National Park Service
U.S. Department of the Interior

Crater Lake National Park

Augment Annie Springs Water Supply

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National Park Service
Crater Lake National Park, Oregon

Purpose and Need for Action

Crater Lake National Park (CRLA) is seeking an additional source of potable water to ensure an adequate long term supply for the park's developed areas. The CRLA public water system serves three separate service areas located on the south side of Crater Lake – Mazama Village, Park Headquarters at Munson Valley, and the Rim Village. The water system is served by a single point of diversion from a sole surface water source at Annie Springs, which feeds Annie Creek. Annie Creek is a headwater tributary of the Wood River, which flows into Upper Klamath Lake via Agency Lake and is a major tributary of the Klamath River.

The National Park Service (NPS) proposes to utilize an existing exploratory well as a new ground water source for potable water that can either supplement the Annie Springs surface water source or provide a sole source of supply to the park water system should Annie Springs not be available. This action is needed to ensure a safe, reliable water supply for domestic and commercial uses at these facilities. The purpose of this action is to supplement the Annie Springs source in CRLA to ensure sufficient water for human consumption, sanitation, life safety, and fire protection, including historic structure protection.

Any water source developed must minimize new effects on the natural and cultural resources of the park and be safely accessible throughout the year.

Background

The primary source of Annie Creek water is snowmelt. During the recent drought, the snowpack has been measured at less than 50% of average. Precipitation was measured at less than 65% of average over three years of drought beginning in 2011 and continuing through 2014.

Since 2008, the NPS has been actively pursuing water conservation measures and alternatives to ensure that there is adequate water to protect park resources, protect human life and safety, and limit adverse effects to park visitors, employees, partners, and local businesses from a reduced water supply. Water meters were installed in 2011 on the four tanks that store treated water for all park uses in the three developed areas. Installation of water-conserving plumbing fixtures and water meters was completed in public use facilities throughout the park and in 42 park housing units in 2014. Concession dining facilities encourage water conservation, such as placing table placards with information about the drought and serving water to guests only on request.

To prevent a possible shut-down of the existing park water system or a park closure as concerns arose over an extended drought and a possible reduction in the water supply, the NPS began to search for alternate sources of potable water in 2013. To minimize adverse effects on park resources, a potential source had to provide adequate quantity and quality of water; be within reasonable distance of park headquarters and Mazama Village where most of the water distribution infrastructure is located; outside the potential wilderness boundary established in 1974; and reasonably accessible for maintenance especially under winter conditions. Using these criteria, four sites were evaluated. After considering geologic characteristics of areas most likely to provide groundwater while meeting the other criteria, the NPS drilled an exploratory well

in the park in October 2013 at the Pacific Crest National Scenic Trail (PCT) trailhead on the south side of Highway 62.

The well was drilled on the plateau about 0.6 mile west of Annie Springs into basalt (bedrock) and cinders along Hwy 62 at PCT trailhead in October 2013 (Figure 1). The presence of several perennial streams on the plateau suggests that the sources of these streams are flows along fractured bedrock. The well was drilled to a depth of 505 feet. The primary water bearing zones were in cinders between 400 and 423 feet and 495 and 504 feet, with a static water level of 322 feet below ground surface. A 24-hour pumping test produced water at an average rate of 82 gallons per minute (gpm) with a drawdown of 17.35 feet. Water quality from the well is excellent. The water meets EPA primary drinking water standards and is suitable for use within a public drinking water system without further treatment.

Figure 1. PCT Test Well - October 2015

ALTERNATIVES

This environmental assessment analyzes two alternatives, a no action alternative and an action alternative. Under the action alternative, the exploratory well would be converted to a production well by adding a pump and the necessary infrastructure that would connect the well to the existing water distribution system at the Mazama Tanks (Figure 2). Several other alternatives for providing potable water that were considered but not carried through for full analysis are also discussed.

Alternative 1: No Action: Annie Springs Water Supply and Distribution System

A no action alternative is defined as either “no project” or a continuation of existing conditions and management. The existing condition and management of the CRLA water supply includes the Annie Springs surface water source and existing storage and distribution system.

Under the no action alternative (Alternative 1), the primary source of potable water to serve CRLA would continue to be surface water from Annie Springs. No new infrastructure (access roads; power; water treatment, storage, and distribution facilities) would be constructed. Existing storage would remain at 535,000 gallons. The seasonal 7 day running average flow pumped from Annie Spring is expected to remain at 55,400 gallons per day (gpd). The NPS would continue to encourage water conservation by park visitors, staff, and concession employees. In addition to water meters that were installed in 2011 in the Mazama area, the Rim Dorm, Café and Gift Shop, and Lodge, the NPS would continue to seek funding to install additional meters to determine use in other facilities and visitor use areas more accurately.

Alternative 2: Production Well with pipeline along original highway alignment (proposed action)

Under Alternative 2, the PCT exploratory well would become the sole source of potable water when the Annie Springs source cannot be used because of extreme low flows or a water rights

call. New infrastructure would be constructed to connect the well to the existing distribution system (Figure 2).

Figure 2. Proposed Action: Alignment of Water, Power, and Communication Line from PCT Well to Existing Munson Valley Water Distribution Line

The PCT production well would fill the Mazama Tanks (200,000 gallons total storage) rather than operating the Mazama booster station pump to bring Annie Springs water to the Mazama tanks. The Mazama Tanks would supply both the Annie Springs Booster Station and the Mazama Service Area. To minimize new disturbance and maximize use of existing infrastructure that provides water to headquarters/Munson Valley area and the Rim, the piping system would be modified so that the valve sequences (direction of water flow) can be operated from either the Annie Springs equipment or from the well. Storage capacity would remain at 585,000 gallons.

To implement this proposal, the following infrastructure would be required.

New infrastructure that requires ground disturbance includes:

- A well house at PCT well, approximately 10 feet x 12.5 feet (125 square feet [sf]).
- A 3,175-foot-long trench for a new waterline from the well along the existing and obliterated highway alignments to connect to the existing Mazama Tank fill line.
- A 3,770-foot-long common utility trench for conduit containing power and fiber-optic communication lines adjacent to the waterline trench. A fiber optic communication line in conduit will control well pump based on tank level inputs to Mazama Booster Station and

read system parameters (pressure, flow) remotely from Mazama or Annie Springs booster stations.

- 13 pull boxes to connect lengths of power supply lines, each approximately 3ft wide x 4ft long x 3ft deep (12 sf each).
- A 6ft x 6ft concrete transformer pad and vault.
- A 4ft x 6ft concrete pad for portable generator.
- 17 pull boxes to connect lengths of fiber optic communication lines, each approximately 3ft wide x 4ft long x 3ft deep (12 sf each).
- A new valve vault, approximately 5ft wide x 8ft long x 6ft deep (45 sf).
- The expansion of the PCT trailhead parking by approximately 3,300 sf to accommodate the area lost to well house and to improve vehicle circulation and provide additional amenities.
- Replacement of existing 6-inch gate valve (1.5 sf) on the supply line to from Annie Spring to the booster stations under Annie Creek bridge, with (2) new 6-inch gate valves and (1) swing check valve (4 sf) prevent pushing water backward into the spring during well supply operations. The existing valves and piping are partially imbedded (50%) within the stream bed behind the wier impoundment. Replacement valves will likewise be submerged to protect from freezing, but visible to allow for operations, service and inspections.

New infrastructure that would be installed without additional ground disturbance includes:

- One 10 horsepower 4-inch submersible pump capable of pumping 50 gpm installed in the PCT well.
- Piping modifications inside the existing concrete vault (vault #2) near the Annie Creek Bridge to connect the suction side of Annie Springs Booster Station to the 6-inch water distribution line from Mazama Water Tanks to bypass the Annie Spring source supply line to the booster station.
- Piping, communications and controls modifications inside Mazama booster station to shut off Annie Spring source when the well and Mazama tanks are used as the supply water source.
- Transformer and power supply modifications to the existing on the northwest road side near Annie Creek Bridge to extend underground primary power supply to the new well site.

The water distribution system requires two parallel trenches to connect the well to the existing water distribution system. The water line is laid in one trench and a second common utility trench for power and communication lines used to manage the water flow. A minimum 3-foot separation is required between the two trenches. The width of the disturbance for excavation is estimated to be about 12 feet to accommodate the heavy equipment (excavator) needed. The trenches would be excavated in previously disturbed areas adjacent to the existing and former highway alignment. Under the proposed action, the trenches would run north from the well underneath the highway, turn east along the existing highway, turn north following the curve of

the obliterated old highway, and turn east above the site of the old Mazama campground to connect to the existing 4-inch cast iron Mazama Tank Fill Line (Figure 2).

The trench underneath the highway would require removal and replacement of asphalt at the highway crossing. Soils disturbed by construction would be treated to reduce erosion and to inhibit dispersion and establishment of invasive plants.

Power supply to new facilities under the proposed action requires a Pacific Power and Light (PPL) Right-of-Way. Annual power consumption for use of the new well is estimated to be 32,225 kW-h.

Additional parking and space for turning a stock trailer would be added at the PCT trailhead to replace the area that would be used for a well house. Additionally, boulders would be placed around the well house to protect well infrastructure that will further reduce the available parking. The new parking area is estimated to require about 3,300 square feet (sf), which would be added on the south and west side of the existing parking area (Figure 3). The expanded area would require minor grading and the removal of approximately 17 trees all under 18 inches in diameter, with the average diameter being 11 inches. Currently the parking area has a gravel surface, though the lot will eventually be paved with asphalt to provide the ability to stripe parking spots and reduce the long term maintenance costs. In the long-term, trailhead amenities will also be added to include picnic tables, hitching posts, signage and a vault toilet. These additional amenities will be added as funding becomes available.

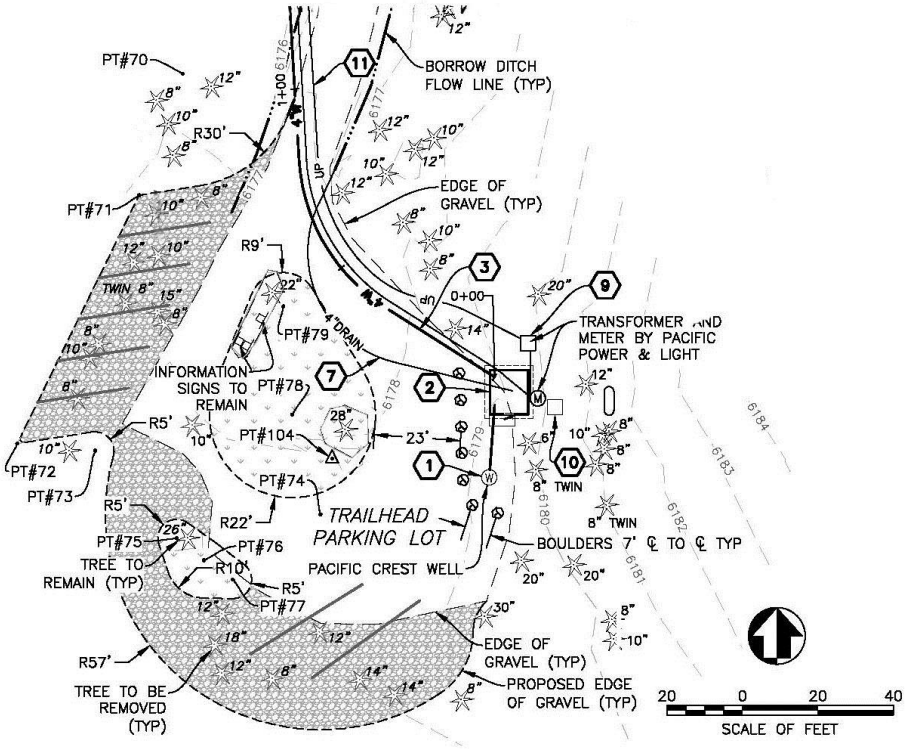


Figure 3. Proposed changes to Pacific Crest Trailhead parking area to accommodate area needed for well infrastructure and to improve vehicle circulation. The shaded gray areas represent the expanded parking area.

Common to Alternatives

Both the no action alternative and the proposed action would continue water conservation actions that include:

- installing low flow shower heads (1.5 gpm) and bathroom sink aerators (0.05 gpm) in in facilities as funding permits;
- installing water meters in presently unmetered facilities and recording actual water consumption;
- concession facility conservation measures, which include information to guests about conservation; and
- providing information to park visitors about water conservation.

Other Alternatives Considered

The NPS considered several alternatives for providing water for park uses.

- **Production well with pipeline along existing highway alignment.** The PCT exploratory well would be converted to a production well. The water line and power/communication lines would follow the existing highway alignment with the trench excavated on either the south and west or north and east shoulders of the highway, and along the western side of Munson Valley Road (Figure 4). The lines would tie into the Annie Springs distribution system at Annie Creek Booster Station. The trench would be approximately 7,250 feet in length (lf) and require more ground disturbance than in the proposed alternative. Due to the topography found along the eastern portion of the road alignment, this alternative would require more extensive engineering in the road corridor to protect the highway. This alternative would have adverse effects on Annie Creek and riparian wetlands from excavation to connect the water and utility lines to the existing Annie Springs distribution system.

Figure 4. Alternative alignments considered of water, power and communication lines from the PCT Well to Existing Munson Valley Water Distribution Line utilizing existing highway corridor.

- **Castle Creek well**. A location for a well was considered in the Castle Creek drainage along Highway 62 about 6,500 feet (1.23 mi) west of the Pacific Crest Trail at about 6,050 feet elevation. Castle Creek is in the Rogue Basin. This alternative would require a minimum of 1.5 acres (ac) of additional ground and vegetation disturbance for water supply and distribution infrastructure to connect to the existing infrastructure. Power use would increase because of the increased distance to move the water. The potential site is on a curve on the highway. Trenching for the distribution and power/communication lines to connect to existing infrastructure would require new ground disturbance in an undisturbed area that is managed as wilderness. Construction in this location would diminish the attributes that support the inclusion of this area in the wilderness proposal for the park.

- **Increase Storage.** Under this alternative, a retention pond or reservoir would be constructed above the Annie Springs source to impound snowmelt runoff. In the case of a water call, water would be released into Annie Creek at the same rate that water is consumed. To match the volume released into the creek with the volume consumed, the reservoir would require a minimum capacity of 28 acre-feet (af) to account for average annual consumption. For peak consumption over a 90-day peak visitation season, the reservoir would require a capacity of 41 af. To ensure that sufficient water is available for structural fire protection, especially for historic structures, additional storage capacity would be needed.

  The NPS estimates that a capacity of 60 af (about 19.6 million gallons) would be sufficient to provide for maximum demand over the 90-day high visitation season plus sufficient water for NPS use and structural fire protection. A one-foot-deep pond would cover 60 acres. A pond ten feet in depth would cover six acres (about the same size as six football fields). Additional storage would be needed to account for water loss to infiltration and evaporation, which would increase the size of the storage facility. In addition to ground disturbance required to excavate a six-acre-minimum pond, new ground disturbance would be required for road access and trenching to move the stored water and release it into Annie Creek. Delivering water into the stream would require piping that would affect riverine and riparian wetlands. Visual quality and scenic resources would be adversely affected if the infrastructure was visible from the Annie Creek overlooks along Highway 62 or from park trails. Demand on park maintenance staff and budget would increase from maintenance of a new access road, including snow plowing. This alternative would have adverse effects on soils, wetlands, vegetation, visual quality, visitor experience, and park operations. All suitable locations for development of the pond and access road are in areas managed as wilderness. This alternative would diminish the attributes that support the inclusion of this area in the wilderness proposal for the park.

- **Haul potable water.** Under this alternative, water trucks would haul potable water from the PCT well to supply visitor facilities. A very large water truck can haul 8,000 gallons per load. The current 7 day running average demand of about 55,400 gpd would require 7 truckloads daily during the high demand season. Impacts from water trucks include increased traffic from slow moving vehicles with resulting adverse effects on air quality and visitor experience

during the high visitor use season. Parking at the PCT trailhead near Annie Springs would be affected daily during the high trail use season.

The water would be delivered to a new 20,000-gallon storage tank that would feed into the Annie Springs Booster Pumping Station. The booster station is located beneath the Annie Creek bridge, which has no existing area for a truck turn around. The PCT trailhead would need to be enlarged to improve truck turn around space. A new truck turnaround would be needed at the booster station which is located adjacent to the PCT spur trail used for access to the campground and store by some PCT hikers. If the water is obtained from a source outside the park in the Klamath Basin, a possible water call could make this source unavailable. If water supply is very limited and the storage tanks are drawn down too low, the capacity for structural fire protection would decrease, which would create the potential for a significant adverse impact on historic structures.

The potential cost of this alterative and likely limited availability of water within the local area during a drought that results in a water call also reduce the feasibility of this alternative. The high cost would also prevent long-term implementation of this strategy, as a permanent fund source is unavailable to support this type of operation.

- **Facility closures or visitor use limits**. Under this alternative, temporary closures of some facilities would be implemented during peak visitation season (July and August) to reduce overall water use in the park. The NPS would consider limiting visitor use to some facilities to reduce water consumption. This alternative would have significant adverse economic and social impacts to local communities that would extend throughout the region and the State of Oregon.

Affected Environment

Setting: Crater Lake National Park is located in the High Cascade mountains in Klamath County in southcentral Oregon. The primary year-round road access is Highway 62 from the west and south. The North Entrance near Highway 138 is closed in winter. Highway 138 runs between Roseburg, on Interstate 5 to the northwest, and Highway 97 to the east. The nearest population centers are Grants Pass, Medford, and Ashland located on Interstate 5 to the southwest, and Klamath Falls to the southeast on Highway 97. The nearest commercial airport with regularly scheduled flights is in Medford. Portland International 250 miles to the north is the largest airport in the region.

Climate and Air Quality: The dominant climatic feature at Crater Lake is winter snow that persists at higher elevations throughout much of the year. The average annual snowfall is about 500 inches. Maximum snow depth at Rim Village has been measured at 18 feet. Average annual precipitation (rain and snow) is 69 inches. Snow can fall at any month of the year. Snow at the Rim generally persists through July. During the drought that began in 2011, the snowpack has been measured at 65% of average. In the winter of 2013-14, snowfall was measured at 50% of average.

Prevailing winds are westerly. Winter storms from the Pacific Ocean that provide the bulk of precipitation come from the west.

In January, the average daily high temperature is 34 F° and the average daily low is 18 F°. In July and August, the average daily high temperature is 69 F° and the average daily low is 41 F°.

Global climate change is expected to alter park climate by increasing the amount of precipitation that falls as rain and decreasing the amount of snow. This change could affect the seasonal distribution of groundwater recharge from precipitation and snow melt. Groundwater systems tend to respond much more slowly to short-term variability in climate conditions than do surface-water systems (USGS 1999). Discharge at Annie Spring is likely to be more sensitive to these changes than the PCT well. The PCT well will remain a viable source of water as long as groundwater levels remain above the elevation of the pump.

Crater Lake National Park is designated as a class I airshed pursuant to Part C of the Clean Air Act, as amended (42 USC 7401 *et seq*.). Class I designations are given to areas where air quality is cleaner than the national ambient air quality standards. Class I areas have the most stringent regulations for the protection of air quality, permitting the lowest increments of air quality degradation.

Air quality in the park is very good to excellent. Primary sources of pollution in the park are smoke from wildfires, prescribed fires, campfires, and vehicle emissions. Pollution varies seasonally. The primary air quality related values for the park are the views of the lake and surrounding area from the rim, and other visibility-related values. The high elevation location of the Rim generally ensures good visibility. Klamath Falls south of the park is a non-attainment area for $PM_{2.5}$. (particulate matter less than 2.5 microns) due primarily to inversions that trap woodsmoke in the low-lying valley. Non-attainment means that a geographic area has not consistently met the clear air levels set by the US Environmental Protection Agency (EPA) in the National Air Quality Standards. The part of Klamath County in which the park is located is excluded from the non-attainment area designated by the EPA. The air quality in Klamath Falls is improving under an attainment plan adopted in 2012 by the Oregon Department of Environmental Quality. All other regulated air pollutants in the area surrounding the park are within Federal standards.

Geology, Topography, and Soils: Crater Lake National Park is the remains of Mount Mazama, one of the volcanic peaks of the Cascade Range, which extends from Mount Lassen in northern California to southern British Columbia. Mount Mazama erupted violently about 7,700 years ago. New vents encircling the peak brought hot flows of pumice, ash, and gas down the steep flanks. The peak subsided under its own weight, leaving a deep caldera. Centuries of melted snow and rain filled the caldera to create the deepest lake in the U.S. The maximum depth is measured at 1,943 feet, with an average depth of 1,500 feet.

The topography of the park is dominated by volcanic peaks and cones that rise steeply above the surrounding plateau. The highest elevation in the park is 8,829-foot Mt. Scott east of the rim. The highest elevation on the rim is Garfield Peak (8,054 ft) reached by a trail from the Rim Village and Lodge. The volcanic soils of Mt. Mazama are easily eroded, forming pinnacles, spires, bluffs, and buttes.

Soils include pumice, ash, and cinders. Basalt outcrops are harder material that does not weather as easily as other volcanic material ejected in the eruption.

Water Resources

Water quality at Crater Lake is excellent. The lake is considered to be the cleanest large body of water in the world, renowned for its spectacular blue color and clarity. Seeps and springs that emerge from the slopes of Mount Mazama have excellent water quality. The water from Annie Springs meets EPA drinking water standards without needing additional treatment. However, NPS treats water collected from Annie Springs to ensure that safe drinking water is delivered to the public water distribution system. The water from the PCT test well also meets EPA primary drinking water standards and is suitable for use in a public drinking water system without further treatment.

The potable water supply is treated through chlorinators at the three booster stations at Annie Springs, Mazama, and Munson Valley/HQ in compliance with NPS policy to treat water to meet US Public Health Service standards.

Snowmelt and rainfall are the primary sources of water for Crater Lake itself and the springs and streams that emerge from Mt. Mazama. Annie Springs at 6000 feet elevation produces year-round flow. Water quantity is measured at the USGS gage located 0.1 mile downstream from the spring (USGS HUC 18010203, 5,982.65 NVGD29). For the 30-year period of record (water years 1978-2004, 2011-2013), the average discharge is 2.83 cubic feet per second (cfs) for an annual discharge of 2,050 acre-feet/year, adjusted for diversion from the spring. (See Appendix 1 for conversion factors between water quantities and volumes.) Maximum discharge of 18 cfs was recorded on July 6, 1984. A minimum discharge of 0.23 cfs was measured on several days in March and April 2002. In 2013, after several years of low precipitation, the maximum discharge was measured at 6.0 cfs in May, with a minimum discharge of 0.72 cfs on March 30. The highest flows generally occur from mid-June through early July from snowmelt. Minimum flows occur from mid-October through April as snowmelt declines. Several small tributaries contribute to the flow of Annie Creek below the spring.

The Crater Lake public water system is served by a single point of diversion prior to a sole surface water source at Annie Springs supplying Annie Creek. The Annie Springs source supplies the NPS water for drinking, sanitation, structural fire protection for both historic and non-historic structures, and life safety protection.

The 2011-2013 average annual daily water demand was 21,000 gpd based on meters located at Mazama area, Rim Dorm, Rim Café and Gift Shop, and Lodge. In the period from July –Sept

2011-2013, seasonal average daily water demand in peak season was 51,000 gpd. Maximum daily use during summer high visitation season is estimated to be 72,000 gpd (about 50 gpm).

The 2013 seasonal average pumped from Annie Springs source of supply was 53,800 gpd. Volume in gpd pumped from the source was 20% greater than flow measured at the point-of-use meters. At times, the stored water in the tanks exceeds the demand, and little or no water is pumped from the source. The peak day volume pumped from the Annie Springs source was 148,200 gpd (0.229 cfs) on July 20, 2013. This peak day volume represents a consolidation of pumping to replenish the three storage tank sites after 2-3 days of little or no pumping.

Annie Creek is a headwater tributary of the Wood River, which flows into Upper Klamath Lake via Agency Lake and is a major tributary of the Klamath River. There is high demand for water in the Klamath River Basin for residential, agricultural, commercial, and industrial uses. Water is also used to sustain fish and wildlife and for recreation. Oregon follows the "prior appropriation" doctrine of surface water use to determine water rights. When there is not enough water to satisfy all the water rights, water users with senior priority dates will receive water, while water users with relatively junior rights will not.

Water rights for the use of surface water for the Klamath River Basin were adjudicated in March 7, 2013 through a Final Order of Determination issued by the Oregon Department of Water Resources. Adjudication is the process of determining the priority date of claims to the use of water. The stakeholders in the adjudication include the Klamath Tribes, private landowners, and the federal government, among others. The adjudication and settlement among the water users has resulted in concerns over the ability of the park to use the Annie Springs surface water source due to long term reliability and sustainability of Klamath Basin water supplies.

Like most of the region, the Klamath basin is experiencing a drought that began in 2011 and became severe in 2013. A continuing drought could require that water uses from surface sources be curtailed for those holding junior rights. Curtailing existing water uses is termed a "call" on the water rights holder.

The NPS holds federal reserved water rights for Annie Creek and its tributaries within the boundary of Crater Lake National Park dating from 1902 and 1932 for "preservation and protection of all natural and historic objects, timber and wildlife, and conservation of scenery."

Of the original 730 claims to water from the Klamath Basin, the NPS holds what is considered a senior, but not the most senior, right. The Klamath Tribes hold the most senior claims dating from "time immemorial" for certain reaches of the major tributaries to Upper Klamath Lake. The Wood River is one of those tributaries. The Tribes also hold other senior claims for lands within the boundaries of the former Klamath Indian Reservation that carry an 1864 priority date based on the 1864 Klamath Treaty. Most of the Klamath Tribes rights are "non-consumptive" and provide for in-stream retention. Therefore, those rights are not available for lease or transfer for consumptive use.

Vegetation: The dominant vegetation at Annie Springs is lodgepole pine *(Pinus contorta* var. *latifolia)* with some red fir *(Abies magnifca* x *procera)* and mountain hemlock *(Tsuga mertensiana)*, and scattered Western white pine *(Pinus monticola)*. The vegetation on the plateau west of Annie Springs is similar with lodgepole pine more abundant. The flat areas tend to be lodgepole pine-dominated, with a greater mixture of species near the riparian areas. As one proceeds upslope, vegetation transitions to mountain hemlock. Understory species include pinemat manzanita *(Arctostaphylos nevadensis)* and long-stoloned sedge *(Carex inops* ssp*. inops),* with higher diversity of herbaceous species around the spring and the headwaters of Annie Creek.

The vegetation in upper Munson Valley near HQ is a mixed mountain hemlock-red fir forest, lodgepole pine and occasional subalpine fir *(Abies lasiocarpa* var*. lasiocarpa)*. Lush meadows and a network of streams support diverse herbaceous vegetation including arrowleaf groundsel *(Senecio triangularis* var*. triangularis)* and green false hellebore *(Veratrum viride)* and shrubs such as willow *(Salix* spp*.)* and mountain ash *(Sorbus scopulina* var*. scopulina).* Dry meadows are dominated by grasses including needlegrass *(Achnatherum occidentalis)* and squirreltail – *(Elymus elymoides)* and herbaceous species such as lupine *(Lupinus andersonii)*, phlox *(Phlox diffusa)*, and Cascade aster *(Eucephalus ledophyllus).*

Invasive plant introductions are a documented threat to the diversity of native vegetation in the park. The species most likely to be introduced into the project area include cheat grass *(Bromus tectorum)*, smooth brome *(Bromus inermis)* , bulbous bluegrass *(Poa bulbosa)*, bull thistle *(Cirsium vulgare)*, St. John's wort *(Hypericum perforatum)* which is also known as Klamath weed, sheep sorrel *(Rumex acetosella)*, yellow rocket *(Barbarea vulgaris)*, and woolly mullein *(Verbascum thapsus)*.

The forest around the PCT well and the existing and obliterated alignment of Highway 62 is dominated by lodgepole pine. The obliterated alignment exhibits sparse regrowth of lodgepole on the roadcut itself with red fir and mountain hemlock on the former road shoulders.

The NPS actively manages vegetation to reduce fire hazard and to improve forest health. Almost a century of fire suppression has created unnaturally high fuel loads and altered functions in some ecological communities that developed in response to wildfires. Park fire crews are creating and maintaining a shaded fuel break approximately 60 feet on either side of Highway 62 between the PCT trailhead and the curve where the old highway has been obliterated. The fuel break reduces the hazard from wildfire for highway users, including park visitors and staff; increases protection for park facilities, employees, and visitors from wildfires in the project area; and provides access for firefighters and highway users who may need to use the highway for egress in the event of a wildfire. Vegetation being removed within the fuel break is primarily small-diameter lodgepole pine, and lower limbs (ladder fuels).

Fish and Wildlife: The streams in the project area are naturally fishless due to their location above steep falls that are natural fish barriers. Annie Falls is a fish barrier. Eastern brook trout have been introduced in many park streams, including Annie Creek and its tributary Munson

Creek. Brook trout are now present upstream of Annie Falls and in Munson Creek around HQ. Bull trout, a threatened species, is discussed below under Threatened and Endangered Species. The riparian areas along Annie Creek, including the project area, are inhabited by Cascade frogs *(Rana cascadae)*, Pacific treefrogs *(Pseudacris regilla)*, and western toads *(Anaxyrus boreas)*. Long-toed salamanders *(Ambystoma macrodactylum)* are possibly present although no surveys have been done specifically targeting this species. Birds (resident and migratory) and mammals in the project area include species that commonly occur in similar forest types and elevations throughout the park.

Cascade frogs breed in ponds and move out of the ponds to occupy riparian areas. There are no ponds within the project area that are suitable breeding habitat for this species. Cascade frogs inhabit riparian areas along Annie Creek in the project area. This species does not currently have any protected status but is considered sensitive because of population declines in other western national parks, such as Lassen Volcanic in northern California, and because of general concerns about documented declines of amphibian populations worldwide.

Sensitive, Threatened, and Endangered Species: The bull trout *(Salvelinus confluentus)* is a federally-listed threatened species that historically occurred in Annie Creek downstream of the project area. Annie Falls is a natural barrier that prevented fish from being in the creek in the project area. Because of the historical distribution of bull trout, Annie Creek as far upstream as the falls is designated critical habitat for bull trout. Bull trout (formerly called Dolly Varden trout) have not been documented in Annie Creek for many decades and are assumed to have been extirpated.

Other sensitive species that occur in habitats in the park similar to those in the project area and therefore could potentially be affected include northern spotted owls (*Strix occidentalis caurina*, federally listed as threatened), the gray wolf (*Canis lupus*, federally listed as endangered), and the Pacific fisher *(Pekania [=Martes] pennanti*, proposed for listing as federally threatened).

The NPS has monitored northern spotted owls at Crater Lake National Park since the early 1990s. The majority of the suitable habitat within the project area is considered foraging or dispersal habitat. The project area has been surveyed for northern spotted owl following the USFWS spotted owl monitoring protocol since 2010 and no spotted owls have been observed. The closest known location of a spotted owl as of 2014 was in the Bear Bluff Known Owl Site 2.1 miles east of the project area. The last confirmed record was a non-nesting pair that was observed in 1996.

In 2014, a gray wolf family group (2 adults, 3 pups) was documented denning outside the boundary of the park. Telemetry data of the male wolf has demonstrated that he has periodically entered the park. It is currently believed that the primary limiting factor for wolves in this region is availability of deer and elk as a food source. The limited amount of disturbance associated with this project will not have an effect on the deer and elk populations in the park.

The Southern Oregon Cascades Population of Pacific fishers are descendants of fishers that were introduced from British Columbia and Minnesota in 1961, and from 1977 to 1981 (Aubry and Lewis 2003, Drew *et al.* 2003). The Pacific fisher is regarded as a habitat specialist in the western United States (Buskirk and Powell 1994). Fishers on the west coast occur primarily in mid- to lower-elevation conifer and mixed conifer-hardwood forests characterized by dense canopies and abundant large trees and snags with cavities, and down logs (Lofroth *et al*. 2010). Information on the current distribution of this population on the western boundary of Crater Lake National Park is from data collected during a 6-year telemetry effort (Aubry and Raley 2006). More recently, a fisher was documented as part of a study conducted in the summer of 2014. As part of this study, four baited remote cameras were approximately one mile of the project area and left out for three weeks, no fisher were documented. In 2013, an incidental observation of a fisher was reported by Crater Lake National Park's Fire Management Officer that was in the project area.

The park contains suitable habitat for wolverines and Canada lynx (federally listed as threatened) but there are no confirmed observations of these species. The rarity of these species and the on-going disturbance from human occupation of the project area make it unlikely that either species occurs in the project area. The USFWS withdrew a proposal to list the wolverine as threatened in August 2014 (FR Vol. 79, No. 156, August 13, 2014, 47522-47545).

The USFWS has recently received petitions to list one bird and one mammal that could occur in the project area.

In April 2013, the USFWS posted a 90-day finding on a petition to list two populations of Black-backed woodpeckers *(Piciodes arcticus)*, including the Oregon Cascades population. The USFWS is currently gathering information on this species prior to issuing a 12-month finding on the petition**.** Black-backed woodpeckers have been documented throughout Crater Lake National Park including a pair observed in 2013 approximately 0.3 miles from the project area (Stephens 2014, Stephens et. al 2011). The black-backed woodpecker is a cavity-nesting bird that nests in late spring, with nest excavation generally occurring from May to July at Crater Lake National Park. This species is most often associated with burned areas and beetle infested areas, but does use undisturbed forest as well.

In January 2012, the USFWS posted the 90-day finding on a petition to list the Sierra Nevada red fox (Vulpes vulpes necator). At the time of the petition, the distribution of Sierra Nevada red fox was believed to be restricted to two small populations: one in the vicinity of Lassen Peak and the other in the vicinity of Sonora Pass, both in California. More recent surveys have documented this subspecies in several locations in Oregon including Crater Lake National Park where genetic analysis has confirmed the presence of native red fox that we believe are the subspecies Sierra Nevada red fox. In October 2015, the USFWS announced their determination on the listing of the Sierra Nevada red fox as threatened or endangered species. As part of the determination, the population of Sierra Nevada red fox was subdivided into two distinct population segments, one occupying southern California (Sierra Nevada population) and

a second located in northern California and Oregon (Southern Cascaded population). It was the determination of the USFWS that the northern distinct population segmented, which includes the population in Crater Lake National Park, did not warrant protection under the Endangered Species Act at this time. Listing of the southern population was determined to be warranted but precluded by higher priority actions and therefore was listed as a Candidate species (USFWS 2015).

Through various methods, the park has documented Sierra Nevada red fox throughout much of the southcentral and southeastern portions of the Park. A total of 109 incidental observations, 2 remote camera photographs, and 4 genetic records of this species have been documented as of 2015. The closest observations were at the Mazama campground approximately 0.3 miles from the project area. An additional observation was noted at Godfrey Glen, 1.7 miles northeast of the project area. One dead individual was collected is association with a motor vehicle accident on Munson Valley Road approximately 1.3 miles northeast of the project area. Very little is known about this species in the park but it is believed to inhabit meadows, dense mature coniferous forest, and talus slopes, and forage on small rodents and lagomorphs such as pikas and rabbits.

Cultural Resources: Twelve archaeological surveys have been completed within a one-mile radius of Annie Spring since 1985, primarily in anticipation of projects involving ground disturbance. Within this area, a largely unsurveyed polygon of 86.5 acres became the focus of the most recent survey conducted in 2014. This polygon is larger than the project area because the mile around Annie Spring contains the highest concentration of prehistoric sites, historic period sites, and isolated finds so far found in Crater Lake National Park. The survey polygon of 2014 (the area of potential effects [APE] for this project) contains several historic period sites and numerous isolated finds. None of these are eligible for listing in the National Register of Historic Places, but the proposed trenching for the waterline lies in close proximity to the Fort Klamath–Rouge River Wagon Road, a recorded historic period site previously determined eligible for listing in the National Register of Historic Places.

The APE lies adjacent to the Fort Klamath–Rouge River Wagon Road built in 1865 and used by visitors as the main approach route to Crater Lake for the following 40 years. Much of the wagon road remains evident within Crater Lake National Park and was the subject of an intensive recording project completed in 2010. Roughly one-half mile of the wagon road is adjacent to the APE and can be protected from impacts associated with proposed project activities. The only other historic period roads within or proximate to the APE include an half-mile section of Highway 62 constructed in 1926 and abandoned in 1968, and a one-lane route through a former campground. The abandoned road section descends from the present location of Highway 62 toward Annie Spring. Material was pushed down onto the old roadbed in an attempt to hide the scar created by the cutslope. The former campground was initially constructed in 1931, but then drastically reconfigured in 1961. Tables, fireplaces, restrooms and other amenities were removed by 1971, so that this site lacks the integrity needed to make it eligible for the National Register of Historic Places.

Portions of the area located between the Annie Spring entrance station and the bridge over Annie Creek, but east and south of the Munson Valley Road served as the site of Park Headquarters between 1903 and 1924. This locality also contained visitor facilities erected by the first park concessionaire in 1907. Called "Camp Arant," it and the first park headquarters were later subsumed by several road realignments, and the construction of ranger stations and support facilities by the National Park Service, as well as a Civilian Conservation Corps development called "Camp Annie Spring" that operated between 1934 and 1942. The CCC camp in turn gave way to construction of Mazama Campground starting in 1957, a facility that expanded over the next decade and eventually removed the need for Annie Spring Campground, located across the Munson Valley Road in the APE.

Visitor Use and Experience: Visitation to the park began to increase substantially after World War 2. Since 1947, annual visitation to Crater Lake NP has averaged about 450,000 visitors. In 2014, the park reported 585,000 recreational visits. The highest number of recorded visits was 615,000 in 2015. The lowest number of visits was 356,500 in 1975, with less than 400,000 visits recorded in 1993 (381,747) and 2006 (388,972). Visitation has increased dramatically in the past several years due to a combination of factors including but not limited to increased length of season due to low snow pack and promotion by travel partners.

Visitation is strongly correlated with how much snow is on the ground when the summer visitation season begins and the date when the Rim Drive is closed by a major winter snowfall. The Rim Drive is open to vehicles as soon as snow can be plowed, generally by July 1. Most visitation occurs between July and September, when snow has been plowed from the Rim Drive and trails are clear of snow. July and August are the months with the months with the highest visitation.

The Annie Spring entrance station is the primary entrance to the park. Visitors cross the Annie Creek bridge to reach the primary visitor facilities and destinations in the park. The Annie Spring public water collection and initial distribution infrastructure is located underneath the bridge.

Year round, the view of the lake from the rim is the primary visitor attraction. When open in summer, the Lodge is a major destination for regional, national, and international visitors. In winter, skiing around the lake on Rim Drive is a popular activity.

The Pacific Crest National Scenic Trail (PCT) traverses the west side of the park from south to north for 33 miles. The PCT is a major trail that stretches 2,663 miles through the western U.S. from its borders at Mexico and Canada. The PCT through the park (excluding the Rim Trail alternate route) is one of two park trails designated for stock use. The exploratory ground water well is located in the PCT parking lot located on Highway 62 west of Annie Springs.

Park Operations: The existing water source for Crater Lake NP at Annie Springs provides water to service areas located at Mazama Village, Headquarters/Munson Valley, and the Rim Village (Table 1).

An underground infiltration gallery at Annie Springs collects water to fill Mazama Tanks and for a booster (pumping) station that serves the Munson Valley and Rim service areas. The Mazama Tanks store water for operation of the campground, Annie Creek Restaurant, cabins, RV park, and concession employee housing. The Annie Springs Booster Station fills the Munson Valley Water Tank to supply the HQ Service Area. The headquarters service area supplies water for the visitor center, park headquarters, administrative areas, and employee housing. A booster station at Munson Valley pumps water from the Munson Valley tank to fill the Garfield Reservoir to supply the Rim facilities, including the lodge, café, gift shop, and visitor center. Each service area has structural fire protection capabilities.

A total of 535,000 gallons is stored for the three service areas. At Mazama, two 100,000 gallon tanks store water, with 80,000 gallons reserved for fire suppression and the rest available for drinking water, sanitation, and facility operations. One 150,000 gallon tank at Munson Valley/Headquarters serves facilities and stores water to be pumped up to the Rim service area. The 185,000-gallon Garfield Reservoir at the rim serves the visitor center, café, Lodge, and concession employee housing.

Park operations at Headquarters/Munson Valley include administrative, management, maintenance, visitor protection and law enforcement, and resource management operations at the HQ area; visitor information, orientation, and interpretive services at the Steel Visitor Center; NPS employee housing; and the Science and Learning Center.

In the Mazama developed area, the campground is located several hundred feet above Annie Creek. The Annie Creek Café and gift shop, cabins, and camper store are adjacent to the campground but are not as close to the canyon rim overlooking Annie Creek. Concession operations are focused on visitor services that occur within developed areas, rather than operations that affect natural and cultural resources. The sewage lagoons for the HQ/Adminstrative area are south of the employee housing area. The Mazama sewage lagoons are southeast of the Mazama concession housing area on the south side of Highway 62. Sewage treatment and disposal represent a major maintenance operation.

TABLE 1. CRATER LAKE FACILITIES SERVED BY WATER SUPPLY AND DISTRIBUTION SYSTEM

Mazama Village **200,000 gallon storage**	**Park HQ/Munson Valley** **150,000 gallons storage**	**Rim Village** **185,000 gallon storage**
Concession Dorms 83 beds	Seasonal housing 11 units (historic structures)	Lodge 80 rooms
Concession 10 RV sites	Seasonal housing 16 duplexes	Lodge Restaurant
Campground 216 sites	Steel Circle housing, employee support facilities	Cafeteria
Campground 15 RV sites	Maintenance Building	Visitor Center
Cabins 10 4-plex	Administrative Offices	Concession Dorm 98 beds
Restaurant	Visitor Center	
Camper store,		

showers/restrooms/concession laundry		

Socioeconomics: Crater Lake is Oregon's only national park. The park is an internationally recognized scenic wonder. The NPS estimates that the park brings in $132 million annually to local and regional businesses. Seventy-five percent of visitors polled in a 2001 visitor survey said their primary reason for visiting the area was to visit the park.

Environmental Consequences

This section discusses the effects of the alternatives for providing an additional water supply to Crater Lake National Park on natural and cultural resources, park visitors, and park operations. The discussion focuses on the project area, including areas affected by operation and maintenance of the water supply and distribution system. The effects are discussed in relation to other past, present, and reasonably foreseeable actions.

Impact Definitions for Natural Resources

Impacts are analyzed according to the type of impact (beneficial or adverse), the timing and duration of impact (short-term, long-term, one-time, occasional, and repeated) and the severity or intensity of impact (no effect, negligible, minor, moderate, or major).

Context—The context of an impact includes consideration of the impacts within the project area, the park as a whole, and local and regional conditions.

Timing and Duration—The timing of an impact is also part of its context. For example, removing brush and trees in October does not affect nesting birds but brushing the same area in June would affect any birds that might be nesting in the vegetation.

The duration of an impact considers whether an effect would happen immediately, the length of time over which an impact occurs, and how long it would be noticeable. Duration is defined as short-term or long-term, although the duration of an effect is related to the resource affected. In general, long-term effects would be those that are repeated over at least several years or that would not be immediately noticeable. Short-term effects would generally be on the order of a year or less, because a year includes one complete growing season for short-lived plants and animals. In the context of resources such as soils or plant communities, for long-lived plants such as trees, or for geological processes such as flooding, long-term refers to effects on the order of decades to centuries.

Type—The type of impact describes whether an action would benefit or harm a resource. A beneficial effect improves the condition of a resource, protects it from damage or loss, or favors the persistence of a resource. A harmful or adverse effect is one that worsens the condition of a resource, damages or degrades a resource, leads to the loss of the resource, alters it irretrievably in an undesirable way, or changes its essential character so that the resource no longer possesses integrity or its defining characteristic. Adverse effects are unfavorable to the conservation and preservation of a resource in its original condition.

Intensity—Intensity, degree, or severity of an impact refers to how much of an effect an action has on a resource and is described as negligible, minor, moderate, or major. Major effects on certain resources may be considered significant. Determining intensity relies on understanding the range of natural variation of a resource. If an action has no effect on a resource, or if the effect is barely noticeable or measurable, the effect is considered negligible. Negligible effects are those that are unnoticeable, undetectable, or result in no change to a resource, or that affect so few individuals that the effect cannot be distinguished from the natural variability for a resource.

Significant effects are always noticeable and result in a permanent change to a resource over a large area or to the entire resource.

Levels of change between negligible and significant are described as minor or moderate. Minor changes to a resource are detectable but there is no long-term or permanent alteration of the resource and the changes are within the range of natural variability. Minor effects are generally noticeable but result in only a slight change to a resource or occur in a small area, and do not change resource function.

Moderate effects are always noticeable, and result in some change to the resource or its function, and occur in several areas. If an action changes the resource completely or a change is irreversible, the effect is considered significant or major. Actions are more likely to result in a gradient of change rather than a distinct level of change, so that some effects may be judged "minor to moderate" to indicate that portions of a resource in different locations might be affected slightly differently by the same action. For natural resources that are distributed discontinuously across a landscape or where individual elements of a resource are not exactly equivalent to other individuals or pieces of the same resource, a range of effects from a single action is likely.

The intensity of an impact also includes consideration of how widespread or local the area of impact would be, the amount of a resource that might be affected, or the number of times an effect would occur. If an action affects all of a resource within the parks, that impact would be considered major or significant.

Intensity of effects on plants or wildlife is based on the number of individuals affected in relation to the total population in the project area, the park, the region, and the range of the species. If only a few individuals of a common plant or animal are affected, the impact would be considered negligible. If an action affects more than a few individuals but the effects are within the natural level of variability for a population or a resource, the effect is considered minor. If an action affects many or all individuals and causes changes to populations that are greater than the natural level of variability, the effect is considered moderate.

Impact Definitions for Cultural Resources

Cultural resources are defined as archeological resources, prehistoric or historic structures, cultural landscapes, and traditional cultural properties. These resources are called "Historic Properties" when they are either listed in or are determined eligible for listing on the National Register of Historic Places under §106 of the National Historic Preservation Act (36 CFR 800, Protection of Historic Properties). Criteria for determining eligibility of listing such resources on the National Register include the following:

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
B. that are associated with the lives of persons significant in our past; or
C. that embody the 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; or
D. that have yielded or may be likely to yield, information important in prehistory or history.

Potential impacts from this project to cultural resources either listed in or eligible to be listed in the National Register of Historic Places were identified and evaluated in accordance with the Advisory Council on Historic Preservation's regulations implementing §106 of the National Historic Preservation Act (36 CFR 800, *Protection of Historic Properties*) by (1) determining the APE; (2) identifying resources present in the APE that are National Register-listed or -eligible; (3) applying the criteria of adverse effect to affected resources; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the Advisory Council's regulations, a determination of no historic properties affected, adverse effect, or no adverse effect must be made for historic properties. A determination of no historic properties affected means that either there are no historic properties present or there are historic properties present but the undertaking will have no effect upon them (36 CFR 800.4(d)(1)). An adverse effect occurs whenever an impact compromises, directly or indirectly, one of the seven aspects of integrity (location, design, setting, materials, workmanship, feeling, or association) which make a historic property eligible for listing on the National Register of Historic Places. Adverse effects also include reasonably foreseeable effects caused by the alternatives that would occur later in time, be farther removed in distance or be cumulative (36 CFR 800.5(a)(1)). A determination of no adverse effect means there is an effect, but the effect would not meet the criteria of an adverse effect, i.e., diminish the characteristics of the cultural resource that qualify it for inclusion in the National Register (36 CFR 800.5(b)).

The criteria for characterizing the severity or intensity of impacts to National Register-listed or -eligible archeological resources, prehistoric or historic structures, cultural landscapes, and traditional cultural properties are the §106 determinations of effect: no historic properties affected, adverse effect, or no adverse effect. The NPS makes a recommended finding of effect and sends it to State Historic Preservation Office requesting concurrence. Often these findings will involve protection measures to avoid adverse effects. A §106 determination of effect

discussion is included in the environmental consequences section for analysis of impacts to National Register-listed or -eligible cultural resources.

Environmental Consequences by Resource

Air Quality: There would be no new effects to air quality under the no action alternative.

Under the proposed action, there would be temporary and localized adverse effects during construction from dust and emissions generated by construction equipment. Excess dust would be mitigated by water sprinkling as needed. Vehicle emissions would be limited through use of vehicles licensed to meet state air quality standards. There would be no detectable long-term adverse effects from operation and maintenance of a new water line, or from the existing supply and distribution system.

Cumulative effects on air quality and air quality related values in the park would result from vehicle traffic, campfires, and smoke from wildfires and prescribed fires in the park and surrounding area. Smoke from wildfires has the potential for significance adverse effects on air quality and visibility, depending on the size, location, and duration of the fires.

The overall adverse effects on air quality and air quality related values from construction, operation, and maintenance of a water supply and distribution system in the park would be negligible.

Soils: Under the no action alternative, there would be no new effects to soils from construction.

Under the proposed action, soils would be affected for construction of a well housing at the PCT trailhead, for installation of new water line and adjacent power and communication lines in adjacent trenches, for installation of pull boxes for power lines along the new water line, and to enlarge the parking area to accommodate a horse trailer at the PCT trailhead to replace the area affected by the well housing.

The 4-inch water line would be buried a minimum of 48 inches deep, requiring a total estimated depth of 54 inches for the trench. The trench is estimated to be a minimum of 18 inches wide. The common utility trench for power and communication lines would be a minimum of 18 inches wide. To accommodate the minimum 3-ft separation required between the two 18-inch-wide trenches, the minimum width of disturbance would be 6 feet. Access for heavy equipment needed to excavate the two trenches would require a minimum width of twelve feet.

Under the proposed action, the total length of the trenches in which the water and utility lines would be buried would be about 3,940 lf.

The total area of disturbance for trenching for water lines would be approximately 1.1 ac, all of which is currently or previously disturbed for road construction.

The trench would follow the obliterated highway to connect to the existing water line to the Mazama tanks. The curve on the obliterated highway was constructed as a road cut as the old alignment descends a slope. The road cut was filled in with debris and rocks pushed onto the road bed in an attempt to hide the scar of the road cut. Several large rocks on the surface are estimated to be similar in size to 1-ton rock slope protection (RSP) material. The length of this section of trenching is about 1,800 feet. Removal of debris or large rocks buried in the debris could result in a disturbed area more than twelve feet in width.

Under both alternatives, the trench underneath the highway would require removal and replacement of asphalt at the highway crossing. The area of asphalt to be excavated and replaced is estimated to be about 30 ft by 6 ft (150 sf).

Soils affected for construction of the well housing are already disturbed by the existing PCT graveled trailhead parking area. Enlarging the parking area to allow a horse trailer to maneuver would affect an additional 3,300 sf adjacent to the existing parking area to replace parking area lost to the new fenced well housing and provide needed trailhead amenities. Soils affected by trenching for the new water, power, and communication lines are in the previously disturbed highway corridor. About 1,970 lf of the trenching would occur within the corridor of the existing highway that is routinely maintained, including snow-plowing, brushing, and resurfacing.

Soils affected by trenching would be stockpiled next the trench and used to backfill the trench. Impacts to soils from construction of a well housing at the PCT trailhead and trenching along the current and obliterated highway alignment for new lines would be localized, long-term, and adverse to the extent that soil disturbance is considered an adverse effect in comparison to undisturbed soil. Additional disturbance to 1.1 acres of soils in a previously disturbed highway corridor is a negligible adverse effect.

Construction equipment would be inspected daily to check for leaks. Potential effects on soils from leaks of petroleum and equipment fluids would be avoided through containment devices. All equipment would be stored, serviced, and fueled on tarps or other containment devices. Any incidental drips would be collected in containers and tarps underneath the equipment and transported out of the park for disposal in an acceptable location. A spill prevention plan would be in place.

Cumulative effects to soils at Crater Lake National Park result from trail maintenance, occasional grading of unsurfaced roads or routine maintenance of road shoulders adjacent to surfaced roads, periodic excavation for repair or maintenance of facilities such as culverts or utility lines, construction of fire lines in the event of wildfires, and from pile burning to reduce hazardous fuels.

The overall effect on soils from new construction, and continued operation and maintenance of a water supply and distribution system in the park would be negligible.

Topography: None of the alternatives, including no action, would require more than minor alterations to the natural topography. For trenching for a new water line under the proposed action, the line would be installed along the existing Highway 62 corridor and along the road cut for the obliterated highway. Effects to topography would be long-term and localized within the existing or former highway corridor. The greatest alteration to topography would occur along the road cut of the obliterated highway where rocks and soil have been placed downslope onto the original roadbed and where minor grading is necessary in the expanded parking area. These effects are considered adverse to the extent that existing topography would be slightly altered. However, the topography where the water line and parking area would be installed was previously altered for construction of the highway and other administrative purposes.

Cumulative effects to topography in Crater Lake National Park result primarily from trail and road maintenance; these effects are negligible. There are no reasonably foreseeable proposals for construction in the park that would affect topography.

The effects to topography under the proposed action from new construction, and operation and maintenance of a water supply and distribution system would be negligible.

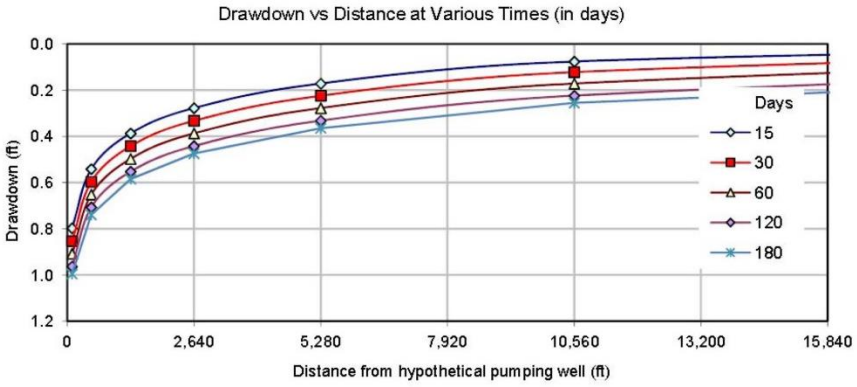
Water Quality: Trenching to install the water, power, and communication lines under the proposed action would have very localized effects from run-off of newly disturbed soils for several years until herbaceous plants and grasses regrow in the disturbed soil. If soil disturbance has the potential for run-off into temporary water courses, mulch would be applied to reduce run-off until soils stabilize in one to two years. There are no permanent streams in the project area that would be affected by run-off from newly disturbed soils. Potential effects on water quality from leaks of petroleum and equipment fluids would be avoided as described above for soils. Impacts to water quality from construction under the proposed action would be negligible.

Water Quantity: Under the no-action alternative, withdrawals from Annie Springs would continue as in the past. The seasonal 7 day running average flow pumped from Annie Spring is expected to remain at 55,400 gpd, unless withdrawals are curtailed as a result of an extended drought or other reduction in water supply.

Under the proposed action, withdrawal from the PCT well is planned to meet the design demand of 50 gpm under intermittent withdrawal periods which will adequately provide for a 7-Day Average Maximum demand of 55,300 gpd.

Withdrawals from the PCT well will lower water levels in the area around the well and may eventually result in a reduction in groundwater discharge to surface streams. Drawdown due to pumping was estimated using an analytical model based on the Theis equation and site specific information (i.e., well logs, aquifer testing, water-quality sampling, geologic mapping, etc.). The results of the modeling indicate that the cone of depression formed by the well after pumping an average day demand (50,000 gpd) for 180 days could extend over 1 mile from the well site (Figure 5).

Due to the complexity of local geology and position of the well on the Pacific Crest, the magnitude, timing, and location of streamflow depletions cannot be predicted with certainty. Depletions could occur in streams in the Rogue Basin, the Klamath Basin, or both. Streamflow depletions will be attenuated by the distance between the well and points of groundwater discharge. The instantaneous depletion to all impacted streams will not exceed the pumping rate from the well and the impacts of the proposed withdrawals from the PCT well on Annie Creek will be less than the impacts of diverting water directly from Annie Spring.



Pumping rate (2013 average summer demand) = 50,000 gpd

Figure 5. Potential Drawdown

Vegetation: Under the no action alternative, there would be no construction-related impacts to vegetation.

Under the proposed action, all construction equipment would be required to be cleaned to remove invasive plants or seeds prior to being used in the park.

The vegetation that would be affected by trenching along the road shoulder in the existing highway corridor and the obliterated highway alignment is primarily regrowth of lodgepole pines, hemlocks, and red fir less than 10 feet in height. The vegetation affected by installing the water line from the obliterated highway down the slope to the tank access road includes sparse understory of shrubs such as pinemat manzanita, herbaceous species, and grasses. Under the proposed action, approximately 1.1 acre of vegetation would be affected by construction of the water line and associated common utility trench from the PCT trailhead along the Highway 62 alignment to the obliterated highway alignment to connect with the existing water line at the Mazama tanks access road.

Approximately 17 lodgepole pines less than 18 inches in diameter and a sparse understory of shrubs would be removed at the PCT trailhead to replace lost parking spaces and to allow for maneuvering of stock trailers. The vegetation to be removed consists of common species that are widespread in similar habitats in the park. Lodgepole pine along the highway corridor and in

developed areas like the campground are routinely cut to reduce fire hazard and for hazard tree removal in the campground.

After the water line is installed, understory vegetation would regrow; small trees would be removed to maintain the functionality of the water line. The effect on native vegetation from construction under the action alternatives is long-term from tree removal; short-term for understory species; localized in 1.1 acres; adverse; and negligible.

The effect on native vegetation from the potential for introduction of invasive plants that could be carried in on construction equipment and in soils disturbed by construction is adverse, long-term, and minor. All construction equipment is required to be cleaned to remove invasive plants or seeds prior to being used in the park. Requiring construction equipment used in the park to be free of invasive plant seeds, active revegetation of disturbed soils, and monitoring of disturbed soils and control of any invasive plants discovered would reduce the adverse effect of invasive plant introduction to negligible.

Cumulative effects on vegetation in the park are related to removal of hazard trees in developed areas, fuel reduction projects to reduce fire hazards, wildfires, periodic brushing and vegetation management along roads and trails, and the potential for introduction of invasive plant species. The cumulative effects are long-term and adverse, and vary from negligible for routine maintenance of roads and trails; minor to moderate from fuel reduction projects and invasive plant introduction; and major or significant from large or catastrophic wildfires.

The overall effects on vegetation in the park from construction associated with the action alternatives is negligible, assuming that disturbed soils are revegetated and invasive plants are controlled.

Wildlife: The proposed action would affect approximately 1.1 ac of wildlife habitat. The habitat along the highway road shoulders is very poor quality because it is subject to noise and disturbance from vehicle traffic on the highway and the vegetation is sparse. The trees to be removed along the obliterated road cut are larger and grow more densely than the trees along Highway 62, and constitute slightly better habitat for nesting migratory birds. The Migratory Bird Treaty Act (MBTA) protects migratory birds including hawks and songbirds. Several species protected under the MBTA nest in and around the project area. Seasonal restrictions on noise and habitat disturbance to protect nesting birds is required under the action alternative. The NPS avoids impacts to birds protected under the MBTA by avoiding removal of vegetation suitable for nesting during the primary nesting season for most migratory birds (May 1– July 31).

Individuals of small sedentary animals that are unable to move away from the construction zone would be killed or displaced. Larger wildlife would move out of the construction area during heavy equipment operations.

The effect on wildlife under the action alternative would be short-term localized disturbance from noise during construction and minor; and long-term and significant for those individuals of small

sedentary species that are killed or permanently displaced. The overall long-term adverse effect on wildlife would be negligible because the construction would occur in a short period of time adjacent to a heavily used highway corridor that is subject to on-going noise and disturbance from vehicle traffic.

Cumulative effects on wildlife in the park are associated with on-going noise and disturbance along roads and in administrative and visitor use areas. Some species of wildlife such as golden-mantled ground squirrels and jays in high visitor use areas are fed by visitors or obtain human food from unguarded picnic tables or improperly disposed garbage. These effects are long-term, adverse, and negligible.

The overall effect on wildlife under the action alternatives is short-term disturbance during construction, and short-term loss of poor quality habitat from vegetation removal and soil disturbance along the road corridor. These effects, together with the cumulative effects from other on-going and reasonably foreseeable actions, are negligible.

Sensitive, Threatened, and Endangered Species: There are no sensitive plants in the project area, and therefore, there would be no effects to sensitive plants from construction under the proposed action.

The proposed action does not have the potential to affect bull trout, or their designated critical habitat.

No suitable habitat for northern spotted owls (nesting, foraging) or Pacific fishers (denning, foraging) would be removed under the proposed action. Noise and disturbance from construction of a water line would occur at the existing PCT trailhead and along the highway corridor. The trailhead, highway corridor, and the abandoned road cut are affected by vehicle noise and hazard fuel reduction projects. Noise and disturbance from construction would be short-term and localized. There would be negligible short-term effects from construction noise and removal of roadside vegetation and small conifers along the abandoned highway, and negligible long-term effects on northern spotted owls and Pacific fishers from short-term noise and disturbance related to operation and maintenance of a new water distribution system.

Ungulates are the primary food source for gray wolves. The limited amount of disturbance associated with this project will not have an effect on the deer and elk populations in the park. Therefore, this project will not affect gray wolves.

Based on the availability of abundant habitat throughout the park, this project is not likely to have adverse effects on black-backed woodpeckers.

While the project area is likely within the home range of several individuals of the Sierra Nevada red fox, the small scope of disturbance associated with this project is unlikely to have a negative effect on this species.

Cultural Resources: Under the no action alternative, there would be no effects on historic resources from construction. Under the no action alternative, if water use in the park is curtailed because of a call on the Annie Springs water right, the quantity of water available for fire protection (both structural and wildfire) would become unpredictable. This would be a potentially significant adverse effect from decreased structural fire protection for historic structures.

The proposed action has the potential to affect the Fort Klamath–Rouge River Wagon Road which is adjacent to the area where trenching for the waterline is proposed. The wagon road would be protected from disturbance by construction fencing with on-site monitors during ground disturbance activities. The NPS archaeological survey has determined that the proposed action would have not adversely affect the Wagon Road or alter the features that make it eligible for listing in the National Register of Historic Places. In a letter dated March 30, 2015 (SHPO Case No. 15-0268) the Oregon SHPO agreed with the NPS determination that no impacts to any significant cultural resources would occur as a result of the proposed action, provided that avoidance recommendations detailed in the NPS report (SHPO no. 27194) are followed.

The proposed action would provide an additional source of water that would be available for fire protection for historic structures from both structural fire and wildfire. This would be a long-term term benefit to cultural resources.

Visitor Use and Experience: Under the no action alternative, there would be no effects on visitor use from construction at the PCT trailhead or along the highway. Under the no action alternative, if water use in the park is curtailed because of a call on the Annie Springs water right, the quantity of water available for structural fire protection would become unpredictable. This would be a potentially significant adverse effect on visitor use and enjoyment of the park, and on human life and safety from decreased fire protection. In the event of a call on water rights, the no action alternative would have a potentially significant adverse effect from park closures or moderate adverse effect from restricted water use.

Under the proposed action, there would be short-term localized effects on visitors at the PCT trailhead and along the highway during construction. There would be short-term effects from loss of parking or closure of the PCT trailhead during construction. The effects would be greater if construction occurs during the primary visitor season. Construction will be weather-dependent, with persistent deep snow affecting the construction schedule.

The PCT parking area would be expanded sufficiently to accommodate any loss of parking capacity and turn-around space for stock trailers. Parking will be better defined and needed trailhead amenities will be added. The result will be long-term beneficial impacts to trail users accessing the PCT from this trailhead.

Under the proposed action, water would be available for structural fire protection. This would be a long-term term moderate benefit to visitors from improving life safety related to structural fires in visitor facilities.

Park Operations: Under the no action alternative, there would be no change in the cost of maintenance and operation of the water system.

Under the proposed action, there would be an increase in cost from operation and maintenance of additional water system components. Power costs would increase to move water from the new well to deliver it to the existing Mazama line or to the Annie Springs booster station. If a new vault is required, there would be a slight increase in cost associated with safety requirements for access to an additional confined space.

Socioeconomics: The no action alternative has the potential for a significant adverse effect on local and regional economy if visitor facilities are closed due to lack of potable water. Restricted water use could result in a moderate adverse effect to visitors shorten their stay in park concession facilities or the local area during the high visitor use season. Under the proposed action, there would be no effect on the local and regional economy as potable water would be withdrawn from the PCT well, and visitor facilities would remain open, should surface water withdrawals be curtailed.

Coordination and Consultation

Endangered Species Act Section 7 Consultations—Section 7 of the Endangered Species Act of 1973, as amended (19 U.S.C. 1536 (c)), requires that federal agencies consult with the USFWS if agency actions have the potential to affect species listed or proposed for listing under the Endangered Species Act or designated critical habitat. Since 2010, the Park has surveyed for northern spotted owls (NSO) in and around the project area following the methodologies described in the 2012 revised version of the USFWS 2011 “Protocol for Surveying Proposed Management Activities that may Impact Northern Spotted Owls” (USFWS 2011). To date, no NSOs have been documented in the project area and the nearest know location of NSO activity is approximately 5km to the southeast. In addition, the vegetation that is planned for removal is not classified as NSO habitat for nesting or foraging. Based on these factors, we conclude that this project will have a “No Effect” on NSOs. While no NSO have been documented to date, because NSO habitat occurs within the vicinity of the project area the site will be sample following USFWS guidance prior to beginning the project to ensure NSOs have not started to occupying the project area.

Cultural Resource Consultations—Federal land management agencies are required to consider the effects of their proposed actions on properties listed in, or eligible for inclusion in, the National Register of Historic Places (i.e., historic properties), and allow the Advisory Council on Historic Preservation a reasonable opportunity to comment as per the National Historic Preservation Act, as amended and its implementing regulations at 36 CFR 800. Agencies are required to consult with Federal, state, local, and tribal governments/organizations, identify historic properties, assess adverse effects to historic properties, and negate, minimize, or mitigate adverse effects to historic properties while engaged in any federal or federally assisted undertaking (36 CFR Part 800). The NPS submitted a survey report and site records to the Oregon state historic preservation officer (SHPO) on February 19, 2015. In a letter dated March

30, 2015 (SHPO Case No. 15-0268) the Oregon SHPO agreed with the NPS determination that no impacts to any significant cultural resources would occur as a result of the proposed action, provided that avoidance recommendations detailed in the NPS report (SHPO no. 27194)" are followed.

Tribal Consultation – On October 13, 2015 NPS staff met with the Klamath Tribes Tribal Council to present the project alternatives and engage in government to government consultation. Tribal concerns included potential impacts to prehistoric archeological sites (none are known to be present in the project area) and potential impacts to surface water flows from ground water withdrawals. The Klamath Tribes hold the most senior claims dating from "time immemorial" for certain reaches of the major tributaries to Upper Klamath Lake and want to ensure that ground water withdrawals would not impact this claim. The Oregon Water Resources Department (WRD) oversees ground water permitting in the state and administers the Klamath River Basin Adjudication, though ground water rights have not been adjudicated. The NPS indicated it will keep the Tribes apprised of the permitting process with the Oregon WRD.

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References

Aubry, K.B., and J.C. Lewis. 2003. Extirpation and reintroduction of fishers *(Martes pennanti)* in Oregon: implications for their conservation in the Pacific states. Biological Conservation 114 (1):79-90.

Aubry, K.B., and C.M. Raley. 2006. Ecological characteristics of fishers (*Martes pennanti*) in the Southern Oregon Cascade Range. USDA Forest Service, Pacific Northwest Research Station, Olympia Forestry Sciences Laboratory. Olympia, Washington, USA. 32 pp.

Bacon, Charles R., 2008, *Geologic Map of Mount Mazama and Crater Lake Caldera, Oregon*, U.S. Geological Survey Scientific Investigations Map 2832.

Buskirk, S.W., and R.A. Powell. 1994. Habitat ecology of fishers and American martens. In: Buskirk, S.W., Harestad, A.S., Raphael, M.G., and Powell, R.A, editors. Martens, sables and fishers: biology and conservation. Ithaca (NY): Cornell University Press. Pp. 283–296.

Drew, R.E., J.G. Hallett, K.B. Aubrey, K.W. Cullings, S.M. Koepf, and W.J. Zielinski. 2003. Conservation genetics of the fisher (Martes pennant) based on mitochondrial DNA sequencing. Molecular Ecology 12: 51-62.

Frank, F.J., and A.B. Harris. 1969, *Water-Resources Appraisal of Crater Lake National Park, Oregon*, U.S. Geological Survey Open-File Report OFR 68-140, 26 pp.

Gleason, Eric. 2010. Fort Klamath – Rogue River Military Wagon Road, State of Oregon Archaeological Site Record 4097, compiled for the National Park Service, Crater Lake National Park, and submitted to Archaeological Services, Oregon State Historic Preservation Office, Salem.

Harmon, Rick. 2002. *Crater Lake National Park: A History*. Corvallis: Oregon State University Press (pp. 84-86, 118-120, 148-149).

Kritzer, Kelly. 2014. Report on the Archaeological Survey of the Proposed Waterline Project, Crater Lake National Park, Oregon. Submitted to Archaeological Services (SHPO report no. 27194), Oregon State Historic Preservation Office, Salem.

Lofroth, EC, J.M. Higley, R.H., Naney, C.M. Raley, J.S. Yaeger, S.A. Livingston, and R.L. Truex. 2011. Conservation of Fishers *(Martes pennanti)* in South-Central British Columbia, Western Washington, Western Oregon, and California-Volume II: Key Finding from Fisher Habitat Studies in British Columbia, Montana, Idaho, Oregon, and California.

International Panel on Climate Change. Climate Change 2007: Working Group I: The Physical Science Basis. How is Precipitation Changing?

http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-3-2.html. Accessed November 5, 2014.

Mark, Steve R. 1997. On an Old Road to Crater Lake. Nature Notes from Crater Lake 28. pp 16-19

Mark, Steve R. 2001/2002. Others Have Passed This Way. Nature Notes from Crater Lake. pp 32-33.

Mark, Stephen R. 2002. Wagon Roads in Crater Lake National Park (Western Half). Oregon Inventory of Historic Properties, Section 106 Documentation Form, Potential Historic District; concurrence with Determination of Eligibility from the Oregon State Historic Preservation Office, June 6, 2003.

Mark, Stephen R. 2003. Addendum to Crater Lake National Park Roads, Historic American Engineering Record documentation, HAER No. OR-107, Library of Congress, Washington, D.C.

Mark, Stephen R. 2012. "Captain Sprague's Big Adventure," *Journal of the Shaw Historical Library* 26, pp. 3-15.

Oregon Water Resources Department. 2013. Water Rights in Oregon. An Introduction to Oregon's Water Laws. November 2013. Salem, OR.

Oregon Department of Environmental Quality. http://www.deq.state.or.us/ag/planning/docs/kFallsEQCpresentation.pdf. Accessed January 16, 2015.

http://www.deq.state.or.us/ag/planning/kfalls.htm. Accessed January 16, 2015.

National Park Service, US Department of the Interior. 2005. Final General Management Plan/Environmental Impact Statement. May 2005. Crater Lake National Park. Oregon. 271 pages. National Park Service Denver, CO.

National Park Service, US Department of the Interior. Monthly Public Use Reports. https://irma.nps.gov/Stats/Reports/Park. Accessed January 20, 2015.

SPF Water Engineering, LLC. 2013. Well Construction and Testing Report. Crater Lake National Park Test Well. PMIS #203499. Prepared for National Park Service. Dec 19, 2013 (draft). Boise, ID.

SPF Water Engineering, LLC. 2014a. Crater Lake National Park (CRLA) New Potable Well to Augment Annie Springs Source. PMIS #203499. Scoping Trip Report. March 25, 2014 (Final) Prepared for the National Park Service. Boise, ID.

SPF Water Engineering, LLC. 2014b. Memorandum. July 29, 2014. Alternative Schematic Design Operating Strategies for: Develop Reliable Supply to Augment Annie Springs, Crater Lake National Park, Oregon, PMIS #203499.

SPF Water Engineering, LLC. 2014. Schematic Design. July 28, 2014. Sheets 1-9.

Stephens, J. L., J. D. Alexander, and S. R. Mohren. 2011. Klamath Network landbird monitoring annual report: 2010 results from Crater Lake National Park, Lassen Volcanic National Park, and Oregon Caves National Monument. Natural Resource Data Series NPS/KLMN/NRDS—2011/175. National Park Service, Fort Collins, Colorado.

Stephens, J. L. 2014. Klamath Network landbird monitoring annual report: 2013 results from Crater Lake National Park and Oregon Caves National Monument. Natural Resource Data Series NPS/KLMN/NRDS—2014/689. National Park Service, Fort Collins, Colorado.

U.S. Fish and Wildlife Service. 2015. Endangered and threatened wildlife and plants; 12-month finding on petition to list Sierra Nevada red fox as an Endangered or Threatened species . Docket No. FWS-R8-ES-2011-0103; 4500030113. Federal Register 80(195):60990-61028.

U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Threatened Species Status for West Coast Distinct Population Segment of Fisher. Federal Register, Vol. 79, No. 194, October 7, 2014, 60419-60443.

U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants; Threatened Status for the Distinct Population Segment of the North American Wolverine Occurring in the Contiguous United States; establishment of a Nonessential Experimental Population of the North American Wolverine in Colorado, Wyoming, and new Mexico. Federal Register, Vol. 79, No. 156, August 13, 2014, 47522-47545.

U.S. Fish and Wildlife Service. 2011. Protocol for Surveying Proposed Management Activities that May Impact Spotted Owls. USDI Fish and Wildlife Service, Portland, OR. 38pp.

U.S. Geological Survey. 1999. Sustainability of Ground-Water Resources. U.S. Geological Survey Circular 1186. U.S. Geological Survey, Denver, CO. 86pp.

U.S. Geological Survey. 2014. Water-resources data for the United States, Water Year 2013: U.S. Geological Survey Water-Data Report WDR-US-2013, site 11503000, accessed at http://wdr.water.usgs.gov/wy2013/pdfs/11503000.2013.pdf

Williams, Howel, revised by Charles R. Bacon, 1984, *Crater Lake National Park and Vicinity*, 1:62,500-scale topographic map, 1988, 42122-H2-PF-625.

Appendix 1
Water Conversion Table

Water measurements are generally described using of three terms. Generally, when referring to a rate to be diverted, the terms used are cubic feet per second (cfs) or gallons per minute (gpm). When discussing volumes of water, such as amount applied to land, reservoir storage capacity, or yearly consumption, the term used is acre/feet (af).

Rates of Flow
One (1) cubic foot per second (cfs) is a rate of water flow that will supply one cubic foot of water in one second and is equivalent to flow rates of:

7.48 gallons per second
448.8 gallons per minute
646,272 gallons per day (gpd)
1.98 acre-feet per day (af/day)

Volume Measurement
One (1) acre-foot is the volume of water that will cover one acre to a depth of one foot and is equal to:

1 af =43,560 cubic feet (cf)
1 af =325,851 gallons (gal)