physical processes of the stream. Tumalo Creek would continue to be able to access its floodplain and transport bed material in a sufficient manner to maintain stream channel stability, freshen spawning gravels, and maintain channel characteristics. There would be a trend of increasing detrimental impacts, although minimal, to channel processes and features.

<u>Reach C-Middle Deschutes River</u>

Reduced stream flow to the Deschutes River (because of increased demand) would reach a maximum of about 10.1 cfs from current conditions during the winter months of November to March when Deschutes flows are at their annual maximums. This reduced flow represents about 1.7% of winter flows in the Middle Deschutes River. Effects to aquatic habitat would be minimal. The reduced stream flow of 1-2 cfs (because of increased demand) reaching the Deschutes River during the summer months represents less than 2% of the total stream flow of 100-150 cfs. Effects to aquatic habitat would be minimal. Any effects would eventually be attenuated by the input of springs near Lower Bridge 26 miles downriver of the confluence with Tumalo Creek. Additional flow returned at Sub-reach A2 during maintenance operations or high turbidity events would augment flows of the Deschutes River if not captured within Reach B by TID withdrawals.

The Middle Deschutes River no longer receives bankfull flows at or near historic conditions because of upriver water management. During the winter months (high flow period), storage of water in Wickiup Reservoir reduces flow below historic rates. Irrigation water diversions at Bend utilize this stored water during the summer season. The "bankfull" discharge that would have occurred in the spring and early summer is now the low flow period for the river. The greatest potential for changes in flow from Tumalo Creek to affect fluvial processes on the middle Deschutes River would occur during these relatively high winter flow periods. However, even with maximum projected demand with the existing system, the change in flow (maximum of ~10 cfs) entering the Deschutes would constitute a 1.7% change in discharge. The effect on stage and fluvial processes would be too small to measure.

Summary of Channel Morphology Reach C: While a trend of decreased flows would indicate a potential for increasing effects to aquatic habitat and channel morphology as demand increases, the effects would be minimal and likely immeasurable. Long term effects to aquatic habitat in this part of the Deschutes River are most heavily affected by water use and conservation practices on the main stem of the Deschutes River upstream. Recently the trend has been toward improved in-stream flows as a result of conservation practices with irrigation districts and the Groundwater Mitigation Program. Conservation practices are ongoing and will continue into the foreseeable future. The Groundwater Mitigation Program is due to expire in 2029 but could be extended.

Direct and Indirect Effects – Aquatic Habitat and Channel Morphology – Proposed Action

As with stream flow, implementation of the Proposed Action would affect aquatic habitat and channel morphology in Tumalo Creek at two different periods – installation and operation. The magnitude and duration of the effects would be different, and will be discussed separately.

Installation:

Replacing the pipeline would impact aquatic habitat and channel morphology of Tumalo Creek at the crossing below Skyliners Bridge within Sub-reach A1-RR. Approximately 80-100 feet of stream channel would be de-watered and unavailable to fish and other aquatic life during the construction period, which may occur intermittently over a 3-4 week period. Downstream fish passage would be maintained but upstream passage would be eliminated during this time. Channel morphology would be temporarily affected by trenching the streambed (intermittent work over a 3-4 week period). After construction is completed at the crossing, the channel morphology would be returned to pre-construction conditions per BMPs Facilities-9 and AqEco-2. As the channel is re-watered post construction, some fine sediment would be entrained and turbidity would increase downstream. This would temporarily impact foraging for redband trout. Effects are anticipated to diminish within 2-3 miles downstream and persist for less than 1 day. Benthic invertebrates and plants would recolonize the stream bed within 1 month. There would be no long term (> 1 month) effects to the channel, redband trout, or redband trout habitat from streambed trenching.

Pipeline installation would require temporary shutdown of the system in fall 2013 for up to two months, but could be longer. This would result in 18.2 cfs additional flow through Sub-reaches A1-RR, A1-B, and A-2, benefitting aquatic habitat overall during this time. Adult habitat would especially benefit. Benefits would vary depending on flows in Crater Creek ditch at this time. There may be a benefit to biological production within Reach B during system shutdown but irrigation demand may claim the additional flow, negating any benefits. Effects to juvenile and adult habitat from augmented stream flow would vary with TID operations. When existing stream flows below the TID diversion are less than approximately 35 cfs, both juvenile and adult habitat would benefit from an increase in stream flow. When stream flows are greater than approximately 35 cfs, juvenile habitat may be reduced and adult habitat would either not be affected or be reduced. Habitat reduction would be on account of increased velocities.

Operations:

Demand for municipal water is projected to increase over time as shown in discussion under the stream flow section. Effects to aquatic habitat and channel morphology are dependent on the magnitude and timing of changes in stream flow, and vary by sub-reach.

As with the No Action Alternative, the potential effects to aquatic habitat is focused on redband trout habitat. The In-stream Flow Study (HDR 2012) compared changes in aquatic habitat between the existing system with a constant diversion of 18.2 cfs, and diversion rates based on projected surface water use. With the Proposed Action, flow control at the Bridge Creek intake would allow more water to be left instream throughout Sub-reach A1 than under existing conditions when demand is less than capacity (<18.2 cfs) or when stream flow is in distribution (July through September 22).

Flow Scenarios:

The in-stream flow study used hydrology data sets comparing the existing system (constant 18.2 cfs diversion rate at the Bridge Creek intake with return flow to Tumalo Creek from the Outback site) to 3 different hypothetical flow scenarios under the Proposed Action that utilizes flow control at the Bridge Creek intake:

1) Current demand (2011 water year). Referred to as the short-term scenario.

2) Projected future water use with an increased demand above current conditions (approximately Year 2020 per Table 18 but represents a future demand scenario rather than a specific year. Referred to as the mid-term scenario.

3) System capacity of 18.2 cfs demand (approximately 2030 and beyond per Table 18). Only the time period of July through September 22nd is compared in the analysis for when the system is run at capacity. This is the period distribution limits municipal water diversion rates below system capacity and augments stream flow throughout Sub-reach A1 - the rest of the year the diversion rates would be identical to the existing system. Distribution does not occur every year. Referred to as the long-term scenario.

Only Sub-reach A1 was considered in the habitat comparison between the No Action and Proposed Action alternatives since instream flows downstream in Sub-reach A2 and Reach B would be identical between the two alternatives (existing system returns flow short of demand back into Sub-reach A2 and Reach B). As previously mentioned, Sub-reach A1 is further broken down into Sub-reach A1-RR Upper, Sub-reach A1-RR Lower, and Sub-reach A1-B.

Tables 30-32, 34-36, 39-41, and 44-46 below display the results of the modeled available redband trout habitat comparing the Proposed Action to the No Action alternative for all 3 flow scenarios for Sub-reaches A1-RR Upper, A1-RR Lower, A1-B, and Sub-reach A1 in its entirety. The results are expressed as the percent of habitat available if the Proposed Action is implemented, compared to the existing system, or No Action alternative. Values greater than 100% represent an increase in habitat, while values less than 100% represent a decrease in habitat by implementing the Proposed Action.

Sub-reach A-1

As described earlier, the proposed system allows control over flow volumes diverted for municipal use to occur at the Bridge Creek intake facility. When demand is less than 18.2 cfs, there would be increased in-stream flow through Sub-reach A1 owing to the project's new ability to control flow at the top of the system rather than return unused water at the top of Sub-reach A2 as is the case with the existing system. In examining projected increases in municipal water demand, improved in-stream flow conditions in Sub-reach A1 would persist until demand meets the current diversion rate of 18.2 cfs and water rights allowed the greater diversion. Long term (beyond approximately 2030) in-stream flow benefits would continue in some years during the months of July, August, and into September when native stream flow is low and is distributed between the City of Bend, TID, and in-stream water rights. Municipal water use is projected to be 15.0 to 15.5 cfs during this time, resulting in an average net benefit in flow of approximately 2.5 to 3 cfs out to and beyond approximately 2033 (Table 16). Based on projected water demand, in the immediate short term (out to approximately 2015) there would be more in-stream flow with the exceptions of the high flow months of April to June and the low flow period of late September through October, in which flows would essentially be the same as the existing system.

More in-stream flow in Sub-reach A1 in the short term would have varying effects on redband aquatic habitat depending on the time of year, stream flow, and life stage. A gradual increase in water demand would decrease in-stream flow augmentations so that by approximately 2030 there would be no difference in stream flow and effects to aquatic habitat and channel morphology compared to the existing system, with the exception of July through September 22 that would continue to have an in-stream flow benefit of nearly 3 cfs, when in distribution.

The stream flow benefit from flow control at the Bridge Creek intake facility would be realized throughout the 10.6 mile sub-reach, or 66.3% of the total project area. All flow benefit to Tumalo Creek from flow control first passes through the 0.2 mile section of Bridge Creek below the intake facility.

Sub-reach A1-RR Upper

Effects to habitat for the 3 flow scenarios are discussed below.

Flow Scenario #1(short term): Increased instream flow, compared to current conditions, exhibited either a neutral or beneficial impact to habitat for all 3 life stages, dependent on the month (Table 30 below). Adult habitat showed the greatest increase, especially in the winter months, with modeled monthly increases of up to 8%.

Table 30 below from the instream flow study (HDR 2013a) compares the Proposed Action habitat conditions to the existing system diversion on a monthly basis for Sub-reach A1-RR Upper. As an example, under the Proposed Action, there would be 106% of adult habitat available in January when compared to the existing system.

Table 30. Sub-reach A1-RR Upper. Monthly percent difference in AUC (available habitat) between the No Action and Proposed Action alternatives for redband trout for Current Water use scenario (HDR, 2013a)

Tumalo Creek - Bend Oregon - A1RR Upper												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Current (2011) Water Use												
Proposed Action Diversions (cfs)>	-10.2	-8.2	-8.1	-11.1	-16.5	-16.5	-17.1	-17.2	-17.2	-16.5	-8.1	-8.3
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			103%	100%	100%	100%	100%					
Trout Juvenile	101%	102%	102%	101%	100%	100%	100%	100%	100%	100%	102%	102%
Trout Adult	106%	107%	108%	103%	100%	100%	100%	101%	101%	102%	107%	107%
	=>100%											

Flow Scenario #2 (mid-term): Increased municipal demand under this scenario would decrease the instream flow benefit and associated habitat benefit compared to flow scenario #1. Still, there would be a neutral or beneficial impact to habitat for all life stages and all months. Adult habitat would again be most benefitted, again primarily in the winter months. The maximum monthly benefit would be 3%.

Table 31. Sub-reach A1-RR Upper. Monthly percent difference in AUC (available habitat) between the No Action and Proposed Action alternatives for redband trout 2020 flow scenario (HDR, 2013a)

Tumalo Creek - Bend Oregon - A1RR Upper												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Projected Year 2020 Water Use												
Proposed Action Diversions (cfs)>	-16.3	-14.6	-14.6	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-14.7	-15
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			102%	100%	100%	100%	100%					
Trout Juvenile	100%	101%	101%	100%	100%	100%	100%	100%	100%	100%	101%	101%
Trout Adult	102%	103%	103%	100%	100%	100%	101%	102%	100%	100%	103%	102%
	=>100%											

Flow Scenario #3 (long term): Since stream flow would be the same, there would be no change in habitat conditions except during distribution between July and September 22nd. During this time, there would be a 1-2% increase in adult habitat but no change in juvenile or spawning habitat. The maximum diversion rate of 18.2 cfs was used in the modeling for September, although distribution would typically result in 2.5 to 3 more cfs instream through September 22nd. This is also the case in Sub-reaches A1-RR Lower and A1-B.

Table 32. Sub-reach A1-RR Upper. Monthly percent difference in AUC (available habitat) between the No Action and Proposed Action alternatives for redband trout maximum use scenario (HDR, 2013a)

Tumalo Creek - Bend Oregon - A1RR Upper												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Projected Long Term Maximum Water Use												
Proposed Action Diversions (cfs)>	-18.2	-18.2	-18.2	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-18.2	-18.2
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			100%	100%	100%	100%	100%					
Trout Juvenile	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Trout Adult	100%	100%	100%	100%	100%	100%	101%	102%	100%	100%	100%	100%
	=>100%											

Approximately 0.2 miles of Bridge Creek from the diversion dam to the confluence with Tumalo Creek is also within this sub-reach, but was not included in the Instream Flow Study area. Since Bridge Creek is a smaller stream with less stream flow than Tumalo Creek within the project area, the anticipated increase of up to 10 cfs on a monthly average would represent a proportionally larger volume of the total stream flow. Gradient is high within this Rosgen A/B type channel, so an increase in velocity may slight decrease spawning or juvenile habitat. Adult habitat is likely to be increased. During the 2011 fisheries survey, this stretch of Bridge Creek had the lowest density of redband trout of all sites sampled within the entire project area.

Base Flow Habitat Assessment: The increase in stream flow was evaluated for effects to base flow habitat conditions for all 3 hypothetical flow scenarios. Under existing conditions, the months of January – March and September and October had less than an excellent habitat rating. Under flow scenario #1, all 5 months would have an increase in base flow and 3 months moved into the excellent habitat rating. Under flow scenario #2, 3 months would have an increase in base flow above existing conditions, and two months would move into the excellent habitat rating. Habitat rating would not change under flow scenario #3, although during the distribution period, most of September may see an increase in base flow of 2-3 cfs, bringing the habitat rating near excellent.

Table 33. Sub-reach A1-RR Upper. Evaluation of trout habitat based on change in base flows under the Proposed Action for 3 hypothetical flow scenarios

Month	Mean Monthly Native Q	Mean Native annual Q	≤25% mean native annual Q	>25% & <50% mean native annual Q	≥50% mean native annual Q	Mean Monthly Q@18.2 cfs diversion	Mean Monthly Q for Flow Scenario #1	Mean Monthly Q for Flow Scenario #2	Mean Monthly Q for Flow Scenario #3
January	59	84	≤21	21.1 - 41.9	≥42	40.8	48.8	42.7	40.8
February	60.2	84	≤21	21.1 - 41.9	≥42	41.9	51.9	45.5	41.9
March	55.7	84	≤21	21.1 - 41.9	≥42	37.5	47.6	41.1	37.5
September	56.4	84	≤21	21.1 - 41.9	≥42	38.2	39.2	38.2	38.2
October	57.3	84	≤21	21.1 - 41.9	≥42	39.1	40.8	39.1	39.1

Summary of Habitat Conditions A1-RR Upper: An increase in stream flow under the Proposed Action would generally benefit redband habitat conditions. Benefits decrease with increased municipal demand. Adult and spawning habitat would especially benefit from additional stream flow during very low flow conditions.

Channel Morphology A1-RR Upper: Channel response to changes in flow will be somewhat dynamic. Initially, even increases in demand with the proposed system would equate to increases in stream flow before current flow levels are met when demand reaches 18.2 cfs. As discussed earlier, the C-type channel that exists through this part of the project area is an alluvial reach of stream, which is more apt to adjust to changes in flow and sediment regime through a series of erosional and depositional processes. At current water use rates of 16.5 cfs during the normal peak flow period of May and June, in-stream flow rates would increase approximately 1.7 cfs. Because channel conditions in this sub-reach of the stream have been restored and is functioning properly, this small augmentation of stream flow would have little to no effect on the channel. Currently the channel has well vegetated banks, has an optimum amount of coarse woody debris in channel and on the floodplain, and is able to access its floodplain during a normal peak flow event with a 1.5 - 2.0 year return interval. This allows the stream to dissipate energy over its floodplain which moderates shear stress to the channel bed and banks. Well vegetated banks help to retain bank stability during these high flow events. Because of the natural variability in discharge during high flow events, this magnitude of change (1.7 cfs) would be well within what would be considered a natural range of variability.

Once demand increases to 18.2 cfs, in-stream flows would diminish slightly during high flow events. Under the Proposed Action, there is no expected change in the ability of the channel to access its floodplain and process bedload during normal bankfull events.

Initially, the 0.2 mile reach of Bridge Creek would often have more stream flow than current conditions (2011 data). Winter flows would increase 8-10 cfs and summer flows 1-2 cfs on average compared to 2011 conditions. Currently, during maintenance operations and high turbidity events when the system is bypassed, the entire discharge of Bridge Creek passes through this reach. No channel instability or bank erosion has occurred as a result of these higher flows due to the inherent natural stability of this Rosgen A/B channel type. Increased discharge associated with the proposed system is expected to be well within the range of channel forming event experienced historically, including rain-on-snow events, prior to the operation of the surface water system. Channel morphology and stream banks are expected to remain stable within this resilient portion of Bridge Creek.

Sub-reach A1-RR Lower

Flow Scenario #1: With additional stream flow under the Proposed Action, trout spawning showed a decrease in available habitat for all 5 months and juvenile habitat showed a decrease in available habitat during the winter months, due to increased velocities. Adult habitat exhibited a neutral effect or a slight benefit (up to 2% increase in winter months). Increased depths results in increased adult habitat.

Table 34. Sub-reach A1-RR – Lower. Monthly percent difference in AUC (available habitat) between the No Action and Proposed Action alternatives for redband trout for Current Water use scenario (HDR, 2013a)

Tumalo Creek - Bend Oregon - A1RR Lower												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Current (2011) Water Use												
Proposed Action Diversions (cfs)>	-10.2	-8.2	-8.1	-11.1	-16.5	-16.5	-17.1	-17.2	-17.2	-16.5	-8.1	-8.3
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			96%	95%	98%	98%	99%					
Trout Juvenile	98%	98%	98%	98%	100%	100%	100%	100%	100%	100%	98%	98%
Trout Adult	102%	102%	102%	101%	100%	100%	100%	100%	100%	101%	102%	102%
	=>100%											
	=>90%											

Flow Scenario #2: The modeling of stream flows under the Proposed Action demonstrated a neutral or slight decrease (1-2%) to spawning and juvenile habitat, due to slightly increased velocities. Adult habitat demonstrated a neutral or slight benefit (1%), mostly benefitting wintering habitat, again due to slightly increased depths.

Table 35. Sub-reach A1-RR – Lower. Monthly percent difference in AUC (available habitat) between the No Action and Proposed Action alternatives for redband trout 2020 flow scenario (HDR, 2013a)

Tumalo Creek - Bend Oregon - A1RR Lower												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Projected Year 2020 Water Use												
Proposed Action Diversions (cfs)>	-16.3	-14.6	-14.6	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-14.7	-15
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			99%	100%	100%	100%	98%					
Trout Juvenile	100%	99%	99%	100%	100%	100%	99%	99%	100%	100%	99%	99%
Trout Adult	100%	101%	101%	100%	100%	100%	100%	101%	100%	100%	101%	101%
	=>100%											
	=>90%											

Flow Scenario #3: Only during the distribution period would flows be different between the alternatives. Under the Proposed Action, spawning and juvenile habitat showed a neutral or slight decrease (1-2%). Adult habitat demonstrated a slight benefit (1%).

Table 36. Sub-reach A1-RR – Lower. Monthly percent difference in AUC (available habitat) between the No Action and Proposed Action alternatives for redband trout maximum use scenario (HDR, 2013a)

Tumalo Creek - Bend Oregon - A1RR Lower												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Projected Long Term Maximum Water Use												
Proposed Action Diversions (cfs)>	-18.2	-18.2	-18.2	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-18.2	-18.2
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			100%	100%	100%	100%	98%					
Trout Juvenile	100%	100%	100%	100%	100%	100%	99%	99%	100%	100%	100%	100%
Trout Adult	100%	100%	100%	100%	100%	100%	100%	101%	100%	100%	100%	100%
	=>100%											
	=>90%											

<u>**Base Flow Habitat Assessment**</u>: Base flow conditions for trout habitat would continue to rate as excellent for all months under all 3 flow scenarios as base flow is maintained or increased in all months.

<u>**Summary of Habitat Conditions A1-RR Lower**</u>: Despite more stream flow under the Proposed Action, habitat conditions for spawning and juvenile habitats at times decreased due to increased velocities. For example, from a review of the habitat suitability curves for juveniles (HDR 2012a), an increase in depth from increased flow would benefit redband juvenile habitat up to 1.3 foot depth (with no further gain at greater depths), but increased velocities above 0.45 feet/second reduces habitat. Therefore, the role of increased velocity has more influence than increased depth in the slight decrease in juvenile habitat modeled.

Transects were chosen to represent typical habitat conditions and frequency, but only cover a small percentage of available habitat. There may be other habitat features and variability not captured in modeling (wood and rocks near the stream edge that would slow velocity, provide microhabitats, etc.)

Channel Morphology A1-RR Lower: The lower part of Sub-reach A1-RR is also a C-type channel that is considered to be in a properly functioning condition with respect to riparian vegetation, coarse woody debris, and access to the floodplain. Here too, because the incremental changes to peak flow values are so small (+1.7 cfs), the magnitude of change to stage and channel shear would be virtually immeasurable. Because of the properly functioning condition of this channel, there would be no effect to channel morphology.

Channel Response for Sub-reach A1-RR (Upper and Lower Combined): There would be more stream flow in Sub-reach A1-RR than existing conditions until demand reached system capacity, with the exception of July through September 22nd when distribution is expected to result in a persistent 2.5 to 3 cfs more stream flow throughout Sub-reach A1. Distribution would not occur every year. Channel features would show little response to a nearly 3 cfs increase in discharge as would occur under the Proposed Action when modeled near median stream flow. Comparing discharges of 58 cfs and 61 cfs, pool and riffle maximum depths increased by 0.04 feet or less, with an average of 0.03 feet. Wetted perimeter averaged an increase of 0.57 feet, or 1.8%, and mean velocities increased by 0.02 feet/second. Mean depths were increased less than .005 feet on average (Table 37 below). The increase in maximum depth, wetted perimeter, and mean depth would minimally increase primary and secondary biological production.

Table 37. Sub-reach A1-RR. Channel response with increase in stream flow of 3 cfs from median discharge of 58 cfs to 61 cfs

Transect	Habitat Type	Change in Water Elevation (ft)	Change in Wetted Perimeter (ft)	Change in Mean Velocity (ft/s)	Change in Mean Depth (ft)
1	Riffle	0.03	0.58	0.02	0
2	Pool	0.04	0.51	-0.02	-0.03
3	Riffle	0.01	0.50	0.06	0.02
4	Riffle	0.02	0	0.07	0.02
5	Pool	0.03	0	-0.02	0.03
6	Riffle	0.03	0.32	0.06	0
7	Riffle	0.02	1.56	0.02	0
8	Pool	0.04	1.05	-0.06	0
Average change		**0.03**	**0.57**	**0.02**	**0.005**

Transects 4-8 were located above most of the accretion flow where median discharge would be less than 58 cfs. Changes may be slightly greater above the accretion area.

Initially, the proposed system would result in up to an additional 8-10 cfs instream during the winter months in Sub-reach A1-RR compared to the existing system (See Table 18– 2011 water use). Channel response was calculated comparing the median discharge of 58 cfs to 67 cfs. All parameters showed a greater increase than the 58 cfs vs. 61 cfs comparison. Maximum depth increased by an average of 0.08 feet, wetted perimeter increased by an average of 1.18 feet (3.7%), mean velocities increased by an average of 0.10 feet/second, and mean depths increased by an average of 0.02 feet. Primary and secondary production would minimally benefit above the 58 cfs vs. 61 cfs comparison, in part limited by the winter season these increased flows would occur when primary and secondary production is subdued.

Table 38. Sub-reach A1-RR. Channel response with increase in stream flow of 9 cfs from median discharge of 58 cfs to 67 cfs

Transect	Habitat Type	Change in Water Elevation (ft)	Change in Wetted Perimeter (ft)	Change in Mean Velocity (ft/s)	Change in Mean Depth (ft)
1	Riffle	0.08	0.58	0.05	0.05
2	Pool	0.11	1.01	0.11	-0.02
3	Riffle	0.04	1.31	0.1	0.05
4	Riffle	0.06	0.51	0.14	0.04
5	Pool	0.07	1.23	0.07	-0.02
6	Riffle	0.07	0.32	0.16	0.05
7	Riffle	0.07	2.03	0.13	0.03
8	Pool	0.1	2.46	0.04	-0.03
Average change		**0.08**	**1.18**	**0.10**	**0.02**

Transects 4-8 were located above most of the accretion flow where median discharge would be less than 58 cfs.

Sub-reach A1-B

Flow scenario #1: The Proposed Action demonstrated a neutral or beneficial effect to all life stages with the exception of a 1% decrease in spawning during June. Higher velocities likely result in this slight decrease at this time. Adult wintering habitat benefitted the greatest, with a maximum benefit of 9%. A relatively large increase in spawning in March (7%) is likely due to more areas being inundated with the increased flows.

Table 39. Sub-reach A1-B. Monthly percent difference in AUC (available habitat) between the Proposed Action and No Action alternatives for redband trout under current water use scenario (HDR 2013a)

Tumalo Creek - Bend Oregon - Sub-reach A1B												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Current (2011) Water Use												
Proposed Action Diversions (cfs)>	-10.2	-8.2	-8.1	-11.1	-16.5	-16.5	-17.1	-17.2	-17.2	-16.5	-8.1	-8.3
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			107%	102%	100%	99%	100%					
Trout Juvenile	103%	103%	103%	101%	100%	100%	100%	100%	100%	101%	103%	103%
Trout Adult	107%	109%	109%	104%	100%	100%	100%	101%	101%	102%	108%	108%
	=>100%											
	=>90%											

Flow Scenario #2: Under the Proposed Action, there would be a neutral or beneficial effect to all life stages, again with adult habitat, primarily wintering habitat, demonstrating the greatest benefit. Benefits are decreased compared to flow scenario #1.

Table 40. Sub-reach A1-B. Monthly percent difference in AUC(available habitat) between the Proposed Action and No Action alternatives for redband trout under projected 2020 water use scenario (HDR 2013a)

Tumalo Creek - Bend Oregon –Sub-reach A1B												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Projected Year 2020 Water Use												
Proposed Action Diversions (cfs)>	-16.3	-14.6	-14.6	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-14.7	-15
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			103%	100%	100%	100%	100%					
Trout Juvenile	101%	101%	101%	100%	100%	100%	100%	101%	100%	100%	101%	101%
Trout Adult	102%	103%	103%	100%	100%	100%	101%	103%	100%	100%	103%	103%
	=>100%											

Flow scenario #3: Under the Proposed Action, there would be a neutral effect to spawning, a neutral or slight increase in juvenile habitat (up to 1%), and a slight increase (1-3%) in adult habitat when in the July through September 22nd distribution period.

Table 41. Sub-reach A1-B. Monthly percent difference in AUC(available habitat) between the Proposed Action and No Action alternatives for redband trout under maximum water use scenario (HDR 2013a)

Tumalo Creek - Bend Oregon - Sub-reach A1B												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Build Alternative Expressed As a Percent of the No Build (18.2 cfs Diversion) Alternative Alternatives Compared under Projected Long Term Maximum Water Use												
Proposed Action Diversions (cfs)>	-18.2	-18.2	-18.2	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-18.2	-18.2
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			100%	100%	100%	100%	100%					
Trout Juvenile	100%	100%	100%	100%	100%	100%	100%	101%	100%	100%	100%	100%
Trout Adult	100%	100%	100%	100%	100%	100%	101%	103%	100%	100%	100%	100%
	=>100%											

Base Flow Habitat Assessment: Base flow conditions for trout habitat would continue to rate as excellent for all months under all 3 flow scenarios as base flow is maintained or increased in all months.

Summary for Habitat Conditions A1-B: Overall, increased flow demonstrated a benefit to redband trout habitat, but benefits would diminish as municipal water demand increases over time. Eventually, if municipal water demand increases during the winter and the system is run at capacity, the only benefits would be realized during the distribution period, when in effect.

Channel response for Sub-reach A1-B: Augmented flow would carry through Sub-reach A1-RR into Sub-reach A1-B. Similar to what was observed in upstream in Sub-reach A1-RR, channel features would show little response to a nearly 3 cfs increase in discharge as would occur under the Proposed Action when modeled near median stream flow. Comparing discharges of 58 cfs and 61 cfs, pool, rapid, and riffle maximum depths increased by 0.04 feet or less, with an average of 0.03 feet. Wetted perimeter only changed at one of the 9 transects, with a mean change of 0.10 feet, or 0.3%.

Mean velocities averaged an increase of by 0.04 feet/second, and mean depths were increased less than

.023 feet on average (Table 42 below). Similar to described above under Sub-reach A1-RR, primary and secondary biological production would minimally benefit.

Table 42. Sub-reach A1-B. Channel response with increase in stream flow of 3cfs from median discharge of 58 cfs to 61 cfs

Transect	Habitat Type	Change in Water Elevation (ft)	Change in Wetted Perimeter (ft)	Change in Mean Velocity (ft/s)	Change in Mean Depth (ft)
1	Riffle	0.03	0	0.05	0.02
2	Riffle	0.03	0	0.04	0.04
3	Pool	0.03	0	0.04	0.03
4	Rapid	0.03	0	0.05	0.03
5	Rapid	0.03	0	0.05	0.03
6	Riffle	0.02	0	0.05	0.03
7	Pool	0.03	0	0.05	0.02
8	Pool	0.04	0.89	-0.01	-0.02
9	Rapid	0.03	0	0.05	0.03
Average change		**0.03**	**0.10**	**0.04**	**0.023**

Given the same reasoning as described above under Sub-reach A1-RR, channel response was calculated comparing the median discharge of 58 cfs to 67 cfs. All parameters showed a greater increase than the 58 cfs vs. 61 cfs scenario. Maximum depth in pools, rapids, and riffles increased by an average of 0.09 feet, wetted perimeter increased by an average of 0.25 feet (0.7%), mean velocities increased by an average of 0.13 feet/second, and mean depth increased by an average of 0.07 feet. Similar to described above under Sub-reach A1-RR, primary and secondary production would increase minimally compared to the 58 cfs vs. 61 cfs scenario (Table 42 above) with the additional 6 cfs stream flow.

Table 43. Sub-reach A1-B. Channel response with increase in stream flow of 9 cfs from median discharge of 58 cfs to 67 cfs

Transect	Habitat Type	Change in Water Elevation (ft)	Change in Wetted Perimeter (ft)	Change in Mean Velocity (ft/s)	Change in Mean Depth (ft)
1	Riffle	0.08	0	0.13	0.07
2	Riffle	0.09	0	0.13	0.10
3	Pool	0.09	0	0.14	0.09
4	Rapid	0.10	0	0.14	0.10
5	Rapid	0.10	0.32	0.14	0.09
6	Riffle	0.07	0	0.13	0.07
7	Pool	0.047	0	0.16	0.06
8	Pool	0.10	1.92	0.07	-0.04
9	Rapid	0.09	0	0.13	0.09
Average change		**0.09**	**0.25**	**0.13**	**0.07**

Channel Morphology A1-B: Sub-reach A1-B is a higher energy Rosgen B-type channel. These channels are characterized as sediment transport sub-reaches, usually contain coarser bedload, and are inherently more stable.

With the installation of the proposed system, stream flow through Sub-reach A1-B, like Sub-reach A1-RR, would initially increase. Changes in stage and channel shear during the bankfull or greater event compared to existing conditions would not be great enough to measurably change channel form, or sediment transport regimes.

Summary of Aquatic Habitat for Sub-reach A1: The results of changes to redband habitat for Sub-reaches A1-RR(Upper and Lower) and A1-B within Sub-reach A1 were combined and presented in Table 44 below.

Flow Scenario #1: For Sub-reach A1 in its entirety, under the Proposed Action the modeling predicts a neutral effect or slight decrease (up to 2%) in spawning habitat, a neutral to slight benefit (up to 2%) increase in juvenile habitat, and a neutral to relatively large increase (up to 7%) in adult habitat, especially in the winter months.

Table 44. Sub-reach A1. Monthly percent difference in AUC(available habitat) between the Proposed Action and No Action alternatives for redband trout under current water use scenario (HDR 2013a)

Tumalo Creek - Bend Oregon - Sub-reach A1 Combined												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Current (2011) Water Use												
Proposed Action Diversions (cfs)>	-10.2	-8.2	-8.1	-11.1	-16.5	-16.5	-17.1	-17.2	-17.2	-16.5	-8.1	-8.3
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			101%	98%	99%	99%	100%					
Trout Juvenile	101%	102%	102%	101%	100%	100%	100%	100%	100%	100%	102%	101%
Trout Adult	106%	107%	107%	103%	100%	100%	100%	101%	101%	101%	107%	106%
	=>100%											
	=>90%											

Flow Scenario #2: The Proposed Action would have a neutral or beneficial effect to all life stages for all months with the exception of spawning in July. Again, wintering habitat for adult redband trout would see the greatest benefit, primarily due to increased depths.

Table 45. Sub-reach A1. Monthly percent difference in AUC (available habitat) between the Proposed Action and No Action alternatives for redband trout under projected 2020 water use scenario (HDR 2013a)

Tumalo Creek - Bend Oregon –Sub-reach A1 Combined												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action (18.2 cfs Diversion) Alternative Alternatives Compared under Projected Year 2020 Water Use												
Proposed Action Diversions (cfs)>	-16.3	-14.6	-14.6	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-14.7	-15
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			101%	100%	100%	100%	99%					
Trout Juvenile	100%	101%	101%	100%	100%	100%	100%	100%	100%	100%	101%	101%
Trout Adult	101%	103%	103%	100%	100%	100%	101%	102%	100%	100%	102%	102%
	=>100%											
	=>90%											

Flow scenario #3: For Sub-reach A1 in its entirety, the Proposed Action demonstrated a slight decrease (1%) in spawning habitat for one month (July), a neutral effect to juvenile habitat, and a slight increase (up to 2%) in adult habitat when Tumalo Creek is in distribution. The increase in adult habitat is primarily due to increased depths.

Table 46. Sub-reach A1. Monthly percent difference in AUC(available habitat) between the Proposed Action and No Action alternatives for redband trout under maximum water use scenario(HDR 2013a)

Tumalo Creek - Bend Oregon –Sub-reach A1 Combined												
All Water Year Types - Sum of AUC 1% to 100%												
Estimated Habitat Available: Proposed Action Expressed As a Percent of the No Action(18.2 cfs Diversion) Alternative Alternatives Compared under Projected Long Term Maximum Water Use												
Proposed Action Diversions (cfs)>	-18.2	-18.2	-18.2	-18.2	-18.2	-18.2	-15.5	-15	-18.2	-18.2	-18.2	-18.2
Species/Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Trout Spawning			100%	100%	100%	100%	99%					
Trout Juvenile	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Trout Adult	100%	100%	100%	100%	100%	100%	101%	102%	100%	100%	100%	100%
	=>100%											
	=>90%											

For Sub-reach A1 in its entirety, the modeling demonstrated that adult habitat would most benefit from additional stream flow, with diminishing benefits as municipal water demand increases over time. Minimal benefits to juvenile habitat from increased flow would also diminish over time as demand increases. Initial decreases to spawning habitat from increased flow and associated increased velocities would diminish over time as demand increases. Eventually, if municipal water demand during winter materializes and the system is at maximum use, there is essentially no difference between the two alternatives as flows would be the same, with the exception of July spawning habitat.

The small differences displayed between the alternatives (often 1-2%) are likely artifacts of the modeling.

Channel Response for Sub-reach A1: Channel response was averaged for the 17 transects within Sub-reach A1 at two different flow scenarios, 58 cfs vs. 61 cfs and 58 cfs versus 67 cfs. All parameters increased with the additional stream flow, with greater increases seen at the higher stream flow. Overall, biological production would increase with more flow, but increased flow would mostly occur during winter when biological production is subdued.

Table 47. Sub-reach A1. Channel response with increase in stream flow of 3 cfs and 9 cfs from median discharge of 58 cfs

Flow Scenario	Mean change in Water Elevation (ft)	Mean Change in Wetted Perimeter (ft)	Mean % Change in Wetted Perimeter	Mean change in velocity (ft/s)	Mean change in depth (ft)
58 cfs vs. 61 cfs	0.03	0.32	1%	0.03	0.023
58 cfs vs. 67 cfs	0.08	0.69	2.1%	0.12	0.05

Sub-reach A-2

Aquatic habitat in Sub-reach A2 would benefit under the Proposed Action in both the short term and long term with elimination of the return flow that has chronically introduced sediment to Tumalo Creek with the existing system. Effects to aquatic habitat based on stream flow would be the same as the existing system since excess water beyond demand is returned to Tumalo Creek under the existing system. Stream flow would be the same in Sub-reach A2 under the Proposed Action as the existing system. Identical to No Action, any changes to redband trout habitat based on stream flow would be a function of increasing municipal water demand. There would continue to be stream flow benefits July through September 22nd due to water rights distribution.

During high turbidity events, all 18.2 cfs of the diverted flow under existing conditions is bypassed at the Outback site and put back in Tumalo Creek at the start of Sub-reach A2. The filtration feature of the treatment plant (once on-line) included as part of the new surface water system would at times allow treatment of the higher turbidity water. This would result in less days of bypassed flow augmenting instream flow (14-60 days annually) within Sub-reach A2 compared to the existing conditions, and would typically occur during snow melt conditions when stream flow is high. The effect to redband trout from less days of augmented flow depends on the time of year, life stage considered, and duration. During the snow melt period, a reduction in flow would typically benefit spawning and have little effect on juvenile and adult habitat.

<u>Channel Morphology A2</u>: Sub-reach A2 is a C-type channel. As discussed previously, channel banks are well vegetated, and there is no evidence of excessive aggradation, degradation, or lateral migration. Because the City of Bend returns unused water that was diverted from Bridge Creek to the stream at the top of Sub-reach A2, flow in this sub-reach is most representative of native flows minus municipal use.

Instream flow through Sub-reach A2 would not change. With the proposed system, water that is not diverted because of limits in demand is routed through Tumalo Creek rather than being returned. As demand increases, stream flow during bankfull events in May and June would decrease slightly. However, because a decrease of 1.7 cfs would be immeasurable in terms of stage, there would be no changes to channel form or bedload transport characteristics through Sub-reach A2 as a result of the operations of the proposed system. Furthermore, this same small change in flow would occur with the existing system, so there would be no difference in the potential for channel response from increased demand between the proposed and existing system.

<u>Reach B</u>

Reach B flows are primarily driven by diversion rates by TID. Effects to aquatic habitat would be nearly the same as described under the No Action alternative. The benefits of reduced turbidity and sedimentation from elimination of the return channel upstream in Sub-reach A2 may carry forth in Reach B but to a lesser degree due to upstream deposition of sediments. The frequency that stream flows drop to near 10 cfs would slightly increase during irrigation season due to the trend of increased municipal water demand (same as No Action). As discussed under the Steam Flow section, the ongoing TID CW37 project has added more instream flow in Reach B and future water conservation measures may further augment flows. During non-irrigation season, habitat would generally benefit from slightly reduced flows due to increased municipal water demand as velocities would be decreased in this higher gradient reach.

Similar to Sub-reach A2, the filtration feature of the treatment plant (once on-line) would at times allow continued treatment of higher turbidity water, resulting in less days of bypassed flow into Tumalo Creek. Both under existing conditions and the Proposed Action, additional stream flow as a result of system bypass may be partially or entirely diverted by TID during April to October depending on instream flow and irrigation needs. The effect to redband trout from less days of augmented flow depends on the time of year, life stage considered, duration, and diversion rate of TID. During the non-irrigation season, less stream flow benefits or has neutral effects to all 3 life stages.

<u>Channel Morphology Reach B:</u> The effects to channel morphology in Reach B would be identical to those discussed under the No Action alternative since flows would be the same. The maximum allowable diversion by the City of Bend during high flow events is 18.2 cfs – the same as current conditions. While demand could increase slightly during typical bankfull flow periods in May and June, flow dynamics through this sub-reach are dominated by the operations of TID's Tumalo Feed Canal. There would be no changes expected to channel form or bedload transport characteristics through Reach B as a result of the operations of the proposed system.

<u>Reach C - Middle Deschutes River</u>

There would be no effect to channel morphology in the middle Deschutes River as a result of implementing the Proposed Action. Conditions would be very similar to the effects of increased demand discussed under the No Action Alternative.

Cumulative Effects – Aquatic Habitat and Channel Morphology

The cumulative effects to channel morphology and aquatic habitat from past, present and the reasonably foreseeable activities adjacent to Tumalo Creek are generally trending toward improved form and function. The Bridge Creek fire that burned 3,364 acres of the upper watershed in 1979, including approximately three miles of Tumalo Creek through Sub-reach A1-RR, and the subsequent salvage logging created the greatest disturbance to the watershed. These events caused channel instability in the locations of disturbance, and increased bedload to downstream sub-reaches.

Once on-line, the filtration plant would allow the system to operate more days annually, and as a result in less days of augmented flow in Tumalo Creek from system shutdown, but would typically occur during snow melt when stream flow is abundant. The effect to redband trout from less days of augmented flow because of filtration capability during high turbidity depends on the sub-reach, time of year, life stage considered, and duration.

Stream restoration projects both in Sub-reach A1-RR (2004-2007), as well as through Sub-reach A2 through Shevlin Park have improved channel form and dimensions, provided access for the channel to its floodplain, improved structural integrity and aquatic habitat by introducing coarse woody debris to the channel and floodplain, and have improved riparian conditions. While this has greatly improved channel stability for C-type channels through Tumalo Creek, it has also helped to mitigate issues of excess bedload being processed through the rest of Tumalo Creek. Most importantly, it has contributed to a stream channel that from a functional standpoint is more resilient to disturbance.

Another ongoing project in the watershed that should be considered for its potential effect on channel morphology is the West Bend Vegetation Management Project, currently under analysis by the Deschutes National Forest. This project proposes vegetation and fuels management on approximately 3700 acres within the Tumalo Creek watershed, with nearly all activities located outside of Riparian Reserves and Riparian Habitat Conservation areas. A total of 2755 acres (7.2% of the Tumalo Creek watershed) is targeted for commercial thinning. This project is not of a magnitude or location with the potential to effect substantial changes in flow or sediment regime, and therefore would not affect channel morphology. Any potential effect from the West Bend Project would be to increase flows through a reduction in transpiration, however these increases would be immeasurable.

Other past, present, and reasonably foreseeable activities within the Tumalo Watershed that have the potential to affect channel morphology are conservation projects implemented by TID, and leases of water rights for in-stream flow. These activities are ongoing and have resulted in increased flow within Tumalo Creek as described in the cumulative effects discussion in the stream flow section of this report. They are projected to continue. There is no anticipated adverse effect to channel morphology from increased flow as these increases would only move flow conditions toward native flow conditions. Additional in-stream flow benefits from conservation practices and in-stream leasing would be most pronounced in Reach B.

While the proposed project does have the potential to decrease water withdrawals by the City of Bend from Tumalo Creek, the magnitude of flow increase during bankfull flow events and the potential effects to channel form and function would be immeasurable. When demand is below the current diversion rate of 18.2 cfs, in-stream flows would increase through Sub-reach A1 during these peak flow events.

3.7.7 Fisheries

3.7.7.1 Existing Condition

Species Present

Historically, Tumalo Creek and its tributaries below natural barriers were inhabited by native redband trout. Native bull trout may have been present as they were believed to be present in the Deschutes River from Bend to Lake Billy Chinook, however there are no historical records of bull trout in Tumalo Creek (ODFW, 1996). Numerous fish population surveys have been conducted on Tumalo Creek and its tributaries in the past couple decades. The documented fish species in the Tumalo Creek watershed are limited to native Columbia River Basin redband trout (*Onchorhyncus mykiss gairdneri*), eastern brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*). Rainbow trout (*Onchorhyncus mykiss irideus*) were stocked in Tumalo Creek until 1972 resulting in limited hybridization with the redband. Tissue samples of redband trout were collected from Tumalo Creek by ODFW in 2006/2007 for genetic analysis. The U.S. Fish and Wildlife Service determined that there was only minimal genetic introgression from hatchery stocks in the redband population (Matala, et al, 2007). Eastern brook trout, native to the east coast of North America were introduced over 60 years ago and have established a self-sustaining population in Tumalo Creek and its tributaries. Brown trout are exotic to North America, having been introduced to the Deschutes River over 60 years ago and have spread their distribution into Tumalo Creek. A majority of the fish in the Tumalo Creek watershed are small in size (less than 8 inches) resulting in relatively light fishing pressure.

Fishing regulations per the 2013 Oregon Sport Fishing Regulations allow fishing year round on Tumalo Creek and tributaries. Daily limit of two trout per day is allowed, but no limit on the size or number of brook trout harvested.

Distribution, Habitat Requirements, and Life History of Redband Trout

The redband trout is a subspecies of rainbow trout (O.mykiss), for which the taxonomic nomenclature has little consensus. Benhke (1992) broke rainbow trout into three groups: (1) coastal rainbow trout west of the Cascade/Sierra mountain divide; (2) interior Columbia River Basin (CRB) redband trout upstream of Celilo Falls, including the Fraser and Athabasca rivers in Canada, upper Klamath River basin, and isolated interior basins of Oregon; and (3) Sacramento-San Joaquin redband trout (Thurow, et al. 2007). CRB redband trout, classified as O.mykiss gairdneri, occupy habitats in eastern Oregon and Washington, much of Idaho, western Montana, northern California and Nevada, and British Columbia. Excluding the Canadian portion of the range, the historical range was thought to occupy over 37,465 stream miles. The present distribution is 42% of historical, or 15,793 miles (May, et al, 2012). Within the Upper Deschutes River basin, redband trout are found throughout the Deschutes River to the headwaters and in many tributary streams.

CRB redband trout exhibit a wide variety of traits across their range such as frequency and timing of spawning, age at maturity, temperature tolerance, and habitat selection (Thurow et al. 2007). Non-anadromous populations exhibit life history forms of adfluvial (lake migratory), fluvial (river migratory), and resident (non-migratory). The redband population in Tumalo Creek is considered resident, meaning that all life stages occur within a relatively small section of the stream. Research by ODFW is currently underway to determine if a fluvial population that utilizes Tumalo Creek inhabits the Middle Deschutes River. Should this fluvial population exist, adult fish would seasonally move into Tumalo Creek to spawn.

Redband trout populations are found in a variety of habitats including small streams, large rivers, and lakes. Populations are found in arid landscapes and montane streams. The sub-species has declined in occurrence and abundance due largely to habitat fragmentation, habitat degradation, and hybridization with other non-native salmonids (Meyer, et al. 2010). In response to population declines, resident forms of redband trout are considered a species of special concern by the U.S. Fish and Wildlife Service, American Fisheries Society, and all states throughout their historic range (Idaho, Oregon, Washington, Nevada, California and Montana) and are classified as a sensitive species by the U.S. Forest Service and the Bureau of Land Management. Within the Pacific Northwest Region of the U.S. Forest Service, redband trout are listed as a sensitive species on the December 2011 Regional Forester Special Status Species List – Sensitive

Vertebrates. They are considered a sensitive species – vulnerable on the 2008 Oregon Sensitive Species list.

Fish Distribution

Fish populations are well distributed within the Tumalo Creek watershed including above natural migration barriers. These populations were likely established above these barriers, such as Tumalo Falls, either from official stockings conducted by ODFW (rainbow trout and brook trout) or by private citizens seeking to increase the area of distribution from downstream sources. Populations are generally distributed in streams up to where low flow, high velocities due to high gradient, or migrational barriers become limiting.

Tumalo Creek was assessed for bull trout populations during the summer of 2011 from the mouth upstream to near Tumalo Falls, using protocol developed by Peterson and others (2002) and adopted by the Western Division of the American Fisheries Society. Bridge Creek below the diversion dam and the South Fork of Tumalo Creek were included in the survey. Methods utilized a combination of electrofishing and night snorkeling at randomly generated sites. No bull trout were observed during the survey. Redband trout were the most frequently observed fish, followed by brook trout and brown trout.

Within the project area, the 2011 fisheries surveys found that Sub-reach A1 is dominated by redband trout but brook trout are also abundant. Brown trout in small numbers are found at the lower end of the reach within Shevlin Park. Sub-reach A2 is also dominated by redband trout but brook trout are again fairly abundant and brown trout are more prevalent. Brown trout are the most abundant species in Reach B, followed closely by redband trout, with brook trout numbers decreasing substantially from the upstream reaches.

The Middle Deschutes River contains populations of mountain whitefish, brown trout, and redband trout, with the whitefish being the dominant species in the sampling reach closest to the confluence with Tumalo Creek (Jacobsen and Jacobs, 2010). Redband trout populations gradually diminish downriver, correlated with warming water temperatures, until they are essentially non-existent to the Lower Bridge area near rm 134. Here, numerous springs augment flows and cool temperatures. Substantial spring inputs from Lower Bridge down to Lake Billy Chinook at rm 120 support an excellent redband trout population (ODFW 1996). Bull trout are found below Big Falls (rm 132) near Lake Billy Chinook.

Indian Ford Juga

An aquatic snail, *Juga hemphilli ssp.* was added to the 2011 Region 6 Sensitive Species List and is a new (un-described) subspecies which somewhat resembles *Juga (Juga) hemphilli maupinensis* in its relatively large size (~25mm) (Frest & Johannes 1995). As a whole, *Juga hemphilli* is known from the headwaters of the Columbia River in British Columbia, the Columbia River Gorge of Oregon and Washington, and the Deschutes River system in Oregon (NatureServe 2009). Although this new subspecies may have been historically widespread in the upper Deschutes system, it is currently known from a single site: Indian Ford Creek, near Indian Ford Campground in the Deschutes National Forest, Deschutes County, Oregon (Frest & Johannes 1995). No abundance estimates have been made for this subspecies, but according to NatureServe (2009), *Juga hemphilli* is declining (10-30%).

The habitat for this subspecies is considered to be streams and spring-seeps (Duncan 2008). The only known site is a medium-sized spring-fed creek, where the subspecies was found in mixed basalt cobble-mud substrate (Frest & Johannes 1995). Macrophytes and epiphytic algae are rare at the site, and the site is considered almost monospecific as far as snails are concerned (Frest & Johannes 1995). It is unlikely that the Indian Ford juga are within the project area. Numerous macroinvertebrate samples taken in Tumalo Creek in the past did not locate any individuals.

A Caddisfly

This species of caddisfly, *Rhyacophila chandleri*, is known only from Siskiyou Co., California, and Lane and Deschutes counties, Oregon, and is a recent addition to the 2011 Region 6 Sensitive Species List. It is thought to be a rare species that is very patchily distributed, and apparently highly localized where it does occur (Wisseman pers. comm. in USDA and USDI 2005). Its range is thought to be in the Cascade

Mountains of Oregon and California. It is associated with very cold, larger spring-fed streams (Wisseman pers. Comm. in USDA and USDI 2005). There is no specific information available on threats to this species or its habitat. Activities that degrade water quality or increase water temperatures would likely have negative impacts on this species (USDA and USDI 2005). Although listed as Suspected on the Deschutes National Forest, this species was reportedly collected in 1982 from Tyee Creek and Devils Lake on the Deschutes National Forest, Bend/Ft. Rock Ranger District (Giersch 2002). This species may exist elsewhere on the forest in headwater spring habitats but sampling for macroinvertebrates has mainly been limited to larger streams and river sections on the Deschutes National Forest and this species was not identified in those samples. Habitat for this caddisfly may exist in the tributary springs within Sub-reach A1-RR but no surveys have been conducted.

3.7.7.2 Environmental Effects – Fisheries

Summary of Effects to Fisheries

- **Sub-reach A1**: The Proposed Action would eliminate potential adverse impacts to redband trout in the case of pipeline failure. The Proposed Action would have short term effects (approximately 1 month) to redband trout during pipeline installation at and in the vicinity of the stream crossing near Skyliners Bridge. The operation of the system under the Proposed Action would have neutral or beneficial effects to redband trout. When diversion rates are less than 18.2 cfs, redband trout would benefit overall.

- **Sub-reach A2**: The Proposed Action would eliminate potential adverse impacts to redband trout in the case of pipeline failure. During operations, there would be no measurable effects between the Proposed Action and the No Action alternatives since stream flow would be identical and any potential water temperature increases would have immeasurable effects to redband trout. Redband trout would benefit from elimination of the return flow channel that contributes sediment and increases turbidity within Tumalo Creek.

- **Reaches B and C**: Benefits would be similar to Sub-reach A2 described above in the case of pipeline failure and elimination of the return flow channel, but to a lesser degree.

Direct and Indirect Effects – Fisheries – No Action

Direct and indirect effects to fisheries under No Action are dependent on changes in aquatic habitat, water temperatures, and other environmental factors and vary by sub-reach. The effects analysis for fisheries focuses on redband trout, and utilizes habitat information from the instream flow study and the water temperature study conducted by HDR for the City of Bend. From the instream flow study, it was shown that a particular discharge has differing effects on redband trout habitat quality for each life stage of spawning, juvenile, and adult. For example, a particular discharge may be optimal for spawning but less than optimal for juvenile and or adult stages.

Pipeline Failure Scenario

Potential effects to fisheries in the event of a pipeline failure are greatest in Sub-reach A1-RR due to the proximity of the pipeline to Tumalo Creek. In the event of pipeline failure, redband trout would potentially be detrimentally impacted by increased turbidity and sedimentation if there was overland flow of sediments into Tumalo Creek. Turbidity affects foraging ability of feeding fish, but effects would only persist for a day or less. Sedimentation of the stream substrate can impact aquatic species microhabitats, macroinvertebrate production that affects fish foraging, and spawning gravel quality. Effects to spawning would be greater should pipeline failure occur during spawning activity. Sedimentation could persist for 1-2 years as sediments are transported down the stream over time.

If sedimentation were to occur in the small tributary springs near Road 4603, habitat for the caddisfly *Rhyacophila chandleri* would be detrimentally impacted. Should this species actually exist here, individuals may perish and the habitat would likely be degraded by sediment for years due to the lack of flushing flows.

Fisheries populations within Sub-reaches A1-B, A2, Reach B, and Reach C would experience similar but continually diminishing short term impacts as Sub-reach A1-RR as sediment moves downstream and is deposited in streambed features. Effects from sediment would be dissipated but chronic for a year or two as sediment is transported downstream during high stream flow events.

As discussed previously, repairs to the pipeline could take several days to a week or two. The system would be bypassed, augmenting stream flow. If repairs occur during the irrigation season, a portion of this additional instream flow may be utilized by TID and not enter Reaches B and C. The additional instream flow during temporary shutdown could have beneficial or detrimental impacts to redband trout habitat depending on life stage considered, sub-reach or reach, time of year, and existing stream flow. Redband adult habitat would benefit under most situations. Primary and secondary production would benefit from the augmented flow should it occur during the late-spring to early-fall months.

Operations

<u>Sub-reach A1-RR</u>

Habitat and water temperatures conditions related to stream flow would remain the same with the continual diversion of 18.2 cfs. The water temperatures are currently within a range favorable to redband trout. Water temperatures are relatively cool, as summer temperature maximums are typically less than 15˚C, with 7 day maximums ranging from 12.4° C to 15.8° C based on monitoring between the years of 1997 and 2009. The site was not monitored every year. Temperatures are likely below the optimum for redband trout. Over time, vegetation within the Bridge Creek Fire area will reach maturity providing additional shading to Tumalo Creek and the tributary streams, and the channel will become narrower and deeper, potentially resulting in a slight cooling of water temperatures. The redband population is expected to remain within a population and age class range observed under existing conditions.

<u>Sub-reach A1-B</u>

Similar to Sub-reach A1-RR, habitat and water temperatures conditions related to stream flow would remain the same with the continual diversion of 18.2 cfs. Although slightly warmer on average (approximately 1°C) than Sub-reach A1-RR, the water temperatures are currently within a range favorable to redband trout. Summer 7 day maximum temperatures, measured at approximately rm 6.8, are typically below 17°C and ranged from 13.5° C to 17.4°C between 1999 and 2007 . The site was not monitored every year. Redband trout would exhibit similar growth rates and population density as existing conditions.

<u>Sub-reach A2</u>

The effects analysis of fisheries closely tracks the discussion under effects to aquatic habitat, in relation to a trend of decreasing flow with increased municipal water demand. As discussed in that section, reduction in stream flow could have either a beneficial or adverse effect on redband trout aquatic habitat, depending on the current stream flow, the time of year, and life stage considered. Adult redband trout habitat would generally be detrimentally impacted by any decrease in stream flow, which would occur as municipal water demand increases over time. Reduced stream flow would reduce primary and secondary production by reducing available habitat for algae, aquatic macroinvertebrates, and other aquatic species due to less wetted area. Impacts would be minimal as wetted perimeter would be slightly reduced (0.25 feet on average) when median flow decreased by 3 cfs as discussed under the aquatic habitat section. Water temperatures are similar to Sub-reach A1-B but slightly warmer as this sub-reach begins just 1.4 miles downstream of the temperature monitoring site within Sub-reach A1-B.

Brown trout become more numerous in this sub-reach that Sub-reach A1-B. Brown trout are piscivorous and are known to feed upon brook trout (Kruger and May 1991) and rainbow trout (Johnson 1981). As they exceed 25.0 cm (10") length, fish and crustaceans become more important in the diet (Raleigh, et al 1986). Brown trout are thought to out-compete both rainbow trout (Gatz et al. 1987) and brook trout for preferred microhabitats. A substantial increase in brook trout larger than 22.9 cm occurred when 40-66% of brown trout of like size were removed and mergansers harassed from a section of the Au Sable River (Shetter and Alexander 1970 in Kruger and May 1991). Adult brown trout may compete with redband for overwintering habitat as they tend to move into deep, low-velocity water that redband occupy (Raleigh, et al 1986). Impacts may occur to the redband trout population as stream flow and associated habitat is diminished over time with increasing municipal water demand. Interspecific competition with brook and brown trout for food and space, and predation by brown trout, would likely increase as stream flows decrease. The abundance and growth rates of redband trout may decrease over time. Age class structure may change.

Reach B

The effects to fisheries closely track the discussion under effects to aquatic habitat, in relation to a trend of decreasing flow with increased municipal water demand. Since diminishing return flows as municipal water demand increases has different effects to redband trout habitat than observed in Sub-reach A2 for the non-irrigation season despite identical flows, owing to differing stream morphology, there may be different effects to redband trout. PHABSIM predicts generally slight beneficial effects would occur to all life stages of redband habitat during the non-irrigation season as flow decreases. Primary and secondary production would be minimally decreased with associated decreased stream flow as municipal water demand increases over time. Wetted perimeter would decrease an average of 0.03 feet when decreasing the median flow 3 cfs.

During the irrigation season, PHABSIM displayed any further decrease in stream flow would result in impacts to all life stages of redband trout. Irrigation water demand decreases flows to near 10 cfs. Growing municipal water demand may slightly increase the frequency that these low flows are reached, but as previously discussed stream flow in this reach during the irrigation season is largely a function of irrigation withdrawals. Water conservation projects are being implemented that have augmented stream flow in recent years and more may occur in the near future. Water temperatures are often elevated above the optimal temperature for growth of redband trout during late summer. Increasing the frequency of flows dropping to near 10 cfs may increase the frequency and duration that water temperatures warm beyond optimal temperatures for redband trout; however impacts to growth, population size, and age class structure would be immeasurable. The 7 day maximum water temperatures for the site just below the TID diversion ranged from 15.2° C to 18.8° C for the years 1999 to 2006 – no sampling was done in 2005. Near the mouth, the 7 day average ranged from 20.3°C to 22.8°C for the years monitored between 2001 - 2009.

Brown trout are the overall dominant species in this reach and are likely suppressing the redband and brook trout populations through interspecific competition for food and space, and predation. However, during the 2011 fish survey, redband trout were dominant in the high gradient lower section of this reach and brook trout were not observed. Water temperature may increase slightly as municipal demand grows, potentially reducing growth rates of redband trout. However, recent water conservation projects have augmented stream flows during critical hot months and may continue to add even more into the future.

Reach C -Middle Deschutes River

Increased municipal water demand would most affect flow during the non-irrigation winter months when flows are at their highest (600-800 cfs). The 1.5 -2% decrease in flow would minimally affect redband habitat and stream ecological functions such as primary production and secondary production. Increasing demand may occasionally slightly reduce stream flow (1-2 cfs) through Reach B into Reach C, a 1-2% reduction during these times, minimally affecting redband trout and stream ecological functions.

Summer water temperatures are elevated in this Reach. The 7 day average maximum ranged from 18.7 to 20.8 during the years 2005-2010. The infrequent 1-2 cfs reduction in stream flow experienced as demand grows would have minimal effects to water temperatures and redband trout.

Effects Determination for Threatened and Sensitive Species

There would be **No Effect** to the threatened species (Middle Columbia River (MCR) steelhead and bull trout. There will be **No Effect** to Chinook salmon Essential Fish Habitat (EFH). For the snail caddisfly, in the event of pipeline failure near Road 4603, No Action **May Impact Individuals and Habitat**, but will not likely contribute to a trend towards federal listing. For redband trout, No Action **May Impact Individuals and Habitat**, but will not likely contribute to a trend towards federal listing. The impacts are a function of increasing municipal water demand that reduces available habitat, especially adult habitat. In the event of pipeline failure, there would be impacts to redband individuals and habitat, related to decreased foraging and spawning substrate degradation from fine sediments inputs, and are expected to range from 1 day up to 1-2 years.

Direct and Indirect Effects – Fisheries – Proposed Action

The implementation of the Proposed Action would affect fisheries in Tumalo Creek at two different periods – installation and operation. The magnitude and duration of the effects would be different, and will be discussed separately.

The long-term sustainability of fisheries and other aquatic species populations depends largely on interactions with other aquatic species, both native and exotic, habitat conditions and water quality, the latter two influenced by activities that occur instream, on the floodplain, and within the uplands of the watershed. Water use projects have potential to impact fish and other aquatic species populations and habitat during construction activities and by altering the timing and volume of stream flows. The hydrology of a stream affects the water depth and velocities that salmonids will encounter, seasonal habitat availability, and in part stream temperatures. Habitat needs of salmonids vary with the season of year and life stage. Each native fish stock appears to have a unique time and temperature for spawning that theoretically maximizes the survival of offspring (Bjornn and Reiser in Meehan 1991). Spawning and both summer and winter rearing habitat could potentially be affected for juvenile and adult life stages by this alternative. The discussion on effects to fisheries focuses on redband trout.

Trout habitat is the product of the geology and soils, topography, vegetation, climate and hydrology of the watershed. These watershed characteristics remain fairly constant and so does the productivity of the aquatic habitats. Changed conditions could however change habitats that may affect fish production (Meehan 1991). The PHABSIM method used in the instream flow study modeled changes in physical habitat for redband trout life stages at differing stream flows but does not account for ecological and biological interactions that could occur within the stream at changing stream flows, such as changes in interspecific and intraspecific competition, predator-prey relationships, food web dynamics, and disease. The Weighted Usable Area that estimates habitat and fish biomass can be unrelated over various increments of flow (Scott and Shirvell 1987, Gore and Nestler, 1988, in Rader and Poff, 1999). Other factors such as available cover, scouring or dewatering of redds, stranding of juvenile fish, and lethal and sub-lethal temperatures can influence population fluctuations (Rader and Poff 1999). Salmonid populations in streams can vary temporally in size, often regulated by climatic factors such as floods, drought, and severe winter weather (Krueger and May 1991).

The Proposed Action would augment flows through Sub-reach A1 due to flow control matching demand, with flow benefits expected to persist in the long term during the months of July to September 22nd when water rights distribution is in effect. The effects of variation in stream flow on population dynamics such as fish survival and growth can be difficult to estimate because of possible confounding issues with the effects of other environmental variables, such as water temperature and fish density (Harvey, et al 2005). If a particular flow favored habitat for a particular life stage, i.e, juvenile, beyond the optimal carrying capacity for that life stage then competition could increase, resulting in higher mortality or reduced vigor and growth. Variation in stream flow may alter water chemistry such as temperature and dissolved oxygen, altering fish growth (Guyette and Rabeni 1995 in Harvey et al 2006). Lower stream discharge may increase predation risk (Heggenes and Borgstrom 1988 in Harvey et al 2006) and reduce foraging opportunities for drift-feeding fish in small streams during the low flow season (Nislow, et al. 2004 in Harvey et al 2006). Conversely, increasing stream flow may reduce predation risk and increase foraging opportunities for fish. The rate of primary and secondary production largely determines the food available to fish (Bjornn and Reiser 1991in Meehan 1991). Higher stream flow might also affect fish growth by increasing autochthonous secondary production (aquatic macroinvertebrates) and the delivery of litter (allochthonous material) and invertebrates from riparian zones. Increased stream flow could also benefit stream ecological processes such as decomposition of organic matter by microorganisms and transport of fine sediment that can influence primary production by stream benthic algae and growth and survival of macroinvertebrates.

From a study of rainbow trout during summer in a small stream, Harvey and others concluded that increasing dry season discharge and limiting aggradation would benefit salmonids (Harvey et al. 2005). In this study, mean fish growth was 1.5 times greater during one summer when the discharge was higher (2.5 times higher in September) than a comparison summer, although temperatures were nearly the same. The need for fish to both avoid predators and acquire food probably contributes to water depth enhancing survival (Harvey and Stewart, 1991 in Harvey et al 2006).

Small increases in discharge in headwater streams may lead to large differences in food availability for trout by promoting more extensive invertebrate drift through increased production and higher water velocities at riffle-pool transitions (Harvey et al. 2005). Entry of benthic macroinvertebrates into drift increases with water velocity (Poff and Ward 1991; Borchardt 1993 in Harvey et al 2006).

Effect of Non-native Fish Introductions

Tumalo Creek is host to two non-native salmonid fish, the brook trout and brown trout. Ecological consequences of non-native stocking of salmonids include competition, predation on native fish, and introduction of parasites and disease to native fish (Krueger and May 1991). Ecological effects can cause native fish species to be (1) eliminated (2) have changes in growth and survival, (3) alter community structure, (4) exhibit combinations of the above, or (5) exhibit no detectable changes (Moyle et al. 1986 in Krueger and May 1991). Native salmonids often exhibit substantial shifts in habitat use and sometimes complete exclusion where non-native fish have been introduced (Fausch 1988 in Hauer and Lamberti 1996).

Competition is the most commonly invoked process used to explain the ecological effects of non-native salmonid introductions (Krueger and May 1991). Non-native fish may compete with natives for food and space, possibly leading to (1) extinction of one species, (2) fluctuating coexistence as the environment alternately favors one species then another, and (3) niche shifts (Moyle and Vondracek 1985 in Krueger and May 1991). Interspecific competition may be most intense during late summer when flows are low and food and space are limited, especially during years of high population abundance (Griffith 1988 in Krueger and May 1991).

Throughout most of the project area redband trout and brook trout are sympatric (co-existing). These two species have co-existed for nearly a century and one species may not be able to monopolize the other. The pre-adaptation for brook trout to spawn in the fall and the redband in the spring/summer when floods damaging to developing eggs and fry could occur at either period may help explain why one species does not monopolize (Seegrist and Gard 1972 in Hauer and Lamberti 1996). The two species may also be somewhat spatially segregated at the microhabitat scale based on a combination of velocity, depth, cover types, and food availability (Hauer and Lamberti 1996).

Population dynamics of streams with sympatric populations of brook trout and rainbow trout have been studied. In eastern North America, where the brook trout is native and the rainbow is introduced, the brook trout was displaced by the rainbow in some stream sections. Competition between the species was thought to be the reason but competitive advantages of the rainbow were unclear (Krueger and May 1991). Brook trout appeared to dominate rainbow in environments of low water velocity and temperature (13 degrees C) but no advantage to either species was observed in high water velocity and temperatures of 19 C (Cunjak and Green 1983, 1984, 1986, Fausch 1988 in Krueger and May 1991). Rainbow trout, under experimental conditions, were more aggressive and displaced brook trout from preferred stream areas (Gibson 1981 in Krueger and May 1991). While habitat segregation could be a function of competitive interaction between the two species, it could also be due to genetically fixed differences in fundamental niche that minimizes competitive interaction (Fausch 1988 in Kruger and May 1991).

In sympatric populations of the two species in the southern Appalachian Mountains, growth rates of the two species was nearly equal until the spring of the second year of life when the rainbow demonstrated a growth advantage, resulting in large size at age for the rainbow that continues on for the remainder of life (Whitworth and Strange 1983 in Krueger and May 1991). Here, the rainbow better occupied shallow pools and riffles that characterized the streams. The brook trout shifted to less favorable positions away from optimal feeding locations, possibly explaining the difference in growth rates between the two species. The size advantage gained by the rainbow further enhanced their ability to occupy preferred feeding locations (Larson and Moore 1985 in Kruger and May 1991). Brook trout biomass increased substantially in four Appalachian streams when most rainbow trout were removed (Moore et al. 1983, Moore et al. 1986, in Kruger and May 1991). Competition was thought to be in part the explanation for the displacement of brook trout by rainbow trout in the Lake Superior area (Rose 1986 in Kruger and May 1991).

Pipeline Installation

Best Management Practices and project mitigations to protect water quality, channel morphology, aquatic habitat, and riparian areas would limit detrimental impacts to fish populations.

Screening of the intake would prevent downstream passage of a rainbow/redband trout population into Bridge Creek below the dam and Tumalo Creek. The genetic status of this population in Bridge Creek is unknown, but there were no native fish present in Bridge Creek above the natural barriers near the mouth after the glaciers retreated approximately 18,000 – 22,000 years ago. They are possibly either rainbow trout stocked by ODFW years ago or native redband carried above the falls in an attempt to increase fish distribution.

Pipeline construction would have short term (<4 weeks) effect to native redband trout in the vicinity of the stream crossing of Tumalo Creek by de-watering of 80-100 feet of the channel. Prior to construction, fish within the vicinity of the crossing would be relocated to upstream areas. Redband trout would reoccupy (within days) the crossing site post-construction. The crossing construction is targeted to occur within the ODFW instream work period of July 1 – October 15th, 2013 or 2014, to protect redband trout and brown trout (ODFW, 2008). ODFW may authorize a work period extension beyond October 15th through a waiver. There would be no long term effects to redband trout populations or habitat. There would be no effects to fish populations or habitat in the Middle Deschutes River. Any increases in turbidity or sedimentation within Tumalo Creek would be negligible in the Middle Deschutes River which is nearly 13 miles downriver from the crossing site.

Bridge Creek Intake and Pipeline Operations

Sub-reach A1-RR

Additional stream flow due to flow control, including an increase in base flows, would provide some ecological and biological benefits to this sub-reach, resulting in some additional forage to redband trout. PHABSIM habitat modeling demonstrated some decrease in spawning and juvenile habitat with increased flows, but adult redband habitat was shown to increase. The accretion zone, especially above the confluence with the South Fork, is an area that would especially benefit stream ecology and redband trout from additional stream flow. Stream flow benefits to adult habitat and primary and secondary production would decrease over time as municipal water demand increases. Under the maximum use flow scenario, benefits compared to the existing system would be limited to the distribution period with a projected increase in stream flow of 2.5 to 3 cfs, and would be minimal as wetted perimeter would only increase less than 0.6 foot on average (<2%) when at or near median flow. Water temperatures may be cooled minimally with additional flow instream through this sub-reach, but temperature benefits would be on a diminishing trend as demand increases. Water temperatures may also decrease minimally as the channel decreases in width (with associated increase in depth) and vegetation increases in height within the Bridge Creek Fire area. Temperatures are generally below what is considered optimal for growth rates of redband trout. No measurable effects to growth rates for redband trout are expected from the minimal potential water temperature changes. The increased forage available for redband trout may increase growth rates, but changes may be immeasurable.

The brook trout is sympatric with the redband trout within this sub-reach. Reduced stream flow could affect interspecific competition between the two species. Brook trout are generally more abundant than redband in the upper end of this sub-reach, possibly a function of gentler gradient and reduced velocities. In addition, this sub-reach contains many off-channel beaver ponds, damming up the tributary streams. These areas are heavily populated with brook trout and may help to explain their large numbers within this sub-reach. Other off-channel habitats and side channels have been observed hosting large numbers of juvenile fish dominated by brook trout. It is unknown if changes in stream flow in this sub-reach as a result of this alternative would favor one species over the other, but slightly higher velocities with increased stream flow may provide a minimal competitive advantage to redband trout over brook trout.

Sub-reach A1-B

Effects would be similar to Sub-reach A1-RR. Additional flow due to flow control would provide some ecological and biological benefits to the sub-reach at most flows such as improved primary and secondary production. Adult redband habitat would be slightly increased. Aquatic macroinvertebrate production would be slightly improved providing some additional forage to redband trout. Water temperatures may be slightly cooled as flows increase and vegetation within the Bridge Creek Fire area increases. Benefits would be on a diminishing trend as demand increases.

Redband trout are more dominant over brook trout in this sub-reach than Sub-reach A1-RR, likely due to higher gradients, higher velocities, and larger substrate size. When demand is below existing conditions, and when Tumalo Creek is in distribution, there may be a slight competitive advantage to redband over brook trout as stream flows and associated velocities would be increased.

Small numbers of brown trout exist at the bottom of this reach, perhaps limited from increasing upstream range by gradient or temperature preferences. Brown trout tend to occupy the lower reaches of low to moderate gradient areas (<1%) in suitable, high gradient river systems (Raleigh, et al 1986). The presence of a third species, and second non-native species, complicates the interactions of interspecific competition and implications to the redband trout. Due to the small numbers and limited range within this sub-reach, interspecific competition with redband trout from brown trout is anticipated to be minimal. Water temperatures are expected to decrease slightly from additional instream flow, and persist long term during the summer distribution period, and would remain within a favorable temperature range for redband trout. These temperatures are also generally within the optimal range for brown trout (12-19°C for adult, 7-12°C for juvenile– Raleigh 1984, et al 1986) and brook trout (11-16°C – Raleigh 1982).

Summary for Sub-Reach A1: Increased stream flow is expected to have beneficial effects to the redband trout population by increasing available habitat and increasing foraging which could potentially lead to an increase in the population and growth rates. Adult habitat would have the greatest benefit. Adult habitat limits the population biomass of resident trout in most streams (Behnke, 1992). However, trout populations and biomass in streams are highly variable and are influenced by many environmental factors such as climate, episodic events, changes in habitat, stream flow, temperature, water chemistry, interspecific and intraspecific competition, predation, and fishing pressure. The temporal variation in fish population abundance is higher than that in many plant and animal populations that represent a variety of life history strategies. Adding to the variation is sampling error and sampling variation in monitoring populations (Gibbs, et al, in Dauwalter et al, 2009). While additional stream flow throughout Sub-reach A1 is expected to benefit redband trout, it may be difficult to measure benefits, especially as municipal water demand increases over time and the stream flow benefit decreases.

Sub-reach A2

Elimination of the return flow would eliminate the periodic source of turbidity and sedimentation to Tumalo Creek, benefitting redband trout. Increased turbidity can affect the ability of trout to forage and fine sediments decreases survival of developing fish embryos and diminishes benthic invertebrate habitat (Meehan 1991).

Stream flows would remain the same as the existing system. There would be no changes in modeled habitat compared to No Action, other than those attributable to projected increasing demand over time. Sub-reach A2 lies between the 4606 and TID gage temperature measuring sites (rm 6.8 and 2.7, respectively). Water temperatures modeled with the Heat Source analysis showed some increases in the 7 day average maximum at lower flows (See Water Quality -section 3.7.5). Potential minimal water temperature changes, likely not detectable by measuring in the field, would not measurably affect growth rates of redband, brook, and brown trout, nor measurably affect the interspecific competition between redband, brook ,and brown trout. Impacts from interspecific completion are expected to be similar to those discussed under No Action.

Reach B

As with Sub-reach A2, elimination of the return flow in Sub-reach A2 would eliminate this periodic source of turbidity and sedimentation to Tumalo Creek, benefitting redband trout, but to a lesser degree than Sub-reach A2 because of upstream deposition of sediments.

Stream flows would remain the same as the existing system. There would be no changes in modeled habitat compared to No Action, other than those attributable to projected increasing demand over time. .

Similar to Sub-reach A2, temperature modeling between the existing system and the Proposed Action demonstrated a slight increase in the 7 day average maximum under the Proposed Action, but with smaller differences that nearly dissipate at the mouth of Tumalo Creek (See Water Quality - section 3.7.5). Potential minimal water temperature changes, likely not detectable by measuring in the field, would not measurably affect growth rates of redband, brook, and brown trout, nor measurably affect the interspecific competition between redband ,brook ,and brown trout. Impacts from interspecific completion are expected to be similar to those discussed under No Action.

Reach C - Middle Deschutes River

The effects to fisheries would be the same as described under No Action. Stream flow entering the Middle Deschutes from Reach B would be unchanged from No Action. The slight temperature change in Tumalo Creek modeled under this alternative would not be measurable and would not affect water temperatures of the Middle Deschutes River, and would not measurably affect redband trout growth or interspecific competition with other fish species.

Cumulative Effects – Fisheries

The cumulative effects to fisheries are closely associated with those discussed under stream flow, water quality, riparian vegetation, and aquatic habitat and channel morphology sections, as these dictate the quality of fisheries habitat. Potential cumulative effects from the Proposed Action focus on operations of the new water system as pipeline installation would have short term effects (less than a few months).

As described under the cumulative effects for aquatic habitat and channel morphology, recently completed in-stream restoration projects of Tumalo Creek have improved habitat conditions for redband trout and continue to capture instream wood moving downstream from upstream sources. As these structures mature and improve, they would provide benefits to redband trout habitat through improved hiding cover and velocity breaks and compliment the augmented stream flows that would be realized under the Proposed Action. As it matures, riparian vegetation within the Bridge Creek Fire area would provide increased benefits to redband trout through improved overhead cover, increased litterfall, and improved foraging from attraction of terrestrial insects. In addition to in-stream work, the West Tumbull Fuels Reduction Project and the Tumalo Floodplain Enhancement Project implemented by the Deschutes National Forest in the last 2-3 years thinned small pine trees adjacent to nearly 1 mile of Tumalo Creek within the Bridge Creek Fire area. These vegetation management activities will improve conditions for riparian vegetation, and improve vigor and growth of residual streamside trees that provide shade and future large wood recruitment in-stream.

A limited harvest of redband trout is allowed on Tumalo Creek, but fishing pressure is light and annual harvest likely has little impact on the population. Implementing the Proposed Action with augmented flow would have some cumulative benefits in Sub-reach A1 to abundance, growth, and vigor of the redband trout population. These benefits and the ability to measure them would diminish over time as demand for municipal water increases.

West Bend DEIS, page 453 Water Quality Cumulative Effects:

The altered flow regime and the elevated water temperatures are two of the main factors influencing fish and other aquatic species populations and habitat. A limited harvest of trout is allowed on streams within the project area (except for brook trout where there is no limit or size of fish), which may reduce the abundance of trout populations. There would be no measurable cumulative effects to aquatic species habitat and populations, because of no measurable cumulative effects to water quality and quantity. These alternatives reduce the potential for wildfire that could reduce shade and long term large woody material recruitment, and potentially severely burn within RRs/RHCAs, especially within mixed conifer stands, that could have short and long term adverse effects to overhead cover, streambank and channel stability, spawning gravel quality, and large wood recruitment.

The fish ladder constructed in 2009 over the TID diversion dam at rm 2.8 allows upstream passage of fish, including brown trout, from lower Tumalo Creek and the Deschutes River into Sub-reach A2 and above. Brown trout populations are likely to increase in Tumalo Creek within a limited range above the ladder, the range likely limited by an increase in gradient near the bottom end of Sub-reach A1-B. Implementing the Proposed Action, which does not change stream flow in Sub-reach A2 and Reach B, or have a measurable effect on stream temperature, is unlikely to increase the upstream distribution of brown trout as the gradient appears to be the controlling factor. Potential water conservation projects resulting in protected senior water rights within Reach B that augment flows would potentially provide beneficial cumulative effects to redband trout growth and survival.

<u>Effects to Threatened and Sensitive Fish Species</u>

Steelhead and Chinook EFH: The Middle Columbia River (MCR) distinct population segment (DPS) of steelhead is listed as threatened by the National Marine Fisheries Service (NMFS). Critical habitat for this species was designated by NMFS, and includes the Deschutes River from the confluence upriver to rm 98, which is over 62 miles downriver of the confluence with Tumalo Creek and below the Pelton Dam complex. MCR steelhead may occur in the Deschutes River below Big Falls at rm 132, which is a natural barrier. Any potential effects to water quality resulting from the construction and operation of the project would be substantially diminished and immeasurable before encountering MCR steelhead or its critical habitat. Therefore, there would be No Effect for MCR steelhead and its critical habitat. The Magnuson-Stevens Fishery Conservation and Management Act (amended 1996) required designation of Essential Fish Habitat (EFH) for Pacific salmon. The Upper Deschutes River Basin (HUC 17070301) has been designated as Chinook salmon EFH. There are no present or historical records of Chinook salmon populations in Tumalo Creek or the Middle Deschutes River above Big Falls at rm 132. There will be No Effect to Chinook salmon EFH due to the downstream amelioration of any effects, adverse or beneficial, from the Proposed Action.

Bull trout*:* Bull trout are listed as threatened by the U.S. Fish and Wildlife Service. Tumalo Creek is not designated or Proposed Critical Habitat for bull trout. Fisheries surveys conducted during 2011 did not locate any individuals. Bull trout are located in the Deschutes River below Big Falls at rm 132, over 28 miles downriver of the confluence with Tumalo Creek, and is also the upriver endpoint for bull trout designated critical habitat in the Deschutes River. No known populations of bull trout are located in the Deschutes River or tributaries above Big Falls. An isolated population is found in Odell Lake but has no surface water connection to the Upper Deschutes River. Any potential effects to water quality resulting from the construction and operation of the project would be substantially diminished and immeasurable before encountering bull trout. There would be **No Effect** to bull trout and its critical habitat.

A draft Bull Trout Recovery Plan was issued by the U.S. Fish and Wildlife Service in 2003 for the Deschutes Recovery Unit. The area below Big Falls, where populations of bull trout exist, was identified as a Core Area, while above Big Falls, where no known bull trout populations exist, was identified as a Core Habitat. While the Recovery Unit Team believed there was potential for reintroduction of bull trout into the Core Habitat, it did not specifically identify Tumalo Creek as a target.

***Redband trout**:* There would be **No Impact** to redband individuals or habitat within Sub-reach A2, Reach B, and Reach C from implementing the Proposed Action because stream flow would remain the same as the existing condition, modeled stream temperature changes are considered immeasurable, and turbidity and sedimentation from upstream pipeline construction would be minimal. Pipeline installation would have temporary (<1 month) detrimental impacts to redband trout and habitat in Sub-reach A1-RR below Skyliners Bridge because of temporarily dewatering a portion of the channel and temporary (<1 month intermittently) turbidity and sedimentation increases. Habitat modeling demonstrated slight decreases in spawning and juvenile habitat in some months under the Proposed Action, which augments stream flow, in most of Sub-reach A1-RR, primarily due to increases in velocity with increased stream flow. However, with additional stream flow, there would be benefits to adult habitat and primary and secondary biological production that would increase forage. The benefits to the redband population from increased stream flow likely counter, and may outweigh, any modeled habitat decreases.

Because there are detrimental impacts to redband trout and its habitat during pipeline installation, this alternative, within Sub-reaches A1-RR and A1-B, **May Impact Individuals and Habitat**, but will not likely contribute to a trend towards federal listing. The impacts are considered temporary (< 1 month) and minimal because they are localized, and Best Management Practices and project design features that limit detrimental impacts would be required. During operations, there are some benefits to biological primary and secondary production and to redband trout habitat and foraging in Sub-reach A1 compared to existing conditions when diversion rates remain below 18.2 cfs.

***Invertebrates**:* There would be **No Impact** to the caddisfly *Rhyacophila chandleri*, or its habitat. The culverts at the Road 4603 crossing of several small springs would be left in place and bored under, with the exception of one damaged culvert of a small seep crossing that would be replaced. This seep has a silty substrate lacking in cobbles, and lacks the habitat requirements for the caddisfly.

Summary of Findings for Proposed, Threatened, Endangered, and Sensitive Species

Table 48 displays the threatened, endangered and sensitive species considered in the analysis of the Bridge Creek Water Supply Project.

Table 48. Summary of Effects Determination to Threatened and Sensitive Aquatic Species

Species	Scientific Name	Status	Occur-rence	Effects Determination
Columbia Basin redband trout	*Oncorhynchus mykiss gairdneri*	S	HD, D	Alt. 1 – MIIH Alt. 2 – MIIH
A caddisfly	*Rhyacophila chandleri*	S	HD, S	Alt. 1 – MIIH Alt. 2 - NI
Bull trout	*Salvelinus confluentus*	T	HN, N	Alt. 1 – NE Alt. 2 - NE
MCR Steelhead	*Oncorhynchus mykiss gairdneri*	T	HN, N	Alt. 1 – NE Alt. 2- NE
Chinook salmon	*Oncorhynhcus tshawytscha*	MS	HN, N	Alt. 1 –NAE Alt. 2 - NAE

Status

S	Sensitive species from Regional Forester's list
T	Federally Threatened
MS	Magnuson-Stevens Act designated Essential Fish Habitat

Occurrence

HD	**Habitat Documented** or suspected within the project area or near enough to be impacted by project activities
HN	**Habitat Not** within the project area or affected by its activities
D	Species **Documented** in general vicinity of project activities
S	Species **Suspected** in general vicinity of project activities
N	Species **Not documented** and not suspected in general vicinity of project activities

Effects Determinations

Sensitive Species

NI	No Impact
MIIH	May Impact Individuals or Habitat but Will Not Likely Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species.
WIFV	Will Impact Individuals with a Consequence that the Action May Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species.
BI	Beneficial Impact

Threatened Species

NE	No Effect
NLAA	Not Likely to Adversely Affect
LAA	May Affect, Likely to Adversely Affect
BE	Beneficial Effect

Chinook Salmon Essential Fish habitat (Magnuson-Stevens Act)

NAE	No Adverse Effect
AE	Adverse Effect on Essential Fish Habitat

3.7.8 Riparian Areas

3.7.8.1 Existing Condition

Riparian areas are important because they provide near steam shading, filter sediments and pollutants from upland sources, provide overhead cover to fish, store water for late summer release, provide floodplain roughness to disperse energy during flood events, provide organic matter that is incorporated into stream food webs, and provide wildlife habitat.

Riparian areas adjacent to Tumalo Creek vary by reach and sub-reach. Widths of riparian zones and floodplains are dependent on valley type and associated stream gradient. Within the project area, wide valley bottoms resulting from glacial scouring have gentle stream gradients and wide floodplains. Moderately steep valley sideslopes are associated with higher stream gradients and narrower floodplains. The new pipeline alignment would be within Riparian Reserves, defined in the NWFP as portions of watersheds where riparian-dependent resources receive primary emphasis. The project area includes all five categories of Riparian Reserves listed in the NWFP. Although the new pipeline alignment as described under the Proposed Action does not enter Riparian Habitat Conservation Areas (RHCA) of lands managed under INFISH, Tumalo Creek within the project area affected by operation of the municipal water system is within a Category 1 RHCA (fish bearing stream).

Sub-reach A1-RR

This sub-reach is within a wide glaciated valley that includes the Bridge Creek Fire restoration area. Riparian areas, including wetlands and floodplains, are found adjacent to seeps, springs, and Tumalo Creek. The proposed new pipeline alignment near riparian areas is limited to the area from the Bridge Creek intake to the south side of Tumalo Creek immediately below Skyliners Bridge. From there on, the pipeline would be buried in the road shoulder outside of riparian areas. Tumalo Creek flows into and meanders across a glacial outwash valley bottom. Within this valley bottom, approximately 100 acres of wetlands can be divided into two main wetland types: 1) scrub shrub and (2) emergent (Cowardin, et. al. 1979). A shrub type wetland is located throughout the valley with it being narrower at the upper end and widens out as the stream gradient decreases and the valley widens. The shrub components consist primarily of mountain alder (*Alnus incana*), red-osier dogwood (*Cornus stolonifera*), various willow (*Salix spp.*), and Douglas spiraea (*Spiraea douglasii*). Engelmann spruce and white fir are scattered throughout this brush component. The depth to groundwater ranges from 1-5 feet with the vegetation becoming saturated and inundated with water every 1-2 years. As the valley widens, stream gradient decreases, and the ground water is closer to the surface, emergent wetland vegetation occurs that consists of various sedges (*Carex spp*.) and native perennial grasses. The emergent depth to groundwater ranges from 1-3 feet with vegetation becoming saturated and inundated with annual springime flows. The Tumalo Creek Restoration project of 2004-2007 planted over 72,000 native riparian shrubs and trees on approximately 12 acres upstream of above Skyliners Bridge. Ponderosa pine, lodgepole pine, and brush species are established on interspersed dry rises within the floodplain. Several springs and beaver ponds have created a diverse wetland between Tumalo Creek and Forest Road 4603. The floodplain width varies from 200-600 feet.

Below Skyliners Bridge there are several private land tracts, including within the floodplain. The valley and floodplain widths gradually decrease moving downstream. This area was not within the boundaries of the Bridge Creek Fire and has a forested floodplain of mixed conifer overstory and mountain alder, willow, and sedge understory. Some disturbance to riparian vegetation and stream shading has occurred on these tracts.

Sub-reach A1-B

This sub-reach is characterized by a narrow valley with steep sideslopes. Riparian areas are limited to areas immediately adjacent to Tumalo Creek within this narrow valley type. The riparian area and floodplain is typically less than 50 feet on either side of Tumalo Creek. Riparian shrubs are dominated by mountain alder and red-osier dogwood. The overstory is dominated by mixed conifer. The valley bottom increases at the downstream end approaching Sub-reach A2.

Sub-reach A2

As the valley floor widens and the stream gradient decreases, the floodplain and riparian area associated with Tumalo Creek becomes wider, typically 200 feet or more. Riparian vegetation is dominated by shrub species of mountain alder, red-osier dogwood, and quaking aspen. The overstory is mixed conifer, with ponderosa pine being dominant. There are wetlands located away from the stream corridor.

Reach B

The riparian area width gradually becomes narrower, becoming limited to areas immediately adjacent to Tumalo Creek. The floodplain width generally is less than 30 feet on either side of the stream at the lower end of the reach. Riparian vegetation is dominated by mountain alder and red-osier dogwood, with an overstory dominated by ponderosa pine on the canyon walls.

Reach C -Middle Deschutes River

Riparian vegetation near the mouth of Tumalo Creek is limited to a narrow band generally less than 50 feet wide confined by steep, rocky canyon walls and dominated by Red-osier dogwood.

Table 49 summarizes wetland and riparian areas adjacent to Tumalo Creek within the project area. Three separate GIS layers were searched to classify riparian vegetation: the National Wetland Inventory (NWI); Deschutes National Forest Wetlands; and Deschutes National Forest Plant Association Groups (PAG). There was no GIS data available in Reach B and only partially for Sub-reach A2, both of which are located off of national forest lands.

Table 49. Acres of National Wetland Inventory wetland acres, Deschutes National Forest wetland acres, and Deschutes National Forest Plant Association Groups (wet types) in Project area

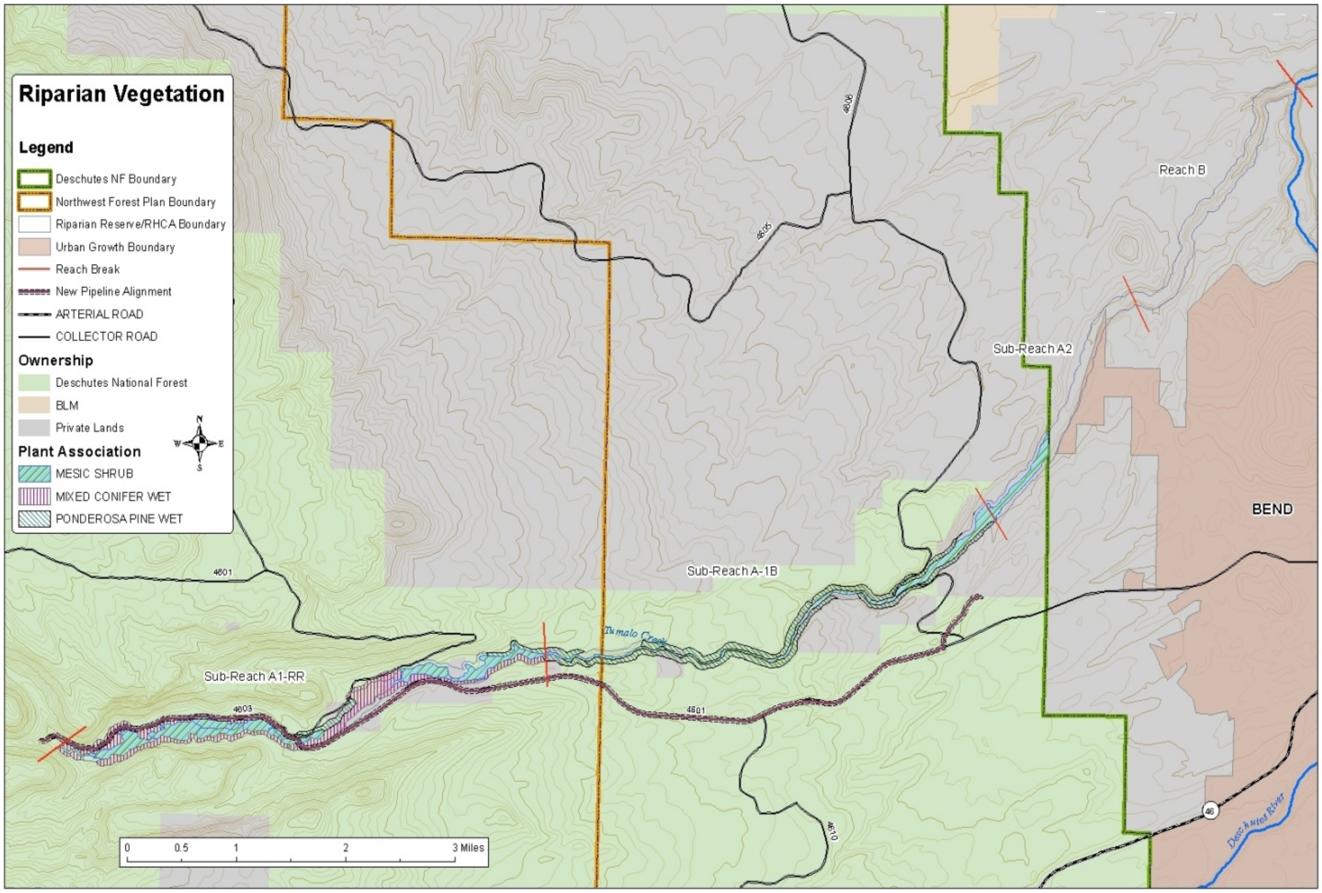
Reach or sub-reach	NWI -FW emergent	NWI – FW forested/shrub	NWI – FW riverine	NWI – FW forested	Total NWI	DNF wetland	PAG - Mesic Shrub	PAG – Mixed conifer wet	PAG – Ponderosa pine wet	Total PAG
A1-RR	7.7	2.8	0.4	0	10.9	258.5	198.2	264.3	32.5	495
A1-B	2.1	16.7	0	0	18.8	56.5	102.4	0.37	231.8	334.6
A-2	0	0	0	10.4	10.4	35.5	35.6	0	0	35.6

No data available for Reach B.

The acres in the table above were generated from within the boundaries of Riparian Reserves and Riparian Habitat Conservation Areas that have as a minimum widths of 300 feet upslope from both sides of Tumalo Creek. The National Wetland Inventory acres are limited and do not accurately capture the nature of the riparian vegetation community in the project area. The mesic shrub component of the PAG would represent the willow and red-osier dogwood shrubs that line the banks and floodplains of Tumalo Creek. Mixed conifer wet and ponderosa pine PAGS may or may not be associated with riparian vegetation but are in areas of higher soil moisture.

Figure 29 below demonstrates the vegetation types within the Riparian Reserves and Riparian Habitat Conservation Areas within the project area using Plant Association Groups.

Figure 29. Riparian vegetation within Riparian Reserves and Riparian Habitat Conservation Areas within the Bridge Creek Water Supply System Project



From Figure 29 and Table 49 above, it is evident that Sub-reach A1-RR has the most extensively developed riparian vegetation community as it lies within the glaciated valley. As discussed above, steep canyon walls limit the development of riparian vegetation in Sub-reach A1-B. In Sub-reach A2, a wider floodplain again allows the establishment of riparian vegetation.

3.7.8.2 Environmental Effects-Riparian Areas

Summary of Effects to Riparian Areas

- **Sub-reach A1**: The Proposed Action would eliminate potential adverse impacts to riparian areas in the case of pipeline failure. The Proposed Action would have short term effects (less than 2 years) to less than 0.3 acres of riparian areas from pipeline installation. Disturbed riparian areas would be re-vegetated and still function as riparian areas. The operation of the system under the Proposed Action would have neutral or minimal beneficial effects to riparian areas compared to the No Action alternative.

- **Sub-reach A2**: Effects from the Proposed Action would be identical to the No Action alternative, with the exception of the likely elimination of approximately 0.5 acre of riparian vegetation associated with the return flow channel.

- **Reaches B and C:** Effects from the Proposed Action would be identical to the No Action alternative.

Direct and Indirect Effects – Riparian Areas – No Action

Under No Action, because the existing pipeline would remain in place, and there would be no installation of any facilities or infrastructure, there would be no disturbance to riparian areas. However, chronic small leaks and the occurrence of a major pipeline break could affect riparian areas. Chronic leaks may perpetuate the encroachment of small areas of riparian vegetation where soil conditions allow. These small leaks are expected to increase in the future as the pipes age. In the event of a pipeline failure, riparian vegetation could be damaged and/or washed away with overland flows of water, soil, and debris. Effects could persist for several years until vegetation recovers.

Riparian areas are influenced by timing, duration, and volume of stream flows. Operation of the existing water system would result in a continual decrease of 18.2 cfs in Tumalo Creek below baseline conditions, except for isolated, short term periods of system shutdown.

Sub-reach A1 (Sub-reaches A1-RR and A1-B)

Sub-reach A1-RR: Under No Action, operation of the existing water system would continue to decrease water available for riparian vegetation, floodplain inundation, and water table elevations in wetlands and meadows, except for isolated, short term periods of system shutdown. The most effect is within the upper portion of the reach where the floodplain is wider, wetlands and meadows are more prevalent, and the capacity to store water is greater.

Sub-reach A1-B: Similar to Sub-reach A1-RR but with less impact as riparian areas are limited.

Sub-reach A2

Under No Action, municipal water use demand is projected to increase over time. This would lead to decreased stream flow in Sub-reach A2 over time, varying by month. May through September is the primary growing season for riparian vegetation. Stream flows are generally at the highest from May – through mid-July. Projected increased demand above existing conditions will increase 1-2 cfs during the growing season, representing 3% or less of available stream flow. Instream water rights limit the volume of water available for municipal use from July - September 22nd.

An evaluation of channel response in the instream flow study found that small changes in flow corresponded to small changes in water elevation. At a median flow of 58 cfs, a decrease of 3 cfs resulted in a decrease in water elevation of .025 foot in riffles and .035 foot in pools. Increased demand when at system capacity (approximately 7-8 cfs) would decrease water elevations approximately .034 foot (.4 inch) compared to current demand (2011 Water Year). There will be a trend of less water available for riparian vegetation, and floodplain and wetland inundation until the demand reaches system capacity at 18.2 cfs, but effects would be minimal due to the small elevational change with decreased stream flow. The greatest potential effect would occur in late September when stream flows are down and projected demand is at system capacity.

Reach B

Potential effects to riparian areas would closely follow the trends discussed under the Stream Flow and Aquatic Habitat sections. Increased municipal water use with projected increased demand may result in a 1-2 cfs reduction in stream flow in Reach B that would have minimal effects to riparian vegetation, floodplain inundation, and water table elevations in meadows and floodplains. Floodplains and riparian areas are relatively narrow in this reach with reduced capacity to store water.

Reach C

Effects would be minimal to riparian vegetation, floodplain inundation, and wetlands as any changes in flow would be minimal.

Direct and Indirect Effects – Riparian Areas – Proposed Action

See Figures 30 and 31, and Appendix B Wetland Report.

The implementation of the action alternative would affect riparian areas at two different periods – installation and operation. The magnitude and duration of the effects would be different, and will be discussed separately.

Installation:

The new pipeline alignment would follow closely the old alignment, and would for the most part be in the road shoulder when close to Tumalo Creek. Once past the bridge, the pipeline alignment is within upland vegetation or under the roadbed and distant from Tumalo Creek in its entire path to the Outback site, and does not cross over any additional drainages. The new pipeline alignment would be within 3.1 miles of Riparian Reserves but most of the alignment would be located outside of riparian vegetation being within the road bed and shoulder.

Wetlands A, B, B2, and C

Near the Tumalo Falls trailhead parking area, the new pipeline will follow the existing pipeline alignment, crossing under small wetlands associated with springs. Riparian vegetation consists of sedges, grasses, mountain alder, and cottonwoods. Disturbance to 0.083 acre of riparian vegetation would occur at this site (wetlands A, B, B2, and C). Within wetland B2, 0.031 acre would be a permanent conversion of a palustrine forested wetland to a palustrine emergent wetland as 4 trees and their associated canopy cover would be removed. Existing riparian vegetation would be excavated, stored on site, and then replaced after the pipeline is placed (BMP AqEco-2).

Wetlands D and E

Construction of the crossing underneath Tumalo Creek below Skyliners Bridge would result in disturbance to 0.19 acre of riparian vegetation consisting of mountain alder, sedges, willows, and Douglas spiraea (wetlands D and E). Within this 0.19 acre of disturbance, 0.04 acres is considered a permanent conversion of palustrine forested wetland to palustrine emergent wetland as 5 trees would be removed. Again, riparian vegetation would be excavated and stored on site for replacement.

Within all wetlands, impacts to riparian vegetation are expected to be short term (< 2 years). Conditions within the fill/removal permits issued by the Division of State Lands (DSL) and Army Corps of Engineers would require riparian vegetation disturbed during construction to be restored to pre-construction conditions to avoid compensatory mitigation. A total of approximately 0.273 acres of riparian vegetation would be disturbed in the short term; with a total of 0.071 acres considered by DSL to be a permanent conversion from palustrine forested wetland to palustrine emergent wetlands because of 9 trees over 6” dbh removed. Adherence to the riparian re-vegetation plan would minimize long term (> 2 years) effects to riparian vegetation. Effects to riparian vegetation would be minimal due to the small area of disturbance and the planned restoration. The wetlands would continue to retain wetland characteristics such as being periodically or permanently saturated or have inundated soils. Post-pipeline installation, the wetlands would continue to support native riparian vegetation typical of the area, which are adapted for life in high moisture soil conditions. Hydrologic and geomorphic processes that provide water and sediment to the wetlands would still function.

Figure 30. Wetlands A, B and C

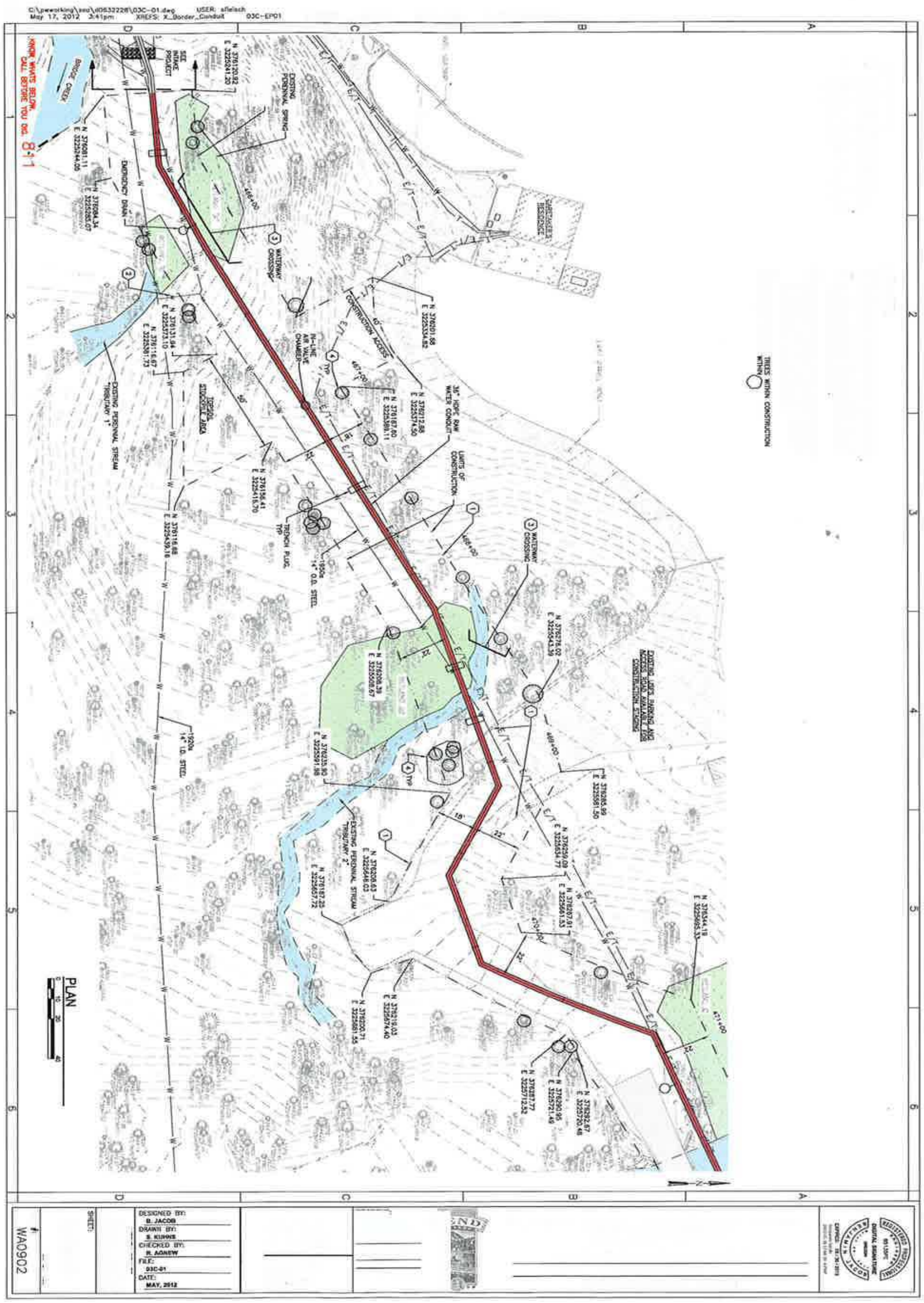
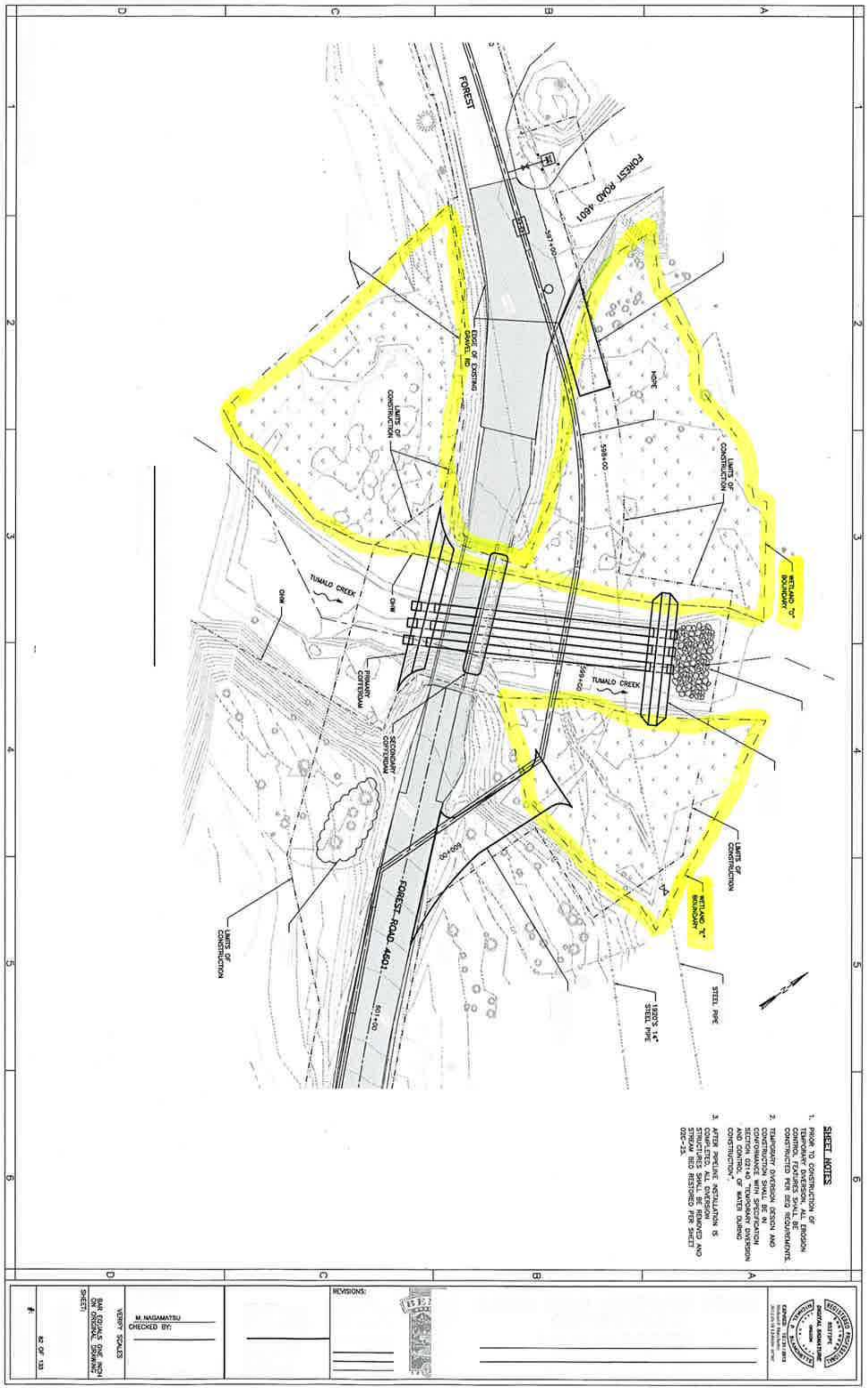


Figure 31. Wetlands D and E



Bridge Creek Intake and Operations:

Sub-reach A1-RR

Effects to riparian areas are related to timing and changes in stream flow. There will be a benefit to riparian vegetation, floodplain inundation, and water table elevations in wetlands and meadows upon project completion compared to existing conditions as less flow would be diverted at Bridge Creek. In the short term (Flow Scenario #1), most of the flow benefit would occur during the non-growing season. As demand increases over time, flow benefits would continue to trend downward but when Tumalo Creek is in distribution, a persistent long term (Flow Scenario #3) flow benefit of approximately 3 cfs would occur during the growing season from July through September 22nd. A 3 cfs increase in flow while discharge is at 58 cfs corresponds to only a 0.03 foot increase in water surface elevation within this reach. Potential increases in bankfull stage flows, which can recharge groundwater in riparian areas, would be minimal and would trend downward as demand increases. Benefits to riparian vegetation would be minimal because of the small change in flows and water table elevation.

Sub-reach A1-B

Any potential impacts to riparian vegetation would be minimal in this high gradient reach because of the inherent limited riparian areas. Similar to Sub-reach A1-RR, a nearly 3 cfs increase in flow when at the median discharge would only result in a water elevation increase of 0.02 to 0.03 feet. Similar to Sub-reach A1-RR, potential increases in bankfull stage would be minimal. Benefits to riparian vegetation would be minimal because of the small change in flows and water table elevation.

Sub-reach A2

Effects to riparian areas would be the same as the existing system since excess water beyond demand is returned to Tumalo Creek under the existing system. Stream flows would not change in Sub-reach A2 under the Proposed Action.

Along the approximately 0.5 mile return flow channel that enters at the head of Sub-reach A2, there is a narrow band (approximately 3-4 feet each bank) of riparian vegetation that became established at the creation of this channel over 85 years ago, amounting to less than 0.5 acre total. With cessation of the return flow, this riparian vegetation is anticipated to disappear and be replaced by upland vegetation species such as bitterbrush and grass species.

Reach B

Effects to riparian areas would be the same as the existing system since excess water beyond demand is returned to Tumalo Creek under the existing system. Stream flows would not change in Reach B under the Proposed Action.

Reach C -Middle Deschutes River

Effects to riparian areas would be the same as the existing system since excess water beyond demand is returned to Tumalo Creek under the existing system, and then enters the Deschutes River. Stream flows would not change in Reach C under the Proposed Action.

The Bridge Creek Water Supply project is consistent with the following Standards and Guides of the Deschutes National Forest LRMP:

- RP1-4 - Riparian areas would be maintained and protected in the long term.
- RP-8 - Cumulative effects to streamflow, water quality, aquatic habitat and channel morphology, fisheries populations, and riparian areas were evaluated. Measures to avoid adverse effects to these resources are included in the design.
- RP-10 - Riparian vegetation would be managed to maintain stream channel and bank structure.
- RP-47 as natural floodplain characteristics would be maintained.

Cumulative Effects – Riparian Areas

Riparian vegetation is impacted at isolated areas from recreational users and along private land tracts. Impacts from installing the pipeline would have negligible short-term (< 2 years) cumulative effects to riparian vegetation. Less than 0.3 acre of riparian vegetation would be disturbed from installation. The Proposed Action would increase water available to riparian areas in Sub-reach A1, cumulatively benefiting past restoration projects along the stream banks of Tumalo Creek and the vegetation management activities that enhance vigor and growth of riparian vegetation (West Tumbull Fuels Reduction, Tumalo Floodplain Enhancement projects). These benefits would diminish over time as municipal water demand increases.

3.7.9 Other Findings

Inland Native Fish Strategy Compliance

The Inland Native Fish Strategy (INFISH) was developed in 1995 to protect habitat and populations of resident native fish outside of anadromous fish habitat on National Forest System lands across several western states. INFISH amended existing Forest Service land and resource management plans.

Management direction within INFISH requires Riparian Habitat Conservation Areas (RHCAs) to be delineated for watersheds on National Forest lands. They are portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. Management of RHCAs is intended to work toward achieving Riparian Management Objectives (RMOs) or not retard the attainment of RMOs, and avoid adverse effects on inland native fish. According to INFISH, “to “retard” would mean to slow the rate of recovery below the near natural rate of recovery if no additional human caused disturbance was placed on the system”.

The RMOs are described by habitat features indicating “good” watershed health and inland native fish habitat. All of the described features may not occur within a specific segment of stream within a watershed, but all generally should occur at the watershed scale for stream systems of moderate to large size (3^{rd} to 6^{th} order streams). RMOs provide the target toward which land managers aim while conducting resource management activities (USDA, 1995).

The RMOs are considered interim until modified by watershed analysis or site-specific analysis. The refinement of the RMOs should better reflect conditions that are attainable in a specific watershed or stream reach based on local natural features and climate. To date, interim RMOs have not been modified to better reflect the attainable conditions in the Tumalo Creek watershed.

Interim RMOs applicable to a forested system, which is appropriate for Tumalo Creek, include pool frequency, width/depth ratio, large woody debris, and water temperature. Tumalo Creek from river mile 10.0 downstream to river mile 6.2 is within National Forest lands managed under INFISH, and is within Sub-reach A1-B. Above river mile 10.0, National Forest lands are managed under the Northwest Forest Plan. Below river mile 6.2 to the mouth, ownership is a mix of private land, state land, and Bend Parks and Recreation District land. The Forest Service has no jurisdiction on how Tumalo Creek and associated riparian zones are managed on these lands downstream of river mile 6.2.

Table 50. Interim Riparian Management Objectives (RMOs)

Habitat Feature	Interim Objectives
Pool Frequency (kf[1]) (all systems)	Varies by channel width (See Table 51 below)
Water Temperatures (sf[2])	No measurable increase in maximum water temperature (7-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period.) Maximum water temperatures below 59° F within adult holding habitat and below 48° F within spawning and rearing habitats.
Large Woody Debris (sf) (forested systems)	East of Cascade Crest in Oregon, Washington, Idaho, Nevada, and western Montana: >20 pieces/mile; >12" diameter; >35' length.
Bank stability (sf) (non-forested systems)	>80 percent stable
Lower Bank Angle (sf) (non-forested systems)	>75 percent of banks with <90 degree angle (i.e., undercut)
Width/Depth Ratio (sf)	<10, mean wetted width divided by mean depth

[1] Key Feature
[2]Supporting Feature

Table 51. Interim objectives for pool frequency

Wetted width (feet)	10	20	25	50	75	100	125	150	200
Pools per mile	96	56	47	26	23	18	14	12	9

Pool frequency:

The section of Sub-reach A1-B managed under INFISH coincides with Reach 2 of a 1999 Deschutes National Forest stream survey of Tumalo Creek. The wetted width for Reach 2 is about 35 feet. The targeted pool frequency is approximately 35 pools/mile (Table 51 above, USDA, 1995). The stream survey data revealed an average of 14 pools/mile, less than predicted under INFISH. Pool frequencies vary between stream types. Rosgen B type channels, which characterizes Sub-reach A1-B, naturally have less pool frequency than lower gradient Rosgen C and E channel types. Pools are typically formed by scour around and over stream features such as instream wood, boulders, rocky outcroppings, and against erosion-resistant stable streambanks. Pool formation is affected by the type and volume of sediment transported in the system (bedload). The bankfull stage and its attendant discharge are related to the formation, maintenance, and dimensions of the channel (Rosgen, 1996), including the formation of pools. Pool frequency in Sub-reach A1-B is not unusual for Rosgen B type channels, and is likely a natural feature rather than the result of anthropogenic causes. As discussed under the Aquatic Habitat and Channel Morphology section, the Proposed Action would cause negligible increases to the channel-forming bankfull flows. There would be negligible to immeasurable changes in channel shear stress values and the ability of the channel to process bedload during normal bankfull events. Thus the ability to scour and retain pools would be maintained. The natural recruitment and movement of large woody material in the stream system has more influence on pool frequency than minimal increases in stream flow that would occur in the Proposed Action. The Proposed Action does not retard or prevent the attainment of the pool frequency RMO.

Width/depth ratio:

The bankfull width/depth ratio is arrived by dividing the bankfull stream width by the bankfull mean depth in a riffle section. The ratio RMO of 10 is not met under current conditions within Reach 2 of the stream survey. The average width/depth ratio was 22.02. Rosgen B type channels typically have a width/depth ratio of > 12 (Rosgen, 1996). Width/depth ratios departed from a stable reference condition and exhibit accelerated streambank erosion. The stream banks within Sub-reach A1-B are stable, indicating the current width/depth ratio is a natural feature of Tumalo Creek and in balance with the flow regime. Discussion under the Aquatic Habitat, Channel Morphology, and Riparian Areas sections concluded that there would be minimal changes in wetted perimeter, riparian vegetation, and channel forming processes under the Proposed Action within Sub-reach A1-B. The Proposed Action would have no measurable effects on width/depth ratios. Thus, the Proposed Action would not retard or prevent attainment of the bankfull width/depth ratios. Downstream of lands managed under INFISH, in Sub-reach A2 and Reach B, the stream flow would not change under the Proposed Action. Thus, the width/depth ratio would not be affected.

Large Woody Debris:

The INFISH standard for a piece of large woody debris is a minimum length of 35 feet and 12" diameter (Table 50 above, USDA, 1995). The pieces of large woody debris exceeds the RMO of 20 pieces/mile in Sub-reach A1-B (31 pieces/mile) under current conditions. The Proposed Action would not harvest streamside trees that would contribute to instream large woody debris, or remove insteam large woody debris. The increased streamflow associated with the Proposed Action would not measurably affect the movement of large woody debris within the channel. For these reasons, the Proposed Action meets this objective.

Water Temperature:

Within Tumalo Creek, the 7 day maximum water temperatures exceed the 59° F (15° C) adult fish holding habitat water temperature objective in some years under current conditions. The frequency that this objective is exceeded increases in a downstream direction. Increases in water temperatures of Tumalo Creek as it flows down valley is due to natural conditions of ambient and solar warming, as there are no diversions or surface tributary influences between Skyliners Bridge (rm 13.4) and the return flow (rm 5.4). The only long term monitored temperature site within lands managed under INFISH is near the downstream end of Sub-reach A1-B at river mile 6.8. Here, the 7 day maximum of 15° C was exceeded 4 years out of 5 between the years of 1999 and 2007. The 7 day maximums ranged from 13.5° C to 17.4° C. Within Reach B below the TID diversion (not on federal land and downstream of lands managed under INFISH), the 7 day 15° C summer maximum was exceeded all years during the sampling period of 1999 – 2006. The 7 day maximums ranged from 15.2° C to 18.8° C (Table 50 below). Near the mouth, the state water quality standard was exceeded all 7 years the stream was monitored between 2001 and 2009. The 7 day maximums ranged from 20.3°C to 22.8°C. Monitoring by the City of Bend during 2010-2012 indicates maximum temperatures have decreased neaer the mouth with augmented stream flows. Irrigation withdrawals have a large influence on water temperatures in this reach, and modeled values using the Heat Source model can't be directly attributed to municipal water use.

Under existing conditions, within Tumalo Creek, the water temperature RMO (8.9°C for spawning/rearing habitats) is met during the early part of the redband trout spawning period of March to July and for rearing during the months of late fall to late spring under existing conditions. This RMO is not met at all times for the summer months under existing conditions within Sub-reach A1-B and within Sub-reach A2 downstream of lands managed under INFISH.

In summary, Tumalo Creek exceeds the 15° C and 8.9° C water temperature RMO at times under existing conditions. The Proposed Action, when augmenting stream flows above existing conditions, decreases temperature in Sub-reach A1-B, trending toward attainment of this objective.

As discussed under the Water Quality section of the EA, the ODEQ's Heat Source model was used to analyze potential thermal regimes along Tumalo Creek from operation of the new system described in the Proposed Action. Projected diversion rates for the City of Bend during average flow years would be held to approximately 15 cfs during the hottest part of the year. During low water years, the diversion rate would be less, approximately 13.1 cfs. Results of the Heat Source modeling are discussed below (also refer to Water Quality section of EA):

- With increased stream flow due to flow control at the Bridge Creek intake, comparative water temperatures were modeled to slightly cool within Tumalo Creek (up to 0.8°C based on the 7 day average maximum temperature at stream flow of 53 cfs) during the hottest months within the entirety of Sub-reach A1. Although the temperature differences between the two alternatives within Sub-reach A1 decrease with increasing stream flow, the actual temperatures decrease with increasing stream flow. The temperature decreases may be immeasurable in the field, especially at higher stream flows.

- The reduced summer temperature benefit through the 10.6 mile Sub-reach A1 accounts for 23% of the 45.8 perennial stream miles within the Tumalo Creek watershed. The benefit includes the 3.8 stream miles managed under INFISH. In all, 40.4 perennial stream miles (88.2% of the watershed) would be reduced in temperature or temperature not affected by the Proposed Action according to the modeling.

- The INFISH water temperature RMO does not apply to Tumalo Creek downstream of the Forest Service boundary (Sub-reach A2 and Reach B). Here, Oregon state water quality standards apply. The potential minimal water temperature increases modeled under the Proposed Action, if actually measured in the field, would not result in exceedence of the 7 day average maximum standard of 18°C within Sub-reach A2.

- Although Sub-reach A2 is located downstream of National Forest lands (starts at river mile 5.4), the modeling showed potential minimal water temperature increases with the Proposed Action compared to the existing system at low stream flow during the hottest months. Sub-reach A2 accounts for 2.6 stream miles (5.7% of the perennial stream miles in the watershed). At a stream flow of 53 cfs, a potential increase of 0.5°C in the 7 day average maximum was modeled below the junction of the return flow and Tumalo Creek (river mile 5.0). At this stream flow, approximately 5 cfs is being returned from the Outback site and mixing with approximately 48 cfs in stream. The minimal increases were modeled to carry downstream into Reach B but at a diminishing rate so that at the mouth of Tumalo Creek the modeled increase was 0.1° C. Reach B accounts for 2.8 perennial stream miles (6.1% of the perennial stream miles in the watershed). As stream flows increase above 53 cfs, modeled temperature differences between the existing system and the Proposed Action diminish and eventually disappear. A stream flow of 53 cfs is exceeded 75-95% of the time during the summer months in Sub-reach A2.

- Modeling assumptions likely led to higher potential temperature increases in Sub-reach A2 and Reach B, as described in the Water Quality section. Warming of the return flow water in the pipeline and overland return channel were not accounted for.

- The degree of accuracy of the Heat Source model is +/- 1°C. The small changes predicted in the model, either cooling or warming, would be immeasurable in the field.

- The accuracy of the thermographs themselves also affects the potential to accurately account for small temperature differences in the field, as described in the Water Quality section. Detecting small changes in temperature in Tumalo Creek between the two alternatives would be difficult with the allowable level of error in thermographs. ODEQ standards for their highest level of accuaracy, Data Quality Level A+, are ± 0.5 degrees C for hydrothermographs (ODEQ2009).

- Recent temperature monitoring has shown that only within Reach B is the state standard of 18°C exceeded, and is a function of low flows resulting from irrigation diversions. No continuous water temperature site is located within Sub-reach A2, but the state standard is met in the nearest upstream site, located approximately 1.4 miles above the start of Sub-reach A2 (Road 4606 site). Water conservation measures have been in effect in recent years that have increased stream flows in Reach B. Summer temperatures have decreased in Reach B in recent years (2010-2012) near the mouth of Tumalo Creek based on City of Bend monitoring. More water conservation projects are planned that should result in a reduction of water temperatures.

- Although the modeling showed a temperature increase of up to 0.5°C in Sub-reach A2 at low flow conditions, and is thought to overestimate the difference between the existing and proposed systems in this particular case, it is acknowledged that such an increase would exceed the 0.3°C rule for cold water protection (OAR 340-41-0028 (11)). However, because Tumalo Creek (A) does not have threatened or endangered salmonids currently inhabiting the creek; (B) has not been designated as critical habitat; and (C) colder water is not necessary to ensure that downstream temperatures achieve and maintain compliance with the applicable temperature criteria (OAR 340-41-0028 (11)(c)), Tumalo Creek is not subject to this State water quality standard.

- The Proposed Action includes monitoring of water temperatures below the return flow to test modeling results. In addition, monitoring would continue on established temperature sites. The monitoring will be used to validate assumptions used during modeling, and to ensure that there are no adverse effects to water temperatures resulting from the project as it is implemented. If adverse effects are identified, the Special Use Permit will be adjusted accordingly.

- In summary, the Proposed Action was modeled to show decreases in summer water temperatures on lands managed under INFISH and would not result in violation of state water quality standards on Tumalo Creek downstream of lands managed under INFISH in Sub-reach A2. Upstream of lands managed under INFISH, recovering riparian vegetation along 3 miles of Tumalo Creek within the Bridge Creek Fire will increase shade over time and potentially provide a slight decrease in maximum temperatures over time, cumulatively benefitting the stream flow benefit. Ongoing water conservation projects are increasing stream flows in Reach B downstream of lands managed under INFISH and should reduce temperatures during the irrigation season. The Proposed Action, when stream flows are augmented above existing conditions, would provide benefits to the water temperature RMO during the hottest months.

Table 52. 7 Day Maximum Average Water Temperatures for Tumalo Creek and Middle Deschutes River

Site	Year	7 Day Maximum Ave. °C	Data Source
tc4960	2005	12.1	UDWC
tc4960	2006	12.2	UDWC
tc4960	2008	11	UDWC
tc4960	2009	12.3	UDWC
tc4780	1995	13.9	FS
tc4780	1997	12.6	FS
tc4780	1999	12.4	FS
tc4780	2000	13.6	FS
tc4780	2002	14.2	FS
tc4780	2003	15.4	FS
tc4780	2004	14.8	FS
tc4780	2005	15.8	FS
tc4780	2006	14.1	FS
tc4780	2007	15.1	FS
tc4780	2008	13.4	FS
tc4780	2009	14.6	FS
tc3880	1999	13.5	FS
tc3880	2000	15.3	FS
tc3880	2003	17.4	FS
tc3880	2005	17	FS
tc3880	2007	16.1	FS
tc3560	1999	15.2	UDWC
tc3560	2000	17.9	UDWC
tc3560	2001	17.8	UDWC
tc3560	2002	17.4	UDWC
tc3560	2003	18.8	UDWC
tc3560	2004	16.8	UDWC
tc3560	2006	16.5	UDWC
tc000-25	2001	21.2	UDWC
tc000-25	2002	22.0	UDWC
tc000-25	2003	22.8	UDWC
tc000-25	2004	20.3	UDWC
tc000-25	2005	21.6	UDWC
tc000-25	2007	20.9	UDWC
tc000-25*	2009	20.4	UDWC
dr160.00	2005	20.5	UDWC
dr160.00	2006	20.7	UDWC
dr160.00	2007	20.7	UDWC
dr160.00	2008	18.7	UDWC
dr160.00	2009	20.8	UDWC
dr160.00	2010	19.3	UDWC

tc4960 = Just downstream of confluence with Bridge Creek, rm 16.0, sub-reach A-1-RR (above accretion)
tc4780 = 100yards downstream of Skyliners Bridge, rm 13.3, sub-reach A-1-RR (below most accretion)
tc3880 = just upstream of Road 4606 crossing, rm 6.8, sub-reach A-1-B
tc3560 = below TID diversion, rm 2.7, Reach B
tc000-25 = near mouth of Tumalo Creek
dr160.00 = Middle Deschutes River just downriver of mouth of Tumalo Creek
UDWC = Upper Deschutes Watershed Council
FS = Deschutes National Forest
***2010-2012 monitoring by City of Bend indicates lower maximum temperatures near mouth.**

Compliance with INFISH Standards and Guidelines

Federal lands managed under INFISH on Tumalo Creek are from river mile 10.0 to 6.2, although there are also private inholdings. The only sub-reach within the INFISH area is Sub-Reach A1-B, which is a sub-set of the larger Sub-reach A1.

> ***LH-1****: Require instream flows and habitat conditions for hydroelectric and other surface water development proposals that maintain or restore riparian resources, favorable channel conditions, and fish passage, reproduction, and growth. Coordinate this process with the appropriate state agencies. During relicensing of hydroelectric projects, provide written and timely license conditions to the Federal Energy Regulatory Commission (FERC) that require fish passage and flows and habitat conditions that maintain/restore riparian resources and channel integrity. Coordinate relicensing projects with the appropriate state agencies.*

Lands managed under INFISH are within Sub-reach A1-B. During decreased demand and water right curtailment July –September 22nd (which would persist into the future), there would be increased stream flow in Sub-reach A1-B compared to existing conditions.

Potential benefits to riparian areas from more stream flow may not be measurable. For example, a 3 cfs increase in stream flow from 58 cfs to 61 cfs in Sub-reach A1-B results in an average of 0.03 foot increase in water elevation, an average increase in mean depth of 0.023 feet, and an average increase in wetted perimeter of 0.10 feet. Riparian resources and channel conditions are maintained with the Proposed Action.

The effects to redband trout habitat from the Proposed Action are discussed in section 3.7.6. Habitat modeling showed that, in general, redband habitat for all life stages was increased under the Proposed Action in Sub-reach A1-B but benefits decreased as demand increases over time. In addition, higher stream flows would inundate more of the stream channel, increasing primary and secondary biological production that would increase forage for redband trout. The effects of variation in stream flow on population dynamics such as fish survival and growth can be difficult to estimate because of possible confounding issues with the effects of other environmental variables. Minimal water temperature decreases predicted in the Heat Source analysis (7 day average maximum) through Sub-reach A1-B would not measurably affect fish reproduction and growth. Downstream of federal lands managed under INFISH (Sub-reach A2), the modeling predicted slight increases in the 7 day average maximum at low flow scenarios. Increases were at least in part due to assumptions made in the modeling effort (See section 3.7.5). If these modeled minimal temperature increases were realized in the field, no measurable changes in fish reproduction or growth would occur.

In summary, the Proposed Action is consistent with S & G LH-1 as riparian resources, channel conditions, fish passage, and fish reproduction and growth are maintained.

> ***LH-3****: Issue leases, permits, rights-of-way, and easements to avoid effects that would retard or prevent attainment of the Riparian Management Objectives and avoid adverse effects on inland native fish. Where the authority to do so was retained, adjust existing leases, permits, rights-of-way, and easements to eliminate effects that would retard or prevent the attainment of the Riparian Management Objectives or adversely affect inland native fish. If adjustments are not effective, eliminate the activity. Where the authority to adjust was not retained, negotiate to make changes in existing leases, permits, rights-of-way, and easements to eliminate effects that would prevent attainment of the Riparian Management Objectives or adversely affect inland native fish. Priority for modifying existing leases, permits, rights-of-way, and easements would be based on the current and potential adverse effects on inland native fish and the ecological value of the riparian resources affected.*

The Proposed Action is consistent with S & G LH-3. The project would not retard or prevent the attainment of the Riparian Management Objectives (see assessment of the RMOs above). As discussed in the Fisheries Biological Evaluation section, the project was found to have No Effect to bull trout. For redband trout, the project May Impact Individuals and Habitat within Sub-reach A1-B since there would be temporary (< 1 month) increases in turbidity from upstream pipeline installation and temporary impacts on fish passage in Sub-reach A1-RR, but will not likely contribute to a trend towards federal listing. Much of the turbidity increase would dissipate before reaching Sub-Reach A1-B. Turbidity increases during pipeline installation may impact foraging for redband trout, but impacts are expected to be minimal. Effects to redband trout within Sub-reach A1-B from operating the new system are discussed above under LH-1. Detrimental impacts to redband trout are avoided. Downstream of national forest lands managed under INFISH, within Sub-reach A2 and Reaches B and C, stream flow would remain the same and potential water temperatures changes would be minimal and immeasurable in the field, therefore avoiding detrimental impacts to native redband trout.

> ***RA-1****: Identify and cooperate with Federal, Tribal, State, and local governments to secure instream flows needed to maintain riparian resources, channel conditions, and aquatic habitat.*

The Proposed Action results in more instream flow in over 10 miles of Tumalo Creek compared to existing conditions due to flow control matching demand, including 3.8 river miles on lands managed by the Forest Service under INFISH. The benefits are expected to persist in the long term (20 years or more) within Sub-reach A1 for the months of July through September 22 when in distribution. The impacts to riparian resources, channel conditions, and aquatic habitat within Sub-reach A1-B are discussed above under S & G LH-1.

> ***RA-4****: Prohibit storage of fuels and other toxicants within Riparian Habitat Conservation Areas. Prohibit refueling within Riparian Habitat Conservation Areas unless there are no other alternatives. Refueling sites within a Riparian Habitat Conservation Area must be approved by the Forest Service or Bureau of Land Management and have an approved spill containment plan.*

The Proposed Action is consistent with S & G RA-4 since it is included as a Best Management Practice. Equipment would be serviced on developed roads at least 500 feet from streams to the extent possible.

<u>Northwest Forest Plan - Aquatic Conservation Strategy Objectives Summary</u>

The Aquatic Conservation Strategy is a component of the Northwest Forest Plan and was developed to restore and maintain the ecological health of watersheds and aquatic systems contained within them on public lands. The Aquatic Conservation Strategy Objectives were developed to manage land use activities to approach a goal of maintaining the natural disturbance regime. The approach seeks to prevent further degradation and restore habitat over broad landscapes.

Bridge Creek from the intake to the junction with Tumalo Creek (0.2 miles distance) and Tumalo Creek from the junction with Bridge Creek at river mile 16.0 downstream to river mile 10 are within lands managed under the NWFP. Drainages upstream of the project area within the Tumalo Creek watershed are also within lands managed under the NWFP.

Forest Service lands within the range of the northern spotted owl will be managed to maintain and restore the following objectives:

> ***ACS Objective 1****: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.*

Within the Tumalo Creek watershed, the potential effects of the Proposed Action are limited to the location of pipeline alignment and instream flows of Tumalo Creek within a 16.0 mile area, and 0.2 miles within

Bridge Creek. Approximately 6.0 miles of Tumalo Creek within the project area is on lands managed under the NWFP. Nearly 10 miles of pipeline would be buried having only short-term impacts (<2 years) to soils, upland vegetation, riparian vegetation, and streams. Approximately half of the pipeline route is located on lands managed under the NWFP. There would be no impact to the distribution, diversity, and complexity of landscape-scale features such as timber stands, landslide-prone areas, sensitive soils, stream networks, or wildlife habitats from installing the pipeline. The Proposed Action will either result in the same stream flow or increased stream flow in Tumalo Creek compared to the existing condition throughout the project area because of flow control, therefore not impacting watershed and landscape-scale features. Minimal effects in the watershed are limited to the stream environment and immediately adjacent stream margins, such as an increase in wetted perimeter and stream depth with increased stream flow in Sub-reach A1. The Proposed Action meets this objective at the local and watershed scales as watershed and landscape-scale features are maintained, and aquatic systems are protected.

> ***ACS Objective 2****: Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include flood plains, wetlands, upsweep areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.*

Drainage network connections are not impacted by the Proposed Action. Installation of the pipeline would have only short term (<2 years) impacts to small areas (0.273 acres) of floodplains and wetlands. The increase in stream flow in Sub-reach A1 resulting from implementing the Proposed Action results in minimal but likely immeasurable benefits to wetlands and the ability of Tumalo Creek to access its floodplain (sections 3.7.6 and 3.7.8). Routes critical for fulfilling life history requirements of aquatic and riparian-dependent species is not affected. The Proposed Action meets this objective at the local and watershed scales as network connections for species are provided.

> ***ACS Objective 3****: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*

The pipeline installation would have only short term impacts (< 2 years) to approximately 50 lineal feet of streambank of Tumalo Creek. Re-vegetation of the banks would ensure long-term integrity of the disturbed area. The stream crossing near Skyliners Bridge would disturb approximately 220 lineal feet across wetlands and the stream bed, of which approximately 40 feet is stream bed. Approximately 500 ft^2 of the streambed would be impacted during the pipeline installation, but would be restored to pre-project conditions after installation. Impacts such as water re-routing, gravel displacement, downstream sedimentation, and turbidity would be short term (< 1 month). The streambed features of Tumalo Creek would not be impacted by the small increase in stream flow in Sub-reach A1 as the ability of the stream to carry bedload would not be measurable affected as described in section 3.7.6. The Proposed Action meets this objective at the local and watershed scales by maintaining the physical integrity of the aquatic system.

> ***ACS Objective 4****: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*

During pipeline installation at the Tumalo Creek crossing, there would be occasional short term (<1 day) increases in turbidity and sedimentation over the course of approximately 1 month, but would be within the range frequently experienced during high flow events. There would be no long term impacts (> 1 month) to water quality from pipeline installation.

As discussed under the Water Quality section of this report, the ODEQ's Heat Source model was used to analyze potential thermal regimes along Tumalo Creek for Operations under the Proposed Action. Projected diversion rates for the City of Bend during average flow years would be held to approximately 15 cfs during the hottest part of the year. Operation of the new water system was shown in the ODEQ Heat Source modeling to slightly cool water temperatures in Sub-reach A1, which includes federal lands managed under the NWFP, based on the 7 day maximum temperature. Within Sub-reach A2 and Reach B downstream of lands managed under the NWFP and not located on federal lands, the modeling showed a slight increase in the 7 day maximum at low flows, even though stream flow would be increased through Sub-reach A1. The relative differences in effects to temperature related to return flows versus cooler upstream flows are too small to be measurable with the technology in place.

The Proposed Action maintains this objective as water quality remains within a range that maintains the biological, physical, and chemical integrity of the system. The Proposed Action takes restorative action on water temperatures within Sub-reach A1 by increasing instream flow through Sub-reach A1 during the hottest months of the year.

> ***ACS Objective 5:*** *Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.*

The single site of pipeline installation under Tumalo Creek would result in short-term (intermittent over approximately 1 month) sediment inputs to Tumalo Creek, primarily when the stream is re-watered after construction is completed. The volume of sediment entrained would likely be less than 1-2 cubic yards and the character, rate, and volume would not be outside the range seen during high flow events. Operation of the new water system would often result in more stream flow in Sub-reach A1. This was shown in the Channel Morphology section (3.7.6) to not adversely impact the ability of the stream to transport and store sediment. Bankfull stage water elevations in Sub-reach A1 are increased minimally under the Proposed Action. This objective is met at the local and watershed scales as the input, storage, and transport of sediment is maintained.

> ***ACS Objective 6:*** *Maintain and restore in-stream flows sufficient to create and restore riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration and spatial distribution of peak, high, and low flows must be protected.*

The pipeline installation affects instream flows only during the fall-winter construction periods that would last for several weeks. At this time, instream flows would be at times increased over existing conditions as the diversion at Bridge Creek would temporarily cease. Operation of the new system would often result in more stream flow than existing conditions. The increase in flows was shown to have negligible effects to sediment routing, wetted perimeter, wetland inundation, and bankfull discharge. The increase in flows is not expected to have measurable impacts to nutrient and wood routing. There would be minimal increases in the magnitude, duration, and spatial distribution of peak, high, and low flows, as more water is returned instream. The Proposed Action, by restoring some stream flow to 0.2 miles of Bridge Creek and over 10 miles of Tumalo Creek, meets this objective at the local and watershed scales. Riparian, aquatic, and wetland habitats are maintained or enhanced and the potential for newly created habitats is increased. There are no adverse effects to riparian, wetland, or aquatic habitats.

> ***ACS Objective 7****: Maintain and restore timing, variability, and duration of flood plain inundation and water table elevation in meadows and wetlands.*

The pipeline installation would temporarily affect this objective during the fall-winter construction period lasting several weeks when instream flow would be increased, potentially slightly increasing water table elevations in meadows and wetlands late in the year. No adverse effects are expected during this time. Operation of the new system would minimally increase bankfull stage elevations, therefore minimally increasing water table elevations in meadows and wetlands as described in section 3.7.8. The ability of Tumalo Creek to access floodplains would be minimally increased, as bankfull and higher flows would be slightly higher. This objective is met at the local and watershed scales by the Proposed Action as floodplain inundation and water table elevations are maintained.

ACS Objective 8: *Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distribution of coarse woody debris sufficient to sustain physical complexity and stability.*

The pipeline installation would temporarily impact (< 2 years) riparian vegetation at the 6 small wetlands impacted by pipeline installation, including the single under-stream crossing of Tumalo Creek. Less than 0.3 acres of wetlands would be impacted. Nine trees over 6" dbh would be removed. Within two years, the riparian vegetation is expected to be re-established. Operation of the new water system, which at times results in higher flows in Sub-reach A1 than the existing system, will have minimal effects to riparian vegetation. This objective is met by the Proposed Action at the local and watershed scales as the species composition and structural diversity of riparian and wetland vegetation would be maintained.

ACS Objective 9*: Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

Pipeline installation would temporarily (< 2 years) impact 0.273 acres of wetland which supports habitat for riparian plants, invertebrates, and vertebrates. The Division of State Lands determined there would be a permanent conversion of a total of 0.071 acres of palustrine forested wetland to palustrine emergent wetland, as 9 trees over 6" diameter would be removed. These 0.071 acres would retain wetland characteristics of having saturated soils and supporting native wetland plant, invertebrate, and vertebrate riparian-dependent species. The only change is in the amount of canopy cover. There is no loss of wetlands or waters of the United States. There would be no long-term impacts (> 2 years) to habitat for native plants, invertebrates, and vertebrate riparian-dependent species. Operation of the new system, with increased stream flow, would have minimal effects to native riparian vegetation. This objective is met by the Proposed Action at the local and watershed scales as habitat supporting invertebrates, native plants, and riparian-dependent species is maintained.

ACS Summary

The Proposed Action of the Bridge Creek Water Supply Project would maintain the 9 objectives of the Aquatic Conservation Strategy. Installation of the pipeline would have minimal short term effects (range of 1 day to < 2 years) to aquatic systems and riparian areas. Impacted soils and riparian areas would be restored. Operation of the new water system would provide some benefits to the aquatic system under the Proposed Action compared to the existing system due to the ability to match demand with flow through control at the intake structure. The Proposed Action restores some stream flow to 0.2 miles of Bridge Creek and over 10 miles of Tumalo Creek, including 6.0 miles managed under the NWFP. The overall ecological health of the aquatic system within the project area would be maintained.

Compliance with NWFP Standards and Guidelines:

LH-1*: Identify instream flows needed to maintain riparian resources, channel conditions, and fish passage.*

The Proposed Action results in more instream flow in 0.2 miles of Bridge Creek and over 10 miles of Tumalo Creek, including 6.0 miles within the NWFP boundaries, compared to existing conditions due to flow control matching demand. The benefits are expected to persist in the long term (20 years or more) within Sub-reach A1 for the months of July through September 22 when in distribution. Instream flows would not change as a result of the Proposed Action in Sub-reach A2 and Reach B, which are downstream of national forest lands. The impacts to riparian resources, channel conditions, and aquatic habitat are discussed below under S & G LH-2. The Proposed Action is consistent with this S & G.

LH-2: *For watersheds besides Tier I Key Watersheds: For hydroelectric and other surface water development proposals, give priority emphasis to instream flows and habitat conditions that maintain or restore riparian resources, favorable channel conditions, and fish passage. Coordinate this process with the appropriate state agencies. During relicensing of hydroelectric projects, provide written and timely license conditions to the Federal Energy Regulatory Commission (FERC) that require flows and habitat conditions that maintain or restore riparian resources and channel integrity. Coordinate relicensing projects with the* *appropriate state agencies.*

Upper Tumalo Creek sub-watershed is a Tier 2 Key Watershed and includes the 0.2 mile reach of Bridge Creek and Tumalo Creek from river mile 16.0 downstream to river mile 12.2. Lower Tumalo Creek sub-watershed, located downstream of Upper Tumalo Creek sub-watershed, is not a Key Watershed. The Proposed Action is consistent with S & G LH-2 as riparian resources are maintained in the long term (> 2 years). There will be short-term (< 2 years) disturbance during pipeline installation to less than 0.3 acres of riparian vegetation and soils. Up to 9 spruce and lodgepole pine trees over 6" dbh within the riparian areas would be removed. Instream flows would not change as a result of the Proposed Action in Sub-reach A2 and Reach B, which are downstream of national forest lands. The Proposed Action results in more instream flow in 0.2 miles of Bridge Creek and over 10 miles of Tumalo Creek, including 6.0 miles within the NWFP boundaries, compared to existing conditions due to flow control matching demand. The benefits are expected to persist in the long term (20 years or more) within Sub-reach A1 for the months of July through September 22 when in distribution. Riparian areas would benefit minimally by receiving slightly more water under the Proposed Action due to the persistent flow increase. The wetted perimeter of the channel would increase by 0.32 feet when the median flow of 58 cfs is increased by 3 cfs. Effects to riparian areas were discussed in detail in section 3.7.8. The Proposed Action would result in minimal changes to channel morphology and redband trout habitat in Sub-reach A1 as described in section 3.7.6. The Proposed Action would have minimal effects on the ability of the channel to transport sediment and form features such as pools and riffles. Pool and riffle depths would increase by an average of 0.023 feet respectively when increasing the median flow of 58 cfs by 3 cfs in Sub-reach A1. Overall, adult redband trout habitat would be improved in Sub-reach A1 and maintained in other sub-reaches and reaches downstream of lands managed under the NWFP. Fish passage would be maintained in the long term (> 1 month). There would be short term effects (approximately 4 weeks) to fish passage during pipeline installation at the lower bridge crossing of Tumalo Creek. The proposed action is consistent with this S & G.

RA-1*: Identify and attempt to secure instream flows needed to maintain riparian resources, channel conditions, and aquatic habitat.*

- The Proposed Action is consistent with this S & G for the rationale given under LH-2 above.

RF–2: *For each existing or planned road, meet Aquatic Conservation Strategy Objectives by:*

a. Minimizing road and landing locations in Riparian Reserves
  - The Proposed Action is consistent as no new roads or landings are constructed in Riparian Reserves.

b. ***Complete watershed analyses (including appropriate geotechnical analyses) prior to construction of new roads or landings in Riparian Reserves.***
  - This does not apply as no new roads or landings are constructed in Riparian Reserves.

c. ***Preparing road design criteria, elements, and standards that govern construction and reconstruction.***
  - The Proposed Action is consistent as Road 4603 reconstruction after the pipeline is placed would follow water quality National Best Management Practices contained in Road – 3, Fac – 9, and AqEco – 2.

d. Preparing operation, and maintenance criteria that govern road operation, maintenance, and management.
  - This does not apply as road operation, maintenance, and management of Road 4603 would be the responsibility of the Forest Service after the project is completed.

e. Minimizing disruption of natural hydrologic flow paths, including diversion of stream flow and interception of surface and sub-surface flow.

- The Proposed Action is consistent as placing the pipeline under Road 4603 would follow water quality National Best Management Practices contained in Road – 3, Fac – 9, and AqEco – 2.

f. Restricting sidecasting as necessary to prevent the introduction of sediment to streams.

- The Proposed Action is consistent as placing the pipeline under Road 4603 would follow water quality National Best Management Practice contained in Road – 3.

g. Avoiding wetlands entirely when constructing new roads.

- This does not apply as no new roads would be constructed.

The Proposed Action is consistent with S & G RF-2 by meeting elements a through g above.

Wetlands and Floodplains

Federal agencies are required to be compliant with the following Executive Orders:

Floodplains: Executive Order 11988 provides direction to avoid adverse impacts associated with the occupancy and modification of floodplains. Avoid direct or indirect support of floodplain development wherever there is a practicable alternative. Floodplains are defined by this order as, ". . . the lowland and relatively flat areas adjoining inland and coastal waters including flood-prone areas of offshore islands, including at a minimum, that area subject to a one percent [100-year recurrence] or greater chance of flooding in any given year."

Wetlands: Executive Order 11990 provides direction to avoid to the extent possible adverse impacts associated with destruction or modification of wetlands. Avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Wetlands are defined by this order as, ". . . areas inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds."

The Proposed Action is consistent with these Executive Orders as adverse impacts are avoided. As described earlier in this document, nearly all of the new pipeline alignment is within an existing roadbed or shoulder, or in areas outside of floodplains and wetlands. Exceptions are small wetlands near the intake facility and the floodplain of Tumalo Creek at the crossing below Skyliners Bridge. During pipeline installation, there would be temporary disturbance at these two areas, with a total area of impact less than 0.3 acre. Impacts would be short-term (< 2 years). A total of 0.071 acres of wetland would be converted to a new classification per the Division of State Lands, but would continue to function as a wetland. Re-vegetation of the area is required under Best Management Practice Fac-9.

Operation of the new surface water system would avoid adverse impacts to floodplains and wetlands. Wetlands A, B, B2, and C described previously under Riparian Areas, would not be affected by operations of the water system. Wetlands and floodplains, including wetlands D and E, would receive more water in Sub-reach A1 due to flow control at the intake compared to existing conditions. An average increase of 0.03 feet in water surface elevation was calculated under the Proposed Action when comparing 58 cfs to 61 cfs for Sub-reach A1. When at or near the bankfull stage discharge, the change in water surface elevation is less as more of the channel is activated.

Deschutes National Forest Land and Resource Management Plan Consistency

The Proposed Action is consistent with the following Standard and Guidelines (S&G's) of the Forest Plan :

- S & Gs RP 1-4 as riparian areas would be maintained and protected in the long term. Effects to riparian areas are described above under section 3.7.8.

- S & Gs RP 6,7 as no measurable adverse effects to water temperature would occur and Best Management Practices are being utilized. The Heat Source Model utilized on Tumalo Creek predicted a small increase in water temperature under the Proposed Action in Sub-Reach A2 and Reach B downstream of national forest lands despite increasing instream flows through Sub-reach A1. The increase is limited temporally and spatially and is likely the function of modeling assumptions (See Water Quality discussion in section 3.7.5).
- S & G RP 8 as cumulative effects to stream flow, water quality, aquatic habitat and channel morphology, fisheries populations, and riparian areas were evaluated. Measures to avoid adverse impacts to these resources are included in the project design.
- S & G RP 10 as riparian vegetation would be managed to maintain stream channel and bank structure.
- S & G RP-47 as natural floodplain characteristics would be maintained.
- S & Gs WT-1, 2 as Water Quality Best Management Practices would be implemented and monitored.

3.8 Wildlife

For more detail, see *Bend Water Source and Skyliners Road Improvements Project Wildlife Report and Biological Opinion*, Shelley Borchert, District Wildlife Biologist, June 6, 2013. This report is incorporated by reference, and on file at the Bend–Fort Rock Ranger District.

This wildlife report, including the biological evaluation (BE) meet the direction of the Forest Service Manual 2600, the Deschutes National Forest Land and Resource Management Plan (LRMP, USDA FS 1990) as amended by the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (Northwest Forest Plan or NWFP) [1994], and as amended by the Regional Forester's Forest Plan Amendment #2 (Eastside Screens, USDA FS 1995), and the Endangered Species Act of 1973.

The BE analyzes effects to federally listed or Candidate Species and Regional Forester Sensitive Species (USDA FS 2011). The wildlife report analyzes effects to LRMP Management Indicator Species (MIS) and habitats, Landbird Focal Species, Birds of Conservation Concern, and High Priority Shorebirds. Analyses incorporated field reconnaissance, GIS data, current literature, and staff knowledge. The Deschutes LRMP and amended NWFP and Eastside Screens present standards and guidelines (S&Gs) for the maintenance of wildlife habitat. Short-term impacts are for 5 years while long-term impacts project are greater than 5 years.

3.8.1 Environmental Consequences – Wildlife

3.8.1.1 No Action Alternative

There is no Proposed Action under this alternative; therefore, there would be no changes from the existing conditions and no effects to wildlife or wildlife habitat. With no Proposed Action to add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative effects.

With the condition of the current pipeline system, failure of the system is likely in the future. It is unknown if this would be long-term leakage or a failure. With either of these potential failures, long-term effects to habitat are not expected. There could be some short-term periods (1 day to 2 weeks) of noise and activity disturbance during pipeline repairs.

3.8.1.2 Proposed Action

Table 53 summarizes the projects actions and the anticipated effects to forested habitat structure and wildlife species. These anticipated effects were used to help analyze the potential effects/impacts to species and their habitat that occur within and adjacent to the project. Refer to the individual species analysis for details.

Table 53. Actions associated with the proposed projects

Proposed Action	Anticipated Direct/Indirect Effects
Upgrades to the Bridge Creek Intake Facility	Noise disturbance. Potential loss of bat roosting habitat.
Installation of 10 miles of new pipeline and old pipeline abandonment	Loss of forested habitat including live trees (0.3 acres), snags, logs, and shrubs (0.5 acres), short-term changes to 1,750 ft² (0.04 acres) of riparian habitat, and noise disturbance.

The new pipeline, after leaving the intake facility, would follow the current path crossing a small spring with a culvert where the pipeline is enclosed by a dirt berm and then proceed to a forested corridor where the current pipeline travels. This corridor would most likely increase from 22 feet to 40 feet wide to allow for heavy equipment to trench a ditch for the new pipeline**.** This would remove 25-50 trees varying from 6-22 inches dbh along a 400 foot linear section from the intake facility to the Tumalo Falls Trail parking lot (NWFP – matrix), and 5-10 trees varying from 8-20" dbh along a 240 foot linear section from the parking lot to the first bridge crossing. Within this section, the pipeline would need to be installed beneath a small spring impacting 750 square feet of riparian habitat. This would include removing any trees and stockpiling the topsoil with as much vegetation intact as possible, diverting the spring, trenching and placing the pipe, then immediately placing back the topsoil and restoring the vegetation.

After the first bridge crossing, the pipeline would be in the roadbed until it reaches the lower bridge crossing of Tumalo Creek. At this point, the pipeline would be constructed underneath Tumalo Creek, which would include removing and stockpiling the topsoil, diverting the creek, trenching and placing the pipe, then placing back the topsoil, impacting 1000 square feet of riparian habitat. After completion of this section, intact riparian vegetation would be replaced from where it was removed, and then allowed to restore to natural conditions. After the pipeline crosses under the creek, it will be underneath the 4601 Road (Skyliners Road) until it crosses northeast over to the Outback site.

Aside from the impacts to a total of 1,750 square feet of riparian habitat with construction of the pipeline, habitat loss from tree and shrub removal is estimated on 0.5 acres (with removal of trees on 0.3 acres). It is possible that if the project is implemented during the breeding season, project activities (felling of trees, brush removal, etc.) could have direct negative impacts to nesting birds. Disturbance during this time could result in nest failure (noise disturbance) or direct loss of individuals (from tree/shrub removal or adults away from the nest for too long). An unknown amount of nesting songbirds could be impacted (it is unknown without surveys if they are in the proposed action areas, but they are expected there if the habitat is available), plus several accipiter pairs that have historically nested adjacent to Skyliners Road. It is also possible that this project could disturb bats at potential day roosting habitat at the bridges, and disturb and remove roosting habitat at the water intake facility. Project Design Criteria will minimize impacts, and none are expected to last beyond the construction period, nor will any temporary impacts lead to a change in status or viability for local populations or species.

Table 54. Cumulative effects to wildlife

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	Potential impacts from the noise disturbance during construction of the proposed project would be caused by construction activities if they occur during the breeding season for birds. The Special Use Permit would include construction provisions for activities such as blasting and rock crushing for areas within ¼ mile of active nests.
Affected Environment	At least 10 known nest sites, available nesting habitat, and home ranges are within the Tumalo Watershed
Effects of Reasonably Foreseeable Future Actions	Short-term disturbance from Skyliners Road construction, West Bend Vegetation-Management projects, and fuelbreak projects.
Mitigation not included in the Proposed Action	None; can't avoid all construction-related noise.
Sum of impacts (cumulative Impact)	There will be unavoidable short-term impacts to wildlife due to noise associated with the Proposed Action and other reasonably foreseeable future actions. All of the impacts are temporary and will not cumulatively threaten any species viability or status.
Regulatory cap (if applicable)	NA.

3.8.2 Biological Evaluation

The BE considers effects to federally listed or proposed species and Regional Forester Sensitive Species. A Forest Programmatic Biological Assessment (BA) for Section 7 informal consultation under the Endangered Species Act was completed in 2010 for projects proposed from 2010 to 2013 (USDA FS 2010). The BA established project design criteria (PDC) to streamline consultation with the U.S. Fish and Wildlife Service (FWS). Project design criteria focus on habitat alteration and disturbance effects. The northern spotted owl and Oregon spotted frog, a candidate Species, were included in the BA. The bald eagle was delisted in 2007 but is under a five-year monitoring plan and managed according to the 2007 National Bald Eagle Management Guidelines. The Pacific fisher and wolverine are more recent Federal Candidate Species and are not included in the 2010 – 2013 BA.

Habitat manipulation affects species differently. An action that may increase habitat for one species may decrease habitat for another species. Federal threatened, endangered, and regionally sensitive species lists are always reviewed first. Species that do not appear on these lists but show up as a management indicator species or focal species (Wildlife Report) may have persistence issues at a regional or national level but may not have persistence issues at the state or local level. In order to get an idea of the level of concern for these species, rankings were obtained from Natureserve Explorer, an online encyclopedia of life, available at http://www.natureserve.org/explorer. Rankings are given for global, national, and state levels. Only the state rankings are used in this analysis. This source has been incorporated into tables 55 and 57.

Table 55 includes those species that are federally listed, candidate, and Regional Foresters Sensitive Species. It describes if and how the species is affected by the Project and the rationale of the stated effects. Those species that are in bold are analyzed further and contain habitat that occurs within or adjacent to the project areas and that the particular habitat and/or species may be negatively affected. Those species that are not in bold may or may not contain habitat within or adjacent to the project area, of which that habitat or species would not be impacted by the proposed project.

Table 55. Federally Listed and Candidate Species and Regional Forester Sensitive Species occurring or potentially occurring on the Forest and effects from the proposed project. Those species in bold receive further consideration and analysis.

Species	Habitat Needs	Status	Effects	Rationale
Federally Listed Species				
Northern spotted owl (*Strix occidentalis caurina*)	**Old growth mixed conifer forests with Douglas-fir & true firs**	**Federal threatened, MIS, S3**	**May affect but is not likely to adversely affect.**	**The pipeline would remove approximately 0.3 acres of dispersal habitat near the intake facility. This would widen the corridor from 22 feet to 40 feet within this patch of dispersal. The project meets project design criteria in the Forest BA; therefore consultation has been completed through the programmatic BA process.**
Northern Spotted Owl Critical Habitat Unit (CHU)			No effect	The project area is approximately 0.42 miles southeast of the revised (2013) CHU boundary. This project would not affect connectivity between this CHU (within the Bend Watershed) and the CHU's that occur north or south.

Species	Habitat Needs	Status	Effects	Rationale
Gray wolf (*canus lupus)*	No particular habitat preference (forest generalist)	Federal Endangered, SH	No effect	There currently is no established pack or breeding population on the Forest.
Regional Forester Sensitive Species				
BIRDS				
Northern bald eagle (*Haliaeetus leucocephalus*)	Lakes, large rivers with nearby large diameter trees, usually ponderosa pine.	Regional Forester Sensitive, MIS, BCC, S4B, S4N	No impact	No habitat
American peregrine falcon (*Falco peregrinus anatum*)	Riparian and cliff habitat.	Regional Forester Sensitive, MIS, BCC, S2B	No impact	Habitat occurs above the 4603 Road adjacent to the Bridge Creek Water Supply project. This species has not been documented within the project area. The habitat would not be removed, and disturbance would not be an issue if this bird were discovered nesting on the cliffs. Construction on this section of the project would not occur until after Labor Day, which is outside of the nesting season.
Lewis's woodpecker (*Melanerpes lewisi*)	Large diameter snags in open ponderosa pine, burned forests.	Regional Forester Sensitive, MIS, BCC, Landbird focal species (ES), S2, S3B	No impact	Habitat occurs adjacent to the Bridge Creek Water Supply project within the Bridge Creek Burn, but the species has not been documented within the project area. The habitat would not be removed, and disturbance would not be an issue if this bird were discovered nesting within the burn because construction on this section of the project would not occur until after Labor Day, which is outside of the nesting season.
White-headed woodpecker (*Picoides albolarvatus*)	Large diameter snags in open ponderosa pine forests.	Regional Forester Sensitive, MIS, S2, S3B	No impact.	This species has not been documented within the project area, but potential habitat does occur. No potential nest trees are expected to be removed. Use of the project area may primarily be for foraging.
Bufflehead (*Bucephala albeola*)	Snags associated with lakes	Regional Forester Sensitive, MIS, S2B, S5N	No impact	No habitat
Harlequin duck (*Histrionicus histrionicus*)	Rapid streams, large trees	Regional Forester Sensitive, MIS, S2B, S3N	No impact	This species has not been documented within the project area, but potential nesting and foraging habitat does occur. Potential nest trees would not be removed and instream project work would occur outside the nesting season.
Tule white-fronted goose (*Anser albifrons elgasi*)	Seasonal migrant (spring and fall), marshes and wetlands	Regional Forester Sensitive, S2, S3N	No impact	No habitat

Species	Habitat Needs	Status	Effects	Rationale
American white pelican (*Pelecanus erythrorhynchos*)	Freshwater lakes with islands available for breeding	Regional Forester Sensitive, S2B	No impact	No habitat
Horned grebe (*Podiceps auritus*)	Lakes	Regional Forester Sensitive, MIS, S2B, S5N	No impact	No habitat
Tricolored blackbird (*Agelaius tricolor*)	Lakeside, bullrush	Regional Forester Sensitive, BCC, S2B	No impact	No habitat
Yellow rail (*Coturnicops noveboracensis*)	Marsh	Regional Forester Sensitive, BCC, S1B	No impact	No habitat
Northern waterthrush (*Seiurus noveboracensis*)	Riparian habitat with dense willows along streambanks	Regional Forester Sensitive, S2B	No impact	This species has not been documented within the project area, but potential habitat does occur and would not be impacted by project activities.
Greater sage grouse (*Centrocercus urophasianus phaeios*)	Sagebrush flats	Federal Candidate, RF Sensitive, BCC, Landbird Focal Species (CP), S3	No impact	No habitat
Mammals				
Townsend's big-eared bat (*Corynorhinus townsendii*)	**Caves, mines, bridges, rock crevices, ponderosa pine and juniper forests.**	**Regional Forester Sensitive, MIS, S2**	**May impact but would not lead to a trend towards Federal listing.**	**Potential day and or night roosting habitat occurs on the bridges, while potential day and night roosting habitat occurs within the water intake building. Surveys will be conducted during the summer of 2013 to determine if these sites are being utilized by bats.**
Pallid bat (*Antrozous pallidus*)	**Arid desert and grasslands with rock crevices, caves, old mines, trees, old buildings**	**Regional Forester Sensitive, S2**	**May impact but would not lead to a trend towards Federal listing.**	**Potential day and or night roosting habitat occurs on the bridges, while potential day and night roosting habitat occurs within the water intake building. Surveys will be conducted during the summer of 2013 to determine if these sites are being utilized by bats.**
Spotted bat (*Euderma maculatum*)	Caves and rock crevices	Regional Forester Sensitive, S2	No impact	Potential habitat occurs within the cliffs above the project area, but these would not be impacted by the project.
Fringed myotis (*Myotis thysanodes*)	**Caves, mines, rock crevices, in desert, grasslands and woodlands**	**Regional Forester Sensitive, S2**	**May impact but would not lead to a trend towards Federal listing.**	**Potential day and or night roosting habitat occurs on the bridges, while potential day and night roosting habitat occurs within the water intake building. Surveys will be conducted during the summer of 2013 to determine if these sites are being utilized by bats.**
Pygmy rabbit (*Brachylagus idahoensis*)	Sagebrush flats	Regional Forester Sensitive, S2	No impact	No habitat

Species	Habitat Needs	Status	Effects	Rationale
Pacific fisher (*Martes pennanti*)	Mixed conifer, riparian, complex physical structure	Federal Candidate, Regional Forester Sensitive, MIS, S2	No impact	No habitat
North American wolverine (*Gulo gulo luscus*)	Mixed conifer high elevation forests	Federal Candidate, Regional Forester Sensitive, MIS, S1	No impact	No habitat
AMPHIBIANS				
Oregon spotted frog (*Rana pretiosa*)	Inhabits shallow edges of lakes and ponds and riparian areas.	Federal Candidate, Regional Forester Sensitive, S2	No impact	This species has not been documented within the project area, and while potential habitat does occur within the Tumalo Creek drainage between the upper and lower bridges, this potential habitat would not be impacted by project activities.
Columbia spotted frog (*Rana luteiventris*)	Slow streams, marshes, ponds, lake edges	Regional Forester Sensitive, S2, S3	No impact	This species has not been documented within the project area, and potential habitat does not occur on the west side of the Bend/Ft. Rock Ranger District.
INVERTEBRATES				
Crater Lake tightcoil (*Pristiloma arcticum crateris*)	**Perennial wet areas along streams.**	**Regional Forester Sensitive, S&M, S1**	**May impact but would not lead to a trend towards Federal listing.**	**The Bridge Creek Water Supply project would be disturbing 4 separate areas for pipeline construction. Approximately 1,750 ft² (0.04 acres) would be impacted by the project. It would not be a permanent loss of habitat. Surveys have been conducted and no tightcoils were found.**
Evening field slug (*Deroceras hesperium*)	**Perennially wet meadows in forested habitats**	**Regional Forester Sensitive, S&M, S1, S2**	**May impact but would not lead to a trend towards Federal listing.**	**The Bridge Creek Water Supply project would be disturbing 4 separate areas for pipeline construction. Approximately 1,750 ft² (0.04 acres) would be impacted by the project. It would not be a permanent loss of habitat. No field slugs were discovered during tightcoil surveys.**
Silver-bordered fritillary (*Boloria selene atrocostalis*)	Wet meadows, bogs, and marshes that contain violets (host plant for caterpillar) and goldenrod (for adult feeding).	Regional Forester Sensitive, S2	No impact	The Bridge Creek Water Supply project would be disturbing meadow and marshy habitats that may contain violets, but not goldenrod; therefore it is suspected that this species would not be here.
Johnson's hairstreak (*Callophyrys johnsoni*)	Coniferous forests, especially old growth	Regional Forester Sensitive, S2	No impact	No habitat

Species	Habitat Needs	Status	Effects	Rationale
Western bumblebee **(*bombus occidentalis*)**	**Native wildflowers, rodent burrows for wintering.**	**Regional Forester Sensitive, S2**	**May impact but would not lead to a trend towards Federal listing.**	**Construction of the pipeline would be trenching areas of potential nesting and winter burrowing and altering habitat for wildflowers along 0.3 acres.**

***Federally listed** species come from the Region 6 Threatened, Endangered, and Sensitive species list for the Deschutes National Forest (December 2011). ***Regional Forester Sensitive** species come from the Region 6 Threatened, Endangered, and Sensitive species list for the Deschutes National Forest (December 2011); **Management Indicator Species** come from the Deschutes National Forest Land and Resource Plan (LRMP)[1990]; **Birds of Conservation Concern (BCC)** come from the US Fish and Wildlife Service Birds of Conservation Concern – BCR 9 (Great Basin) [2008]; **Landbird Focal Species (ES)** come from the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington (Altman 2000); **Landbird Focal Species(CP)** come from the Conservation Strategy for Landbirds in the Columbia Plateau of Eastern Oregon and Washington (Altman 2000); Oregon Sensitive Species determined from the **Natureserve** database for Oregon (2012): S1, critically imperiled, S2 = imperiled, S3 = vulnerable, S4 = apparently secure, S5 = secure, B = breeding, N = non-breeding, SH = possibly extirpated.

3.8.3 Threatened and Endangered Species – Northern Spotted owl

The Northern Spotted Owl is a Federally Threatened, Management Indicator Species, designated as S3-Vulnerable.

3.8.3.1 Habitat Needs and Existing Condition for Nesting, Roosting, and Foraging (NRF) Habitat

Suitable nesting, roosting and foraging (NRF) habitat on the Deschutes National Forest includes stands of mixed conifer, ponderosa pine with an understory of white fir, and mountain hemlock with subalpine fir, all exclusive to a narrow forested band below the high-elevation subalpine forests and above the low-elevation lodgepole pine/ponderosa pine forests. Suitable habitat is naturally fragmented by intrusions of lava and other forest types. It is generally not found in large patches but as inclusions within other stands (USDA FS 2010).

Suitable nest sites are generally in cavities in the boles of either dead or live trees. Platform nests may also be used (but more rarely), which include abandoned raptor nests, broken treetops, mistletoe brooms, and squirrel nests. Relatively heavy canopy habitat with a semi-open understory is essential for effective hunting and movement (USDA FS 2010).

Edge effects from large forest openings may adversely impact the microhabitat conditions necessary for suitable owl habitat as well as contribute to increased risk to spotted owls imposed by predators or to competition from the barred owl (*Strix varia*) (USDA FS 2010).

Habitat conditions that support good populations of northern flying squirrels (*Glaucomys sabrinus*), western red-backed voles (*Clethrionomys californicus*), and other nocturnal or crepuscular small mammals, birds, and insects are essential to supporting spotted owls (USDA FS 2010).

The Northwest Forest Plan allocations for the project area are Administratively Withdrawn and Matrix. These only occur within the western half of the project area. The project area is also not within a late successional reserve (LSR). NRF habitat does not occur within the project areas and thus would not be removed with the proposed actions. Project activities would generate noise disturbance, and in some areas along Skyliners Road, blasting may occur. Because of these activities, Region 6 (R6) Protocol surveys for northern spotted owls (USDI FWS 2011) were conducted in 2010, 2011, and 2012. The surveys covered NRF habitat within ¼ mile of the 4603 Road (from the bridge to Tumalo Falls) and 1-mile of the 4601 Road (Skyliners Road). No vocal or visual detections occurred during these surveys. There are also no historic or current pairs or resident singles within the project area.

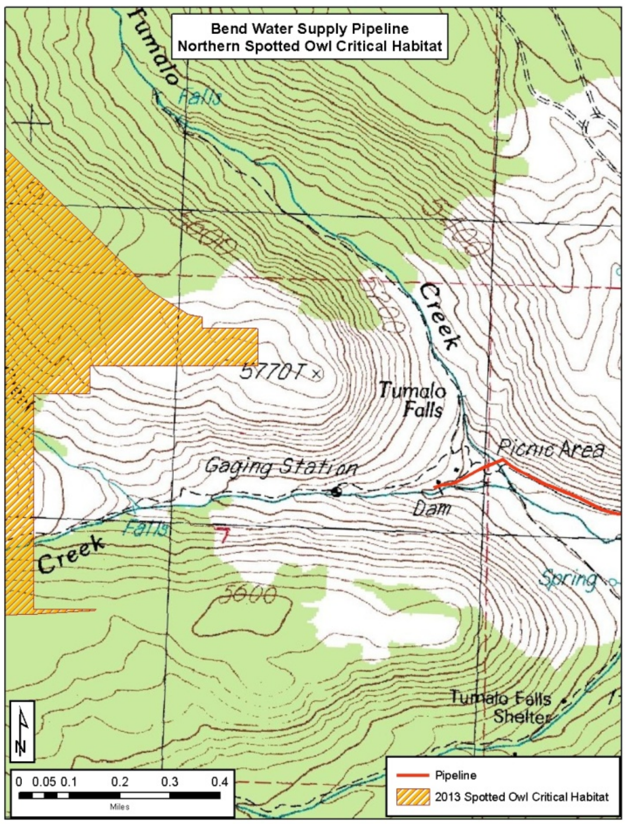
3.8.3.2 Critical Habitat

The final rule designating critical habitat for the northern spotted owl was published in the Federal Register on December 4, 2012. With the revised critical habitat unit (CHU) boundaries, this project occurs 0.42 miles southeast of the nearest CHU (see Figure 31).

A letter from the Regional Office dated December 14, 2012 regarding how to proceed with ongoing and proposed actions was reviewed, and it was determined that since this project does not occur within a CHU, no additional consultation with the USFWS was necessary for this project.

The Bridge Creek Water Supply project would have no effect to critical habitat as it occurs outside of the revised CHU boundary and would have no affect to connectivity between CHU's (see Figure 32).

Figure 32. Project proximity to the 2013 Critical Habitat boundary



3.8.3.3 Habitat Needs and Existing Condition for Dispersal Habitat

Dispersal habitat is important for the movement of spotted owl young away from natal areas or adults moving from one territory to another. Spotted owl dispersal habitat, as well as NRF habitat, can act as corridors or movement habitat for a variety of other wildlife species that utilize mature forests.

The 2010-2013 BA definition for dispersal habitat is a minimum of 30% canopy closure regardless of plant association, and a minimum average diameter of 7 inch dbh for lodgepole pine stands, and 11 inch dbh for mountain hemlock, ponderosa pine and mixed conifer stands. Only mixed conifer stands of dispersal habitat occur within the project area.

Within the project area, dispersal habitat occurs in a 6-acre patch of trees adjacent to the Tumalo Falls Trailhead parking lot. The proximity of this dispersal habitat next to a heavily utilized trailhead would reduce the possibility of this habitat being utilized in the daylight hours.

Approximately 0.3 acres of dispersal habitat would be removed to widen the current pipeline corridor.

Road Analysis

A baseline analysis was conducted to determine what the existing condition is for roads and motorized trails within the 10th field watershed this project occurs within (Tumalo Creek), and if these roads and trails may be having an effect on spotted owls and NRF habitat within the project area. Roads and motorized trails are avenues of noise disturbance and fragmentation for these owls.

There are no known spotted owl activity centers within this watershed, thus there are no current or ongoing effects to this species from the current road density. The number of miles of road that occur within the watershed is 98.2. Of these miles, 1.8 miles occur within spotted owl NRF habitat. Although these NRF patches are not currently occupied, the presence of a road could affect whether or not a spotted owl would utilize these areas.

There are no designated motorized OHV trails within the watershed, but 96 miles of roads are available for OHV use.

The Bridge Creek Water Supply project would not be increasing road or motorized trail density within the project area or watershed, and thus would not add to potential negative effects to northern spotted owls.

3.8.3.4 Environmental Consequences – Northern Spotted Owl

No Action Alternative

There is no proposed action under this alternative; therefore there would be no changes from the existing conditions and no effects to spotted owls. With no proposed action to add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative effects.

With the condition of the current pipeline system, failure of the system is likely in the future. It is unknown if this would be long-term leakage or a failure. With either of these potential failures, effects to spotted owl NRF and dispersal habitat are not expected.

Proposed Action

There would be no removal of NRF habitat or habitat constituents as a result of the proposed actions. This project would have an effect to spotted owl dispersal habitat within the project area. There may be up to 25-50 trees ranging in dbh from 6” to 22” removed from a 6-acre patch of dispersal habitat from actions associated with the Project. This would occur in an existing right-of-way corridor from the current pipeline between the intake facility and the Upper Tumalo Creek bridge crossing (approximately 640 feet long), and is expected to increase fragmentation and the width of this corridor from 22 feet to 40 feet. This would remove approximately 0.3 acres of dispersal habitat. This patch of dispersal habitat occurs within the Bridge Creek Fire that occurred in 1979 and burned the surrounding forest. For owls that would disperse through the area, this patch would be an area where an owl could stop and be provided security while moving through the area. Widening the corridor through here would not prevent a spotted owl from utilizing the area, but would reduce the effectiveness and function of this patch of dispersal habitat.

In the future, if northern spotted owls were found to be utilizing any suitable NRF habitat adjacent to the project area prior to or during project activities, seasonal restrictions would be followed to protect any nesting owls and their habitat. Maintenance surveys should be conducted to assure whether or not these stands remain vacant, or become occupied by a single or a pair of northern spotted owls.

Consistency

The Pipeline Project meets applicable NSO PDC’s of the 2010-2013 Joint Aquatic and Terrestrial Programmatic Biological Assessment (BA) and is covered by the scope of this document. Improving the City of Bend’s Bridge Creek Water Supply System is consistent with the Forest Plan.

Conclusion

The Bridge Creek Water Supply project would "not effect" critical habitat, but it "may affect and is not likely to adversely affect" spotted owls and dispersal habitat. Although dispersal habitat is being removed, the project would result in less than 0.1% cumulative loss of dispersal habitat within the Upper Tumalo Creek Subwatershed. Also, the loss of dispersal habitat from increasing the width of the current pipeline right-of-way is not expected to reduce an owls' ability to move through the area, but it does reduce the effectiveness and function of this patch of dispersal habitat. Small openings in forest habitat do not hinder dispersal of northern spotted owls (Forsman et al 2002, p.22). Based on this information, the Bridge Creek Water Supply project would not contribute to a downward trend of viability for the northern spotted owl at the Forest level.

There would be no effect to critical habitat, since there is no critical habitat unit currently mapped within the project area. The project area is not within a late-successional reserve.

The Forest consulted in a Level 1 streamlining discussion with Jennifer O'Reilly with the FWS Pacific Region Ecological Services field office in Bend, Oregon, on October 31, 2011, to discuss the project. Discussions led to a consensus of the proposed calls for the project and that this project meets applicable NSO PDCs of the 2010–2013 Joint Aquatic and Terrestrial Programmatic Biological Assessment (BA) and is covered by the scope of this EA. A BE, along with the necessary Compliance Checklist and Project Monitoring Form, has been submitted to the Level 1 team for packaging and submission to FWS. No further consultation with FWS is necessary.

3.8.3.5 Cumulative Effects – Northern Spotted Owl

The actions associated with the Project would add incrementally to ongoing and reasonably foreseeable actions, including ongoing post-sale activities with the West Tumbull Project and reasonably foreseeable actions including the West Bend Project. While this project would add to the loss of dispersal habitat within the subwatershed (0.3 acres) the additive or incremental effects from the loss of less than 0.1% of the available dispersal habitat within the Upper Tumalo Creek Subwatershed (>13,000 acres) from this proposed action would not be significant at this scale or the Forest scale.

Table 56. Cumulative effects on northern spotted owl (NSO) habitat

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	Proposed Action will result in disturbance to 0.3–0.5 acre of NSO dispersal habitat.
Affected Environment	Zero acres of NSO NRF areas and several thousand acres of dispersal habitat in the project area.
Effects of Reasonably Foreseeable Future Actions	Zero acres of NRF areas and up to several thousand acres of dispersal habitat impacted as a result of the in West Bend timber sale. No NRF would be impacted by the fuelbreaks.
Mitigation not included in the Proposed Action	None.
Sum of impacts (cumulative Impact)	Sum of acres "may effect, not likely to adversely affect" NSO. Can't avoid the minimal removal of trees, and can't replace habitat until trees reach dispersal
Regulatory cap (if applicable)	ESA, NWFP.

3.8.4 Sensitive Species

3.8.4.1 Regional Forester Sensitive Species Considered

Regional Forester Sensitive Species were considered and effects to six species were analyzed: the Crater Lake tightcoil, evening field slug, Townsend's big-eared bat, pallid bat, fringed myotis, and western bumblebee. The bald eagle, bufflehead, harlequin duck, Tule white-fronted goose, American white pelican, horned grebe, tricolored blackbird, yellow rail, northern waterthrush, greater sage grouse, spotted bat, pygmy rabbit, Pacific fisher, North American wolverine, the Oregon and Columbia spotted frog, silver-bordered fritillary, and Johnson's hairstreak are all Sensitive Species that are known to occur or potentially occur on the Forest. There is no suitable habitat for any of these species in or near the project area. Therefore, these species have been given the determination of **"No impact"** from implementation of the proposed project. The American peregrine falcon, Lewis' woodpecker, and white-headed woodpecker all contain habitat adjacent to the project area, but because nesting and foraging habitat would not be removed, and the species have not been documented within the project areas, these species have been given the determination of **"No impact"** from implementation of the proposed projects.

BATS

Since the following bat species share similar habitats, they are grouped together: Townsend's big-eared bat (*Regional Forester's Sensitive, Management Indicator Species, S2- Imperiled*), pallid bat (*Regional Forester's Sensitive, S2 – Imperiled),* and fringed myotis (*Regional Forester's Sensitive, S2 – Imperiled).*

The greatest current threat to these bat species is disturbance during winter hibernation. All three species will hibernate in caves, mines, and buildings. The Townsend big-eared bat is more tied to these types of structures for hibernation, where the pallid bat and the fringed myotis will also hibernate in rock crevices. The fringed myotis is also sensitive to the loss of old growth forests and large snags.

White-nose syndrome is an emerging disease that has resulted in the mortality of > 5,000,000 hibernating bats in the eastern and midwestern U.S. and Canada since 2006 (USDA FS 2012). The disease is associated with a newly described species of fungus (*Geomyces destructans*) that appears on the noses, wings, ears, and/or tail membranes of afflicted bats, but may also be absent. Nine species have been documented with *G. destructans* and six of these with WNS. Although bat-to-bat contact is the primary means of transmission, the fungus has been observed in laboratory tests to adhere to human boots, clothing, and gear. Concern is growing that recreational caving may increase the risk of transmitted the fungus and the disease to the western U.S.

If the *G. destructans* fungus and WNS reach caves in Central Oregon, effects to Townsend's big-eared bat, pallid bat, and fringed myotis are not known. Predictions of which species affected are based in part on the species' particular biology and hibernation adaptations. Bat species which hibernate in large clusters may be more susceptible to WNS due to the closer bat-to-bat contact.

Habitat Needs and Existing Condition

These bat species are dependent on caves, or cave-like structures (mines and buildings) rock crevices, rock faces/cliffs, tunnels, and bridges as roost sites. Other habitat associations, including foraging, are coniferous forests, mixed mesophytic forests, forested lava flows, deserts, native prairies, perennial and intermittent riparian streams, active agricultural areas, and coastal areas.

Existing Conditions

There is suitable foraging habitat for these bat species within and adjacent to the project area, with high quality foraging habitat available along the Bridge Creek and Tumalo Creek riparian areas. Roosting habitat in large snags and large live trees is limited, but the adjacent cliffs along Tumalo Creek provide roosting habitat. Potential day and night roosting habitat also occurs on the bridges and the water intake building (under the roof infrastructure and near the chimney) within the project area. There are no caves or mines nearby that would provide hibernacula habitat and the building does not provide the necessary structure to provide for this type of habitat either. There have been no sightings of bats or their presence (urine or guano) in and around the building by the caretaker or any other folks who have been in and around the building.

Environmental Consequences – Bats

No Action Alternative

Since there is no proposed action under this alternative, there would be no change from the current existing condition and therefore no impacts to bat species or their habitat. Without a proposed action that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative impacts.

Proposed Action

The Bridge Creek Water Supply project would be working adjacent to both the upper and lower bridges along Tumalo Creek, potentially impacting day roosting bats if they occur. These bridges will be surveyed (utilizing exit surveys prior to and after sunset during optimal weather conditions) by qualified Forest Service wildlife biologists during the summer of 2013 to determine if they are being utilized for day or night roosting bats. If the bridges are utilized as day roosts, the bats could be impacted by work that would occur adjacent to these bridges and possibly fly to another area to roost, which would make them vulnerable to predators. If the bridges are utilized for night roosting, there would be no impacts from this project as work would not occur during the evening.

Removal of the water intake building could also impact roosting bats. This building could also be utilized for day and/or night roosting. To determine if this building is being utilized by bats, summer exit surveys, similar to those at the bridges, should also be conducted here to determine at what capacity, if any, that it may be used. If bats are found or the surveys do not occur, a seasonal restriction may be necessary for timing of removing the building (after September 15). Utilizing exclusion techniques may also be necessary if bats are found and the building must be removed prior to the seasonal restriction.

The Bridge Creek Water Supply project **"may impact"** Townsend's big-eared bats, pallid bats, and fringed myotis by either disturbance at potential day roost sites at the bridges or disturbance to potential day roosting bats and/or loss of potential day/night roosting habitat at the water intake building. The impacts are not expected to be significant to lead towards a downward trend to Federal listing. The impacts would be mitigated by project design criteria addressed below. The impacts to habitat from this project are also not expected to add incrementally to ongoing and reasonably foreseeable actions; therefore cumulative impacts to these bat species or their habitats are not expected.

Consistency

This project would not be impacting cave habitat and would be consistent with the Deschutes LRMP S&Gs.

Conclusion

Implementation of the Bridge Creek Water Supply project **may impact** these three bat species. They are all considered imperiled by Natureserve (2012). It is unknown to what capacity (if any) that the bridges or water intake building are being used for by bats. Pre-activity surveys should occur during the summer to determine if the species occurs. If so, then potential impacts could be reduced by restricting project activities at the water intake building and the upper and lower bridge crossing to late September through mid-October and utilizing exclusion techniques.

CRATER LAKE TIGHTCOIL AND EVENING FIELDSLUG

The Crater Lake Tightcoil is a Regional Forester's Sensitive, Survey and Manage, with a designation of S1-Critically Imperiled.

Habitat Needs and Existing Condition

The **Crater Lake tightcoil** is a dependent on wet or moist areas associated with riparian habitats. Gowan and Burke (1999) describe habitat in the eastern Cascades as perennially moist situations in mature conifer forests and among rushes, mosses, and other surface vegetation and woody debris within 10 meters (33 feet) of open water in wetland springs, seeps, and riparian areas, generally in areas which remain under snow longer periods in the winter. Xeric areas and permanent water bodies are barriers to movement (Natureserve 2012).

The Crater Lake tightcoil is present within the Tumalo Creek Watershed. It was discovered in 1999 near Tumalo Creek and its associated springs. Since this time several other sites along the creek have been discovered. These sites have all been located between the lower bridge crossing and the upper bridge crossing within wet meadow habitat. Approximately 100 acres of riparian habitat occur between these two bridges (0.04 acres occur within the project area). The amount of suitable Crater Lake tightcoil habitat within these 100 acres of riparian habitat is unknown.

According to Duncan (2005), the **evening fieldslug** is associated with perennially wet meadows in forested habitats. Microsites include a variety of low vegetation, litter, and debris; rocks may also be used as refugia. Little detail is known about exact habitat requirements for the species due to the limited number of verified sites. However, this species appears to have high moisture requirements and is almost always found in or near herbaceous vegetation at the interface between soil and water, or under litter and other cover in wet situations where the soil and vegetation remain constantly saturated. Because of the apparent need for stable environments that remain wet throughout the year, suitable habitat may be considered to be limited to moist surface vegetation and cover objects within 30 m. (98 ft.) of perennial wetlands, springs, seeps and riparian areas. Typical landscape features that may provide constant moisture conditions include springs and seeps, as well as wetlands in depressions and around perennial ponds.

Both of these species are also considered Survey and Manage species (2011 Survey and Manage Settlement Agreement Species List) within the Northwest Forest Plan allocations and are managed as described in the 2001 ROD. Pre-disturbance surveys are required for both species, although for the evening fieldslug, equivalent-effort pre-disturbance surveys are required. Surveys were conducted during the fall of 2010 utilizing protocol for the Crater Lake tightcoil (Duncan et al. 2003). Although the tightcoil was the primary species being surveyed, any other mollusk species were noted if found.

The Bridge Creek Water Supply project has four areas where it would cross potential Crater Lake tightcoil and evening fieldslug habitat. Between the intake facility and the Tumalo Falls Trail parking area, the new pipeline would follow the existing 1950's pipeline alignment.

The first crossing occurs 120 feet from the intake facility, and crosses a spring that has a culvert to divert water through a berm approximately 4 feet deep where the existing pipe occurs. The second crossing would be immediately south of the Tumalo Falls parking area. This riparian area consists of sedges, grasses, mosses, huckleberry, and mountain alder. Down woody material also occurs here. Approximately 750 ft² of riparian vegetation would be disturbed at this site. Existing riparian vegetation would be excavated, stored on site, and then replaced after the pipeline is placed. The third crossing would be at the upper Tumalo Creek Bridge, and replace the current aerial pipeline that crosses the creek. Several trees would need to be removed here, all outside of the current riparian area, to make room for the larger pipeline that would be placed here. The fourth crossing would be where the proposed pipeline will cross underneath Tumalo Creek below Skyliners Bridge. This would result in disturbance to approximately 1000 ft² of riparian vegetation consisting of lodgepole pine, mountain alder, sedges, willows, and Douglas spirea.

There were no Crater Lake tightcoils or evening fieldslugs found at any of the riparian areas that would be impacted by the pipeline crossings. The surveys conducted looked 150 feet and 300 feet above and below the identified crossings (if habitat was present). The Crater Lake tightcoil was identified below the third crossing (at the upper bridge) and above the fourth crossing (at Skyliners Bridge). The habitat and species found at the upper bridge and lower bridge would not be impacted by pipeline construction. The actual crossing at the upper bridge contains marginal habitat for both species and is dominated by steep slopes and rock; the crossing below Skyliners Bridge also contains marginal habitat for these species as the area is drier and contains less habitat elements necessary for the species life history. Although neither species was identified at the second crossing (near the parking lot), this area has the highest potential as suitable habitat as it is wetter and provides mosses and woody debris.

This project conforms with the January 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (2001 ROD S&Gs) as modified by the 2011 Settlement Agreement in *Conservation Northwest v. Sherman et al.*, No-08-1067-JCC (W.D. Wash), and utilizes the 2011 Settlement Agreement species list.

Environmental Consequences – Crater Lake Tightcoil and Evening Fieldslug.

No Action Alternative

Since there is no proposed action under this alternative, there would be no change from the existing condition and therefore no impacts to Crater Lake tightcoils and evening fieldslugs or their habitat. Without a proposed action that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative impacts.

With the condition of the current pipeline system, failure of the system is likely in the future. It is unknown if this would be long-term leakage or a failure. If long-term leakage occurs in mollusk habitat, it could potentially increase available habitat by retaining moisture in areas that may dry up during the drier months. If there is a failure in mollusk habitat, the potential rush of water could wash away habitat constituents including vegetation and woody debris, plus it could wash away individual tightcoils and fieldslugs. The degree of impact would be dependent upon where the failure occurred.

Proposed Action

The proposed pipeline crossings would not impact any known sites for Crater Lake tightcoil. There were no mollusk species found during protocol surveys where the impacted areas would occur. Adverse effects to riparian vegetation is expected to be short-term (<2 years), as the riparian vegetation would be excavated and stored on site for immediate replacement. Conditions within the fill/removal permits issued by the Division of State Lands and Army Corps of Engineers would require riparian vegetation disturbed during construction to be restored to pre-construction conditions to avoid compensatory mitigation. A riparian restoration plan has been developed and will be implemented. There would be no long term (> 2 years) adverse effects to riparian vegetation. Less than 0.1% of the available total riparian habitat (approximately 100 acres) between the lower and upper bridges of Tumalo Creek would be impacted by the Bridge Creek Water Supply project (the acres of suitable habitat for these two mollusk species from the 100 acres of measured riparian habitat between the two bridge crossings is unknown).

The Bridge Creek Water Supply project may impact Crater Lake tightcoil and evening fieldslugs by the alteration of 0.04 acres of suitable habitat, but the impact is not expected to be significant to lead towards a downward trend to Federal listing. The impacts of the alteration of habitat would be mitigated by project design criteria addressed below. The impacts to habitat from this project are also not expected to add incrementally to ongoing and reasonably foreseeable actions as there is not overlap of impacts from other projects; therefore cumulative impacts to this species or its habitat are not expected.

Consistency

This project meets the provisions of the 2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (USDA and USDI 2001). Survey have been conducted, with no Crater Lake tightcoils or evening fieldslugs found within riparian areas that would be impacted by construction of the pipeline; therefore there would be no inadvertent loss of undiscovered sites. All suitable habitat and known sites for Crater Lake tightcoils located between the upper and lower bridge would not be impacted by this project.

Conclusion

Implementation of the Bridge Creek Water Supply project **may impact** Crater Lake tightcoils, the evening fieldslug and 1750 ft² (0.04 acres) of local riparian habitat (less than 0.1% of the total available habitat between the upper and lower bridge crossings). This species is considered critically imperiled by Natureserve (2012), but the impacts associated with this project would not lead to a trend towards Federal listing. The reasons for this include that areas of known populations within the Tumalo Creek drainage would not be impacted by this project and surveys did not reveal any tightcoils at the four specific crossings (only one of the crossings has highly probable habitat for tightcoils, while three of the crossings have marginal habitat and a low probability of tightcoils being present). Although the activities associated with the project could directly harm any tightcoils that could be present at the time construction activities occur, the potential for this impact could be reduced by first removing the riparian vegetation and soil intact as much as possible prior to trenching and also returning it back in place as intact as possible. The habitat would not be completely extirpated, as these measures would be the least impactful way possible, with the expectation to return to pre-disturbance conditions within 2 years. The impacts would also be minimized by the construction activities occurring later in the summer after Labor Day, when these areas have become drier.

Table 57. Cumulative effects to Crater Lake Tightcoil and Evening Fieldslug

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	The Proposed Action could impact these species, but the impact is not expected to lead towards a trend to federal listing.
Affected Environment	Total of 100 acres of probable habitat in Tumalo Creek between the two crossings.
Effects of Reasonably Foreseeable Future Actions	None, no effects to habitat
Mitigation not included in the Proposed Action	None. Avoidance of temporary habitat disturbance is not possible due to construction requirements of pipeline.
Sum of impacts (cumulative Impact)	Same as described in the proposed Action. No additional or cumulative effects.
Regulatory cap (if applicable)	Short-term loss of less than 0.0001% of the available habitat and loss of an unknown number of individuals. 1,750 ft² of habitat in four areas disturbed by project, resulting in probable loss of some individuals.

WESTERN BUMBLEBEE

The bumblebee is a Regional Forester's Sensitive, with a designation of S2-Imperiled.

Bumblebees will visit a range of different plant species and are important generalist pollinators of a wide variety of flowering plants and crops (Goulsen 2003a; Heinrich 2004). Although bumblebees do not depend on a single type of flower, some plants rely solely on bumblebees for pollination. In addition, native bees, such as bumblebees are adapted to local conditions (Goulsen 2003b). For example, bumblebees can forage in cold, rainy conditions. Certain wild pollinators are well adapted for specific plants and as a whole can pollinate a wide variety of crops. For example, medium or long-tongued bees are necessary to pollinate red clover and field beans while short-tongued bees are better adapted to pollinating oilseed rape. Finally, bumblebees and many other native bees can perform buzz pollination which allows them to be superior pollinators of some crops including tomatoes, cranberries, and blueberries (Goulsen 2003a). Reduced populations or even the loss of bumblebees would have serious ecological impacts upon our ecosystem due to their important role as pollinators. Such consequences may include reduced seed set and inbreeding of plants, changes in plant communities, as well as affecting a wide array of other organisms dependent upon bumblebees for survival. Finally, a wide variety of crops which benefit from pollination by bumblebees would be negatively affected due to reduced pollination.

Habitat alterations including those that could destroy, fragment, alter, degrade or reduce the food supply produced by flowers, as well as destruction of nest sites and hibernation sites for overwintering queens, such as abandoned rodent burrows and bird nests, adversely affect these bees. Agriculture and urban development alter landscapes and habitat required by bumblebees. The sizes of bumblebee populations diminish and inbreeding becomes more common as habitats become fragmented. This in turn decreases the genetic diversity and increases the risk of population decline.

When exotic plants invade and dominate native grasslands, they may threaten bumblebees by competing with the native nectar and pollen plants relied upon by bumblebees. A small invasive parasite of the honeybee, the small hive beetle (*Aethina tumida*), can also infest bumblebee colonies. Although it has not been well studied, it could severely impact bumblebee colonies. The invasion of exotic plants and insects should be restricted as much as possible by reducing the rate of introduction of new species and by controlling populations of invasives.

Populations of the western bumblebee in central California, Oregon, Washington and southern British Columbia have mostly disappeared. It is difficult to accurately assess the magnitude of these declines since most of this bee's historic range has not been sampled systematically.

No surveys were conducted for western bumblebees in the project area. It is a newly listed Regional Forester sensitive species that was added in December 2011, therefore there is no District or Forest data to determine occupancy or acres of suitable habitat on the District or project area. Wildflowers occur in small numbers in the project area, as well as nest and hibernation sites.

Environmental Consequences – Western Bumblebee

No Action Alternative

Since there is no proposed action under this alternative, there would be no change from the current existing condition and therefore no impacts to western bumblebees or their habitat. Without a proposed action that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative impacts.

Proposed Action

Construction that would occur in the current pipeline corridor from the water intake building to the first bridge crossing could temporarily remove flowering plants for the short term and nesting and hibernation sites. Without surveys it is unknown if this species occurs here.

The Bridge Creek Water Supply project may impact western bumblebees by loss of flowering plants and destruction of potential nesting and hibernation habitat. Although the probability of this species occurring here is low, any loss of a hibernating queen or loss of a nesting colony could adversely impact this species. The impacts of the potential loss of individuals and alteration/destruction of habitat could be mitigated by project design criteria addressed below. The potential impacts to the western bumblebee from this project would add incrementally to ongoing and reasonably foreseeable actions from the West Bend project (loss of bitterbrush, a potential food source and potential loss of nests and/or hibernating queens). The loss of food source would be less the 0.01% of the total that could be available within the subwatersheds; the number of individuals that could be lost, which would be more critical, is unknown without knowing if this species can be found on the District and what habitats it focuses on.

Consistency: NA

Conclusion

Implementation of the Bridge Creek Water Supply project may impact western bumblebees. This species is considered imperiled by Natureserve (2012). Too little is known about this species on the District and Forest such as whether or not they occur and what habitats they may focus on. Pre-activity surveys should occur during the spring and summer to determine if the species occurs. Potential impacts could be reduced by restricting project activities between the water intake building and the first bridge crossing to late September through mid-October.

3.8.5 Other Wildlife Species of Concern

The wildlife report analyzes impacts to the species and habitats listed below. Table 58 includes those species and whether they are impacted by the Bridge Creek Water Supply project and the rationale of the stated impacts. Those species that are in bold are analyzed further and contain habitat that occurs within or adjacent to the project area and that the particular habitat and/or species may be negatively impacted. The species and/or habitat that are not in bold may or may not contain habitat within or adjacent to the project area, of which that habitat or species would not be impacted by the proposed projects and no further analysis necessary.

- LRMP Management Indicator Species (MIS)
- LRMP Special or Unique Habitats
- LRMP Snags and down wood/green tree replacements
- LRMP Late and Old Structural Stands and Connectivity (Eastside Screens)
- Survey and Manage Species
- Focal Landbird Species
- Birds of Conservation Concern
- High Priority Shorebirds

Table 58. Impact Conclusions for LRMP Management Indicator Species and Habitats, Survey and Manage Species, Special Habitats, Landbird Focal Species, Birds of Conservation Concern, and High Priority Shorebirds. Those species in bold receive further consideration.

Species or Habitat	Impacts under Proposed Actions	Rationale for Impacts Conclusions
Management Indicator Species		
Northern spotted owl (*Strix occidentalis caurina*) **Northern Spotted Owl CHU** **Analyzed within the BE.**	**May affect but is not likely to adversely affect.** **No effect.**	**The pipeline would remove approximately 0.3 acres of dispersal habitat near the intake facility. This would widen the corridor within this patch of dispersal. The Project would still meet project design criteria in the Forest BA.**

Species or Habitat	Impacts under Proposed Actions	Rationale for Impacts Conclusions
Bald eagle (*Haliaeetus leucocephalus*)	No impact.	Habitat includes lakes and large rivers with nearby large diameter trees, usually ponderosa pine. This project is not within or adjacent to this type of habitat.
Golden eagle (*Aquila chrysaetos*)	No impact.	Habitat includes elevated nest sites in open ponderosa pine or mixed conifer or cliff habitat. This habitat occurs adjacent to the pipeline project and a historical nest site does occur. The pair has not been active in several years. If they were once again found nesting, disturbance to the pair would not be an issue. Construction on this section of the project would not occur until after Labor Day, which is outside of the nesting season.
American peregrine falcon (*Falco peregrinus anatum*)	No impact.	Habitat includes riparian and cliff areas. This habitat occurs above the 4603 Road adjacent to the Bridge Creek Water Supply project. This species has not been documented within the project area. Disturbance would not be an issue if this bird were discovered nesting on the cliffs because construction on this section of the project would not occur until after Labor Day, which is outside of the nesting season.
Great gray owl (*Strix nebulosa*)	No impact.	Habitat includes mature and old growth forests with meadows and openings. This project occurs near meadows, but suitable nesting habitat does not occur adjacent to these meadows.
Northern goshawk (*Accipiter gentiles*)	**May impact. Portions of the project are expected to occur during the nesting season. Noise disturbance from construction activities within ¼ mile of an active nest (within 1 mile for blasting) could disrupt nesting birds.**	**Noise disturbance during the nesting season could potentially cause the birds to be away from the nest for too long or abandon the site. This would be more substantial during the period May through July.**

Species or Habitat	Impacts under Proposed Actions	Rationale for Impacts Conclusions
Cooper's hawk (*Accipiter cooperi*)	**May impact. Portions of the project are expected to occur during the nesting season. Noise disturbance from construction activities within ¼ mile of an active nest (within 1 mile for blasting) could disrupt nesting birds.**	**Noise disturbance during the nesting season could potentially cause the birds to be away from the nest for too long or abandon the site. This would be more substantial during the period May through July.**
Sharp-shinned hawk (*Accipter striatus*)	**May impact. Portions of the project are expected to occur during the nesting season. Noise disturbance from construction activities within ¼ mile of an active nest (within 1 mile for blasting) could disrupt nesting birds.**	**Noise disturbance during the nesting season could potentially cause the birds to be away from the nest for too long or abandon the site. This would be more substantial during the period May through July.**
Red-tailed hawk (*Buteo jamaicensis*)	No impact.	Habitat includes large snags and open country interspersed with forests. There are no known nests adjacent to the project areas plus no suitable nest trees would be removed. The area could be part of a home range for this species.
Woodpeckers/cavity nesters. Species with potential habitat include the Lewis's woodpecker, Williamson's sapsucker, red-naped sapsucker, downy woodpecker, hairy woodpecker, white-headed woodpecker, northern flicker, and pileated woodpecker. Lewis' woodpecker and white-headed woodpecker are analyzed within the BE.	**May impact Williamson's sapsucker.**	**Habitat for this species includes large-diameter trees and snags in ponderosa pine and mixed conifer forests. Large snags would not be removed, but several smaller snags (<12" dbh) would be removed. Several large trees (foraging habitat) would be removed for the pipeline adjacent to the Tumalo Falls Trailhead parking area, including several small cottonwood trees. The project is consistent with Forest LRMP S&G's.**
Waterfowl	No impact.	Habitat includes lakes, ponds, and streams. This project would not impact the stream during the nesting season.
Osprey (*Pandion haliaetus*)	No impact.	Habitat includes large snags associated with fish bearing water bodies. There is potential habitat, but no known nests in the area.
Great blue heron (*Ardea herodias*)	No impact.	This species requires riparian edge habitats (lakes, streams, marshes, estuaries). Potential habitat does not occur adjacent to the pipeline stream

Species or Habitat	Impacts under Proposed Actions	Rationale for Impacts Conclusions
		crossings.
American marten (*Martes americana*)	No impact.	Habitat includes mixed conifer of high elevation late successional forests with abundant down woody material. This project is not within or adjacent to this type of habitat.
Townsend's big-eared bat (*Corynorhinus townsendii*) **Analyzed within the BE**	**May impact but would not lead to a trend towards Federal listing.**	**Roosting and hibernacula includes caves, buildings, bridges, and ponderosa pine and juniper habitats. Surveys have not been conducted at the bridges or water intake building to determine bat occupancy (day and/or night roosting), and should be conducted during the summer of 2013 to determine if the sites are being used. If so, a seasonal restriction may need to be placed so that construction activities at these sites do not occur until after September 15 and before March 15, when the likelihood of bats occupying the building or bridges would be low. Exclusion measures may also need to be taken.**
Wolverine (*Gulo gulo luscus*)	No impact.	Habitat includes mixed conifer high elevation forests. This habitat type suitable for wolverine does not occur within the project area.
Elk (*Cervus elaphus*)	No impact.	The project occurs in summer range for elk. No key elk area is present. Elk are wide ranging surrounding the project and would avoid the area during construction.
Mule Deer (*Odocoileus hemionus*)	No impact.	The project is in mule deer summer range (no hiding cover would be removed). Deer would avoid the area during construction.
Other habitats and species analyzed		
Special or Unique Habitats	**May impact.**	**The Bridge Creek Water Supply project would cross four riparian areas impacting 1750 ft^2 of riparian habitat.**

Species or Habitat	Impacts under Proposed Actions	Rationale for Impacts Conclusions
Snags, Down Wood and Log Associated Species	**May impact.**	**Snags > 21" dbh would not be removed. The Bridge Creek Water Supply project would remove current down wood within the pipeline corridor.**
Late and Old Structural Stage Stands and Connectivity	No impact.	No LOS stands occur within the project area. Project activities would not degrade connectivity between LOS stands.
Survey and Manage Species includes the Crater Lake tightcoil, evening field slug, and the great gray owl. **The Crater Lake tightcoil and evening field slug are analyzed within the BE.**	**May impact the Crater Lake tightcoil and evening field slug but would not lead to a trend towards Federal listing.** No impact to the great gray owl.	**Habitat includes perennial wet areas along streams. The Bridge Creek Water Supply project would be disturbing this type of habitat in 4 separate areas (1750 ft²) for pipeline construction. It would not be a permanent loss of habitat as measures would be taken to reduce impacts to riparian vegetation.** Habitat includes mature and old growth forests with meadows and openings. This project occurs near meadows, but suitable nesting habitat does not occur adjacent to these meadows.
Landbird Focal Species. Species with potential habitat include the white-headed woodpecker, pygmy nuthatch, chipping sparrow, Lewis' woodpecker, brown creeper, Williamson's sapsucker, flammulated owl, hermit thrush, and olive-sided flycatcher.	**May impact chipping sparrow, brown creeper, Williamson's sapsucker, and hermit thrush.** No impact to white-headed woodpecker, pygmy nuthatch, Lewis' woodpecker, flammulated owl, and olive-sided flycatcher.	**This project is consistent with Forest LRMP for woodpeckers , and with Design Criteria, is consistent with the Landbird Conservation Strategy for these species.** Species nesting habitat would not be removed.
Birds of Conservation Concern. Species with potential habitat include the golden eagle, American peregrine falcon, flammulated owl, Lewis' woodpecker, white-headed woodpecker, and Williamson's sapsucker. Lewis' woodpecker and white-headed woodpecker are analyzed within the BE.	**May impact Williamson's sapsucker. Analyzed within the LRMP MIS section for woodpeckers.** No impact to golden eagle, American peregrine falcon, flammulated owl, Lewis' woodpecker and white-headed woodpecker.	**Project is consistent with Forest LRMP for woodpeckers; foraging and potential nesting habitat for Williamson's sapsuckers would be removed (0.3 acres).** Species nesting and foraging habitat would not be impacted by the project.
High Priority Shorebirds	No impact	No wetland, wet meadow, or shrub/grass habitat occurs in or near project areas.

Management Indicator Species come from the Deschutes National Forest Land and Resource Plan (LRMP)[1990]; **Birds of Conservation Concern (BCC)** come from the US Fish and Wildlife Service Birds of Conservation Concern – BCR 9 (Great Basin) [2008]; **Landbird Focal Species (ES)** come from the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington (Altman 2000); and **Shorebird*s*** come from the 2004 US Fish and Wildlife Service U. S. Shorebird Conservation Plan.

3.8.6 LRMP Management Indicator Species and Habitats

The Deschutes LRMP identifies management indicator species (MIS) and habitats to assess effects of management activities for a wide range of wildlife species with similar habitat needs. LRMP habitat categories include Special or Unique Associated Habitats, Snags and Down Wood, and Late and Old Structural Stage (LOS) stands and Connectivity.

Management Indicator Species analyzed in this wildlife report include the northern goshawk, Cooper's hawk, sharp-shinned hawk and Williamson's sapsucker.

Management Indicator Species not analyzed in this report include northern spotted owl (analyzed in the BE), bald eagle, golden eagle, American peregrine falcon, great gray owl, red-tailed hawk, waterfowl, osprey, great blue heron, American marten, Townsend's big-eared bat, wolverine, elk, and deer, either due to a lack of habitat or that habitat occurs, but no impacts to the habitat or species are expected. The proposed project would not contribute to a negative trend in viability at the Forest level for any of these species. LRMP habitats not analyzed from lack of habitat constituents or the habitat would not be impacted by the project include late and old structural stands and connectivity (Eastside Screens).

Northern Goshawk: ***MIS, S3B-Vulnerable at breeding habitat***

In Oregon, goshawks tend to select mature or old-growth stands of conifers for nesting, typically those having a multi-layered canopy with vegetation extending from a few meters above ground to more than 40 meters high. Generally nesting sites are chosen that are near a source of water and are on moderate slopes, usually having a northerly aspect. This habitat type is quite similar to that used by the Cooper's hawk, but the trees tend to be older and taller and have a better-developed understory of coniferous vegetation (Reynolds et al. 1982). Foraging generally occurs within these mature stands where small openings occur. These birds generally forage on passerines (e.g. songbirds), but often utilize small mammals such as rodents as well as the occasional snowshoe hare. Some gallinaceous bird species are also preyed upon such as blue and ruffed grouse. Species and abundance of gallinaceous prey varies in the range of the goshawk depending on elevation and latitude (Marshall et al. 2006).

One historical goshawk nest site occurs within ¼ mile of the Bridge Creek Water Supply project. This site was not active during the 2011 nesting season and was not surveyed during the 2012 nesting season.

Cooper's Hawk and Sharp-shinned Hawk: ***Management Indicator Species, S4-Apparently Secure***

The Cooper's hawk prefers coniferous, mixed and deciduous forests, as well as riparian, juniper, and oak woodlands. Vegetative profile around nests are trees 30-60 and 50-70 years old in northwest and eastern Oregon, respectively with tree density of 265/ac. and 469/ac. Coopers hawks commonly nest in deformed trees infected with mistletoe (Marshall et al. 2006).

Sharp-shinned hawks in Oregon breed in a variety of forest types that have a wide range of tree species, though conifers dominate most. Nests have been located at elevations that range from roughly 300 to 6,000 feet. Vegetative characteristics found at nest sites, include high tree density and high canopy cover, which produce cool, shady conditions. Nest stands preferred by sharp-shinned hawks are younger than those preferred by Coopers' and goshawk, usually 25-50 yr old, even-aged stands. In eastern Oregon all nest sites found by Reynolds et al. (1982) were in even-aged stands of white fir, Douglas-fir, ponderosa pine, or aspen, with ground vegetation limited to grasses and creeping barberry (Marshall et al. 2006).

Three historical Cooper's hawk nest sites and one historical sharp-shinned hawk nest site occur within ¼ mile of the Bridge Creek Water Supply project. These sites were not active during the 2011 nesting season and were not surveyed during the 2012 nesting season.

Environmental Consequences - LRMP Management Indicator Species

No Action Alternative

There is no proposed action under this alternative; therefore there would be no changes from the existing conditions. There are no expected negative impacts to any of the accipiter species. Without a proposed action that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative impacts.

With the condition of the current pipeline system, failure of the system is likely in the future. It is unknown if this would be long-term leakage or a failure. With either of these potential failures, impacts to accipiters and their habitat is not expected.

Proposed Action

The proposed activities associated with the project would not be removing or disturbing habitat for any of these accipiter species. The timing of the activities could negatively impact nesting pairs within ¼ mile of Skyliners Road from the noise disturbance possibly causing nesting failure. It is likely that the project would proceed during the nesting season due to contractor timing/other restrictions, etc. Activities that can occur outside of the nesting season (between September 1 and February 28 for goshawk or September 1 and April 14 for Cooper’s hawk and sharp-shinned hawk) should proceed during these times. The Bend Pipeline is expected to take several months to complete, possibly beginning in the summer of 2013 or 2014 (between the water intake and lower bridge crossing) and finishing the Skyliners portion in 2014 or 2015.

Although this project may impact the above accipiter species (one goshawk pair, three Cooper’s hawk pairs, and one sharp-shinned hawk pair) if construction occurs during the breeding season, since this project is not removing habitat, and will only potential affect one or two breeding seasons, it is not expected to add incrementally to ongoing and reasonably foreseeable actions; therefore cumulative impacts to this species or its habitat are not expected from the Bridge Creek Water Supply project.

Consistency

By following the recommended mitigation and Design Criteria, the project is consistent with LRMP Standards and Guidelines.

Conclusion

It is possible that if the projects occur during the breeding season, project activities could have direct, negative impacts to five pairs of nesting accipiters and their young. Disturbance during this time could result in nest failure (noise disturbance) or direct loss of individuals (adults away from the nest for too long), which would be more critical during the period of egg laying, incubation, and hatching (varies, but in this area May to July). The Cooper’s and sharp-shinned hawks are considered “apparently secure” by Natureserve (2012), while the northern goshawk is considered “vulnerable” on breeding grounds.

The proposed actions from the project would result in no change in habitat, but may impact individuals through disturbance by project activities. The increase in disturbance would be insignificant at the scale of the Forest, and thus continued viability of the northern goshawk, Cooper’s hawk, and sharp-shinned hawk species are expected on the Deschutes National Forest. This determination is based on a 2012 Forest wide habitat analysis that determined habitat is available for 77-108 pairs of goshawks (LRMP manages for 40 pairs), 48-166 pairs of Cooper’s hawks (LRMP manages for 60 pairs), and 375-628 pairs of sharp-shinned hawks (LRMP manages for 60 pairs).

Table 59. Cumulative effects to raptor habitat (goshawk, Cooper's hawk, sharp-shinned hawk)

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	The Proposed Action will result in the removal of trees large enough to be nesting trees, but there are currently no known nests in trees that are to be removed. There are known nests within ¼ mile of Forest Service Road 4603. Surveys of known nest sites prior to construction will be conducted. If any of those known nests are found to be active, or other active nests are identified, construction will be restricted in certain areas to avoid disturbance to nest cores.
Affected Environment	At least ten known nest sites, acres of nesting habitat, size of home range and number of home ranges in watershed.
Effects of Reasonably Foreseeable Future Actions	West Bend Vegetation Project, Skyliners Road reconstruction. Potential for disturbance to an unknown amount of home range habitat. Nesting cores will be protected.
Mitigation not included in the Proposed Action	Can't avoid the minimal removal of trees and can't replace habitat until new trees are large enough to be habitat.
Sum of impacts (cumulative Impact)	Removal of large nesting trees and trees and vegetation that serve as foraging habitat, and construction activities could disturb or alter foraging patterns. Although cumulative effects may impact individuals, they are not expected to contribute to a downward trend in populations.
Regulatory cap (if applicable)	ESA.

WOODPECKERS

Red-naped Sapsucker: *Management Indicator Species, Landbird Focal Species, S4 Apparently Secure*

This species inhabits a variety of coniferous forest communities within which there are stands of quaking aspen. In mountains, it also uses riparian woodlands of willow and other deciduous trees (Csuti et al. 2001).

According to Altman (2000), conservation issues for this species include: lack of recruitment of young aspen due to livestock grazing and fire suppression; reduced presence of large aspen trees and snags due to limited replacement; encroachment of conifer trees into aspen stands; and competition for nest cavities with European starlings

Conservation strategies include: assess the potential for use of fire in restoration of aspen stands; manual treatment (thinning) could be used in areas prior to introducing fire; maintain all snags; eliminate or modify grazing; and starling controls may be necessary.

The red-naped sapsucker has not been observed within the project area. Potential habitat would occur along Tumalo Creek and its associated springs where quaking aspen and other deciduous trees occur.

Williamson's Sapsucker: *Management Indicator Species, Landbird Focal Species, Bird of Conservation Concern, S4 Apparently Secure*

Williamson's sapsuckers are a focal species for large snags in mixed conifer habitat. They will often utilize ponderosa pine habitat, specifically dead and live trees for foraging and select for large (>20"dbh) snags for nesting (Bull et al. 1986). Mellen et al. (2006) show this species utilizes large diameter snags at high densities (nesting in snags 20 to 34" dbh).

According to Altman (2000), conservation issues for this species include: loss of large diameter snags to logging; snag management policies on managed lands are often deficient in large snags required by this species unless recruitment snags are maintained through the rotation; and fire suppression has resulted in closed understories which inhibit growth of large trees.

Conservation strategies include: extend rotation ages to retain snags; retain largest live trees, particularly dying or defective trees in harvest units; retain known or suitable nesting and roosting snags and restrict access from firewood cutters.

While some habitat has been lost to timber harvest and the Bridge Creek Fire, snag habitat for this species is increasing within the watershed due to increased stand densities and stress on larger trees.

Williamson's sapsuckers have not been sighted within the watershed or the project area, but their foraging sign has been seen within the mixed conifer plant association groups (PAGs). Williamson's sapsucker foraging sign occurs on black cottonwood trees adjacent to the upper bridge over Tumalo Creek. Approximately 2,313 acres of habitat occur within the Upper Tumalo Creek Subwatershed where the proposed project occurs.

Downy Woodpecker: *Management Indicator Species, S4 Apparently Secure*

Potential habitat within the watershed and project area would occur within the deciduous and mixed deciduous-coniferous forests or riparian areas (Marshall et al. 2003, Csuti et al. 2001) adjacent to Tumalo Creek and its associated springs (approximately 3-5 acres within the project area). Downy woodpeckers have not been observed within the project area.

Environmental Consequences – Woodpeckers

No Action Alternative

There are no impacts to red-naped sapsuckers, Williamson's sapsuckers, or downy woodpeckers because there is no proposed action under this alternative, and without a proposed action that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative impacts. With the condition of the current pipeline system, failure of the system is likely in the future. It is unknown if this would be long-term leakage or a failure. With either of these potential failures, impacts to woodpeckers and their habitat is not expected.

Proposed Action

Construction of the Bend Pipeline is expected to remove nesting and foraging habitat for these three species of woodpeckers. For Williamson's sapsuckers, approximately 0.3 acres of habitat would be impacted, which is small, but occurs within the stand that did not burn in the Bridge Creek Fire adjacent to the Tumalo Falls Trailhead parking area. This stand is approximately 6 acres in size. Habitat removal for red-naped sapsuckers and downy woodpeckers is also minor, and would not be measured in acres as it would be in number of trees. The number of hardwood trees removed from riparian habitat is five larger cottonwood trees ($\geq$12" dbh) and several sapling-sized alder and willow trees. Green hardwood trees would be removed from riparian habitats to allow for construction of the pipeline. Where the pipeline crosses riparian habitats, trees would not be allowed to regrow. Where this habitat occurs, the Bridge Creek Water Supply project would occur during the late summer and fall, so direct impacts to nesting woodpeckers is not expected.

Consistency

This project would be consistent with Forest Plan S&G's for snags. The Bridge Creek Water Supply project would also be consistent with the Conservation Strategy for Landbirds for the red-naped sapsucker, but adds to an identified issue of removal of hardwood trees. The project would not be consistent with habitat strategies for the Williamson's sapsucker by potentially removing large trees and snags to expand the pipeline corridor near the Tumalo Falls Trailhead parking area.

Cumulative Impacts

For red-naped sapsuckers and downy woodpeckers, this project is not expected to add incrementally to ongoing and reasonably foreseeable actions (no other projects, including West Bend or the fuelbreak projects, are expected to remove hardwoods); therefore, cumulative impacts from this project are not expected. The proposed Bend Pipeline is additive to ongoing projects in the watershed that remove dead wood (e.g. hazard trees and firewood cutting) and future timber sales including the West Bend Project. Since the amount of dead wood removed is minor, the additive effect of this project would be less than 0.1% of the available habitat within the subwatershed.

Table 60. Cumulative effects to red-naped sapsuckers, Williamson's sapsuckers, and downy woodpeckers

Considerations	Findings
Effect of Proposed Action (issuance of conditioned SUP)	Loss of 0.3 acre of hardwood nesting and foraging habitat for three species of woodpeckers.
Affected Environment	One six acre stand
Effects of Reasonably Foreseeable Future Actions	None. Future vegetation growth in currently cleared existing pipeline corridor will add habitat.
Mitigation not included in the Proposed Action	None
Sum of impacts (cumulative Impact)	0.3 acre lost, about the same gained over time.
Regulatory cap (if applicable)	LRMP, Landbird Conservation Strategy

Conclusion

There may be impacts to these species by a small reduction in habitat; however, the impacts are expected to be minimal with a loss of 0.3 acres of habitat for Williamson's sapsucker (2,313 acres occur within the Upper Tumalo Creek Subwatershed) and four potential nest trees for downy woodpeckers and red-naped sapsuckers (17 acres occur within the Upper Tumalo Creek Subwatershed). The Bridge Creek Water Supply project would result in less than 0.1% decrease in habitat for these woodpecker species within the Upper Tumalo Creek Subwatershed. Because of this minimal loss of habitat across the Forest, the overall direct, indirect and cumulative effects would result in a small negative trend of habitat. This loss of habitat would be insignificant at the scale of the Forest. The Bridge Creek Water Supply project is consistent with the Forest Plan, and thus continued viability of these woodpecker species is expected on the Deschutes National Forest. All three of these woodpeckers are considered "apparently secure" by Natureserve (2012).

3.8.7 Special or Unique Associated Habitats

3.8.7.1 Snags and Down Wood

A snag is defined as a dead tree that is over 10" diameter at breast height (dbh) and taller than 10 feet. Down woody material is considered to be dead and down material that is greater than 5 inches in diameter (Mellen et. al 2006). The most notable species using snags and down woody material are the primary cavity nesters (e.g. woodpeckers and nuthatches) that excavate nest cavities in decayed wood in standing trees. Vacated cavities are subsequently used by many other birds, bats, American marten, and small mammals (i.e., secondary cavity users).

Logs provide organic and inorganic nutrients in soil development, provide microhabitats for invertebrates, plants, amphibians, and other small vertebrates, and provide structure for riparian associated species in streams and ponds. Size, distribution, and orientation may be more important than tonnage or volume. Small logs provide escape cover or shelter for small species.

Small mammals use logs extensively as runways, making these areas important for birds of prey or other mammals that feed on these small mammals. Orientation has also been shown to be important, where logs that lie along a contour are used more than those lying across contours. Larger sized logs are also used more often and by a larger variety of species than smaller logs (Bull et al. 1997).

The Forest lies on the eastside of the Cascades where there is a limited availability of water and nutrients as compared to the west side of the Cascades. This, combined with overcrowded stand conditions due to fire suppression, has led to tree mortality above historic levels especially in smaller size classes. In particular, plant association groups (PAGs) that tend to be drier (i.e., ponderosa pine and mixed conifer dry) may recruit a higher level of down wood today than did historically. It is also assumed that fire suppression in the watershed has decreased the consumption rate of down wood; while other human practices such as firewood gathering has removed down wood.

Snags and down wood do not occur in abundance within and adjacent to the project area. The upper portion of this project occurs within the Bridge Creek Fire area that occurred in 1979. Post-fire, snags and down wood were removed from the burn. In the lower portion of the project area, hazard tree removal by the County occurs adjacent to Skyliners Road, and forested lands adjacent to Skyliners Road have been thinned within the past 10-15 years. These thinning are to improve conditions for future large-diameter trees that would provide the potential for snag and down wood recruitment over time. Long-term, the stands are anticipated to develop late-seral conditions that would provide more snags, green tree replacements, and downed wood.

3.8.8 Environmental Consequences – Snags and Down Wood

No Action Alternative

There is no proposed action under this alternative; therefore there would be no changes from the existing conditions. There are no expected negative impacts to snags and down wood. Without a proposed action that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative impacts.

With the condition of the current pipeline system, failure of the system is likely in the future. It is unknown if this would be long-term leakage or a failure. With either of these potential failures, impacts to current snag and down wood habitat are not expected.

Proposed Action

Snags and downed wood would not be removed in a majority of the project area as most of the project would be placed within the road prism of the 4606-100 Road and the 4603 Road (Skyliners Road). The Bridge Creek Water Supply project may remove snags (2-6 snags <12”dbh) and any down wood (4-8 pieces ≥8” dbh) in the current pipeline corridor between the intake and the upper bridge crossing.

This amount of dead wood removal in the upper portion of the pipeline project is minor compared to that which occurs within the entire Upper Tumalo Creek Subwatershed. On a landscape scale this would be insignificant, but in the smaller scope of this project, it may impact the species that could be utilizing this 6-acre patch of forested habitat and the security of small mammals crossing the widened pipeline corridor.

Cumulative Effects

This project would add incrementally to ongoing and reasonably foreseeable actions. The proposed West Bend Project, the fuelbreak projects, the ongoing West Tumbull Project, localized woodcutting and hazard tree removal have additional activities that would further degrade snag and down wood habitat. Because of the small amount of this habitat impacted by the Bridge Creek Water Supply project compared to that available within the entire Upper and Lower Tumalo Creek Subwatershed, and the continuity of snags being created in all habitat types across the watershed due to ongoing insect mortality, additive or cumulative effects of the proposed actions with other ongoing or reasonably foreseeable projects that remove snags would not be measureable.

Consistency

The Bridge Creek Water Supply project is not a timber harvest projects and removes very little of this habitat. This project would be consistent with the Deschutes National Forest LRMP S&G's for snags and down wood.

Conclusion

The proposed project is expected to have no impact to snags and down wood availability within the Upper and Lower Tumalo Creek Subwatersheds, and would not contribute to loss of viability for any cavity nesting species, or other species dependent on this form of habitat.

3.8.7.2 Late and Old Structural Stands and Connectivity

The goal of late and old structural stage (LOS) stands is to provide representation of landscape ecology and habitat for plants and animal species associated with old growth forest ecosystems. Late and old structural stages are defined by the Eastside Screens as multi-strata stands with large trees and single strata stands with large trees. Multi-stratum stands are comprised of two or more tree canopy layers and two or more cohorts of trees. Medium and large sized trees dominate the overstory but trees of all size classes may be present. Stand structure and tree sizes are diverse. Single stratum stands are comprised of a single dominant canopy stratum consisting of medium or large sized trees. Large trees are common. Young trees are absent or few in the understory. The stand may appear "park-like." Multi-stratum LOS conditions are favorable to those species that require or prefer more complex forested structure, e.g. northern goshawk, while the single stratum LOS habitats are preferred by species such as the white-headed woodpecker and pygmy nuthatch.

Maintaining connectivity between habitats, particularly late and old structured habitat, is believed to be important for numerous wildlife species to allow free movement and interaction of adults and dispersal of young. Management direction pertaining to maintaining connectivity between late and old structured stands, as well as allocated old growth management areas and late-successional stands is provided by the Eastside Screens and Northwest Forest Plan.

LOS habitat does not occur within the project area, and thus neither LOS habitat nor the connectivity between this habitat would be impacted by the Bridge Creek Water Supply project.

3.8.9 Survey and Manage Species

The Northwest Forest Plan requires that certain rare species be surveyed prior to ground-disturbing activities so that the location of these rare species can be considered in the design of the projects. The Crater Lake tightcoil, evening field slug and great gray owl are three Survey and Manage Species and their habitat is considered within site disturbing activities.

In general, Survey and Mange species requirements associated with this project, per the 2001 ROD Standards and Guidelines are as follows:

1. Manage for known sites based on the known sites database

2. Complete pre-disturbance surveys for Category A and C species if activity is potentially habitat disturbing such that it is likely to have a significant negative impact on the species' habitat, life cycles, microclimate, or life support requirements. Complete equivalent-effort pre-disturbance surveys for Category B4 species.

Surveys were conducted for the Crater Lake tightcoil, a Category A species. These surveys would complete the equivalent-effort pre-disturbance survey requirements for the evening field slug, a Category B4 species. Both of these species are analyzed in the BE because they are also considered a sensitive species. Habitat for the great gray owl (Category C species) does not occur in the project area.

This project conforms with the January 2001 *Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines* (2001 ROD S&Gs).

3.8.10 Focal Landbird Species

The biological objectives of the Forest Service Landbird Strategic Plan (January 2000) are to maintain, restore, and protect habitats necessary to sustain healthy migratory and resident bird populations. Biological objectives are all based on “where ecologically appropriate,” meaning actions must occur in the proper habitat addressed to be consistent. The purpose of the strategic plan is to provide guidance for the Landbird Conservation Program and to focus efforts in a common direction.

On a more local level, the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington (Altman 2000) outlines conservation measures, goals and objectives for specific habitat types found on the east-slope of the Cascades and the focal species associated with each habitat type. The Forest is in the Central Oregon subprovince. Table 61 lists specific habitat types, habitat feature needed and conservation focus, and the focal bird species for each. There is no lodgepole pine, or subalpine fir plant associations in the project area; therefore, black-backed woodpecker, and blue grouse are not analyzed. There is a small amount of meadow habitat associated with the Bridge Creek Water Supply project, but it is not sandhill crane habitat.

The focal landbird species that have potential habitat within or adjacent to the project area are white-headed woodpecker, pygmy nuthatch, chipping sparrow, Lewis’ woodpecker, brown creeper, Williamson’s sapsucker, flammulated owl, hermit thrush, and olive-sided flycatcher. No impacts are expected to the white-headed woodpecker, pygmy nuthatch, Lewis’ woodpecker, flammulated owl, and olive-sided flycatcher by the project. The Bridge Creek Water Supply project would not be impacting nesting habitat for these species, as no nesting habitat would be removed. Impacts to the other species are discussed below, with exception to the Williamson’s sapsucker, which is addressed in the LRMP MIS species section above.

Table 61. Priority habitat features and associated focal landbird species for Central Oregon

Habitat	Habitat Feature	Focal Species for Central Oregon
Ponderosa Pine	**Large patches of old forest with large snags**	**White-headed woodpecker**
	Large trees of old forest with large snags	**Pygmy nuthatch**
	Open understory with regenerating pines	**Chipping sparrow**
	Large trees of old forest with large snags patches of burned old forest, cottonwoods	**Lewis's woodpecker**
Mixed Conifer (Late-Successional)	**Large trees**	**Brown creeper**
	Large snags	**Williamson's sapsucker**
	Interspersion grassy openings and dense thickets	**Flammulated owl**
	Multi-layered/dense canopy	**Hermit thrush**
	Edges and openings created by wildfire	**Olive-sided flycatcher**
Lodgepole Pine	Old growth	Black-backed woodpecker
Meadows	Wet/dry	Sandhill Crane
Aspen	Large trees with regeneration	Red-naped sapsucker
Subalpine fir	Patchy presence	Blue grouse

Chipping Sparrow: *Landbird Focal Species, S4 - Apparently Secure*

Chipping sparrows are a focal species of more open ponderosa pine stands with active regeneration (Altman 2000). The chipping sparrow is a low-tree/ground-nester that uses open-overstory ponderosa pine and lodgepole pine (Marshall et al. 2003). This species prefers these open coniferous forests or stands of trees interspersed with grassy species or other areas of low foliage suitable for ground foraging (Farner 1952). In Central Oregon, they are found in good numbers in juniper, ponderosa pine, and lodgepole pine forests. This bird species feeds primarily on seeds of grasses and herbaceous annuals, adding insects and other invertebrates when breeding (Middleton 1998). Habitat changes have brought on increased risk of cowbird brood parasitism and competition with house sparrows and house finches (Middleton 1998).

According to Altman (2000), conservation issues for this species include: understory removal because of fire hazard or as part of restoration activities, intensive grazing, and vulnerability to cowbird parasitism where matrix land-use provides for cowbirds. Conservation strategies listed in Altman (2000) include: conduct overstory removal and burning outside the nesting season (April 15 – July 15), and conduct thinning and/or overstory removal to provide suitable open conditions.

Biological objectives under the landbird conservation strategy are to provide the following conditions in ponderosa pine forests: (1) interspersion of herbaceous ground cover with shrub and regenerating pine patches; (2) 20-60% cover in the shrub layer; (3) > 20% of the shrub layer in regenerating sapling conifers (especially pines); and (4) a mean canopy cover 10-30%.

Habitat for the chipping sparrow occurs adjacent to Skyliners Road for almost the entire length. Although this habitat is there, the likeliness of this species nesting adjacent to the road is low due to existing noise disturbance. Between the Upper and Lower Tumalo Creek Subwatersheds, there is >17,000 acres of available nesting habitat.

Brown Creeper: *Landbird Focal Species, S4 Apparently Secure*

Brown creepers are a focal species for large trees within the mixed conifer (i.e. white or Douglas-fir) plant association (Altman 2000). They usually nest under loose, sloughing bark of relatively large diameter dead trees (Marshall et al. 2003).

According to Altman (2000), conservation issues for this species include: loss of large diameter trees (especially Douglas-fir) to logging and indications that it may be a forest interior species (i.e. avoids edges to openings). Conservation strategies discussed in Altman (2000) include: maintaining stands in the largest tracts possible to reduce the amount of edge and fragmentation; designate areas of unmanaged late-successional forest likely to provide the most suitable nesting habitat; managing for large diameter trees through longer rotation periods; and in harvest units retained trees should be clumped rather than dispersed and should be primarily Douglas-fir.

Marshall et al. (2003) cites literature that suggests creeper numbers are reduced by clear cutting and thinning, but will utilize closed canopied stands. Information in Mellen et al. (2006) suggests that brown creepers will utilize snags 9 to 22", but there was no information in regards to densities.

The stand of habitat adjacent to the Tumalo Falls Parking area contains potential habitat for brown creepers. This species was observed during late summer suggesting it could have nested in the stand, or it was foraging here. The Upper Tumalo Creek Subwatershed, where the habitat that would be impacted occurs, contains >1,000 acres of nesting habitat.

Hermit Thrush: *Landbird Focal Species, S4 Apparently Secure*

Hermit thrushes are a focal species of multi-layered, dense mixed conifer stands (Altman 2000). This species breeds in mature forests of all types that provide a shaded understory of brush and small trees (Aldrich 1968). The hermit thrush nests on the ground, in dense brush, or in small trees (Mannan 1980).

According to Altman (2000), conservation issues for this species include: alteration of habitats (loss of understory and structural complexity) from fire, grazing, and winter recreational activities. Conservation strategies discussed in Altman (2000) include: retain tracts of forest as unmanaged or lightly managed to ensure structural diversity.

Hermit thrushes have been observed within the Bridge Creek Water Supply project area in the stand adjacent to the Tumalo Falls Trailhead parking. No nesting was confirmed but it is assumed because of the presence of suitable habitat and the observations of adults in suitable habitat during the breeding season. The Upper Tumalo Creek Subwatershed, where the habitat that would be impacted occurs, contains >2,000 acres of available nesting habitat.

Environmental Effects – Focal Landbird Species

No Action Alternative

There is no proposed action under this alternative; therefore there would be no changes from the existing conditions. There are no expected negative impacts to chipping sparrows, brown creepers, or hermit thrushes. Without a proposed action that would add incrementally to the ongoing or reasonably foreseeable actions, there would be no cumulative impacts.

With the condition of the current pipeline system, failure of the system is likely in the future. It is unknown if this would be long-term leakage or a failure. With either of these potential failures, impacts to these bird species and their habitat are not expected.

Proposed Action

This project would not remove habitat for the chipping sparrow, but project activities would occur adjacent to its habitat during the nesting season along Skyliners Road. Project activities that include noise disturbance could impact this species if it occurs during the nesting season (April 15 – July 15) (Altman 2000). The habitat would be considered low quality due to its proximity to Skyliners Road because of existing disturbance, although this species could still nest here. Any chipping sparrows that would nest close to the road would be at an increased risk of nest failure due to brown-headed cowbird parasitism plus an increased potential of being struck (while foraging) by passing cars.

Removal of trees for the Bridge Creek Water Supply project adjacent to the Tumalo Falls Trailhead Parking area would remove approximately 0.3 acres, within a 6-acre stand, of potential nesting and foraging habitat for the brown creeper and hermit thrush due to the increase in size of the pipeline corridor from 22 feet to 40 feet. In the scope of the entire Upper Tumalo Creek Subwatershed where this 6-acre stand occurs, this amount of acreage removed is minimal. The increase in size of the current corridor would increase the width of habitat fragmentation within this patch, thus decreasing the effectiveness of this forested patch to deter predation and nest parasitism for these bird species.

Cumulative Effects

The Bridge Creek Water Supply project would add incrementally to ongoing and reasonably foreseeable actions. The proposed West Bend Project and the fuelbreak projects are expected to treat additional acres of suitable habitat within the watershed for all three of the above species (<1% for the hermit thrush and brown creeper, and 35% for the chipping sparrow), while the ongoing West Tumbull Project would treat additional habitat post-sale (<0.1% for the chipping sparrow), removing additional habitat for the chipping sparrow. Since the acres impacted by the Bridge Creek Water Supply project are minimal compared to that available within the Upper and Lower Tumalo Creek Subwatersheds, additive or cumulative effects of the proposed actions with other ongoing or reasonably foreseeable projects that remove habitat are very minimal. Cumulatively, less than 0.1% additive reduction in suitable habitat for these species is expected from implementation.

Consistency

The Bridge Creek Water Supply project is consistent with the Conservation Strategy for Landbirds if noise disturbing project activities are avoided during the nesting period for the chipping sparrow (April 15 to July 15). This project is consistent with the Conservation Strategy for Landbirds because overall stand characteristics remain the same even if a few large trees are removed.

Conclusion

The Bridge Creek Water Supply project would remove 0.3 acres of brown creeper and hermit thrush habitat (less than 0.1% of the total available habitat within the subwatersheds). This loss of habitat is minimal, plus current habitat quality for the chipping sparrow is compromised by its adjacency to Skyliners Road and for the brown creeper and hermit thrush by the fragmentation from the current pipeline corridor.

The Bridge Creek Water Supply project would not remove habitat for the chipping sparrow, but project activities would occur adjacent to its habitat during the nesting season. Project design criteria and the mitigation measure could reduce these potential impacts. All three species are considered "apparently secure" by Natureserve (2012), so although the project may impact habitat and individuals, it is not expected to contribute to a downward trend in populations.

3.8.11 Birds of Conservation Concern

The Birds of Conservation Concern (*BCC*, USDI FWS 2008) identifies species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the ESA. The goal is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservations actions. Bird Conservation Regions (BCRs) were developed based on similar geographic parameters. BCR 9 (Great Basin) encompasses the District. Golden eagle, American peregrine falcon, flammulated owl, Lewis's woodpecker, white-headed woodpecker and Williamson's sapsucker are listed as BCC, but have been previously analyzed in other sections of this document.

3.8.12 High Priority Shorebirds

The U.S. Shorebird Conservation Plan (USDI FWS 2004) identifies the conservation status of U.S. and Canadian shorebird populations. The proposed project would not impact any of these species either due to a lack of habitat or project activities occurring outside of potential habitat.

3.9 Soils

For more detail, see *Bend Water Source and Skyliners Road Improvements Project Soils Resource Report*, Peter Sussman, March 20, 2013. This report is incorporated by reference, and on file at the Bend–Fort Rock Ranger District.

3.9.1 Management Direction – Soils

The Deschutes Land and Resource Management Plan (LRMP) includes Forest-wide standards and guidelines that direct land management activities to promote the maintenance or enhancement of soil productivity. Forest Standards and Guidelines applicable to this project are:

1) Limiting the use of mechanical equipment in sensitive soil areas (SL-5).

The Pacific Northwest Region developed soil quality standards and guidelines to limit detrimental soil disturbances associated with management activities (FSM 2520, R-6 Supplement No. 2500-98-1). Region 6 guidance supplements the Forest LRMP standards and guidelines designed to protect or maintain soil productivity and describes detrimental soil impacts as those that meet the criteria described below:

- ***Detrimental Compaction:*** for volcanic ash/pumice soils—an increase in soil bulk density of 20%, or more, over the undisturbed level.
- ***Detrimental Puddling:*** loss of soil structure when the depth of ruts or imprints exceeds 6 inches.
- ***Detrimental Displacement:*** the removal of more than 50% of the A horizon from an area greater than 100 ft^2, which is at least 5 feet in width.

The Regional supplement to the Forest Service Manual (FSM 2520, R-6 Supplement No. 2500- 98-1) provides policy for planning and implementing management practices which maintain or improve soil quality. This Regional guidance is consistent with Deschutes LRMP interpretations for standards and guidelines SL-3 and SL-4 that limit the extent of detrimental soil conditions within activity areas.

3.9.2 Desired Landscape Condition

The primary management goal for the soil resource is to maintain or enhance soil conditions at acceptable levels without impairment of the productivity of the land. The extent of detrimental soil disturbances is minimized through the application of management requirements and mitigation measures designed to minimize, avoid or eliminate potentially significant impacts, or restoration techniques that rectify impacts in site-specific areas. The land effectively absorbs and distributes water, and erosion rates occur within natural ranges of variability. The biological productivity of soils is ensured by management prescriptions that retain adequate supplies of surface organic matter and coarse woody debris without compromising fuel management objectives and the risk of soil damage from surface wildfire.

3.9.3 Existing Condition – Soils

The Bend Waterline project area is located on the eastern flanks of the Cascade Range within the glaciated valley of Tumalo Creek and on upland lava plains adjacent to a deeper canyon reach of the creek. The landforms, rocks, and soil in the glaciated valley are a combination of products of volcanism and glaciation, while those on the upland lava plains are primarily volcanic. The planning area encompasses valley bottomland, glaciated valley side and toe slopes, lateral moraines and gently sloping lava plains. Valley and upland slopes generally range from 0–30%, although steeper side-slopes of glacial moraines exceed 30%.

Landtypes mapped in the Soil Resource Inventory (SRI) for the Deschutes National Forest are based on similarities in soil, landforms, geology, and climatic conditions that influence defined patterns of soil and vegetation (Larsen 1976). The project area dissects a number of landtype units described in the SRI, including units 26, 37, 64, and complexes GJ, GP and XD.

Dominant surface soils in the project area have developed from volcanic ash and pumice deposits on all of these landtypes and vary in depth from 10 to 40 inches. Surface and subsurface textures of the ash-influenced soils are primarily sandy loams and loamy sands. Mineral soil consists mainly of sand-sized soil particles with little or no structural development due to the young geologic age of the volcanic parent materials. Soils are non-cohesive (loose) and have naturally low bulk densities with a relatively low to moderate susceptibility to compaction.

Upland soils have high infiltration and percolation rates that readily drain moisture from storm events or snowmelt. Subsurface soils comprised of older ash have moderate percolation rates and a moderate capacity to store water. Subsurface bedrock materials or glacial till also have a moderate capacity to store water but may be impermeable at depth. As a result, much of the water yielded from these lands is delivered as base flow to Tumalo Creek through deep seepage and subsurface re-charge.

Soils formed and located on riparian floodplains or bottomland terraces are extremely variable in texture, depth, degree of wetness, and rock fragment content. Soils located on floodplains are somewhat poorly drained and susceptible to compaction due to low soil strength when wet. Soils located on terraces adjacent to the floodplains of Tumalo Creek are moderately well drained, although seasonal water tables are present and some of these areas are within the flood prone width of the channel.

SRI Landtype Interpretations

The biophysical characteristics of SRI landtype units can be interpreted during planning for proposed management activities to identify hazards, management suitability, and productivity potentials. Potential hazards include the susceptibility of the soil resource to compaction, displacement, and erosion as a result of mechanical disturbances. The predominantly sandy-loam textured soils within the project area are moderately susceptible to compaction, displacement and erosion as a result of mechanical disturbances. These ash influenced soils are not susceptible to soil puddling damage due to their lack of plasticity and cohesion.

The project area is generally covered by loose, non-cohesive ash deposits that overlay buried glacial till or residual soils formed from the weathering of basaltic and andesitic lavas. Surface soils have sandy loam textures with little or no structural development within the principal root development zone (4 to 12 inches in depth) where changes in soil compaction (bulk density) are assessed according to Regional direction (FSM 2521.03). Soils with these textures and lack of structure can be compacted to detrimental levels as a result of vibrational and compressional forces from heavy machinery and are also easily displaced by machinery maneuvering on slopes under dry moisture conditions.

Surface erosion from water appears to occur at relatively low rates within the project area because of high infiltration rates, sufficient vegetative cover and organic litter layer accumulation on the surface. However, landtypes located on the glacial moraines and valley toe slopes within the upper portion of the project area have steeper slopes with moderate erosion hazard ratings and a moderate concern for surface erosion from water runoff. These areas lie within an elevation band that has a moderate to high risk for rain-on-snow or intense thunderstorm events are the most likely to produce overland flows capable of eroding surface soils. Disturbances that reduce vegetative cover, displace organic surface layers, or reduce soil porosity through compaction can increase the rate and extent of erosion from overland flows during these types of events.

3.9.3.1 Sensitive Soil Types

Criteria for identifying sensitive soils are included in the Deschutes Forest Plan (Deschutes LRMP (Appendix 14, Objective 5). Sensitive soils within the project area are typically soils with seasonally high water tables (SRI landtypes 5 & 8). The sensitive portions are a fraction of the mapped landtype area and are confined to specific areas of the dominant landform that are generally too small to delineate at the scale of the SRI mapping.

3.9.3.2 Existing Condition of the Soil Resource

The existing condition of the soil resource is directly related to the extent of natural and managed disturbances that have occurred within the area. Disturbances include natural events such as wildfire, wind and landslides, or managed activities such as timber harvest, road building, and recreation uses. Disturbances can cause changes to soil quality by removing vegetative cover, displacing organic surface layers, or compacting the soil. Mechanical activities can alter soil porosity and the quantity and quality of organic matter on the soil surface.

3.9.3.3 Natural Disturbances

There is currently no evidence of detrimental soil conditions from natural disturbance events within the project area. No major windthrow events have occurred in the recent past and landslides are not evident as a disturbance regime in this location. The 1979 Bridge Creek Fire, totaling 3,364 acres, burned vegetation and natural fuels within the western and northern portions of the planning area. Although the fire caused stand replacement mortality of overstory trees and consumed understory shrubs and grasses, the extensive cover of shrubs, grasses and planted trees nearly thirty years after the fire indicate that ground-level heating does not appear to have been elevated to temperatures capable of altering soil properties that affect site productivity. The minor extent of any severely burned soil was likely confined to small localized areas where individual logs or stumps were completely consumed by fire. Although current levels of coarse woody debris are relatively low, existing vegetation and forest litter are providing adequate sources of ground cover to protect mineral soil from water and wind erosion. As a result of these conditions, natural soil disturbances were not included as existing sources of detrimental soil conditions within any of the activity areas proposed for this project.

3.9.3.4 Management Disturbances

Management activities within the project area have incurred localized areas of detrimental disturbance to the soil resource. The existing pipeline corridor was disturbed in the 1920s and 1950s, and has essentially recovered from any adverse effects to soil productivity, as evidenced by the vigorous growth of trees and shrubs over the pipeline. Skyliners Road, Forest Road 4603 and Forest Road 4606-100 are existing areas of disturbance committed to the long term transportation system.

Management activities within or adjacent to the pipeline corridor include salvage harvest operations following the Bridge Creek Fire and fuels treatment thinning and mowing within the Skyliners Wildland Urban Interface under the West Tumbull project. Localized areas of upland disturbance also occurred for access to the Tumalo Creek Bridge to Bridge Restoration Project. Detrimental disturbance from these activities was limited to localized areas of compaction and displacement where machinery traveled and maneuvered to complete the various management activities. As a result, impacts to the soil resource within the construction width of the pipeline corridor on National Forest lands are considered to be within Deschutes LRMP Standards for maintaining soil productivity.

3.9.4 Environmental Consequences – Soils

No Action Alternative

There are no effects to the soil resource in this alternative. Previously disturbed areas that will remain as they are include Skyliners Road and Road 4603. The existing pipeline corridor was disturbed in the 1920s and 1950s, and has essentially recovered from any adverse effects to soli productivity, as evidenced by on the vigorous growth of trees and shrubs over the pipeline.

Proposed Action

Management activities proposed under this project primarily include trenching under the existing roads to install the new pipe. All reasonable Best Management Practices (BMPs) would be applied to minimize the effects of project activities on the soil resource. The BMPs are tiered to the Soil and Water Conservation Practices Handbook (FSH 2509.22), which contains conservation practices that have proven effective in protecting and maintaining soil and water resource values. The Oregon Department of Forestry evaluated more than 3,000 individual practices and determined a 98% compliance rate for BMP implementation, with 5% of these practices exceeding forest practice rules (National Council for Air and Stream Improvement 1999). A variety of BMP's would be used during and after implementation to control erosion from roads and construction sites.

Peripheral travel of machinery off of the existing road surfaces is likely to occur during trenching and pipe laying activities, incurring localized areas of disturbance in the form of compaction or displacement. Disturbed soil would likely be compacted to levels considered detrimental to plant growth in localized areas where multiple trips of machinery occurred off of existing road and shoulder surfaces. These activities may also displace the surface soil horizons, although this is likely to be localized and within acceptable LRMP and R6 standards. Measures are included in the project Design Criteria for the rehabilitation of compacted or exposed mineral soil adjacent to the pipeline/roadway corridor following construction activities. As a result, the susceptibility of the volcanic ash soils to erosion from raindrop impacts and overland flows, as well as the effects on the productivity of these areas, are expected to be minimal and localized.

New disturbance of the soil resource, including small areas of sensitive riparian soils, would occur where new pipeline was not installed beneath an existing road. This includes a 40 foot wide corridor approximately 600 feet in length between the intake facility and the Upper Tumalo Creek Bridge, and a corridor approximately 200 feet in length within and adjacent to Tumalo Creek at the stream crossing by Skyliners's Bridge. Trenching activities would incur direct impacts to riparian soils within an area of approximately 750 ft^2 where two small springs are present in the upper corridor and approximately 1,000 ft^2 where the pipeline would cross the floodplains and channel of Tumalo Creek in the lower corridor. Design Criteria in the EA would minimize the impacts from these activities on sensitive riparian soils by including the salvage of topsoil and riparian vegetation during excavation and guiding their replacement, to the extent possible, after construction is completed. These areas will be regraded, stabilized for erosion, and monitored for revegetation success for at least two years.

The new pipe installation between the intake facility and the Upper Tumalo Creek Bridge would disturb upland soils where machinery accessed the roadless corridor, dug the new trench and placed the pipe. Disturbance would occur within a 40 foot wide corridor approximately 600 feet in length centered on the excavated trench line. Soils within this corridor have thin A horizons that are likely to be displaced and mixed into the susbsurface A/C horizon as a result of machine traffic and trenching activities. The soil is also likely to be compacted in areas where multiple machine trips occur over the same piece of ground. Design Criteria in the EA would minimize the impacts from these activities on the soil by salvaging topsoil during excavation and replacing it, to the extent possible, after construction is completed. These areas will be regraded, decompacted to some degree and stabilized for erosion following the installation of the pipe. Additional mulch or top soil would be imported, if deemed necessary, prior to the seeding or transplanting of native vegetation. These areas would be monitored for revegetation success for at least two years.

The new pipe installation underneath Tumalo Creek just downstream of the Skyliners Bridge would disturb up to 3,200 ft^2 of upland soils on the north side of the creek and up to 8,000 ft^2 on the south side of the creek, depending on machinery access and maneuvering. These impacts would be limited in extent as a result of design criteria that direct the City to reduce the disturbance footprint to only that which is needed and minimize the extent of new disturbance from mechanical treatment. Appropriate Best Management Practices would also be applied to the construction activities in these areas, with particular consideration of the steep slope exiting the creek channel on the south side. An Erosion Control Plan that includes the installation of silt fences and erosion control structures would minimize the extent of erosion from these upland areas during excavation and installation operations. Disturbed soils would be regraded, decompacted to some degree, stabilized, mulched and seeded following the installation of pipe. These areas would also be monitored for revegetation and stabilization success for at least two years.

3.9.5 Cumulative Effects – Soils

There are no major soil-related concerns associated with the combined effects of the proposed action with foreseeable future activities. There are no site-specific mitigation measures or KV project activities recommended by other resource specialists for the Bend Waterline Project that would cause additional soil impacts from ground disturbing activities from those analyzed previously under Alternative 2. The soil disturbance displayed in this analysis from the proposed activities would be localized within the project area and mitigated to some degree by rehabilitation measures and Best Management Practices included in the Design Criteria.

Foreseeable future activities that overlap the project area include continued recreation use in the Tumalo Creek valley, West Bend Vegetation management project, the fuelbreak projects, and reconstruction and standard road maintenance of Skyliners Road, Forest Road 4603 and roads peripheral to these collectors. These activities are expected to have localized impacts to the soil resource that would minimally add to overall disturbance levels resulting from this project. Road maintenance activities would reduce accelerated erosion rates where improvements are necessary to correct drainage problems on specific segments of existing road. Surface erosion can usually be controlled by implementing appropriate Best Management Practices (BMPs) that reduce the potential for indirect effects to soils in areas adjacent to roadways. Incidental disturbances from hikers and mountain bikers are not expected to have a measurable effect on site productivity within the individual activity areas of this project. As a result, the effects of soil disturbances incurred by the proposed activities are not expected to combine with those from foreseeable future activities to a level exceeding LRMP Standards for the soil resource.

3.10 Climate Change

For more detail, see *Bend Water Source and Skyliners Road Improvements Project Climate Chang Assessment Report*, Rod Bonacker, January 29, 2013. This report is incorporated by reference, and on file at the Bend–Fort Rock Ranger District.

3.10.1 Introduction

The impacts on forests from climate change and the effects on climate change from forest management are complex and sometimes negated by the different factors involved. The most expected condition in Central Oregon is a warming time and potentially less snowfall. The best comparison to the average condition is the drought cycles experienced in this area due to the pacific decadal oscillation (also known as El Niño and La Niña) (Hessl et al. 2004). According to the Climate Impacts Group, based out of the University of Washington, climate modeling for the Pacific Northwest predicts a future rate of warming of approximately 0.5 degrees Fahrenheit per decade for the Pacific Northwest through at least 2050, relative to the 1970–1999 average temperature. Temperatures are projected to increase across all seasons, although most models project the largest temperature increases in summer (June–August), and the average temperatures could increase beyond the year-to-year variability observed in the Pacific Northwest during the 20th century as early as the 2020s. With climate change, increases in drought, fires, and greater vulnerability to insects and diseases can be expected.

3.10.2 Regulatory Framework

The Forest Service does not have a national policy or guidance for managing carbon, and the tools for estimating carbon and sequestration are not fully developed. Current direction for addressing climate change issues in project planning and the NEPA process is provided in the document *Climate Change Considerations in Project Level NEPA Analysis* (USFS 2009). This document outlines the basic considerations for assessing climate change in relation to project-level planning.

3.10.2.1 Forest Service Strategic Framework for Responding to Climate Change

The Forest Service mission is to sustain the health, diversity, and productivity of the National Forests and Grasslands to meet the needs of present and future generations. The agency has developed the *Strategic Framework for Responding to Climate Change* because climate change threatens our ability to fulfill that mission (USFS 2008). The *Strategic Framework* describes several inter-related programs of the agency to help forests, grasslands and humans mitigate and adapt to global climate change.

Table 62. Strategic framework's seven goals to address climate change

Aspect	Goals
Foundational	**Science** – Advance our understanding of the environmental, economic, and social implications of climate change and related adaptation and mitigation activities on forests and grasslands.
	Education – Advance awareness and understanding regarding principles and methods for sustaining forests and grasslands, and sustainable resource consumption, in a changing climate.
Structural	**Alliances** – Establish, enhance, and retain strong alliances and partnerships with federal agencies, State and local governments, Tribes, private landowners, non-governmental organizations, and international partners to provide sustainable forests and grasslands for present and future generations.
	Policy – Integrate climate change, as appropriate, into Forest Service policies, program guidance, and communications and put in place effective mechanisms to coordinate across and within Deputy Areas.
Action	**Sustainable Operations** – Reduce the environmental footprint of Forest Service operations and be a leading example of a green organization.
	Adaptation – Enhance the capacity of forests and grasslands to adapt to the environmental stresses of climate change and maintain ecosystem services.
	Mitigation – Promote the management of forests and grasslands to reduce the buildup of greenhouse gases, while sustaining the multiple benefits and services of these ecosystems.

3.10.3 Existing Condition

There is uncertainty about how the climate will change within the project area in the future. This portion of central Oregon has gone through at least five distinct periods of warming climate over the past 110 years (NASA Global Climate Change Website climate.jpl.nasa.gov). In the Western United States and at the continental scale (1 km), long-term satellite data show consistently earlier onsets of spring greening and corresponding increases in length of growing season (Forest Service Climate Change Resource Center: www.fs.fed.us/ccrc).

3.10.3.1 Climate Change Research

The Oregon Climate Change Research Institute summarized their predictions for regional climate change in a report to the legislature (Oregon Climate Assessment Report, 2010);

- Average annual temperatures are likely to increase at a rate of 0.2 to 1 degree F through the 21st century.
- There will likely be an increase in regional warming and drying patterns in the summer, with an average multi-model decrease of 14% in summer precipitation by the 2080s.
- Summer water supplies will decrease as a result of reduced snowpack and less summer precipitation. By mid-century, Cascade snowpacks are projected to be less than half of what they were in the 20th century.
- Because of increased summer temperatures and decrease summer precipitation, irrigation demands will be greater than today.
- Wildfire is projected to increase in all Oregon forest types in the coming decades.

3.10.3.2 Vegetation and Fire Risk

Although there is uncertainty about what the climate future may be, the predicted climate change scenario for this area would exacerbate the conditions for the forests in the project area. Under the warmer/drier scenario of future climate, ponderosa pine will be the most impacted because of its sensitivity to density. Under either alternative, there would be no direct changes to the forested vegetation, and no releases of greenhouse gases would occur.

Droughts may increase the probabilities of insect epidemics and uncharacteristic severe wildfire (areas burned may increase by factors of 2 to 3). Plant communities at upper (cold) and lower (dry or hot) timberlines, as well as riparian areas and wetlands, are most likely to show strong direct effects of climatic change. High elevation species could be extirpated. Species that have chilling requirements for seed germination may have lower reproductive success. Shifts in the range and distribution of species are anticipated. A drier and warmer climate may favor invasive species. (Vora, 2012).

The recently released Draft National Climate Change Assessment (National Climate Assessment and Development Advisory Committee, 2013) documented several Key Findings related to climate change and fire risk:

Impacts on Forests

The combined impact of increasing wildfire, insect outbreaks, and diseases is virtually certain to cause additional forest mortality by the 2040s and long-term transformation of forest landscapes. Almost complete loss of subalpine forests is expected by the 2080s.

Climate change will alter Northwest forests by increasing wildfire risk, insect and disease outbreaks, and by forcing longer-term shifts in forest types and species. Many impacts will be driven by water deficits, which increase tree stress and mortality, tree vulnerability to insects, and fuel flammability. The cumulative effects of disturbance – and possibly interactions between insects and fires – will cause the greatest changes in Northwest forests (Littell et al. 2010; McKenzie et al. 2008). A similar outlook is expected for the Southeast region (See Ch. 20: Southeast, Key Message 3).

Although wildfires are a natural part of most Northwest forest ecosystems, warmer and drier conditions have helped increase the number and extent of wildfires in western U.S. forests since the 1970s (Littell et al. 2010; McKenzie et al. 2008; McKenzie et al. 2004; Westerling et al. 2006). This trend is expected to continue under future climate conditions. By the 2080s, the median annual area burned in the Northwest would quadruple relative to the 1916-2007 period to 2 million acres (range 0.2 to 9.8 million acres) under a scenario that assumes continued increases in emissions through mid-century but declines thereafter (A1B). The probability of a very large fire year would increase from 1 in 20 to 1 in 2 (Littell et al. 2010).

Consequences and likelihoods of changes
The likelihoods of increased disturbance and altered forest distribution are very high in areas dominated by natural vegetation, and the resultant changes in habitat would affect native species and ecosystems. Subalpine forests and alpine ecosystems are especially at risk, and may undergo almost complete conversion to other vegetation types by the 2080s (Rogers et al. 2011). Changes in the risk of very large, high-intensity, stand-replacing fires cannot yet be predicted, but such events could have enormous impacts for forest dependent species (McKenzie et al. 2004). Increased wildfire could exacerbate respiratory and cardiovascular illnesses in nearby populations due to smoke and particulate pollution (Baron et al. 2008; Karl et al. 2009; Washington State Department Ecology 2012).

Heather Greaves at Oregon State University (Thesis, 2012) estimated potential changes to wildfire regimes under various climate change scenarios. She used a simulation model to characterize potential response of fire, vegetation, and landscape dynamics to a range of possible future climate and fire management scenarios. The simulation landscape was part of the Deschutes National Forest, just south of the project area, and did not include the Tumalo Watershed.

She found that changes in precipitation had little effect on fire characteristics or vegetation and landscape characteristics, indicating that simulated precipitation changes were not sufficient to significantly affect vegetation moisture stress or fire behavior on this landscape. Current heavy fuel loads controlled early fire dynamics, with high mean fire intensities occurring early in all simulations. Increases in fire frequency accompanied all temperature increases, leading to decreasing fuel loads and fire intensities over time in warming scenarios. With no increase in temperature or in fire frequency, high fire intensities and heavier fuel loads were sustained. Over time, more fire associated with warming or less fire suppression increased the percentage of the landscape occupied by non-forest and fire-sensitive early seral forest successional stages, which tended to increase the percentage of fire area burning at high severity (in terms of tree mortality). This fire-vegetation relationship may reflect a return to a more historical range of conditions on this landscape.

3.10.3.3 Direct, Indirect, and Cumulative Effects on Climate Change of the No Action Alternative and Proposed Action

The scope and degree of change from either action alternative is minor relative to the amount of forested land available as a whole. A project of this magnitude (about 0.01% of watershed) would have such minimal contributions of greenhouse gases that its impact on global climate change would be infinitesimal. Therefore, at the global scale, the Proposed Action's direct and indirect contribution to greenhouse gases and climate change would be negligible, and therefore the project's cumulative effects on greenhouse gases and climate change would also be negligible.

The Intergovernmental Panel on Climate Change has summarized the contributions to climate change of global human activity sectors in its Fourth Assessment Report (IPCC 2007). The top three anthropogenic (human-caused) contributors to greenhouse gas emissions (from 1970–2004) are: fossil fuel combustion (56.6% of global total), deforestation (17.3%), and agriculture/waste/energy (14.3%). IPCC subdivides the deforestation category into land use conversions, and large scale deforestation. Deforestation is defined as removal of all trees, most notably the conversion of forest and grassland into agricultural land or developed landscapes (IPCC 2000).

This project does not fall within any of these main contributors of greenhouse gas emissions.

3.10.3.4 Direct and Indirect Effects of Climate Change on Water Supply –No Action Alternative and Proposed Action

In summary, in Central Oregon, current predictions for climate changes over the next 100 years are for more fluctuation in weather and weather extremes. Temperature is likely to increase (mean annual 5-7 °F increase by 2100), mostly in the summer. Changes in precipitation are uncertain in the Central Oregon rain shadow. There will likely be more winter rain than snow compared to present, and more rain over snow events, resulting in higher winter and spring stream flow and lower late summer-fall stream flow. Diminished winter snow packs (perhaps 40% less) and earlier snowmelt could impact available water for urban, agriculture and recreation uses in Central Oregon. These impacts would likely be less in slow draining deeper groundwater systems (Deschutes and Metolius Rivers, and lowermost Crooked River south of Pelton Dam) than they will be in areas with fast draining shallow groundwater systems (Ochoco National Forest). Streams like Tumalo Creek with large groundwater influence will likely see reduced summer-fall volumes.

Climate change has the potential to affect flows in the creek the same for either the No Action Alternative or the Proposed Action. The difference between the two alternatives is what happens in response to scenarios where water availability is less than demand as a result of flow reductions. Regardless of climate–induced flow reductions, when demand is at or less than 18.2 cfs, or during proportioned curtailment, the Proposed Action results in more water being left in the creek to flow through Reach A, than what can occur under the No Action Alternative.

For Tumalo Creek, the peak flow period will likely shift from May to July to possibly as early as December or January. Less snow pack means less spring and summer discharge, perhaps as much as 30-40% less. The City's current surface water use is highest in May through October to take advantage of peak flows. The City would likely be able to continue to match winter demand to flow availability, and perhaps even increase surface water use in the winter if warranted by demand. But, they would be affected by apportioned water curtailment much earlier in the year, and forced to rely more heavily on groundwater to meet demand during the summer. Under the No Action Alternative, 18.2 cfs would continue to be diverted regardless of demand, as long as water from Tumalo Springs remained constant. Under the Proposed Action, flows in excess of demand or in excess of any curtailment reduction, would remain in the creek to flow through Reach A.

Historic high flow events associated with rain-on-snow have typically occurred in fall, but could become more likely to occur in winter. The primary impact on the City water system of these rain-on-snow events is increased turbidity, potentially resulting in temporary shut-downs, depending on the type of treatment the City chooses to comply with the LT-2 rules. Temporary shutdowns have less impact on the overall water supply in the winter when demand is low and flows are high, rather than in the fall or summer when demand is high and flows are low. Under the No Action Alternative, shutdown means that all flows diverted bypass the storage facility and are returned to Tumalo Creek in the lower portion of Reach A. Under the Proposed Action, depending on the treatment type, a water quality shutdown could mean that diversion would cease, and all flows would remain in the creek through Reach A.

All water users on the stream will be proportionally curtailed sooner in the summer than now. A 30% reduction in typical monthly flows during May to June would result in the City having 14.7 cfs of total water rights available rather than 21 cfs. The instream water right availability would be reduced from 8 to 5.6 cfs. Under the No Action Alternative, a reduction in flow available to the City results in more water bypassing the storage facility and returned to the creek in the lower portion of Reach A. Under the Proposed Action, any reduced flow would not be diverted in the first place, and would remain in the creek to pass through Reach A.

Because of reduced flows and higher air temperatures, water temperatures during low summer flows may tend to be warmer, causing stress to native fish and other aquatic organisms that require colder water. Species may move higher into the watershed, seeking colder, deeper waters, or they may migrate downstream closer to, or into the Deschutes River, where higher flows could mitigate the local warming effects.

3.10.3.5 Direct, Indirect, and Cumulative Effects of Climate Change on Fire Risk – No Action Alternative and Proposed Action

In Tumalo Creek, under either the No Action Alternative or the Proposed Action, fire risk is largely, as is true for all of eastern and Central Oregon, a matter of “when”, not “if”. The longer the area remains unburned, the closer it is to the next fire. There is little that can be done, except to modify forest conditions and fuel loadings so that fire effects may be reduced, or pre-suppression planning that may increase the chances of altering the size or direction of fire spread.

Under scenarios that predict warmer air temperatures and less precipitation, wildfires that start in in the Tumalo watershed, and wildfires that start outside, but are likely to burn into the watershed are all more likely to burn hotter, be more difficult to control, get larger, and have greater effects on vegetation, at least for the first fire return episode. After that, fuel loadings and fire intensities will be lower until stands recover their pre-fire condition, typically 80 to 100 years. Some vegetation types may not return to their pre-fire condition or composition as warmer and drier climate change may foster different seral regimes and plant communities.

There are no climate change predictions that would indicate an increase in fire starts for a given area, but again, more starts will become established fires and more starts will escape initial control efforts. Above average fire seasons, based on acres burned, will become more frequent.

Where the issue is water supply and water quality, fire has the likely outcome of temporarily increasing the former, and decreasing the latter. A fire that affects Tumalo Creek under any climate scenario has the potential to remove vegetation cover and alter soils such that run-off and erosion are increased until vegetation cover is restored. Under the climate change scenarios described above, post-fire flow increases would be most likely to occur earlier in the year that they do now. The City might be able to take advantage of them if winter demand warranted, but they would not likely aid any low flow conditions that would occur in summer and fall. Water quality could be temporarily impacted by soil movement into the creek causing increased turbidity. Temporary turbidity-related shutdowns could become more frequent. A membrane treatment plant can be effective to the limits of its capacity, but would require more maintenance and cleaning.

The only difference between the No Action Alternative and the Proposed Action in response to a fire under any climate change scenario would be that any temporary shut-down of water to the City’s storage and treatment facility would result in water not being diverted at Bridge Creek as it is now, so that it would continue to flow through Reach A.

The West Bend Vegetation management project, the Bear Wallow Mastication Project (draft Decision Memo, July 2013) and the Bend Municipal Watershed Fuelbreak Project (scoping, February 2013) all are designed to modify fuel loads and arrangements in strategic areas in order to modify fire behavior and provide effective areas “to provide safe ingress and egress for public and fire crews, and provide a location for fire crews to make a stand on an advancing fire.” All three projects provide the potential to reduce the likelihood and /or the intensity of a fire moving into the project area and Municipal Watershed from the wilderness or the Inventoried Roadless Area where suppression is much more difficult.

3.11 Other Effects

3.11.1 Municipal Watersheds

There is no de-facto or designated municipal watersheds in the project area. The intake structure is approximately ¼ mile outside the boundary of the Bend Municipal Watershed, but no project activities are proposed within the boundary, or that would affect the watershed.

3.11.2 Prime Farmland, Rangeland, and Forestland

There are no lands within the project area that are classified as prime farm or rangelands. Prime forestland is not applicable to lands within the National Forest System.

3.11.3 Civil Rights and Environmental Justice

Civil Rights legislation and Executive Order 12898 direct an analysis of the proposed alternatives as they relate to specific subsets of the American population. The subsets of the general population include ethnic minorities, people with disabilities, and low-income groups.

There would be no effect to civil rights, including those of minorities and women. Activities associated with the action alternatives would possibly be governed by Forest Service permits, which are awarded to qualified permittees regardless of race, color, sex, religion, or other such factor. Forest Service permits contain nondiscrimination requirements. The identified activities would not affect employment, would not provide consumer goods, and would not affect the civil rights, privileges, or status quo of consumers, minority groups, and women.

With implementation of either alternative, there would be no disproportionately high and adverse human health or environmental effects on minority or low-income populations. Nearby Skyliners community would mainly be affected more than others by short term disturbance caused by construction activities.

The effects of the proposal on the social context of the protected groups are within those described in the Deschutes National Forest LRMP and FEIS. The benefits and risks associated with implementation of the alternatives are provided to all members of the public. The action alternatives provide opportunities for all groups, regardless of racial and economic composition.

Public involvement activities described in Section 1.8 summarize the efforts made by the City to provide the opportunity for public comments. Implementation of the Proposed Action is not anticipated to cause disproportionate adverse human health or environmental effects to minority or low-income populations.

3.11.4 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time, such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line right of way or road. Where it is constructed outside the road prism, the pipeline is an irretrievable commitment of National Forest System lands because it will be maintained only for the purposes of a utility corridor for the life of the Special Use Permit.

The Proposed Action would not be expected to create any impacts that would cause irreversible damage to soil productivity.

Soils dedicated to management facilities are considered an irretrievable loss of soil productivity until their functions have been served and disturbed sites are returned back to a productive capacity. Under the action alternative, the cumulative amount of detrimentally disturbed soil from the management facilities would remain within allowable Forest Plan standards and guidelines.

3.11.5 Wilderness

The project area does not contain any congressionally designated Wilderness Areas, potential wilderness areas, or Inventoried Roadless Areas. The nearest Wilderness Area is the Three Sisters Wilderness, approximately 14 miles to the west-northwest. There would be no impacts from any alternative to wilderness character.

3.11.6 Inventoried Roadless Areas

Inventoried Roadless Areas (IRAs) are areas identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, Volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps (36 CFR 294.11).

3.11.6.1 Existing Condition

The proposed activities are less than one mile from the Bend Watershed Inventoried Roadless Area.

3.11.6.2 Environmental Consequences

There would be no direct impacts to the Bend Watershed Inventoried Roadless Area because no activities are proposed within the IRA. No tree cutting or road building would occur. No impacts to wildlife habitat would occur because no actions are proposed within the IRA. During construction of the pipeline, noise, dust and exhaust fumes may indirectly impact the inventoried roadless area and people recreating in the inventoried roadless area. This would last for the duration of construction activities for approximately 1 year. No other indirect impacts would occur from the construction of the project.

While there may be indirect effects to the Inventoried roadless area from dust, construction sounds and exhaust fumes from the construction of the pipeline at the west end of the project, there is unlikely to be cumulative impacts from other on-going or reasonably foreseeable future projects. This is because the implementation of the pipeline construction is not scheduled to occur during other construction or operations of other activities. The reconstruction of Skyliners road is meant to occur directly after construction and installation of the pipeline. Therefore while dust, noise and fumes would continue with the road reconstruction, it would not overlap in space and time with the pipeline construction. Implementation of a future project, the West Bend Vegetation Management project, is not likely to overlap in space and time with the construction of the pipeline either. While this project may also contribute to dust, noise and exhaust fumes, the decision on the West Bend Project is due to be made in 2013 and implementation may occur in 2014 but it is not certain at this time.

3.11.7 Potential Wilderness Areas

Potential wilderness areas are identified using inventory procedures found in Forest Service Handbook (FSH) 1909.12, Chapter 71. Potential wilderness areas (PWAs) are not a land designation decision, they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (Chapter 72), and lastly they are not preliminary administrative recommendations for wilderness designation (Chapter 73).

3.11.7.1 Methodology

The project area was assessed to determine if the area would meet the criteria for inclusion in a potential wilderness inventory. For an area to be included in an inventory as a potential wilderness area, the area must meet either criteria 1 and 3 or criteria 2 and 3 below:

1. Areas contain 5,000 acres or more.
2. Areas contain less than 5,000 acres, but can meet one or more of the following criteria:
   - Areas can be preserved due to physical terrain and natural conditions.
   - Areas are self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System.
   - Areas are contiguous to existing wilderness, primitive areas; Administration endorsed wilderness, or potential wilderness in other Federal ownership, regardless of their size.
3. Areas do not contain forest roads or other permanently authorized roads, except as permitted in areas east of the 100th meridian.

3.11.7.2 Existing Condition

The project area is already roaded and is not more than 5,000 acres. The upper portion of the project area where the intake is would also not be included in a potential wilderness area inventory because of the existing facilities for the dam, pipeline and intake structure. Therefore none of the project area where improvements are being proposed would meet the criteria for inclusion in a potential wilderness inventory. The area surrounding these improvements, especially at the intake structure on Bridge Creek, could be included in a potential wilderness inventory because of the Inventoriedy Roadless Area and the unroaded condition of the Bend Watershed.

3.18.7.3 Environmental Consequences

Proposed Action

All proposed actions would occur within already impacted areas that are either roaded or already have had a corridor cleared in the forest for the existing pipeline. The proposal would not build any new roads, and construction of the pipeline would mostly occur within and under an existing road, therefore the action would not affect any potential wilderness area adjacent to the project area. Where the proposal widens the pipeline corridor outside the road corridor, the action would also not affect a potential wilderness area because actions are within a previously impacted area, or directly adjacent to roads where hazard trees haven removed in the past.

Therefore the pipeline proposal would not impact a potential wilderness area because proposed actions are limited to areas currently impacted with roads and / or tree cutting.

CHAPTER 4.0 COORDINATION AND CONSULTATION

The Forest Service consulted the following individuals, federal, state, and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment:

4.0.1 Team Members

Steve Bigby, Road Manager, Transportation Planner
Rod Bonacker, Team Leader
Shelley Borchert, Wildlife Biologist
Penni Borghi, Heritage Program Manager
Peggy Fisher, Forest Engineer
Jason Gritzner, Forest Hydrologist
Robin Gyorgyfalvy, Landscape Architect
Marv Lang, Recreation Planner
Beth Peer, Environmental Coordinator
Charmane Powers, Botanist
Todd Reinwald, Soil Scientist
Tom Walker, Fish Biologist
Sherri Johnson, PNW Laboratory, Fisheries Research

4.0.2 Federal, State, and Local Agencies

City of Bend

Heidi Landsdown
Tom Hickmann
Patrick Griffiths
Ryan Oster
Mary Winter

Deschutes County, Road Department

George Kolb

Oregon Department of Environmental Quality

Bonnie Lamb
Dan Turner

Oregon Department of Water Resources

Kyle Gorman

Oregon Department of Fish and Wildlife

Brett Hodgsen
Ted Wise

Federal Highway Administration

Mike Odem
Jennifer Corwin
Michael Schurke

4.0.3 Others

HDR Engineering, Inc.

Bryan Black
Susan Haupt Jeff
Fuchs Jarvis
Caldwell
Michael Kasch
Marc Auten
Sandy Siemens

Owen Schmidt, Owen Schmidt LLC
Brian O'Neill, University of Oregon

4.0.4 Public Involvement

The proposal was provided to the public and other agencies for comment during the NEPA Scoping period held between December 18, 2012 and January 22, 2013. Over 400 individuals, organizations, and agencies were contacted.

In response to the scoping notification, 13 written comments were received. Comments were used to define necessary detail in the analysis and develop Project Design Criteria. Those who contacted us included:

Paul Dewey, Central Oregon Landwatch
Kimberley Priestley, Oregon WaterWatch
Ted Wise, Oregon Dept of Fish and Wildlife
Doug Heiken, Oregon Wild
Mike Ogle
Mike Lovely
Dr. Michael Tripp
Mike Walker
Kelly Esterbrookk and Jim Terhaar
Su Skjersaa Lukinbeal
Doug Werme
Toby Bayard
Dr. Tad Hodgert

The following is a list of agencies and organizations that were sent notification of the Proposed Action:

Tribes

Confederated Tribes of the Warm Springs
Burns Paiute Tribe
The Klamath Tribes

Federal, State, and Local Agencies

Senator Ron Wyden
Senator Jeff Merkley
Congressman Greg Walden

US Fish & Wildlife Service, Nancy Gilbert
Bureau of Land Management, Stephen Robertson
Oregon Department of Fish and Wildlife, Ted Wise
Oregon Department of Forestry, Stuart Otto
Oregon Department of Transportation, Bob Bryant
Oregon Parks and Recreation Department, Jan Houck
Deschutes County Department of Public Works, Tom Blust
Deschutes County Community Development, Nick Lelack
City of Bend, Roger Prowell
Visit Bend, Doug La Placa

Interest Groups

Oregon Wild, Tim Lillebo, Eastern Oregon Field Representative
Sierra Club, Marilyn Miller
Upper Deschutes Watershed Council, Ryan Houston
Upper Deschutes River Natural Resources Coalition, Don Mercer
Deschutes River Conservancy, Scott McCaulou
Northwest Environmental Defense Center
Deschutes Basin Land Trust, Brad Chalfant
Blue Mountains Biodiversity Project, Karen Coulter
Cascadia Wildlands Project, Josh Laughlin American
Forest Resource Council, Chuck Burley

News Organizations

The Bend Bulletin
KTVZ

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CHAPTER 6.0 APPENDICES

Appendix A – Revegetation Plan, October 4, 2012

Appendix B – Wetland Report, February 13, 2013

Appendix C – Response to Public Comments, Revised October 20, 2013.