CITY OF BANDON

OFF-CHANNEL RESERVOIR FEASIBILITY STUDY 2016

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INTRODUCTION

SECTION 1: INTRODUCTION

This feasibility study is being prepared to evaluate the Off-Channel Reservoir project in Bandon, Oregon in detail and outlines the steps taken and methods used for completion of the evaluation. This study has been prepared under a grant from the Water Conservation, Reuse and Storage Grant (Grant GA-0101-17) administered by the Oregon Water Resources Department. The objective of the proposed Off-Channel Reservoir project is to establish off-channel storage to insure municipal water supply during low flow or drought conditions from water diverted from Ferry Creek and so that instream flows can be better managed to meet the needs of irrigators and improve late summer fish passage conditions.

The proposed reservoir would be located off Cardinal Lane, approximately 0.3 miles southwest of the diversion on Ferry Creek and 0.2 miles west of Geiger Creek Reservoir. The reservoir site would be located entirely on property owned by the City of Bandon. Figure 1.1 shows a vicinity map of Bandon.

The proposed reservoir would be designed to store up to a maximum of 100 acre-feet of water diverted from Ferry Creek utilizing the City's existing point of diversion and pump station. Water would be piped to the reservoir in a new 12-inch diameter pipe that would use the existing utility easement and parallel the City's treated water main. Water would be diverted from the Ferry Creek during the peak runoff season for raw water storage. The stored raw water would be used to supply municipal needs during tourist season and to directly supplement late summer flows in Ferry and Geiger Creeks.

The proposed Off-Channel Reservoir project is expected to benefit multiple uses such as instream flow, water supply, instream and riparian habitat and water quality. The proposed project should allow for water management that would better meet both instream and out-of-stream needs.

Climate models suggest that the state's average summer precipitation will decline in the future and that the wildfire threat is projected to increase. The proposed Off-Channel Reservoir would provide the City resiliency and security for the predicted climate change and the resulting increased wildfire threat.

Study Description

The following includes a brief description of the scope of work and purpose of the feasibility study. In general, the feasibility study was prepared to identify deficiencies or challenges that would prevent implementation of the project and to more clearly define the benefits and costs associated with implementation and long-term operation of the project.

Panoramic view of Lot 2400 after brush was cleared in May 2014.

Scope of Work

The scope of work approved by Oregon Water Resources Department for development of this feasibility study included the following tasks:

Task 1. Complete Water Rights Analysis – This task included determining the means by which surface water will be diverted to fill the proposed reservoir. This task assessed the feasibility of the following options: water right permit amendment; water right transfer; new storage water right permit and new surface water right from reservoir; or use of existing surface water rights. This task included coordinating with Oregon Water Resources Department on how to successfully navigate the administrative issues associated with providing permitted water for the project.

Task 2. Complete Biological Assessment, Wetlands Delineation, Environmental Resources Review, Analysis of Permitting Issues – This task included the preparation of a Biological Assessment, following the outline and format of RUS Bulletin 1794-602, Section "3.5.1 Biological Resources Information: Threatened and Endangered Species; Fish and Wildlife: Vegetation". The assessment included a review of state and federal lists of threatened or endangered species and candidate species that may be affected by the project. The fish, wildlife and vegetation resources within the project area are described and the short term and long term affects to these resources is discussed. A wetland investigation was conducted to determine whether there were any wetlands present in the project area. A plant survey was conducted in mid-July 2016 to determine if the Western lily, *Lilium occidentale* was present in the vicinity of the project site.

Task 3. Assess Environmental and Archaeological Impacts -This task conducted a wetland delineation to determine if wetlands are present in the area, using online and regulatory sources. The site was examined on foot for the presence of hydrophytic vegetation, wetland hydrology, and hydric soils. This task also included a complete assessment with Oregon Department of Fish and Wildlife (ODFW), U.S. Fish and Wildlife Service, Oregon State Historic Preservation Office (SHPO), Coquille Indian Tribe of environmental or archaeological impacts to the site.

Task 4. Assess Impact To Other Water Users And To The Fish Hatchery - This task assessed the impact of the proposed off-channel reservoir to other water users in the drainage and to ODFW's Bandon Fish Hatchery, including the development of a recommended operating scheme that would maximize the use of the reservoir to benefit instream flow resources and supply municipal needs.

Task 5. Identify Permits and Prepare Permit Applications -This task analyzed the permitting issues and requirements for the proposed project. Necessary permits were identified and the applications were prepared and submitted.

Task 6. Hydrological Investigation – This task included field gathering of flow data on Ferry and Geiger Creeks to determine natural inflow and hydrologic conditions of the basin tributary to the proposed reservoir.

Task 7. Geotechnical Exploration – This task included subsurface soil sampling, testing, and preparation of a report to address the geotechnical suitability of the site for reservoir construction and provide recommendations for design of the reservoir embankment.

Task 8. Cost Estimate – This task included development of a total estimate of reservoir construction costs and long-term operation and maintenance costs.

Task 9. Identify Financing Opportunities and Rate Impact Analysis – This task identified funding options and investigated impacts of construction and O&M costs to water rates.

Task 10. OAR 690-600-0050 (2) Planning Study Criteria – This task identified planning study criteria additional obligations as required by OAR 690-600-0050(2)

a. Analyses of by-pass, optimum peak, flushing and other ecological flows of the affected stream and the impact of the storage project on those flows;

b. Comparative analyses of alternative means of supplying water, including but not limited to the costs and benefits of conservation and efficiency alternatives and the extent to which long-term water supply needs may be met using those alternatives;

c. Analyses of environmental harm or impacts from the proposed storage project; and

d. Evaluation of the need for and feasibility of using stored water to augment in-stream flows to conserve, maintain and enhance aquatic life, fish life and any other ecological values;

e. In addition, if the storage project is for municipal use, the grant agreement will require an analysis of local and regional water demand and the proposed storage project's relationship to existing and planned water supply projects.

Feasibility Study Purpose

The purpose of this feasibility study is to identify and address the necessary requirements and the costs of implementing the project so that the City can make informed decisions on how to fund and construct the project. The feasibility study is also intended to identify and evaluate weaknesses or barriers that could prevent implementation of the project.

Based on the available data collected, this site has been determined to be suitable for reservoir construction. Detailed reservoir design analysis will be completed when the rest of the site has been cleared and is accessible.

Proposed Schedule for Off-Channel Reservoir Construction

The proposed schedule for the Off-Channel Reservoir is dependent upon funding opportunities becoming available. The City plans to apply for funding as soon as the feasibility study is complete and is in the process of developing plans to take a bond issue to the voters.

SECTION 2:
BACKGROUND

SECTION 2: BACKGROUND

The City of Bandon owns two reservoirs in which raw water is stored. One reservoir is on Ferry Creek and the other is on Geiger Creek. Ferry Creek Reservoir can store no more than a maximum of 5 acre-feet of its 20-5/8 acre-feet permitted water right and Geiger Creek Reservoir can store a maximum 3 acre-feet of its 90 acre-feet of permitted water right, if they were dredged. However, a survey conducted in 2014 determined that total existing capacity for both reservoirs was only 3.38 acre-feet. Expanding storage for these two reservoirs would be very expensive, problematic due to permitting issues, difficult to get through the dam safety approval process, and challenging because both dams are owned Oregon Department of Fish and Wildlife (ODFW).

The proposed reservoir site is situated on two parcels located on Cardinal Lane outside Bandon city limits. Lot 2300 was logged sometime prior to 1994 and doesn't appear to have been reforested. Lot 2400 is currently timberland. The site is fairly flat with a slope ranging from 0.5% to a maximum of 5.0%. This topography is favorable for constructing a reservoir that would be approximately 11.5 acres in size, 6 to 8 feet higher than the average base elevation, and approximately 16 feet deep, total. Figure 2.1 shows the vicinity map and Figure 2.2 shows a contour map of the site.

This site is close to the City's Water Treatment Plant. There is an easement that follows the boundary of the adjacent property that allows for the installation of a transmission line. This transmission line would supply the reservoir with water from the City's existing point of diversion on Ferry Creek and allow transportation of water from the reservoir to the treatment plant. In addition, the average base elevation of the site is 123 feet, which is close to the elevation of the water treatment plant and would allow utilization of the same pump station currently used. Access to the proposed reservoir is via a private road for which the City has both utility and access easements. There is existing electrical access available from Bandon Electric.

The water stored in the reservoir will be procured from the City's existing point of diversion on Ferry Creek in accordance with Oregon Water Resources Department's requirements. Water right applications for a new storage right and the right to withdraw from the reservoir are in the process of being completed for submission to Oregon Water Resources Department.

The proposed reservoir would be surrounded by a vegetative buffer, a minimum of 50 feet wide, and would be enclosed by a six (6) foot tall security fence. The proposed reservoir would be lined to prevent water loss and intrusion from nearby surface and groundwater sources and it would be covered to prevent evaporation loss, reduce water temperature, and to prevent waterfowl and mosquito use.

The proposed site is not located within a flood hazard area. Construction of a reservoir at this site will not alter any water courses. The proposed use will not force a significant change in, or significantly increase the cost of, accepted farming or forest practices on agriculture or forest lands in the surrounding area.

Prior to construction activities, timber and brush will be cleared from the site and this activity will subject property owners in the nearby area to noise and smoke for a limited time. Cardinal Lane will be impacted by the log trucks transporting timber offsite. It is anticipated that most of the on-site material will be suitable for use in the construction of the reservoir and upland storage site, so Cardinal Lane will be minimally impacted. Property owners will be notified prior to these activities being conducted and Cardinal Lane will be maintained during this work and returned to as good or better condition.

Once constructed, the reservoir will not emit any sound. No dwellings or other buildings shall be constructed on this site. A 50-foot vegetated buffer will be constructed around the perimeter so the reservoir will not be visible from adjacent properties. Trees within this buffer will be removed as needed to prevent wind-thrown trees from damaging the reservoir. A security fence will be constructed around the perimeter of the reservoir to prevent wildlife from entering the reservoir. The reservoir will need little regular maintenance, so use of the access road will be limited to annual reservoir cleaning and brushing and mowing.

SECTION 3:

BIOLOGICAL ASSESSMENT

SECTION 3: BIOLOGICAL ASSESSMENT

A complete Biological Assessment (BA) was prepared by an environmental consultant, Land And Environmental Services, Inc. The BA follows the outline and format of RUS Bulletin 1794A-602, Section "3.5.1 Biological Resources Information: Threatened and Endangered Species; Fish and Wildlife; Vegetation". The assessment includes a review of state and federal lists of threatened or endangered species and candidate species, and identification of any listed species or critical habitat that may be affected by the project. The fish, wildlife and vegetation resources within the project area are described and the short term and long term affects to the resources are discussed. The BA includes a plant survey to determine if the endangered Western lily, *Lilium occidentale* is present in the vicinity of the project.

BIOLOGICAL ASSESSMENT
CITY OF BANDON
OFF-CHANNEL RAW WATER RESERVOIR
BANDON, COOS COUNTY, OREGON
T28S R14W Section 29, TL 2400, 2300, 900, 2200

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ACRONYMS

BA – Biological Assessment
CH – Critical Habitat
COE – U.S. Army Corps of Engineers
DPS – Distinct Population Segment
DSL – Oregon Department of State Lands
EFH – Essential Fish Habitat
ESU – Evolutionary Significant Unit
ER – Environmental Report
LAWESI – Land And Water Environmental Services, Inc.
OC – Oregon Coast
ODA – Oregon Department of Agriculture
ODFW – Oregon Department of Fish and Wildlife
ORBIC – Oregon Biodiversity Information Center
OWRD – Oregon Water Resources Department
MSA – Magnuson-Stevens Fishery Conservation Management Act
NOAA – National Oceanographic and Atmospheric Administration
NMFS – National Marine Fisheries Service
NRCS – Natural Resources Conservation Service
USDA – U.S. Department of Agriculture
USFWS – U.S. Fish and Wildlife Service

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APPENDICES

EXECUTIVE SUMMARY

This document is the Biological Assessment (BA) for the City of Bandon Off-Channel Raw Water Reservoir project. The purpose of the project is providing the community with adequate water during periods of drought and low water flow. The action site location is east of Bandon (See Vicinity Map, Appendix A), found on Coos County Tax Assessor Map#28S14W29C. The reservoir will be located on tax lot numbers 2400 and 2300, and a pipe line will be installed in the utility easement of lots 900 and 2200. The new pipeline will be routed under Ferry Creek to the pump station on the east side of Ferry Creek, and will parallel the existing treated water line in the existing utility right-of-way to the reservoir. (See Site Plan, Appendix D.)

This BA was prepared by Land And Water Environmental Services, Inc. for The Dyer Partnership Engineers and Planners, Inc. The Oregon Water Resources Department (OWRD) is the funding agency.

The action site is located in the Lower Coquille hydrological unit (HUC 1710030507), near the confluence of Geiger Creek and Ferry Creek. Ferry Creek enters the Coquille River estuary approximately 1.25 straight line miles from the point of diversion for this project. (See Portion of USGS Map, Appendix B.)

The soil type of the proposed reservoir site is Bullards sandy loam, 7-12% slopes, which is a non-hydric soil but can have inclusions of Blacklock fine sandy loam which is hydric. (See Soil Map and Legends, Appendix E.) No wetlands were found on the action site.

The potential reservoir site is approximately 300 feet west of Geiger Creek, but at a higher elevation than the stream. The reservoir site location is 118-127 feet above mean sea level. Geiger Creek is at approximately 80 feet above mean sea level, flowing north toward its confluence with Ferry Creek.

Comments and guidance were sought from the resource Agencies and others with knowledge pertinent to the conditions of the habitat, and the likelihood of cultural resources on the action site. (See Responses to Requests for Comments, Appendix G.)

The species considered in this biological assessment occur, or historically occurred, in Coos County as recorded by the Oregon Biodiversity Information Center (ORBIC).

A two mile radius data search of species records was obtained from ORBIC. Ten of the species which will be considered in this BA have records of being present within the two mile radius of the project site. These species are: *Arborimus albipes* (White-footed vole), *Bassariscus astutus* (Ringtail), *Charadrius nivosus nivosus* (Western snowy plover), *Lilium occidentale* (Western lily), *Oncorhynchus kisutch* (OC coho), *Oncorhynchus mykiss* (Steelhead), *Oncorhynchus tshawytscha* (Chinook), *Phacelia argentea* (Silvery phacelia), *Plebejus saepiolus littoralis* (Coastal greenish blue butterfly), and *Progne subis* (Purple martin).

The anadramous fish, the white-footed vole, and the Western lily are those species most suited to the available habitat in the vicinity of the action site.

The white-footed vole is likely to be located in Section 19, but would be found near the streams, living in alders, on which they feed. Best management construction practices, especially in the riverine zone must be utilized.

Western lily habitat was not found on the action site. A survey was preformed during this species flowering period on 15 July 2016 to make sure they were not missed in the thick scrub/shrub habitat. The shrub/scrub vegetation was removed in late January, and although during the April site visit it appeared that new growth was returning, the July site visit revealed that the rebound grown had been limited. The site was surveyed by Madeleine Vander Hayden of USFWS, LAWESI and Dyer Partnership personnel.

The streams near the action site are Essential Salmonid Habitat (ESH). The National Marine Fisheries Service has requested that the City apply through the Habitat Conservation Planning process for an incidental take permit. If federal money is sought for this project in the future then full consultation would be required.

Concurrently with the biological assessment, the likelihood of cultural resources on the action site was researched by contacting the archaeologist of the Coquille Tribe and the State Historic Preservation Office. There are no records of cultural resources on the site, but if artifacts or remains are found during construction, activity should stop and the Coquille Tribe and the State Historic Preservation Office should be contacted.

INTRODUCTION

Proposed Action

The City of Bandon, Oregon is proposing to build an off channel raw water reservoir to prevent future water shortfalls. This document is the biological assessment for the proposed site. Issues evaluated during the writing of this document include the possible impacts on or near the project site to biological resources.

Land And Water Environmental Services, Inc. (LAWESI) of Oakland, Oregon preformed this biological assessment for The Dyer Partnership Engineers and Planners of Coos Bay, Oregon.

The proposed site where the reservoir would be located is found at T28S R14W Sec. 29 on the Bandon 7.5 minute Quadrangle, 1970, and has the Coos County Tax Lot numbers 2400 and 2300 on Map# 28S14W29C. There will be a pipe line installed across lot 900 and lot 2200, within an existing utility easement where there are currently other utilities. A pump station in Ferry Creek will divert water from the creek to the reservoir during high flow conditions in Ferry Creek. Water from the reservoir will be pumped to the water treatment plant to provide water for the City during low flows in the summer, and a portion will be returned to Ferry Creek to supplement stream flow. The point of diversion is on the east side of Ferry Creek at the Bandon Fish Hatchery. Approximately 10 acres of scrub/shrub habitat and 10 acres of coniferous woodland habitat would be converted to a water storage reservoir.

Alternative Actions Considered

Dredging and repair of the reservoirs on Ferry and Geiger Creeks was one of the alternatives considered to expand water storage. Expanding the storage capacity of the current reservoirs is problematic due to expense, permitting issues, the dam safety approval process, and ownership of the dams, only one of which is owned by the City.

Another option considered was installing a new 1.0 or 2.0 million gallon treated water tank. This option is far more expensive per gallon of water than a raw water storage reservoir.

The City owns an alternate parcel similar to the proposed site, which was considered, but which does not at this time have utilities.

The no action alternative would mean that the City remains vulnerable to periods of drought and low stream flows.

The proposed action would provide water storage for the City of Bandon against times of drought and low water flow, and supplement Ferry Creek during low flows. An off channel reservoir is less of an environmental risk during construction than repairing the in channel reservoirs.

BIOLOGICAL RESOURCES

The purpose of this biological assessment is to consider the effects this project may have on the biological resources in the area of the site being considered for the City of Bandon raw water storage reservoir. Approximately 10 acres of scrub/shrub habit and 10 acres of coniferous woodland habitat would be converted to a water storage reservoir.

The site is located in the Lower Coquille hydrological unit (HUC 1710030507), near the confluence of Geiger Creek and Ferry Creek. Ferry Creek enters the Coquille River approximately 1.25 miles from the point of diversion for this project. The point of confluence of Ferry Creek with the River is at the Coquille River Estuary near the boat basin, approximately river mile one.

The site of the proposed reservoir is approximately 300 feet west of Geiger Creek, but at a higher elevation than the stream. The reservoir site location is 118-127 feet above mean sea level. Geiger Creek is at approximately 80 feet above mean sea level, flowing north toward its confluence with Ferry Creek.

The project site is located in the coastal lowlands of the Coast Range Ecoregion. The soil is Bullards sandy loam, 7 to 12 percent slopes which is a non-hydric soil, but can have inclusions of Blacklock fine sandy loam which is hydric.

The species considered in this biological assessment occur, or historically occurred, in Coos County as recorded by the Oregon Biodiversity Information Center (ORBIC).

Mammals: Threatened or Endangered Species

In addition to the species considered in this document there are seven whale species listed by National Marine Fisheries Service (NMFS) and Oregon Department of Fish and Wildlife (ODFW) which may occur off the coast of Coos County, but have no habitat on this site and are not enumerated in this document.

Canis Lupus (Gray wolf) is listed by United Sates Fish and Wildlife Service (USFWS) and by ODFW as endangered. Grey wolves can survive in a variety of habitats. At the present time in western Oregon, wolves are only found in the Cascades. During the course of this biological assessment the gray wolf was delisted by the state of Oregon. At this point in time there are believed to be 110 wolves in residence in Oregon. Wolves west of Hwys. 395-78-95 remained protected by USFWS.

Enhydra lutris (Sea otter) is listed by ODFW as threatened. Sea otter are found in the Marine and Estuarine Ecoregion. The project site is in the Coastal Ecoregion.

Eumetopias jubatus (Stellar sea lion, aka Northern sea lion) is listed by NMFS as threatened. Northern sea lion are found in the Marine and Estuarine Ecoregion. The project site is in the Coastal Ecoregion.

Ursus arctos (brown bear) is listed by USFWS as threatened. This species is considered extirpated

from the state of Oregon.

Mammals: Proposed, Candidate, Species of Concern, and Sensitive Species

Arborimus albipes, aka *Phencomys albipes* (White-footed vole) is designated by USFWS as a species of concern. White-footed vole are found in wooded riverine habitat with thick shrub undergrowth where red alder and hazel are available. There are ORBIC data records of white-footed vole occurring near the project site. The wooded areas along Geiger and Ferry Creeks may be habitat for the white-footed vole. The construction plans for this project should include management practices that will minimize disturbance to the riverine zone during construction.

Arborimus longicuadus (Red tree vole), north coast DPS, is designated by USFWS as a candidate species and by ODFW as a sensitive (vulnerable) species. Red tree voles are mostly arboreal and found in mature conifers where they eat the new growth tips. This species is more likely to be found at locations moderately higher in elevation than the project site, in the Coast Range with mature conifer forest.

Bassariscus astutus (Ringtail) is designated by ODFW as a sensitive (vulnerable) species. Ringtails are nocturnal, and though seldom seen sometimes live in buildings, though their natural preference is for rocky areas near water. There is an ORBIC data record of this species in the City of Bandon. There may be ringtail in the area, but the thick shrub/scrub of the project site is not the rocky habitat ringtails prefer.

Corynorhinus townsendii townsendii (Townsend's western big-eared bat) is designated by USFWS as a species of concern and by ODFW as a sensitive (critical) species. This species prefers cavern like structures such caves and mines, but will roost and hibernate in buildings. There are no caves, mines, or buildings on the project site.

Lasionycteris noctivagans (Silver-haired bats) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. This bat is found in the fissures of tree bark, buildings, rocks, and wood piles. The trees remaining on the project site are not mature enough to have fissured bark for bats to roost.

Martes caurina (Pacific marten), Coastal population, is designated by ODFW as a sensitive (vulnerable) species. Pacific marten are omnivores, and the many species of berries found in the project area rate highly in their diet. The project area was in the historical the range of this species, but the fragmentation of the forest so near a coastal town has decreased the range value for this species.

Myotis californicus (California myotis) is designated by ODFW as a sensitive (vulnerable) species. In the winter this bat roosts in caves, mines, and buildings. In the summer it can be found in a wider range of places including trees and shrubs. It is likely that there are bats in the area. The trees remaining on the project site are not mature enough to have fissured bark for bats to roost.

Myotis evotis (Long-eared bat) is designated by USFWS as a species of concern. This species is found in a variety of areas and roosts in tree bark, caves, and buildings. In the Pacific Northwest this bat

prefers tall snags reaching into or above the forest canopy. There are likely bats found in the area, but this project will not impact any likely bat roosting habitat.

Myotis thysanodes (Fringed myotis) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. This bat is found in oak, pinion, juniper; desert scrub habitat. The fringed myotis breeds in large colonies and roosts in caves, mines, and buildings. There is no likely roosting habitat for this species on the project site.

Myotis volans (Long-legged myotis) is designated bu USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. This bat roosts in trees, crevices, and buildings. There are likely bats found in the area, but this project will not impact any likely bat roosting habitat.

Myotis yumanensis (Yuma myotis) is designated by USFWS as a species of concern. Found near forests and water where they feed on associated insects, this bat species roosts in a variety of places but nurseries are usually in tree cavities. The remaining trees in this location are not mature enough to provide nursery habitat.

Pekania pennanti aka *Marte pennanti* (Fisher) USFWS has proposed threatened status for the west coast DPS, and ODFW has designated fisher as a sensitive (critical) species. This species prefers closed canopy forests, and at this point in time is not found in the Coast Range.

Birds: Threatened or Endangered Species

Brachyramphus marmoratus (Marbled murrelet) is listed by USFWS and ODFW as threatened, and critical habitat has been designated. Marbled murrelet is a seabird that seeks mature conifers to lay their eggs since they do not build nests but instead lay their eggs directly on broad limbs. The eastern portion of the project site has coniferous woods, but with inadequate limbs for nest platforms.

Charadrius nivosus nivosus (Western snowy plover) is listed by USFWS and ODFW as threatened, and critical habitat has been designated. There are ORBIC records of Western snowy plover on beaches within a 2 mile radius of the project site. This ocean shore bird nests on sand beaches. The project site does not contain habitat for this species.

Pelecanus occidentalis californicus (California brown pelican) has been delisted by USFWS, but is listed by ODFW as endangered. Brown pelican is an ocean bird that may be found on the coast and estuary from April through October. The project site does not contain habitat for this species.

Strix occidentalis caurina (Northern spotted owl) is listed by USFWS and ODFW as threatened, and critical habitat has been designated. Spotted owls nest in mature dense coniferous forest. The woodland habitat remaining on the project site is not adequate for this species.

Phoebastria albatrus (Short-tailed albatross) though not found in ORBIC, this species is listed by USFWS and ODFW as endangered. There is no habitat for this ocean bird on the project site.

Birds: Species of Concern, and Sensitive Species

Accipiter gentilis (Northern goshawk) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. This raptor prefers closed canopy forest in remote settings at elevations between 1,900 and 6,100 feet for summer breeding, may be present in Coast Range in the winter. The woodland habitat remaining on the project site is not adequate for this species.

Athene cunicularia hypugaea (Western burrowing owl) is designated by USFWS as a species of concern and by ODFW as a sensitive (critical) species. This bird nests in vacated burrows and culverts, and prefers grassland, shrub steppes, and savannah. Burrowing owl is more likely to be found in eastern Oregon.

Cerorhinca monocerata (Rhinoceros auklet) is designated by ODFW as a sensitive (vulnerable) species. This seabird nests in colonies, creating burrows in coastal headland areas. There is no habitat for this species on the project site.

Contopus cooperi (Olive-sided flycatcher) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. Preferred habitat is forest edges and riparian zones. Could be in the area May through August near streams.

Empidonax traillii brewsteri (Little willow flycatcher) is designated by ODFW as a sensitive (vulnerable) species. This bird breeds in heavy shrub habitat, preferring willows and riparian area. Cow bird parasitism is a serious problem for this species. May be found in the area near streams.

Falco peregrinus anatum (American peregrine falcon) is designated by ODFW as a sensitive (vulnerable) species. In the Pacific Northwest peregrine falcons are known to hunt for birds on beaches and dunes especially during the winter. This species may be in the vicinity but probably not on the project site.

Fratercula cirrhata (Tufted puffin) ODFW sensitive (vulnerable) species. This bird is an ocean cliff dweller. There is no habit on the project site for this species.

Haematopus bachmani (Black oystercatcher) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. This bird is found along rocky shores, and gravel beaches along the coast. There is no habit on the project site for this species.

Haliaeetus leucocephalus (Bald eagle) is designated by ODFW as a sensitive (vulnerable) species. Though delisted by USFWS this species remains protected under the Bald and Golden Eagle Protection Act (Eagle Act). Prefers to nest in trees near large bodies of water. No nesting trees for were found on the action site.

Histrionicus histrionicus (Harlequin duck) is designated by ODFW as a sensitive (vulnerable)species. This bird nests near mountain streams in the summer, then returns to rocky coastal areas during the winter. There is no habit on the project site for this species.

Icteria virens (Yellow-breasted chat) is designated by USFWS as a species of concern. This bird's

preferred habitat is dense scrub/shrub near a riparian zone. The yellow-breasted chat is a rare summer visitor to the Oregon coast north of Curry County.

Melanerpes formicivorus (Acorn woodpecker) is designated by USFWS as a species of concern. Acorn woodpeckers prefers open oak and mixed woodland. Likely extirpated from Coos County since the 1990's.

Melanerpes lewis (Lewis's woodpecker) is designated by USFWS as a species of concern and by ODFW as a sensitive (critical) species. The Lewis' woodpecker prefers pine-oak forest, riparian woodland, and orchards. Rarely found on the coast.

Oreortyx pictus (Mountain quail) is designated by USFWS as a species of concern. Preferred habitat of the mountain quail is brushy mountain areas, but is occasionally in the winter found on the coast in the transitional areas between beachgrass and forest, and sometimes at feeders.

Patagioenas fasciata aka *Columba fasciata* (Band-tailed pigeon) is designated by USFWS as a species of concern. This bird's preferred habitat is coniferous forest, and riparian areas. Usually found at higher elevations that the project area, but is adapting to city life.

Podiceps grisegena (Red-necked grebe) the breeding population is considered by ODFW a sensitive (critical) species. This grebe winters on the coast in protected saltwater. The breeding population is found in summer at Upper Klamath Lake.

Pooecetes gramineus affinis (Oregon vesper sparrow) is designated by USFWS as a species of concern. This sparrow's preferred habitat is grassland and farmland where it nests under low shrubs. Rare on the coastal slopes of Coos County.

Progne subis (Purple martin) USFWS species of concern, ODFW sensitive (critical) species. There is an ORBIC record of purple martin nesting in boxes in Bandon. Purple martin nest in summer months in western Oregon in a variety of open land from clear cuts to parks. The scrub-shrub habitat present before the site was cleared, and the forest habitat are too dense for this bird.

Ptychoramphus aleuticus (Cassin's auklet) is designated by ODFW as a sensitive (vulnerable) species. Cassin's auklet is a seabird that feeds in the ocean and nests colonially, burrowing on cliffs and islands along the coast. There is no habitat on site for this species.

Sialia mexicana (Western bluebird) is designated by ODFW as a sensitive (vulnerable) species. Blue bird's preferred habitats include open conifer forest, oak woodland, and farmland. The habitat available on the project site is thick shrub and woodland with heavy undergrowth, not the preference of this specie.

Reptiles: Threatened or Endangered Species

There are four species of marine turtles listed by NMFS and ODWF as endangered or threatened which may occur in the Marine and Estuarine Ecoregion along the coast of Coos County. There is no habitat

for these marine turtles on the project site, and they are not enumerated in this document.

Reptiles: Species of Concern, and Sensitive Species

Actinemys marmorata (Western pond turtle) is designated by ODFW as a sensitive (critical) species. The subspecies *Actinemys marmorata marmorata* (Northern Pacific pond turtle) is designated by USFWS as a species of concern. The pond turtle's preferred habitat is near ponds and small streams. This species may be present in the nearby streams, Geiger and Ferry Creeks. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Amphibians: Species of Concern, and Sensitive Species

Anaxyrus boreas aka *Bufo boreas* (Western toad) is designated by ODFW as sensitive (vulnerable) species, but is recorded in ORBIC with a question mark for Coos County. The preferred breeding habitat of this species is marsh or shallow lakes, near woodland. There maybe areas near, but not on the project site where this species could lay eggs.

Aneides ferreus, (Clouded salamander) is designated by ODFW as sensitive (vulnerable) species. The clouded salamander is found in moist forests, clear cuts, and burns where it lives in the decaying wood of large conifers and feeds on invertebrates; also found sheltering in rock crevices. The project site lacks the type of woody debris on which this species depends.

Ascaphus truei (Coastal tailed frog) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. This species is found in cool coastal streams in the Coast Range and Cascades. The tailed frog may be in streams near the site, but are not likely to be found on the project site. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Plethodon elongatus (Del Norte salamander) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. Found in rocky outcrops of forests. This species' range extends from southern Coos County south to Humboldt and Trinity Counties in California. Not found in the project area.

Rana boylii (Foothill yellow-legged frog) is designated by USFWS species of concern and by ODFW as a sensitive (vulnerable) species. This frog species is found near permanent streams and may be found at the streams near this project. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Rhyacotriton variegatus (Southern torrent salamander) is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. This species is found in cool streams near coniferous forest in the Coast Range, and might be found at the streams near this project. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Fish: Threatened or Endangered Species

Acipenser medirostris, Green sturgeon (Southern DPS) is listed by NMFS as threatened and critical habitat has been designated. Sturgeon spend much of there life in the ocean but enter major rivers along the Pacific coast to spawn. The rivers and estuaries where the southern distinct population segment of *Acipenser medirostris* run are the Sacramento River and rivers south of the Sacramento. The small streams nearest the project site are not habitat for sturgeon.

Oncorhynchus kisutch, Coho salmon aka OC coho (Oregon Coast ESU) is listed by NMFS as threatened and freshwater streams along the Oregon Coast are designated critical habitat under section 305 of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Under MSA, Essential Fish Habitat (EFH) is designated if the stream is or was historically accessible to coho and Chinook salmon. Although OC coho is not listed by ODFW, Essential Salmonid Habitat (ESH) has been designated for OC coho based on the OC coho Evolutionary Significant Unit (ESU), and is designated a sensitive (vulnerable) species. There are ORBIC records of coho salmon (pop. 3) within a 2 mile radius of the project site, and this species is known to be in Ferry Creek. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Thaleichthys pacificus, Eulachon aka smelt (Southern DPS) is listed by NMFS as threatened and critical habitat has been designated. The Umpqua River to the north and the Klamath River to the south are included in the critical habitat. Smelt run in larger rivers than the small streams near the project site.

Fish: Species of Concern, and Sensitive Species

Acipenser medirostris, Green sturgeon (Northern DPS) is designated by NMFS as a species of concern and by ODFW as a species of concern. Sturgeon spend much of there life in the ocean but enter major rivers along the Pacific coast to spawn. The rivers and estuaries where the northern distinct population segment of *Acipenser medirostris* run are the Klamath River and rivers north of the Klamath. The small streams nearest the project site are not habitat for sturgeon.

Entosphenus tridentatus, Pacific lamprey is designated by USFWS as a species of concern and by ODFW as a sensitive (vulnerable) species. Lamprey spend the majority of their life (3-7 years) living in a larval stage as filter feeders in the sand. As adults they migrate to the ocean where they are parasitic on marine fish for up to three years, then return to fresh water for about a year before spawning in gravel bottomed streams. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Lampetra ayresii, River lamprey is designated by USFWS as a species of concern. The larval stage (ammocoete) live as filter feeders in sandy back waters of streams. The adults live in streams, estuaries, and near shore sea until returning to streams to spawn in graveled riffles. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Oncorhynchus clarkii, Coastal cutthroat trout (Oregon Coast ESU) is designated by USFWS as a species of concern. This trout prefers the reaches of streams and rivers within a hundred miles of the Pacific. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Oncorhynchus mykiss, Steelhead (Oregon Coast ESU, summer run) is designated by NMFS as a species of concern. The summer run of steelhead return to freshwater from the ocean, May through August, and mature before spawning. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Oncorhynchus mykiss, Steelhead (Oregon Coast ESU, winter run), is designated by NMFS as a species of concern and by ODFW as sensitive (vulnerable) species in the Coquille drainage. The winter run of steelhead return to freshwater already mature, November through April, and spawn. There are ORBIC records of winter run steelhead (pop. 31) within a 2 mile radius of the project site, and this species is known to be in Ferry Creek. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Oncorhynchus tshawytscha, Chinook salmon (Oregon Coast ESU, spring run) in designated by ODFW as sensitive (critical) species. Chinook are the largest salmon species and use the largest gravel when spawning. There are ORBIC records of spring run Chinook (pop. 27) within a 2 mile radius of the project site. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Invertebrates: ORBIC List 1 & 2 Species

ORBIC List 1 contains species that are threatened with extinction or presumed to be extinct throughout their range. ORBIC List 2 contains species that are threatened with extirpation or presumed to be extirpated from the state of Oregon.

Anodonta californiensis (California floater mussel) is an ORBIC list 2 species, and considered by USFWS a species of concern. This species is listed in ORBIC as occurring in Coos County with a question mark. The question mark in ORBIC listings can mean that the species is rarely collected as opposed to truly rare. There is considerable debate amongst taxonomists with regard to the species divisions in *Anodonta.* This freshwater mussel is found in lakes and lake like streams. There may be freshwater mussels in nearby streams. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Bombus occidentalis (Western bumblebee) is an ORBIC list 2 species. The Western bumblebee has suffered a serious decline in western Oregon in recent decades, at this time it is rare and unlikely to be found in the area. Insect foraging habitat will be decreased by this project, but this project is unlikely to adversely affect any western bumblebee.

Callophrys johnsoni (Johnson's hairstreak butterfly) is an ORBIC list 2 species. Found in coniferous forest, often old growth, where it lives on pine dwarf mistletoe. Not usually found on the coast of Oregon. There is no habitat on the project site for this butterfly.

Cicindela hirticollis siuslawensis (Siuslaw sand tiger beetle) is an ORBIC list 2 species. A now rare species of beetle found on beaches at the mouth of rivers along the coast, occurs in the Bandon area. There is no habitat for this beetle on the project site.

Gonidea angulata (Western ridged mussel) is an ORBIC list 2 species. This freshwater mussel is found in cool streams at low to mid elevations. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Littorina subrotundata (Newcomb's littorine snail) is an ORBIC list 2 species, and considered by USFWS a species of concern. This species is a marine snail. There is no habitat on the project site for this species.

Monadenia fidelis beryllica aka *flava* (Green sideband snail aka Pacific sideband) is an ORBIC list 1 species. This rare subspecies is found in southwestern Oregon on the western slope of Coast range in forest and riverine habitat. The majority records for the occurrence of this subspecies are for Curry County.

Plebejus saepiolus littoralis (Coastal greenish blue butterfly) is an ORBIC list 1 species, and is considered by USFWS as a species of concern. There is an ORBIC record of this butterfly on beach habitat within a two mile radius of the project area. There is no habitat on the project site for this species.

Pomatiopsis californica (Pacific walker snail) is an ORBIC list 1 species. The Pacific walker is a semiaquatic species found in moist leaf litter near streams. The species range is in the fog zone along southern Oregon and northern California coast. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Invertebrates: Species of Concern, and ORBIC List 3 & 4 Species

ORBIC List 3 contains species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range. ORBIC List 4 contains species which are of conservation concern, but are not currently threatened or endangered.

Anodonta oregonensis (Oregon floater mussel) is an ORBIC list 4 species. There is considerable debate amongst taxonomists with regard to the species divisions in *Anodonta*. *Anodonta* are more tolerant of poor water quality than other freshwater mussels. There may be freshwater mussels in nearby streams. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction.

Bembidion tigrinum (Cryptic beach carabid beetle) is an ORBIC list 3 species. Species habitat is coastal beaches. There is no habitat on the project site for this species.

Margaritifera falcata (Western pearlshell mussel) is an ORBIC list 4 species. This long lived freshwater mussel once widely distributed in the Pacific drainage has become extirpated from some large rivers due to sedimentation, and the decrease in host fish. There may be freshwater mussels in

nearby streams. The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction

Megomphix hemphilli (Oregon megomphix snail) is an ORBIC list 4 species. This terrestrial snail is found in mid elevations (500-1500 ft.), in association with big leaf maple, under moist rotting logs. The project site lacks likely habitat for this species.

Nabicula propinqua (Marsh damsel bug aka marsh nabid) is an ORBIC list 3 species. A carnivorous bug found in marsh habitat. There is no habitat on the project site for this species.

Platylygus pseudotsugae (Douglas-fir plant bug aka Douglas-fir platylyngus) is an ORBIC list 3 species. Found in association with Douglas-fir host, more likely at higher elevation. There is no habitat on the project site for this species.

Saldula villosa (Hairy shore bug) is an ORBIC list 3 species. Rare species found in salt marsh habitat. Known from only one specimen in Coos County. There is no habitat on the project site for this species.

Teratocoris paludum (Pale plant bug aka pale teratocoris sedge bug) is an ORBIC list 3 species. Found in intertidal zone. There is no habitat on the project site for this species.

Plants: Threatened or Endangered Species

Abronia umbellata ssp. *breviflora* (Pink sandverbena) is designated by USFWS as a species of concern, and is listed by Oregon Department of Agriculture (ODA) as endangered. This plant lives on sand beaches. There is no habit for this species on the project site.

Chloropyron maritimum ssp. *palustre,* formerly *Cordylanthus maritimus p.,* (Pt. Reyes bird's beak) is designated by USFWS as a species of concern, and is listed by ODA as endangered. This plant grows in saltwater marsh. There is no habitat for this species on the project site.

Lilium occidentale (Western lily) is listed by USFWS and ODA as endangered. There are ORBIC records of western lily in a 2 mile radius of the project site. This lily grows on the edge of bogs within the fog zone of the coast. Both the shrub/scrub and the wooded area of the project site are too shaded for western lily to bloom. No bogs were located on site. The main standing water on site appears to be where septic test pits were dug.

Phacelia argentea (Silvery phacelia) is designated by USFWS as a species of concern, and is listed by ODA as threatened. There are ORBIC records of silvery phacelia within a 2 mile radius of the project site. This species grows on beaches, dunes, and coastal bluffs. There is no habitat for this species on the project site.

Plants: Species of Concern, and Candidate Species

Bensoniella oregana (Bensonia) is designated by USFWS as a species of concern and by ODA as a

candidate species. This plant is found in transitional zones between forest and meadow at higher elevation (2000-5000 feet) than the project site. There is no habitat for this species on the project site.

Limbella fryei (Limbella moss) is designated by USFWS as a species of concern and by ODA as a candidate species. This moss is is found in tall shrub marsh growing on the lower trunks of shrubs such as willow and the surrounding leaf litter. There is no habitat for this species on the project site.

Sidalcea malviflora ssp. *patula* (Coast checker bloom or mallow) is designated by USFWS as a species of concern and by ODA as a candidate species. Often found along roadsides in the Coast Range in southern Oregon and northern California. Habitat is open coastal forests and bluffs. This species may be along roads in the area of the site.

Triteleia hendersonii var. *leachiae* (Leach's brodiaea aka Blue-striped brodiaea) is designated by USFWS as a species of concern and by ODA as a candidate species. Found on well drained slopes, and has been observed in the Coquille watershed. The project site lacks hillsides.

SITE CONDITIONS

At the time of LAWESI biologist's first site visit, in January 2016, the scrub/shrub habitat contained *Gaultheria shallon* (salal) 30%, *Vaccinium ovatum* (Evergreen huckleberry) 25%, *Arctostaphylos columbiana* (Hairy manzanita), *Pinus contorta* (Shore pine), *Chamaecyparis lawsoniana* (Port Orford cedar); *Arbutus menziesii* (Pacific madrone). There were no wetlands present, though there was water retained in places that had reportedly in the past been dug for septic test pits. The vegetation was dense, and appeared to be transitioning to mixed forest habitat by the number of young trees colonizing.

The forest habitat overstory included *Pinus contorta* (Shore pine), *Tsuga heterophylla* (Western hemlock), and *Pseudotsuga menziesii* spp. *menziesii* (Douglas fir). The understory included *Gaultheria shallon* (salal), *Vaccinium ovatum* (Evergreen huckleberry), *Rubus parviflorus* (Thimble berry), and *Rhododendron macrophyllum* (Pacific rhododendron).

At the time of the second site visit, in April 2016, the scrub/shrub vegetation had been bladed off and test borings had been drilled. The forest habitat was unaltered from the January 2016 site visit. (See photo report in Appendix F.)

CUMULATIVE AND INDIRECT EFFECTS

This project will permanently impact ten acres of mixed forest (mostly coniferous) and ten acres of shrub/scrub habitat. No wetlands will be impacted. No threatened or endangered species will be adversely affected.

MITIGATION

The construction plans for this project should include management practices that will minimize disturbance to the stream areas during construction. Best management construction practices to prevent erosion during a storm event would be followed.

INFORMATION SOURCES

Responses to Request for Comments (See Appendix G.)

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Vander Hayden, Madeleine, Fish and Wildlife Biologist, Coordinator, Oregon Coastal Program, USFWS

April 15, 2016 (includes request for comments):
Amsberry, Kelly, Native Plant Conservation Program, Oregon State University

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Phippen, Kenneth W., Oregon Coast Branch Chief, National Marine Fisheries Service

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Hansen, Glenn L., Douglas County Librarian, research assistance

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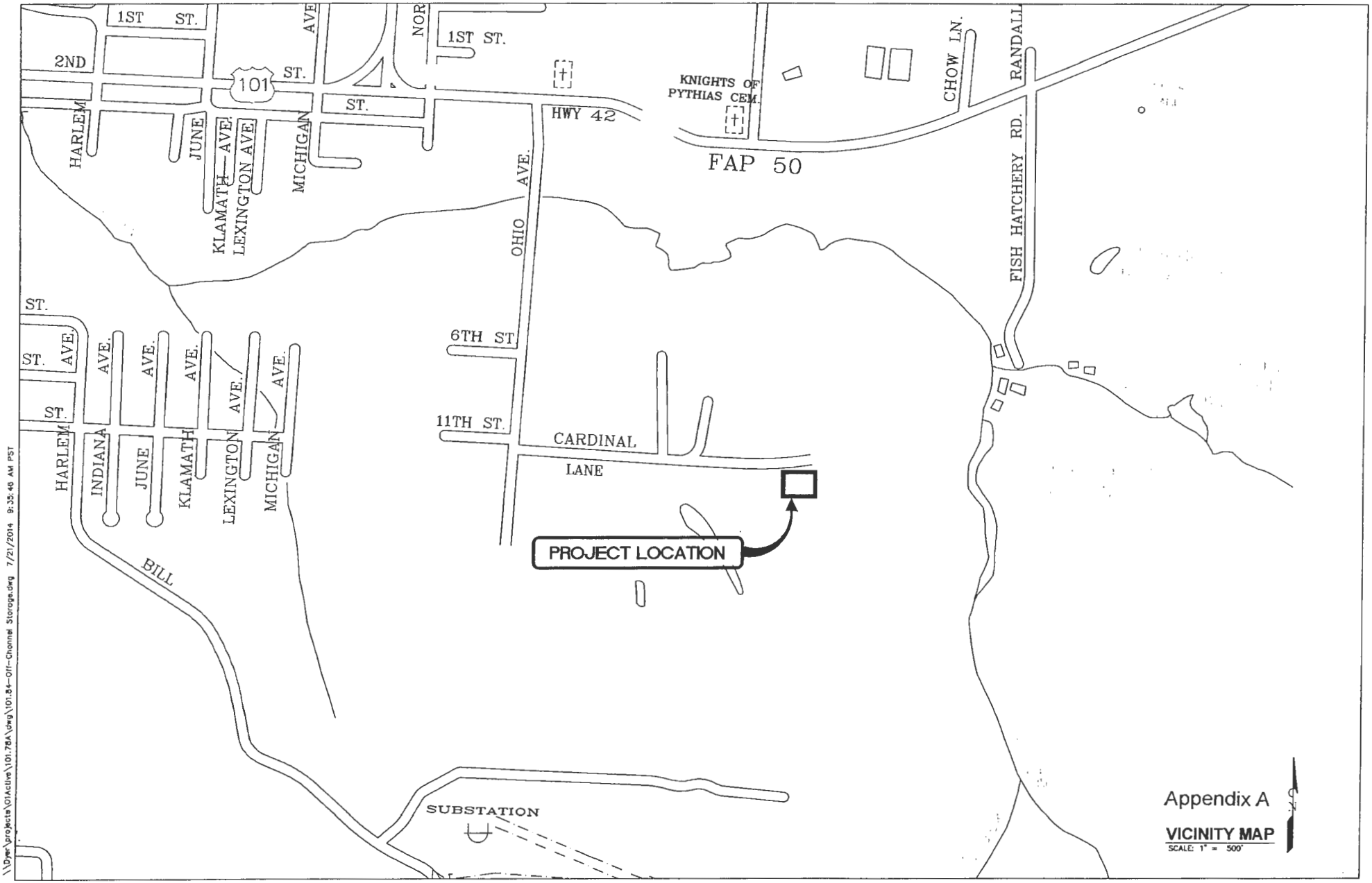
Document Preparation

Dayl Waldron
Land And Water Environmental Services, Inc.
2016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FISH HATCHERY RD.
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CARDINAL
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PROJECT LOCATION
INDIANA
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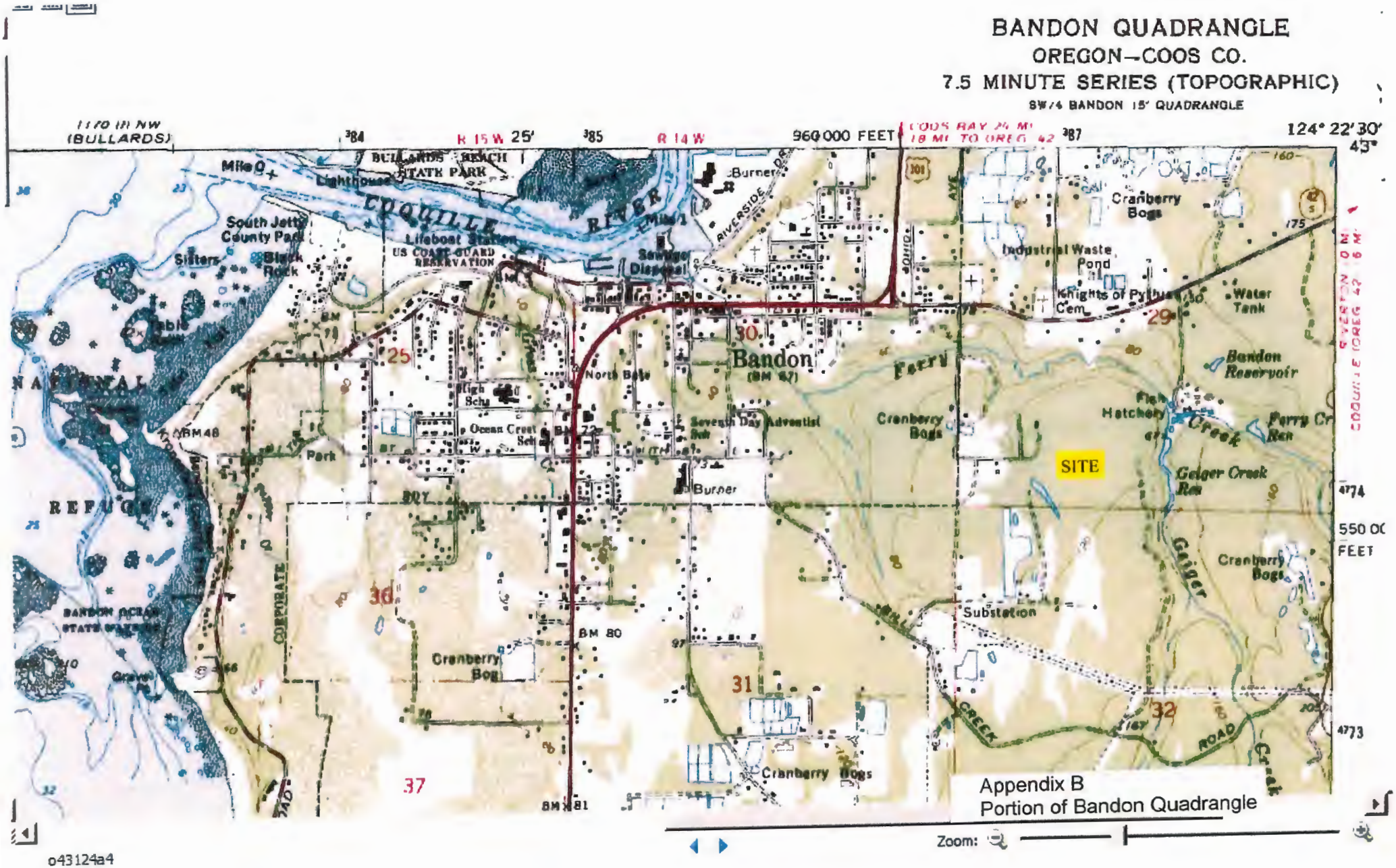
SUBSTATION
Appendix A
VICINITY MAP
SCALE: 1" = 500'


BANDON QUADRANGLE
OREGON—COOS CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SW/4 BANDON 15' QUADRANGLE
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Bandon
Bullards Beach State Park
Lighthouse
Coquille River
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South Jetty County Park
Lifeboat Station US Coast Guard Reservation
Sewage Disposal
Burner
Cranberry Bogs
Industrial Waste Pond
Knights of Pythias Cem.
Water Tank
Bandon Reservoir
Fish Hatchery
Ferry Creek
Ferry Cr Res
Geiger Creek Res
SITE
North Bend
High Sch
Ocean Crest Sch
Seventh Day Adventist
Park
Substation
Geiger
Corporate
Bandon Beach State Park
Gravel Pit
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Cranberry Bogs
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Appendix B
Portion of Bandon Quadrangle
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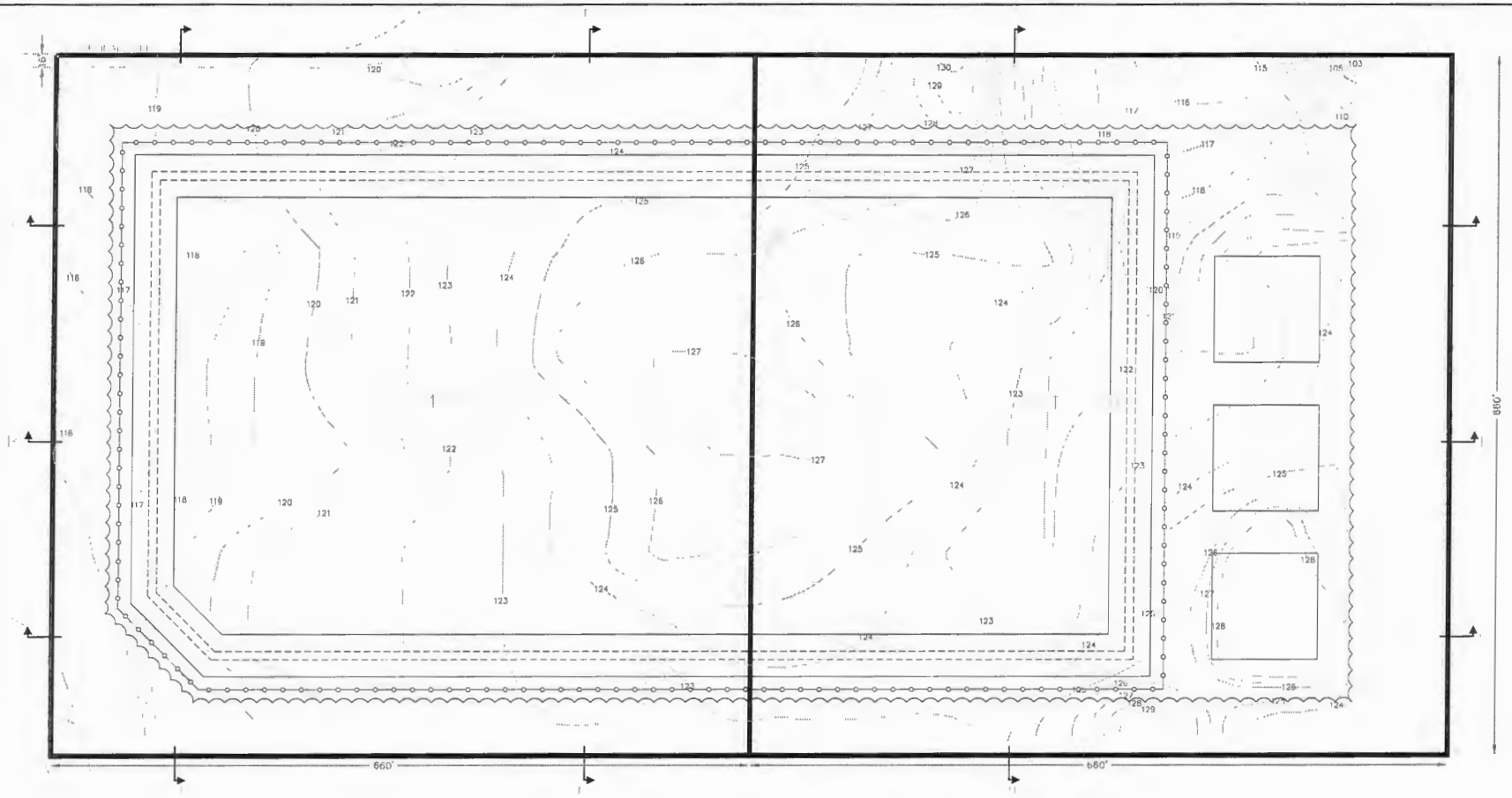


PRELIMINARY – NOT FOR CONSTRUCTION

NOTE:
PRELIMINARY DESIGN ONLY
ALL SLOPES AND DIMENSIONS ARE APPROXIMATE
ELEVATIONS BASED OFF OF GOOGLE EARTH

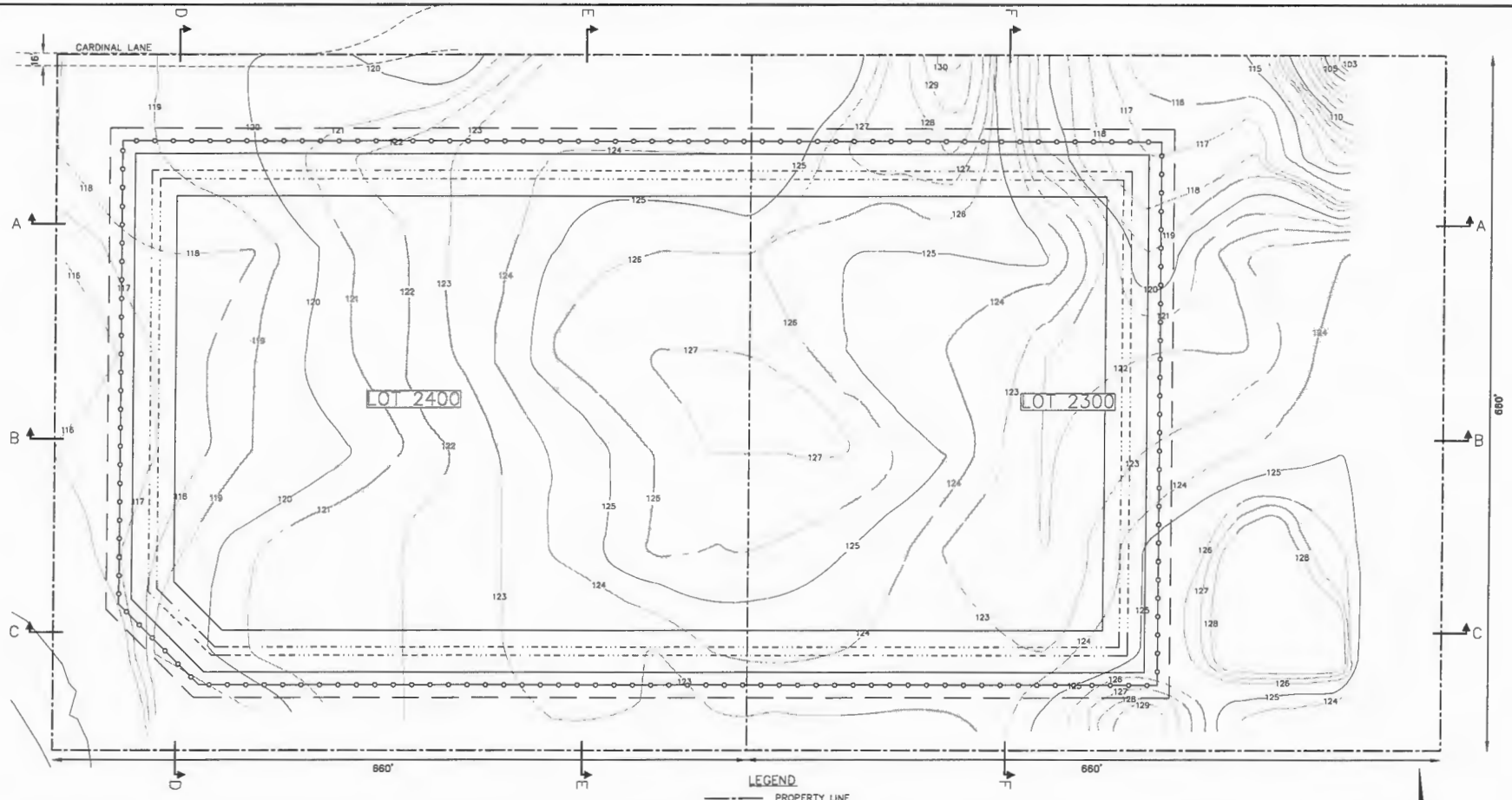
PLAN SCALE

Appendix C, page 1 of 2

OFF-CHANNEL RAW WATER RESERVOIR
CITY OF BANDON

PRELIMINARY CONTOUR MAP

PROJECT NO.	DRAWING NO.
101.84	
DATE	SHEET NO.
SEPT, 2014	1 OF 2



LEGEND

- PROPERTY LINE
- PROPOSED TOE DIKE
- PROPOSED TOB DIKE
- PROPOSED CHAIN LINK FENCE
- BRUSH LINE PROPOSED
- MINOR CONTOUR LINES
- MAJOR CONTOUR LINES
- 124 ELEVATION

N

PLAN SCALE
50 0 50 100

CITY OF BANDON
P.O. BOX 57
BANDON, OREGON 97411
(541) 347-2437

28S 14W 29C 2300
28S 14W 29C 2400

NOTE:
PRELIMINARY DESIGN ONLY
ALL SLOPES AND DIMENSIONS ARE APPROXIMATE
ELEVATIONS BASED OFF OF GOOGLE EARTH

PRELIMINARY - NOT FOR CONSTRUCTION

SUBMITTED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

REVISIONS				
REVISED	DESCRIPTION	SUBMIT	APPR'D.	DATE

DESIGNED: -
DRAWN: -
CHECKED: -
APPROVED: -

THE DYER PARTNERSHIP
ENGINEERS & PLANNERS, INC.
1330 TEAKWOOD AVENUE
COOS BAY, OREGON 97420
TELEPHONE: (541) 269-0732
www.dyerport.com

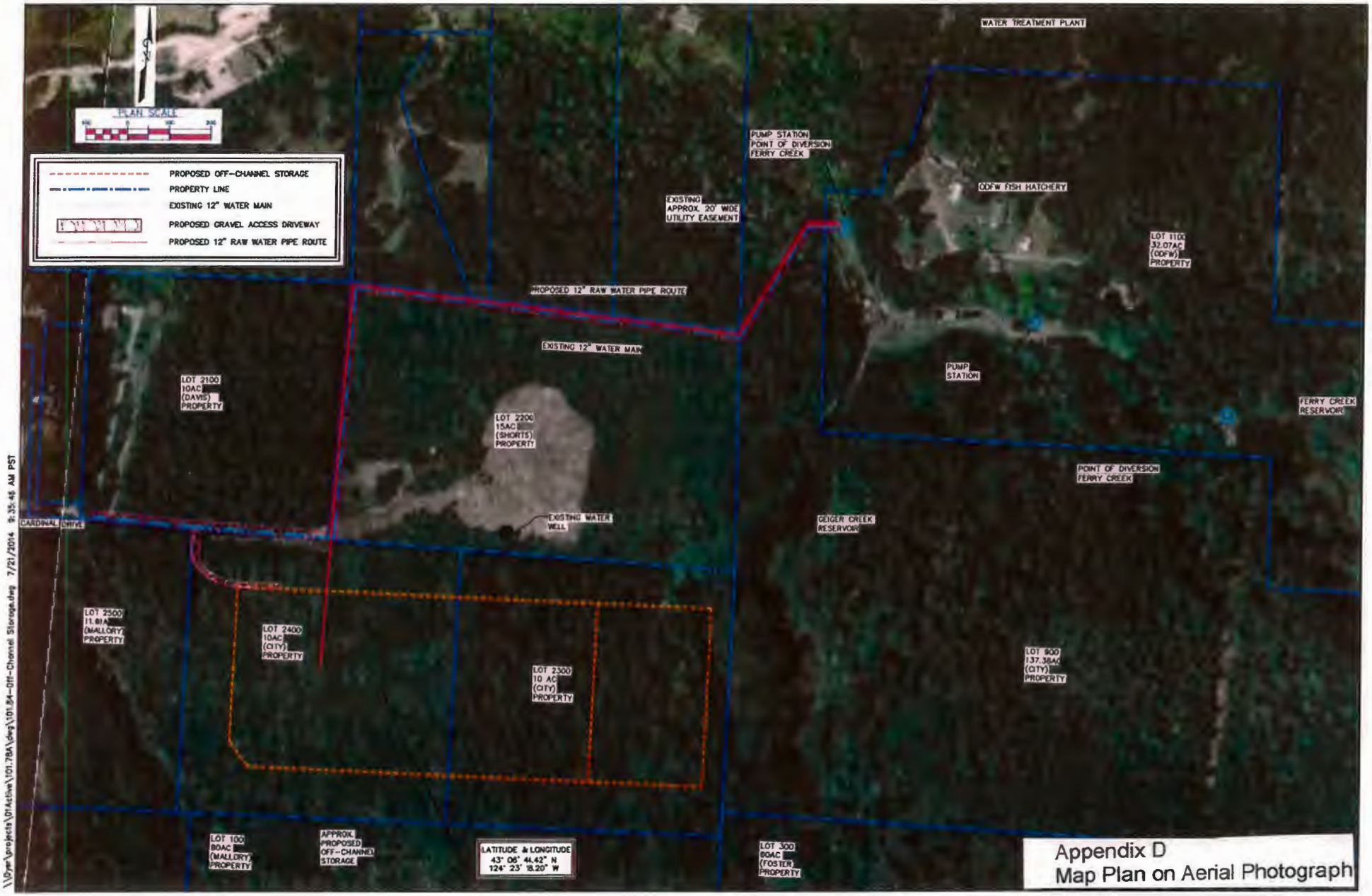
LINE IS 1 INCH AT FULL SCALE
IF NOT 1-INCH - SCALE ACCORDINGLY

Appendix C, page 2 of 2

OFF-CHANNEL RAW WATER RESERVOIR
CITY OF BANDON

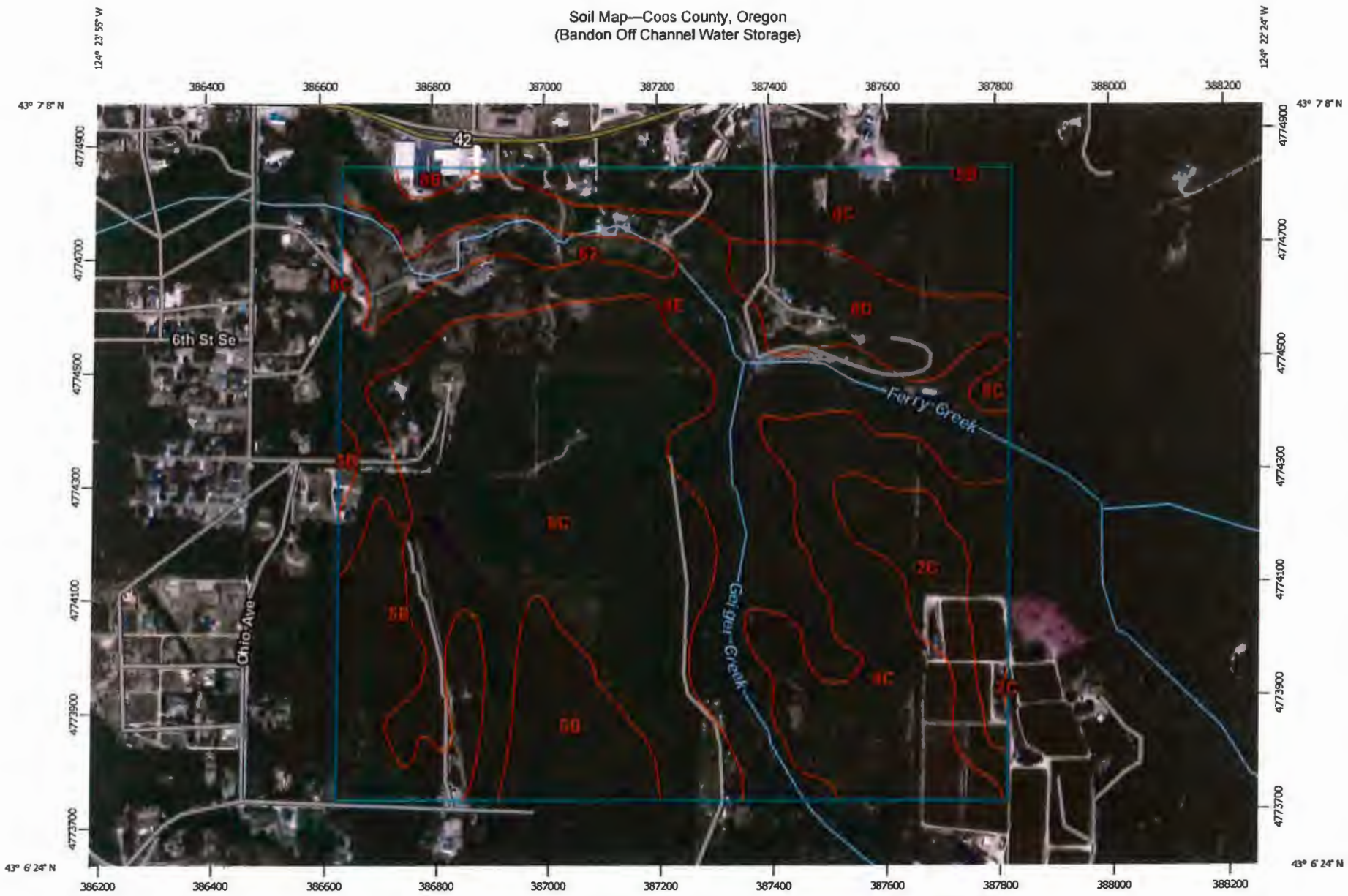
PRELIMINARY CONTOUR MAP

PROJECT NO.	DRAWING NO.
101.84	
DATE	SHEET NO.
SEPT, 2014	1 OF 2



\\Dyer\projects\01Active\101.78A\dwg\101.84-Off-Channel Storage.dwg 7/21/2014 9:35:46 AM PST

Soil Map—Coos County, Oregon
(Bandon Off Channel Water Storage)



Appendix E
Soil Map and Legends, page 1 fo 3

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Coos County, Oregon
Survey Area Data: Version 10, Sep 18, 2015

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 6, 2010—Jul 13, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Appendix E
Soil Map and Legends, page 2 fo 3

Map Unit Legend

Coos County, Oregon (OR011)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
2C	Bandon-Blacklock complex, 0 to 12 percent slopes	13.4	4.1%
5B	Blacklock fine sandy loam, 3 to 7 percent slopes	37.6	11.4%
8B	Bullards sandy loam, 0 to 7 percent slopes	1.3	0.4%
8C	Bullards sandy loam, 7 to 12 percent slopes	167.9	51.0%
8D	Bullards sandy loam, 12 to 30 percent slopes	17.5	5.3%
8E	Bullards sandy loam, 30 to 50 percent slopes	80.0	24.3%
62	Willanch fine sandy loam	11.7	3.6%
Totals for Area of Interest		**329.5**	**100.0%**

Appendix E
Soil Map and Legends, page 3 of 3

APPENDIX F

SITE PHOTOGRAPHS:

January 2016

April 2016

1. January 2016, scrub/shrub habitat. Shore pine, evergreen huckleberry.

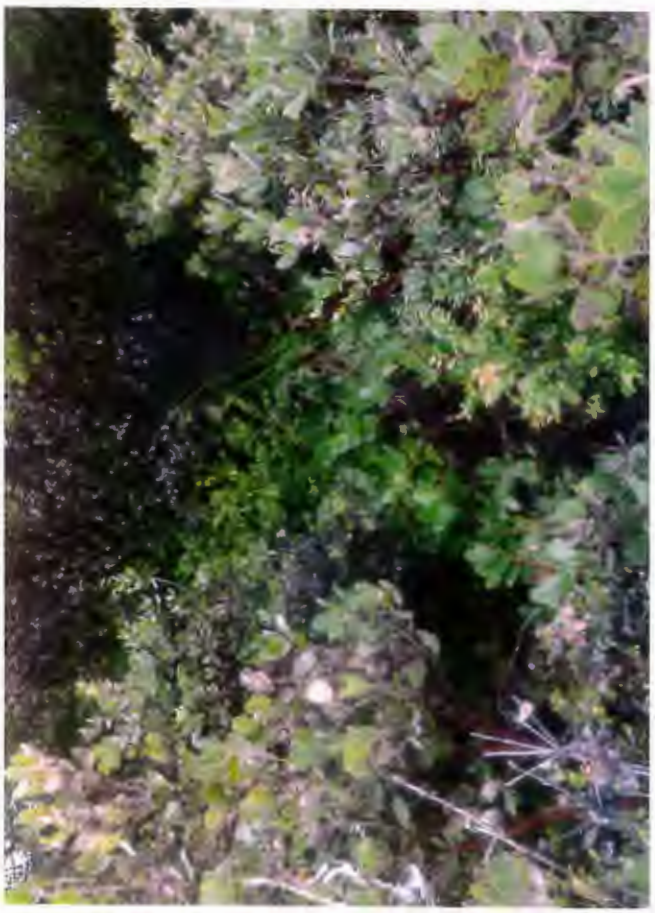
2. Hairy manzanita, salal, western hemlock, Douglas fir.

3. Hairy manzanita, Pacific madrone, evergreen huckleberry, salal, broom

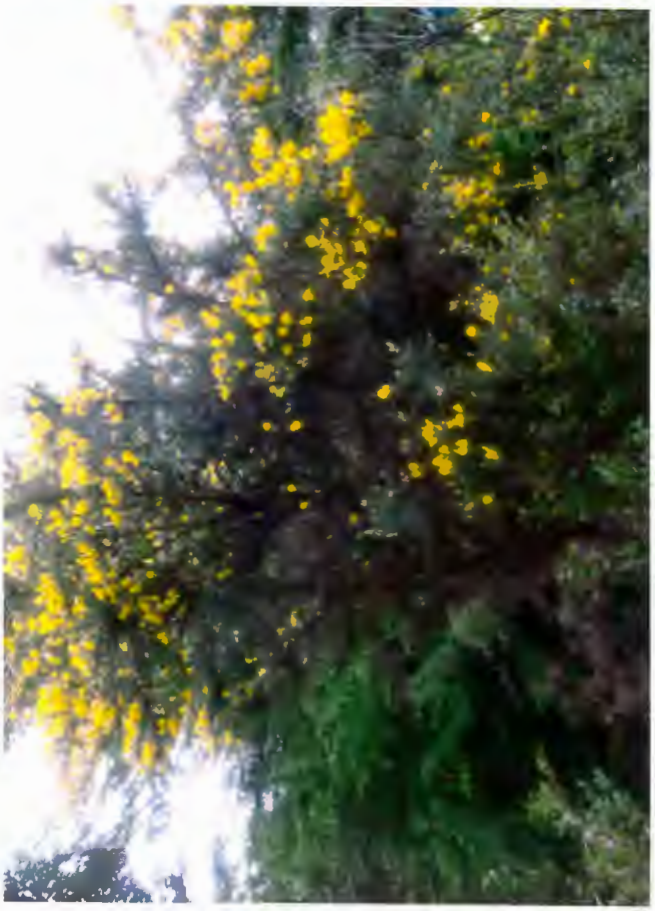
4. Pacific rhododendron center of photo.

6. Manzanita

8. Gorse



5.



7. Broom

9. Water standing in reported septic test pit.

10.

11. Young trees colonizing .

12. Utility right-of-way leading to Ferry Creek.

1. April 22, 2016, area that was scrub/shrub has been cleared.

2. Looking east toward forested area.

3. Sandy patch where test pit was dug.

4. Forested area and under growth of salal, and evergreen huckleberry.

5. Understory of thimbleberry, evergreen huckleberry, salal, rhododendron, coastal willow

6. Dense under growth

7. Western hemlock, Douglas fir, Pacific rhododendron

8. Shore pine, coastal willow

APPENDIX G

RESPONSES TO REQUEST FOR COMMENTS:

April 4, 2016:
Rippee, Kassandra, Archaeologist, Tribal Historic Preservation Officer, Coquille Indian Tribe

April 13, 2016:
Vander Hayden, Madeleine, Fish and Wildlife Biologist, Coordinator, Oregon Coastal Program, USFWS

April 15, 2016 (includes request for comments):
Amsberry, Kelly, Native Plant Conservation Program, Oregon State University

April 26, 2016:
Curtis, Ross, SHPO Archaeologist, State Historic Preservation Office

May 3, 2016:
Phippen, Kenneth W., Oregon Coast Branch Chief, National Marine Fisheries Service

COQUILLE INDIAN TRIBE

3050 Tremont Ave. North Bend, OR 97459
Telephone: (541) 756-0904 ~ Fax: (541) 756-0847
www.coquilletribe.org

April 4, 2016

Land and Water Environmental Services, Inc.
PO Box 448
119 NE 2nd Street, Suite B
Oakland, OR 97462

Re: City of Bandon Off-Channel Raw Water Storage Reservoir Project

Thank you for the opportunity to comment on the proposal to site an off-channel reservoir located near the confluence of Geiger Creek and Ferry Creek, Oregon. The Coquille Indian Tribe concurs with the anticipatory finding of no historic properties/cultural resources effected. We request that we be contacted immediately if any known or suspected cultural resources are encountered during the work.

Extreme caution is recommended during project related groundbreaking activities. If archaeological materials are discovered, uncovered, or disturbed, on the property, we will discuss the appropriate actions with all necessary parties. ORS 97.745 prohibits the willful removal, mutilation, defacing, injury, or destruction of any cairn, burial, human remains, funerary objects, or objects of cultural patrimony of a Native Indian. ORS 358.920 prohibits excavation, injury, destruction, or alteration of an archaeological site or object, or removal of an archaeological object from public or private lands.

Thank you again and feel free to contact me at (541) 808-5554 if you have any questions.

Best,

Kassandra Rippee, MA
Archaeologist
Tribal Historic Preservation Officer
Coquille Indian Tribe

CRT15540

Print | Close Window

Subject: Request for comments on city of Bandon off-channel raw water storage
From: Madeleine Vander Heyden <madeleine_vanderheyden@fws.gov>
Date: Wed, Apr 13, 2016 3:53 pm
To: <dwaldron@landandwater.biz>

Ms. Waldron,

I was forwarded your request for comments on the subject line project. I'm the US Fish and Wildlife Service lead for the Federally endangered western lily. There are indeed a few populations in the Bandon area, and a few individuals were found in the city's watershed several years ago.

The western lily occurs on two types of soils, decomposed peat or muck substrate, or soils that are poorly drained due to a shallow iron pan (e.g., Blacklock, Bandon, or Bullard series in Oregon), or clay layer (e.g., Joeney series in Oregon). It requires a habitat that maintains a delicate balance between maintaining adequate moisture to avoid desiccation during the growing season, and avoiding prolonged inundation when it needs to grow; thus, the close association with soils that either "perch" water near the surface and stay relatively moist, or where the water table drops seasonally to expose the bulbs.

The 23 extant principle populations (including CA occurrences) range in size from less than 0.1 acre to more than 6 acres, totaling about 40 acres of occupied habitat. Due to the rarity of this species, any potential impacts to potentially suitable but unsurveyed sites are a concern. Occasionally a new population is discovered, and I have hopes to find others.

I am requesting a site visit to determine whether the proposed development may contain western lilies. July would be ideal for detecting flowering individuals; would this be possible? Also, would you please send me a map of proposed activities?

Thank you for considering the western lily.

Madeleine

Madeleine Vander Heyden
Fish and Wildlife Biologist
Coordinator, Oregon Coastal Program
U. S. Fish and Wildlife Service, Newport Field Office
83673 North Bank Lane
Bandon, Oregon 97411
541-347-1470 ext. 4

Print | Close Window

Subject: RE: Request for Comments on the City of Bandon
From: "Amsberry, Kelly" <amsberrk@science.oregonstate.edu>
Date: Fri, Apr 15, 2016 5:14 pm
To: <dwaldron@landandwater.biz>
Cc: "Robert Meinke" <meinker@science.oregonstate.edu>

Hi Day!!

As required by OAR 603-073, the City of Bandon and/or OWRD will need to request a consultation by ODA prior to initiating ground breaking activities that may impact T/E species. The consultation request must originate from the land management agency - more information is available on our website. http://www.oregon.gov/ODA/programs/PlantConservation/PermitsConsultations/Pages/AboutPermitsConsultations.aspx

Only T/E plant species listed by ODA are protected by the OAR , not "all T&E listed, proposed, candidate, species of concern, and sensitive species that may occur in the area as established by Oregon Biodiversity Information Center (ORBIC) records"). A survey for plants likely to occur will be required - we usually start with the plant species found in the county where the project occurs, which are *Lilium occidentale*, *Phacelia argentea*, *Abronia umbellata* var. *breviflora*, and *Cordylanthys maritimus* ssp. *palustris*. It sounds from the description below like the site may have suitable habitat for *Lilium occidentale*, but probably not for *Phacelia argentea*, unless the site contains sandy areas not mentioned. And it looks like it's too far from the coast for the other two. A survey will be required for *Lilium occidentale* (and for the *Phacelia* if there are sandy areas) - our website has information on survey timing, surveyor qualifications, etc., as well as a template to use for survey results. (Is using the survey template what you mean by "the biological assessment of this site will follow the Department of Agriculture format"? ODA does not require a biological assessment, nor provide a format). A lily survey would probably best be done in late June-July, and most any time in the summer for the *Phacelia*.
http://www.oregon.gov/ODA/programs/PlantConservation/PermitsConsultations/Pages/ConsultationProcess.aspx

Bob Meinke is currently handling consultations for our agency; please contact him at 541 737-2317 or meinker@science.oregonstate.edu

Feel free to contact me too, if you have additional questions! We have been working on lily recovery for the last few years, so would be interested to know if there are more publically owned lily populations out there.

Kelly Amsberry
Native Plant Conservation Program
Oregon Department of Agriculture
2082 Cordley Hall, Dept. of Botany and Plant Pathology

Oregon State University
Corvallis, OR 97331
(541) 737-4333
(541) 602-1729

From: dwaldron@landandwater.biz [mailto:dwaldron@landandwater.biz]
Sent: Friday, April 15, 2016 1:54 PM
To: kamsberry@oda.state.or.us
Subject: Request for Comments on the City of Bandon

Off-Channel Raw Water Storage Reservoir Project
Lat. 43.112372, Long. -124.387882

The City of Bandon and the Oregon Water Resources Department (OWRD) are in the initial planning stage of a project to store raw water in an off channel reservoir. This is a first of its kind funding by OWRD, with a view to begin addressing future water shortfalls in our communities. A first step in this process will be examining potential sites for their suitability. Amongst the issues to be evaluated are the possible impacts to the biological and cultural resources on or near the project site.

The Dyer Partnership Engineers and Planners has assisted the City in choosing a reservoir site that fits the community's needs and the geophysical requirements. They will be designing the project plans. Land And Water Environmental Services will be writing a biological assessment for the project.

The proposed location where the reservoir would be located is found at T28S R14W Sec. 29 on the Bandon 7.5 minute Quadrangle, 1970, and has the Coos County Tax Lot numbers 2400 and 2300 on Map# 28S14W29C. There will be a pipe line installed across lot 900 and lot 2200, within an existing utility easement where there are currently other utilities. A pump station in Ferry Creek will divert water from the creek to the pond during high flow conditions in Ferry Creek. The point of diversion is on the west side of Ferry Creek opposite the Bandon Fish Hatchery. Approximately 10 acres of land that is now scrub/shrub habit and 10 acres of coniferous woodland habitat would be converted to a water storage reservoir.

The site is located in the Lower Coquille hydrological unit (HUC 1710030507), near the confluence of Geiger Creek and Ferry Creek. Ferry Creek enters the Coquille River approximately 1.25 miles from the point of diversion for this project. The soil type of the reservoir site is Bullards sandy loam, which is a non-hydric soil but can have inclusions of Blacklock fine sandy loam which is hydric.

The reservoir site is approximately 300 feet west of Geiger Creek, but at a higher elevation than the stream. The reservoir site location is 118-127 feet above mean sea level. Geiger Creek is at approximately 80 feet above mean sea level, flowing north toward its confluence with Ferry Creek.

The biological assessment of this site will follow the Department of Agriculture format and consider all T&E listed, proposed, candidate, species of concern, and sensitive species that may occur in the area as established by Oregon Biodiversity Information Center (ORBIC) records.

A two mile radius data search of species records has been obtained from ORBIC. Ten of the species which will be considered in the biological assessment have records of being present within the two mile radius of the project site. These species are: *Arborimus albipes* (White-footed vole), *Bassariscus astutus* (Ringtail), *Charadrius nivosus nivosus* (Western snowy plover), *Lilium occidentale* (Western lily), *Oncorhynchus kisutch* (OC coho), *Oncorhynchus mykiss* (Steelhead), *Oncorhynchus tshawytscha* (Chinook), *Phacelia argentea* (Silvery phacelia), *Plebejus saepiolus littoralis* (Coastal greenish blue butterfly), and *Progne subis* (Purple martin).

We would appreciate your assistance with information you may have specific to this site concerning cultural resources, rare species or critical habitat in the area.

Sincerely:

Ms Dayl Waldron
Land And Water Environmental Services, Inc.
PO Box 448
Oakland, OR 97462
dwaldron@landandwater.biz
(541-459-4141)

Oregon

Parks and Recreation Department
State Historic Preservation Office
725 Summer St NE Suite C
Salem, OR 97301-1266
Phone (503) 986-0690
Fax (503) 986-0793
www.oregonheritage.org

April 26, 2016

Mr. Dayl Waldron
Land & Water Enviro Services Inc
PO Box 448
Oakland, OR 97462

RE: SHPO Case No. 16-0574
City of Bandon, Off-Channel Raw Water Storage Reservoir Project
Reservoir creation, intaling pipe, pump station
28S 14W 29 Taxlot 2400 and 2300, Bandon, Coos County

Dear Mr. Waldron:

Our office recently received a request to review your application for the project referenced above. In checking our statewide archaeological database, it appears that there have been no previous surveys completed near the proposed project area. However, the project area lies within an area generally perceived to have a high probability for possessing archaeological sites and/or buried human remains. In the absence of sufficient knowledge to predict the location of cultural resources within the project area, extreme caution is recommended during project related ground disturbing activities. Under state law (ORS 358.905 and ORS 97.74) archaeological sites, objects and human remains are protected on both state public and private lands in Oregon. If archaeological objects or sites are discovered during construction, all activities should cease immediately until a professional archaeologist can evaluate the discovery. If you have not already done so, be sure to consult with all appropriate Indian tribes regarding your proposed project. If the project has a federal nexus (i.e., federal funding, permitting, or oversight) please coordinate with the appropriate lead federal agency representative regarding compliance with Section 106 of the National Historic Preservation Act (NHPA). If you have any questions about the above comments or would like additional information, please feel free to contact our office at your convenience. In order to help us track your project accurately, please reference the SHPO case number above in all correspondence.

Sincerely,

Ross Curtis
SHPO Archaeologist
(503) 986-0676
ross.curtis@oregon.gov

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
Oregon Coast Branch
2900 Stewart Parkway
ROSEBURG, OREGON 97471

May 3, 2016

Dayl Waldron
Land and Water Environmental Services, Inc.
P.O. Box 448
Oakland, Oregon 97462

Re: Comments on the City of Bandon Off-Channel Raw Water Storage Reservoir, Ferry Creek, Bandon, Coos County, Oregon

Dear Ms. Waldron:

The National Marine Fisheries Service (NMFS) received your March 30, 2016 letter requesting comments on the City of Bandon off-channel raw water storage reservoir. This letter regards the potential impacts to any Endangered Species Act (ESA) listed species, critical habitat, or essential fish habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) that may be found in the vicinity of the proposed reservoir. This letter does not satisfy consultation under the ESA nor the MSA, instead it communicates the presence of NMFS trust resources associated with both of those acts. The City of Bandon and Oregon Water Resources Department are in the planning phases of this project and are evaluating the possible impacts to biological resources near the site. Information on ESA-listed species' distribution, copies of Federal Register documents designating listed species status, and links to various ESA and EFH consultation policies and tools may be found on our website at: http://www.westcoast.fisheries.noaa.gov/.

Based on the information you provided, three species listed as threatened under the ESA occur in the proposed action area, which extends into the Coquille River estuary because the amount of water discharged from Ferry Creek will be reduced. Oregon Coast (OC) coho salmon (*Oncorhynchus kisutch*) are present in Ferry Creek which is also designated critical habitat for them. North American green sturgeon (*Acipenser medirostris*) (green sturgeon) and Pacific eulachon (*Thaleichthys pacificus*) (eulachon) are present in the Coquille River estuary, but it is not designated critical habitat for either species.

The proposed action will divert water from Ferry Creek during winter high flow conditions. Any changing of winter high flows will have resultant changes in the dynamic balance between water and sediment which forms and maintains stream channels. Those channel changes will adversely affect fishery resources that rely on them. Furthermore, winter water withdrawal will occur during OC coho salmon spawning and incubation, two life stages sensitive to stream flow.

If this project has a Federal nexus, section 7 of the ESA requires Federal agencies to consult with us for projects that may affect listed species. For this proposed action, formal consultation is warranted because we expect this project is likely to adversely affect our ESA trust resources. Please refer to section 7 of the ESA and its implementing regulations (50 CFR Part 402) for information on interagency consultation. A biological assessment will be required and you indicate that one will be written according to Department of Agriculture format. We are not familiar with this format, but it is unlikely to meet current standards for NMFS. We suggest you look at the U.S. Fish and Wildlife Service's (FWS) template found here: http://www.fws.gov/midwest/endangered/section7/ba_guide.html, then call us at the number below to discuss.

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Ferry Creek is designated EFH under the MSA for species of Pacific Coast salmon (Chinook salmon and coho salmon).

If this project does not have a Federal nexus, Section 10(a)(1)(B) allows NMFS and FWS to issue non-Federal proposed actions a permit through the Habitat Conservation Planning process. For more information see here: http://www.fws.gov/endangered/what-we-do/hcp-overview.html.

This letter constitutes the required notification of the presence of a Federally-listed threatened or endangered species or critical habitat under NMFS' jurisdiction in the area that may be affected by the proposed project (Appendix A to Part 330, section C. 13(5)(I)).

We thank you for the opportunity to provide you a list of ESA-listed species, designated critical habitat, and EFH that may be affected by your proposed action. We would like to take this opportunity to recommend that as you continue to develop your project, early coordination with the appropriate state and Federal agencies that have a regulatory interest in your project or jurisdiction over resources within your project area will likely improve the efficiency of the regulatory review of your project, and may result in a more timely outcome.

Please direct any questions regarding this letter to Chuck Wheeler, fisheries biologist in the Oregon Coast Branch of the Oregon Washington Coastal Area Office at 541.957.3379 or chuck.wheeler@noaa.gov.

Sincerely,

Kenneth W. Phippen
Oregon Coast Branch Chief
Oregon Washington Coastal Area Office
West Coast Region – NOAA Fisheries

cc: Jon Unger, OWRD
Matt Winkel, City of Bandon

APPENDIX H

AGENCY LISTS:

Oregon Department Fish and Wildlife, revised October 2014, "Threatened, Endangered, and Candidate Fish and Wildlife Species in Oregon"

Oregon Department Fish and Wildlife, 2008 "Sensitive Species List"

U.S. Fish and Wildlife Service, updated 9/22/2015, "Federally Listed, Proposed, Candidate, Delisted Species and Species of Concern"

Oregon Department of Agriculture, 4/6/2009, "Oregon Listed Plants"

US Department of Agriculture, Threatened & Endangered (Plants), downloaded 1/21/2016

National Marine Fisheries Service (NMFS), updated map 10/31/2012, "Status of ESA Listings & Critical Habitat Designations for West Coast Salmon & Steelhead"

NMFS
http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/salmon_and_steelhead_listings.html

Threatened, Endangered, and Candidate Fish and Wildlife Species in Oregon

Common Name	Scientific Name	State status*	Federal status
FISH			
Borax Lake Chub	*Gila boraxobius*	E	E
Bull Trout (Range-wide)	*Salvelinus confluentus*		T
Columbia River Chum Salmon	*Oncorhynchus keta*		T
Foskett Speckled Dace	*Rhinichthys osculus* ssp	T	T
Green sturgeon (Southern DPS)	*Acipenser medirostris*		T
Hutton Spring Tui Chub	*Gila bicolor* ssp.	T	T
Lahontan Cutthroat Trout	*Oncorhynchus clarki henshawi*	T	T
Lost River Sucker	*Deltistes luxatus*	E	E
Lower Columbia River Chinook Salmon	*Oncorhynchus tshawytscha*		T
Lower Columbia River Coho Salmon	*Oncorhynchus kisutch*	E	T
Lower Columbia River Steelhead	*Oncorhynchus mykiss*		T
Middle Columbia River Steelhead	*Oncorhynchus mykiss*		T
Modoc sucker	*Catostomus microps*		E
Oregon Chub	*Oregonichthys crameri*		T
Oregon Coast Coho Salmon	*Oncorhynchus kisutch*		T
Pacific Eulachon/Smelt (Southern DPS)	*Thaleichthys pacificus*		T
Shortnose Sucker	*Chasmistes brevirostris*	E	E
Snake River Chinook Salmon (Fall)	*Oncorhynchus tshawytscha*	T	T
Snake River Chinook Salmon (Spring/Summer)	*Oncorhynchus tshawytscha*	T	T
Snake River Sockeye Salmon	*Oncorhynchus nerka*		E
Snake River Steelhead	*Oncorhynchus mykiss*		T
Southern Oregon Coho Salmon	*Oncorhynchus kisutch*		T
Upper Columbia River Spring Chinook Salmon	*Oncorhynchus tshawytscha*		E
Upper Columbia River Steelhead	*Oncorhynchus mykiss*		E
Upper Willamette River Chinook Salmon	*Oncorhynchus tshawytscha*		T
Upper Willamette River Steelhead	*Oncorhynchus mykiss*		T
Warner Sucker	*Catostomus warnerensis*	T	T
AMPHIBIANS AND REPTILES			
Columbia spotted frog	*Rana luteiventris*		C
Green Sea Turtle	*Chelonia mydas*	E	T
Leatherback Sea Turtle	*Dermochelys coriacea*	E	E
Loggerhead Sea Turtle	*Caretta caretta*	T	E
Oregon spotted frog	*Rana pretiosa*		T
Pacific Ridley Sea Turtle	*Lepidochelys olivacea*	T	T
BIRDS			
Brown Pelican	*Pelecanus occidentalis*	E	
California Least Tern	*Sterna antillarum browni*	E	E
Marbled Murrelet	*Brachyramphus marmoratus*	T	T
Northern Spotted Owl	*Strix occidentalis caurina*	T	T
Short-tailed Albatross	*Diomedea albatrus*	E	E
Streaked horned lark	*Eremophila alpestris strigata*		T
Western Snowy Plover	*Charadrius alexandrinus nivosus*	T	T (Coastal population only)
Yellow-billed cuckoo	*Coccyzus americanus*		PT

Common Name	Scientific Name	State status*	Federal status
MAMMALS			
Blue Whale	*Balaenoptera musculus*	E	E
Canada lynx	*Lynx canadensis*		T
Columbian White-tailed Deer (Lower Columbia River population only)	*Odocoileus virginianus leucurus*		E
Fin Whale	*Balaenoptera physalus*	E	E
Fisher	*Martes pennanti*		C
Gray Whale	*Eschrichtius robustus*	E	
Gray Wolf	*Canis lupus*	E	E[1]
Humpback Whale	*Megaptera novaeangliae*	E	E
Kit Fox	*Vulpes macrotis*	T	
North Pacific Right Whale	*Eubalaena japonica*	E	E
Northern (Steller) Sea Lion	*Eumetopias jubatus*		T
Red tree vole	*Arborimus longicaudus*		C
Sea Otter	*Enhydra lutris*	T	T
Sei Whale	*Balaenoptera borealis*	E	E
Sperm Whale	*Physeter macrocephalus*	E	E
Washington Ground Squirrel	*Urocitellus [Spermophilus] washingtoni*	E	C
Wolverine	*Gulo gulo*	T	

Threatened, Endangered, and Candidate Fish and Wildlife Species in Oregon
(T=threatened, E=endangered, C=candidate, DPS=Distinct Population Segment, P=Proposed)

* listed under the Oregon Endangered Species Act (ORS 496.171 through192)

1: The gray wolf is protected as endangered under the authority of the Federal ESA in Oregon west of Highways 395, 78, and 95.

Revised October 2014

Oregon Department of Fish and Wildlife
SENSITIVE SPECIES LIST
Organized by Category

An asterisk (*) indicates that the species, Distinct Population Segment (DPS) or Evolutionarily Significant Unit (ESU) is federally listed as threatened or endangered by either NOAA's National Marine Fisheries Service or the U.S. Fish and Wildlife Service. Parenthetical scientific names are proposed taxonomic changes not yet adopted by the American Fisheries Society Committee on Names of Fishes.

Sensitive Species: Fish. USGS Hydrologic Unit (HU) distribution is based on current known distribution as described in the ODFW Native Fish Status Report, literature review, or expert information. A species or Species Management Unit (SMU) may be distributed in all or a portion of the HU where appropriate habitat exists. For anadromous species, the distribution does not include migration corridors. Figure 2 displays the location of the hydrologic units in Oregon.

SENSITIVE – CRITICAL

Common Name	Scientific Name	USGS HU distribution (current)
FISH		
Modoc Sucker*	*Catostomus microps*	Goose Lake (18020001)
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi* (Behnke 2002)	Upper John Day (17070201)
Chum Salmon (Columbia River ESU)*	*Oncorhynchus keta*	Lower Columbia (17080006), Lower Columbia-Clatskanie (17080003), Lower Willamette (17090012), Lower Columbia-Sandy (17080001)
Chum Salmon (Coastal Chum Salmon SMU/Pacific Coast ESU)	*Oncorhynchus keta*	Nehalem (17100202), Necanicum (17100201), Wilson-Trask-Nestucca (17100203), Yamhill (17090008), Siletz-Yaquina (17100204)
Steelhead (Klamath Mountains Province ESU, Klamath Summer Steelhead SMU)	*Oncorhynchus mykiss*	Upper Klamath River (18010206)
Steelhead (Lower Columbia River ESU/SMU, winter run)*	*Oncorhynchus mykiss*	Lower Columbia (17080006), Lower Columbia-Clatskanie (17080003), Lower Willamette (17090012), Lower Columbia-Sandy (17080001), Clackamas (17090011), Middle Columbia-Hood (17070105)
Steelhead (Lower Columbia River ESU/SMU, summer run)*	*Oncorhynchus mykiss*	Middle Columbia-Hood (17070105)
Steelhead (Middle Columbia River ESU, summer run)*	*Oncorhynchus mykiss*	Lower Deschutes (17070306), Trout (17070307), Upper Deschutes (17070301), Lower Crooked (17070305), Upper John Day (17070201), North Fork John Day (17070202), Middle Fork John Day (17070203), Lower John Day (17070204), Umatilla (17070103), Walla Walla (17070102)
Great Basin Redband Trout (Catlow Valley Redband Trout SMU)	*Oncorhynchus mykiss newberrii* (Behnke 2002)	Guano (17120008)
Great Basin Redband Trout (Goose Lake Redband Trout SMU)	*Oncorhynchus mykiss newberrii* (Behnke 2002)	Goose Lake (18020001)

Common Name	Scientific Name	USGS HU distribution (current)
Great Basin Redband Trout (Warner Lakes Redband Trout SMU)	*Oncorhynchus mykiss newberrii* (Behnke 2002)	Warner Lake (17120007)
Great Basin Redband Trout (Fort Rock Redband Trout SMU)	*Oncorhynchus mykiss newberrii* (Behnke 2002)	Summer Lake (17120005)
Chinook Salmon (Upper Willamette River ESU, spring run/Willamette Spring Chinook SMU)*	*Oncorhynchus tshawytscha*	Molalla-Pudding (17090009), North Santiam (17090005), South Santiam (17090006), Mckenzie (17090004), Middle Fork Willamette (17090001), Coast Fork Willamette (17090002), Upper Willamette (17090003)
Chinook Salmon (Coastal Spring Chinook SMU)	*Oncorhynchus tshawytscha*	Wilson-Trask-Nestucca (17100203), Siletz-Yaquina (17100204), Alsea (17100205), Coquille (17100305), North Umpqua (17100301), South Umpqua (17100302)
Chinook Salmon (Lower Columbia River Chinook ESU/SMU, fall run)*	*Oncorhynchus tshawytscha*	Lower Columbia (17080006), Lower Columbia-Clatskanie (17080003), Lower Columbia-Sandy (17080001), Clackamas (17090011), Middle Columbia-Hood (17070105), Lower Willamette (17090012)
Chinook Salmon (Lower Columbia River Chinook ESU/SMU, spring run)*	*Oncorhynchus tshawytscha*	Lower Columbia-Sandy (17080001), Clackamas (17090011)
Oregon Chub*	*Oregonichthys crameri*	North Santiam (17090005), Upper Willamette (17090003), South Santiam (17090006), Mckenzie (17090004), Middle Fork Willamette (17090001), Coast Fork Willamette (17090002)
Umpqua Chub	*Oregonichthys kalawatseti*	Umpqua (17100303), North Umpqua (17100301), South Umpqua (17100302)
Bull Trout (Willamette Bull Trout SMU)*	*Salvelinus confluentus*	Mckenzie (17090004), Middle Fork Willamette (17090001)
Bull Trout (John Day Bull Trout SMU)*	*Salvelinus confluentus*	North Fork John Day (17070202), Middle Fork John Day (17070203), Upper John Day (17070201)
Bull Trout (Umatilla Bull Trout SMU)*	*Salvelinus confluentus*	Umatilla (17070103)
Bull Trout (Grande Ronde Bull Trout SMU)*	*Salvelinus confluentus*	Upper Grande Ronde River (17060104), Wallowa River (17060105), Lower Grande Ronde (17060106)
Bull Trout (Imnaha Bull Trout SMU)*	*Salvelinus confluentus*	Imnaha River (17060102)
Bull Trout (Hells Canyon Bull Trout SMU)*	*Salvelinus confluentus*	Brownlee Reservoir (17050201), Powder River (17050203)
Bull Trout (Hood River Bull Trout SMU)*	*Salvelinus confluentus*	Middle Columbia-Hood (17070105)
Bull Trout (Malheur River Bull Trout SMU)*	*Salvelinus confluentus*	Upper Malheur (17050116)
Bull Trout (Odell Lake Bull Trout SMU)*	*Salvelinus confluentus*	Upper Deschutes (17070301)
Bull Trout (Klamath Lake Bull Trout SMU)*	*Salvelinus confluentus*	Upper Klamath Lake (18010203), Sprague (18010202)

SENSITIVE - CRITICAL

Common Name	Scientific Name	Ecoregion
AMPHIBIANS		
Columbia Spotted Frog	*Rana luteiventris*	Columbia Plateau, Northern Basin and Range
Oregon Spotted Frog	*Rana pretiosa*	
Foothill Yellow-legged Frog	*Rana boylii*	Willamette Valley
Northern Leopard Frog	*Lithobates pipiens*	
REPTILES		
Western Painted Turtle	*Chrysemys picta bellii*	
Western Pond Turtle	*Actinemys marmorata*	
Western Rattlesnake	*Crotalus oreganus*	Willamette Valley
BIRDS		
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	
Red-necked Grebe	*Podiceps grisegena*	Breeding Population
Ferruginous Hawk	*Buteo regalis*	Columbia Plateau
Yellow Rail	*Coturnicops noveboracensis*	
Upland Sandpiper	*Bartramia longicauda*	
Yellow-billed Cuckoo	*Coccyzus americanus*	
Burrowing Owl	*Athene cunicularia*	Blue Mountains, Columbia Plateau, Eastern Cascades Slopes and Foothills, Klamath Mountains, Willamette Valley
Common Nighthawk	*Chordeiles minor*	Willamette Valley
Lewis's Woodpecker	*Melanerpes lewis*	
White-headed Woodpecker	*Picoides albolarvatus*	
Streaked Horned Lark	*Eremophila alpestris strigata*	Coast Range, Klamath Mountains, Willamette Valley
Purple Martin	*Progne subis*	
Yellow-breasted Chat	*Icteria virens*	Willamette Valley
Oregon Vesper Sparrow	*Pooecetes gramineus affinis*	Klamath Mountains, Willamette Valley
Sage Sparrow	*Amphispiza belli*	Columbia Plateau
Western Meadowlark	*Sturnella neglecta*	Willamette Valley
MAMMALS		
Townsend's Big-eared Bat	*Corynorhinus townsendii*	
Fisher	*Martes pennanti*	

SENSITIVE – VULNERABLE

Common Name	Scientific Name	USGS HU distribution (current)
FISH		
Goose Lake Sucker	*Catostomus occidentalis lacusanserinus* (Moyle 2002)	Goose Lake (18020001)
Alvord Chub	*Gila alvordensis* (*Siphateles alvordensis*)	Alvord Lake (17120009)
Miller Lake Lamprey	*Lampetra minima* (*Entosphenus minimus*)	Williamson (18010201), Sprague (18010202)
Western Brook Lamprey	*Lampetra richardsoni*	Columbia River system and coastal streams including the Rogue
Pacific Lamprey	*Lampetra tridentate* (*Entosphenus tridentata*)	Columbia River system and coastal streams including the Rogue
Coastal Cutthroat Trout (Lower Columbia Coastal Cutthroat Trout SMU/ Southwestern Washington/Columbia River ESU)	*Oncorhynchus clarkii clarkii*	Lower Columbia-Clatskanie (17080003), Lower Columbia (17080006), Lower Willamette (17090012), Middle Columbia-Hood (17070105), Lower Columbia-Sandy (17080001), Clackamas (17090011)
Coho Salmon (Coastal Coho Salmon SMU/Oregon Coast ESU)*	*Oncorhynchus kisutch*	Nehalem (17100202), Necanicum (17100201), Wilson-Trask-Nestucca (17100203), Siletz-Yaquina (17100204), Alsea (17100205), Siuslaw (17100206), Siltcoos (17100207), Umpqua (17100303), Coos (17100304), South Umpqua (17100302), Coquille (17100305), Sixes (17100306), North Umpqua (17100301)
Coho Salmon (Southern Oregon/Northern California Coasts ESU/Rogue (and Klamath) Coho SMU)*	*Oncorhynchus kisutch*	Middle Rogue (17100308), Lower Rogue (17100310), Illinois (17100311), Upper Rogue (17100307), Applegate (17100309)
Inland Columbia Redband Trout	*Oncorhynchus mykiss gairdneri*	Lower Owyhee (17050110), Jordan (17050108), Middle Owyhee (17050107), South Fork Owyhee (17050105), East Little Owyhee (17050106), Lower Malheur (17050117), Upper Malheur (17050116), Bully (17050118), Willow (17050119), Burnt River (17050202), Lower Snake-Asotin (17060103), Walla Walla (17070102), , Lower Grande Ronde (17060106), Middle Fork John Day (17070203), Lower John Day (17070204), Brownlee Reservoir (17050201), Powder River (17050203), Imnaha River (17060102), North Fork John Day (17070202), Upper Grande Ronde River (17060104), Wallowa River (17060105), Willow (17070104), Umatilla (17070103), South Fork Crooked (17070303), Upper Crooked (17070304), Upper John Day (17070201), Little Deschutes (17070302), , Lower Crooked (17070305), Upper Deschutes (17070301), Trout (17070307), Middle Columbia-Hood (17070105), Lower Deschutes (17070306)
Great Basin Redband Trout (Malheur Lakes Redband SMU)	*Oncorhynchus mykiss newberrii* (Behnke 2002)	Silvies (17120002), Harney-Malheur Lakes (17120001), Silver (17120004), Donner Und Blitzen (17120003),
Great Basin Redband Trout (Chewaucan Redband Trout SMU)	*Oncorhynchus mykiss newberrii* (Behnke 2002)	Lake Abert (17120006)
Great Basin Redband Trout (Upper Klamath Basin Redband Trout SMU)	*Oncorhynchus mykiss newberrii* (Behnke 2002)	Sprague (18010202), Upper Klamath Lake (18010203), Williamson (18010201), Lost River (18010204), Upper Klamath River (18010206)

Common Name	Scientific Name	USGS HU distribution (current)
Steelhead (Upper Willamette River ESU, winter run/Willamette Winter Steelhead SMU)*	*Oncorhynchus mykiss*	Tualatin (17090010), Yamhill (17090008), Molalla-Pudding (17090009), North Santiam (17090005), South Santiam (17090006), Upper Willamette (17090003), Middle Willamette (17090007)
Steelhead (Oregon Coast ESU, summer run/Coastal Summer Steelhead SMU)	*Oncorhynchus mykiss*	Siletz-Yaquina (17100204), North Umpqua (17100301)
Steelhead (Oregon Coast ESU, winter run/Coastal Winter Steelhead SMU)	*Oncorhynchus mykiss*	Nehalem (17100202), Necanicum (17100201), Wilson-Trask-Nestucca (17100203), Siletz-Yaquina (17100204), Alsea (17100205), Siuslaw (17100206), Umpqua (17100303), Coos (17100304), North Umpqua (17100301), South Umpqua (17100302), Coquille (17100305), Sixes (17100306)
Steelhead (Klamath Mountains Province ESU, summer run/Rogue Summer Steelhead SMU)	*Oncorhynchus mykiss*	Upper Rogue (17100307), Middle Rogue (17100308), Applegate (17100309), Lower Rogue (17100310)
Steelhead (Snake River Basin ESU/Snake Summer Steelhead SMU)*	*Oncorhynchus mykiss*	Imnaha River (17060102), Upper Grande Ronde River (17060104), Wallowa River (17060105), Lower Grande Ronde River (17060106)
Chinook Salmon (Mid-Columbia River ESU/SMU, fall run)	*Oncorhynchus tshawytscha*	Lower Deschutes (17070306)
Chinook Salmon (Rogue Spring Chinook SMU)	*Oncorhynchus tshawytscha*	Upper Rogue (17100307), Middle Rogue (17100308)
Chinook Salmon (Middle Columbia Spring Chinook SMU	*Oncorhynchus tshawytscha*	Lower Deschutes (17070306), Upper Deschutes (17070301), Lower Crooked (17070305), Upper John Day (17070201), North Fork John Day (17070202), Middle Fork John Day (17070203)
Chinook Salmon (Southern Oregon/Northern California Coast ESU, fall run/Rogue Fall Chinook SMU)	*Oncorhynchus tshawytscha*	Lower Rogue (17100310), Illinois (17100311), Chetco (17100312), Upper Rogue (17100307), Middle Rogue (17100308), Applegate (17100309), Sixes (17100306)
Millicoma Dace	*Rhinichthys cataractae* ssp.	Coos (17100304)
Bull Trout (Deschutes Bull Trout SMU)*	*Salvelinus confluentus*	Lower Deschutes (17070306), Upper Deschutes (17070301)

SENSITIVE - VULNERABLE

Common Name	Scientific Name	Ecoregion
AMPHIBIANS		
Cope's Giant Salamander	*Dicamptodon copei*	
Columbia Torrent Salamander	*Rhyacotriton kezeri*	
Southern Torrent Salamander	*Rhyacotriton variegatus*	
Cascade Torrent Salamander	*Rhyacotriton cascadae*	
Larch Mountain Salamander	*Plethodon larselli*	
Del Norte Salamander	*Plethodon elongatus*	
Siskiyou Mountains Salamander	*Plethodon stormi*	
Clouded Salamander	*Aneides ferreus*	
Black Salamander	*Aneides flavipunctatus*	
Oregon Slender Salamander	*Batrachoseps wrightorum*	
Rocky Mountain Tailed Frog	*Ascaphus montanus*	
Coastal Tailed Frog	*Ascaphus truei*	
Western Toad	*Anaxyrus boreas*	
Northern Red-legged Frog	*Rana aurora*	Klamath Mountains, Willamette Valley
Cascades Frog	*Rana cascadae*	
Columbia Spotted Frog	*Rana luteiventris*	Blue Mountains, Eastern Cascades Slopes and Foothills
Foothill Yellow-legged Frog	*Rana boylii*	Coast Range, Klamath Mountains, West Cascades
REPTILES		
Northern Sagebrush Lizard	*Sceloporus graciosus graciosus*	Columbia Plateau
Common Kingsnake	*Lampropeltis getula*	
California Mountain Kingsnake	*Lampropeltis zonata*	
BIRDS		
Greater Sage-Grouse	*Centrocercus urophasianus*	Blue Mountains, Columbia Plateau, Eastern Cascades Slopes and Foothills
Spruce Grouse	*Falcipennis canadensis*	
Mountain Quail	*Oreortyx pictus*	Northern Basin and Range
American White Pelican	*Pelecanus erythrorhynchos*	Breeding Population
Snowy Egret	*Egretta thula*	Breeding Population
Northern Goshawk	*Accipiter gentilis*	
Swainson's Hawk	*Buteo swainsoni*	
Ferruginous Hawk	*Buteo regalis*	Blue Mountains, Eastern Cascades Slopes and Foothills
American Peregrine Falcon	*Falco peregrinus anatum*	
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	
Greater Sandhill Crane	*Grus canadensis tabida*	Central Valley Population (Oregon Breeding Population)
Black Oystercatcher	*Haematopus bachmani*	
Long-billed Curlew	*Numenius americanus*	Blue Mountains, Columbia Plateau, Eastern Cascades Slopes and Foothills

SENSITIVE - VULNERABLE

Common Name	Scientific Name	Ecoregion
BIRDS continued		
Franklin's Gull	*Larus pipixcan*	
Cassin's Auklet	*Ptychoramphus aleuticus*	
Rhinocerous Auklet	*Cerorhinca monocerata*	
Tufted Puffin	*Fratercula cirrhata*	
Flammulated Owl	*Otus flammeolus*	
Burrowing Owl	*Athene cunicularia*	Northern Basin and Range
Great Gray Owl	*Strix nebulosa*	
Acorn Woodpecker	*Melanerpes formicivorus*	Willamette Valley
American Three-toed Woodpecker	*Picoides dorsalis*	
Black-backed Woodpecker	*Picoides arcticus*	
Pileated Woodpecker	*Dryocopus pileatus*	Blue Mountains, Eastern Cascades Slopes and Foothills, Klamath Mountains
Olive-sided Flycatcher	*Contopus cooperi*	
Willow Flycatcher	*Empidonax traillii adastus*	Blue Mountains, Columbia Plateau, Eastern Cascades Slopes and Foothills, Northern Basin and Range
Little Willow Flycatcher	*Empidonax traillii brewsteri*	Coast Range, Klamath Mountains, West Cascades, Willamette Valley
Loggerhead Shrike	*Lanius ludovicianus*	Blue Mountains, Columbia Plateau, Eastern Cascades Slopes and Foothills
White-breasted Nuthatch (=Slender-billed Nuthatch)	*Sitta carolinensis aculeata*	Coast Range, Klamath Mountains, West Cascades, Willamette Valley
Western Bluebird	*Sialia mexicana*	Coast Range, Klamath Mountains, West Cascades, Willamette Valley
Grasshopper Sparrow	*Ammodramus savannarum*	
Bobolink	*Dolichonyx oryzivorus*	
MAMMALS		
California Myotis	*Myotis californicus*	
Fringed Myotis	*Myotis thysanodes*	
Long-legged Myotis	*Myotis volans*	
Hoary Bat	*Lasiurus cinereus*	
Silver-haired Bat	*Lasionycteris noctivagans*	
Spotted Bat	*Euderma maculatum*	
Pallid Bat	*Antrozous pallidus*	
Pygmy Rabbit	*Brachylagus idahoensis*	
Black-tailed Jackrabbit	*Lepus californicus*	Willamette Valley
White-tailed Jackrabbit	*Lepus townsendii*	
Western Gray Squirrel	*Sciurus griseus*	Willamette Valley
Red Tree Vole	*Arborimus longicaudus*	Coast Range
Ringtail	*Bassariscus astutus*	
American Marten	*Martes americana*	Blue Mountains, Coast Range
Columbian White-tailed Deer*	*Odocoileus virginianus leucurus*	Coast Range (Columbia River Population)

Coos

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

LISTED SPECIES

Mammals

Gray wolf	*Canis lupus*	E
(Conterminous USA, lower 48 states, except where otherwise designated)		
Canada lynx	*Lynx canadensis*	CH T
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	E
(Columbia River population)		

Birds

Marbled murrelet	*Brachyramphus marmoratus*	CH T
(Washington, Oregon and California population)		
Western snowy (coastal) plover	*Charadrius alexandrinus nivosus*	CH T
(Pacific coast population)		
Yellow-billed cuckoo	*Coccyzus americanus*	T
(Western population)		
Streaked horned lark	*Eremophila alpestris strigata*	CH T
Short-tailed albatross	*Phoebastria albatrus* — Not in ORBIC	E
Northern spotted owl	*Strix occidentalis caurina*	CH T

Reptiles and Amphibians

Inland:

Oregon spotted frog	*Rana pretiosa*	PCH T

Marine:

Loggerhead sea turtle	*Caretta caretta*	E
Green sea turtle	*Chelonia mydas*	T
Leatherback sea turtle	*Dermochelys coriacea*	E
Olive (=Pacific) ridley sea turtle	*Lepidochelys olivacea*	T

Fish

Inland:

Modoc sucker	*Catostomus microps*	CH E
Warner sucker	*Catostomus warnerensis*	CH T
Shortnose sucker	*Chasmistes brevirostris*	PCH E
Lost River sucker	*Deltistes luxatus*	PCH E
Hutton tui chub	*Gila bicolor ssp.*	T
Borax Lake chub	*Gila boraxobius*	CH E
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*	T
Foskett speckled dace	*Rhinichthys osculus ssp.*	T
Bull trout	*Salvelinus confluentus*	CH T
(Conterminous USA, lower 48 states)		

Invertebrates

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

Crustaceans:		
Vernal pool fairy shrimp	*Branchinecta lynchi*	CH T
Insects:		
Taylor's checkerspot butterfly	*Euphydryas editha taylori*	CH E
Fender's blue butterfly	*Icaricia icarioides fenderi*	CH E
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	CH T

Plants

McDonald's rockcress	*Arabis macdonaldiana*	E
Applegate's milk-vetch	*Astragalus applegatei*	E
Golden paintbrush	*Castilleja levisecta*	T
Willamette daisy	*Erigeron decumbens var. decumbens*	CH E
Gentner's fritillary	*Fritillaria gentneri*	E
Water howellia	*Howellia aquatilis*	T
Western lily	*Lilium occidentale*	E
Large-flowered woolly meadowfoam	*Limnanthes pumila spp. grandiflora*	CH E
Bradshaw's desert parsley	*Lomatium bradshawii*	E
Cook's lomatium	*Lomatium cookii*	CH E
Kincaid's lupine	*Lupinus sulphureus spp. kincaidii*	CH T
MacFarlane's four o'clock	*Mirabilis macfarlanei*	T
Rough popcornflower	*Plagiobothrys hirtus*	E
Nelson's checker-mallow	*Sidalcea nelsoniana*	T
Spalding's catchfly	*Silene spaldingii*	T
Malheur wire-lettuce	*Stephanomeria malheurensis*	CH E
Howell's spectacular thelypody	*Thelypodium howellii spp. spectabilis*	T

PROPOSED SPECIES

No Proposed Endangered Species		PE
No Proposed Threatened Species		PT

Mammals

Fisher (West Coast population)	*Martes pennanti*	PT

CANDIDATE SPECIES

Mammals

Red tree vole (North Oregon Coast population)	*Arborimus longicaudus*	
Washington ground squirrel	*Urocitellus washingtoni*	

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

Birds

Xantus's murrelet	*Synthliboramphus hypoleucus*

Reptiles and Amphibians

Inland:

Columbia spotted frog (Great Basin population)	*Rana luteiventris*

Plants

Northern wormwood	*Artemisia campestris var. wormskioldii*
Siskiyou mariposa lily	*Calochortus persistens*
Whitebark Pine	*Pinus albicaulis*

DELISTED SPECIES

Mammals

Gray wolf (Rocky Mountain population)	*Canis lupus*
Columbian white-tailed deer (Douglas County population)	*Odocoileus virginianus leucurus*

Birds

Aleutian Canada goose	*Branta canadensis leucopareia*
American Peregrine falcon	*Falco peregrinus anatum*
Bald eagle (USA, lower 48 states)	*Haliaeetus leucocephalus*
Brown pelican (Entire, except U.S. Atlantic coast, FL, AL)	*Pelecanus occidentalis*

Fish

Inland:

Oregon chub	*Oregonichthys crameri*

SPECIES OF CONCERN

Mammals

Pallid bat	*Antrozous pallidus pacificus* — Coos Co.
White-footed vole	*Arborimus albipes*
Pale western big-eared bat	*Corynorhinus townsendii pallescens*
Townsend's western big-eared bat	*Corynorhinus townsendii townsendii* — Coos Co.
Spotted bat	*Euderma maculatum*
Silver-haired bat	*Lasionycteris noctivagans* — Coos Co.

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

Hoary bat	*Lasiurus cinereus*
Small-footed myotis bat	*Myotis ciliolabrum*
Long-eared myotis bat	*Myotis evotis*
Fringed myotis bat	*Myotis thysanodes*
Long-legged myotis bat	*Myotis volans*
Yuma myotis bat	*Myotis yumanensis*
Preble's shrew	*Sorex preblei*
Camas pocket gopher	*Thomomys bulbivorus*
Goldbeach western pocket gopher	*Thomomys mazama helleri*
Pistol River pocket gopher	*Thomomys umbrinus detumidus*
Terrestrial:	
Pygmy rabbit	*Brachylagus idahoensis*

Birds

Northern goshawk	*Accipiter gentilis*
Tricolored blackbird	*Agelaius tricolor*
Western burrowing owl	*Athene cunicularia hypugaea*
Upland sandpiper	*Bartramia longicauda*
Ferruginous hawk	*Buteo regalis*
Greater sage-grouse	*Centrocercus urophasianus*
Black tern	*Chlidonias niger*
Olive-sided flycatcher	*Contopus cooperi*
Yellow rail	*Coturnicops noveboracensis*
Willow flycatcher	*Empidonax traillii adastus*
Black oystercatcher	*Haematopus bachmani*
Harlequin duck	*Histrionicus histrionicus*
Yellow-breasted chat	*Icteria virens*
Acorn woodpecker	*Melanerpes formicivorus*
Lewis' woodpecker	*Melanerpes lewis*
Mountain quail	*Oreortyx pictus*
Band-tailed pigeon	*Patagioenas fasciata*
White-headed woodpecker	*Picoides albolarvatus*
White-faced ibis	*Plegadis chihi*
Oregon vesper sparrow	*Pooecetes gramineus affinis*
Purple martin	*Progne subis*
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*

Reptiles and Amphibians

Northern Pacific pond turtle	*Actinemys marmorata marmorata*
Rocky Mountain tailed frog	*Ascaphus montanus*
Coastal tailed frog	*Ascaphus truei*
Oregon slender salamander	*Batrachoseps wrighti*
Common kingsnake	*Lampropeltis getula*
California mountain kingsnake	*Lampropeltis zonata*

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

Del Norte salamander	*Plethodon elongatus*
Larch Mountain salamander	*Plethodon larselli*
Siskiyou Mountains salamander	*Plethodon stormi*
Northern red-legged frog	*Rana aurora aurora*
Foothill yellow-legged frog	*Rana boylii*
Cascades frog	*Rana cascadae*
Southern torrent (seep) salamander	*Rhyacotriton variegatus*
Northern sagebrush lizard	*Sceloporus graciosus graciosus*

Fish

Goose Lake sucker	*Catostomus occidentalis lacusanserinus*
Jenny Creek sucker	*Catostomus rimiculus ssp.*
Klamath largescale sucker	*Catostomus snyderi*
Malheur mottled sculpin	*Cottus bairdi ssp.*
Margined sculpin	*Cottus marginatus*
Slender sculpin	*Cottus tenuis*
Alvord chub	*Gila alvordensis*
Sheldon tui chub	*Gila bicolor eurysoma*
Oregon Lakes tui chub	*Gila bicolor oregonensis*
Summer Basin tui chub	*Gila bicolor ssp.*
Catlow tui chub	*Gila bicolor ssp.*
River lamprey	*Lampetra ayresi*
Pacific lamprey	*Lampetra tridentata*
Goose Lake lamprey	*Lampetra tridentata ssp.*
Pit roach	*Lavinia symmetricus mitrulus*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
Coastal cutthroat trout	*Oncorhynchus clarki ssp*
Great Basin redband trout	*Oncorhynchus mykiss gibbsi*
Catlow Valley redband trout	*Oncorhynchus mykiss ssp.*
Umpqua chub	*Oregonichthys kalawatseti*
Millicoma dace	*Rhinichthys cataractae ssp.*

Invertebrates

Annelid Worms:	
Oregon giant earthworm	*Megascolides macelfreshi*
Arachnids:	
Malheur pseudoscorpion	*Apochtonius malheuri*
Clams:	
California floater mussel	*Anodonta californiensis*
Peaclam	*Pisidium ultramontanum*
Crustaceans:	
Malheur Cave amphipod	*Stygobromus hubbsi*
Flatworms and Roundworms:	
Planarian	*Kenkia rhynchida*

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

Insects:

American acetropis grass bug	*Acetropis americana*
Denning's agapetus caddisfly	*Agapetus denningi*
Beller's ground beetle	*Agonum belleri*
Scott's apatanian caddisfly	*Allomyia scotti*
Cascades apatanian caddisfly	*Apatania tavala*
Franklin's bumblebee	*Bombus franklini*
Siskiyou chloealtis grasshopper	*Chloaeltis aspasma*
Blue Mountains cryptochian caddisfly	*Cryptochia neosa*
Mt. Hood primitive brachycentrid caddisfly	*Eobrachycentrus gelidae*
Green Springs Mountain farulan caddisfly	*Farula davisi*
Mt. Hood farulan caddisfly	*Farula jewetti*
Tombstone Prairie farulan caddisfly	*Farula reaperi*
Sagehen Creek goeracean caddisfly	*Goeracea oregona*
Lynn's clubtail dragonfly	*Gomphus lynnae*
Schuh's homoplectran caddisfly	*Homoplectra schuhi*
Goeden's lepidostoman caddisfly	*Lepidostoma goedeni*
Siskiyou carabid beetle	*Nebria gebleri siskiyouensis*
Columbia Gorge neothremman caddisfly	*Neothremma andersoni*
Tombstone Prairie oligophlebodes caddisfly	*Oligophlebodes mostbento*
Insular blue butterfly	*Plebejus saepiolus insulanus*
Roth's blind ground beetle	*Pterostichus rothi*
Obrien rhyacophilan caddisfly	*Rhyacophila colonus*
Haddock's rhyacophilan caddisfly	*Rhyacophila haddocki*
One-spot rhyacophilan caddisfly	*Rhyacophila unipunctata*
Wahkeena Falls flightless stonefly	*Zapada wahkeena*

Snails:

Newcomb's littorine snail	*Algamorda newcombiana*
Columbia pebblesnail	*Fluminicola fuscus (= columbianus)*
Minor Pacific sideband snail	*Monadenia fidelis minor*

Plants

Pink sand-verbena	*Abronia umbellata spp. breviflora*
Henderson ricegrass	*Achnatherum hendersonii*
Wallowa ricegrass	*Achnatherum wallowaensis*
Henderson's bentgrass	*Agrostis hendersonii*
Howell's bentgrass	*Agrostis howellii*
Blue Mountain onion	*Allium dictuon*
Robinson's onion	*Allium robinsonii*
Malheur Valley fiddleneck	*Amsinckia carinata*
Bog anemone	*Anemone oregana var. felix*
Hell's Canyon rock-cress	*Arabis hastatula*
Koehler's rock-cress	*Arabis koehleri var. koehleri*
Rogue canyon rock cress	*Arabis modesta*

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Crater Lake rock-cress	*Boechera Arabis suffrutescens var. horizontalis*
Gasquet manzanita	*Arctostaphylos hispidula*
Estes' artemisia	*Artemisia ludoviciana spp. estesii*
Laurence's milk-vetch	*Astragalus collinus var. laurentii*
Mulford's milk-vetch	*Astragalus mulfordiae*
Bastard kentrophyta	*Astragalus tegetarioides*
Bensoniella	*Bensoniella oregona*
Upward-lobed moonwort	*Botrychium ascendens*
Prairie moonwart	*Botrychium campestre*
Crenulate grape fern	*Botrychium crenulatum*
Mountain grape fern	*Botrychium montanum*
Twin-spike moonwort	*Botrychium paradoxum*
Stalked moonwort	*Botrychium pedunculosum*
Cox's mariposa lily	*Calochortus coxii*
Greene's mariposa lily	*Calochortus greenei*
Howell's mariposa lily	*Calochortus howellii*
Peck's mariposa lily	*Calochortus longebarbatus var. peckii*
Green-band mariposa lily	*Calochortus macrocarpus var. maculosus*
Broad-fruit mariposa lily	*Calochortus nitidus*
Umpqua mariposa-lily	*Calochortus umpquaensis*
Howell's camassia	*Camassia howellii*
Dwarf evening-primrose	~~*Camissonia* pygmaea~~ *Eremothera*
Saddle Mountain bittercress	*Cardamine pattersonii*
Idaho sedge	*Carex idahoa*
Chamber's paintbrush	*Castilleja chambersii*
Fraternal paintbrush	*Castilleja fraterna*
Mendocino coast indian paintbrush	*Castilleja mendocinensis*
Purple alpine paintbrush	*Castilleja rubida*
Cliff paintbrush	*Castilleja rupicola*
Slender wild cabbage	*Caulanthus major var. nevadensis*
Barren valley collomia	*Collomia renacta*
Pt. Reyes bird's-beak	*Cordylanthus maritimus spp. palustris* — Coos Co.
Cold-water corydalis	*Corydalis aquae-gelidae*
Baker's cypress	~~*Cupressa* bakeri~~ *Hesperocyparis*
Greeley's springparsley	*Cymopterus acaulis var. greeleyorum*
Clustered lady's-slipper	*Cypripedium fasciculatum*
Pale larkspur	*Delphinium leucophaeum*
Willamette Valley larkspur	*Delphinium oreganum*
Peacock larkspur	*Delphinium pavonaceum*
Few-flowered bleedingheart	*Dicentra pauciflora*
Frigid shootingstar	*Dodecatheon austrofrigidum*
Oregon fireweed	*Epilobium oreganum*
Siskiyou willow-herb	*Epilobium siskiyouense*
Siskiyou daisy	*Erigeron cervinus*

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Englemann's daisy	*Erigeron engelmannii var. davisii*
Howell's daisy	*Erigeron howellii*
Oregon fleabane	*Erigeron oreganus*
Golden buckwheat	*Eriogonum chrysops*
Crosby's buckwheat	*Eriogonum crosbyae*
Cusick's buckwheat	*Eriogonum cusickii*
Prostrate buckwheat	*Eriogonum prociduum*
Green buckwheat	*Eriogonum umbellatum var. glaberrimum*
Pacific wallflower	*Erysimum menziesii spp. concinnum*
Coast Range fawn lily	*Erythronium elegans*
Wayside aster	*Eucephalus vialis*
Queen-of-the-forest	*Filipendula occidentalis*
Purdy's fritillary	*Fritillaria purdyi*
Warner Mountain bedstraw	*Galium serpenticum spp. warnerense*
Bristly gentian	*Gentiana plurisetosa*
Waldo gentian	*Gentiana setigera*
Seaside gilia	*Gilia millefoliata*
Boggs Lake hedge-hyssop	*Gratiola heterosepala*
Cronquist's stickseed	*Hackelia cronquistii*
Purple-flowered rush lily	*Hastingsia bracteosa var. atropurpurea*
Large-flowered rush lily	*Hastingsia bracteosa var. bracteosa*
Shaggy horkelia	*Horkelia congesta spp. congesta*
Henderson's horkelia	*Horkelia hendersonii*
Cooper's goldflower	*Hymenoxys ~~lemmonii~~*
Grimy ivesia	*Ivesia rhypara var. rhypara*
Shelly's ivesia	*Ivesia rhypara var. shellyi*
Fragrant kalmiopsis	*Kalmiopsis fragrans*
Large-flowered goldfields	*Lasthenia ornduffii*
Thin-leaved peavine	*Lathyrus holochlorus*
Davis' peppergrass	*Lepidium davisii*
Hazel's prickly-phlox	*Leptodactylon pungens spp. hazeliae*
Kellogg's lily	*Lilium kelloggii*
Frye's Limbella	*Limbella fryei*
Bellinger's meadowfoam	*Limnanthes floccosa spp. bellingerana*
Dwarf woolly meadowfoam	*Limnanthes floccosa spp. pumila*
Red-fruited desert parsley	*Lomatium erythrocarpum*
Greenman's desert parsley	*Lomatium greenmani*
Ochoco lomatium	*Lomatium ochocense*
Suksdorf's desert parsley	*Lomatium suksdorfii*
Colonial luina	*Luina serpentina*
Mt. Ashland lupine	*Lupinus ~~aridus~~ spp. ashlandensis* lepidus
Cusick's lupine	*Lupinus cusickii*
White meconella	*Meconella oregana*
Smooth stickleaf	*Mentzelia mollis*

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

Packard's stickleaf	*Mentzelia packardiae*
Detling's microseris	*Microseris laciniata spp. detlingii*
Disappearing monkeyflower	*Mimulus evanescens*
Membrane-leaved monkeyflower	*Mimulus hymenophyllus*
Siskiyou monardella	*Monardella purpurea*
Sessile mousetail	*Myosurus sessilis*
Wolf's evening-primrose	*Oenothera wolfii*
Barrett's penstemon	*Penstemon barrettiae*
Blue-leaved penstemon	*Penstemon glaucinus*
Peck's penstemon	*Penstemon peckii*
Red-root yampah	*Perideridia erythrorhiza*
Silvery phacelia	*Phacelia argentea* — Coos Co.
Playa phacelia	*Phacelia inundata*
Siskiyou phacelia	*Phacelia leonis*
Mackenzie's phacelia	*Phacelia lutea var. mackenzieorum*
Least phacelia	*Phacelia minutissima*
Coral seeded allocarya	*Plagiobothrys figuratus var. corallicarpus*
Desert allocarya	*Plagiobothrys salsus*
Oregon semaphore grass	*Pleuropogon oregonus*
San Francisco bluegrass	*Poa unilateralis*
Profuse-flowered mesa mint	*Pogogyne floribunda*
Williams combleaf	*Polyctenium williamsiae*
Snake River goldenweed	*Pyrrocoma radiata*
Dalles Mt. buttercup	*Ranunculus triternatus*
Bartonberry	*Rubus bartonianus*
Saddle Mountain saxifrage	*Saxifraga hitchcockiana* Micranthes
Ertter's ragwort	*Senecio ertterae*
Western senecio	~~*Senecio*~~ *hesperius* Packera
Whitetop aster	*Sericocarpus rigidus*
Henderson's checker-mallow	*Sidalcea hendersonii*
Bristly-stemmed sidalcea	*Sidalcea hirtipes*
Maple-leaved checker-mallow	*Sidalcea malachroides*
Coast checkermallow	*Sidalcea malviflora spp. patula* — Coos Co.
Cascade Head catchfly	*Silene douglasii var. oraria*
Hitchcock's blue-eyed grass	*Sisyrinchium hitchcockii*
Pale blue-eyed grass	*Sisyrinchium sarmentosum*
Western necklace	*Sophora leachiana*
Biennial stanleya	*Stanleya confertiflora*
Oregon sullivantia	*Sullivantia oregana*
Howell's tauschia	*Tauschia howellii*
Woven-spored Lichen	*Texosporium sancti-jacobi*
Short-podded thelypody	*Thelypodium brachycarpum*
Arrow-leaf thelypody	*Thelypodium eucosmum*
Howell's thelypody	*Thelypodium howellii spp. howellii*

FEDERALLY LISTED, PROPOSED, CANDIDATE, DELISTED SPECIES AND SPECIES OF CONCERN UNDER THE JURISDICTION OF THE FISH AND WILDLIFE SERVICE WHICH MAY OCCUR WITHIN OREGON

Douglas' clover	*Trifolium douglasii*
Leiberg's clover	*Trifolium leibergii*
Owyhee clover	*Trifolium owyheense*
Leach's brodiaea	*Triteleia hendersonii var. leachiae*
Western bog violet	*Viola primulifolia spp. occidentalis*
Small-flowered deathcamas	*Zigadenus fontanus*

Definitions:

Listed Species: An endangered species is one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered in the foreseeable future.

Proposed Species: Taxa for which the Fish and Wildlife Service or National Marine Fisheries Service has published a proposal to list as endangered or threatened in the Federal Register.

Candidate Species: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

Delisted Species: A species that has been removed from the Federal list of endangered and threatened wildlife and plants.

Species of Concern: Taxa whose conservation status is of concern to the U.S. Fish and Wildlife Service
(many previously known as Category 2 candidates), but for which further information is still needed. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing.

Key:

E	Endangered
T	Threatened
CH	Critical Habitat has been designated for this species
PE	Proposed Endangered
PT	Proposed Threatened
PCH	Critical Habitat has been proposed for this species

Notes:

Marine & Anadromous Species: Please consult the National Marine Fisheries Service (NMFS) (http://www.nmfs.noaa.gov/pr/species/) for marine and anadromous species. The National Marine Fisheries Service (NMFS) manages mostly marine and anadromous species, while the U.S. Fish and Wildlife Service manages the remainder of the listed species, mostly terrestrial and freshwater species.

Marine Turtle Conservation and Management: All six species of sea turtles occurring in the U.S. are protected under the Endangered Species Act of 1973. In 1977, NOAA Fisheries and the U.S. Fish and Wildlife Service signed a Memorandum of Understanding to jointly administer the Endangered Species Act with respect to marine turtles. NOAA Fisheries has the lead responsibility for the conservation and recovery of sea turtles in the marine environment and the U.S. Fish and Wildlife Service has the lead for the conservation and recovery of sea turtles on nesting beaches. For more information, see the NOAA Fisheries webpage on sea turtles

http://www.nmfs.noaa.gov/pr/species/turtles/.

Gray Wolf: In 2008, the Service published a final rule that established a distinct population segment of the gray wolf (Canis lupis) in the northern Rocky Mountains (which includes a portion of Eastern Oregon, east of the centerline of Highway 395 and Highway 78 north of Burns Junction and that portion of Oregon east of the centerline of Highway 95 south of Burns Junction). Any wolves found west of this line in Oregon belong to the conterminous USA population [see 73 FR 10514]. On May 5, 2011, the Fish and Wildlife Service published a final rule – as directed by legislative language in the Fiscal Year 2011 appropriations bill – reinstating the Service's 2009 decision to delist biologically recovered gray wolf populations in the Northern Rocky Mountains. Gray wolves in Oregon are State-listed as endangered, regardless of location.

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Overview

Currently, there are 60 plant species that are administratively protected in the State of Oregon. Of these 60 species, 30 are listed as endangered and 28 are listed as threatened. Two species, *Arabis macdonaldiana* (pdf, 399 KB) and *Howellia aquatilis*, have been federally listed, but the Oregon Administrative Rules (OAR 603-073) have not been updated to reflect the state protection that is conferred by federal listing. All federally listed plant species occurring in Oregon are administratively protected by the Oregon Department of Agriculture. In addition, Oregon has 76 candidate species.

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Endangered plant species

Scientific Name	Common Names
Abronia umbellata ssp. *breviflora*	Pink sandverbena Coos Co.
*Arabis macdonaldiana**	Red Mountain rockcress
Artemisia campestris ssp. *borealis* var. *wormskioldii*	Northern wormwood
Astragalus applegatei	Applegate's milkvetch
Astragalus mulfordiae	Mulford's milkvetch
Calochortus coxii	Crinite mariposa lily
Calochortus indecorus	Sexton Mountain mariposa lily
Calochortus umpquaensis	Umpqua mariposa lily
Castilleja levisecta	Golden paintbrush
Cordylanthus maritimus ssp. *palustris*	Point Reyes bird's-beak Coos Co.
Delphinium leucophaeum	White rock larkspur
Delphinium pavonaceum	Peacock larkspur
Erigeron decumbens	Willamette daisy
Fritillaria gentneri	Gentner's fritillary

Haplopappus radiatus	Snake River goldenweed
Ivesia rhypara var. *rhypara*	Grimy ivesia
Lilium occidentale	Western lily Coos Co.
Limnanthes floccosa ssp. *grandiflora*	Big-flowered wooly meadowfoam
Lomatium bradshawii	Bradshaw's desert parsley
Lomatium cookii	Cook's desert parsley
Lomatium erythrocarpum	Red-fruited lomatium
Lupinus cusickii	Cusick's lupine
Mentzelia mollis	Smooth mentzelia
Mirabilis macfarlanei	Macfarlane's four o'clock
Plagiobothrys hirtus	Rough popcornflower, rough allocarya
Plagiobothrys lamprocarpus	Shiny-fruited allocarya
Ranunculus reconditus	Dalles Mountain buttercup
Silene spaldingii	Spalding's campion
Stephanomeria malheurensis	Malheur wire-lettuce
Thelypodium howellii ssp. *spectabilis*	Howell's spectacular thelypody
Trifolium owyheense	Owyhee clover

* Species has been listed federally, but the Oregon Administrative Rules (OAR 603-073) have not yet been updated. All federally listed plant species occurring in Oregon are administratively protected by the State of Oregon.

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Threatened plant species

Scientific Name	Common Name
Amsinckia carinata	Malheur Valley fiddleneck
Aster curtus	White-topped aster
Aster vialis	Wayside aster
Astragalus collinus var. *laurentii*	Laurent's milkvetch
Astragalus diaphanus var. *diurnus*	South Fork John Day milkvetch
Astragalus peckii	Peck's milkvetch
Astragalus sterilis	Sterile milkvetch
Astragalus tyghensis	Tygh Valley milkvetch
Botrychium pumicola	Pumice grape-fern
Calochortus howellii	Howell's mariposa lily

Eriogonum chrysops	Golden buckwheat
Eriogonum crosbyae	Crosby's buckwheat
Erythronium elegans	Coast Range fawn lily
Gratiola heterosepala	Boggs Lake hedge hyssop
Hackelia cronquistii	Cronquist's stickseed
Hastingsia bracteosa	Large-flowered rush lily
*Howellia aquatilis**	Howellia
Lepidium davisii	Davis' peppergrass
Limnanthes floccosa ssp. *pumila*	Dwarf meadowfoam
Lomatium greenmanii	Greenman's desert parsley
Lupinus sulphureus ssp. *kincaidii*	Kincaid's lupine
Mentzelia packardiae	Packard's mentzelia
Microseris howellii	Howell's microseris
Oenothera wolfii	Wolf's evening-primrose
Phacelia argentea	Silvery phacelia Coos Co.
Pleuropogon oregonus	Oregon semaphore grass
Sidalcea nelsoniana	Nelson's checkermallow
Silene douglasii var. *oraria*	Cascade Head catchfly
Thelypodium eucosmum	Arrow-leaf thelypody

* Species has been listed federally, but the Oregon Administrative Rules (OAR 603-073) have not yet been updated. All federally listed plant species occurring in Oregon are administratively protected by the State of Oregon.

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Candidate plant species

Scientific Name	Common Name
Achnatherum hendersonii	Henderson ricegrass
Agrostis howellii	Howell's bentgrass
Arabis koehleri var. *koehleri*	Koehler's rockcress, shrubby rockcress
Arabis suffrutescens var. *horizontalis*	Crater Lake rockcress
Asarum wagneri	Green-flowered wild ginger
Astragalus tegetarioides	Deschutes milkvetch, bastard kentrophyta
Bensoniella oregana	Bensoniella Coos Co.
Bolandra oregana	Oregon bolandra
Botrychium ascendens	Upswept moonwort, upward-lobed moonwort

Botrychium crenulatum	Dainty moonwort, crenulate grape-fern
Botrychium paradoxum	Paradox moonwort, twin-spike moonwort
Botrychium pedunculosum	Stalked moonwort
Calochortus greenei	Greene's mariposa lily
Calochortus longebarbatus var. *peckii*	Peck's mariposa lily
Calochortus persistens	Siskiyou mariposa lily
Camassia howellii	Howell's camassia
Camissonia pygmaea	Pygmy evening primrose, dwarf evening primrose
Cardamine nuttallii var. *gemmata*	Purple dentaria, purple toothwort
Cardamine pattersonii	Saddle Mountain bittercress
Carex constanceana	Constance's sedge
Caulanthus major var. *nevadensis*	Nevada wild cabbage, slender wild cabbage
Cimicifuga elata	Tall bugbane
Collomia renacta	Barren Valley collomia
Corydalis aquae-gelidae	Clackamas corydalis, cold water corydalis
Cypripedium fasciculatum	Clustered lady slipper
Delphinium oreganum	Willamette Valley larkspur
Draba howellii	Howell's whitlow grass
Epilobium oreganum	Oregon willowherb
Epilobium siskiyouense	Siskiyou willowherb
Erigeron howellii	Howell's daisy, Howell's fleabane
Erigeron oreganus	Oregon daisy, Oregon fleabane
Eriogonum cusickii	Cusick's buckwheat, Cusick's eriogonum
Eriogonum prociduum	Prostrate buckwheat
Filipendula occidentalis	Queen of the forest
Frasera umpquaensis	Umpqua frasera, Umpqua swertia
Gentiana setigera	Elegant gentian, Waldo gentian
Hackelia diffusa var. *diffusa*	Diffuse stickseed
Horkelia congesta ssp. *congesta*	Shaggy horkelia
Lasthenia macrantha ssp. *prisca*	Large flowered goldfields, perennial lasthenia
Leptodactylon pungens ssp. *hazeliae*	Snake River prickly phlox, Hazel's prickly phlox
Limbella fryei	Frye's limbella moss
Limnanthes floccosa ssp. *bellingeriana*	Bellinger's meadowfoam
Limnanthes gracilis var. *gracilis*	Slender meadowfoam

Lomatium suksdorfii	Suksdorf's lomatium
*Luina serpentina**	Colonial luina
Lupinus lepidus var. *ashlandensis*	Ashland lupine, Mount Ashland lupine
Meconella oregana	White meconella
Mimulus evanescens	Disappearing monkeyflower
Mimulus hymenophyllus	Thinsepal monkeyflower, membrane-leaved monkeyflower
Mimulus jungermannioides	Jungermann's monkeyflower, hepatic monkeyflower
*Mimulus patulus**	Stalk leaved monkeyflower
Montia howellii	Howell's montia
Myosurus sessilis	Sessile mousetail
Penstamon barrettiae	Barrett's penstemon
Perideridia erythrorhiza	Red root yampah
Phacelia minutissima	Least phacelia
Plagiobothrys figuratus ssp. *corallicarpus*	Coral seeded allocarya
Ranunculus austrooreganus	Southern Oregon buttercup
Rorippa columbiae	Columbia cress
Rubus bartonianus	Bartonberry
Saxifraga hitchcockiana	Saddle Mountain saxifrage
Sedum moranii	Rogue River stonecrop
Sedum oblanceolatum	Applegate stonecrop
*Senecio ertterae**	Ertter's senecio
Senecio hesperius	Western senecio
Sidalcea campestris	Meadow sidalcea, meadow checkermallow
Sidalcea hirtipes	Hairy stemmed checkermallow, bristly-stemmed sidalcea
Sidalcea malviflora ssp. *patula*	Mallow sidalcea, coast checker bloom Coos Co.
Sisyrinchium sarmentosum	Pale blue eyed grass
Sophora leachiana	Western sophora, western necklace
Streptanthus howellii	Howell's streptanthus
Sullivantia oregana	Oregon sullivantia, sullivantia
Tauschia howellii	Howell's tauschia
Trifolium leibergii	Leiberg's clover
Triteleia hendersonii var. *leachiae*	Leach's brodiaea, blue-striped brodiaea Coos Co.
Viola primulifolia ssp. *occidentalis*	Western bog violet

* Species was previously listed as threatened or endangered by the Oregon Department of Agriculture, but has since been delisted.

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Threatened and endangered plant definitions

Endangered species

(a) Any native plant species determined by the director to be in danger of extinction throughout all or any significant portion of its range; or

(b) Any plant species listed as an endangered species pursuant to the federal Endangered Species Act of 1973 (PL 93-205, 16 USC § 1531), as amended.

Threatened species

(a) Any native plant species the director determines is likely to become endangered within the foreseeable future throughout all or any significant portion of its range; or

(b) Any plant species listed as a threatened species pursuant to the federal Endangered Species Act of 1973 (PL 93-205, 16 U.S.C. § 1531), as amended.

Candiate species

Any plant species designated for study by the director (of the Oregon Department of Agriculture) whose numbers are believed low or declining, or whose habitat is sufficiently threatened and declining in quantity and quality, so as to potentially qualify for listing as a threatened or endangered species in the foreseeable future.

Delisted species

Any plant species, previously listed as threatened or endangered by the Oregon Department of Agriculture, which has been removed from list. All delisted species are placed on the candidate species list.

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USDA United States Department of Agriculture
Natural Resources Conservation Service

NRCS | PLANTS

Threatened & Endangered

Protected Plants for All Scientific Names

Jurisdiction = Federal and State
State Distribution = U.S. States (Oregon)
73 records returned

Protected plants that are synonyms retain their protected status, and are indented beneath the current PLANTS accepted name; common names are from PLANTS.

United States	USFWS Endangered Species Program. 2014. *All plants (January 2014)* (http://ecos.fws.gov/tess_public/pub/listedPlants.jsp). US Fish and Wildlife Service, Washington, DC.
Oregon	Oregon Natural Heritage Information Center. 2004. *Rare, threatened and endangered species of Oregon* (http://orbic.pdx.edu/plants/view_plants2.php, 5 May 2006). Oregon Natural Heritage Information Center, Oregon.

Coos Co.

Symbol	Scientific Name	Common Name	Federal Protected Status†	State Protected Status†
ABUMB	*Abronia umbellata* Lam. ssp. *breviflora* (Standl.) Munz	pink sand verbena		OR (E) — yes
AMCA8	*Amsinckia carinata* A. Nelson & J.F. Macbr.	Malheur Valley fiddleneck		OR (T)
ARMA33	*Arabis macdonaldiana* Eastw.	MacDonald rockcress	E	
ARPA7	*Arenaria paludicola* B.L. Rob.	marsh sandwort	E	
ARCAW	*Artemisia campestris* L. ssp. *borealis* (Pall.) H.M. Hall & Clem. var. *wormskioldii* (Besser ex Hook.) Cronquist	field sagewort		OR (E)
ASAP	*Astragalus applegatei* M. Peck	Applegate's milkvetch	E	OR (E)
ASCOL	*Astragalus collinus* Douglas ex G. Don var. *laurentii* (Rydb.) Barneby	Laurent's milkvetch		OR (T)
ASCUS2	*Astragalus cusickii* A. Gray var. *sterilis* (Barneby) Barneby	barren milkvetch		OR (T)
ASDI2	*Astragalus diaphanus* Douglas ex Hook.	transparent milkvetch		
ASDID4	*Astragalus diaphanus* Douglas ex Hook. var. *diurnus* (S. Watson) Barneby ex M. Peck			OR (T)
ASER4	*Astragalus eremiticus* Sheldon	hermit milkvetch		
ASAM14	*Astragalus ampullarioides* (S.L. Welsh) S.L. Welsh		E	
ASMU	*Astragalus mulfordiae* M.E. Jones	Mulford's milkvetch		OR (E)
ASPE4	*Astragalus peckii* Piper	Peck's milkvetch		OR (T)
ASTY	*Astragalus tyghensis* M. Peck	Tygh Valley milkvetch		OR (T)
BOPU2	*Botrychium pumicola* Coville ex Underw.	Crater Lake grapefern		OR (T)
CACO41	*Calochortus coxii* M. Godfrey & F. Callahan	Cox's mariposa lily		OR (E)
CAHO11	*Calochortus howellii* S. Watson	Howell's mariposa lily		OR (T)

Coos Co

CAIN18	*Calochortus indecorus* Ownbey & M. Peck	Sexton Mountain mariposa lily		OR (E)
CAUM5	*Calochortus umpquaensis* N.A. Fredricks	Umpqua mariposa lily		OR (E)
CALE27	*Castilleja levisecta* Greenm.	golden Indian paintbrush	T	OR (E)
COMAP	*Cordylanthus maritimus* Nutt. ex Benth. ssp. *palustris* (Behr) T.I. Chuang & Heckard	Pt. Reyes bird's-beak		OR (E) — Yes
DENUO	*Delphinium nuttallii* A. Gray ssp. *ochroleucum* (Nutt.) Warnock	upland larkspur		
DELE	*Delphinium leucophaeum* Greene			OR (E)
DEPA4	*Delphinium* ×*pavonaceum* Ewan (pro sp.) [*menziesii* × *trolliifolium*]	peacock larkspur		OR (E)
ERDED	*Erigeron decumbens* Nutt. var. *decumbens*	Willamette fleabane	E	OR (E)
ERCH6	*Eriogonum chrysops* Rydb.	bitterroot buckwheat		OR (T)
ERCR10	*Eriogonum crosbyae* Reveal	Crosby's buckwheat		OR (T)
ERME5	*Erysimum menziesii* (Hook.) Wettst.	Menzies' wallflower	E	
EREL13	*Erythronium elegans* Hammond & K.L. Chambers	Coast Range fawnlily		OR (T)
EUVI8	*Eucephalus vialis* Bradshaw	wayside aster		
ASVI4	*Aster vialis* (Bradshaw) S.F. Blake			OR (T)
FRGE	*Fritillaria gentneri* Gilkey	Gentner's fritillary	E	OR (E)
GRHE	*Gratiola heterosepala* H. Mason & Bacig.	Boggs Lake hedgehyssop		OR (T)
HACR4	*Hackelia cronquistii* J.L. Gentry	Cronquist's stickseed		OR (T)
HABRB	*Hastingsia bracteosa* S. Watson var. *bracteosa*	largeflower rushlily		OR (T)
HOAQ	*Howellia aquatilis* A. Gray	water howellia	T	
ILRIR	*Iliamna rivularis* (Douglas ex Hook.) Greene var. *rivularis*	streambank wild hollyhock		
ILCO4	*Iliamna corei* Sherff		E	
IVRHR	*Ivesia rhypara* Ertter & Reveal var. *rhypara*	grimy mousetail		OR (E)
LEDA2	*Lepidium davisii* Rollins	Davis' pepperweed		OR (T)
LIOC2	*Lilium occidentale* Purdy	western lily	E	OR (E) — Yes
LIPU8	*Limnanthes pumila* Howell	woolly meadowfoam		
LIFLP2	*Limnanthes floccosa* Howell ssp. *pumila* (Howell) Arroyo	woolly meadowfoam		OR (T)
LIPUG	*Limnanthes pumila* Howell ssp. *grandiflora* (Arroyo) S.C. Meyers & K.L. Chambers	woolly meadowfoam		
LIFLG	*Limnanthes floccosa* Howell ssp. *grandiflora* Arroyo	woolly meadowfoam	E	OR (E)
LOBR	*Lomatium bradshawii* (Rose ex Mathias) Mathias & Constance	Bradshaw's desertparsley	E	OR (E)
LOCO8	*Lomatium cookii* J.S. Kagan	agate desertparsley	E	OR (E)
LOER2	*Lomatium erythrocarpum* R.J. Meinke & Constance	redfruit desertparsley		OR (E)
LOGR2	*Lomatium greenmanii* Mathias	Greenman's biscuitroot		OR (T)
LUORK	*Lupinus oreganus* A. Heller var. *kincaidii* C.P. Sm.	Kincaid's lupine	T	
LUSUK	*Lupinus sulphureus* Douglas ex Hook. ssp. *kincaidii* (C.P. Sm.) L. Phillips			OR (T)

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MEMO2	*Mentzelia mollis* M. Peck	soft blazingstar		OR (E)
MEPA5	*Mentzelia packardiae* Glad.	Packard's blazingstar		OR (T)
MIHO2	*Microseris howellii* A. Gray	Howell's silverpuffs		OR (T)
MIMA2	*Mirabilis macfarlanei* Constance & Rollins	MacFarlane's four o'clock	T	OR (E)
OEWO	*Oenothera wolfii* (Munz) P.H. Raven, W. Dietr. & Stubbe	Wolf's evening primrose		OR (T)
PHAR	*Phacelia argentea* A. Nelson & J.F. Macbr.	sanddune phacelia (Silvery P.)		OR (T) — yes
PLHI6	*Plagiobothrys hirtus* (Greene) I.M. Johnst.	rough popcornflower	E	OR (E)
PLLA3	*Plagiobothrys lamprocarpus* (Piper) I.M. Johnst.	shinyfruit popcornflower		OR (E)
PLOR3	*Pleuropogon oregonus* Chase	Oregon semaphoregrass		OR (T)
PYRA2	*Pyrrocoma radiata* Nutt.	ray goldenweed		OR (E)
RATR6	*Ranunculus triternatus* A. Gray	obscure buttercup		
RARE5	*Ranunculus reconditus* A. Nelson & J.F. Macbr., nom. illeg.			OR (E)
SERI4	*Sericocarpus rigidus* Lindl.	Columbian whitetop aster		
ASCU2	*Aster curtus* Cronquist			OR (T)
SINE2	*Sidalcea nelsoniana* Piper	Nelson's checkerbloom	T	OR (T)
SIDOO	*Silene douglasii* Hook. var. *oraria* (M. Peck) C.L. Hitchc. & Maguire	seabluff catchfly		OR (T)
SISP2	*Silene spaldingii* S. Watson	Spalding's silene	T	OR (E)
STMA5	*Stephanomeria malheurensis* Gottlieb	Malheur wirelettuce	E	OR (E)
THHOS2	*Thelypodium howellii* S. Watson ssp. *spectabilis* (M. Peck) Al-Shehbaz	Howell's thelypody		OR (E)
THHOS	*Thelypodium howellii* S. Watson var. *spectabilis* M. Peck		T	
TROW	*Trifolium owyheense* Gilkey	Owyhee clover		OR (E)

†Code	Protected Status
E	Endangered
T	Threatened

Time Generated: 01/21/2016 03:49 PM MST

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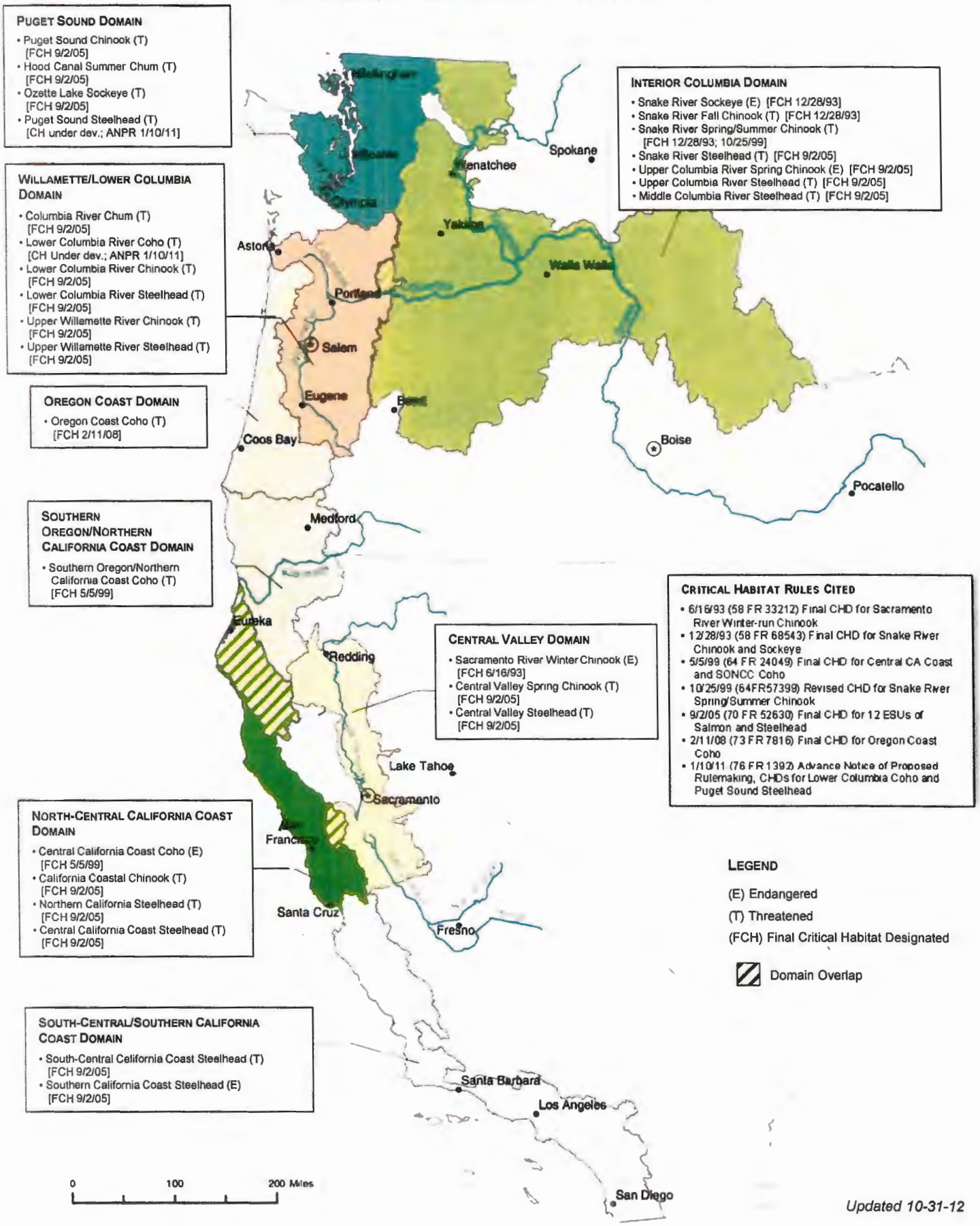
Status of ESA Listings & Critical Habitat Designations for West Coast Salmon & Steelhead



Updated 10-31-12

SECTION 4:
WATER RIGHTS

SECTION 4: WATER RIGHTS

This study will consider the options of providing storage water rights for the proposed off-channel reservoir using the existing surface water rights as the water supply.

Background

The City has 11.0 cfs of surface water rights from both Ferry and Geiger Creeks, but only diverts a maximum of 1.6 cfs. Based on projected population growth and need, the City will need to increase their maximum diversion to approximately 4.5 cfs by the year 2040. See Table 4.1.

Table 4.1
Projected Population Growth and Water Need

Year	Residents Inside City Limits Full Time	Residents Outside City Limits Full Time	Residents Inside City Limits Peak Additional	Residents Outside City Limits Peak Additional	Transient Off Peak	Transient Peak Additional	Total	Use Max. Raw Diverted, cfs
2015	3104	203	288	9	263	486	4353	1.26
2020	3114	206	292	10	266	493	4381	2.87
2030	3198	209	297	10	270	501	4485	2.88
2035	3196	209	296	10	270	501	4482	2.88
2040	3185	208	295	10	269	499	4466	4.48

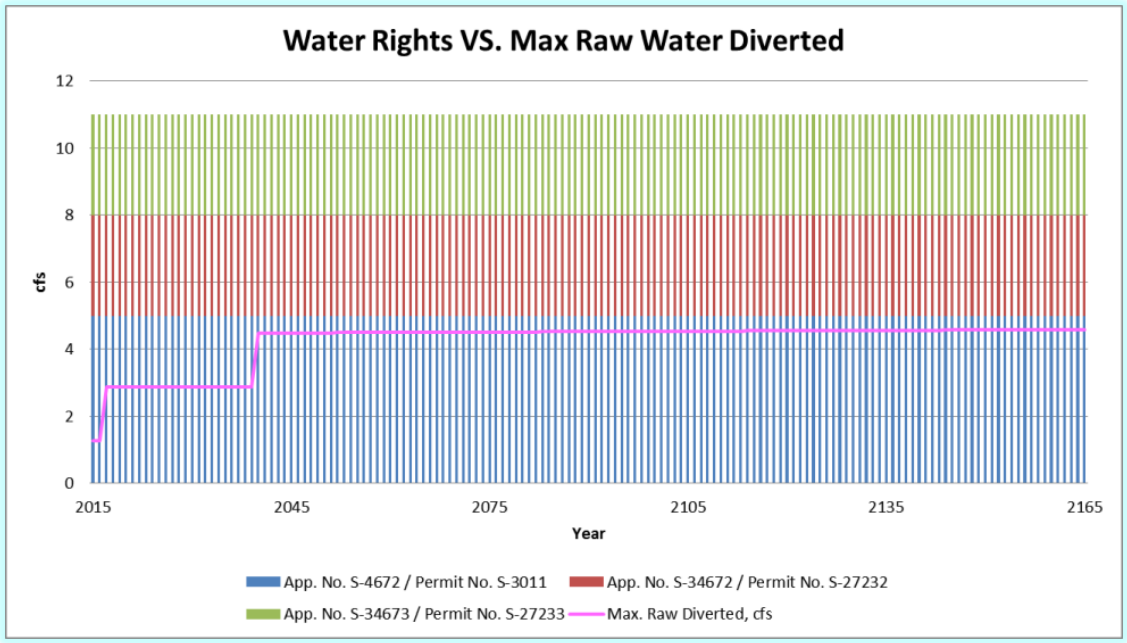
The City's water rights are listed in Table 4.2:

Table 4.2
Existing Water Rights

App. No.	Permit No.	Cert. No.	Trans. No.	P-date	Stream/Reservoir	Magnitude
S-4982	S-3011	N/A	T-8195	6/19/1916	Geiger Creek	5.0 cfs
S34672	S-27232	N/A	T-8195	3/7/1961	Geiger Creek	3.0 cfs
S-34673	S-27233	N/A	T-8195	3/7/1961	Ferry Creek	3.0 cfs
E-481	E-27	9754	N/A	1/24/1910	Ferry Creek	2.0 cfs
R-5017	R-368	N/A	N/A	7/5/1916	Geiger Crk. Res.	90.0 ac-ft
R-501	R-28	9755	N/A	1/24/1910	Ferry Creek Res.	20-5/8 ac-ft

The City has adequate surface water rights from both Ferry and Geiger Creeks for future needs as shown in Table 4.1.

Figure 4.1



The City has two raw water intakes, one located below Ferry Creek Reservoir and the other below the fish hatchery, at the confluence of Ferry and Geiger Creeks. Bandon Hatchery is a non-consumptive water user and has water intakes and rights on both Ferry and Geiger Creeks. Water diverted by the fish hatchery flows through the fish tanks and then returns to Ferry Creek.

Stream flows in Ferry and Geiger Creek varies seasonally. Both creeks have upstream agriculture use, which is generally higher during late August through October. This is also the period when streamflows drop due to low precipitation. The lowest recorded flow in Ferry Creek (above the confluence with Geiger Creek) was 1.3 cfs, as reported in the 1992 Water Master Plan (date unknown). In addition, the 1992 Water Master Plan states that, according to information provided by the Oregon State University, Agricultural Experimental Station, 1992 was the driest precipitation year in over 30 years of records. This 1.3 cfs flow was considered to be a 1/100 low flow value for Ferry Creek. The total water supply available at the confluence of Ferry and Geiger Creeks could fall to as low as 1.7 cfs during a dry month. According to the City's Water Management and Conservation Plan (WCMP), October 2013, the maximum daily demand (MDD) is 1.70 cfs. The projected MDD for the year 2040 is 1.74 cfs. This means there is the potential for demand to exceed water supply during dry months.

Currently there is no way of verifying streamflows in the main confluence of Ferry Creek. A stream gauge, located just downstream from the confluence of Ferry and Geiger Creeks, had been abandoned, but the City, in cooperation with the local Watermaster and Oregon Water Resources Department, is in the process of reinstating it. The stream gauge is predicted to be transmitting data as soon August 2016.

The City has insufficient capacity to store raw water in their existing in-channel reservoirs. Ferry Creek Reservoir can only store approximately 1.61 acre-feet of it 20-5/8 acre-feet certificated water right and Geiger Creek Reservoir can only store approximately 1.78 acre-feet of its 90 acre-feet permitted water right. There is an approximate total of 3.39 acre-feet of raw water storage, however, both reservoirs need dredging and the current capacities of the reservoirs, based on surveys conducted in 2014 are shown in Figure 4.2:

Figure 4.2
Reservoir Capabilities

Reservoir	Acre-Feet	Gallons
Ferry Creek	1.61	541,000
Geiger Creek	1.78	580,015
Total	3.39	1,121,015

The dams that impound the water for both of these reservoirs are owned by Oregon Department of Fish and Wildlife, which owns and operates the Bandon Hatchery. Ferry Creek Reservoir, which is located on property owned by Oregon Department of Fish and Wildlife, was originally constructed to store 20-5/8 acre-feet of water. Geiger Creek Reservoir is located on property owned by the City of Bandon. It was originally constructed to store a maximum of 2.73 acre-feet and, according to the 1992 Water Master Plan, was intend primarily to aid in the diversion of water from the creek.

The City investigated dredging both reservoirs to increase storage. Because of the condition of the dam and the period of time that Ferry has been silted in, dredging could not be as extensive as needed. The estimated storage if the proposed dredging was completed would be less than 4 acre-feet. It was determined that dredging the main body of Geiger Reservoir would not significantly increase storage.

Expanding storage to the full amount of the listed water right for these two instream reservoirs would provide adequate storage for the City, but it would be very expensive. The estimated cost to repair the dam and dredge Ferry Creek Reservoir to increase its capacity to 3.59 acre-feet was $3,307,000. The estimated cost to dredge Geiger Creek Reservoir was $274,000. Reservoir expansion would be problematic due to permitting issues, difficult to get through the dam safety approval process, and challenging because both dams are not owned by the City.

Proposed Changes to Water Rights

The City has investigated a number of ways to change or transfer their existing water rights to the proposed off-channel reservoir and / or obtaining a new storage water right using the existing surface water rights to supply water to the proposed off-channel reservoir.

A. "Move", by manner of Water Right Permit Amendment, the place of storage for 85 ac-ft of 90 acre-feet from Geiger Creek Reservoir to off-channel reservoir. (ORS 537.211) (4) The holder of a water right permit may change the point of diversion, change the point of appropriation, change the point of diversion to allow the appropriation of ground water or use the water on land to which the right is not appurtenant).The application was prepared and this option was discussed at a phone conference held November 3, 2014 with the City, Oregon Water Resources Department (OWRD), and Oregon Department of Fish and Wildlife attending. The Permit Amendment option was rejected by OWRD due to another case being decided by the Oregon Department of Justice.The City hired Martha Pagel, water rights attorney, to assist with the process, however, this alternative is not considered likely to be approved by OWRD.

B. "Move", by Water Right Transfer, 15 acre-feet of 20-5/8 ac-ft of storage from Ferry Creek Reservoir to off-channel reservoir. The application was prepared, however, OWRD are putting applications to "move" reservoir locations on hold pending litigation and rule making related to that. (OAR 690-380)

C. Develop a "bulge in the system" that would be used as an in-system storage facility, some what like the City's Middle Pond. This option is more commonly used for irrigation uses, where the water held in the pond are used on a rotational basis, but not stored for use outside the irrigation season. According to the OWRD field manual, water can be kept in a bulge in the system pond for up to 72 hours for non-agricultural use. Municipal use is year round, however the purpose of this reservoir, is to divert water during the rainy season for use during the dry season, so water would be held far longer than 72 hours. Some use of the stored water may be necessary during the rainy season when the Fish Hatchery is treating their fish, however, this use would be minor. This alternative would likely not be approved by OWRD.

D. Apply for incremental perfection of claim of beneficial use (partial perfection) for 1.6 cfs of 5.0 cfs of Application No. S-4982 / Application No. S-3011, Geiger Creek, domestic use. This alternative certificates a portion of a permitted surface water that is currently in use and that has a 1916 priority date. Certificating a portion of this permit secures the rights to the use of water. Martha Pagel, water rights attorney, is assisting the City through this process.

E. Apply for a Transfer for the type of use for Application No. S-4982 / Application No. S-3011, Geiger Creek, from domestic use to municipal use after Patial Perfection is approved by OWRD. Martha Pagel, water rights attorney, is assisting with this process.

F. Apply for a new water right to store water and for a new water right to withdraw water from the the new reservoir. Martha Pagel, water rights attorney, is assisting with this process.

SECTION 5:

ARCHAEOLOGICAL AND ENVIRONMENTAL IMPACTS

SECTION 5: ARCHAEOLOGICAL AND ENVIRONMENTAL IMPACTS

This section will consider archaeological impacts, environmental impacts and analyses of environmental harm to reservoir area and streams from the proposed project.

Madeleine Vander Heyden, Fish and Wildlife Biologist Coordinator, Oregon Coastal Program with U.S. Fish and Wildlife Service, was contacted in 2014 regarding any listed bird species around the project area. She said that marbled murrelets and spotted owls are the listed birds in this region, but she wasn't aware of any in the area. She said that she would check on the possibility of eagles in the area.

Madeleine was also involved with the plant survey to look for the endangered Western lily, *Lilium occidentale*.

Kassandra Rippee, Tribal Archaeologist with the Coquille Tribe of Indians made a site visit on February 22, 2016 to specifically look at the organic material found during the geotechnical excavations. She said that she didn't see anything, such as shell fragments, that might be a cultural resource. She said that tsunami was the most likely explanation for the organic material found near the bottom of the one of the test pits. She had visited the project site prior to the site brushing, however the vegetation made it impossible to access the site. She will return to examine the timbered parcel when it is logged. It, too, is inaccessible due to brushy conditions.

No wetlands were identified in the cleared parcel. Verification of whether any wetlands are within the timbered parcel will be conducted once the logging is complete. A 401 Water Quality Certificate will be obtained as part of the process. See Section 9 for additional information regarding permitting.

SECTION 6:

IMPACTS TO OTHER WATER USERS AND FISH HATCHERY

SECTION 6: IMPACTS TO OTHER WATER USERS AND FISH HATCHERY

This section will consider impacts to other water users and the Fish Hatchery from the proposed project.

The City holds water rights on the Ferry and Geiger Creek systems with the oldest priority dates. The Ferry Creek reservoir is certificated with a priority date of 1910 and the Geiger Creek reservoir is permitted with a priority date of 1916. The City's surface water right, Application No. S-4982/Permit No. S-3011/Transfer No. 8195, is permitted with a priority date of 1916. Because Oregon's water laws are based on the principle of prior appropriation, the user with first water right or earliest priority is the last to be shut off during times of low stream flows. That means the City should be the last to be denied water from Ferry Creek.

The City currently diverts water from their existing Backup or Lower Pump Station located at the same point of diversion intended to be used to supply the off-channel reservoir. Application No. S-4982/Permit No. S-3011/Transfer No. 8195 is currently in the process of being submitted to OWRD for an incremental Claim of Beneficial Use (Partial Perfection) of 1.6 cfs of the 5.0 cfs surface water right total. Utilizing this point of diversion will not lessen stream flow.

The City does not intend to increase the maximum diversion rate to supply the proposed reservoir, however, if the size of the City increases, as forecast to, within the next 25 years, then the diversion rate may be increased to a maximum of 3.2 cfs. Raising the diversion rate, by installing an additional 50 HP pump at the existing point of diversion, would allow the water treatment plant to increase in size to keep up with water demand. This could, also, allow more flexibility in the diversion schedule for filling the reservoir in regard to flows for fish runs and stream turbidity.

Oregon Department of Fish and Wildlife (ODFW) have a certificated surface water right for 3.0 cfs with a priority date of 1925. This right is for "flow through" water and is designated for fish propagation at the Bandon Fish Hatchery. The right diverts water from Ferry and South Fork Ferry (Geiger) Creeks from the existing reservoirs on each of the creeks. This water is diverted and returned to Ferry Creek above the existing point of diversion that is proposed to be used for the off-channel reservoir. Water diverted for the off-channel reservoir would not impact the Fish Hatchery in terms of lessening creek flows. Having the off-channel reservoir would mean there would be water available to supply municipal needs during periods when the Fish Hatchery is doctoring their fish and allow flexibility when stream flows are low.

Another surface water right with a priority date of 1929 is Bandon Trout Farm, Inc. This another "flow through" right that allows for 3.5 cfs to be diverted from Ferry Creek through a series of fish ponds and returned to Ferry Creek downstream. The point of diversion for this water right is downstream from the existing point of diversion proposed to be used for the off-channel reservoir. It is unknown at this time whether Bandon Trout Farm is still in business or whether this water is being used as per the permitted use.

Downstream from the existing point of diversion that is intended to supply the proposed off-channel reservoir are Oregon Water Resources Department's (OWRD) instream water rights for anadromous and resident fish rearing purposes. These rights vary with month and diversion times at rates would have to be coordinated with upstream migrations of fish. See Section 7 Hydrological Analysis for further information.

Upstream from the Ferry and Geiger Creek Reservoirs are several surface water rights that are, in general, intended for agricultural use. Approximately nine of these rights, totaling approximately 5.5 cfs have priority dates that range from 1925 through 1947. At present these rights should be impacted by low

flows because the City has a more senior right. If the off-channel reservoir were to be built, the reservoir would lessen the impact of low stream flows, by allowing the agricultural users to continue to use water during the late summer / early fall period when their water use is higher.

All water rights on the Ferry and Geiger Creek basins are listed on a chart at the end of this section.

Ferry Creek is considered to be over allocated, meaning there is insufficient streamflow to meet the demands of the surface water rights currently issued. OWRD has stated that no new surface water rights will be granted to divert water from the Ferry and Geiger Creek system. The City has sufficient surface water rights to supply the reservoir without seeking additional water rights from Ferry Creek or Gieger Creek.

Ferry Creek is reported to have dropped to 1.3 cfs during the period between 1977 and 1996 when the stream gauge, located just downstream of the point of diversion, was in operation. This amounts to little more than a trickle of stream flow and would greatly impact the City's ability to withdraw sufficient amounts of water for municipal use.

At present, Ferry Creek does not have an operating stream gauge. The City is coordinating with OWRD to reinstate this stream gauge and data should be available by August or September of this year.

Climate change tends to increase the frequency of droughts. The drought that has persisted through the summer months, from 2014 water year to present, puts additional pressure on the Ferry and Geiger Creek system. The trend of hotter and drier summers presents an escalated risk of wildfires. Bandon has had a history of devastating wildfires within the city. The City is located in an area that is infested with gorse, a highly flammable bush. This reservoir would provide necessary water storage to combat potential wildfires in the City.

Augmenting low flows during dry months would benefit the water quality for aquatic organisms by increasing flow depth and reducing river temperature. The need for augmenting stream flows has become more apparent with the change in climate and agricultural diversion for summer and fall crops. The majority of agricultural water use coincides with the historical low flow periods. Climate change has shown a tendency to increase the frequency of drought years which exacerbates the depletion of stream flows. During extreme low flows in Ferry Creek there is barely enough water to sustain the municipal diversion rate. Augmenting low flows may be required by some funding agencies.

Diverting raw water during the wet winter months and storing it for use during the dry summer months in an off-channel reservoir will benefit other water users and the environment. During the wet months the primary users are the Fish Hatchery and ODFW for fish migrating to spawning grounds, however, it must be noted that there is no existing fish passage past either Ferry or Geiger Creek dams. During the dry summer months the stream is used by almost all of the water right holders, primarily for agricultural use, but also for municipal use.

SECTION 7:

HYDROLOGICAL ANALYSIS

SECTION 7: HYDROLOGICAL ANALYSIS

The proposed off channel reservoir will divert raw water from Ferry Creek just downstream of the confluence with Geiger Creek at an existing point of diversion. The diverted raw water will be used for municipal treatment supply and could be used for streamflow augmentation. This section will provide insight to the physical and hydrological characteristics of the watershed and the associated impacts of the off channel reservoir. The information produced in this section will be used to address the hydraulic and hydrologic feasibility of implementing the proposed off channel reservoir. To better understand the hydraulic and hydrologic relationships within the watershed, the following major tasks were undertaken:

A. Identify the physical characteristics of the watershed

B. Identify environmental constraints and regulations

C. Identify a relationship between streamflow and meteorological events

D. Verify the feasibility of diverting raw water to the off channel reservoir

E. Verify the feasibility of releasing raw water for municipal use and streamflow augmentation

F. Address future changes

Definitions:

EPA – U.S. Environmental Protection Agency
OHW – Ordinary High Water Line
MHHW – Mean Higher High Water
MSL – Mean Sea Level
DEQ – Oregon Department of Environmental Quality
ODFW – Oregon Department of Fish and Wildlife
cfs – cubic feet per second
ac-ft – acre-feet

Watershed

The contributing watershed is comprised of the Ferry Creek basin which has an area of 1189.5 acres (1.86 square miles) and the Geiger Creek basin which has an area of 1524.5 acres (2.4 square miles). The lower reaches of Ferry Creek are near sea level and the upper reaches of Geiger Creek are near 400-feet above sea level. The contributing watershed begins at the point of diversion which has an approximate elevation of 50 feet above sea level. The highest point in the watershed is around 400 feet above sea level. The watershed has an average slope of 1.8% with a shallower slope of 0.5% near the lower reaches and the point of diversion. Ferry Creek is a third order perennial stream with 3 second order tributaries. Geiger Creek is a third order perennial stream with 2 second order tributaries. Geiger and Ferry Creek basins are adjacent to each other and form a larger contributing basin that comprises the watershed for the point of diversion. The point of diversion is located on the lower reach of Ferry Creek adjacent to the confluence with Geiger Creek. Appendix A shows the watershed delineation. The upper portions of the watershed consist mainly of agricultural and forested lands. The agriculture in the watershed is dominated by cranberry bogs. The forested portion of the watershed consist of shore pine, Sitka spruce, western hemlock, and Douglas-fir. The lower portions of the watershed consist of mainly low density urban developments with sporadic forestland. The proposed off channel reservoir has a relatively small footprint

of 7.3 acres when compared to the contributing watershed 2,714 acres. The addition of the proposed off-channel reservoir will only have a minor impact on the overall hydrological function of the watershed. Table 7.1 is a summary of the watershed characteristics and these values will be used as basepoint data for the hydrologic analysis.

Table 7.1
Physical Characteristics of the Watershed

DESCRIPTION	VALUE
Ferry Creek Basin Area	1,189.5 Acres
Geiger Creek Basin Area	1,524.5 Acres
Watershed Area	2,714 Acres
Watershed Average Slope	1.8%
Number of Second Order Tributaries to Ferry Creek	3
Number of Second Order Tributaries to Geiger Creek	2
Lowest Point in Watershed	50 feet above MSL
Highest Point in Watershed	400 feet above MSL
Ferry Creek Gauge Station	STA# 14327120

The only river gauging station in the watershed is Ferry Creek Station No. 14327120 which is located downstream of the confluence of Geiger Creek and Ferry Creek. The gauging station is also located near the planned point of diversion for the off channel reservoir. The flow data can be assumed realistic and accurate because of the close proximity of the gauging station to the point of diversion. The gauging station is currently out of service but historic flow data is available from the Oregon Water Resources Department (OWRD). Published flow data is available from 1977 to 1982 and 1994 to 1996. Table 7.2 is a summary of the flow data from the Ferry Creek gauging station.

Table 7.2
Ferry Creek Streamflow Data

Month	Average Ferry Creek Flow (cfs)	Minimum Ferry Creek Flow (cfs)	Maximum Ferry Creek Flow (cfs)	STDV Ferry Creek Flow (cfs)
January	14.7	3.0	125.0	15.9
February	16.7	2.2	80.0	14.5
March	12.2	3.0	58.0	8.8
April	6.8	0.3	100.0	7.5
May	9.0	3.7	56.0	7.8
June	5.2	1.5	11.0	1.8
July	3.7	0.9	6.3	1.3
August	3.2	0.8	18.0	1.5
September	4.2	1.4	13.0	2.3
October	3.8	0.3	24.0	2.7
November	9.0	2.4	45.0	7.3
December	12.8	2.2	100.0	14.1

During the drier months the flow rate in Ferry Creek has a low standard deviation and is consistently around 4 cfs which is attributed to groundwater base flow. In the winter months the flow rate is highly variable and depends on the precipitation which is attributed to surface water runoff. This watershed is very responsive to precipitation and drought which cause large fluctuations in flowrate. During the drier months the flows in Ferry Creek are at the lowest which also correspond to the highest water demand period for agricultural diversion. The primary agricultural use in the watershed is from cranberry growers. These growers divert raw water to their cranberry bogs for irrigation and as part of their harvesting techniques. The combination of drought and agricultural diversion causes stress on the watershed which impacts the municipal water source and environmental flows. During wet weather the watershed experiences an abundance of streamflow in Ferry Creek. Raw water diverted to the off channel reservoir during high flows in Ferry Creek would have a minimal impact on the overall streamflow. Wet weather flow conditions are the ideal period for raw water diversion to the off channel reservoir.

Climate

The watershed has a Marine West Coast-Mediterranean climate (Köppen classification Csb), which is common to most of the Oregon coast. Climate data for this section is based on published daily meteorological observations from the Western Regional Climate Center Station ID: Bandon 2 NNE, Oregon (350471). In the winter months rain and overcast conditions are common and the summers are mostly dry. Below freezing temperatures and snow can occur during the winter; however, this is not very common and usually occurs on average less than once a year. Extreme temperatures of 20 °F or lower are extremely rare, usually happening about once every five years. Summers are dry and cool with an average July high temperature of about 68 °F while lows are generally in the 50s °F. Bandon's highest reading of 100 °F occurred on September 21, 1990 and the lowest reading of 8 °F was observed only three months later on December 21, 1990. The moderate climate is beneficial to off channel raw water storage because the stored water temperature will stay fairly consistent. Water quality is predictable and easier to control with consistent water temperatures. Table 7.3 below is a summary of the temperature and precipitation for the watershed.

Table 7.3
30-Year Average Climate Data

Month	Mean Max. Temperature (F)	Mean Temperature (F)	Mean Min. Temperature (F)	Mean Precipitation (in)
Jan	55	47.2	39.4	9.46
Feb	56	47.6	39.2	7.23
Mar	56.9	48.7	40.5	7.01
Apr	58.4	50.2	41.9	4.51
May	61.8	53.6	45.4	3.22
Jun	64.9	57	49.2	1.77
Jul	67.5	59.6	51.7	0.39
Aug	68.1	59.7	51.3	0.61
Sep	67.4	57.9	48.5	1.32
Oct	63.6	54.2	44.8	3.99
Nov	57.7	49.9	42	8.88
Dec	54.3	46.6	38.8	10.32
Annual	61	52.7	44.4	58.71

Environmental

The Geiger Creek and Ferry Creek watersheds play host to a delicate ecosystem and the Oregon Coast coho salmon (*Oncorhynchus kisutch*) which is considered threatened. Ferry Creek downstream of the Ferry Creek dam is considered essential salmon habitat which restricts certain construction activities and riparian zone development. The off channel reservoir will be constructed outside of any riparian zones and will have no construction impacts to Ferry Creek. It is unlikely that the construction of the off channel reservoir will trigger a regulatory consultation. Appendix B shows the extent to which Ferry Creek is considered essential salmon habitat. Under most circumstances, both National Marine Fisheries Service and Oregon Department of Fish and Wildlife require a minimum water depth of 1 foot and streamflow temperature deviation of less than one degree Fahrenheit for fish passage. Low flow conditions in Ferry Creek downstream of the confluence with Geiger Creek occur for most of the summer dry period (June – October). Table 7.4 lists environmental data. Augmenting streamflow by diverting twenty-five percent of all water diverted to the off channel reservoir would help maintain the minimum depth in lower Ferry Creek during low flow conditions. The temperature in Ferry Creek will be monitored upstream and downstream of the streamflow augmentation discharge point. If the temperature deviation between upstream and downstream exceeds one degree Fahrenheit, then streamflow augmentation will be reduced or stopped entirely until adequate temperature differentials are achieved. Currently OWRD, in cooperation with the City of Bandon, is installing a new stream gauge station at the location of a presently inoperable existing stream gauge. The new gauge station will allow the City to monitor and control raw water diversion and streamflow augmentation based on real time data.

Table 7.4
Environmental Data

Description	Value
Migratory Salmonid Species Present	Yes, Salmon & Steelhead
Threatened Species Present	Yes, Oregon Coast coho salmon
Minimum Fish Passage Water Depth	1 Foot
Maximum Change in Water Temperature	1 Degree Fahrenheit
Temperature and DO Monitoring Station	Yes, Located at Bandon Fish Hatchery
Downstream Gauge Station	Yes, Located Adjacent to Point of Diversion

Hydrology and Hydraulics

Ferry Creek and Geiger Creek convey surface and base flow to two small existing dams that impound raw water within the watershed. One dam is on Ferry Creek and the other dam is on Geiger Creek. A capacity survey in 2014 indicated that together they store approximately 3.38 acre-feet of raw water. These two dams are considered balancing reservoirs and are capable of supplying the raw water demand for approximately 2.5 days during normal conditions. Balancing reservoirs are intended to supply immediate fluctuations in water demand and do not impound water as a long term supply source. Both balancing reservoirs pump raw water to a small settling pond called Middle Pond. Raw water is pumped from Middle Pond to the Bandon water treatment plant for municipal use. The off channel reservoir will be considered an impounding or storage reservoir. Storage reservoirs are intended to divert and store raw water during high flow conditions and then use the stored raw water during low flow conditions. The proposed 100 acre-feet off channel reservoir will utilize the City's existing 12-inch intake pipe and pump station.

The intent of the hydrological analysis is to verify the feasibility of diverting enough raw water to adequately supply municipal needs and streamflow augmentation. To verify feasibility it is necessary to identify the quantity and timing of raw water diversion to the off channel reservoir. The feasibility analysis of diverting raw water to the off channel reservoir includes the following major tasks:

A. Produce a relationship between streamflow records and precipitation data.

B. Produce a unit hydrograph of the watershed using streamflow records and precipitation data.

C. Produce a rating curve for an idealized section of Ferry Creek to identify a streamflow threshold that would cause water depths below the 1-foot minimum.

D. Analysis of rating curve with the streamflow records to identify ideal periods for raw water diversion and streamflow augmentation.

E. Produce a typical diversion and streamflow augmentation schedule. Compare diversion and streamflow augmentation schedule with municipal demand to verify raw water availability.

F. Compare raw water availability with future demand projections to verify adequate future supply.

Streamflow and Precipitation Relationship

Historic flow data between 1977 to 1982 and 1994 to 1996 from the Oregon Water Resources Department was used along with published daily meteorological observations from the Western Regional Climate Center Station ID: Bandon 2 NNE, Oregon (350471) to produce a relationship between streamflow and precipitation. Individual isolated rainfall events and the corresponding streamflow response for each month of the year were analyzed to identify a relationship between precipitation and streamflow. It is apparent form the data that the Ferry Creek watershed is highly responsive to any amount of precipitation. Saturated antecedent soil conditions allow for higher streamflow during wet periods of the year. During dry antecedent soil conditions the initial quantity of precipitation is consumed through groundwater infiltration and evapotranspiration which causes a lag in the streamflow response. Results of the monthly streamflow and precipitation relationship are summarized in Table 7.5 and flow precipitation relationships are in Appendix C.

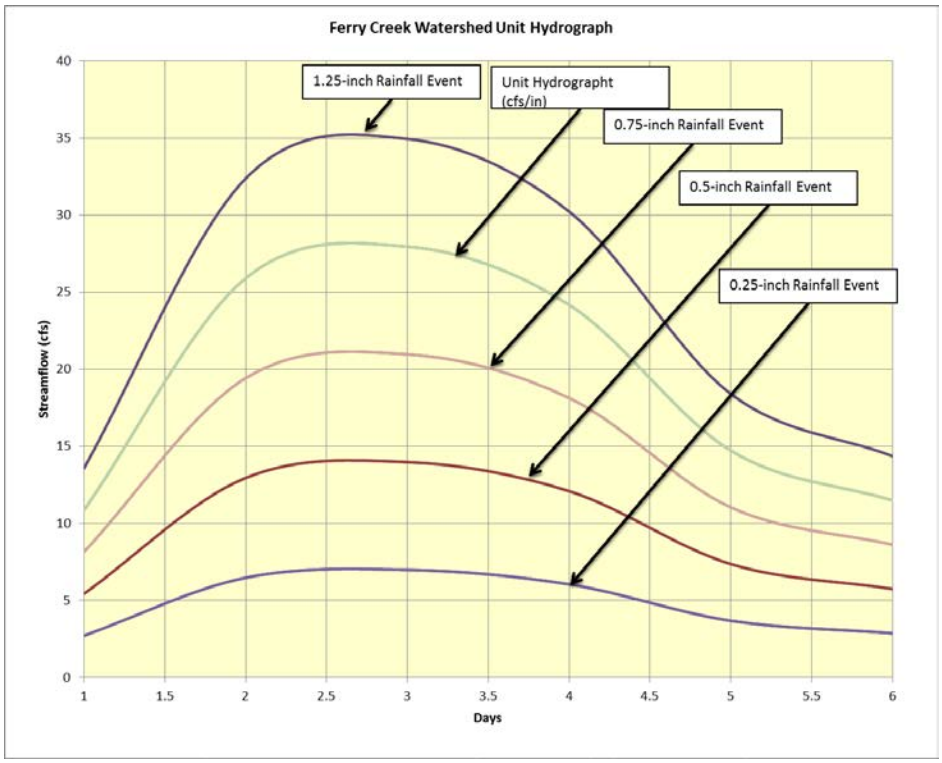
Table 7.5
Average Monthly Streamflow

Month	Average Streamflow (cfs)	Average Precipitation (in)
January	12.8	9.5
February	14.5	7.2
March	10.7	7.0
April	10.6	4.5
May	9.0	3.2
June	5.2	1.8
July	3.7	0.4
August	3.2	0.6
September	4.2	1.3
October	3.8	4.0
November	9.0	8.9
December	12.7	10.3

Unit Hydrograph

The unit hydrograph is used to approximate the streamflow response for any given rainfall event. Knowing the streamflow response to rainfall events is used to identify ideal times for raw water diversion. The unit hydrograph is developed by dividing every point on a streamflow response hydrograph by the average excess precipitation. The unit hydrograph for the watershed was developed by averaging 10 separate isolated rainfall events and their corresponding streamflow response hydrographs. Figure 1 shows the anticipated streamflow response for several rainfall events. Unit hydrograph development calculations are included in Appendix D.

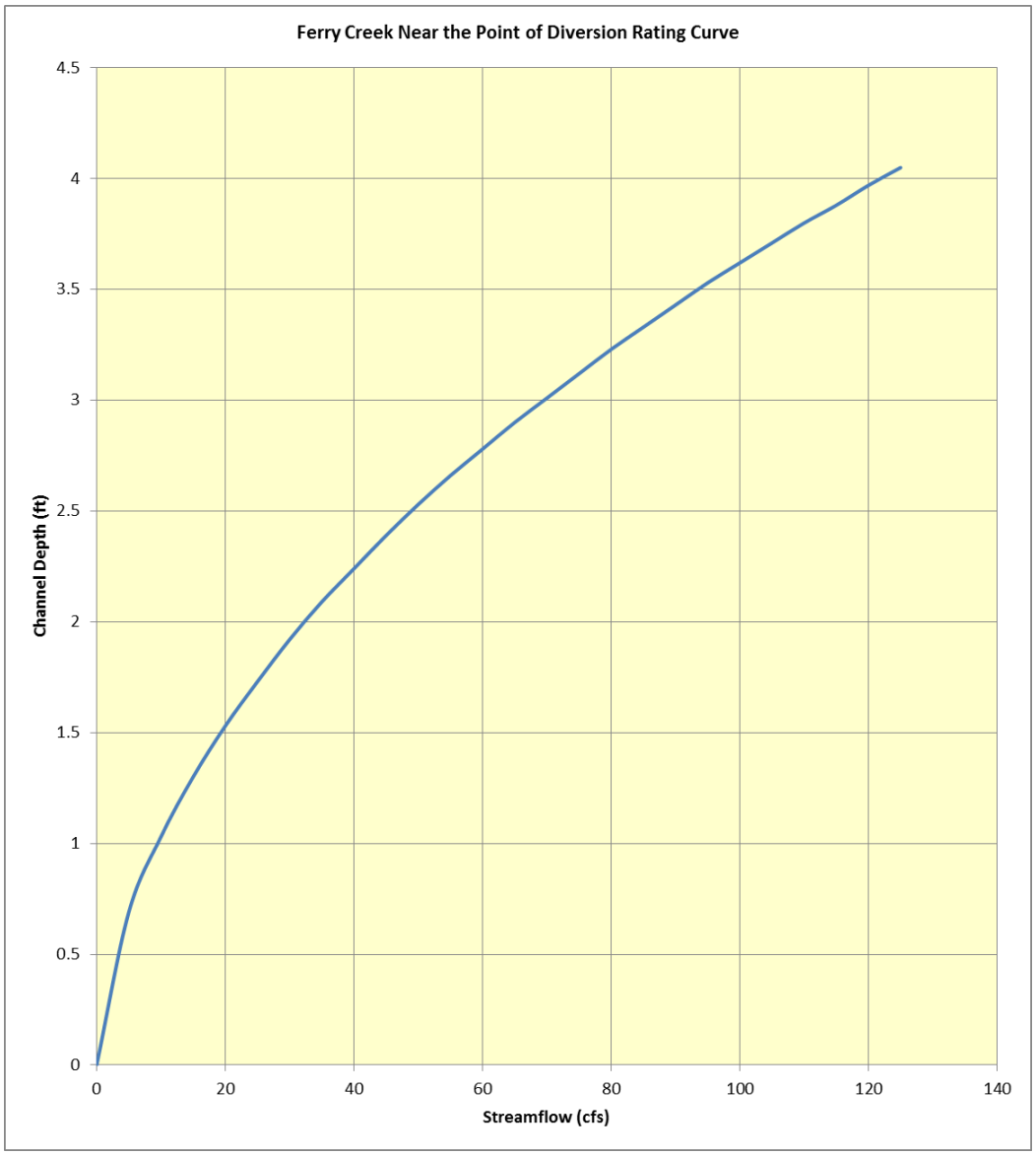
Figure 7.1
Streamflow Response



Ferry Creek Rating Curve

A rating curve of a typical section of Ferry Creek near the point of diversion will identify the relationship between streamflow and channel depth. The rating curve is developed by using the Manning's equation for open channel flow. The normal channel depth was calculated for various flowrates in Ferry Creek near the point of diversion. The channel geometry of Ferry Creek changes depending on the location in the watershed. The reach near the point of diversion is narrow with steep channel side slopes. For this analysis the channel geometry was approximated. Rating curve development calculations are included in Appendix E. The minimum streamflow to provide a channel depth of 1 foot is approximately 10 cubic feet per second. Figure 7.2 shows the approximate rating curve for Ferry Creek near the point of diversion.

Figure 7.2
Ferry Creek Rating Curve



Analysis

From approximately May to October the average water depth in Ferry Creek is at or below the minimum depth required for fish passage. From approximately November to April the average water depth in Ferry Creek exceeds the minimum depth required for fish passage. The ideal period for raw water diversion to the off channel reservoir is between November and April, when streamflow exceeds 10 cfs. See Table 7.6.

Table 7.6
Ferry Creek Streamflow

Description	Value
Streamflow in Exceedance of 10 cfs per Year (days)	108
Streamflow Below 10 cfs per Year (days)	257

Raw Water Diversion and Streamflow Augmentation Schedule

The intent of creating a raw water diversion and streamflow augmentation schedule is to model the typical operation of the off channel reservoir. Modeling the typical operation of the off channel reservoir will give insight to the diversion and augmentation timing and verify the feasibility of a sustainable operation. The diversion and streamflow augmentation schedule was created using historic streamflow and municipal demand averages. The daily streamflow in Ferry Creek near the point of diversion was approximated by taking the individual daily average for each day throughout the year. The municipal daily averages were developed from the City of Bandon water treatment plant records from 2009 to 2013. Table 7.7 shows the average daily raw water demand and raw water availability for off channel storage based on the City of Bandon's 1.6 cfs water right. The average daily raw water available for diversion to the off channel reservoir is equivalent to the water right (1.6 cfs) minus the average daily raw water demand. The off channel reservoir will be lined to prevent water loss from infiltration and will have a semi-rigid cover to reduce water loss to evaporation. For this analysis water loss to infiltration and evaporation are assumed to be negligible.

Table 7.7
Raw Water Demand

Month	Average Daily Raw Water Demand (gpd)	Average Daily Raw Water Demand (cfs)	Average Daily Raw Water Available for Diversion to the Off Channel Reservoir (cfs)
Jan	431,289	0.667	0.933
Feb	412,685	0.639	0.961
Mar	472,563	0.731	0.869
Apr	460,540	0.713	0.887
May	558,964	0.865	0.735
Jun	691,863	1.071	0.529
Jul	845,348	1.308	0.292
Aug	820,530	1.270	0.330
Sep	675,555	1.045	0.555
Oct	552,744	0.855	0.745
Nov	412,668	0.639	0.961
Dec	426,986	0.661	0.939

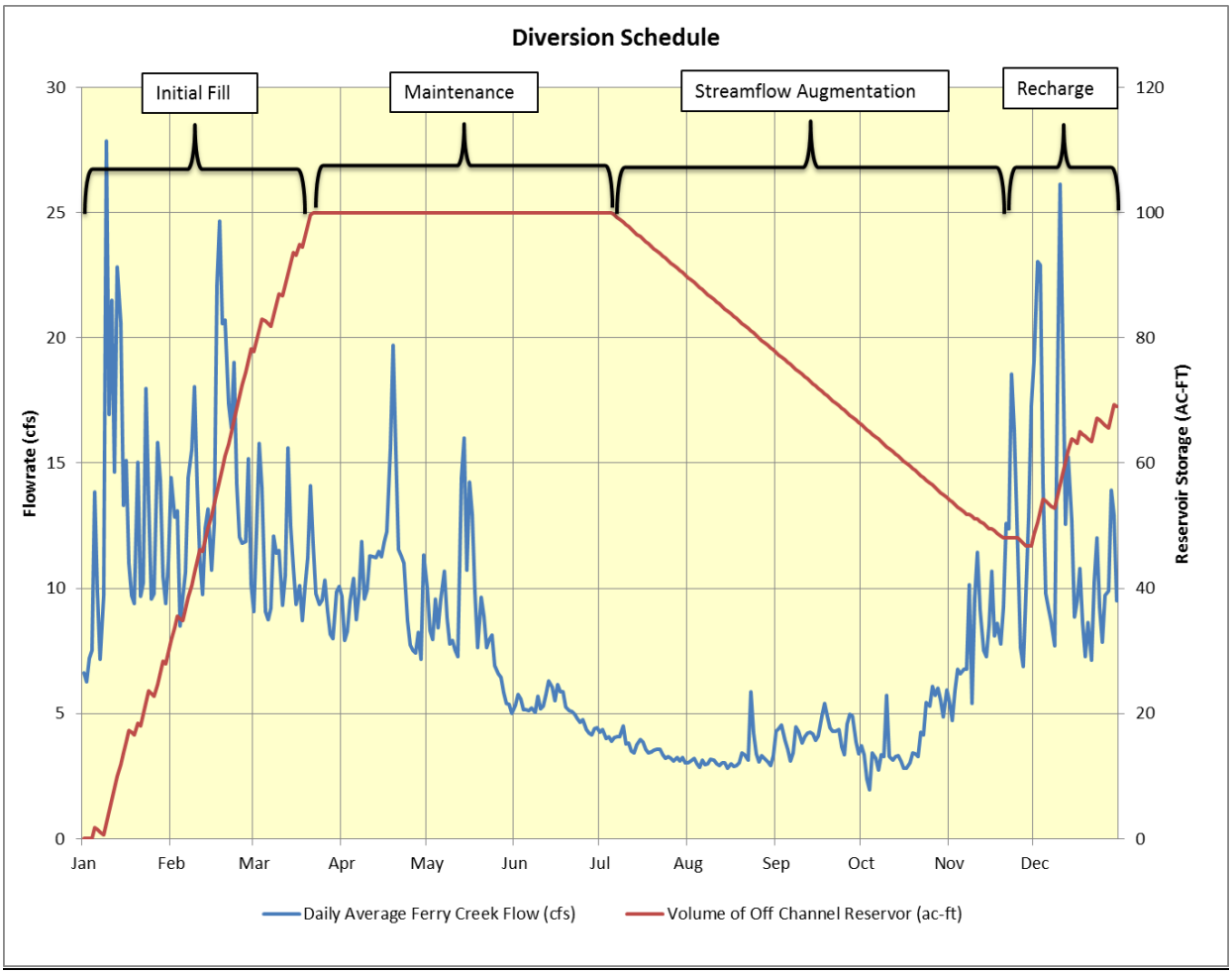
Raw water diversion to the off channel reservoir and to the City of Bandon water treatment plant combined will not exceed the 1.6 cfs water right threshold. Raw water diversion to the off channel reservoir is dependent on the depth in the active stream channel. When streamflow exceeds 10 cfs then there is enough water depth in the active channel to provide fish passage and raw water will be diverted to the off channel reservoir for storage. On average there are 108 days a year that the streamflow exceeds 10 cfs. Streamflow augmentation will occur from July to November when streamflow in the active channel is below 10 cfs. On average there are 143 days a year between July and November that the streamflow is below 10 cfs and raw water will be released back into Ferry Creek. The quantity of raw water released for streamflow augmentation will be twenty-five percent of the raw water diverted for storage. Table 8 is a summary of the off channel reservoir diversion parameters.

Table 7.8
Raw Water Diversion and Streamflow Augmentation

Description	Value
Total Raw Water Diverted per Year (ac-ft)	166.5
Streamflow in Exceedance of 10 cfs per Year (days)	108
Streamflow Augmentation per year (July to November, days)	143
Minimum Reservoir Volume during Normal Operation (ac-ft)	45
Time for Initial Fill (days)	82

The off channel reservoir is assumed to begin diversion on January 1st and will achieve 100 acre-feet of storage in approximately 82 days. During the spring months of March through June the off channel reservoir will operate in a “maintenance” mode. While in maintenance mode raw water will be diverted to the off channel reservoir then released to the Bandon water treatment plant which will allow for raw water storage cycling. The reservoir will be near capacity during the spring months. During the months of July through November raw water will most likely not be diverted to the off channel reservoir due to low flows in Ferry Creek. The off channel reservoir will operate in a “streamflow augmentation” mode. By the end of summer the off channel reservoir raw water storage volume will be reduced to approximately 45 acre-feet. Beginning in November the streamflow depth in Ferry Creek exceeds the threshold for fish passage and raw water will begin to be diverted to the off channel reservoir. During the winter months the off channel reservoir is anticipated to fill at a rate of 1.8 acre-feet per day. The off channel reservoir will reach capacity in mid to late January. The raw water diversion and streamflow augmentation schedule is illustrated in Figure 7.3 and Appendix F for tabulated values.

Figure 7.3
Raw Water Diversion and Streamflow Augmentation Schedule



Future

The intent of the off channel reservoir is to provide the City of Bandon with a sustainable and secure raw water source now and for future demands. Future water demands are dependent on population growth, industrial uses, and impacts from climate change. Population growth is directly correlated with growth in water demand. The City of Bandon has a relatively low permanent population growth rate which has only a small impact on the water demand increase. To meet the current water demands the off channel reservoir would need to receive raw water for approximately 40 days per year. On average there are a 108 days per year that raw water could be diverted to the off channel reservoir without impacting environmental streamflow. If water demand increases then the duration of raw water diversion to the off channel reservoir would also increase. Under these assumptions the off channel reservoir has the capacity to support a significant increase in water demand or a significant decrease in raw water availability. Raw water availability in Ferry Creek will most likely decrease due to increased agricultural demands and climate change. The overall decrease in raw water availability is uncertain and unpredictable but it is unlikely that raw water availability in Ferry Creek would become insufficient for future demands. The off channel reservoir will protect the City of Bandon from the impacts of increased water demand and decreased water availability.

SECTION 8:

GEOTECHNICAL INVESTIGATION

SECTION 8: GEOTECHNICAL INVESTIGATION

A preliminary geotechnical investigation was prepared by Foundation Engineering, Inc. in March/April 2016. The investigation only considered the cleared parcel, Lot 2400. Lot 2300 is currently covered in mature timber and dense, impenetrable brush.

The study concludes the site is suitable for reservoir construction. The Preliminary Geotechnical Investigation follows.

Preliminary Geotechnical Investigation

Bandon Off-Channel Reservoir

Bandon, Oregon

Prepared for:

Dyer Partnership Engineers & Planners, Inc.
Coos Bay, Oregon

April 11, 2016

Foundation Engineering, Inc.

Professional Geotechnical Services

Foundation Engineering, Inc.
Professional Geotechnical Services

Barbara Negherbon, P.E., CWRE
Dyer Partnership Engineers & Planners, Inc.
1330 Teakwood Avenue
Coos Bay, OR 97420

April 11, 2016

Bandon Off-Channel Reservoir
Preliminary Geotechnical Investigation
Bandon, Oregon

Project 2161003

Dear Ms. Negherbon:

We have completed the requested geotechnical investigation for the above-referenced project. Our report includes a description of our work, a discussion of site conditions, a summary of field and laboratory testing and conclusions concerning the suitability of the site for the planned reservoir.

Based on the work completed to date, we have concluded the site is suitable for reservoir construction. Key geotechnical issues pertaining to site grading and reservoir design and construction are also discussed. Detailed geotechnical design recommendations will be provided in a future geotechnical investigation.

It has been a pleasure assisting you with this phase of your project. Please do not hesitate to contact us if you have any questions or if you require further assistance.

Sincerely,

FOUNDATION ENGINEERING, INC.

Erin J. Gillaspie, P.E.
Staff Engineer

James K. Maitland, P.E., G.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
10701
OREGON
July 18, 1980
JAMES K. MAITLAND
EXPIRES: 12/31/16

EJG/JKM/wg
enclosure

PRELIMINARY GEOTECHNICAL INVESTIGATION

BANDON OFF-CHANNEL RESERVOIR
BANDON, OREGON

BACKGROUND

The City of Bandon is conducting a feasibility study to develop an off-channel raw water reservoir as a means to store a maximum of 100 acre-feet of water. The City currently utilizes storage in Ferry and Geiger Creek Reservoirs; however, neither reservoir is capable of storing its permitted water storage rights of 20 5/8 acre-feet and 90 acre-feet, respectively. The City owns both reservoirs, however, both Ferry and Geiger Creek dams are owned by the Oregon Department of Fish and Wildlife (ODFW). Construction of the new reservoir is currently planned for 2018, pending resolution of water rights issues and fund raising.

The Dyer Partnership Engineers & Planners, Inc. (Dyer) was selected as the project's lead designer. Dyer retained Foundation Engineering, Inc. as the geotechnical consultation for the project. Our scope of work was outlined in a proposal dated January 13, 2015, and authorized by a signed service agreement dated January 15, 2016. The scope of work was subsequently modified to include supplemental exploratory drilling.

LOCATION, PROJECT DESCRIPTION AND RESERVOIR OPERATION

Location

The project is located ±1,500 feet east of the Bandon city limits, ±700 feet southeast of the terminus of Cardinal Lane. The site location is shown in Figure 1A (Appendix A). The proposed reservoir site will encompass Parcels 2300 and 2400. However, only Parcel 2400, which was recently cleared of brush, was investigated during the current phase. Parcel 2300 is currently forested with dense undergrowth and is essentially inaccessible. Investigation of this parcel will be delayed until the suitability of Parcel 2400 for reservoir construction has been established.

Project Description

Only conceptual drawings were available at the time this report was prepared. We understand a nominal berm width of 8 feet is anticipated and balanced cut-and-fill construction is planned.

The two parcels comprising the proposed reservoir site have a combined plan dimension of ±660x1320 feet. The new raw water reservoir will have a minimum capacity of 50 acre-feet, although a capacity of up to 100 acre-feet is desired. The conceptual plans show a rectangular reservoir occupying most of the site, along with

three settling pond at the east end of the property. We estimated the reservoir will occupy a plan area of ±410x840 feet (measured from the center of the berms). An access road will extend into the facility from the northwest corner. Conceptual plans indicate the site will also have a ±50-foot wide perimeter buffer zone and access area for vegetation maintenance (e.g., mower and brush hog). The top of the berms will provide equipment access for pond cleaning.

Reservoir Operation

Water will be pumped from the City's existing pump station downstream of the ODFW Fish Hatchery. The new 12-inch diameter waterline will parallel the existing 14-inch diameter treated water main, using the City's existing utility easement. Water will be pumped into the three settling ponds, where turbidity will be allowed to settle out. The water will then be pumped into the reservoir. The settling ponds allow easier cleaning and should lower annual operating and maintenance costs. There will be a minimum of three inflow/outflow points and water will be gravity-piped back to the pump station where it will be pumped to the middle pond and onto the water treatment plant. The reservoir will have mixers and/or aerators for water quality.

The reservoir will be lined and covered to reduce evaporation and bird use. Approximately 25% of the diverted water will be used to augment stream flows. However, due to potential fish health issues, it is not currently known if the water from the reservoir will be returned to Geiger Creek or Ferry Creek.

LITERATURE REVIEW

Available geologic and seismic publications, maps and web sites were reviewed to characterize the local and regional geology and evaluate relative seismic hazards at the site. Local water well logs available from the Oregon Water Resources Department (OWRD) website were also reviewed, along with information from other geotechnical and seismic hazard investigations previously completed by Foundation Engineering and others in the area.

SITE RECONNAISSANCE

We conducted a site reconnaissance on February 9, 2016, to observe site and surface features. Our reconnaissance included a traverse of Parcel 2400 and photographs were taken of the cleared terrain. We looked for evidence of slope instability, concentrated surface runoff, surface erosion and natural drainages. The underbrush within Parcel 2300 and the terrain south and west of Parcel 2400 was too dense for access.

FIELD EXPLORATION

We completed six test pits and four borings at the site. The explorations were continuously logged by an experienced engineer. The final logs (Appendix B) were prepared based on a review of the field logs, the laboratory test results, and an examination of the soil and rock samples in our office. The approximate test pit and

boring locations are shown in Figure 2A, (Appendix A). These locations were established by pacing and are approximate. The elevation contours shown on the figure were estimated by Dyer and are approximate. We assume the exploration locations will be surveyed prior to issuance of our final report. Therefore, that report will include ground surface elevations at individual exploration locations.

Test Pits

The original scope of work included only exploratory test pits. Six test pits were dug within Parcel 2400 on February 11, 2016, using a Kobelco K210 tracked excavator provided by the City. Repeated caving of the test pit sidewalls in all test pits limited the depth of exploration to a maximum depth of ±18 feet. Soil samples representing each soil unit encountered were retained for possible laboratory testing and observation in our office. The soil profiles and sampling depths are summarized on the test pit logs (Appendix B).

We encountered a stratum of concentrated wood debris in the bottom of TP-6. This layer extends from ±15 to at least 18 feet. TP-6 terminated at ±18 feet, but we could not determine how deep the organics extended because of repeated sidewall caving. Our scope of work was subsequently expanded to included exploratory drilling to investigate the extent of the organic material.

Borings

Four supplemental exploratory borings were completed between March 21 and 23, 2016, to evaluate the thickness, composition and lateral extent of the organics found in TP-6 (discussed below). The borings were completed using a CME-850, track-mounted drill rig with mud-rotary drilling techniques. The borings extended to maximum depths ranging from ±35 to 50 feet.

Disturbed soil samples were typically obtained in the borings at 2.5-foot intervals to ±20 feet, and at ±5-foot intervals thereafter. Sampling was completed using a split-spoon sampler in conjunction with the Standard Penetration Test (SPT). The SPT, which is run each time the split-spoon is driven, provides an indication of the relative stiffness or density of the soils. The sampling depths and SPT data for each boring are summarized on the logs (Appendix B).

A 1-inch diameter, PVC standpipe piezometer was installed in BH-3. The slotted screen was installed from ±10 to 20 feet. Ground water levels within the piezometer will be measured periodically to monitor seasonal fluctuations. BH-1 was backfilled with bentonite grout and BH-2 and BH-4 were backfilled with bentonite chips.

LOCAL GEOLOGY

The City of Bandon and the project site are located west of the Coast Range foothills on the Southern Oregon Coast. Bandon is at the transition from the Coast Range to the Klamath Mountains geographic province. Much of the bedrock is geologically and structurally complex.

Local geologic mapping indicates the site is underlain by Pioneer terrace deposits, followed by siltstone and mudstone of the Melange of Sixes River (Wiley et al., 2014). Our explorations encountered terrace deposits primarily consisting of loose to very dense sand followed by close jointed siltstone at depths ranging from ±28 to 40 feet below the existing grades. However, BH-3 did not encounter bedrock above the maximum depth of 46 feet. The subsurface conditions encountered in our explorations are consistent with the mapped local geology. Additional details are provided in the Subsurface Conditions section of this report and on the exploration logs found in Appendix B.

DISCUSSION OF POTENTIAL GEOLOGIC AND SEISMIC HAZARDS

Erosion

The ground surface was disturbed by recent brushing activities. However, no evidence of active surface erosion was observed within the cleared site or the surrounding terrain.

The predominant site material is sand, which is subject to erosion by wind or water if not covered with topsoil and vegetation. During construction it will be important to keep disturbance of site vegetation to the adjacent terrain to a minimum. We understand a ±50-foot wide buffer will be maintained around the perimeter of the planned facility. It will be important to maintain vegetation in the buffer zone throughout and following construction. It is assumed the new perimeter berm will be built using predominantly sand. Most of the inside slope will be covered with a liner. However, it will be critical to develop and maintain a vegetative cover on all exposed soil surfaces at the top and exterior slope of the new berm.

Seismic Hazards

Faults and Earthquakes. No mapped faults cross the site; however, the site is located between two mapped north-trending faults (Beaulieu and Hughes, 1975; Wiley et al., 2014). These faults are not considered active in the Quaternary (USGS, 2006). The US Geologic Survey (USGS) does recognize the northwest-trending Coquille anticline, which is located ± ½ mile south of the site, as a potentially active structure. Its most recent deformation is estimated to be less than 15,000 years (USGS, 2006). No historic earthquake epicenters are located within ±5 miles of the site since 2008 (DOGAMI, 2016b).

The site is located ±45 miles east of the CSZ. Therefore, the site would experience severe shaking from a large magnitude earthquake along the subduction zone (DOGAMI, 2016b).

Ground Motion Amplification. The existing subsurface conditions at this site and adjacent sites indicates relatively shallow bedrock (siltstone of the Melange of Sixes River). Therefore, we estimate the potential for ground motion amplification is low.

Liquefaction. Relative high SPT N-values were recorded in the borings, suggesting the sand underlying the planned reservoir is typically medium dense to dense. As a result, the liquefaction hazard is low due to the relative density of the sand.

Landslides and Earthquake-Induced Landslides. The site is relatively flat, there are no mapped or historic landsides at the site (DOGAMI, 2016b; DOGAMI, 2016a), and we did not observe any landslides or surface features during our site reconnaissance and exploration that would suggest slope instability. Therefore, the risk of landslides or earthquake-induced slope instability is low.

During our site reconnaissance, we noted a break in the pavement on Ohio Street SE between SE 5th and SE 6th Streets. The break, shown in Photo 1 (Appendix A), extends across the entire width of the road. The break suggests creep or slope movement to the north. This soil movement is located ±1500 feet northwest of Parcel 2300, and does not appear to represent a hazard to the planned reservoir project.

Earthquake-Induced Instability of Engineered Fills. Man-made fills supporting structures or other infrastructure will be engineered to remain stable during an earthquake. Therefore, the risk of instability should be low if the fills are constructed in accordance with appropriate geotechnical guidelines for material type, placement and compaction.

Tsunami Inundation. The site is at ±El. 115 to 125 feet and is well above the tsunami inundation zone for all the earthquake scenarios for either a local (CSZ) or distal (Alaskan) sources (DOGAMI, 2012).

A more detailed seismic hazard review and analysis will be completed to fulfill the requirements of a site-specific seismic hazard study as defined in the current Oregon Structural Specialty Code (OSSC).

SITE CONDITIONS

Site Topography and Vegetation

A topographic site map was provided by Dyer. However, it is our understanding the topographic contours were estimated based on satellite imagery and are approximate. Uneven terrain at the time of our field work appeared to confirmed a relatively high variance between the current topography and that shown on the site plan. We assume a topographic survey of the site will be completed prior to issuance of our final report.

Parcel 2400 was originally covered by thick brush including salal and small fir trees typically ±1 to 3 inches in diameter (Photo 2, Appendix A). We also noted scattered stumps of larger, previously logged trees. The parcel was recently cleared. Photos 3 and 4 show the appearance of the parcel after clearing, at the time of our initial field exploration. Parcel 2300 is heavily wooded with numerous fir trees up to ±2 to 3 feet in diameter and thick underbrush. Photo 5 shows a partial view of Parcel 2300 from Parcel 2400.

The terrain west of Parcel 2400 slopes down at ±5%, to an elongated pond. Satellite imagery indicates the water surface at this pond lies at ±El. 107 to 108. We understand a ±50-foot wide vegetated buffer is planned between the new reservoir and the existing pond. There are no significant slopes to the north and south of Parcel 2400.

SUBSURFACE CONDITIONS

Test Pits

Approximately 3 to 12 inches of surficial organics (duff) currently covers the site. The duff consists of primarily roots, plant and wood debris generated from recent clearing activities.

The duff is underlain by sand of the Pioneer terrace deposits. The upper ±3 to 6 feet of the terrace deposits consist of brown to red-brown, moist, fine, silty sand. Some fine roots extend to a depth of ±2 feet. At TP-5 and TP-6, the darker colored sand was weakly to moderately cemented. At the other test pits, the cementation was very weak or absent.

The sand changes to grey with trace silt below ±3 to 6 feet. This unit extends to the bottom of TP-1 through TP-5 (i.e., ±13 to 16 feet). However, at TP-6 the grey sand was silty and underlain by a layer of concentrated organics in a matrix of dark grey to dark brown, silty sand. The organics extend from ±15 to at least 18 feet (the limits TP-6).

At all locations, the depths of the test pits were limited by repeated caving of the sidewalls.

Borings

BH-1. BH-1 was drilled near TP-6, along the eastern edge of Parcel 2400. At BH-1, loose, silty fine sand was encountered to ±4.5 feet, followed by medium dense to dense, fine sand with trace silt to ±15 feet.

Silty fine sand with scattered to some organics (wood) was encountered from ±15 to 17 feet and scattered wood debris was encountered from ±19 to 20 feet. This approximately corresponds to the organics found at TP-6. However, the organic matter is less concentrated. N-values of 6 and 36 were recorded in this layer, suggesting a loose to dense consistency. The lower value likely reflects the presence of softer organic matter, but may be due in part to higher silt content.

Fine sand with trace to some silt was encountered from ±17 to 25 feet. N-values of 22 and 31 were recorded in this unit, indicating the sand is predominantly medium dense to dense. Fine to coarse sand with some silt follows to ±40 feet. N-values of 38 to 62 indicate this unit is dense to very dense.

Dark grey, slightly weathered to moderately weathered, close-jointed, very weak (R1) siltstone was encountered at ±40.0 feet (Melange of Sixes River). The siltstone grades with depth to a grey, slightly weathered to fresh, weak (R2) sandstone. The sandstone extends to at least ±50.3 feet, the limits of our exploration. N-values in the bedrock ranged from 83 to practical sampling refusal (i.e., 50 blows for less than 6 inches of penetration).

BH-2. BH-2 was drilled near the south edge of the parcel. The soil profile at BH-2 consisted of predominantly fine sand with trace silt to ±17 feet and some silt from ±17 to 20 feet. N-values in this layer ranged from 26 to 40, suggesting the sand is medium dense to dense. Dense, fine to coarse sand with some silt was encountered from ±20 to 27 feet. The organics encountered in TP-6 and BH-1 were absent at BH-2.

The sand is underlain by very dense, sandy gravel with some silt ±27 to 34.5 feet. Practical refusal was recorded in this layer.

Extremely weak (R0) highly weathered to decomposed siltstone was encountered from ±34.5 to 36.5 feet, the limits of our exploration. An N-value of 44 was recorded in this formation.

BH-3. BH-3 was located along the north edge of the parcel. Predominantly fine sand with trace silt was encountered to ±23.5 feet. N-values ranged from 26 to 69, suggesting the sand is medium dense near the ground surface, becoming dense with depth. The sand contained trace to some silt below ±20 feet and an N-value of 47 indicates the sand at this depth is dense.

Medium dense sandy gravel with silty sand interbeds was noted from ±23.5 feet to ±30 feet. An N-value of 24 was recorded in this layer at 25 feet.

A layer of stiff clayey silt with scattered to some organics was encountered from ±30 to 35 feet. An N-value of 14 was recorded in the clayey silt.

The clayey silt was underlain by silty, fine sand to a depth of 46.5 feet, the limits of exploration. N-values of 29 near the top of the layer, 80 at ±40 feet, and practical refusal at 45 feet indicate the sand grades from medium dense to very dense.

BH-4. BH-4 was drilled along the west side of the site. At this location, silty, fine sand extends to ±5 feet, followed by fine sand with trace silt to ±17.0 feet. N-values ranged from 13 to 55, suggesting the sand is predominantly medium dense, grading with depth to dense to very dense.

Medium dense to very dense gravelly sand with silty sand interbeds was encountered from ±17 to 28 feet. N-values in this stratum ranged from 22 to practical refusal.

Extremely weak (R0), highly weathered to decomposed siltstone was encountered from ±28 feet to 43 feet. Weak (R2), slightly weathered sandstone was encountered from ±43.0 to 45.5 feet, the limits BH-4.

Water Wells and Ground Water Levels

Water Wells. We located several logs for water wells near the subject property from the OWRD website. They include, among others, wells located on the property north of Cardinal Lane (Tax Lot 2200), an undeveloped lot to the north of the (Tax Lot 804) and a residence on Ohio Street SE (Tax Lot 1900). For reference, these logs have been included in Appendix B.

The nearest well to the proposed reservoir was located on Tax Lot 2200 (north of Parcel 2400). That log reported brown, cemented sand from 0 to 9 feet, followed by grey, cemented sand to 16 feet. Grey, cemented sand and gravel was encountered from 16 to 40 feet, the limits of the well. A static water level of 21 feet was recorded on June 6, 2014.

The well on Tax Lot 804 reported 1 foot of topsoil followed by alternating layers of sand. Some gravel was reported mixed with the sand from 18 to 24 feet. Gravel mixed with sand and sandy clay was encountered between 24 and 33 feet, followed by sandy clay (33 to 35 feet) and brown siltstone to 43 feet (the bottom of the well). A static water level of 26 feet was reported on August 6, 2014.

The log from the well on Ohio Street reports brown sand mixed with clay to a depth of 12 feet, followed by brown sand to 23 feet and brown, coarse sand to 44 feet. Blue metamorphic rock was encountered from 44 to 53 feet (the limits of the well). A static water level at 23 feet was reported on February 8, 1993.

Ground Water. We observed slow to rapid ground water infiltration in the exploratory test pits at depths of ±1 to 6.5 feet. Ground water typically accumulated in the test pits during exploration to a depth of ±5 to 7.5 feet (see Photo 6, Appendix A). Where active seepage was not observed, the sands appeared to be wet below ±5 feet.

The use of drilling mud in the borings precluded direct observation of any ground water in the borings at the time of drilling. A piezometer was installed at BH-3 and an initial water level of ±2 feet was observed on March 22. We repeatedly attempted to bail the water out of the piezometer, but were able to lower the water level to only ±4 feet. The water level quickly rebounded from ±4 feet to 2 feet. Therefore, the measured ground water level of 2 feet below the existing ground surface appears representative of the current ground water level at BH-3. We will continue to monitor the piezometer for seasonal fluctuations.

FIELD AND LABORATORY TESTING

Laboratory Testing

The laboratory work included natural water content and percent fines tests to help classify the soils and estimate their overall engineering properties. Results of the classification tests are summarized in Table 1C (Appendix C). The water contents are also included on the boring logs.

A moisture density curve (ASTM D698) was completed on a sample of sand from TP-1 to establish compaction characteristics of the sandy soil. A single moisture-density point was also run on a sample from TP-4. Both samples were taken with the upper portion of the soil profile to reflect the likely source of fill generated by the reservoir excavation. The results of these tests are summarized in Figure 1C (Appendix C).

The laboratory tests indicate the sands at TP-1 have a maximum dry density of ±103.7 pcf at an optimum water content of ±16.8%. These values are for the relatively clean sand (i.e., less than 2% fines). Sample S-4-1 had ±24.4% fines and the single moisture-density point suggests the maximum dry density is probably 2 to 3 pcf higher and the optimum water content is likely 2 to 4% wetter than that for TP-1.

Natural water contents of the sand within ±10 feet of the ground surface typically ranged from ±15% to ±25%. Several high water contents recorded near the ground surface were associated with the presence of organic matter. The test results indicate the water contents are currently ±5 to 10% above the optimum water content for compaction.

We completed gradation analysis on sample S-1-2 from TP-1 at ±4 to 5.0 feet, and sample S-6-2 from TP-6 at ±3 to 3.5 feet. The analyses indicate S-1-2 consists of ±3.8% medium sand (i.e., between No. 10 and No. 40 sieve), ±94.6% fine sand (i.e., between No. 40 and No. 200 sieve) and 1.6% fines (i.e., passing the No. 200 sieve). Therefore, the soil sample consists of predominantly uniform, fine sand. Sample S-6-2 consisted of 0.9% coarse sand, 2.1% medium sand, 93.6% fine sand, and 2.1% fines. Therefore, its gradation is very similar to S-1-2. Based on the results of the two tests and the appearance of samples from other test pits and borings, we expect the soil underlying the expected limits of reservoir construction will consist of predominantly fine sand with trace to some fines.

pH and Resistivity Testing

pH and resistivity tests were completed to evaluate the corrosivity of the soil. The pH test results were run on samples of the sand and silty sand from the upper ±10 feet of the site. The results, summarized in Table 2C (Appendix C), indicate moderately acidic soils with pH values ranging from 5.6 to 5.8.

In-situ resistivity testing (ASTM G57) was completed near the center of Parcel 2400. The approximate test location (designated R-1) is shown on Figure 2A (Appendix A). The resistivity test was completed using a Nilsson 400, 4-pin, soil resistance meter. The 4–pin resistance meter provides an estimate of the average resistivity of a soil profile extending to a depth equal to the spacing between the pins. The test was performed with the pins spaced at 5, 10 and 20-foot intervals. The recorded resistivities, summarized in Table 3C (Appendix C), ranged from ±80,000 to 85,000, which is not uncommon for sandy soils. The relatively high resistivities suggest the soils are not significantly corrosive.

PRELIMINARY CONCLUSIONS

Based on the work completed to date, we have concluded the following:

1. The soils at the site are suitable for construction of the planned water storage reservoir. This assumes the subsurface conditions within Parcel 2300 are similar to those encountered within Parcel 2400. This assumption should be confirmed by future exploration.
2. There are no known natural hazards (e.g., faulting, liquefaction, or slope instability) that would preclude using the site for the planned project.
3. The predominant soil within the anticipated limits of the earthwork for the new reservoir consists of silty sand to sand with trace silt. Where concentrated organics are present relatively close to the base of berms and reservoir, the organics should be removed during construction. Concentrated organics were encountered at ±13 feet at only TP-6. Based on currently assumed limits of reservoir excavation, we anticipate these organics will extend below the bottom of the reservoir.
4. The site is underlain by siltstone and sandstone of the Melange of Sixes River at depths ranging from ±28 to 40 feet. Bedrock is not expected to impact reservoir construction.
5. Ground water rises to very shallow depths (±1 to 5 feet) during the winter. The drop in the ground water level during dry weather should be determined with future piezometer readings. The presence of shallow ground water may pose a significant construction challenge if ground water levels do not drop significantly during the summer, and would require a significant dewatering effort. Elevated ground water could also adversely impact operations once the reservoir is in operation.
6. Based on preliminary design assumptions, the floor of the planned reservoir and perimeter berms will be built using predominantly silty sand. The excavated soil will be suitable for construction of the perimeter berms. It should be assumed the upper ±1 foot of soil will not be suitable for berm construction, but may reused as landscaping material on the exterior surfaces of the embankment and surrounding terrain.

DISCUSSION

Reservoir Dimensions and Earthwork Volumes

The conceptual site layout provided by Dyer shows the reservoir floor with dimensions of ±375x805 feet (measured from the anticipated inside toe to inside toe of the berms). A total capacity in the range of 50 to 100 acre-feet is planned. This capacity equates to a water depth of ±7 to 14 feet for the assumed reservoir dimensions. Assuming 3 feet of freeboard, the resulting total berm height is ±10 to 17 feet (measured from the top of the berm to the bottom of the reservoir). It should be noted that a total embankment height in excess of 10 feet results in a statutory dam classification.

A balanced cut and fill is planned. That is, the soil generated by the reservoir excavation will be used to construct the perimeter berms. Approximately 1 foot of site stripping will be required to remove surface duff, vegetation, and most roots. Deeper stripping may be required in some areas to remove tree roots. For the plan dimensions described above, each additional foot of excavation within the reservoir floor would generate ±11,000 yd^3 of fill. To estimate excavation depths, we assumed a nominal berm with a top width of 8 feet, a berm height of 10 feet and 3:1 interior and exterior slopes. This represents the estimated berm height for the minimum desired reservoir capacity (50 acre-feet). We estimate a gross excavation depth of ±4 feet (including 1 foot of site stripping) would generate enough material to construct the perimeter berm. A taller berm would require proportionally deeper cuts and fills.

For purposes of discussing soils conditions, we assumed nominal excavation depths in the range of ±4 to 9 feet. It should be understood that all assumed dimensions and volumes are approximate and are intended for discussion and planning purposes only.

Shallow Ground Water

The water surface in the pond to the east of the site lies at ±El. 107 to 108. Static water levels of the nearest water wells to the north ranged from depths of 21 to 26 feet. The reason for the large discrepancy in water levels in not currently known, but the seepage noted in the test pits and in the water level observed in the piezometer suggest ground water during the winter and early spring lies at ±1 to 5 feet. It is possible the water observed in the test pits and piezometer represent a perched condition that develops during the winter. In that case, the true water table may be deeper and closer to the levels reported in nearby wells. If so, this condition may improve significantly during the summer when rains cease and the sandy soils drain.

Key Geotechnical Issues

Planning for design and construction of the new reservoir should consider the following key geotechnical issues:

1. Sandy soils are typically relatively highly permeable. Therefore, a membrane liner should be planned for the new reservoir.
2. Extensive earthwork will be required for reservoir construction and the native sand will be highly sensitive to disturbance. We anticipate the soil will easily pump or rut under construction equipment when moist of the optimum water content and tend to loosen easily under foot or equipment traffic when dry, even if compacted.

   One possible option to help maintain grades during construction and expedite the subsequent installation of the membrane liners would be to amend the soil. The sand in the bottom of the reservoir and the interior slopes could be amended with cement to create a soil-cement surface that would help resist erosion and disturbance, and expedite liner installation.

3. Ground water will be a construction issue if shallow ground water persists into the summer. Future piezometer readings will help establish seasonal fluctuations and summer levels. Final design, including the maximum depth of excavation, may be predicated on the future piezometer readings. If shallow ground water persists into the summer or fall, it should be assumed a significant dewatering effort will be required prior to and during the earthwork. Furthermore, an underdrain system will be required to prevent the liner from floating in the event the reservoir is drained.
4. Site grading work should be planned for dry weather (typically between late June to mid-October) when aeration and compaction of the silty sand is feasible. Even during the dry summer and fall months, soils excavated from several feet below the current ground surface are will likely be wet of the optimum moisture for compaction. However, the clean (relatively fines-free) sand will typically drain and dry quickly. Therefore, contractors should plan for a site grading schedule that permits aeration and drying of the soils prior to compaction.
5. For preliminary design, we recommend assuming a 3:1 slope for both interior and interior sides of the berm. If soil amendment is planned, a 3.5:1 interior slope should be considered to expedite the work.
6. The sandy soils are expected to be highly erodible once the vegetation is removed. Therefore, once the bulk of the earthwork is completed, all exposed soil surfaces should be seeded so a mature cover of vegetation is in place before the onset of the winter rains. This recommendation may require staggered landscaping and/or maintenance of seeding during dry summer months in the event the site grading extends into the fall.
7. We expect very modest settlement of the perimeter berms based on the observed density of the underlying sand. It is assumed the berm fill will be engineered (i.e., well-compacted) and should not undergo significant settlement due to self-weight. Any organic matter exposed at or near the bottom of the reservoir should be excavated. Deeper organic matter can be left in place. Some localized compression of the organics may occur. However, the resulting settlement is expected to be modest since the added weight of the water will be partially off-set by the weight of the excavated soil.

FUTURE GEOTECHNICAL WORK

Development of design and construction documents will require a more detailed geotechnical investigation. Future geotechnical work should include the following key elements:

1. Field exploration for Parcel 2300 to investigate subsurface conditions. The exploration should include test pits and borings similar to that completed for Parcel 2400. We also recommend installing additional piezometers in selected borings and periodic monitoring to establish seasonal fluctuations in ground water levels.

2. Additional laboratory testing to provide strength parameters for slope stability analysis of the berms and compaction characteristics of the on-site soils.
3. Engineering analysis to establish the interior and exterior berm slopes and evaluate berm stability. Although the reservoir will not function as a dam, the planned embankment height may exceed the 10-foot limit of the OWRD definition of a small dam. Therefore, the analysis and design of the embankments may have to meet the OWRD requirements for "statutory" dams.
4. Development of detailed geotechnical recommendations for site grading and reservoir design and construction.
5. A site-specific seismic hazard study meeting the requirements for essential facilities, according to the current Oregon Structural Specialty Code (OSSC) and OWRD requirements. The seismic hazard study should include:
    - review of the local and regional geologic, tectonic and seismic setting
    - review of regional seismic and earthquake history
    - selection of seismic sources and recommended design earthquakes
    - evaluation of site-specific seismic hazards (e.g., liquefaction, fault rupture, and slope instability risks)
    - recommended Site Class and parameters for seismic design
    - appropriate OSSC response spectra

Based on the proximity of the planned reservoir to adjacent residences, we anticipated the design of the new facility will require a breach analysis (by others) to quantify the potential impact on residences.

VARIATION OF SUBSURFACE CONDITIONS, USE OF THIS REPORT AND WARRANTY

The analysis, conclusions and preliminary recommendations contained herein are based on the assumption that the soil profiles and the ground water levels encountered in the test pits and borings completed within Parcel 2400 and the information reported in nearby water well logs are representative of overall site conditions. It is assumed future geotechnical work will include exploration of Parcel 2300.

This report was prepared for the exclusive use of the Dyer Partnership Engineers & Planners, Inc., the City of Bandon, and other design consultants for the Bandon Off-Channel Reservoir project in Bandon, Oregon. Information contained herein should not be used for other sites or for unanticipated construction without our written consent. This report is intended for preliminary planning only. It is assumed a design-level geotechnical investigation will be completed to develop recommendations for site grading and reservoir design and construction. Anyone using the information to estimate construction quantities or costs should understand the preliminary nature of the information and should do so at their own risk.

Our services do not include any survey or assessment of potential surface contamination or contamination of the soil or ground water by hazardous or toxic materials. We assume that those services, if needed, have been completed by others.

Our work was done in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

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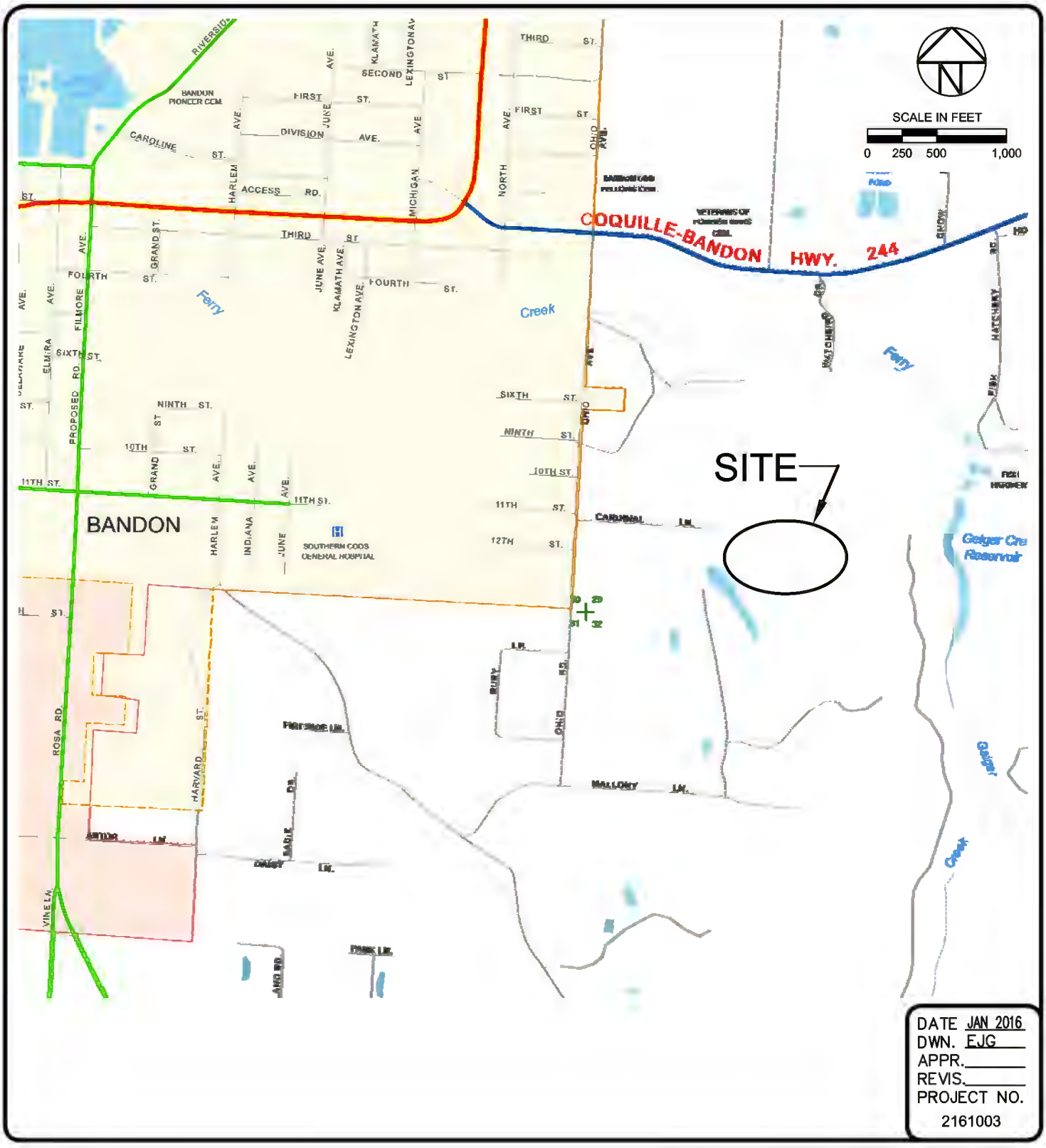
Appendix A

Figures and Photos

Professional
Geotechnical
Services

Foundation Engineering, Inc.



DATE JAN 2016
DWN. EJG
APPR.
REVIS.
PROJECT NO.
2161003

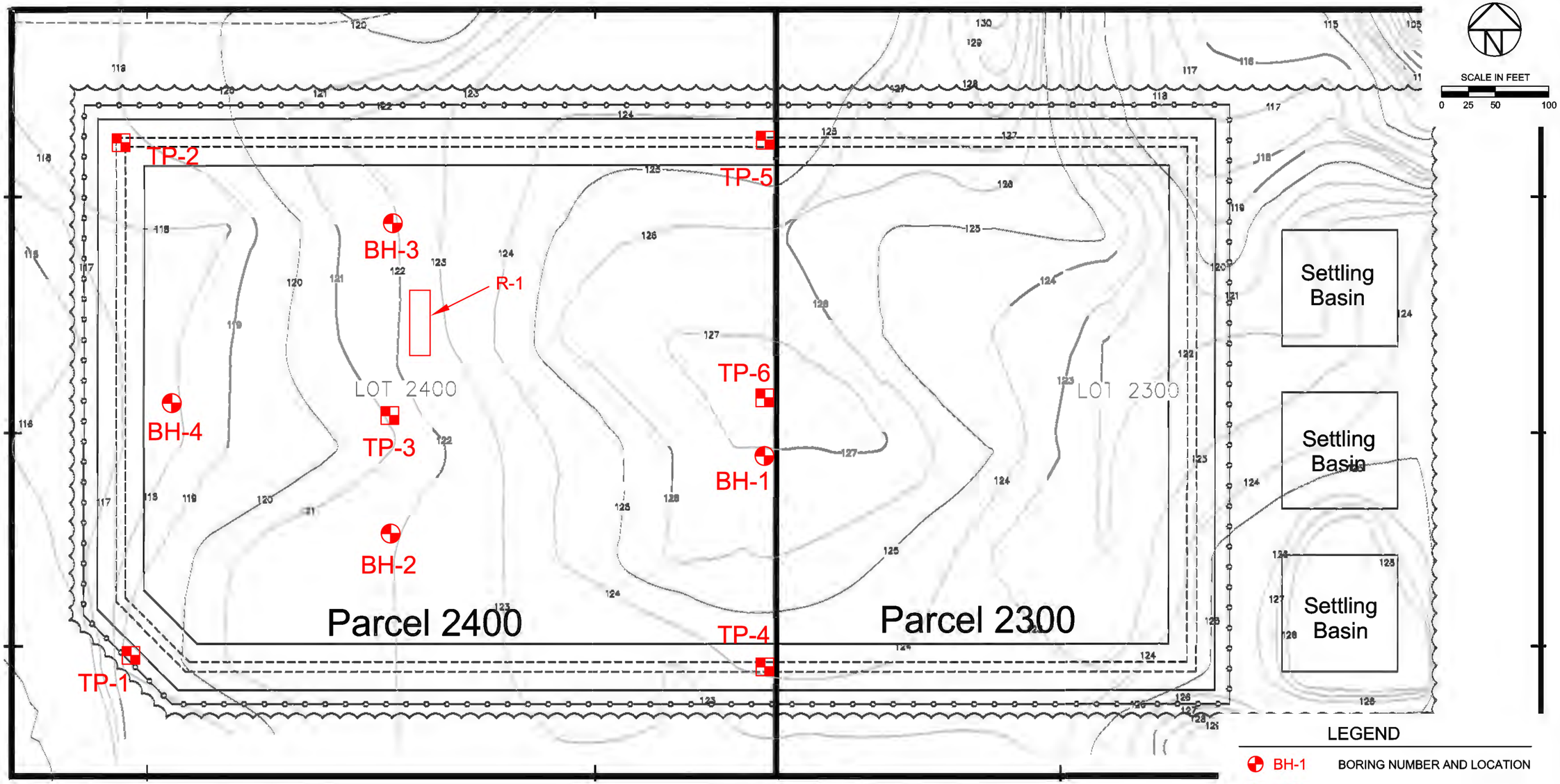
FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES
820 NW CORNELL AVENUE
CORVALLIS, OR 97330-4517
BUS. (541) 757-7845 FAX (541) 757-7850

VICINITY MAP

BANDON OFF-CHANNEL RESERVOIR
BANDON, OREGON

FIGURE NO.
1A

FILE NAME: FIG 1A



NOTES:
1. BORING LOCATIONS WERE ESTABLISHED BY PACING AND ARE APPROXIMATE.
2. SEE REPORT FOR A DISCUSSION OF SUBSURFACE CONDITIONS.
3. BASE MAP PROVIDED BY THE DYER PARTNERSHIP ENGINEERING.
4. ELEVATION CONTOURS BASED ON SATELLITE IMAGES AND SHOULD BE CONSIDERED APPROXIMATE.

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DATE JAN 2016
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APPR.
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PROJECT NO. 2161003

SITE LAYOUT AND TEST PIT LOCATIONS

BANDON OFF-CHANNEL RESERVOIR
BANDON, OREGON

FIGURE NO. **2A**

FILE NAME:FIG 2A

Photo 1. Offset on road pavement

Photo 2. Typical underbrush

Photo 3. View of site after brush clearing

Photo 4. View of site after brush clearing

Photo 5. View of Parcel 2300

Photo 6. Typical water in test pits

Appendix B

Boring and Test Pit Logs

Professional
Geotechnical
Services

Foundation Engineering, Inc.

DISTINCTION BETWEEN FIELD LOGS AND FINAL LOGS

A field log is prepared for each boring or test pit by our field representative. The log contains information concerning sampling depths and the presence of various materials such as gravel, cobbles, and fill, and observations of ground water. It also contains our interpretation of the soil conditions between samples. The final logs presented in this report represent our interpretation of the contents of the field logs and the results of the sample examinations and laboratory test results. Our recommendations are based on the contents of the final logs and the information contained therein and not on the field logs.

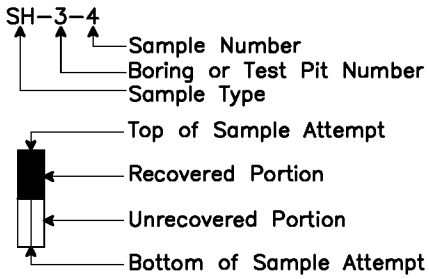
VARIATION IN SOILS BETWEEN TEST PITS AND BORINGS

The final log and related information depict subsurface conditions only at the specific location and on the date indicated. Those using the information contained herein should be aware that soil conditions at other locations or on other dates may differ. Actual foundation or subgrade conditions should be confirmed by us during construction.

TRANSITION BETWEEN SOIL OR ROCK TYPES

The lines designating the interface between soil, fill or rock on the final logs and on subsurface profiles presented in the report are determined by interpolation and are therefore approximate. The transition between the materials may be abrupt or gradual. Only at boring or test pit locations should profiles be considered as reasonably accurate and then only to the degree implied by the notes thereon.

SAMPLE OR TEST SYMBOLS



S – Grab Sample
SS – Standard Penetration Test Sample (split–spoon)
SH – Thin–walled Shelby Tube Sample
C – Pavement Core Sample
CS – Rock Core Sample

▲ Standard Penetration Test Resistance equals the number of blows a 140 lb. weight falling 30 in. is required to drive a standard split–spoon sampler 1 ft. Practical refusal is equal to 50 or more blows per 6 in. of sampler penetration.

● Water Content (%).

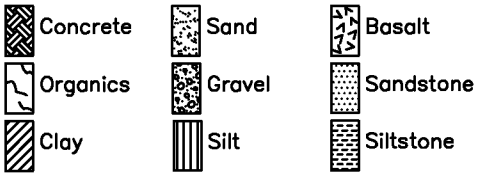
UNIFIED SOIL CLASSIFICATION SYMBOLS

G – Gravel	W – Well Graded
S – Sand	P – Poorly Graded
M – Silt	L – Low Plasticity
C – Clay	H – High Plasticity
Pt – Peat	O – Organic

FIELD SHEAR STRENGTH TEST

Shear strength measurements on test pit side walls, blocks of soil or Shelby tube samples are typically made with Torvane or Field Vane shear devices.

TYPICAL SOIL/ROCK SYMBOLS



WATER TABLE

Water Table Location

(1/31/16) Date of Measurement

FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES

820 NW Cornell Avenue
Corvallis, OR 97330
BUS. (541) 757–7645

7857 SW CIRRUS DRIVE, BUILDING 24
BEAVERTON, OR 97008
BUS. (503) 641–1541

SYMBOL KEY

BORING AND TEST PIT LOGS

Explanation of Common Terms Used in Soil Descriptions

Field Identification	Cohesive Soils			Granular Soils	
	SPT*	S_u** (tsf)	Term	SPT*	Term
Easily penetrated several inches by fist.	0 – 2	< 0.125	Very Soft	0 – 4	Very Loose
Easily penetrated several inches by thumb.	2 – 4	0.125–0.25	Soft	4 – 10	Loose
Can be penetrated several inches by thumb with moderate effort.	4 – 8	0.25 – 0.50	Medium Stiff	10 – 30	Medium Dense
Readily indented by thumb but penetrated only with great effort.	8 – 15	0.50 – 1.0	Stiff	30 – 50	Dense
Readily indented by thumbnail.	15 – 30	1.0 – 2.0	Very Stiff	> 50	Very Dense
Indented with difficulty by thumbnail.	>30	> 2.0	Hard		

* SPT N–value in blows per foot (bpf)
** Undrained shear strength

Term	Soil Moisture Field Description
Dry	Absence of moisture. Dusty. Dry to the touch.
Damp	Soil has moisture. Cohesive soils are below plastic limit and usually moldable.
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is wetter than the optimum moisture content and above the plastic limit.

Term	PI	Plasticity Field Test
Non–plastic	0 – 3	Cannot be rolled into a thread at any moisture.
Low Plasticity	3 – 15	Can be rolled into a thread with some difficulty.
Medium Plasticity	15 – 30	Easily rolled into thread.
High Plasticity	> 30	Easily rolled and re–rolled into thread.

Term	Soil Structure Criteria
Stratified	Alternating layers at least ¼ inch thick.
Laminated	Alternating layers less than ¼ inch thick.
Fissured	Contains shears and partings along planes of weakness.
Slickensided	Partings appear glossy or striated.
Blocky	Breaks into small lumps that resist further breakdown.
Lensed	Contains pockets of different soils.

Term	Soil Cementation Criteria
Weak	Breaks under light finger pressure.
Moderate	Breaks under hard finger pressure.
Strong	Will not break with finger pressure.

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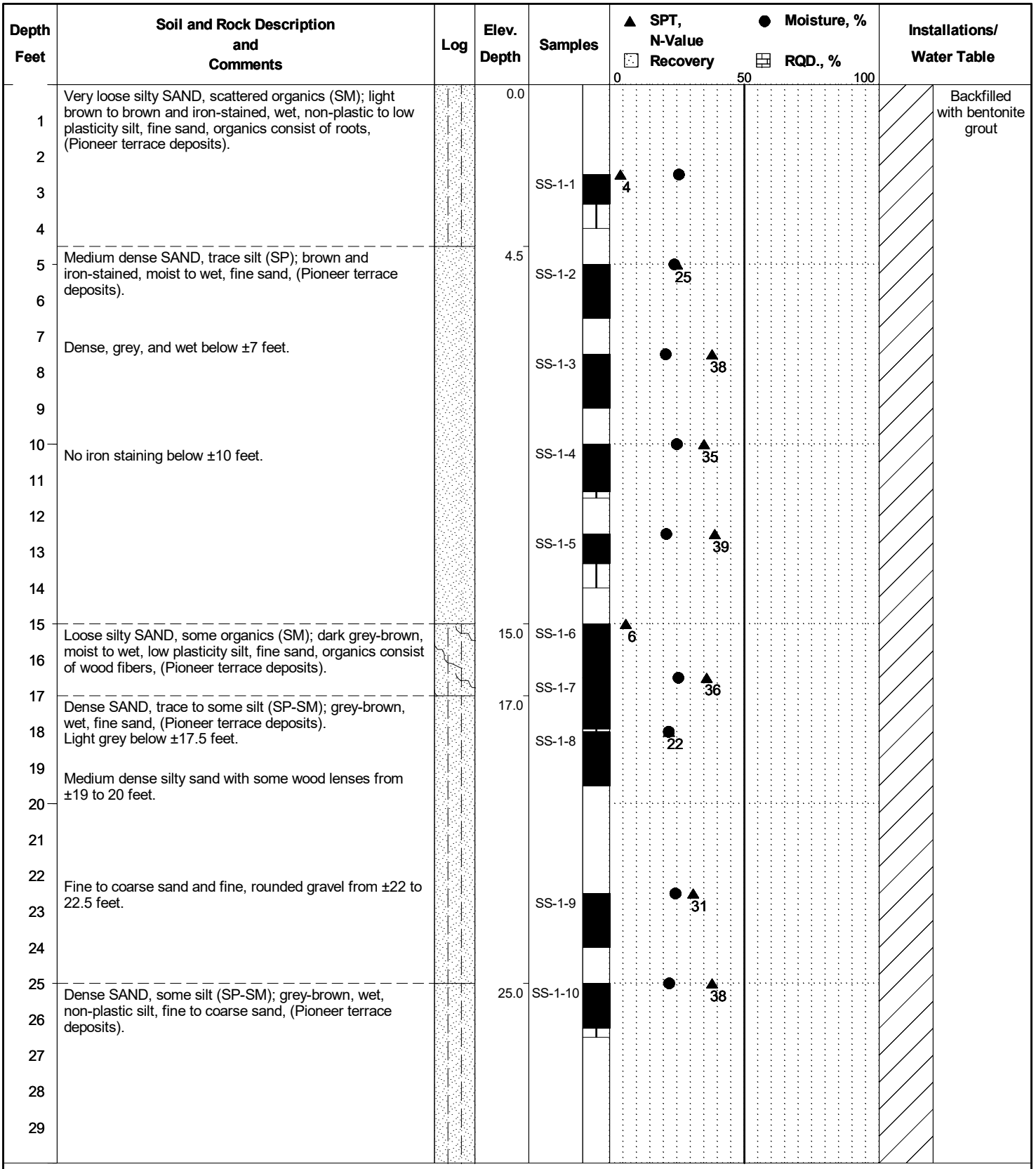
COMMON TERMS

SOIL DESCRIPTIONS



Project No.: 2161003

Surface Elevation: N/A

Date of Boring: March 21, 2016

Boring Log: BH-1

Bandon Off-Channel Reservoir

Coos County, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth	Samples	SPT, N-Value / Recovery / Moisture, % / RQD., % (0 — 50 — 100)	Installations/ Water Table
31				SS-1-11	46	
32						
33						
34						
35	Fine sand below ±35 feet.			SS-1-12	62	
36	Silty with scattered wood and weak to moderate cementation below ±36 feet.					
37						
38						
39						
40	Very weak (R1) SILTSTONE; dark grey, slightly to moderately weathered, sheared, calcite veining, (Melange of Sixes River).		40.0	SS-1-13	91/10"	
41						
42						
43						
44						
45				SS-1-14	83	
46						
47						
48						
49						
50	Weak (R2) SANDSTONE; grey, slightly weathered to fresh, fine sand, (Melange of Sixes River).		50.0	SS-1-15	50/1st 3 ½"	
	BOTTOM OF BORING		50.3			

Project No.: 2161003

Surface Elevation: N/A

Date of Boring: March 21, 2016

Foundation Engineering, Inc.

Boring Log: BH-1

Bandon Off-Channel Reservoir

Coos County, Oregon

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth	Samples	SPT, N-Value / Recovery / Moisture, % / RQD., % (0 – 50 – 100)	Installations/ Water Table
1	Medium dense SAND, trace silt (SP); brown and iron-stained, wet, fine sand, (Pioneer terrace deposits).		0.0			Backfilled with bentonite chips
5				SS-2-1	26	
10	Dense and light grey-brown and iron-stained below ±10 feet.			SS-2-2	37	
13				SS-2-3	33	
15	Medium dense from ±15 to 17 feet.			SS-2-4	26	
17	Some silt below ±17 feet.			SS-2-5	40	
20	Dense SAND, trace to some silt (SP-SM); light grey to brown, wet, fine to coarse sand, fine sand interbeds, (Pioneer terrace deposits).		20.0	SS-2-6	37	
25				SS-2-7	35	
27	Very dense sandy GRAVEL, some silt (GP-GM); grey, wet, fine to coarse sand, fine to coarse gravel, subrounded to rounded gravel, (Pioneer terrace deposits).		27.0			

Project No.: 2161003

Surface Elevation: N/A

Date of Boring: March 22, 2016

Boring Log: BH-2

Bandon Off-Channel Reservoir

Coos County, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth	Samples	SPT, N-Value / Recovery / Moisture, % / RQD., % (0 — 50 — 100)	Installations/ Water Table
31				SS-2-8	50/5"	
32						
33						
34						
35	Extremely weak (R0) SILTSTONE; dark grey, highly weathered to decomposed, sheared (Melange of Sixes River).		34.5	SS-2-9	44	
36						
	BOTTOM OF BORING		36.5			

Project No.: 2161003

Surface Elevation: N/A

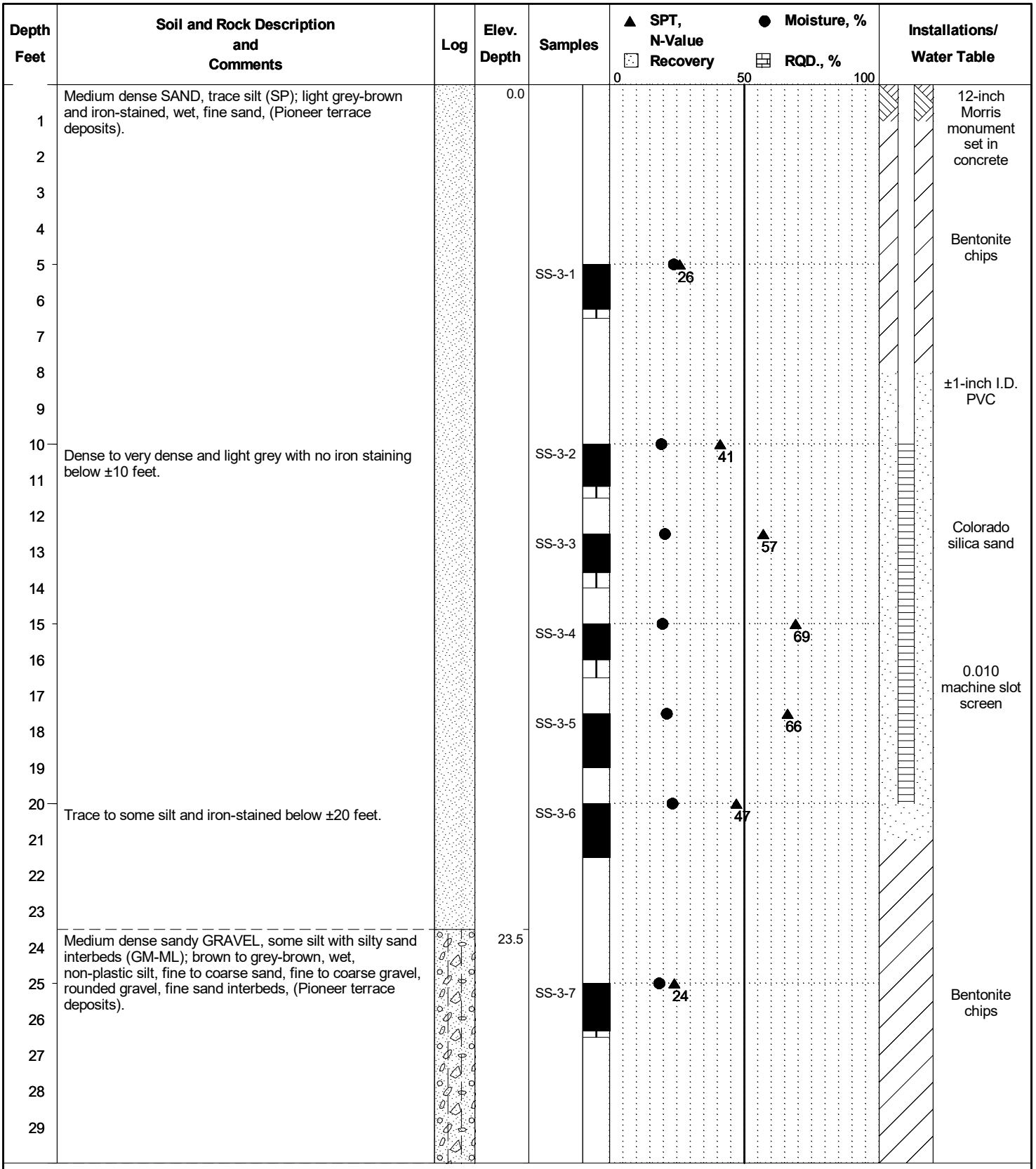
Date of Boring: March 22, 2016

Foundation Engineering, Inc.

Boring Log: BH-2

Bandon Off-Channel Reservoir

Coos County, Oregon



Project No.: 2161003

Surface Elevation: N/A

Date of Boring: March 22, 2016

Boring Log: BH-3

Bandon Off-Channel Reservoir

Coos County, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth	Samples	SPT, N-Value / Moisture, % / Recovery / RQD., % (0 — 50 — 100)	Installations/ Water Table
31	Stiff clayey SILT, scattered to some organics (MH); grey and dark brown, moist, high plasticity, organics consist of wood fibers, (Pioneer terrace deposits).		30.0	SS-3-8	14	
35	Medium dense silty SAND (SM); grey, moist to wet, low plasticity silt, fine sand, (Pioneer terrace deposits).		35.0	SS-3-9	29	
40	Very dense below ±40 feet.			SS-3-10	80	
45	Weak cementation below ±45 feet.			SS-3-11	50/5½"	
	BOTTOM OF BORING		46.0			

Project No.: 2161003

Surface Elevation: N/A

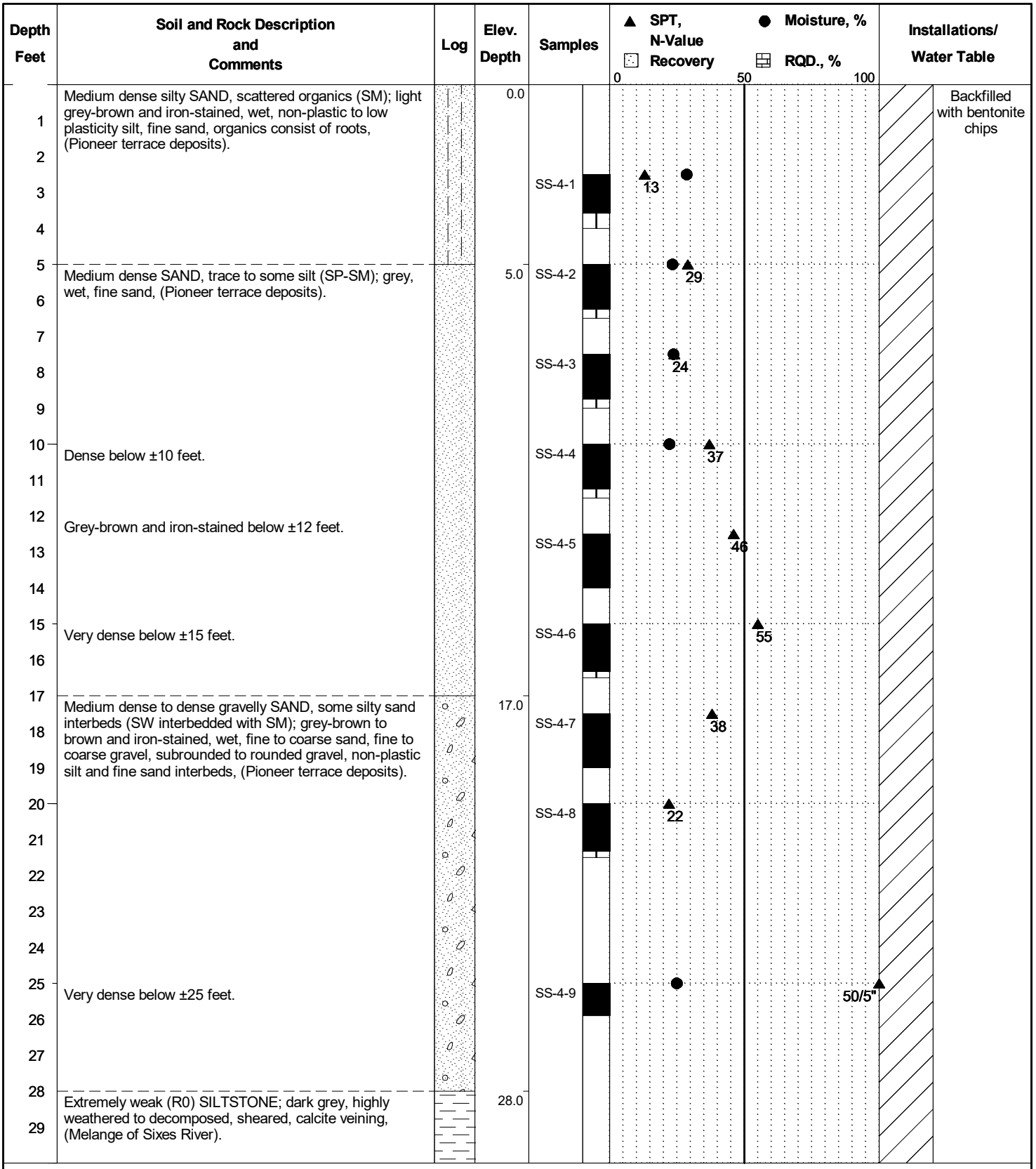
Date of Boring: March 22, 2016

Foundation Engineering, Inc.

Boring Log: BH-3

Bandon Off-Channel Reservoir

Coos County, Oregon



Project No.: 2161003

Surface Elevation: N/A

Date of Boring: March 23, 2016

Boring Log: BH-4

Bandon Off-Channel Reservoir

Coos County, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth	Samples	▲ SPT, N-Value / ● Moisture, % / ⊡ Recovery / ⊞ RQD., % (0 — 50 — 100)	Installations/ Water Table
31				SS-4-10	42	
32						
33						
34						
35				SS-4-11	43	
36						
37						
38						
39						
40	Slightly weathered below ±40 feet.			SS-4-12	79	
41						
42						
43	Weak (R2) SANDSTONE; grey, slightly weathered, fine sand, calcite veining, (Melange of Sixes River).		43.0			
44						
45				SS-4-13	50/1st 5½"	
	BOTTOM OF BORING		45.5			

Project No.: 2161003

Surface Elevation: N/A

Date of Boring: March 23, 2016

Foundation Engineering, Inc.

Boring Log: BH-4

Bandon Off-Channel Reservoir

Coos County, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
Surface: Organics (duff) consisting of plant and woody debris. Roots extend to ±3 feet. Slow seepage at ±3.5 feet. Ground water filled test pit to ±7.5 feet.	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	S-1-1 S-1-2 S-1-3						Dense silty SAND, scattered organics (SM); brown to grey and iron-stained, wet, non-plastic to low plasticity silt, fine sand, (Pioneer terrace deposits). Very dense SAND, trace silt (SP); light grey to grey, wet, fine sand, (Pioneer terrace deposits). Sandy gravel lens with fine to coarse, subrounded gravel at ±3 feet. BOTTOM OF TEST PIT

Project No.: 2161003

Surface Elevation: N/A (Approx.)

Date of Test Pit: February 11, 2016

Test Pit Log: TP-1

Bandon Off-Channel Reservoir

Coos County, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
Surface: Organics (duff) consisting of plant and woody debris. Rapid seepage at ±1 foot. Roots extend to ±3 feet. Ground water filled test pit to ±5 feet.	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	 S-2-1 S-2-2 S-2-3						Dense silty SAND, some organics (SM); brown and iron-stained, wet, non-plastic silt, fine sand, organics consist of roots, (Pioneer terrace deposits). Very dense SAND, trace silt (SP); light grey to grey and iron-stained, wet, fine sand, (Pioneer terrace deposits). BOTTOM OF TEST PIT

Project No.: 2161003

Surface Elevation: N/A (Approx.)

Date of Test Pit: February 11, 2016

Test Pit Log: TP-2

Bandon Off-Channel Reservoir

Coos County, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
Surface: Organics (duff) consisting of plant and woody debris. Moderate seepage at ±2.5 feet. Roots extend to ±2.5 feet.	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	S-3-1 S-3-2 S-3-3 S-3-4 S-3-5 S-3-6						Dense silty SAND, some gravel (SM); brown, moist, low plasticity silt, fine to coarse sand, fine gravel, subrounded gravel, (Pioneer terrace deposits). Dense to very dense silty SAND to SAND, some silt (SM); brown and iron-stained, wet, non-plastic silt, fine sand, (Pioneer terrace deposits). Some weak cementation at ±2.5 to 3.5 feet. Very dense SAND, trace silt (SP); light grey to grey, wet, fine sand, (Pioneer terrace deposits). Light grey below ±12 feet. BOTTOM OF TEST PIT

Project No.: 2161003

Surface Elevation: N/A (Approx.)

Date of Test Pit: February 11, 2016

Test Pit Log: TP-3

Bandon Off-Channel Reservoir

Coos County, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
Surface: Organics (duff) consisting of plant and woody debris. Slow seepage at ±3 feet. Roots extend to ±4 feet. Ground water filled test pit to ±6 feet.	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	S-4-1 S-4-2 S-4-3 S-4-4						Medium dense silty SAND, scattered organics (SM); brown, wet, low plasticity silt, fine sand, (Pioneer terrace deposits). Medium dense to dense SAND, some silt (SP-SM); brown, wet, non-plastic silt, fine sand, (Pioneer terrace deposits). Very dense SAND, trace silt (SP); grey, wet, fine sand, (Pioneer terrace deposits). BOTTOM OF TEST PIT

Project No.: 2161003

Surface Elevation: N/A (Approx.)

Date of Test Pit: February 11, 2016

Test Pit Log: TP-4

Bandon Off-Channel Reservoir

Coos County, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
Surface: Organics consisting of plant and woody debris.	1	S-5-1						Medium dense to dense silty SAND, some to scattered organics (SM); red-brown, moist, low plasticity silt, fine to coarse sand, organics consist of roots, (Pioneer terrace deposits).
	2	S-5-2						
Roots extend to ±3 feet.	3							Very dense SAND, trace silt (SP); brown and iron-stained, moist, fine sand, weak to moderate cementation, (Pioneer terrace deposits).
	4	S-5-3						
	5							Wet below ±5 feet.
	6							
	7	S-5-4						Very dense SAND, trace silt (SP); grey, wet, fine sand, weak cementation, (Pioneer terrace deposits).
	8							
	9	S-5-5						
	10	S-5-6						
	11							
	12	S-5-7						
	13	S-5-8						
	14							
No seepage or groundwater to the limit of excavation.	15							BOTTOM OF TEST PIT
	16							
	17							
	18							
	19							

Project No.: 2161003

Surface Elevation: N/A (Approx.)

Date of Test Pit: February 11, 2016

Test Pit Log: TP-5

Bandon Off-Channel Reservoir

Coos County, Oregon

Comments	Depth, Feet	Sample #	Location	Class Symbol	Water Table	C, TSF	Symbol	Soil and Rock Description
Surface: Organics (duff) consisting of plant and woody debris.	1	S-6-1						Stiff SILT, some sand (ML); grey-brown, wet, low plasticity, fine to coarse sand, (topsoil).
	2							
	3	S-6-2						Dense to very dense SAND, trace silt (SP); brown and iron-stained, wet, non-plastic silt, fine sand, weak to moderate cementation, (Pioneer terrace deposits).
	4							
	5							
	6	S-6-3						Very dense silty SAND (SM); grey and iron-stained, wet, low plasticity silt, fine sand, weak cementation, (Pioneer terrace deposits).
Rapid seepage at ±6.5 feet.	7	S-6-4						
	8							
	9							
	10	S-6-5						
	11							
	12							
	13							
	14							
	15							
	16	S-6-6						ORGANICS, in silty SAND matrix (OL); dark brown to dark grey, wet, low plasticity silt, fine sand, organics consist of wood and decomposed organic material (Pioneer terrace deposits).
	17							
	18							
	19							BOTTOM OF TEST PIT

Project No.: 2161003

Surface Elevation: N/A (Approx.)

Date of Test Pit: February 11, 2016

Test Pit Log: TP-6

Bandon Off-Channel Reservoir

Coos County, Oregon

Appendix C

Laboratory Test Results

Professional
Geotechnical
Services

Foundation Engineering, Inc.

Table 1C. Natural Water Contents and Percent Fines

Sample Number	Sample Depth (ft)	Natural Water Content (percent)	Percent Fines
S-1-1	3.0 – 3.5	22.3	
S-1-2	4.0 – 5.0	20.3	1.6
S-1-3	10.0 – 11.0	25.3	
S-2-1	4.0 – 4.5	17.1	
S-2-2	7.0 – 8.0	19.8	
S-2-3	9.0 – 10.0	20.5	
S-3-1	0.0 – 0.5	53.7	
S-3-2	1.0 – 1.5	36.6	
S-3-3	2.5 – 3.5	21.3	
S-3-4	4.5 – 5.0	25.5	
S-3-5	9.0 – 10.0	17.6	
S-3-6	13.0 – 14.0	22.2	
S-4-1	0.5 – 1.5	25.7	24.4
S-4-2	3.0 – 3.5	27.7	
S-4-3	6.0 – 7.0	18.1	
S-4-4	11.0 – 12.0	16.8	
S-5-1	0.0 – 0.5	56.1	
S-5-2	1.5 – 2.0	26.9	
S-5-3	4.0 – 4.5	8.2	
S-5-4	6.5 – 7.0	15.8	
S-5-5	8.5 – 9.0	19.1	
S-5-6	9.5 – 10.0	16.5	
S-5-7	11.5 – 12.0	14.7	
S-5-8	12.5 – 13.0	16.4	
S-6-1	1.0 – 1.5	38.7	

Table 1C. Natural Water Contents and Percent Fines

Sample Number	Sample Depth (ft)	Natural Water Content (percent)	Percent Fines
S-6-2	3.0 – 3.5	19.6	3.4
S-6-3	6.0 – 6.5	18.1	
S-6-4	7.0 – 7.5	19.4	
S-6-5	9.5 – 10.0	33.7	12.7
SS-1-1	2.5 – 4.0	25.7	
SS-1-2	5.0 – 6.5	24.0	
SS-1-3	7.5 – 9.0	20.8	
SS-1-4	10.0 – 11.5	24.9	
SS-1-5	12.5 – 14.0	21.0	
SS-1-6	15.0 – 16.5	49.2	6.8
SS-1-7	16.5 – 18.0	25.5	
SS-1-8	18.0 – 19.5	21.9	
SS-1-9	22.5 – 24.0	24.4	
SS-1-10	25.0 – 26.5	22.1	
SS-1-11	30.0 – 31.5	17.5	
SS-1-12	35.0 – 36.5	26.4	
SS-2-1	2.5 – 4.0	22.9	
SS-2-2	5.0 – 6.5	22.4	
SS-2-3	7.5 – 9.0	21.5	
SS-2-4	10.0 – 11.5	24.5	
SS-2-5	17.5 – 19.0	24.4	
SS-2-6	20.0 – 21.5	20.0	
SS-2-7	25.0 – 26.5	25.9	
SS-2-8	30.0 – 30.8	11.9	
SS-3-1	5.0 – 6.5	23.8	2.9
SS-3-2	10.0 – 11.5	19.2	
SS-3-3	12.5 – 14.0	20.5	

Table 1C. Natural Water Contents and Percent Fines

Sample Number	Sample Depth (ft)	Natural Water Content (percent)	Percent Fines
SS-3-4	15.0 – 16.5	19.6	
SS-3-5	17.5 – 19.0	21.2	
SS-3-6	20.0 – 21.5	23.3	
SS-3-7	25.0 – 26.5	18.4	
SS-3-8	30.0 – 31.5	46.6	
SS-3-9	35.0 – 36.5	26.6	
SS-3-10	40.0 – 41.5	29.2	
SS-4-1	2.5 – 4.0	28.6	17.7
SS-4-2	5.0 – 6.5	23.3	
SS-4-3	7.5 – 9.0	23.7	5.8
SS-4-4	10.0 – 11.5	22.2	
SS-4-9	25.0 – 25.9	24.9	

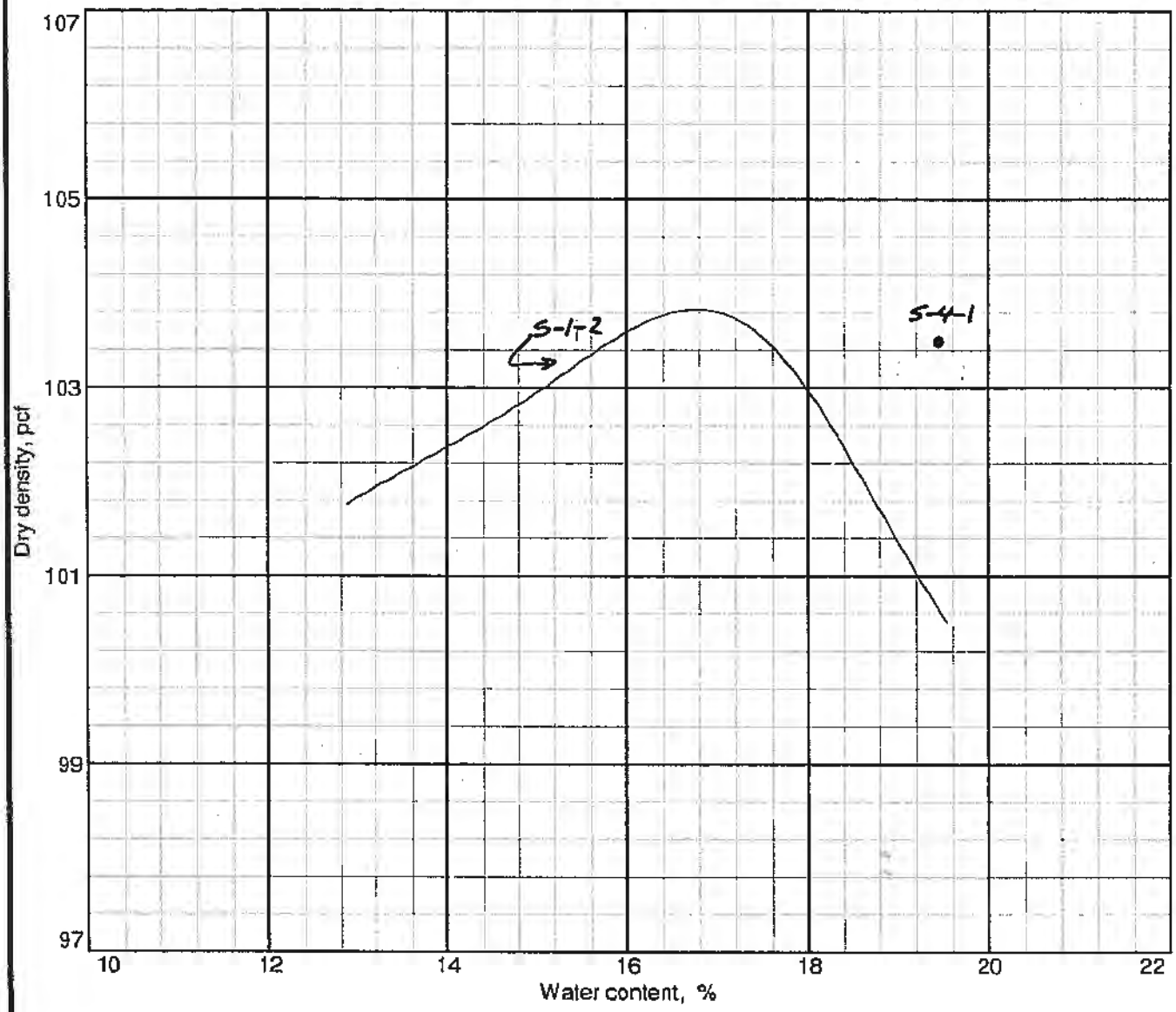
Table 2C. pH Test Results (ASTM G51)

Sample Number	Sample Depth (ft)	Sample Description	pH
SS-1-1	2.5 – 4.0	silty SAND	5.8
SS-3-1	5.0 – 6.5	fine SAND	5.6
SS-4-3	7.5 – 9.0	fine SAND	5.8
SS-2-2	10.0 – 11.5	fine SAND	5.7

Table 3C. Summary of Resistivity Testing

Location	Pin Spacing (ft.)	Resistivity (Ω-cm)
R-1 (near center of Parcel 2400)	5	84,260
	10	85,218
	20	80,430

MOISTURE - DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Dry density = 103.5 pcf Moisture 19.4 %	brown silty SAND

Project No. 2166001-602 **Client:** Foundation Engineering, Inc.; project #2161003
Project: Bandon Off - Channel Reservoir

● **Source:** 5986 **Sample No.:** S-4-1 **Elev./Depth:** 0.5-1.5'

MOISTURE - DENSITY RELATIONSHIP TEST
FEI Testing & Inspection, Inc.
Corvallis, OR

Remarks:
Check Point applied to S-1-2 curve

Figure 1C

SECTION 9:
PERMITTING

SECTION 9: PERMITTING

This task identifies the required permits and applications that must be prepared and submitted for approval. The following agencies were contacted and respective permitting needs are listed as follows:

A. SHPO & Tribes – prehistoric and historic – no permit necessary

1. Coquille Tribe of Indians – Kassandra Rippee, tribal archaeologist made preliminary site visit. She will make another site visit when second parcel has been cleared enough to view.

2. Confederated Tribes of the Siletz Indians – made calls to Robert Kentta, but no return calls from him.

B. United States Army Corps of Engineers (USACE) & Department of State Lands (DSL) - no permits necessary.

C. Section 401 Water Quality Certification is in the process of being obtained.

D. Department of Environmental Quality (DEQ) National Pollutant Discharge Elimination System (NPDES) 1200C Permit – erosion control - obtained approval for site clearing and preliminary geotechnical investigation 10/27/14 File No. 123948 Permit No. 30432.

E. A permit for reservoir construction will be obtained during the design process.

F. Section 10 of the Rivers and Harbors Appropriation Act of 1899 – no obstructions, or excavations and fills shall be constructed in any navigable waterways as part of this project.

G. Section 404 Clean Water Act – No disposal dredging or fill material discharged into navigable water, shellfish beds, and fishery areas is anticipated.

H. Conditional Use Permit from Coos County – obtained approval March 17, 2015 Final Decision and Order for AP-15-05 City of Bandon.

I. A new water right permit for storage and the withdrawal from the new reservoir are in the process of being obtained from Oregon Water Resources Department (OWRD).

J. Consulting with the following:

1. Oregon State Historic Preservation Office – no permits necessary because of no potential issues.

2. Coquille Tribe – no permits necessary but Tribal Archaeologist made site visit will visit again once site is cleared of vegetation.

3. Confederated Tribes of Siletz Indians – no permits necessary but Tribe contacted and there was no response

4. US Fish & Wildlife Service – no permits necessary, contacted regarding bird concerns.

5. National Marine and Fisheries Service – contacted, responded to concerns about impacts to fish in main Ferry Creek. If federal funding is sought, then full consultation with NMFS will be required.

6. Oregon Department of Fish & Wildlife – contacted, responded to concerns about water quality issues.

SECTION 10:

FEASIBILITY LEVEL COST ESTIMATE

SECTION 10: FEASIBILITY LEVEL COST ESTIMATE

This section addresses the cost estimate at the feasibility study level. It is intended to serve as a budgetary guide and to support evaluations of project feasibility or funding requirements in support of planning and to establish a budget.

Purpose

The City of Bandon lacks both, a sufficient surface water supply, during the dry season, and raw water storage, necessary to provide the city with water when water supply is low and demand is high.

Background information

The City studied options to expanding the City's water storage prior to proceeding with pursuing the raw water storage facility option. The following options were considered:

- Dredging Ferry and Geiger Creek Reservoirs to expand raw water storage
- Repairing Ferry Creek Dam, so that water levels could be raised, to increase raw water storage.
- Installing a new 1.0 MG or new 2.0 MG treated water tank.

The study concluded the cost per gallon of water for constructing a raw water storage facility was far lower than any of the other options and offers the most storage volume.

Scope

The City purchased a ten-acre parcel in 2014 for the purpose of constructing an off-channel reservoir, so no property will have to be purchased for this project. This parcel is contiguous another ten-acre parcel and will provide an adequately sized site to construct the reservoir, settling ponds, and overflow basin. Both these parcels are contiguous to the property that the City water treatment plant is located. This property is not within the city, but is in close proximity. It has access to electric service and there is a utility easement that runs from the property to the Backup Pump Station. The property is approximately the same elevation as Middle Pond, so the same pumps at the Backup Pump Station can be used to pump water to the proposed off-channel reservoir.

The raw water storage facility will consist of the 100-acre-foot off-channel reservoir that will occupy approximately a 20-acre site. A sedimentation basin will allow lower O&M costs by allowing sediment settle out before entering the raw storage facility. This basin can be cleaned much easier than the larger raw water storage basin. Emergency overflow will be directed to an energy-dissipator basin and bioswale. The site will be enclosed by a 50-foot wide buffer of natural vegetation (brush) and will be security-fenced and gated.

The reservoir will be constructed of native materials, as determined by the geotechnical study, to be appropriate for reservoir construction. Materials excavated for the reservoir will be used to construct the berm. This will minimize trucking of materials in and out of the site.

The raw water storage basin will be lined to eliminate leakage and so nearby wells are not adversely impacted by water from the local water table migrating into the storage basin. The raw water storage basin will be covered to eliminate evaporation. The combination of the liner and cover will serve as significant water conservation measures.

The cover will be insulated and will keep water cool and minimize algae growth. Mixers and aerators will keep the water from stratifying. Stratification of stored water results in difficulty in treating this water, the possibility of algal blooms, and adverse impacts to fish if this water is released into the stream.

Water for the reservoir will be pumped from the existing Backup Pump Station, located downstream from the Fish Hatchery, through a new 12-inch diameter pipe, located in an existing utility easement. An existing 14-inch treated water main and electrical lines already utilize the easement. Water will be diverted from the reservoir by gravity to the Backup Pump Station, where it will be pumped to the treatment plant.

Water may be released for stream augmentation at the Backup Pump Station, if determined necessary by funding or regulatory agencies.

A fish screen will be provided at the intake in the raw water storage basin if required by regulatory agencies.

A SCADA system will be installed to provide telemetry control of valves and pumps.

Basis for Cost Estimate

The costs for construction and associated engineering have be developed and summarized on the feasibility level cost estimate.

The following assumptions were used to determine construction costs:

- The project will receive funding for the entire project.
- Environmental regulations will not change.
- The construction costs are in today's dollars and should be adjusted to reflect inflation at the time of design.
- The geotechnical properties of the timbered site (Lot 2300) will be the same as the cleared area (Lot 2400) that was examined during the feasibility study.
- The materials and equipment used in the cost estimate will still be available.
- Preliminary and final design will not change significantly.

The estimated construction costs are based on a preliminary design and costs derived from similar projects and input from material and equipment suppliers. These costs are shown in Table 10.1.

Table 10.1
Total Project Cost Estimate

No.	Item	Quantity	Unit	Unit Price	Total Price
1	Construction Facilities and Temp. Controls	1	LS	$637,700.00	$ 637,700
2	Site Preparation	1	LS	$7,500.00	$ 7,500
3	Access Road Construction	1	LS	$1,300.00	$ 1,300
4	Dike Road Surfacing	1	LS	$12,500.00	$ 12,500
5	Geotextile Fabric	3,500	SY	$2.00	$ 7,000
6	Aggregate Base	1,000	Ton	$26.00	$ 26,000
7	Perimeter Drainage Ditch	2,550	LF	$2.00	$ 5,100
8	Foundation Stabilization	375	CY	$40.00	$ 15,000
9	Stripping - Removal	74,200	CY	$3.75	$ 278,250
10	Stripping - Reinstallation	74,200	CY	$3.25	$ 241,150
11	Excavation - used for sediment & overflow basins	26,100	CY	$3.50	$ 91,350
12	Excavation/Embankment - used for berm	52,200	CY	$4.00	$ 208,800
13	Cement Amendment for slope stabilization	15,600	CY	$6.00	$ 93,600
14	Pond Surface Fine Grading	1	LS	$10,000.00	$ 10,000
15	Pond Anchor Trench	1,500	LF	$5.00	$ 7,500
16	Pond Underdrains	1	LS	$25,000.00	$ 25,000
17	Pond Liner Underlainment	700,000	SF	$0.60	$ 420,000
18	Pond Lining (includes leakage testing)	700,000	SF	$1.00	$ 700,000
19	Floating Algae Control Cover	275,000	SF	$3.00	$ 825,000
20	Mixer / Aerator Unit	3	EA	$57,000.00	$ 171,000
21	Johnson Fish Screen w/ Air Scour System	1	LS	$25,000.00	$ 25,000
22	12" Misc. Fittings	8	EA	$1,100.00	$ 8,800
23	12" Gate Valve	1	EA	$2,100.00	$ 2,100
24	12" Check Valve	2	EA	$6,000.00	$ 12,000
25	8" Check Valve	1	EA	$4,000.00	$ 4,000
26	12" Float Valve	1	EA	$20,000.00	$ 20,000
27	Emergency Spillway Structure	2	EA	$3,000.00	$ 6,000
28	Safety Equipment (for maintenance)	1	LS	$10,000.00	$ 10,000
29	Creek Crossing	1	LS	$20,000.00	$ 20,000
30	Pipe Inlet & Outfall Structures (Manifold Systen	2	EA	$20,000.00	$ 40,000
31	Pump Station Connection	1	LS	$25,000.00	$ 25,000
32	Pump Station Improvements	1	LS	$75,000.00	$ 75,000
33	12" DIP Restrained Joint Waterline - Class C	150	LF	$110.00	$ 16,500
34	12" DIP Restrained Joint Waterline - Class B	400	LF	$85.00	$ 34,000
35	12" DIP Waterline - Class B	1,750	LF	$70.00	$ 122,500
36	12" C900 PVC Waterline - Class C	1,600	LF	$65.00	$ 104,000
37	8" C900 PVC Waterline - Class C	150	LF	$45.00	$ 6,750
38	Concrete Anchor Wall	2	EA	$1,500.00	$ 3,000
39	Combination Air Release Valve w/vault	1	EA	$2,100.00	$ 2,100
40	Standard Blowoff Assembly	1	EA	$1,150.00	$ 1,150

No.	Item	Quantity	Unit	Unit Price	Total Price
41	SCADA	1	LS	$25,000.00	$ 25,000
42	Electrical to site by Bandon Electric	1	LS	$50,000.00	$ 50,000
43	Electrical Site Service	1	LS	$6,000.00	$ 6,000
44	HP Generator System	1	LS	$50,000.00	$ 50,000
45	10HP duplex pump station	1	LS	$75,000.00	$ 75,000
46	Pre-sedimentation Basin System Exc/Emb	2,800	CY	$4.00	$ 11,200
47	Pre-sedimentation Basin Liner/Underlainment	9,600	SF	$1.30	$ 12,480
48	Safety Equipment (for maintenance)	1	LS	$2,500.00	$ 2,500
49	Energy Dissipator Basin	1	LS	$7,500.00	$ 7,500
50	Overflow Bioswale Exc/Emb	4,500	CY	$3.50	$ 15,750
51	Security Fence	3,600	LF	$75.00	$ 270,000
52	Security Gate	1	EA	$10,000.00	$ 10,000
53	Erosion & Sediment Control	1	LS	$7,000.00	$ 7,000
54	Landscaping	1	LS	$25,000.00	$ 25,000
				Construction Total	**$ 4,889,000**
				Contingency	**$ 1,222,000**
				Engineering	**$ 733,000**
				Permitting	**$ 61,000**
				Geotechnical	**$ 55,000**
				Water Rights	**$ 20,000**
				Planning	**$ 93,000**
				Administration	**$ 147,000**
				Project Total	**$ 7,220,000**

The cost per acre-foot is $72,220 and the cost per gallon is $0.22.

Annual Operating and Maintenance Costs

Annual maintenance activities were identified with input from City staff. Preventative maintenance consists of tasks considered necessary to keep the reservoir in good working order. Monitoring and inspection are items that should be regular maintenance duties and may be conditions of the reservoir permit. Replacement, maintenance, and calibration items include the costs to replace and maintain items that require substantial costs that may not occur annually but will require budgeting for. Table 10.2 lists the annual operating and maintenance costs for the off-channel reservoir.

Table 10.2
Annual O&M Costs

No.	Item	Quantity	Unit	Unit Price	Total Price
Preventive Maintenance					
1	Vegetation Mowing	1	EA	$227.16	$ 227
2	Brush Removal	2	EA	$494.20	$ 988
3	Maintain/grade embankment & access roads	1	EA	$483.51	$ 484
4	Maintain/repair embankment	1	EA	$98.18	$ 98
5	Remove and repair rodent damage	1	EA	$84.00	$ 84
6	Maintain/Repair security fence	1	EA	$100.00	$ 100
7	Cleaning (algea & dirt)	1	EA	$500.00	$ 500
8	Cleaning basin & spillway (sediment removal)	1	EA	$3,000.00	$ 3,000
9	Repair & verify calibration of measurement equip.	1	EA	$650.00	$ 650
10	Dredge settling pond(s) (once every 5 years)	0.2	EA	$10,000.00	$ 2,000
Monitoring/Inspection					
11	Monitoring - visual	12	EA	$50.00	$ 600
12	Inspection - after storm/disaster events	3	EA	$150.00	$ 450
13	Inspection - all with Engineer	1	EA	$1,000.00	$ 1,000
	(SHORT LIVED ASSETS) TOTAL MAINT. AND MONITORING/INSPECTION COSTS				$ 10,181
Replacement/Calibration, maintenance					
14	Valves (maintain all valves once every 7 years)	0.05	EA	$7,750.00	$ 400
15	Valves (replace 2 valves once every 20 years)	0.05	EA	$8,000.00	$ 400
16	10 HP Pump (replace 2 pumps once every 20 years)	0.05	EA	$50,000.00	$ 2,500
17	SCADA (calibration once a year)	1	EA	$500.00	$ 500
18	Mixer/aerators (replace all once every 10 years)	0.10	EA	$171,000	$ 17,100
19	Floating Algae Control Cover (rep. 25% every 20 years)	3,438	EA	$3.00	$ 10,313
	TOTAL REPLACEMENT AND CALIBRATION COSTS				$ 31,213
Note: based total current unit price costs *0.1 equals 1 of 20 years*					
	TOTAL YEARLY OPERATING & MAINTENANCE COSTS				**$ 41,394**

SECTION 11:

FUNDING AND RATE ANALYSIS

SECTION 11: FUNDING AND RATE ANALYSIS

The City of Bandon is unable to finance this project without some form of governmental funding assistance, such as low-interest loans or grants. This section summarizes the funding needed to construct and operate the proposed off-channel reservoir.

Income – Water Rates

The City's rate structure consists of a base rate, which includes the first 2,000 gallons and a price per each 1,000 gallons used thereafter. The City of Bandon's average water bill cost for 4,000 gallons is $16.10. Bandon's water bill for 7,500 gallons is $21.30. The authority to raise water rates must be approved by the voters of the City. Currently the City's Utility Commission is working on a water rate ballot measure. In addition, the City will be commissioning a water rate study July 2016.

Construction of the proposed off-channel reservoir may require ratepayers in the City of Bandon to pay higher rates for water service.

There appears to be two viable funding options for this project: funding from OWRD or a combination of funding from USDA and OWRD.

Impact to Ratepayers

The following financial scenarios are based on a total project cost of $7,220,000 as seen in Figure 11.1.

Figure 11.1
One Stop Financial Summary

Bandon										7/7/16	
				County:	Coos	Statewide					
				Population:	3,105	3,582,600					
				% LMI:	42.7%						
Compliance Issue? (Y/N)			N	MHI	36,156	$50,521	71.57% of State				
Number Jobs Created			0	County Unemp.	6.50%	4.50%	144.44% of State			Per EDU	
				Distress #	0		Threshold Rate @ 1.25% MHI			37.66	
Total Project Cost:				# EDUs*	3,861		Residential utility rate - say			21.30	
	$ 7,220,000			Annual O&M	731,000		O&M per EDU per mo.			15.78	
Less Local	$ -			Current debt pmt	44,759		Existing debt pmt/EDU/mo.			0.97	16.74
Needed	$ 7,220,000										
				Financing Scenarios							
Type	Award	Select	Loan	Grant	Annual Debt Payment	Rate *	Term (years)	Total of payments	Monthly Debt per EDU	Debt Cost - EDU/Mo.	Gap
USDA / RUS	7,220,000		7,220,000	-	383,717	4.35%	40	15,348,661	8.28	25.03	
IFA / SPWF	7,220,000		7,220,000		450,999	3.77%	25	11,274,984	9.73	26.48	
OWRD/USDA	7,220,000		4,220,000	3,000,000	254,368	4.35%	30	7,631,038	5.49	22.23	-20,000
OWRD/IFA	7,220,000		4,220,000	3,000,000	263,603	3.77%	25	6,590,087	5.69	22.43	
OWRD *	7,200,000	x	7,200,000	-	219,280	1.00%	40	8,771,212	4.73	21.48	
										selected	21.48

Notes: *Estimated rates; Direct rates are set quarterly. Oregon Bond Bank rates are set at time of the Bond Sale. ** USDA/RUS Payment includes 10% Annual Debt Service; ***DEQ Rate is "an estimate of the Effective rate" reflecting an annual fee; **These Scenarios are ESTIMATES ONLY and should not be considered actual rates, costs or funding commitments.**

LOAN AND GRANT FUNDING IS SUBJECT TO AVAILABILITY OF FUNDS.

** OWRD will not cover the cost of procuring water rights*

Former City Manager, Chris Good, attended a Developmental One Stop Finance Meeting on October 19, 2015. The meeting was attended by USDA/RUS, IFA/SPWF, and OWRD/OWRD. A variety of loan and grant opportunities were considered from the three funding sources.

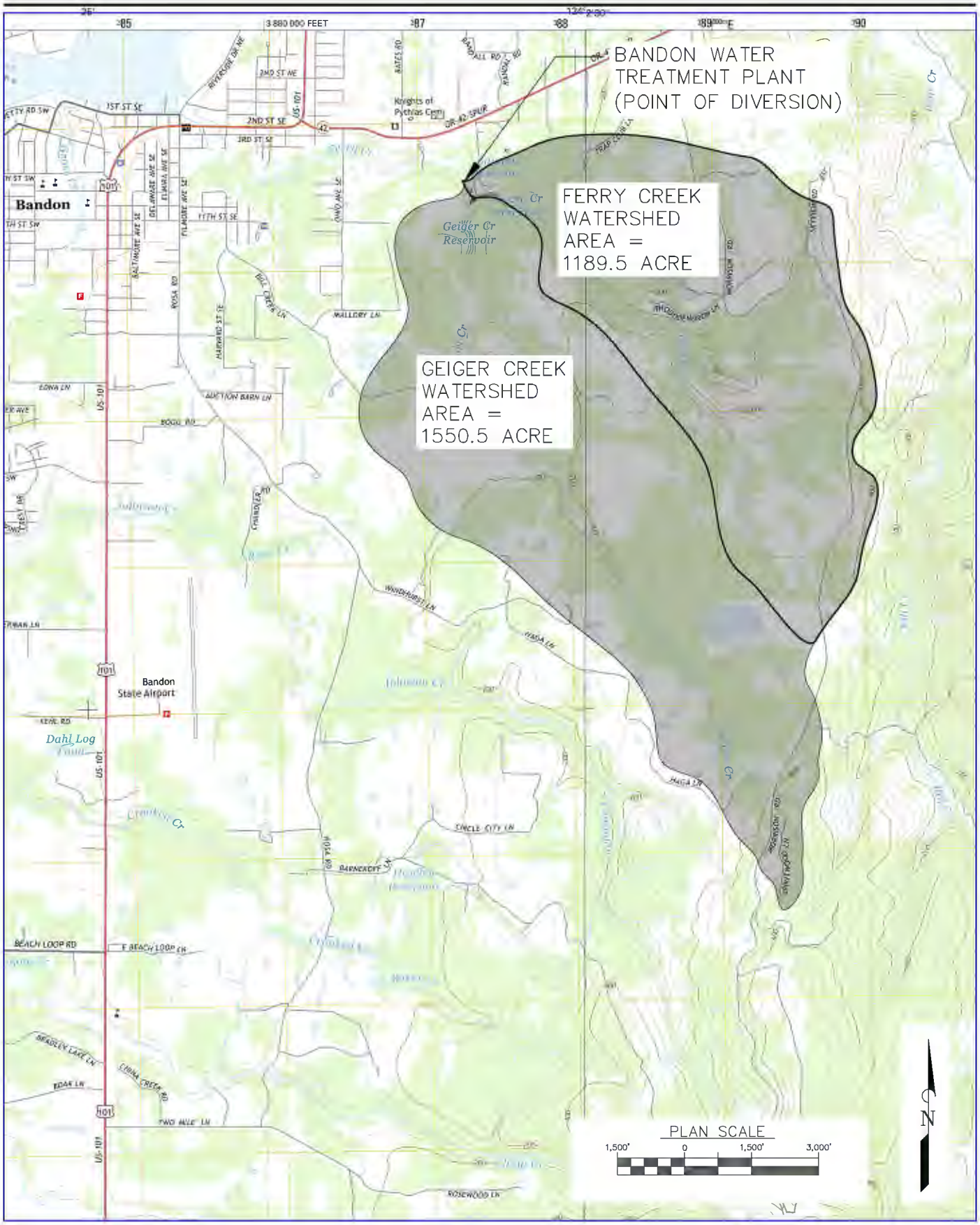
The City is considering a General Obligation bond to fund loan repayments.

The City's current annual operating budget is $690,000 and their current debt service payment is $44,759. The estimated annual O & M cost for the raw water storage facility is approximately $41,000.

The selected alternative is the loan funded by OWRD. OWRD stated that they do reimburse costs for procuring the water rights, however if the City pays the estimated $20,000 cost to cover the water rights, the total cost, including interest, will be the most economical.

APPENDICES

APPENDIX A: **WATERSHED DELINEATION**

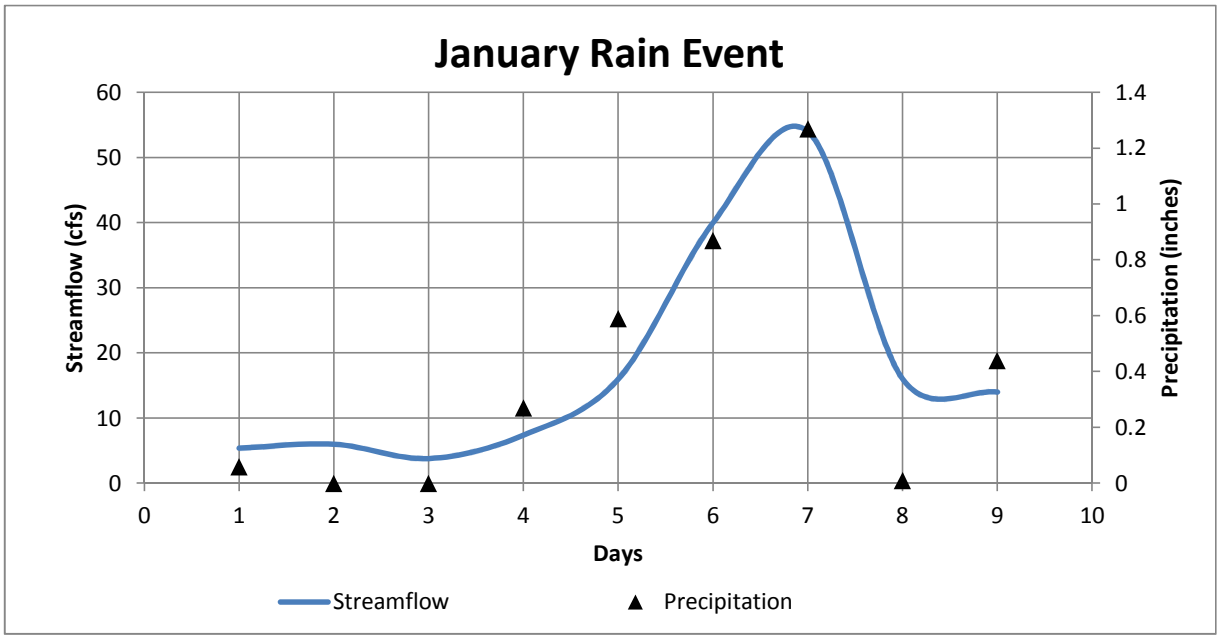


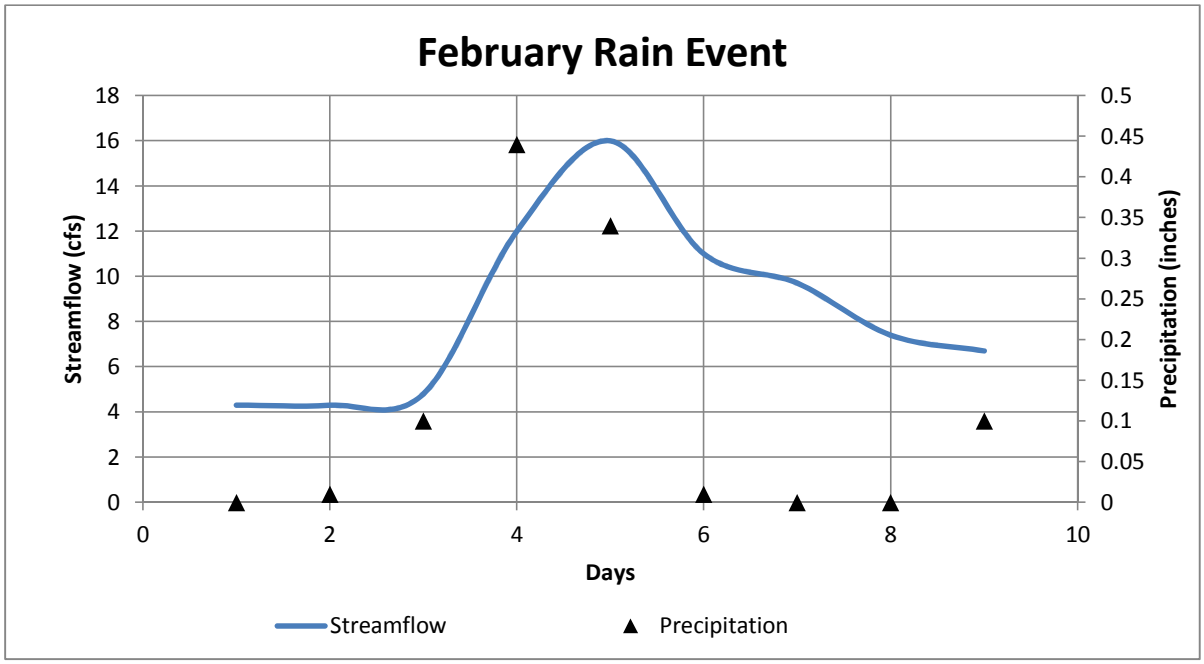
THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	***CITY OF BANDON*** ***OFF CHANNEL RESERVOIR FEASIBILITY STUDY***	FIGURE NO. ***1***
DATE: JUNE 2016	***WATERSHED DELINEATION MAP***	
PROJECT NO.: 101.92		

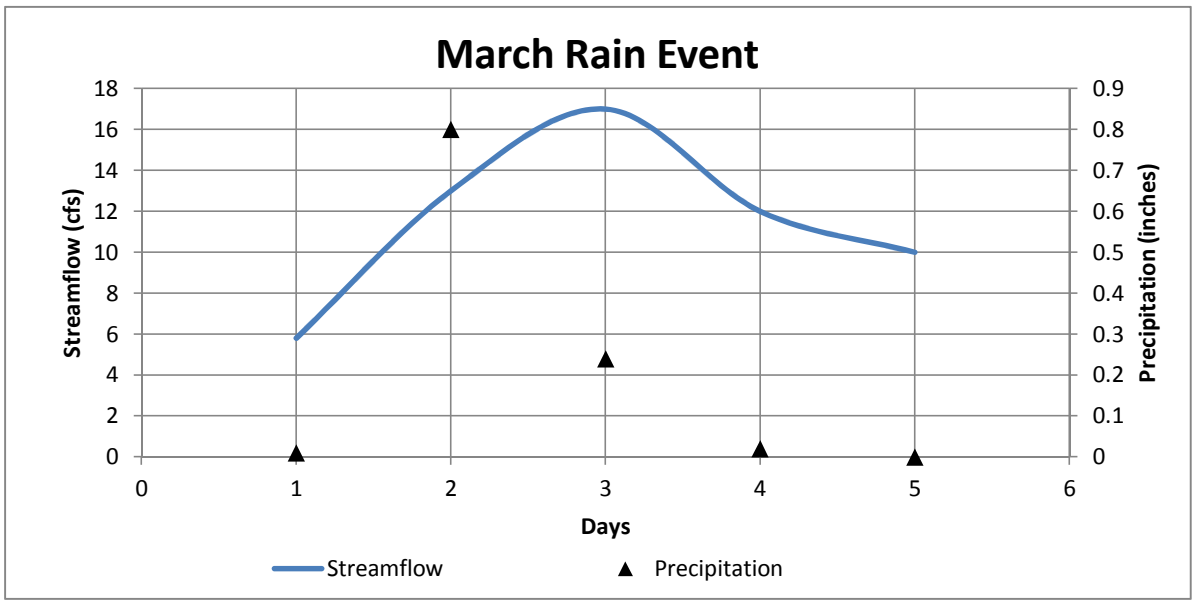
APPENDIX B: **ESSENTIAL SALMON HABITAT**

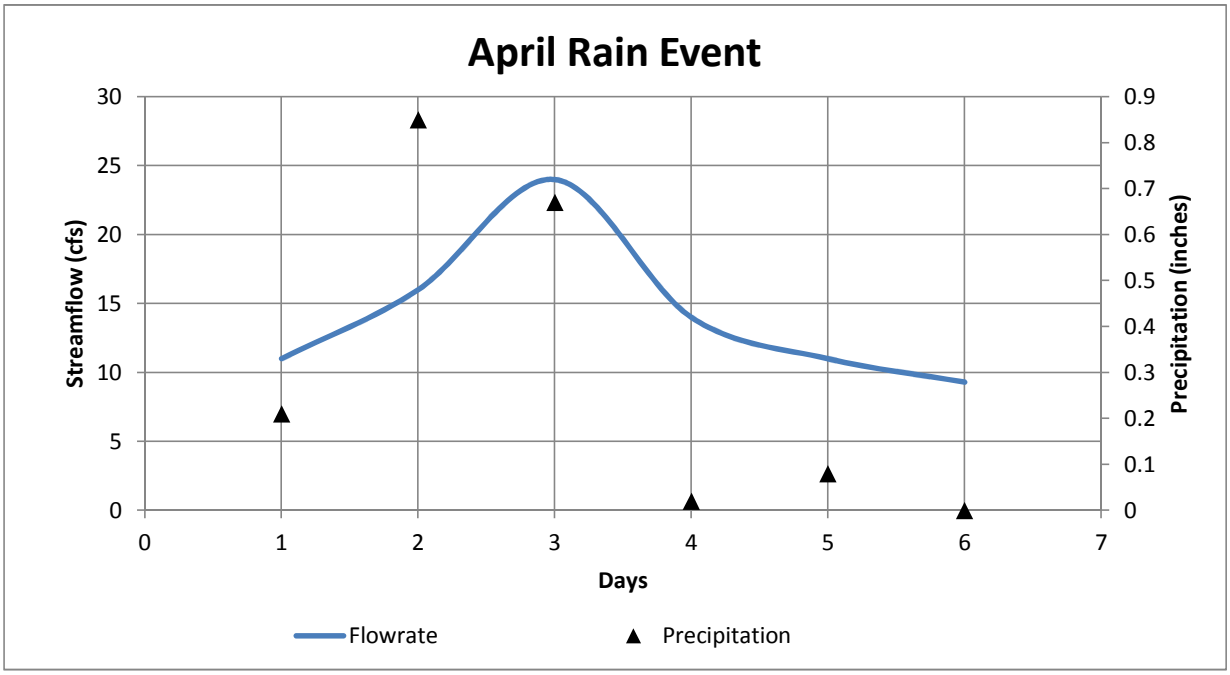
THE DYER PARTNERSHIP ENGINEERS & PLANNERS, INC.	***CITY OF BANDON OFF CHANNEL RESERVOIR FEASIBILITY STUDT***	FIGURE NO. **2**
DATE: JUNE 2016	***ESSENTIAL SALMON HABITAT***	
PROJECT NO.: 101.92		

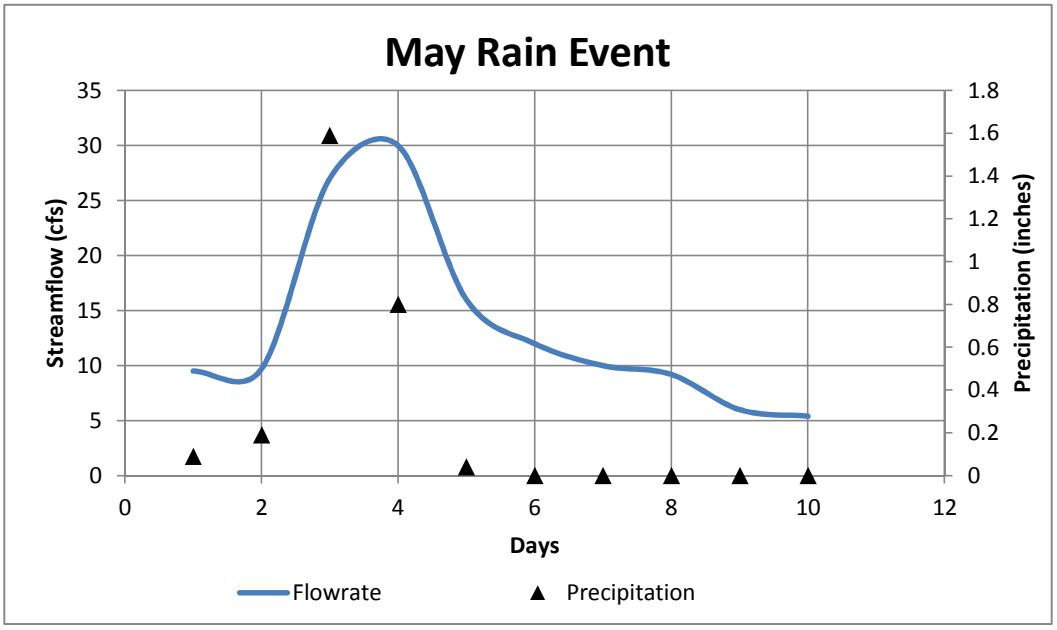
APPENDIX C: **FLOW PRECIPITATION RELATIONSHIP**

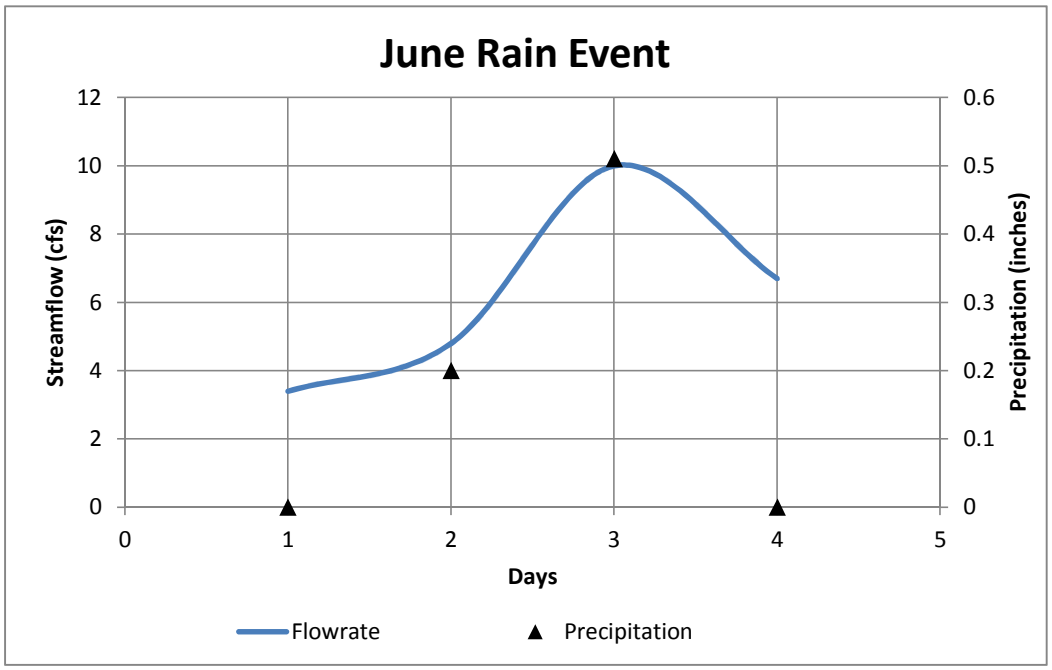

January Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Precipitation

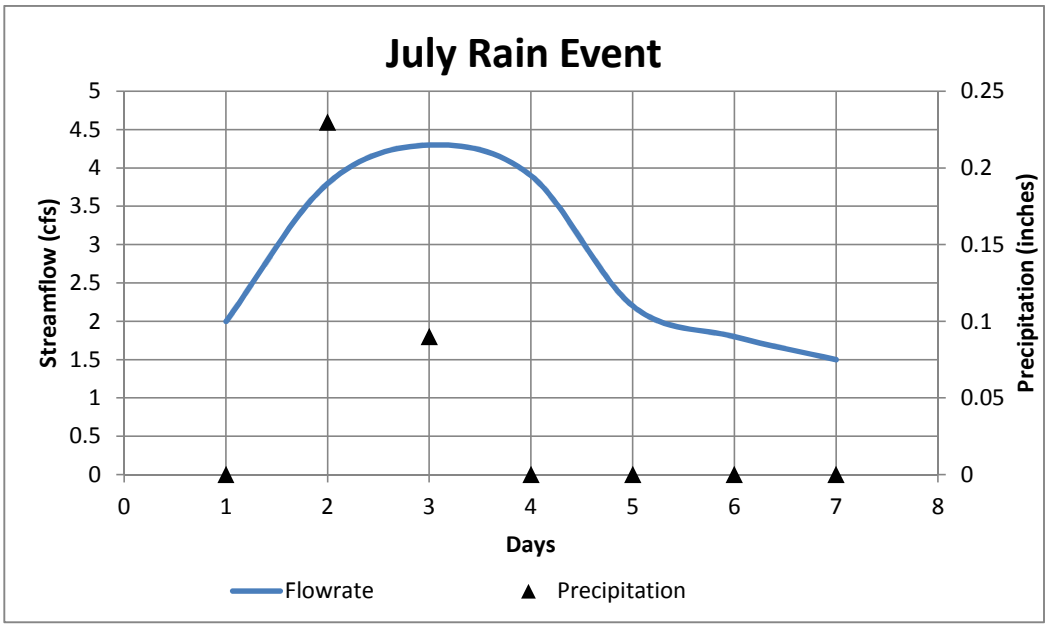

February Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Precipitation

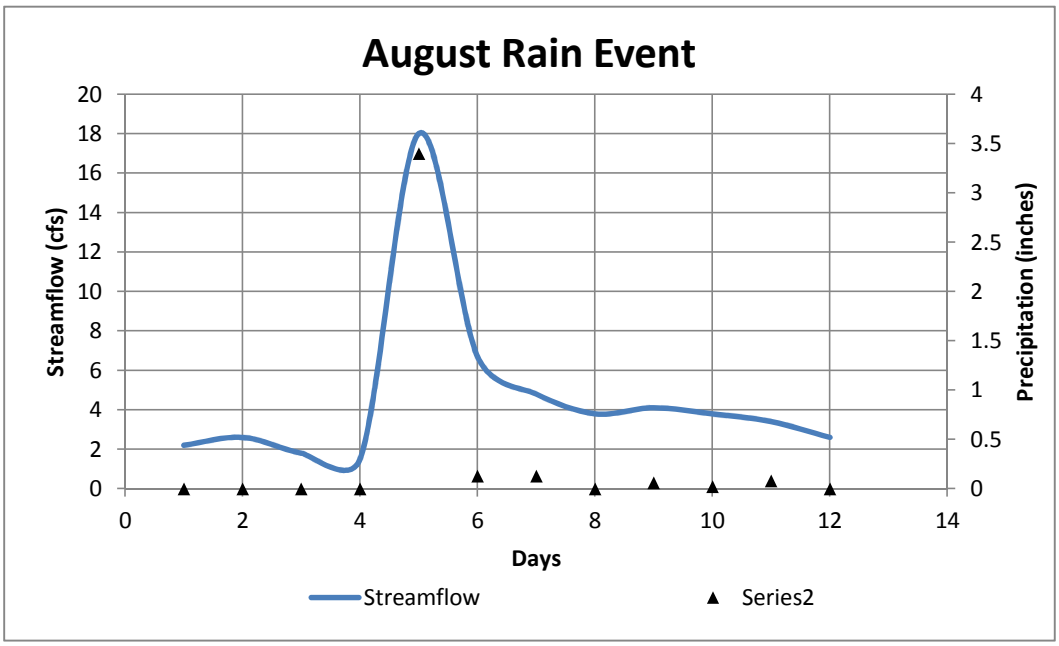

March Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Precipitation

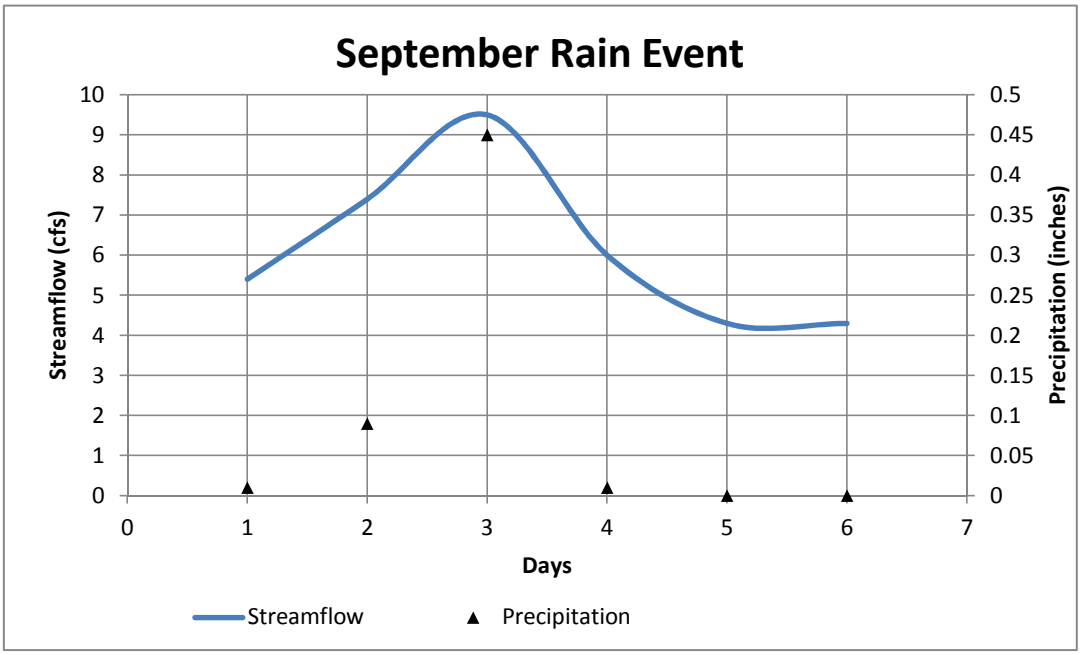

April Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Flowrate
Precipitation

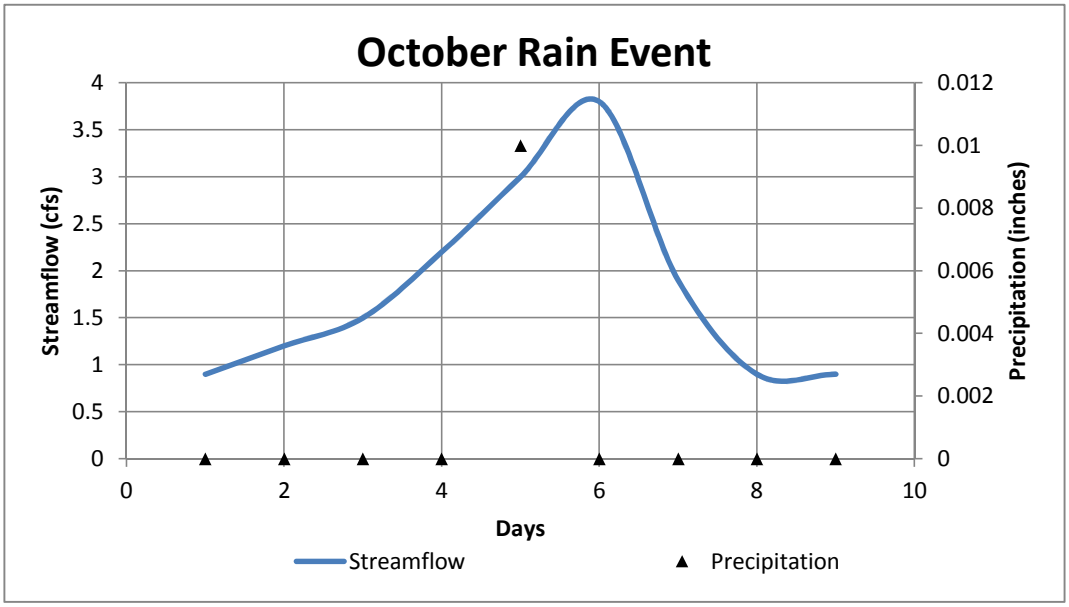

May Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Flowrate
Precipitation

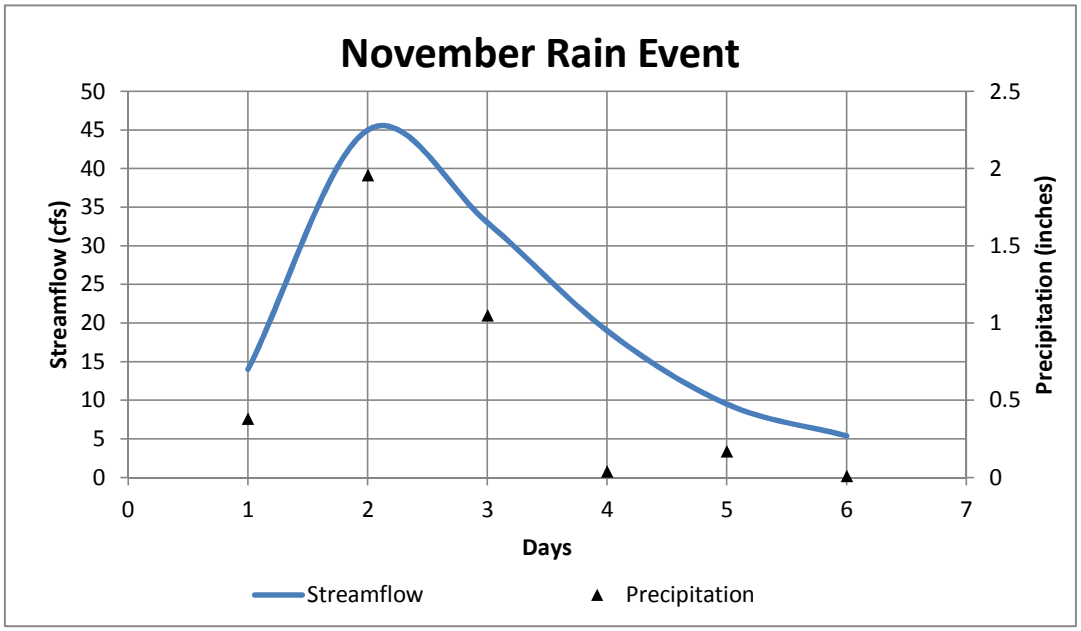

June Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Flowrate
Precipitation

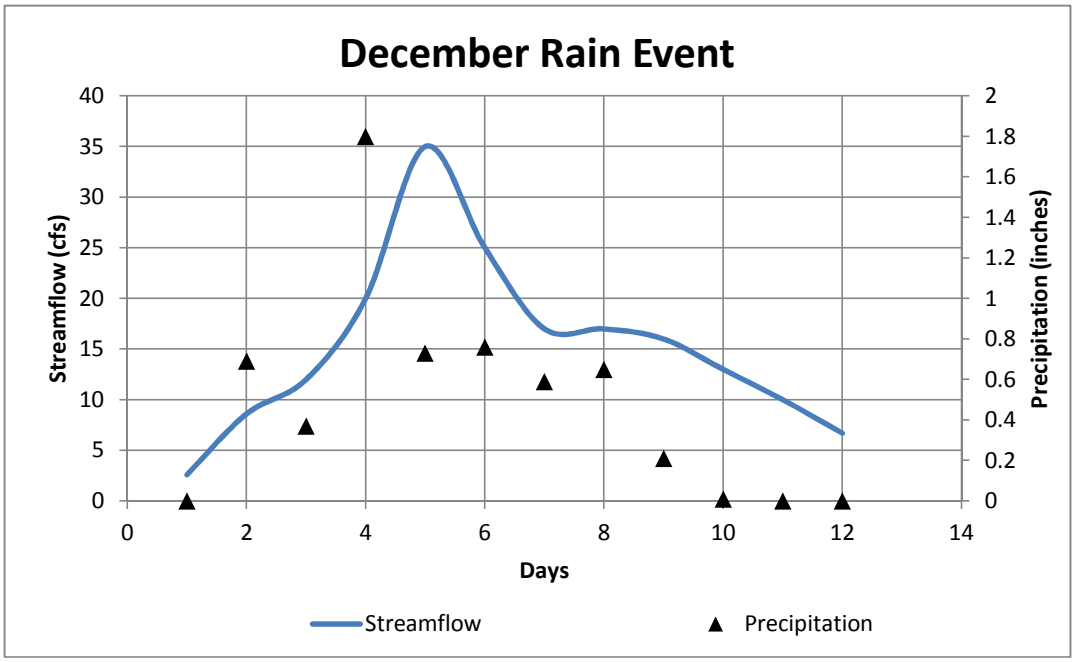

July Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Flowrate
Precipitation


August Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Series2


September Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Precipitation


October Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Precipitation


November Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Precipitation

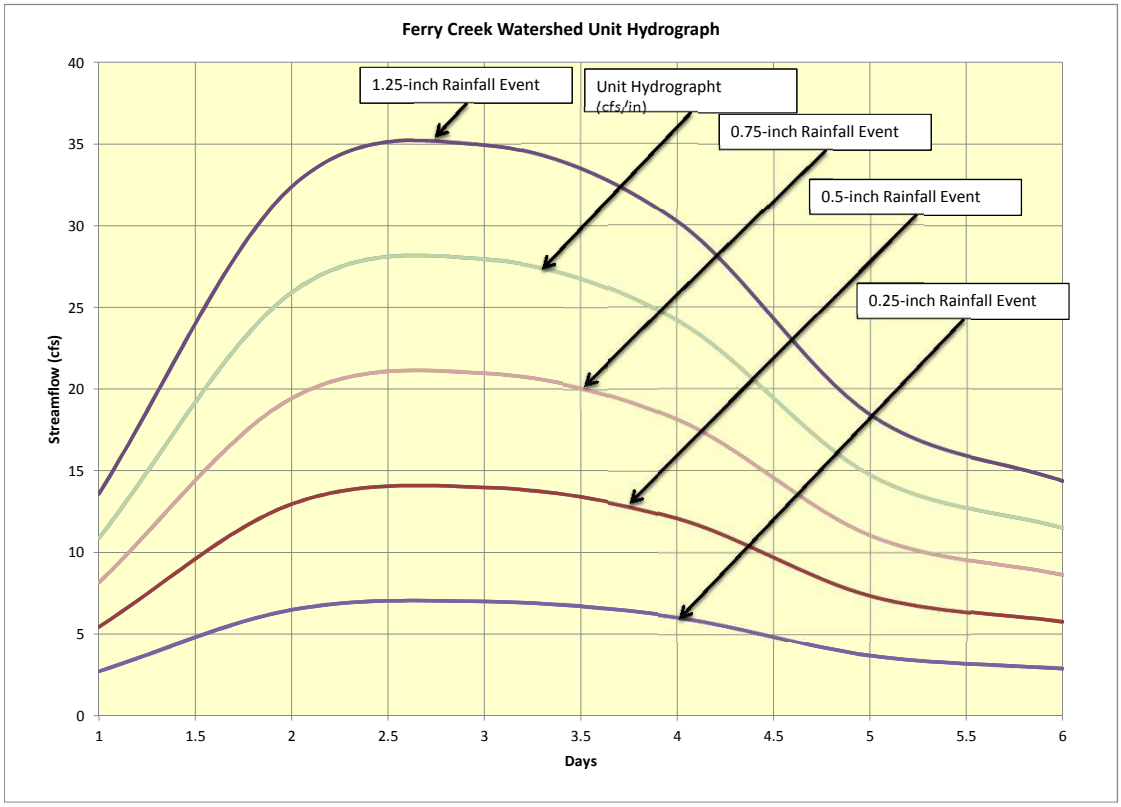

December Rain Event
Streamflow (cfs)
Precipitation (inches)
Days
Streamflow
Precipitation

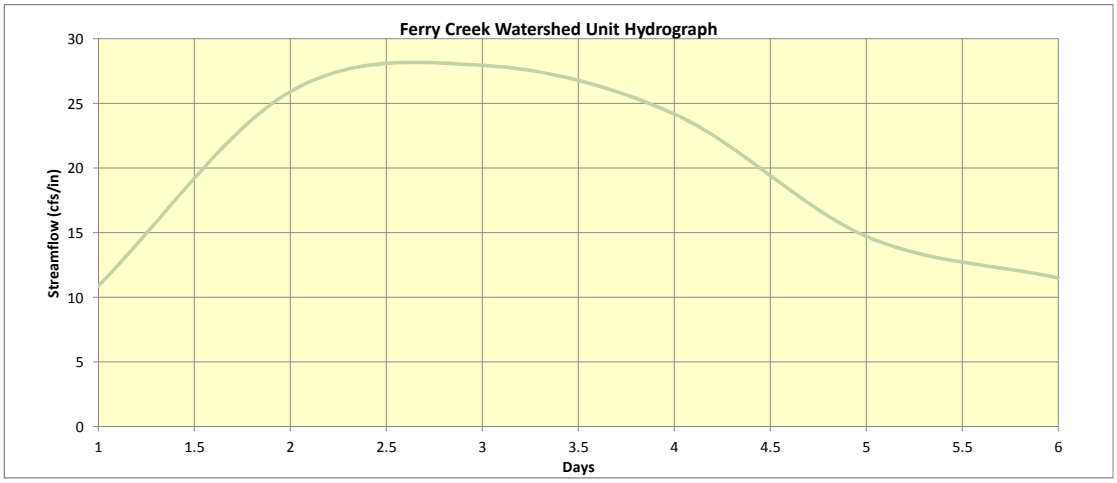
APPENDIX D: **UNIT HYDROGRAPH**

	Average Daily Flow (cfs)	# Days	Volume of excess runoff (cuft)	Unit Hydrograph (cfs/in)
STORM # 1	1.5	1	129600	4.438999572
	18	2	1555200	53.26799486
	6.7	3	578880	19.82753142
	4.8	4	414720	14.20479863
Pave (in)	3.8	5	328320	11.24546558
0.337913977	4.1	6	354240	12.1332655
STORM # 2	5.4	1	466560	16.84654472
	7.4	2	639360	23.08600572
	9.5	3	820800	29.63743978
	6	4	518400	18.71838302
Pave (in)	4.3	5	371520	13.41484116
0.320540508	4.3	6	371520	13.41484116
STORM # 3	1.5	1	129600	12.98323935
	2.2	2	190080	19.04208438
	3	3	259200	25.9664787
	3.8	4	328320	32.89087302
Pave (in)	1.9	5	164160	16.44543651
0.115533571	0.9	6	77760	7.789943609
STORM # 4	14	1	1209600	12.80105463
	45	2	3888000	41.14624702
	33	3	2851200	30.17391448
	19	4	1641600	17.37285985
Pave (in)	9.5	5	820800	8.686429927
1.09365989	5.4	6	466560	4.937549643
STORM # 5	8.6	1	743040	8.41849726
	12	2	1036800	11.74674036
	20	3	1728000	19.5779006
	35	4	3024000	34.26132606
Pave (in)	25	5	2160000	24.47237576
1.021559993	17	6	1468800	16.64121551
STORM # 6	7.4	1	639360	5.779332504
	16	2	1382400	12.49585406
	40	3	3456000	31.23963516
	54	4	4665600	42.17350746
Pave (in)	16	5	1382400	12.49585406
1.280424685	14	6	1209600	10.93387231
STORM # 7	4.8	1	414720	9.07334428
	12	2	1036800	22.6833607
	16	3	1382400	30.24448093
	11	4	950400	20.79308064
Pave (in)	9.7	5	838080	18.33571657
0.529022139	7.4	6	639360	13.98807243
STORM # 8	11	1	950400	14.84523577
	16	2	1382400	21.59307021
	24	3	2073600	32.38960531
	14	4	1209600	18.89393643
Pave (in)	11	5	950400	14.84523577
0.740978464	9.3	6	803520	12.55097206
STORM # 9	9.7	1	838080	10.66518757
	27	2	2332800	29.68660458
	30	3	2592000	32.98511621
	16	4	1382400	17.59206198
Pave (in)	12	5	1036800	13.19404648
0.909501116	10	6	864000	10.99503874
STORM # 10	2	1	172800	12.79089506
	3.8	2	328320	24.30270062
	4.3	3	371520	27.50042438
	3.9	4	336960	24.94224537
Pave (in)	2.2	5	190080	14.06998457
0.156361223	1.8	6	155520	11.51180556

Watershed Area	
2740	ac
1.19E+08	sqft

# Days	Unit Hydrograph (cfs/in)	0.25 Inch Rainfall Eve (cfs)	0.5 Inch Event Hydrograph (cfs)	0.75 Inch Event Hydrograph (cfs)	1.25 Inch Event Hydrograph (cfs)
1	10.9	2.7	5.4	8.1	13.6
2	25.9	6.5	13.0	19.4	32.4
3	28.0	7.0	14.0	21.0	34.9
4	24.2	6.0	12.1	18.1	30.2
5	14.7	3.7	7.4	11.0	18.4
6	11.5	2.9	5.7	8.6	14.4





APPENDIX E: **RATING CURVE**

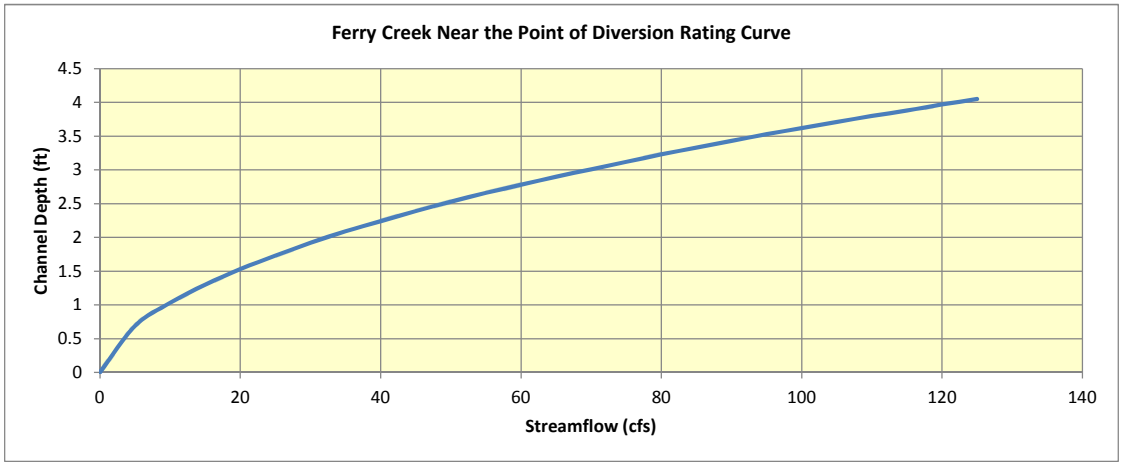
Description - The Mannings equation for trapazoidal open channel flow was used for this analysis

INPUT

Description	Value
Roughness Coefficient	0.02
Left Side Slope (H:V)	1.0
Right Side Slope (H:V)	1.0
Bottom Width (H:V) ft	4.0
Channel Slope (ft/ft)	0.005

OUTPUT

Streamflow (cfs)	Normal Depth (ft)	Velocity (ft/sec)	Flow Area (sqft)	Wetted Perimeter (ft)	Top Width (ft)
0	0	0	0	0	0
5	0.69	1.6	3.22	5.9	5.4
10	1.03	1.9	5.19	6.9	6.1
15	1.30	2.2	6.9	7.7	6.6
20	1.53	2.4	8.47	8.3	7.1
25	1.73	2.5	9.94	8.9	7.5
30	1.92	2.6	11.35	9.4	7.8
35	2.09	2.8	12.7	9.9	8.2
40	2.24	2.9	14	10.3	8.5
45	2.39	3.0	15.26	10.8	8.8
50	2.53	3.0	16.49	11.2	9.1
55	2.66	3.1	17.69	11.5	9.3
60	2.78	3.2	18.87	11.9	9.6
65	2.90	3.3	20.02	12.2	9.8
70	3.01	3.3	21.15	12.5	10.0
75	3.12	3.4	22.26	12.8	10.3
80	3.23	3.4	23.35	13.1	10.5
85	3.33	3.5	24.42	13.4	10.7
90	3.43	3.5	25.48	13.7	10.9
95	3.53	3.6	26.53	14.0	11.1
100	3.62	3.6	27.57	14.2	11.2
105	3.71	3.7	28.59	14.5	11.4
110	3.80	3.7	29.6	14.7	11.6
115	3.88	3.8	30.6	15.0	11.8
120	3.97	3.8	31.58	15.2	11.9
125	4.05	3.8	32.56	15.5	12.1



APPENDIX F: **DIVERSION SCHEDULE**

Date	Daily Average Ferry Creek Flow (cfs)	Daily Average Municipal Demand Flow (cfs)	Daily Diversion Off Channel Reservoir Flow (cfs)	Streamflow Augmentation Raw Water Release Flow (cfs)	Volume of Off Channel Reservor (ac-ft)
1-Jan	6.6375	0.66735	0.00000	0.08167	0.00000
2-Jan	6.275	0.66735	0.00000	0.19434	0.00000
3-Jan	7.2	0.66735	0.00000	0.19434	0.00000
4-Jan	7.5375	0.66735	0.00000	0.19434	0.00000
5-Jan	13.8375	0.66735	0.93265	0.00000	1.84989
6-Jan	9.8125	0.66735	0.00000	0.19434	1.46442
7-Jan	7.15	0.66735	0.00000	0.19434	1.07895
8-Jan	9.725	0.66735	0.00000	0.19434	0.69348
9-Jan	27.875	0.66735	0.93265	0.00000	2.54337
10-Jan	16.925	0.66735	0.93265	0.00000	4.39325
11-Jan	21.4875	0.66735	0.93265	0.00000	6.24314
12-Jan	14.625	0.66735	0.93265	0.00000	8.09303
13-Jan	22.825	0.66735	0.93265	0.00000	9.94291
14-Jan	20.5875	0.66735	0.93265	0.00000	11.79280
15-Jan	13.3125	0.66735	0.93265	0.00000	13.64269
16-Jan	15.1125	0.66735	0.93265	0.00000	15.49257
17-Jan	11.025	0.66735	0.93265	0.00000	17.34246
18-Jan	9.725	0.66735	0.00000	0.19434	16.95699
19-Jan	9.3875	0.66735	0.00000	0.19434	16.57152
20-Jan	15.05	0.66735	0.93265	0.00000	18.42141
21-Jan	9.6875	0.66735	0.00000	0.19434	18.03594
22-Jan	10.225	0.66735	0.93265	0.00000	19.88583
23-Jan	17.9875	0.66735	0.93265	0.00000	21.73571
24-Jan	13.5375	0.66735	0.93265	0.00000	23.58560
25-Jan	9.5875	0.66735	0.00000	0.19434	23.20013
26-Jan	9.7875	0.66735	0.00000	0.19434	22.81466
27-Jan	15.825	0.66735	0.93265	0.00000	24.66455
28-Jan	14.3125	0.66735	0.93265	0.00000	26.51443
29-Jan	10.4625	0.66735	0.93265	0.00000	28.36432
30-Jan	9.4	0.66735	0.00000	0.19434	27.97885
31-Jan	11.0875	0.66735	0.93265	0.00000	29.82874
1-Feb	14.4375	0.63856	0.96144	0.00000	31.73572
2-Feb	12.825	0.63856	0.96144	0.00000	33.64271
3-Feb	13.0875	0.63856	0.96144	0.00000	35.54969
4-Feb	8.4875	0.63856	0.00000	0.19434	35.16422
5-Feb	9.65	0.63856	0.00000	0.19434	34.77875
6-Feb	10.65	0.63856	0.96144	0.00000	36.68574
7-Feb	14.425	0.63856	0.96144	0.00000	38.59272
8-Feb	15.5375	0.63856	0.96144	0.00000	40.49970
9-Feb	18.0375	0.63856	0.96144	0.00000	42.40669
10-Feb	14.15	0.63856	0.96144	0.00000	44.31367
11-Feb	11.1	0.63856	0.96144	0.00000	46.22066
12-Feb	9.7375	0.63856	0.00000	0.19434	45.83519
13-Feb	12.4	0.63856	0.96144	0.00000	47.74217
14-Feb	13.15	0.63856	0.96144	0.00000	49.64916
15-Feb	10.7375	0.63856	0.96144	0.00000	51.55614
16-Feb	12.5375	0.63856	0.96144	0.00000	53.46312
17-Feb	22.125	0.63856	0.96144	0.00000	55.37011
18-Feb	24.675	0.63856	0.96144	0.00000	57.27709
19-Feb	20.55	0.63856	0.96144	0.00000	59.18407
20-Feb	20.7	0.63856	0.96144	0.00000	61.09106
21-Feb	17.375	0.63856	0.96144	0.00000	62.99804
22-Feb	16.4125	0.63856	0.96144	0.00000	64.90502
23-Feb	19.0125	0.63856	0.96144	0.00000	66.81201
24-Feb	14.1625	0.63856	0.96144	0.00000	68.71899
25-Feb	12.0375	0.63856	0.96144	0.00000	70.62598
26-Feb	11.8125	0.63856	0.96144	0.00000	72.53296
27-Feb	11.8875	0.63856	0.96144	0.00000	74.43994
28-Feb	15.175	0.63856	0.96144	0.00000	76.34693
29-Feb	10.15	0.63856	0.96144	0.00000	78.25391
1-Mar	9.0625	0.73121	0.00000	0.19434	77.86844
2-Mar	12.2625	0.73121	0.86879	0.00000	79.59165
3-Mar	15.8	0.73121	0.86879	0.00000	81.31487
4-Mar	14.0375	0.73121	0.86879	0.00000	83.03808
5-Mar	9.0625	0.73121	0.00000	0.19434	82.65261

Date	Daily Average Ferry Creek Flow (cfs)	Daily Average Municipal Demand Flow (cfs)	Daily Diversion Off Channel Reservoir Flow (cfs)	Streamflow Augmentation Raw Water Release Flow (cfs)	Volume of Off Channel Reservor (ac-ft)
6-Mar	8.7375	0.73121	0.00000	0.19434	82.26714
7-Mar	9.2	0.73121	0.00000	0.19434	81.88167
8-Mar	12.1	0.73121	0.86879	0.00000	83.60489
9-Mar	11.3875	0.73121	0.86879	0.00000	85.32810
10-Mar	11.5125	0.73121	0.86879	0.00000	87.05131
11-Mar	9.325	0.73121	0.00000	0.19434	86.66584
12-Mar	10.5	0.73121	0.86879	0.00000	88.38906
13-Mar	15.625	0.73121	0.86879	0.00000	90.11227
14-Mar	12.475	0.73121	0.86879	0.00000	91.83548
15-Mar	10.8125	0.73121	0.86879	0.00000	93.55869
16-Mar	9.3625	0.73121	0.00000	0.19434	93.17322
17-Mar	10.125	0.73121	0.86879	0.00000	94.89644
18-Mar	8.725	0.73121	0.00000	0.19434	94.51097
19-Mar	10.0875	0.73121	0.86879	0.00000	96.23418
20-Mar	11.2375	0.73121	0.86879	0.00000	97.95739
21-Mar	14.1	0.73121	0.86879	0.00000	99.68061
22-Mar	11.7625	0.73121	0.86879	0.00000	100.00000
23-Mar	9.8	0.73121	0.00000	0.19434	100.00000
24-Mar	9.35	0.73121	0.00000	0.19434	100.00000
25-Mar	9.5375	0.73121	0.00000	0.19434	100.00000
26-Mar	10.325	0.73121	0.86879	0.00000	100.00000
27-Mar	9.0875	0.73121	0.00000	0.19434	100.00000
28-Mar	8.1875	0.73121	0.00000	0.19434	100.00000
29-Mar	8	0.73121	0.00000	0.19434	100.00000
30-Mar	9.8625	0.73121	0.00000	0.19434	100.00000
31-Mar	10.0875	0.73121	0.86879	0.00000	100.00000
1-Apr	9.675	0.71261	0.00000	0.19434	100.00000
2-Apr	7.925	0.71261	0.00000	0.19434	100.00000
3-Apr	8.275	0.71261	0.00000	0.19434	100.00000
4-Apr	9.5125	0.71261	0.00000	0.19434	100.00000
5-Apr	10.4	0.71261	0.88739	0.00000	100.00000
6-Apr	8.7625	0.71261	0.00000	0.19434	100.00000
7-Apr	9.8	0.71261	0.00000	0.19434	100.00000
8-Apr	11.875	0.71261	0.00000	0.00000	100.00000
9-Apr	9.575	0.71261	0.00000	0.19434	100.00000
10-Apr	9.9125	0.71261	0.00000	0.19434	100.00000
11-Apr	11.3125	0.71261	0.88739	0.00000	100.00000
12-Apr	11.25	0.71261	0.88739	0.00000	100.00000
13-Apr	11.2125	0.71261	0.88739	0.00000	100.00000
14-Apr	11.4625	0.71261	0.88739	0.00000	100.00000
15-Apr	11.25	0.71261	0.88739	0.00000	100.00000
16-Apr	11.825	0.71261	0.88739	0.00000	100.00000
17-Apr	12.2625	0.71261	0.88739	0.00000	100.00000
18-Apr	15.5875	0.71261	0.88739	0.00000	100.00000
19-Apr	19.6875	0.71261	0.88739	0.00000	100.00000
20-Apr	15.4875	0.71261	0.88739	0.00000	100.00000
21-Apr	11.5625	0.71261	0.88739	0.00000	100.00000
22-Apr	11.2875	0.71261	0.88739	0.00000	100.00000
23-Apr	11.025	0.71261	0.88739	0.00000	100.00000
24-Apr	8.725	0.71261	0.00000	0.19434	100.00000
25-Apr	7.75	0.71261	0.00000	0.19434	100.00000
26-Apr	7.5125	0.71261	0.00000	0.19434	100.00000
27-Apr	7.4	0.71261	0.00000	0.19434	100.00000
28-Apr	8.2375	0.71261	0.00000	0.19434	100.00000
29-Apr	7.15	0.71261	0.00000	0.19434	100.00000
30-Apr	11.31428571	0.71261	0.88739	0.00000	100.00000
1-May	9.985714286	0.86491	0.00000	0.19434	100.00000
2-May	8.3	0.86491	0.00000	0.19434	100.00000
3-May	7.971428571	0.86491	0.00000	0.19434	100.00000
4-May	9.571428571	0.86491	0.00000	0.19434	100.00000
5-May	8.428571429	0.86491	0.00000	0.19434	100.00000
6-May	9.585714286	0.86491	0.00000	0.19434	100.00000
7-May	10.67142857	0.86491	0.00000	0.00000	100.00000
8-May	8.8	0.86491	0.00000	0.19434	100.00000
9-May	7.785714286	0.86491	0.00000	0.19434	100.00000
10-May	7.928571429	0.86491	0.00000	0.19434	100.00000
11-May	7.514285714	0.86491	0.00000	0.19434	100.00000

Date	Daily Average Ferry Creek Flow (cfs)	Daily Average Municipal Demand Flow (cfs)	Daily Diversion Off Channel Reservoir Flow (cfs)	Streamflow Augmentation Raw Water Release Flow (cfs)	Volume of Off Channel Reservor (ac-ft)
12-May	7.271428571	0.86491	0.00000	0.19434	100.00000
13-May	14.41428571	0.86491	0.00000	0.00000	100.00000
14-May	16.01428571	0.86491	0.00000	0.00000	100.00000
15-May	10.71428571	0.86491	0.00000	0.00000	100.00000
16-May	14.22857143	0.86491	0.00000	0.00000	100.00000
17-May	12.95714286	0.86491	0.00000	0.00000	100.00000
18-May	9.857142857	0.86491	0.00000	0.19434	100.00000
19-May	7.614285714	0.86491	0.00000	0.19434	100.00000
20-May	9.642857143	0.86491	0.00000	0.19434	100.00000
21-May	8.9	0.86491	0.00000	0.19434	100.00000
22-May	7.642857143	0.86491	0.00000	0.19434	100.00000
23-May	7.942857143	0.86491	0.00000	0.19434	100.00000
24-May	8.142857143	0.86491	0.00000	0.19434	100.00000
25-May	6.928571429	0.86491	0.00000	0.19434	100.00000
26-May	6.6	0.86491	0.00000	0.19434	100.00000
27-May	6.428571429	0.86491	0.00000	0.19434	100.00000
28-May	5.842857143	0.86491	0.00000	0.19434	100.00000
29-May	5.385714286	0.86491	0.00000	0.19434	100.00000
30-May	5.357142857	0.86491	0.00000	0.19434	100.00000
31-May	5.025	0.86491	0.00000	0.19434	100.00000
1-Jun	5.325	1.07054	0.00000	0.19434	100.00000
2-Jun	5.75	1.07054	0.00000	0.19434	100.00000
3-Jun	5.5875	1.07054	0.00000	0.19434	100.00000
4-Jun	5.1625	1.07054	0.00000	0.19434	100.00000
5-Jun	5.15	1.07054	0.00000	0.19434	100.00000
6-Jun	5.125	1.07054	0.00000	0.19434	100.00000
7-Jun	5.2125	1.07054	0.00000	0.19434	100.00000
8-Jun	5.05	1.07054	0.00000	0.19434	100.00000
9-Jun	5.7	1.07054	0.00000	0.19434	100.00000
10-Jun	5.1875	1.07054	0.00000	0.19434	100.00000
11-Jun	5.2875	1.07054	0.00000	0.19434	100.00000
12-Jun	5.7625	1.07054	0.00000	0.19434	100.00000
13-Jun	6.3125	1.07054	0.00000	0.19434	100.00000
14-Jun	6.0625	1.07054	0.00000	0.19434	100.00000
15-Jun	5.5125	1.07054	0.00000	0.19434	100.00000
16-Jun	6.15	1.07054	0.00000	0.19434	100.00000
17-Jun	5.8625	1.07054	0.00000	0.19434	100.00000
18-Jun	5.8875	1.07054	0.00000	0.19434	100.00000
19-Jun	5.25	1.07054	0.00000	0.19434	100.00000
20-Jun	5.1125	1.07054	0.00000	0.19434	100.00000
21-Jun	5.075	1.07054	0.00000	0.19434	100.00000
22-Jun	4.975	1.07054	0.00000	0.19434	100.00000
23-Jun	4.7875	1.07054	0.00000	0.19434	100.00000
24-Jun	4.6375	1.07054	0.00000	0.19434	100.00000
25-Jun	4.7625	1.07054	0.00000	0.19434	100.00000
26-Jun	4.35	1.07054	0.00000	0.19434	100.00000
27-Jun	4.2	1.07054	0.00000	0.19434	100.00000
28-Jun	4.1625	1.07054	0.00000	0.19434	100.00000
29-Jun	4.3875	1.07054	0.00000	0.19434	100.00000
30-Jun	4.45	1.07054	0.00000	0.19434	100.00000
1-Jul	4.25	1.30804	0.00000	0.19434	100.00000
2-Jul	4.3625	1.30804	0.00000	0.19434	100.00000
3-Jul	4	1.30804	0.00000	0.19434	100.00000
4-Jul	4.0875	1.30804	0.00000	0.19434	100.00000
5-Jul	3.9	1.30804	0.00000	0.19434	100.00000
6-Jul	4.05	1.30804	0.00000	0.19434	99.64354
7-Jul	4.0875	1.30804	0.00000	0.19434	99.25807
8-Jul	4.075	1.30804	0.00000	0.19434	98.87261
9-Jul	4.5	1.30804	0.00000	0.19434	98.48714
10-Jul	3.8	1.30804	0.00000	0.19434	98.10167
11-Jul	3.8125	1.30804	0.00000	0.19434	97.71620
12-Jul	3.5	1.30804	0.00000	0.19434	97.33073
13-Jul	3.425	1.30804	0.00000	0.19434	96.94527
14-Jul	3.7375	1.30804	0.00000	0.19434	96.55980
15-Jul	3.9625	1.30804	0.00000	0.19434	96.17433
16-Jul	3.875	1.30804	0.00000	0.19434	95.78886
17-Jul	3.575	1.30804	0.00000	0.19434	95.40339

Date	Daily Average Ferry Creek Flow (cfs)	Daily Average Municipal Demand Flow (cfs)	Daily Diversion Off Channel Reservoir Flow (cfs)	Streamflow Augmentation Raw Water Release Flow (cfs)	Volume of Off Channel Reservor (ac-ft)
18-Jul	3.4125	1.30804	0.00000	0.19434	95.01793
19-Jul	3.45	1.30804	0.00000	0.19434	94.63246
20-Jul	3.5375	1.30804	0.00000	0.19434	94.24699
21-Jul	3.5625	1.30804	0.00000	0.19434	93.86152
22-Jul	3.5625	1.30804	0.00000	0.19434	93.47605
23-Jul	3.35	1.30804	0.00000	0.19434	93.09059
24-Jul	3.225	1.30804	0.00000	0.19434	92.70512
25-Jul	3.275	1.30804	0.00000	0.19434	92.31965
26-Jul	3.2125	1.30804	0.00000	0.19434	91.93418
27-Jul	3.1125	1.30804	0.00000	0.19434	91.54871
28-Jul	3.2375	1.30804	0.00000	0.19434	91.16324
29-Jul	3.1	1.30804	0.00000	0.19434	90.77778
30-Jul	3.25	1.30804	0.00000	0.19434	90.39231
31-Jul	3.0375	1.30804	0.00000	0.19434	90.00684
1-Aug	3.05	1.26964	0.00000	0.19434	89.62137
2-Aug	3.1125	1.26964	0.00000	0.19434	89.23590
3-Aug	3.225	1.26964	0.00000	0.19434	88.85044
4-Aug	2.9875	1.26964	0.00000	0.19434	88.46497
5-Aug	2.8625	1.26964	0.00000	0.19434	88.07950
6-Aug	3.125	1.26964	0.00000	0.19434	87.69403
7-Aug	2.95	1.26964	0.00000	0.19434	87.30856
8-Aug	3.0125	1.26964	0.00000	0.19434	86.92310
9-Aug	3.1625	1.26964	0.00000	0.19434	86.53763
10-Aug	3.15	1.26964	0.00000	0.19434	86.15216
11-Aug	2.9875	1.26964	0.00000	0.19434	85.76669
12-Aug	2.925	1.26964	0.00000	0.19434	85.38122
13-Aug	3.05	1.26964	0.00000	0.19434	84.99576
14-Aug	3.05	1.26964	0.00000	0.19434	84.61029
15-Aug	2.8125	1.26964	0.00000	0.19434	84.22482
16-Aug	2.9875	1.26964	0.00000	0.19434	83.83935
17-Aug	2.875	1.26964	0.00000	0.19434	83.45388
18-Aug	2.9375	1.26964	0.00000	0.19434	83.06842
19-Aug	3.05	1.26964	0.00000	0.19434	82.68295
20-Aug	3.425	1.26964	0.00000	0.19434	82.29748
21-Aug	3.35	1.26964	0.00000	0.19434	81.91201
22-Aug	3.1375	1.26964	0.00000	0.19434	81.52654
23-Aug	5.875	1.26964	0.00000	0.19434	81.14108
24-Aug	4.2125	1.26964	0.00000	0.19434	80.75561
25-Aug	3.4	1.26964	0.00000	0.19434	80.37014
26-Aug	3.0625	1.26964	0.00000	0.19434	79.98467
27-Aug	3.325	1.26964	0.00000	0.19434	79.59920
28-Aug	3.225	1.26964	0.00000	0.19434	79.21373
29-Aug	3.0625	1.26964	0.00000	0.19434	78.82827
30-Aug	2.9125	1.26964	0.00000	0.19434	78.44280
31-Aug	3.325	1.26964	0.00000	0.19434	78.05733
1-Sep	4.2875	1.04531	0.00000	0.19434	77.67186
2-Sep	4.3875	1.04531	0.00000	0.19434	77.28639
3-Sep	4.55	1.04531	0.00000	0.19434	76.90093
4-Sep	3.925	1.04531	0.00000	0.19434	76.51546
5-Sep	3.5625	1.04531	0.00000	0.19434	76.12999
6-Sep	3.1125	1.04531	0.00000	0.19434	75.74452
7-Sep	3.4375	1.04531	0.00000	0.19434	75.35905
8-Sep	4.4625	1.04531	0.00000	0.19434	74.97359
9-Sep	4.275	1.04531	0.00000	0.19434	74.58812
10-Sep	3.8375	1.04531	0.00000	0.19434	74.20265
11-Sep	4.075	1.04531	0.00000	0.19434	73.81718
12-Sep	4.2125	1.04531	0.00000	0.19434	73.43171
13-Sep	4.25	1.04531	0.00000	0.19434	73.04625
14-Sep	4.175	1.04531	0.00000	0.19434	72.66078
15-Sep	3.925	1.04531	0.00000	0.19434	72.27531
16-Sep	4.1125	1.04531	0.00000	0.19434	71.88984
17-Sep	4.9	1.04531	0.00000	0.19434	71.50437
18-Sep	5.4125	1.04531	0.00000	0.19434	71.11891
19-Sep	4.8875	1.04531	0.00000	0.19434	70.73344
20-Sep	4.45	1.04531	0.00000	0.19434	70.34797
21-Sep	4.3	1.04531	0.00000	0.19434	69.96250
22-Sep	4.275	1.04531	0.00000	0.19434	69.57703

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23-Sep	4.35	1.04531	0.00000	0.19434	69.19157
24-Sep	3.675	1.04531	0.00000	0.19434	68.80610
25-Sep	3.3625	1.04531	0.00000	0.19434	68.42063
26-Sep	4.5875	1.04531	0.00000	0.19434	68.03516
27-Sep	4.9625	1.04531	0.00000	0.19434	67.64969
28-Sep	4.9125	1.04531	0.00000	0.19434	67.26422
29-Sep	3.8625	1.04531	0.00000	0.19434	66.87876
30-Sep	3.385714286	1.04531	0.00000	0.19434	66.49329
1-Oct	3.728571429	0.85528	0.00000	0.19434	66.10782
2-Oct	3.357142857	0.85528	0.00000	0.19434	65.72235
3-Oct	2.374285714	0.85528	0.00000	0.19434	65.33688
4-Oct	1.96	0.85528	0.00000	0.19434	64.95142
5-Oct	3.442857143	0.85528	0.00000	0.19434	64.56595
6-Oct	3.2	0.85528	0.00000	0.19434	64.18048
7-Oct	2.757142857	0.85528	0.00000	0.19434	63.79501
8-Oct	3.371428571	0.85528	0.00000	0.19434	63.40954
9-Oct	3.271428571	0.85528	0.00000	0.19434	63.02408
10-Oct	5.728571429	0.85528	0.00000	0.19434	62.63861
11-Oct	3.285714286	0.85528	0.00000	0.19434	62.25314
12-Oct	3.142857143	0.85528	0.00000	0.19434	61.86767
13-Oct	3.271428571	0.85528	0.00000	0.19434	61.48220
14-Oct	3.328571429	0.85528	0.00000	0.19434	61.09674
15-Oct	3.114285714	0.85528	0.00000	0.19434	60.71127
16-Oct	2.814285714	0.85528	0.00000	0.19434	60.32580
17-Oct	2.814285714	0.85528	0.00000	0.19434	59.94033
18-Oct	3.028571429	0.85528	0.00000	0.19434	59.55486
19-Oct	3.428571429	0.85528	0.00000	0.19434	59.16940
20-Oct	3.4	0.85528	0.00000	0.19434	58.78393
21-Oct	3.271428571	0.85528	0.00000	0.19434	58.39846
22-Oct	4.242857143	0.85528	0.00000	0.19434	58.01299
23-Oct	4.157142857	0.85528	0.00000	0.19434	57.62752
24-Oct	5.428571429	0.85528	0.00000	0.19434	57.24205
25-Oct	5.3	0.85528	0.00000	0.19434	56.85659
26-Oct	6.071428571	0.85528	0.00000	0.19434	56.47112
27-Oct	5.728571429	0.85528	0.00000	0.19434	56.08565
28-Oct	6	0.85528	0.00000	0.19434	55.70018
29-Oct	5.542857143	0.85528	0.00000	0.19434	55.31471
30-Oct	4.857142857	0.85528	0.00000	0.19434	54.92925

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31-Oct	5.942857143	0.85528	0.00000	0.19434	54.54378
1-Nov	5.428571429	0.63854	0.00000	0.19434	54.15831
2-Nov	4.714285714	0.63854	0.00000	0.19434	53.77284
3-Nov	5.914285714	0.63854	0.00000	0.19434	53.38737
4-Nov	6.771428571	0.63854	0.00000	0.19434	53.00191
5-Nov	6.6	0.63854	0.00000	0.19434	52.61644
6-Nov	6.785714286	0.63854	0.00000	0.19434	52.23097
7-Nov	6.771428571	0.63854	0.00000	0.19434	51.84550
8-Nov	10.15714286	0.63854	0.00000	0.00000	51.84550
9-Nov	5.414285714	0.63854	0.00000	0.19434	51.46003
10-Nov	9.6	0.63854	0.00000	0.19434	51.07457
11-Nov	11.42857143	0.63854	0.00000	0.00000	51.07457
12-Nov	9.128571429	0.63854	0.00000	0.19434	50.68910
13-Nov	7.528571429	0.63854	0.00000	0.19434	50.30363
14-Nov	7.271428571	0.63854	0.00000	0.19434	49.91816
15-Nov	8.528571429	0.63854	0.00000	0.19434	49.53269
16-Nov	10.67142857	0.63854	0.00000	0.00000	49.53269
17-Nov	8.085714286	0.63854	0.00000	0.19434	49.14723
18-Nov	8.614285714	0.63854	0.00000	0.19434	48.76176
19-Nov	7.757142857	0.63854	0.00000	0.19434	48.37629
20-Nov	9.257142857	0.63854	0.00000	0.19434	47.99082
21-Nov	12.58571429	0.63854	0.00000	0.00000	47.99082
22-Nov	12.37142857	0.63854	0.00000	0.00000	47.99082
23-Nov	18.54285714	0.63854	0.00000	0.00000	47.99082
24-Nov	16.34285714	0.63854	0.00000	0.00000	47.99082
25-Nov	11.44285714	0.63854	0.00000	0.00000	47.99082
26-Nov	7.614285714	0.63854	0.00000	0.19434	47.60535
27-Nov	6.871428571	0.63854	0.00000	0.19434	47.21989
28-Nov	9.785714286	0.63854	0.00000	0.19434	46.83442
29-Nov	12.81428571	0.63854	0.00000	0.00000	46.83442
30-Nov	17.2875	0.63854	0.00000	0.00000	46.83442
1-Dec	19.075	0.66069	0.93931	0.00000	48.69751
2-Dec	23.0375	0.66069	0.93931	0.00000	50.56060
3-Dec	22.9125	0.66069	0.93931	0.00000	52.42369
4-Dec	14.18571429	0.66069	0.93931	0.00000	54.28679
5-Dec	9.771428571	0.66069	0.00000	0.19434	53.90132
6-Dec	9.228571429	0.66069	0.00000	0.19434	53.51585
7-Dec	8.685714286	0.66069	0.00000	0.19434	53.13038
8-Dec	7.714285714	0.66069	0.00000	0.19434	52.74491
9-Dec	17.81428571	0.66069	0.93931	0.00000	54.60801
10-Dec	26.12857143	0.66069	0.93931	0.00000	56.47110
11-Dec	19.77142857	0.66069	0.93931	0.00000	58.33419
12-Dec	12.54285714	0.66069	0.93931	0.00000	60.19729
13-Dec	15.24285714	0.66069	0.93931	0.00000	62.06038
14-Dec	12.7	0.66069	0.93931	0.00000	63.92347
15-Dec	8.857142857	0.66069	0.00000	0.19434	63.53800
16-Dec	9.5	0.66069	0.00000	0.19434	63.15253
17-Dec	10.8	0.66069	0.93931	0.00000	65.01563
18-Dec	8.628571429	0.66069	0.00000	0.19434	64.63016
19-Dec	7.257142857	0.66069	0.00000	0.19434	64.24469
20-Dec	8.628571429	0.66069	0.00000	0.19434	63.85922
21-Dec	7.142857143	0.66069	0.00000	0.19434	63.47375
22-Dec	10.25714286	0.66069	0.93931	0.00000	65.33685
23-Dec	12.02857143	0.66069	0.93931	0.00000	67.19994

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24-Dec	9.257142857	0.66069	0.00000	0.19434	66.81447
25-Dec	7.842857143	0.66069	0.00000	0.19434	66.42900
26-Dec	9.728571429	0.66069	0.00000	0.19434	66.04354
27-Dec	9.885714286	0.66069	0.00000	0.19434	65.65807
28-Dec	13.92857143	0.66069	0.93931	0.00000	67.52116
29-Dec	12.92857143	0.66069	0.93931	0.00000	69.38425
30-Dec	9.514285714	0.66069	0.00000	0.19434	68.99878