Council Business Meeting

February 19, 2019

Agenda Item	10x20 Progress and Findings	
From	Adam Hanks Tom McBartlett	Assistant to the City Administrator Electric Utility Director
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SUMMARY

On November 5, 2018 City staff supplied a Request for Proposals (RFP) for a large scale (10-13 MW) solar generation project to be located on the City owned Imperatrice Property. The intent of the RFP was to solicit and receive current, market-based proposals to assist in determining the cost to the City of the electricity generated as well as a realistic timeline for the completion of the proposed project.

Because of the impact of the City's current wholesale power contract with Bonneville Power Administration (BPA) on the financial viability of the project, it was determined that a meeting with key BPA and City Staff (including Mayor Stromberg) should occur prior to the decision to release the RFP. That meeting occurred on January 11, 2019 and provided confirmation of several key points regarding the "take or pay" provision of the current contract.

This agenda item is intended to elicit direction from Council regarding the existing RFP and to receive direction on other potential desired next steps.

POLICIES, PLANS & GOALS SUPPORTED

Climate and Energy Action Plan Action BE 1-3 – Facilitate and encourage solar energy production
City Council Goal 4.4 – Examine long term use of Imperatrice property
Ordinance 3144 – "10 by 20" Ordinance (Sept 6, 2016)

PREVIOUS COUNCIL ACTION

- Initial draft RFP presented to Council September 17, 2018.
- Updated Final draft RFP presented to Council November 5, 2018

BACKGROUND INFORMATION

The issuance of an RFP was determined to be the next step the in continued effort to meet the requirements of the 10 by 20 ordinance that was approved by Council in September of 2016. This citizen authored Ordinance mandates that the City "cause to produce" ten percent of the community's annual electricity consumption from clean, local and new sources by 2020.

The following 10 by 20 ordinance related agenda items have come before Council since the Ordinance's approval that in combination provide a solid background of the issues and work done to date.

November 15, 2016 – Discussion of policy questions to be addressed regarding the 10 by 20 Ordinance

February 21, 2017 - 10 by 20 Ordinance Project Update

July 17, 2017 – 10 by 20 Status Update

December 18, 2017 – 10 by 20 Ordinance Activity Update

September 17, 2018 – Initial Review of draft RFP

November 5, 2018 – Review of Final Draft RFP (removed from agenda, but materials part of packet)

Several important report/studies have been completed that relate to the project and are in the RFP appendix. These materials have been provided to Council in previous project updates and are available using the meeting links provided above.

1) Solar PV Generation Interconnect Analysis – OS Engineering – January 31, 2017
2) Biological Assessment of the Imperatrice Property – Pacific Crest Consulting LLC – August 2017
3) BPA Take or Pay Response – December 2017
4) Conservation Commission Recommendation on Solar Project at Imperatrice site – December 2017
5) Electric Utility Rate Design Study – Utility Finance Solutions, LLC – May 15, 2018

NEW INFORMATION

Current BPA Contract

The City's Electric Utility has an existing twenty-year wholesale power contract with Bonneville Power Administration which expires in 2028. Customers of BPA fall into one of three categories:

- Load Following – Purchasing all power needs from BPA with load shaping provided as part of the service
- Block – Purchasing a specific estimate amount of annual power (may or may not include load shaping)
- Slice/Block – Purchasing a combination of fixed and variable power, each with different pricing structures

The City of Ashland chose to sign a contract as a Load Following customer. This provides the City with the lowest and most stable wholesale cost for power and also provides for all of the annual load shaping and transmission needs of the Electric Utility. The contract includes a provision called "Take or Pay", meaning the customer (the City) must pay for their calculated load whether they use it or not up to a calculated "rate period high water mark", which is calculated every two years and addresses changes in (Tier 1 system capacity) and power consumption due to growth (increase), energy efficiency and renewables (decrease) and commercial/industrial fluxuations in power needs.

Take or Pay and 10 by 20

In general, the Take or Pay provision means that significant local energy that is either purchased or generated by the City will have its own cost per kWh **and** will still be charged by BPA, in effect causing a surcharge on the locally generated power. This contract structure provides all customers of BPA with a level and equitable distribution of the cost of power in the BPA system. If Take or Pay was not a part of the contract, customers could pick and choose how much BPA power they wanted at any time, leaving the remaining customers to pay for the now higher cost of the remaining power generated.

Importantly, the contract defines the level of local energy generation that becomes subject to the Take or Pay provision. Local generation that is exempt from Take or Pay includes the following:

- Local generation sources in place prior to the contract signing (The City's hydro generation at Reeder Reservoir is a pre-existing customer resource)
- Net metered, electrically independent generating systems of less than 200 kw (over 400 of these solar systems on the City's distribution grid currently)
- One utility scale generation resource with a maximum generation of 1 MW (requires review/approval by BPA as is not specifically permitted in the contract)

BPA Contract Meeting (Jan 11, 2019)

City staff and Mayor Stromberg met with five key senior BPA staff to clarify, clearly understand and request exemption from the Take or Pay provision of the contract. The result was a higher-level understanding of the basic structure and business model that BPA is Congressionally required to operate within and how deviation/exemption from this or other contract provisions would affect BPA and cause concern/opposition from its other 144 wholesale customers.

While take or pay remains a component of the City's contract and continues to impact the financial viability of a large-scale solar project as proposed in the RFP, several important and relevant discoveries and clarifications emerged from this productive meeting, including:

- BPA is able and willing to only charge the City the difference between the City's wholesale purchase price and BPA spot market sale price should the City create local generation that triggers Take or Pay. This slightly reduces the impact of the "sur-charge" when Take or Pay is triggered.
- BPA will begin their process for the development of the post 2028 contracts in late 2019 and is scheduled to have final contracts available for customer review and execution by 2025.
- City staff indicated their desire and willingness to play a meaningful role in the development of the 2028 contracts, which was well received by BPA staff.

FISCAL IMPACTS

Significant staff time has been invested in the 10 by 20 Ordinance implementation efforts since its approval in fall of 2016. Additional costs of approximately $25,000 have been incurred to develop the Interconnection Analysis, the biological assessment and the rate design analysis addendum. The addendum was completed by the City's Cost of Service and Rate Design consultant Utility Financial Solutions LLC and calculated retail kWh rate increases of 15-18 percent across the various customer classes (residential, commercial, gov't, muni, etc.) based on estimated additional purchase and transmission costs associated with the Imperatrice Solar Project.

The RFP was developed by staff with technical City's assistance from a partner agreement with the Bonneville Environmental Foundation (BEF) at no additional cost to the City. BEF continues to provide technical assistance and guidance as needed. OS Engineering, the City's contract Electrical Systems Engineering consultant, is available under the existing financial terms of the contract for future technical assistance as needed.

STAFF RECOMMENDATION

With formal clarity of the impact of the Take or Pay provision of the existing BPA contract, staff is requesting Council direction on the immediate future of the draft project RFP, as well as more broad direction of future focus in meeting the ordinance. To assist Council in providing this staff direction, staff suggests that a Study Session be held in the near future to present options to clearly define 10 by 20 objectives and move forward on projects that; 1) meet those objectives; 2) do not trigger the Take or Pay provision of the existing BPA contract; and 3) also align with and/or compliment other Council goals and objectives.

ACTIONS, OPTIONS & POTENTIAL MOTIONS

No motion is needed at this time, only direction as summarized in the staff recommendation

REFERENCES & ATTACHMENTS

Attachment 1: Final Draft RFP – Solar Project at Imperatrice Property
10 by 20 Ordinance Complete Summary Booklet

Request for Proposals
City of Ashland
Ashland SOLAR RFP
Issued:
Due Date:

Ashland Municipal Electric Utility
90 N Mountain Ave
Ashland, OR 97520

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I. INTRODUCTION

A. CITY OVERVIEW

The City of Ashland Municipal Electric Utility ("Ashland" or the "City") is the second oldest Municipal Utility in Oregon. With Ashland's publicly owned utility, citizens control the policy making and operations of the utility directly through its elected officials. This assures local control and accountability. Ashland is interested in diversifying its generation portfolio while meeting certain energy resource goals set forth by Ordinance #3134, locally referred to as the "10 by 20" Ordinance. It is with these goals in mind that the City is issuing the "Ashland Solar Park RFP" to procure via power purchase agreement (PPA) the equivalent to approximately 13MW DC capacity of solar photovoltaic resource. The solar capacity to be developed and sold to Ashland will be referred to as "the Project".

II. GENERAL INFORMATION

A. RFP SCHEDULE

Event	Target Schedule
Issue RFP	November 12, 2018
Bidders Questions Due	December 7, 2018
Confirmation of Intention to Submit a Proposal	December 21, 2018
Proposals Due	January 11, 2019
Interviews	TBD–No earlier than January 22, 2019
Selection	TBD
Execution of Contract	TBD
Project Commercial Operation, no later than	December 31, 2020

B. COMMUNICATIONS

All communications from companies responding to this RFP ("Bidders"), including questions pertaining to this RFP, must be submitted via email. Ashland will respond to Bidders via email, or conference call. All submittals, questions, and communications shall be conducted through the following single point of contact:

Adam Hanks
Assistant to the City Administrator
City of Ashland
Email: adam.hanks@ashland.or.us
Phone: 541-552-2046

C. ELIGIBILITY REQUIREMENTS FOR RESPONDENTS

1. INSURANCE REQUIREMENTS
   Bidder will complete the Bidder's Insurance Proposal document provided in the RFP appendix

2. FINANCIAL INFORMATION AND CREDIT REQUIREMENTS
   Bidder will complete the Bidder's Credit Information document provided in the RFP appendix

D. RESERVATION OF RIGHTS AND DISCLAIMERS

Ashland has prepared the information provided in this RFP to assist interested persons and entities in making a decision whether to respond with a proposal. Ashland reserves the right to modify, change, supplement or withdraw the RFP at its sole discretion. No part of this document or any other correspondence from Ashland, its employees, officers or consultants shall be taken as legal, financial or other advice, nor as establishing a contract or any contractual obligations. All communication between Bidders and Ashland shall be conducted in writing via email.

Ashland makes no representations or warranties regarding the completeness of the information contained within the RFP and does not purport that this RFP contains all of the information needed for Bidders to determine whether to submit a proposal. Neither Ashland nor its employees, officers or consultants will make, or will be deemed to have made, any current or future representation, promise or warranty, expressed or implied, as to the accuracy, reliability or completeness of the information contained within the RFP or any other information provided to Bidders.

Bidders who submit proposals do so without legal recourse against Ashland, City Council, directors, management, employees, agents or contractors, due to Ashland's rejection, in whole or in part, of their proposal or for failure to execute any agreement with Ashland. Ashland shall not be liable to any Bidder or to any other party, in law or equity, for any reason whatsoever related to Ashland's acts or omissions arising out of, or in connection with, the RFP process.

Ashland reserves the right to reject, for any reason, any and/or all proposals. Ashland further reserves the right to waive any irregularity or technicality in proposals received, or to consider alternatives outside of this solicitation, at its sole discretion, to satisfy its capacity and energy needs. In addition, Ashland reserves the right, at its sole discretion, to modify or waive any of the criteria contained herein and/or the process described herein.

No Bidder will have any claim whatsoever against Ashland, its employees, officers, or consultants arising from, in connection with, or in any way relating to this RFP. Without limiting the generality of the foregoing, each Bidder agrees, by and through its submission of a proposal, that rejection of a proposal will be without liability on the part of Ashland, its employees, officers, or consultants, nor shall a Bidder seek recourse of any kind against any of the foregoing on account of such rejection. The filing of a proposal shall constitute an agreement of the Bidder to each and all of these conditions. Each Bidder and recipient of this RFP is responsible for all costs incurred in evaluating, preparing and responding to this RFP. Any other costs incurred by any Bidder during negotiations are also the responsibility of the Bidder.

E. CONFIDENTIALITY AGREEMENT

Bidders will be required to execute a mutual confidentiality agreement prior to entering into final negotiations.

F. NOTICE OF INTENT TO BID

Bidders shall respond to this request via email to confirm their intentions to submit a proposal no later than December 21, 2018.

III. PROJECT INFORMATION

A. RESOURCE DESCRIPTION

Ashland is asking Bidders to propose to develop, design, procure, and construct a solar photovoltaic facility at the Bidders suggested optimum location within the area identified as “Below the TID East Lateral Ditch” on the map titled Imperatrice Boundary Map provided in the RFP appendix. The Project shall generate at least 17,000 MWhs per year. The Bidder may propose either a fixed tilt or a single axis-tracking project based on the lowest levelized cost of energy over 25 years.

B. SITE DESCRIPTION

The City owned property known as the “Imperatrice Ranch” comprises over 850 acres on multiple parcels. As noted above, the project shall be located within the area denoted as “Below the TID East Lateral Ditch in the map provided in the RFP appendix. A variety of additional maps and more detailed property information is also provided in the appendix for Bidder reference and use.

C. POINT OF DELIVERY

1. Pacific Power BALANCING AUTHORITY: The Project will interconnect under the BPA Small Generator Interconnection Process (SGIP) and any other Pacific Power requirements.

2. ASHLAND MUNICIPAL ELECTRIC UTILITY SYSTEM: The specified points of connection will be at the Mountain Avenue substation and the Ashland substation. The Bidder will extend the 12.47kV distribution line from each of the substations using the engineering requirements and preliminary engineering design report completed by OS Engineering for the City of Ashland in January of 2017 and provided for reference in the RFP appendix. Pricing for the distribution line extension shall include all costs for substation connection through primary transformer connection at the Project site.

3. PACIFIC POWER INTERCONNECTION: The City is not currently soliciting project responses that utilize direct connections to Pacific Power lines.

D. DRAWINGS AND DOCUMENTATION

The following additional reference documents and property maps are provided in the RFP appendix for bidder reference and use:

1. Geotechnical Report: titled Factual Geotechnical Report – Wastewater Treatment Plant Phase II, prepared by Carollo Engineers, November 13, 1998

2. Biological Assessment – Imperatrice Property, prepared by Pacific Crest Consulting, LLC August 2017.

3. PV Interconnection Analysis – Prepared for the City of Ashland by OS Engineering, January 31, 2017

4. General Site Maps: Several additional site/property maps are provided for reference.

E. WAGES

The Project will require Oregon State Prevailing Wages for the 2018 Bureau of Labor and Industries rates for Jackson County.

F. ENVIRONMENTAL ATTRIBUTES

Ashland intends to be the sole recipient of the environmental attributes of the Project. If the project is proposed with environmental attributes to others, a clear description of the attributes, as well as the reasoning and value for doing so shall be provided.

IV. STATEMENT OF WORK

The Bidder shall be responsible for all aspects of the development, design, procurement, construction, and commissioning of the facility, including, but not limited to distribution infrastructure extension and obtaining all necessary easements/permits to construct the facility.

V. REQUEST FOR PROPOSAL CONTENT

Proposals for the "Ashland Solar RFP" must be submitted electronically by the due date. Each proposal must be contained in a single PDF file and formatted in the following manner. Additional supporting documentation may be included as appendices, where clear references are provided to the applicable section.

A. PROPOSAL FORMAT:

1. EXECUTIVE SUMMARY:
   a. The executive summary shall provide an overall description of the Project with key benefits to Ashland and other elements distinguishing the Bidder's proposal.

2. PRICING:
   a. Bidder shall provide the total system pricing
   b. Bidders shall propose a cost per kWh that the City will pay to purchase the electricity generated by the project.
   c. Bidders shall provide a schedule showing the price the City would pay to purchase the project from the proposer at any time during the 25-year life of the project, should the City decide it wants ownership.
   d. INTERCONNECTION UPGRADES: The Project will require interconnection upgrades and distribution line extensions to the project site. Bidders shall submit a line item for these costs separately. Bidders may include the costs of these upgrades in the per kWh price or show them as a separate cost.

3. EXPERIENCE AND QUALIFICAITONS:
   a. BIDDER EXPERIENCE: describe the pertinent experience to the proposed Project. Provide at least three client references from completed projects.
   b. GENERATING FACILITIES: describe the number, size, and type of solar facilities placed in service.
   c. RESOURCE SUPPLY: describe the Bidder's ability to provide adequate resources to execute the Project, specifically pertaining to solar module, inverter, and racking procurement within the Project's development timeframe. Also describe any subcontracting agreements with quality control and assurance provided by Bidder.

4. TECHNICAL INFORMATION
    a. DRAWINGS: provide a one-line diagram and a conceptual drawing of the proposed array overlaid on the existing parcel.
    b. PRODUCTION: provide an excel-based third party production model such as PVsyst or equal, showing loss diagram with de-rate factors, and estimated yearly production in kWh for a 25-year project lifetime.
    c. PROJECTED PROJECT SCHEDULE: provide a schedule for the Project from contract execution to commercial operation with pertinent milestones.
    d. ENVIRONMENTAL COMPLIANCE PLAN: include a description of how the Project will comply with environmental laws and regulation. Provide a description of the applicable permits and assessments required, with proposed solutions.
    e. PROPOSED FACILITY EQUIPMENT: Bidder shall provide the proposed project components specifications**.** Solar module manufacturers shall be "Tier 1" as defined by Bloomberg New Energy Finance.

5. WARRANTIES:
    a. PROPOSED EQUIPMENT WARRANTIES: list the duration of the equipment warranty for modules, inverters, transformers, and racking hardware.
    b. WORKMANSHIP: list the duration of applicable workmanship warranties.
    c. TOTAL SYSTEM WARRANTY: if applicable, provide the system warranty and services provided by Bidder.
    d. O&M SERVICES: Bidder shall provide details on their O&M offering such as on-call, pro-active monitoring, preventative maintenance, vegetation management, panel cleaning, and associated costs.

VI. BID EVALUATION AND SELECTION

A. GENERAL

Ashland will evaluate proposals based on the reasonableness and timeliness of project execution, prior experience of the respondent and the lowest cost of energy.

B. PRICE FACTORS (50% total)

Ashland will favor those project proposals that provide the lowest levelized cost of energy over the lifetime of the system, estimated at 25 years.

C. NON-PRICE FACTORS (50% total)

1. EXPERIENCE (20%)
    a. Project Development Experience
    b. Firm and Project Team References
    c. Design/Build Experience
    d. Project Ownership/O&M Experience

e. Financial Capability

2. TECHNOLOGY (15%)
   a. Equipment Quality
   b. Technical Feasibility
   c. Equipment Supply Control
   d. System Efficiency

3. ENVIORNMENTAL STEWARDSHIP (15%)
   a. Protection of natural landscape
   b. Integration of wildlife protection/enhancement at project site

VII. STATEMENT OF WORK

The following will be the responsibility of the Bidder.

1. PERMITTING: The Bidder will be responsible for all permitting, including but not limited to building permits, easements, conditional use permits, environmental compliance permits, and State Historical Preservation permits.

2. SITE MODIFICATIONS: The Bidder will determine the maximum extent of the site modifications necessary, including but not limited to civil engineering, access roads, foundation design, site modifications, grading, and vegetation removal. Bidder will also be responsible for site stabilization during construction and any rehabilitation of soils and vegetation at the completion of the construction. Inclusions shall be listed in the RFP response.

3. UTILITY INTERCONNECTION: The Bidder will be responsible for any and all interconnection applications and approvals between BPA, Pacific Power and the City of Ashland, and all required utility interconnection infrastructure to interconnect the Project.

4. EPC: The Bidder will be responsible for all Engineering, Procurement, and Construction to deliver a fully operational PV system to Ashland.

5. TELEMETRY: The Bidder will be responsible for all required telemetering as required by the BPA SGIP process and/or any similar Pacific Power requirement as identified. Bidder may list the assumed costs for telemetry separately.

6. FENCING: The Bidder shall provide a security plan for the project that considers, and addresses impacts on wildlife, while also meeting all applicable safety and security regulations.

7. MONITORING: an online dashboard for reading the Project's real time production shall be procured, installed, and commissioned by

Bidder. The monitoring must be revenue grade and be displayed for a minimum of 10 years.

8. COMMISSIONING: Bidder must provide a 3RD party commissioning report listing compliance with contracts, manufacturer recommendations, and industry accepted minimum standards such as IEC 62446. Any non-compliant issues must be addressed prior to final payment. Bidder will provide a pre-commission testing procedure, commissioning start-up with performance capacity check and production metering and verification at 3, 6, or 12 months.

Biological Assessment

Imperatrice Property

City of Ashland, Oregon

Prepared for:

CITY OF ASHLAND

Prepared by:

Pacific Crest Consulting, LLC

August 2017

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Acronyms and Abbreviations

BLM	Bureau of Land Management, US Department of the Interior
CS	Oregon State Conservation Strategy Species
City	City of Ashland, Oregon
GIS	Geographic Information System
GPS	Global Positioning System
GRSPs	Grasshopper Sparrows
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
ORBIC	Oregon Biodiversity Information Center
Pacific Crest	Pacific Crest Consulting, LLC
POE	Port of Entry, Oregon Department of Transportation
Property	Imperatrice Property, City of Ashland, Oregon
TID	Talent Irrigation District
USFS	Forest Service, US Department of Agriculture
USFWS	US Fish and Wildlife Service

1.0 INTRODUCTION

This report presents the methods and results for the biological assessment of the City of Ashland's (City) Imperatrice Property (Property) conducted by Pacific Crest Consulting, LLC (Pacific Crest) during spring and summer of 2017. Efforts requested by the City and undertaken by Pacific Crest included:

- Protocol-level surveys for target species of:
  - Plants (vascular and non-vascular (bryophytes))
  - Lichens
  - Spring fungi (including mushrooms and truffles)

- Protocol-level surveys for grasshopper sparrows (*Ammodramus savannarum*; GRSPs)

- Informal surveys for target species of:
  - Invertebrates
  - Mammals
  - Reptiles
  - Amphibians
  - Birds other than GRSPs (see further notes in 2.1.1 Special Status Species)

- Inventory of all vascular plant species

- Inventory of unique biological features, including:
  - Wildlife passage areas and barriers
  - Dense concentrations and large infestations of noxious weeds
  - Potential migratory bird nest sites
  - Bat hibernacula
  - Other habitats or features viewed as unique

2.0 METHODS

2.1 Target Species

Multiple sources informed the target species lists for each survey included in this report. The categories of target species are described in the following sections. Because many of the plant, lichen, and fungi species addressed in this report do not have common names, all are referred to by scientific names in the text, with common names listed as applicable; a common name is generally given only once for any given species of these taxa groups, at its first occurrence in the text. Primary target species are those for which protocol surveys were conducted; secondary species are those for which informal surveys were conducted.

2.1.1 Special Status Species

Special status species of plants, lichens, and fungi were primary targets for the surveys included in this report (Table 1). This included:

- State and federally listed Threatened, Endangered, and Candidate plants
- U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) Sensitive and Strategic plants, lichens, and fungi
- Oregon Biodiversity Information Center (ORBIC) plants, lichens, and fungi.
- Survey and Manage plants, lichens, and fungi

GRSPs were also a primary target. In addition to the species identified in Table 1, Pacific Crest personnel were prepared to identify and document any unexpected, unknown, or out-of-expected-range species that may have been of conservation concern.

Secondary target special status species included mammals, reptiles, amphibians, invertebrates, and birds other than GRSPs.

Although secondary targets, Pacific Crest elected to create a list of special status mammals, birds, reptiles, and amphibians (Table 2) with the potential to occur in, or near to, the Study Area, developed from the following sources:

- United States Fish and Wildlife Service (USFWS) informal list of threatened, endangered, proposed, candidate, species of concern, and migratory birds, generated using the Information, Planning, and Conservation System (IPaC; USFWS 2017).
- Oregon Department of Fish and Wildlife (ODFW) lists of threatened, endangered, candidate, and sensitive animal species in the State of Oregon (ODFW 2017 a and b);
- Oregon Biodiversity Information Center (ORBIC 2016)
- Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c)

Bird and mammal taxa listed by the ODFW, by the USFWS as species of concern, and/or by ORBIC on Lists 1, 2, 3, or 4 are included, but have no legal status or protection on private land in the State of Oregon. On non-federal public lands (*e.g.*, state, county, city lands), animal species listed by ODFW as threatened or endangered are protected by the Oregon Endangered Species Act (Oregon Revised Statute 497). Federally listed threatened, endangered, candidate, and proposed taxa are protected under the Federal Endangered Species Act, bald and golden eagles are protected under the federal Bald and Golden Eagle Protection Act, and migratory birds are protected under the federal Migratory Bird Treaty Act.

Lists of target species other than the above taxa groups are available at http://inr.oregonstate.edu/orbic/rare-species/rare-species-oregon-publications.

2.1.2 Noxious Weeds

Species of noxious weeds were primary targets. Pacific Crest documented dense concentrations and large infestations of Oregon Department of Agriculture (ODA) target species (ODA 2017a; Table 3) or those that were uncommon or previously unknown in the area, or had a high potential of infestation.

2.2 Protocol

Pacific Crest implemented the following protocols for primary target species during the survey effort:

- *2008 Sporocarp Survey Protocol for Macrofungi, Version 1.0* (Van Norman et al. 2008)
- *Survey Protocols for Protection Buffer Bryophytes* (USFS and BLM 1999a)
- *Survey and Manage Survey Protocols—Vascular Plants* (USFS and BLM 1999b)
- *Survey Protocols for Survey and Manage Category A and C Lichens in the Northwest Forest Plan Area, Version 2.1* (USFS and BLM 2003a)
- *2003 Amendment to the Survey Protocol for Survey & Manage Category A & C Lichens in the Northwest Forest Plan Area, Version 2.1 Amendment* (USFS and BLM 2003b)
- *Survey Protocol Guidance for Conducting Equivalent Effort Surveys under the Northwest Forest Plan Survey and Manage Standards and Guidelines* (USFS and BLM 2006)
- *Survey and Manage Category B Fungi Equivalent-Effort Survey Protocol, Version 1.0* (Van Norman 2010)

Secondary species were searched for informally and concurrently with protocol surveys for other taxa groups. Except for certain bird species, secondary species were not surveyed for under applicable protocols. See 2.7.4 Point Counts for more information on bird survey methods.

2.3 Study Area

The Study Area encompassed the entire Property (Figure 1), consisting of 876 continuous acres across multiple tax lots, immediately north of Interstate Highway 5 and associated north-bound Port of Entry (POE). The Study Area includes portions of sections T38S R1E 27, 28, 32, and 33.

2.4 Habitat Assessment and Delineation

The Study Area was assessed and delineated for primary target species of vascular plants, lichens, and fungi. The Study Area exists within the Klamath Mountains level 3 ecoregion, only two miles from the western edge of the West Cascades level 3 ecoregion. It includes portions of the Western Oregon Interior Valleys (Rogue / Illinois) and Oak Savannah Foothills level 4 ecoregions. Therefore, it was considered possible that populations of target species known or suspected from interior valley and oak-associated habitats of both aforementioned level 3 ecoregions could be found in the Study Area. Initial topographical map and orthoquad inspection of the entire Study Area, as required by various protocols, revealed a wide variety of suitable primary target special status species habitats, including:

- Oak woodlands
- Rock outcrops and rock gardens
- Meadows
- Drainages (ephemeral / seasonal)

Field surveys confirmed this diversity of habitat types.

The Study Area was also assessed for secondary target species of animals except invertebrates, the results of which are discussed in Table 2.

2.4.1 Threatened and Endangered Plants

Pacific Crest conducted a pre-survey botanical habitat suitability analysis on the Study Area and found that *Fritillaria gentneri* (Gentner's fritillary) was the only species with federal or state listing of Threatened, Endangered, or Candidate with a high likelihood of occurring. *Fritillaria gentneri* has a federal listing of Endangered. The Property is well within the known range of this species and populations have been found nearby. Pacific Crest identified the area containing habitat with highest potential for suitability to be the oak woodlands at the north end of the Property.

Multiple other target special status species with federal or state listing, *Limnanthes floccosa* ssp. *grandiflora* (large-flowered wooly meadowfoam; federally Endangered), *L. floccosa* ssp. *pumila* (dwarf wooly meadowfoam; state Threatened), *Lomatium cookii* (Agate Desert lomatium; federally Endangered), *Meconella oregana* (white fairypoppy), and *Eucephalus vialis* (wayside aster) had limited potential to be found in the survey area. The former three taxa are known from vernal pool habitats nearby to the north in the Rogue Valley: *Limnanthes floccosa* ssp. *grandiflora* and *Lomatium cookii* are known from the Agate Desert while *L. floccosa* ssp. *pumila* is known only from the tops of Upper Table Rock and Lower Table Rock. The only potential habitat for these taxa in the Study Area was initially identified as a small seasonal pond near the eastern property line and a small flat area at the extreme northwest near Butler Creek. The valley bottom near Interstate 5 may have had vernal pool habitat historically, but has been heavily grazed and impacted by livestock and the pre-survey analysis revealed no current habitat. There was low probability to find these taxa in other seasonally moist habitats such as seasonal drainages. *Meconella oregana* had potential to be found in various meadow and oak woodland communities. *Eucephalus vialis* had potential to be found in the shrub or oak communities within the Study Area. Multiple other species with federal and/or state status were included in Table 1 but had relatively lower potential to be found in the Study Area.

2.4.2 Sensitive and Strategic Species

Many of the target Sensitive and Strategic plant and lichen species were found to have a moderate to high likelihood of occurring. Two species, *California macrophylla* (*Erodium macrophyllum*; round-leaved filaree;) and *Ranunculus austro-oreganus* (southern Oregon buttercup) were known to exist in the Study Area (personal communication, Kristi Mergenthaler, Southern Oregon Land Conservancy, 4/25/17). Other species with a moderate to high likelihood of occurring included, but were not limited to, *Calochortus spp* (mariposa lilies)*, Camissonia (Tetrapteron) graciliflora* (hill suncup)*, Carex spp* (sedges)*, Cheilanthes spp* (lipferns)*, Cryptantha milobakeri, Diplacus spp* (monkeyflowers)*, Leptogium burnetiae, Limnathes floccosa ssp bellingeriana, Pellaea andromedifolia* (cliffbrake)*, Plagiobothrys spp* (popcorn flowers)*, Orthotrichum euryphyllum, Schistidium cinclidodonteum,* and *Solanum parishii* (Parish's nightshade).

2.4.3 Survey and Manage Species

The Survey and Manage target species list includes plants, lichens, and fungi. These species were listed with Survey and Manage primarily based on rarity within and dependence on old-growth coniferous or mixed forests. Coniferous and mixed forest habitats do not exist in the Study Area. Therefore, there was very little potential for most Survey and Manage plant, lichen, and fungi species to exist in the Study Area.

2.5 Historical Data Review

The BLM Geographic Biotic Observations and USFS Natural Resource Information System databases track observations of noteworthy species on and near BLM and USFS lands. The Oregon Flora Project rare plant and atlas database (OFP 2017) was also consulted. These databases were queried for known site locations of target species within the vicinity of the Study Area (April 26, 2017). The results showed no site locations within the Study Area. Known target species occurrences within a three-mile radius of the Study Area include two of *Fritllaria gentneri*, one of *Martes pennanti* (fisher), one of *Horkelia tridentata* (three-toothed horkelia), and multiple of *Ranunculus austro-oreganus*.

Further results of the data review and literature reviews for plants, lichens, fungi, and animals (except invertebrates) are detailed in Table 1 and Table 2.

2.6 Survey Schedule

Two separate survey efforts occurred to coincide with optimum detection of target species of vascular plants and grasshopper sparrows, respectively. Optimal fungi fruiting conditions coincided with optimal vascular plant spring phenology. Lichens and non-vascular plants can generally be surveyed for any time of year. Therefore, plant, lichen, and fungi surveys occurred concurrently and took place from April 28, 2017 through May 23, 2017, including a first visit throughout the entire study area and revisits to selected parts. Revisits for late-season plant species then occurred occasionally until August 5, 2017.

Surveys for GRSPs were conducted on May 2-4, May 6-9, May 15, and May 18, 2017.

2.7 Field Survey Methods

Survey methods from multiple protocols, listed earlier in this report, were used during the Project surveys. The methods in the protocols are detailed below.

2.7.1 Intuitive Controlled Survey Method

Multiple protocols recommend the Intuitive Controlled Survey method for plants, lichens, and fungi in all parcels greater than 2.5 acres in size (USFS and BLM 1999b, USFS and BLM 2003a, USFS and BLM 2003b, USFS and BLM 2006, Van Norman 2010, Van Norman et al. 2008). One protocol, *Survey Protocols for Protection Buffer Bryophytes* (USFS and BLM 1999a), requires this method for all parcels, including those less than 2.5 acres in size. The Study Area is greater than 2.5 acres in size; the Intuitive Controlled Survey method was therefore implemented.

This method incorporates lines that traverse the survey area and target the full array of major vegetation types, aspects, topographical features, habitats, and substrate types within a given area. While en-route, the surveyor searches for target species, and when the surveyor arrives at an area of high potential habitat (as defined in the pre-field review or encountered during the field visit), a Complete Survey for the target species is conducted (see below).

2.7.2 Complete Survey Method

The Complete Survey method for plants, lichens, and fungi was used when special or high potential habitats were encountered. This approach consists of a 100 percent visual examination of the habitat. High potential habitats within the Study Area included large outcroppings, seasonal and perennial drainages, areas with significant native bunchgrass populations, and some areas with *Quercus garryana* (Oregon white oak). A large percentage of the Study Area had moderate potential habitat for target plant species and therefore received a higher intensive survey than that required by the Intuitive Controlled Survey method but not a full 100% examination. The general vascular plant inventory was completed concurrently with surveys for target special status species under the Intuitive and Complete survey protocols.

2.7.3 Hypogeous Fungi

All implemented fungi survey protocols require searches for hypogeous fungi—truffles. These surveys were conducted by raking microhabitats of higher potential (e.g., small mammal digs and the underside of litter mats in the oak woodlands). Surveyors used four-tine rakes to gently peel back the litter layer, and soil was inspected for the presence of truffles. If no truffles were found, the area was restored and the surveyor moved to a new area.

2.7.4 Point Counts

Point count surveys for GRSPs occurred throughout the entire Study Area and were conducted between the hours of 0630 and 1200 during optimal conditions for detecting this species. For the purposes of these surveys, the property was divided into two portions: the area above the Talent Irrigation District (TID) East Canal and the area below the canal. Point count surveys were conducted along north-south running transect lines above the canal and along east-west running transect lines below the canal. Initially, transect lines were spaced 100 meters apart with call stations approximately every 50 meters; however, the call station placement was changed during the course of the survey in the following way: in areas where traffic noise made auditory detection difficult, call stations were maintained at 50-meter intervals; however, in areas where habitat was open and birds were easy to hear, call stations were spaced at 100 meters for efficiency and to avoid duplicate recordings of individuals. Five minutes was spent at each call station recording all birds observed both visually and by sound.

2.7.5 Monumenting Target Species Sites and Recording Site Data

Target special status plant species sites were generally monumented with orange-glo pin flags placed around population perimeters; exceptions are detailed below in 3.0 Results. Perimeters of most larger populations were recorded on global positioning system (GPS) units for subsequent use in Geographic Information Systems (GIS). All GPS coordinates in this report and associated documents are in Universal Transverse Mercator, Zone 10, North American Datum of 1983 projection. Data for locations of target special status species were recorded on standardized ORBIC report forms (Figure 2), submitted separately from this report. Applicable noxious weed populations were mapped, except for large infestations occupying the entire Study Area, which are noted below in 3.2 Noxious Weeds. GRSP detections were mapped. Special status plant and noxious weed population locations were documented in GIS; the related shapefiles are available upon request. Plant and bird inventory lists were documented in Excel spreadsheets.

3.0 RESULTS

The following sections detail the results of the field surveys.

3.1 Current Environment

Although the Study Area mostly slopes gently to the south and southwest, it covers a wide variety of aspects, with slopes ranging from approximately flat to steep. The Study Area can be viewed as three distinct habitats:

- Oak woodlands in the far northern part of the Study Area
- Meadows between the oak woodlands and the TID canal to the south
- Meadows downslope of the TID canal

3.1.1 Oak Woodlands

The woodlands generally slope steeply to the north from a broad ridgeline and are dominated by *Quercus garryana, Toxicodendron diversilobum* (poison oak), *Symphoricarpos spp* (snowberries), *Prunus subcordata* (Klamath plum), the latter occasionally forming distinct thickets. These woodlands displayed a higher ratio of native versus non-native forb and grass coverage compared to the remainder of the Study Area; *Festuca idahoensis* ssp *roemeri* (Roemer's fescue, Idaho fescue) was found to be common here. Canopy cover varies greatly.

3.1.2 Meadows Between the Oak Woodlands and TID Canal

The meadows between the oak woodlands and the TID canal were dominated primarily by exotic annual grasses and forbs, although dominant native species were also present. Dominant species included *Vicia villosa* (winter vetch), *Vicia sativa* (garden vetch), *Centaurea solstitialis, Poa bulbosa* (bulbous bluegrass), *Erodium cicutarium* (reds-stem stork's bill), *Geranium dissectum* (cutleaf geranium), *Geranium molle* (dovefoot geranium), *Avena fatua* (wild oat), *Elymus caput-medusae, Trifolium spp* (clovers), *Galium parisiense* (bedstraw), *Lomatium utriculatum* (common lomatium), *Tragopogon dubius* (yellow salsify), *Madia spp* (tarweeds), *Bromus japonicus* (field brome), *B. hordaceous* (soft brome), *B. tectorum* (cheatgrass), and *Vulpia microstachys* (small fescue). Of these, it is difficult to state what species were more dominant than others. These species occurred in varying concentrations across this part of the Study Area. Additionally, different species became more dominant as seasonal phenology progressed and early-bloomers senesced while late-bloomers became more prevalent. There were additional species that were very common, although not as abundant as the above dominants; these included *Calochortus tolmiei* (Tolmie startulip), *Dichelostemma capitatum* (bluedicks), *Calystegia occidentalis* (chaparral false bindweed), *Achyrachaena mollis* (blow-wives), and many others.

This area was historically grazed and likely was previously dominated by native bunchgrass communities. Non-native plant coverage during 2017 was approximately 85% or more on average, with native species coverage at approximately 40%, on average. It was difficult to determine exact numbers for these percentages and other percentages given in this report with any accuracy, due to constantly changing plant phenology throughout the growing season and associated changes in biomass of any given species. Nonetheless, Pacific Crest personnel were expecting a higher non-native-to-native ratio than observed.

Outside of areas with summer moisture, shrubs comprised a very small amount of the vegetation coverage and consisted mostly of *Prunus subcordata, Toxicodendron diversilobum,* and exotic fruit trees, as scattered individuals and small patches.

Islands consisting primarily of native vegetation were found in this area, roughly overlapping with populations of *Ranunculus austro-oreganus* (see 3.2 Special Status Plants, Lichens, and Fungi), and were dominated by varying concentrations of native species including *Festuca idahoensis* ssp *roemeri*, *Horkelia daucifolia* (carrotleaf horkelia), *Eriophyllum lanatum* (Oregon sunshine), *Achnatherum lemmonii* (Lemmon's needlegrass), *Pseudoroegneria spicata* (bluebunch wheatgrass), *Phlox speciosa* (showy phlox), *Lomatium spp* (desertparslies), and *Achillea millefolium* (common yarrow), although non-native species were also common in these areas. These islands are likely not common in most adjacent parcels outside of the Study Area.

Large populations of *Microseris laciniata* ssp *detlingii* (Detling's silverpuffs) were also found, primarily on the flats and gentle slopes in the far northwest part of the Study Area; this species is endemic to southwestern Oregon and adjacent areas in northern California; it was previously a target special status species. *Plectritis congesta* (shortspur seablush) was abundant in the vicinity.

A small seasonal pond was found in the northeast part of T38S R1E S33, approximately 0.25 miles north of the eastern parking area and Property legal access point. Common plants here included *Lolium perenne* (perennial ryegrass), *Hordeum murinum* (mouse barley), and *Eleocharis spp* (spikerushes).

The oak woodlands mentioned above and the slopes between them and the TID canal likely serve as winter range for elk and deer. Elk and deer were observed in the Study Area during the survey efforts; the front cover of this report displays a herd of elk in the Study Area. Additional mammals incidentally observed in the Study Area included one black bear, three coyotes, one grey fox, and many smaller mammals.

3.1.3 Meadows Downslope of the TID Canal

This area had a much higher amount of moisture than areas upslope of the TID canal. This moisture originated from active irrigation diverted from the canal at multiple points along its length as it runs through the Study Area. Several natural springs and seeps added surface moisture; subterranean seepage from the canal was also a possible contributor. The vast majority of the area was observed to be grazed by livestock. Grazing was heavy throughout most of the area and extensive post-holing by cattle was evident. The exception was a narrow strip set apart by active electric fences located to either side of the drainage that runs south through the center of the Study Area; it is in this strip that the only *California macrophylla* populations downslope of the canal were found. It was uncertain if this strip was part of the grazing lease, as it was fenced and had only light evidence of grazing, which may have originated from livestock that had escaped the fencing but had been quickly and efficiently recovered.

Vegetation in this area included many of the same species dominant upslope of the canal, but often in very different concentrations, with *Vicia spp*, *Calochortus tolmiei, Dichelostemma capitatum*, and others less common, while *Centaurea solstitialis* and others became more abundant. *Brassica rapa* (field mustard), *Shedonorus arundinaceus* (tall fescue), *Alopecurus pratense* (meadow foxtail), and others became dominant downslope of the canal, while existing only in traces upslope of the canal. *Shedonorus arundinaceus* and *Alopecurus pretense* were especially dominant in areas receiving higher volumes of irrigation water, notably at and upslope of the corrals in the southeast part of the Study Area. *Brassica rapa* was especially abundant in the southwest part of the Study Area near the POE. *Juncus effusus* (common rush) was common in some parts. *Rubus armeniacus* and *Rosa canina* (dog rose), with lesser amounts of *Rosa rubiginosa* (*R. eglentaria*; sweetbriar rose) were much more common downslope of the canal than upslope of it. Overall, vegetation in the area downslope of the canal was much denser, taller, and lusher than upslope of the canal; these conditions occasionally impeded foot travel when combined with the often irregular, post-holed, and wet ground surface. This condition receded later in the summer as plants senesced or were grazed down.

As with areas upslope of the TID canal, this area was historically grazed and likely was previously dominated by native bunchgrass communities. Non-native coverage in 2017 was approximately 98%, with native species coverage at approximately 15%, on average.

3.1.4 Other Features of the Study Area

Most drainages in the Study Area were lined with various concentrations of *Salix spp* (willows)*, Rubus armeniacus, Carex densa* (dense sedge)*, Juncus spp* (rushes)*, Dipsacus fullonum* (Fuller's teasel), *Shedonorus arundinaceus*, and other typical riparian species; *Prunus cerasifolia* (cherry plum) was abundant in one drainage. Most of the drainages still had flowing water, at least in the lower stretches, at time of final revisits in early August; Hamby Spring in the southwest area downslope of the TID canal was still flowing strong.

The TID canal traverses the slope through the Study Area. It currently functions as a partial barrier to wildlife travel; certain terrestrial species may find it difficult to cross the flow of relatively deep water when the canal is flowing, although it should be noted that it does not flow for a substantial part of the year and travel may be less impeded then. There are two foot-bridges crossing the canal in the far western and eastern part of the Study Area, respectively, although the western one is composed of metal mesh that would likely inhibit most terrestrial wildlife travel during times of water flow in that canal. A maintenance road follows the canal for its length through the Study Area.

A wooden-pole powerline corridor exists in the northern part of the Study Area and a buried gas pipeline corridor roughly parallels it to the immediate south. Associated maintenance roads follow these right-of-way corridors. A large pile of treated wood poles, assumingly associated with the powerline corridor construction, was observed at coordinates 524880E/4675620N. A small radio facility exists in the far southeast part of the Study Area near Eagle Mill Road and is accessible by vehicle from it.

A network of trails exists in the Study Area, observed to be used by people on foot, horseback, and OHV. People were seen from distance and personally encountered on the trails throughout the survey efforts, often in relatively large numbers. The trails, for the most part, were found to exist upslope of the TID canal. Most of the OHV use was observed in relation to the grazing leases downslope of the canal. However, OHV use was additionally observed on the trails in the western part of the survey area and their use was evident off-trail in that vicinity as well. The utility right-of-way corridors also had evidence of regular OHV use, much of which was assumingly in relation to infrastructure maintenance. Trails were observed cutting through multiple *California macrophylla* populations (see 3.2 Special Status Plants, Lichens, and Fungi) and trampling was evident at each of those populations. Rerouting of these trails may assist to lessen trampling.

3.2 Special Status Plants, Lichens, and Fungi

Fourteen populations (Figure 3) of *California macrophylla,* (Figure 4) totaling approximately 8.0 acres, were found in the Study Area. This species was originally documented in Oregon by Thomas Howell in 1887, with the associated herbarium collection noting “hills near Ashland”. It is possible that his original collection was made at one of the Study Area populations. ORBIC previously listed this species with an “EX” status (assumed to be extirpated in Oregon) until Pacific Crest personnel discovered a new location near the city of Eagle Point, Oregon. Since then, five populations were found in the Study Area by Kristi Mergenthaler and ODA personnel (personal communication, Kristi Mergenthaler, Southern Oregon Land Conservancy, 4/25/17). *California macrophylla* is currently listed by ORBIC (2016) with a “1” status (threatened or endangered throughout its range), the highest list status that ORBIC can assign. This species may soon receive additional listing through the State of Oregon. The Oregon sites represent the northern-most known extent of this species; it is also known from California and Baja California. The California Native Plant Society (2017) lists *California macrophylla* as a 1B.2 (rare, threatened, or endangered in CA and elsewhere).

Nearly all *California macrophylla* plants were found upslope and north of the TID canal. Two small populations were found downslope from the canal. Active grazing by livestock was observed downslope of the canal, where much of the ground had been trampled, whereas there was no current grazing by livestock observed upslope of the canal. Much of the ground downslope of the canal was observed to be irrigated. It is assumed that active grazing, associated trampling, and wet ground make for unfavorable conditions for the growth of *California macrophylla.* The two small populations downslope of the canal were found in an area between electric fences where grazing did not appear to be nearly as heavy as in the areas outside of the fencing, and irrigation was not evident at the time of population discovery.

One small plant rosette, potentially that of *California macrophylla* (Figure 3), was found downslope of the TID canal in early August. Due to immaturity and a lack of flowers and fruit, it was not possible to be certain of an identification. Although the leaves appear to be those of *California macrophylla*, the observed plant was growing well outside of the normal window of phenology for that species, did not have the reddish coloration that the stems and leaves of that species often have, was growing downslope of the canal in less desirable conditions, and all observed *C. macrophylla* plants in verified populations elsewhere in the Study Area were senescent at that time, casting doubt that the rosette in question was *C. macrophylla.* Nonetheless, it was monumented with several strips of yellow/black-striped flagging tied to small rocks in case a revisit would be made in future years.

Five populations (Figure 5) of *Ranunculus austro-oreganus* (Figure 6), totaling approximately 241 acres, were found in the Study Area, all upslope of the TID canal. The oak woodlands to the far north of the Study Area had the greatest concentrations. *Ranunculus austro-oreganus* is currently listed by ORBIC (2016) with a “1” status (threatened or endangered throughout its range), the highest list status that ORBIC can assign; it is also a state Candidate species with ODA. This species is endemic to Jackson County, found primarily in the Rogue Valley and adjacent foothills.

Approximately 633 acres contained vegetative *Ranunculus* plants (Figure 5), including overlap with verified *Ranunculus austro-oreganus* populations. Densities of vegetative plants within the 633 acres varied greatly, often being very widespread and isolated; very few existed downslope of the canal, those plants were also typically observed as depauperate. Due to a lack of flowers (a diagnostic characteristic for discerning *Ranunculus austro-oreganus*), it was not possible to know what species these vegetative plants were. They might flower in future years and a positive identification could then be made. However, it should be noted that no flowering *Ranunculus occidentalis* (western buttercup) was observed in the Study Area, the only other feasible species that the vegetative plants could be.

One site (Figure 5) of *Collema quadrifidum* (Figure 6) was found, present on multiple *Quercus garryana* trunks in approximately one acre of the oak woodlands in the far northern part of the Study Area. This tiny, gelatinous lichen is difficult to discern in the field, blending in with numerous other dark, similarly-sized lichens and blemishes on the tree trunks, and is best identified by its four-celled, polygonal spores as observed under the microscope. Due to the *Collema quadrifidum* being found off the ground on tree trunks, no pin flags were used to monument the site; a labeled set of yellow/black striped flagging was instead used, positioned on a tree trunk near the population center.

No *Fritillaria gentneri* were found. Vegetative *Fritillaria* plants were found, but these plants were impossible to identify to species without flowers. The vegetative plants were found only in the oak woodlands in the far northern part of the Study Area, existed in same vicinity as numerous flowering *Fritillaria affinis* (a non-target species), and possibly may all be that species. No target special status species of spring fungi were found.

3.3 Noxious Weeds

Silybum marianum (milk thistle; Figure 7) was found in one location along the southern boundary of the Study Area and consisted of approximately 80 specimens covering 10% of a >60 m^2 population area. The population extended from the property fenceline downslope to the POE exit ramp; it is likely that the POE was the vector of introduction. This species has rarely been found in southwestern Oregon. The Medford District BLM (personal communication, Bryan Wender, Medford District BLM Botanist, 8/14/17) has only one record of this invasive species on their lands, found in the Cow Creek Watershed of Douglas County. WeedMapper (ODA 2017b) revealed one site in Jackson County, near Rogue Valley International Airport.

Spartium junceum (Spanish broom; Figure 7) was found in two locations along the TID canal. Each location consisted of one plant. Though the populations sizes were very small, this species is reported here due to it being an uncommon invader in southwestern Oregon. WeedMapper (ODA 2017b) shows three sites in Jackson County, all in the far northern part of the county. Pacific Crest personnel know of one site in the City of Ashland, on Siskiyou Boulevard, which had apparently been treated (sprayed) recently.

Rubus armeniacus (Himalayan blackberry; Figure 7) was found throughout a substantial portion of the Study Area. The vast majority of the populations were found from the TID canal and downslope to the Study Area boundary. The average percent coverage within the population polygons was 15%. Besides large and dense infestations, multiple smaller infestations were also mapped, primarily in areas upslope of the canal where the species was much less common. A trace amount of *Rubus laciniatus* (cutleaf blackberry) was found mixed in with the *Rubus armeniacus*.

Centaurea solstitialis (yellow starthistle) and *Elymus caput-medusae* (medusahead rye) were found throughout the Study Area and are therefore not represented in Figure 7. Both species had an average coverage across the Study Area of approximately 35% each. Concentrations of both species were lighter in the oak woodlands in the far northern part of the Study Area, found most frequently in openings between trees, and heavier downslope of the TID canal.

Cirsium arvense (Canada thistle), *Cirsium vulgare* (bull thistle), *Conium maculatum* (poison hemlock), and *Phalaris arundinacea* (reed canarygrass) were all found as widely scattered, very small populations (often only as one isolated plant). These species were found primarily in areas of moisture along the TID canal and irrigated areas downslope of the canal. A small trace of *Hypericum perforatum* (St. Johnswort) was found along the canal. These species are not further documented in this report due to the small population sizes within the Study Area and overall commonness of these species in southwestern Oregon.

One potential population of *Cyperus esculentus* (yellow nutsedge) was found downslope of the canal (Figure 7). It was originally observed early in the season while immature and could not be confidently identified. By the time a return visit was made later in the season, cattle had grazed the plants down beyond recognition. The identification could therefore not be verified.

Although not a target noxious weed species, *Thinopyrum ponticum* (*Elymus elongata*; tall wheatgrass, European quackgrass) was observed infesting the entire gas pipeline right-of-way in the northern part of the Study Area. The pipeline right-of-way was nearly a complete monoculture of *Thinopyrum ponticum*; it had outcompeted other vegetation and was spreading out from there. It has potential to quickly spread and take out other parts of the Study Area. This species is a pale grey-green color and this infestation is visible on aerial photography as a wide, pale strip cutting across the Study Area. This species is similar to the target noxious species *Elymus repens* (quackgrass, couchgrass), and many of the *Thinopyrum ponticum* specimens in the Study Area exhibited some features characteristic of *Elymus repens*, including very wide leaves and acute glumes, although the majority of features still pointed towards *T. ponticum*. There is potential for *Thinopyrum ponticum* to be considered by ODA for noxious weed listing in the future.

The Study Area has multiple possible vectors of noxious weed introduction including: Interstate 5 and associated POE adjacent to the Study Area, vehicular traffic within the Study Area (OHV's, right-of-way maintenance vehicles), livestock, TID canal, non-vehicular trail traffic (foot, bike, horse). Much of the vegetation between the southern property fenceline and Interstate 5 / POE is mowed annually, possibly slowing the spread of weeds from those two dispersal vectors, although the stretch of exit ramp with the *Silybum marianum* had not been mowed; it may be too steep to maintain.

3.4 Birds

Thirty-four GRSPs were detected during the surveys (Figure 8). The majority (thirty-two of thirty-four) were singing males; two GRSPs were flushed from vegetation and the sex of these two birds is unknown. Thirty-two detections were recorded above the TID canal; two were recorded below the canal. GRSPs have Federal Species of Concern, Oregon Department of Fish and Wildlife (ODFW) Conservation Strategy Species, and ORBIC2 status. See Table 4 for ORBIC rank definitions. Other special status bird species detected during the point counts include:

- Acorn woodpecker (*Melanerpes formicivorus*)
- Chipping sparrow (*Spizella passerine*)
- Oak titmouse (*Baeolophus inornatus*)
- Peregrine falcon (*Falco peregrinus*)
- Western meadowlark (*Sturnella neglecta*)
- White-tailed kite (*Elanus leucurus*)
- Yellow-breasted chat (*Icteria virens*)

Table 4 contains further notes on the occurrences of the target special status avian species within the Study Area and includes rank status(es) of each species.

3.5 Other Sites of Interest

No other special status target species were found.

Multiple populations of a species of *Phaeocalicium* (Figure 9) were found on twigs of *Quercus garryana* in the oak woodlands in the far northern part of the Study Area. Species of *Phaeocalicium* belong to a group of organisms commonly known as pin lichens. Their spores are borne atop a small stalk and are distributed by wind and insects travelling the length of the twigs. The collection in question is similar to *Phaeocalicium interruptum*, a species without special status, but differs by multiple morphological and chemical features. It is possibly a new species: one that is new to science, not described, and un-named. A collection has been sent to a pin lichen expert for another opinion; this report will be updated when a determination has been returned. Determinations are also still out for several invertebrate collections.

One large "log" of petrified wood (Figure 10) was found along the boundary of the study area at coordinates 525445E/4675296N, placing it just within the Study Area. The overall length is unknown; it continued underground and its large size and heavy weight prevented movement and further exploration. This feature may serve as an attraction to visitors.

A series of scattered rock outcrops exist on a steep south-facing slope running approximately 0.25 miles west-east through the Study Area in T38S R1E S27. Other, smaller sets of outcrops are occasional throughout much of the Study Area.

No other biological sites of interest, as defined in 1.0 Introduction, were found in the Study Area.

3.6 Inventories

A total of two-hundred-fifty-two vascular plants were recorded during the surveys (Table 5). Note that multiple taxa are not identified past genus. Additionally, several recorded taxa were observed only along Butler Creek; it is uncertain how much of that creek actually exists in the project area due to conflicts in GIS mapping compared to on-the-ground property line evidence. Pacific Crest elected to document all bird species detected during the surveys for GRSPs; fifty-three avian species in total were detected (Table 4).

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Tables

Table 1: Special status plants, lichens, and fungi

Taxon1	Scientific Name	Federal Status2	ODA Status2	SEN/STR/S&M2	Likelihood to Exist in Study Area
VA	*Adiantum jordanii*			SEN	LOW. Habitat includes moist, shaded hillsides, springs, riparian areas. SW OR populations are found mostly on serpentine. No serpentine present in Study Area, although shaded riparian is found to far north in oak woodland. Most known sites in SW OR are west of Grants Pass.
VA	*Agrostis hendersonii*			STR	LOW. Found in vernal pools and other moist areas in valley grasslands. Historical collection from Sams Valley, but is presumed extirpated in OR.
FU	*Alabtrellus ellisii*			SM-B	LOW. Typically found in older coniferous forests at higher elevations than the Study Area, although this species is occasionally found in hardwood communities. Known sites exist in coniferous forest in the SW OR Cascades.
VA	*Allium bolanderi var. bolanderi*			STR	MODERATE. Habitat includes rocky clay soils, although this species typically prefers serpentine. Known sites exist at Howard Prairie and NW of Grants Pass.
VA	*Allium peninsulare*			SEN	LOW. Habitat includes meadows. Many populations nearby in the Hyatt / Howard Prairie area, although these populations are found in higher elevation snowmelt meadows. Found at lower elevations in CA.
VA	*Androsace elongata ssp. acuta*			STR	LOW. Habitat includes dry, primarily north-facing meadows. Previously known from one historic site in Jackson County (1887), now assumed to be extirpated.
BR	*Anoectangium aestivum*			STR	LOW. Lower elevation springs and seeps, often over rock, although this species typically prefers calcareous substrates in SW OR. One known site near Wimer.
VA	*Arabis modesta*			SEN	MODERATE. Shaded slopes at low to moderate elevations; often associated with rock. Known sites near Shady Cove, Applegate, and NW of Grants Pass.
VA	*Astragalus californicus*			SEN	LOW. Low to moderate elevation, dry, open, meadows, woodlands, shrub communities; although known sites in SW OR are south of the Siskiyou crest in CSNM (Cascade-Siskiyou National Monument) and found in communities more similar to those of the Great Basin.
VA	*Astragalus gambelianus*			SEN	MODERATE. Dry, open, grassy areas at low to moderate elevations. Known sites at Sampson Creek and southern part of CSNM.
FU	*Balsamia nigrans*			STR	MODERATE. Associates with species of oak. Known sites in Jackson and Josephine counties.
BR	*Bryum calobryoides*			SEN	LOW. Prefers crevices in rock at higher elevations, occasionally found at lower elevations. Known sites along Siskiyou crest and near Hyatt Lake.
LI	*Calicium quercinum*			STR	LOW. Grows on trunks of oaks at low to moderate elevations. No known sites in SW OR.

VA	*California macrophylla*			SEN	PRESENT. Known sites documented in Study Area prior to 2017 survey efforts.
VA	*Callitriche marginata*			SEN	MODERATE. Primarily a species of vernal pool habitats in SW OR. Could exist in seasonal pond in east part of Study Area or vernal pools undetected during desktop analysis.
VA	*Calochortus greenei*		SC	SEN	LOW. Habitat includes clay soils in meadows, shrub communities, and other areas of exposure as low as 2400' elevation. However, all known sites in SW OR are in the Klamath watershed south of the Siskiyou crest.
VA	*Calochortus monophyllus*			SEN	MODERATE. One known site upslope of the Study Area, higher in elevation, in forest on the south side of Grizzly Peak. Can grow as low as 1300' elevation.
VA	*Calochortus nitidus*			STR	LOW. Habitat includes meadows. One known site near Greensprings, although it is much higher in elevation than the Study Area.
BR	*Campylopus subulatus*			STR	LOW. Found from sea level to moderate elevations. Known sites in Josephine County. Prefers areas without human-induced disturbance or heavy plant competition.
VA	*Carex comosa*			SEN	LOW. Found in wet areas from sea level to 1200'. Nearest known site is historic, found along the Rogue River.
VA	*Carex crawfordii*			STR	MODERATE. Found at pond and lake margins that dry up in summer, from sea level to moderate elevations. Rumored site near Grizzly Peak.
FU	*Cazia flexiascus*			STR	MODERATE. Associates with *Quercus garryana* and other hardwoods. Known sites in Rogue Valley vacinity.
VA	*Cheilanthes covillei*			SEN	MODERATE. Rock crevices at a variaty of elevations and plant communities. Known sites in Jackson County near Heppsie Mt.
VA	*Cheilanthes intertexta*			SEN	MODERATE. Rock crevices at a variaty of elevations and plant communities. Known sites throughout Jackson County.
VA	*Chlorogalum angustifolium*			SEN	MODERATE. Clay soils of dry areas with high light exposure at lower elevations. Widely scattered known sites in Jackson and Josephine counties.
FU	*Clavariadelphus occidentalis*			SM-B	LOW. Typically a species of mixed and coniferous forests, although it is rarely found in hardwood communities. Many known sites in southern Oregon.
FU	*Clavariadelphus subfastigiatus*			STR	LOW. Typically a species of mixed and coniferous forests, although it is rarely found in hardwood communities. Three known sites in SW OR.
LI	*Collema quadrifidum*			STR	PRESENT. Prefers *Quercus garryana* trunks at low to moderate elevations. Many known sites in Jackson County.
VA	*Cryptantha milo-bakeri*			SEN	MODERATE. Rocky or gravelly slopes at low to moderate elevations. Known sites in Jackson (Applegate area) and eastern Josephine counties.
VA	*Cyperus acuminatus*			SEN	LOW. Found at vernal pools, seasonal ponds, ditches, and other wet areas at low elevations. The only previously known sites in SW OR are historic and near Grants Pass.
VA	*Delphinium nudicaule*			SEN	LOW. Grows in well-drained areas (often talus or gravel) and along river banks and low to moderate elevations. Known sites in Jackson and Josephine counties.

FU	*Dendrocollybia racemosa*			STR	MODERATE. Found on decayed remains of other mushrooms in a variety of habitats (including hardwood and shrub communities) at low to moderate elevations. Known sites in Jackson (mostly near Shady Cove) and Josephine counties, including one at French Flat found under manzanita.
BR	*Didymodon norrisii*			STR	MODERATE. Habitat includes a variety of rock substrates in a variety of plant communities from low to moderate elevations. Known sites in Jackson County near Siskiyou Summit and Shady Cove.
VA	*Diplacus bolanderi*			SEN	MODERATE. Grassy areas and openings in chaparral from low to moderate elevations. Observed in areas of disturbance. Known sites in Applegate Valley.
VA	*Diplacus congdonii*			SEN	MODERATE. Oak woodlands, grassy areas, and openings in chaparral from low to moderate elevations. Known sites in Applegate Valley.
BR	*Entosthodon californicus*			STR	MODERATE. Found on clay soils in seasonally wet areas, often associated with disturbance. Known sites at Table Rocks.
BR	*Entosthodon fascicularis*			SEN	MODERATE. Found on a variety of soils in seasonally wet areas, often associated with disturbance. Known sites near Grants Pass.
BR	*Ephemerum crassinervium*			SEN	MODERATE. Found on a variety of soils in seasonally wet areas, often associated with disturbance; one Jackson County site was found in water-filled cow tracks. Known sites in Jackson and Josephine counties.
VA	*Ericameria arborescens*			SEN	LOW. Dry forest, hardwood and shrub communities at low to moderate elevations, often in foothills. Only known sites in OR are in western Curry County; however, it is found throughout CA in a variety of habitats.
VA	*Erigeron cervinus*			SEN	LOW. Prefers rocky areas, but also grows in open areas. Usually at moderate to higher elevations. Occasionally found in vernally wet areas at lower elevations. Nearest known site is in Josephine County.
VA	*Eschscholzia caespitosa*			SEN	LOW. Dry, often brushy areas at lower elevations. Nearest known sites are near Glendale and Hellgate.
VA	*Eucephalus vialis*		ST	SEN	MODERATE. Low to moderate elevation ecotones, but generally involving coniferous and mixed forest.
VA	*Fritillaria eastwoodiae*			STR	LOW. Dry slopes. Rumored sites at Lower Table Rock and near Gold Hill, otherwise no sites in close proximity.
VA	*Fritillaria gentneri*	FE	SE	SEN	HIGH. Low to high elevation ecotones, mixed forests, shrub communities. Study Area is well within species range and known sites are in relatively close proximity.
VA	*Hackelia bella*			SEN	LOW. Moderate to higher elevations. Known from Table Mountain and Grizzly Peak vacinity, but at higher elevations.
VA	*Horkelia tridentata ssp. tridentata*			SEN	LOW. Dry areas, typically in open forest, on granitic or other igneous soils, at low to high elevations. Known sites are in Ashland Watershed, although these are higher elevation than the Study Area, found exclusively on granite, and favor ridgelines.
VA	*Juncus kelloggii*			STR	LOW. Vernal pools, springs, meadows at low elevations. ORBIC lists a known site in Josephine County.
LI	*Leptogium burnetiae*			STR	MODERATE. Found on *Quercus garryana* trunks at low to moderate elevations. Nearest known verified site is near Shady Cove; another unverified site exists near Buckhorn Springs.

VA	*Limnanthes alba ssp. gracilis*		SC	SEN	LOW. Wet meadows, streamsides, ditches, cliff bases at typically low elevations. Only one known site in Jackson County, found near City of Rogue River.
VA	*Limnanthes floccosa ssp. bellingeriana*		SC	SEN	MODERATE. Vernally wet areas with high light exposure, from low to moderate elevations. Many known sites in Cascades of Jackson County.
VA	*Limnanthes pumila ssp. grandiflora*	FE	SE	SEN	LOW. Vernal pool habitat, but endemic to Agate Desert.
VA	*Limnanthes pumila ssp. pumila*		ST	SEN	LOW. Vernal pool habitat, but endemic to Table Rocks.
VA	*Lomatium cookii*	FE	SE	SEN	LOW. Vernally moist habitats, often vernal pools. Known from two concentrations of populations: one in the Agate Desert, the other in the Illinois Valley.
VA	*Meconella oregana*		SC	SEN	MODERATE. Found in a variety of plant communities, often vernally moist, usually with moderate to high light exposure, at low elevations. Known populations near Medford, Jacksonville, Applegate.
VA	*Microseris douglasii ssp. douglasii*			STR	LOW. Meadows with heavy clay soils. The only known site in Oregon was near Ashland but has not been seen since the late 1800's and is presumed extirpated.
VA	*Nemacladus capillaris*			SEN	MODERATE. Dry slopes at a variety of elevations. In SW OR, prefers meadow edges in areas of higher percentages of bare mineral soil. Multiple known sites in Cascades of Jackson County, especially in CSNM.
BR	*Orthotrichum bolanderi*			STR	MODERATE. Rock features at low to mdoerate elevations in a variety of plant communities. Known sites near Sampson Creek and Medford.
BR	*Orthotrichum euryphyllum*			STR	MODERATE. Rocks in seasonal drainages, usually with moderate to high light exposure. Known sites throughout much of the Cascades of southern OR.
BR	*Orthotrichum hallii*			STR	MODERATE. Rock features at low to mdoerate elevations in a variety of plant communities. Known sites near Medford.
VA	*Pellaea andromedifolia*			SEN	MODERATE. Rocky areas at low to moderate elevations. Known sites in Jackson and Josephine counties.
LI	*Peltigera pacifica*			SM-E	LOW. Typically in coniferous or mixed forests, but can be found in a variety of habitats. Known site in Ashland Watershed; several more in western Jackson County.
LI	*Peltula euploca*			STR	MODERATE. Rocky areas (basalt, andesite) at lower elevations. Known sites at Upper Table Rock, Applegate Valley, CSNM, Horseshoe Ranch.
BR	*Phymatoceros phymatodes*			SEN	LOW. Mineral soil substrates that remain wet late into summer. Multiple sites on Medford BLM lands in SW OR.
VA	*Pilularia americana*			SEN	MODERATE. Vernally wet habitats including vernal pools and pond margins. Known sites at Table Rocks.
VA	*Pinus sabiniana*			STR	LOW. Foothill woodlands at low to moderate elevations. Common in the Trinity Mountains and elsewhere in CA; very rare in OR as natural sites, but is frequently planted as an ornamental.
VA	*Plagiobothrys austiniae*			SEN	MODERATE. Vernally wet areas, such as seeps and ephemeral drainages, typically in meadows, at low to moderate elevations. Known sites at Table Rocks and Cascades of Jackson County.

VA	*Plagiobothrys figuratus ssp. corallicarpus*		SC	SEN	MODERATE. Vernally wet areas, often rocky, in meadows at low to moderate elevations. Known sites near Greensprings, Medford, Grants Pass.
VA	*Plagiobothrys greenei*			SEN	MODERATE. Vernally wet areas, such as seeps and ephemeral drainages, typically in meadows, at low to moderate elevations. Known sites in the Cascades of Jackson County.
VA	*Plagiobothrys lamprocarpus*		SE	STR	LOW. Assumed habitat is vernally wet areas with higher light exposure. Known only from one historic site near Grants Pass (1921) and is assumed extinct.
BR	*Porella bolanderi*			SEN	MODERATE. Rock outcrops in oak woodlands. Known sites in Ashland Watershed and Cascades of Jackson County.
FU	*Psathyrella quercicola*			STR	MODERATE. Grows on *Quercus garryana* at low elevations. Known sites from Jackson and Josephine counties, including the type locality.
BR	*Racomitrium depressum*			SEN	LOW. Rocks along ephemeral drainages with high light exposure, mostly at moderate to higher elevations in southern OR. Known sites near Howard Prairie.
VA	*Rafinesquia californica*			SEN	MODERATE. Meadows and post-burn areas in variety of communities from low to high elevations. Large, robust populations were previously found throughout the Squire and Quartz Fire areas in the Applegate.
VA	*Ranunculus austro-oreganus*		SC	SEN	PRESENT. Known sites documented in Study Area prior to 2017 survey efforts.
VA	*Rhamnus ilicifolia*			SEN	MODERATE. Chaparral and oak woodlands from low to moderate elevations. Several sites known along the CA border in CSNM and near Applegate Ranger Station.
VA	*Rhynchospora alba*			SEN	LOW. Wet areas from low to high elevations. Known sites in southern OR are moderate to high elevation, often associated with *Sphagnum*.
VA	*Ribes divaricatum var. pubiflorum*			SEN	LOW. Wet areas and forest edges. Multiple known sites west of Grants Pass.
VA	*Romanzoffia thompsonii*			SEN	LOW. Vernally wet areas, such as seeps and springs, on steep slopes with high light exposure. Known SW OR sites are near Flounce Rock at ~4000' elevation.
FU	*Sarcodon fuscoindicus*			STR	LOW. Typically found in coniferous forests but occasionally in hardwoods. Widely scattered across western OR, inclusing one site in northern Jackson County.
BR	*Schistidium cinclidodonteum*			SEN	MODERATE. Rocks in seasonal drainages, usually with moderate to high light exposure. Known sites throughout much of the Cascades of southern OR.
VA	*Scirpus pendulus*			SEN	MODERATE. Wet areas in a variety of plant communities from low to moderate elevations. Known site near Grizzly Peak.
VA	*Sidalcea hickmanii ssp. petraea*			SEN	LOW. Dry shrub communities on ridges. One known site: Sams Valley
VA	*Solanum parishii*			SEN	MODERATE. Found in a variety of dry plant communities at a variety of elevations. Known sites throughout much of Jackson County.
FU	*Spathularia flavida*			SM-B	LOW. Typically found in coniferous forests and only rarely in hardwoods. Numerous known sites in Jackson County.

VA	*Tetrapteron graciliflorum*			SEN	MODERATE. Meadows, shrub communities, oak woodlands at low to moderate elevations. Known sites in CSNM, Applegate vacinity, and elsewhere in Jackson County.
BR	*Trichostomum tenuirostris var. tenuirostris*			STR	LOW. Various moist substrates in various plant communities at a wide variety of elevations. Known site near Wagner Butte is in coniferous forest.
VA	*Triteleia ixioides ssp. scabra*			STR	LOW. Foothill meadows and woodlands, in clay and granitic soils.
LI	*Umbilicaria hirsuta*			STR	MODERATE. Rock features in a variety of exposures in a variety of elevations. Known sites in CSNM, near Lake of the Woods, near Wimer.
VA	*Wolffia borealis*			SEN	LOW. Areas of stagnant water such as ponds, lakes. Known sites at Parsnip Lakes in CSNM, and Sharron Fen, both at ~4500' elevation.
VA	*Wolffia columbiana*			SEN	LOW. Areas of stagnant water such as ponds, lakes. Known site near Gold Hill.

[1] VA = vascular plant, BR = bryophyte, LI = lichen, FU = Fungus

[2] Federally Listed Species: FE = Endangered, FT = Threatened, SOC = Species of Concern. Oregon Department of Agriculture: SE = Endangered, ST = Threatened, SC = Candidate. STR = Strategic, SEN = Sensitive. S/M Category definitions: Category A = Manage all known sites; pre-disturbance surveys practical, strategic surveys. Category B = Manage all known sites; pre-disturbance surveys not practical and not applicable; strategic surveys; equivalent effort surveys required for most bryophytes, lichens and fungi for habitat-disturbing projects in old growth. Category C = Manage high-priority sites; pre-disturbance surveys practical; strategic surveys. Category D = Manage high-priority sites; pre-disturbance surveys not practical or not necessary; strategic surveys. Category E = Manage all known sites; pre-disturbance survey not applicable; strategic surveys. Category F = known site management and pre-disturbance surveys not applicable; strategic surveys

Table 2: Special status birds, mammals, reptiles, and amphibians

Common Name *Scientific Name*	Status[1] USFWS STATE ORBIC	Habitat and Ecology	Likelihood to Occur in the Study Area
Amphibians			
Northern red-legged frog *Rana aurora*	SOC SV, CS 4	Prefers cool and calm or still waters of streams, marshes or ponds, often near or in moist forests. Breed in winter and early spring laying eggs attached to stems of emergent vegetation or submerged branches in permanent water bodies. Highly terrestrial outside of the breeding season. Known historically from Jackson County including records in the Lower Rogue and Applegate watersheds.	**Low.** Suitable habitat for this species exists along the drainage in the middle of the Study Area and in adjacent wetlands areas; however, it is overall of marginal quality for this species (not within humid woodlands).
western toad *Anaxyrus boreas boreas*	- SV, CS 4	Historically found throughout Jackson County near aquatic sites (streams, rivers, lakes, ponds, and springs). Occurs in a wide variety of habitats as long as there is suitable aquatic habitat for breeding and is adapted to agricultural environments such as vegetated irrigation canals.	**Moderate.** Suitable habitat for this species exists along the drainage in the middle of the Study Area and in adjacent wetlands areas; however, this species has disappeared from much of its original range and is now uncommon.
Reptiles			
California kingsnake *Lampropeltis californiae*	SOC SV 4	Found in a wide variety of habitats. In Oregon, it occurs along the Rogue and Umpqua river valleys, often in dense vegetation along watercourses but also in farmland, chaparral, and deciduous and mixed conifer woodlands.	**Moderate.** There is suitable habitat in the Study Area and there are historic records of this species in the region.
California mountain kingsnake *Lampropeltis zonata*	SOC SV, CS 4	Found in a diversity of habitats often pine forests, oak woodlands, and chaparral; commonly in open wooded areas near streams.	**Moderate.** There is suitable habitat in the Study Area and there are historic records of this species in the region.
western rattlesnake *Croatalus oreganus* ssp. *oreganus*	- SC 4	Occurs in a variety of habitats from deserts to chaparral to open forests, usually near rocks, cliffs, or downed logs.	**Present.** There is suitable habitat for this species in the Study Area and they were observed in the Study Area during surveys.
Birds			
white-tailed kite *Elanus leucurus*	- - 4	Lower elevation grasslands, agricultural areas, meadow, oak woodlands, riparian woodlands, marshes and wetlands; nest in trees or tall shrubs. Breeding season is approximately February to July.	**Present.** This species was observed flying over the Study Area and hunting nearby on several occasions during the breeding season (early May). No nest was observed in the Study Area and there is only limited suitable nesting trees/shrubs available within the Study Area; most likely this bird was nesting nearby, possibly in the trees growing on the adjacent property to the east.

Common Name *Scientific Name*	Status[1] USFWS STATE ORBIC	Habitat and Ecology	Likelihood to Occur in the Study Area
bald eagle *Haliaeetus leucocephalus*	BCC SV 4	This species is usually found near water and breeds in forested areas adjacent to large bodies of water. Nests in trees, rarely on cliff faces and on the ground in treeless areas.	**Present (assumed).** There is no suitable nesting habitat for this species in the Study Area, though it is fairly common to the greater region. A bald eagle was recorded in the Study Area on April 29, 2016 and on January 4 and 25, 2014 (eBird 2017).
ferruginous hawk *Buteo regalis*	SOC SV, CS 4	A rare, but regular winter visitor to Jackson County. Prefers flat, rolling grasslands or shrubsteppe regions including sagebrush shrublands, and edges of western juniper and pinyon-juniper woodlands and other forests. Breeds in northeastern Oregon and found year-round in southeastern Oregon.	**Present (assumed).** A ferruginous hawk was observed in the Study Area on February 27, 2017 (eBird 2017).
golden eagle *Aquila chrysaetos*	- - 4	Inhabits a wide variety of open and semi-open habitat types including grasslands, shrublands, woodlands, and coniferous forests. Often nests on cliffs bordering rivers, will also nest in trees, on ground, on river banks, and on human-made structures.	**Present (assumed).** There is suitable foraging habitat for this species in the Study Area though it would be unlikely to nest there due to a lack of preferred nesting habitat. Two golden eagles were observed in the Study Area on March 4, 2016 and on January 4, 2014 and one was observed in the Study Area on January 25, 2014 (eBird 2017).
short-eared owl *Asio flammeus*	BCC (year-round) CS 3	Inhabits open terrain, most often marshes, but also grasslands, dunes, agricultural fields, meadows, and pastures. Breeding season is typically from April to August.	**Low.** Suitable habitat exists in the Study Area; however, this species is a rare to irregular visitor to Jackson County during the non-breeding season (November - April).
burrowing owl *Athene cunicularia*	SOC SC, CS 4	Habitat includes deserts, open grasslands, shrublands, and other open areas such as vacant lots near human habitation or airports. Nests in abandoned mammal burrows. They have disappeared from the Rogue Valley and are rare in Jackson County, though they once were considered common.	**Low.** The Study Area contains suitable habitat for this species; however burrowing owls are not currently known to breed in Jackson County and are considered a rare to irregular visitor during the non-breeding season (October - April).
common nighthawk *Chordeiles minor*	- CS 4	Forage over wide variety of habitats throughout the state. Nest on bare ground in open areas. Breeding season is typically June to August.	**Moderate.** Species may forage over the Study Area, only reside in the Rogue Valley during the breeding season; unlikely to nest in the Study Area because of limited bare ground.

Common Name ***Scientific Name***	**Status[1] USFWS STATE ORBIC**	**Habitat and Ecology**	**Likelihood to Occur in the Study Area**
rufous hummingbird *Selasphorus rufus*	BCC (breeding)	Breed in the Rogue Valley, typically in open forest near meadows and riparian thickets in mountainous areas. Breeding typically begins anywhere from April to July, depending on elevation.	**Moderate**. This species is common in the region however the habitat in the Study Area is only marginally suitable breeding habitat for this species.
Lewis's woodpecker *Melanerpes lewis*	SOC/BCC (year-round) SC, CS 2	Typically inhabits open forests at lower elevations. Nests in white oak, ponderosa pine, mixed oak-pine, and cottonwood riparian woodlands of eastern Oregon (also in the Klamath River drainage). Common in the Rogue Valley from November through March.	**Present (assumed).** Limited suitable habitat for this species occurs in the Study Area and it is likely to pass through the Study Area during winter foraging. There is a record of six Lewis's woodpeckers in the Study Area from January 4, 2014 (eBird 2017).
acorn woodpecker *Melanerpes formicivorous*	SOC CS 4	Occur in oak woodlands, mixed oak-pine woodlands and oak savannah. Primary food is acorns. Very common resident in the Rogue Valley.	**Present.** This species was detected in the Study Area in the oak woodland area during the breeding season (May) and may nest within the Study Area or nearby.
American peregrine falcon *Falco peregrinus*	BCC (breeding) SV, CS 4	Inhabits a variety of open habitats. Nests on cliff ledges, or buildings or bridges, usually near water. Breeding season is approximately March through August.	**Present.** This species was observed flying through the Study Area during the breeding season (early May); there is no suitable nesting habitat within the Study Area, but this species may nest on nearby cliffs.
little willow flycatcher *Empidonax trailii brewsteri*	- SV, CS 4	Breeds in willows and other riparian vegetation along stream courses, lakes and marshes, also in thickets at edges of forest clearings or fields in proximity to water. Breeding season is typically June to August.	**Low.** This species is a fairly common migrant but a rare and irregular breeder in Jackson County. The habitat in the Study Area is marginal for this species and it is unlikely to occur.
loggerhead shrike *Lanius ludovicianus*	BCC (year-round) CS 4	This species occurs in open habitats with shrubs and trees for perching and nesting.	**Low.** The Study Area contains suitable habitat for this species; however this species is not known to breed in Jackson County and considered a rare and irregular visitor during the non-breeding season.

Common Name ***Scientific Name***	**Status[1] USFWS STATE ORBIC**	**Habitat and Ecology**	**Likelihood to Occur in the Study Area**
streaked horned lark *Eremophila alpestris strigata*	T SC, CS 1	Nest where there is little or no vegetation including sparsely vegetated agricultural areas, pastures, grasslands, shrublands, playa margins, and alpine areas. Wintering habitats used are very similar to breeding habitats. Breeding season is March to August. The streaked horned lark has been extirpated throughout much of its range, including the Rogue Valley. Although this subspecies was known as a common permanent resident of the Rogue Valley in the early 1900s, the last confirmed breeding record was in 1976. Horned larks are currently only expected as rare and irregular visitors to Jackson County during the non-breeding season (September to February); however, these birds could be any of the four subspecies which frequently form mixed flocks in winter (only *E. a. strigata* breeds west of the Cascades). A flock of wintering streaked horned larks was confirmed in the Rogue Valley in winter 2015-2016 (USFWS 2016).	**Low.** There is suitable habitat in the Study Area for this subspecies which used to be a permanent resident of the Rogue Valley, but is currently considered to be extirpated. There is some likelihood that this subspecies could occur in the Study Area in the winter.
purple martin *Progne martin*	SOC SC, CS 2	Forage in open areas on the wing. Nest in cavities, often using woodpecker nest holes or nest boxes. Breeding season habitat typically open areas (open forest, open water, large meadows, fire scars in forests, or open areas near cities and towns) near to nest cavities (in trees, nest boxes, or crevices in cliffs or buildings).	**Moderate.** The Study Area has suitable foraging habitat adjacent to limited suitable nesting habitat for this species which is known to breed near the Study Area (breeding birds observed 2015-2017 off Valley View Road approximately two miles to the northwest [eBird 2017]). There is a record from July 26, 2013 of a juvenile hawking insects along an irrigation ditch off Butler Creek Road (mapped location is approximately 0.5 mile west of the northwest corner of the Study Area) (eBird 2017).
oak titmouse *Baeolophus inornatus*	BCC (year-round) - -	Common resident of the Rogue Valley in oak, mixed oak-pine, and oak-riparian woodlands and in mature chaparral communities. Nest in cavities, usually abandoned woodpecker holes or digs its own nest in soft wood (less common).	**Present.** This species was detected in the Study Area in the oak woodland area during the breeding season (May) and may nest within the Study Area.

Common Name ***Scientific Name***	**Status[1] USFWS STATE ORBIC**	**Habitat and Ecology**	**Likelihood to Occur in the Study Area**
slender-billed nuthatch *Sitta carolinensis aculeata*	- SV, CS 3	This subspecies of white-breasted nuthatch generally inhabits the wooded slopes of the major interior valleys west of the Cascades and is a common resident of the Rogue Valley. Inhabits lower elevation deciduous, mixed conifer-deciduous, oak, ponderosa pine, and juniper woodlands. Nests in natural tree cavities or abandoned woodpecker holes.	**Present.** This species was detected in the Study Area in the oak woodland area during the breeding season (May) and may nest within the Study Area.
golden-crowned kinglet *Regulus satrapa*	- - 4	Common breeding bird in coniferous forest habitats in Jackson County; often come down in elevation in winter.	**High.** The Study Area is not suitable breeding habitat for this species, however they are common in the region and could be encountered in the Study Area anytime outside of nesting season.
western bluebird *Sialia mexicana*	- SV, CS 4	Common nesting bird in Jackson County; occupy a variety of habitats including farms, parks, open woodlands (riparian, oak, and oak-ponderosa pine); require cavities for nesting and typically use abandoned woodpecker holes, natural cavities, or nest boxes.	**Present (assumed).** There are multiple eBird records of the species in the Study Area. One record is during the breeding season (May 21) and this species would be likely to nest in the Study Area where suitable nesting cavities exist (eBird 2017).
chipping sparrow *Spizella passerina*	- CS 4	Common breeding bird in Jackson County. Typically found in open woodlands, savannahs, and openings in forests. Most birds have arrived by mid-April and depart by September; rare or irregular in the non-breeding season, though some birds are likely resident.	**Present.** This species was detected at the eastern edge of the Study Area near the end of North Mountain Avenue in early May; the Study Area may contain some marginally suitable nesting habitat.
Oregon vesper sparrow *Pooecetes gramineus affinis*	SOC SC, CS 2	This subspecies of vesper sparrow breeds west of the Cascades in Oregon. In Jackson County, it is an uncommon to fairly common summer resident in mountain grasslands; typically arriving in April and departing between July and October. A range-wide inventory and habitat assessment conducted in 2015 found birds to be notably absent from lower elevation grasslands and pasturelands in the Rogue Valley (where they are common in the Umpqua Valley); all detections in the Rogue Basin were above 2,000 feet and were primarily in montane meadows (Altman 2015).	**Low.** Although the Study Area is suitable habitat for this species, it appears to prefer higher elevation grasslands in the region and has a only low likelihood to occur.
grasshopper sparrow *Ammodramus savannarum*	-- SV, CS 2	Generally inhabit short to mid-height, open to moderately open grasslands, sometimes with scattered shrubs, and prefer large tracts of habitat to small	**Present.** This species was thoroughly documented in the Study Area in a study completed by the Klamath Bird Observatory

Common Name ***Scientific Name***	**Status[1] USFWS STATE ORBIC**	**Habitat and Ecology**	**Likelihood to Occur in the Study Area**
		ones. Many pairs often nest close to each other because of limited suitable habitat; territory sizes between one and four acres have been documented. Birds nest on the ground below a dome of grass; frequently have two broods; nesting typically occurs from April to August. A summer resident of limited distribution in Jackson County.	(KBO) in 2016 which found 32 singing males in the Study Area (Stephens 2016). The grasshopper sparrow survey conducted by Pacific Crest Consulting in 2017 also documented 32 singing males in roughly the same locations (Figure 8). An informal survey conducted by KBO in 2014 found 20 grasshopper sparrows mostly in the same area (Stephens 2016).
yellow-breasted chat *Icteria virens*	SOC CS 4	A summer resident found in brush and thickets in open areas and understory of riparian woodlands along streams. They typically arrive in southern Oregon in May and depart in September. Nest in cups build in dense thickets.	**Present.** This species was observed in the Study Area along the small drainage in the center of the property as well as the TID in early May and is likely to nest in suitable habitat within the Study Area and nearby. Brush along the TID in the western portion of the Study Area (and likely along the entire length) was mowed this year sometime between mid-May and mid-June (C. Scott pers. observation), removing some of the suitable nesting habitat for chats in this area.
western meadowlark *Sturnella neglecta*	- CS 4	Very common summer resident in Jackson County and fairly common in winter as well when it may form small flocks. Inhabits open grasslands, pastures, some agricultural fields, meadows, and sometimes open woodlands. Nests are in depressions on the ground under domes of grass; territories sizes reported between several and 10+ acres.	**Present.** The most commonly encountered species during surveys of the Study Area conducted by Pacific Crest Consulting. Known to breed throughout most of the Study Area where suitable habitat is abundant, particularly above the TID.
tricolored blackbird *Agelaius tricolor*	BCC (breeding) -- 2	Uncommon to fairly common summer resident (rare but regular year-round resident); though typically resident in most of their range, most birds migrate to Oregon to breed. Prefer freshwater marshes with emergent vegetation or thickets for nesting; often nest in Himalayan blackberry shrubs around wetlands. They breed in colonies, often alongside red-winged blackbirds (may fly as far as four miles from nesting site to forage).	**Present.** Observed on one occasion (April 29) on the west side of the Study Area below the TID. The latest being from May 1, 2017 where five tricolored blackbirds were observed in the Study Area (eBird 2017). There is suitable nesting habitat in the southern portion of the Study Area for this species and it may breed there or nearby.
Mammals			

Common Name *Scientific Name*	Status[1] USFWS STATE ORBIC	Habitat and Ecology	Likelihood to Occur in the Study Area
Townsends's big-eared bat *Corynorhinus townsendii*	SOC SC, CS 2	Known to occur in many habitats but typically inhabits forested regions west of the Cascades. Uses caves, abandoned mines, buildings, and tunnels as roosts.	**Low.** There is no roosting habitat in the Study Area and this species is not anticipated to forage over the site.
pallid bat *Antrozous pallidus*	SOC SV, CS 2	This species inhabits a variety of habitats, typically shrublands and woodlands of arid regions but also open woodlands and forests (ponderosa pine, oak), preferably near water. They use narrow crevices in caves, mines, buildings and, less often, rock or debris piles and hollow trees for roosting; night roosts include abandoned buildings, rock overhangs, and bridges.	**Moderate.** This species may forage in the Study Area; the Study Area does contain some roosting habitat (hollow trees, rock piles), but lacks their more preferred sites (caves, bridges).
hoary bat *Lasiurus cinereus*	- SV, CS 4	Forest-dweller, day roosts in trees, resides in coniferous and deciduous forests and forages along riparian corridors and brushy areas.	**Low.** Suitable habitat exists in the limited oak woodland portion of the Study Area and this species may forage along Butler Creek.
California myotis *Myotis californicus*	- SV, CS 4	This bat typically forages over or near open water; it uses cliff faces, tree crevices, or caves for roosting. Seeks shelter after foraging during active season (does not use fixed roosts), and hibernates during winter in northwest.	**Moderate.** Suitable foraging and roosting habitat in the Study Area.
long-eared myotis *Myotis evotis*	SOC - 4	Generally associated with forested habitats or forest edges west of the Cascades; forages in openings in dense forest, between trees in open forest, and over willow-lined streams; roosts in wide variety of refugia including buildings, caves, mines, bridges, hollow trees, loose bark, and rock crevices.	**Low.** Suitable habitat exists near to the Study Area and this species may forage along Butler Creek. Not expected to roost in the Study Area
little brown myotis *Myotis lucifugus*	- - 4	Closely associated with water; found in moist forests or riparian woodlands. Commonly roost in structures and maternity colonies often located in structures, caves, or hollow trees; they hibernate in caves.	**Low.** Limited suitable habitat in the Study Area.
fringed myotis *Myotis thysanodes*	SOC SV, CS 2	Found in a wide variety of habitats but seems to have a presence for forests or riparian areas; roosts in caves, mines, buildings.	**Low.** Limited suitable habitat in the Study Area.
long-legged myotis *Myotis volans*	SOC SV, CS 4	Typically occurs in forests, but also in some desert and riparian habitats. Uses buildings, hollow trees and crevices in rock outcrops for maternity roosts. Uses caves and mines for winter roosts.	**Low.** Suitable habitat exists in the limited oak woodland portion of the Study Area.

Common Name ***Scientific Name***	**Status[1] USFWS STATE ORBIC**	**Habitat and Ecology**	**Likelihood to Occur in the Study Area**
Yuma myotis *Myotis yumanensis*	SOC - 4	Highly associated with water; typically forages over open water such as rivers, lakes, ponds. Establish large colonies in buildings, mines, caves and bridges and also take solitary refuge in buildings, tree bark/crevices. In western Oregon, mostly found in Douglas-fir forests, Sitka spruce forest and oak and ponderosa pine woodlands.	**Low.** Limited suitable habitat in the Study Area.
Brazilian free-tailed bat *Tadarida brasiliensis*	- - 4	Colonial species that appears to be a permanent resident in Oregon; roots frequently include caves, hollow trees, and buildings; colonies can be very large. Noted to be common to the Ashland area (Verts and Carraway 1998).	**Moderate.** May forage in the Study Area; less likely to roost in the Study Area due to lack of large roosting areas preferred by this species (caves, barns), but could roost in the limited oak woodland habitat or in structures nearby.
western gray squirrel *Sciurus griseus*	- CS 4	Generally inhabits oak woodlands, also mixed forests with hardwoods and conifers, as well as riparian areas and urban parks and orchards adjacent to natural habitats.	**Moderate.** Suitable habitat exists in the limited oak woodland portion of the Study Area; this species is locally common.
black-tailed jackrabbit *Lepus californicus*	- - 4	This species is found in open habitats including grasslands, shrubland, pastures, fields, and edges of forests.	**Present.** This species was observed in a field adjacent to the Study Area and there is suitable habitat throughout the Study Area for this species.
gray wolf *Canis lupus*	E CS 2	Occur over a wide-variety of habitats, though closely associated with dense coniferous forests west of the Cascades. Wolf territories ranging in size from 25 square miles to more than 1,000 square miles have been reported.	**Low.** Evidence of gray wolves has been documented as near as approximately 15 miles east of the Study Area (Keno Unit) near Howard Prairie as recently as 2017; gray wolves could hunt in the Study Area but would not be expected to reside there (ODFW 2017c).

[1] Status Code Definitions:

USFWS and STATE:

E: Endangered
T: Threatened
C: Candidate
SOC: Species of Concern
BCC: Bird of Conservation Concern
SC: Sensitive - Critical. SC species are imperiled with extirpation from a specific geographic area of Oregon because of small population sizes, habitat loss or degradation, and/or immediate threats.
SV: ODFW Sensitive - Vulnerable. SV species are facing one or more threats to their populations and/or habitats.
CS: ODFW Oregon Conservation Strategy (CS) Species

ORBIC:

List 1: Taxa that are threatened with extinction or presumed to be extinct throughout their entire range.
List 2. Taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon.
List 3: Taxa for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
List 4: Taxa which are of conservation concern but are not currently threatened or endangered.

Table 3: ODA list of noxious weeds

Common Name	Scientific Name	ODA List
Velvetleaf	*Abutilon theophrasti*	B
Biddy-biddy	*Acaena novae-zelandiae*	B
Russian* knapweed	*Acroptilon repens*	B
Jointed goatgrass	*Aegilops cylindrica*	B
Ovate goatgrass	*Aegilops ovata*	A
Barbed goatgrass	*Aegilops triuncialis*	A, T
Quackgrass	*Elymus repens (Agropyron r.)*	B
Tree of Heaven	*Ailanthus altissima*	B
Camelthorn	*Alhagi maurorum (A. pseudalhagi)*	A
Garlic mustard	*Alliaria petiolata*	B, T
Yellowtuft	*Alyssum murale, A. corsicum*	A, T
Ragweed	*Ambrosia artemisiifolia*	B
Skeletonleaf bursage	*Ambrosia tomentosa*	A
Indigo bush	*Amorpha fruticosa*	B
Common bugloss	*Anchusa officinalis*	B, T
Hoary alyssum	*Berteroa incana*	A, T
False brome	*Brachypodium sylvaticum*	B
White bryonia	*Bryonia alba*	A
Butterfly bush	*Buddleja davidii (B. variabilis)*	B
Flowering rush	*Butomus umbellatus*	A, T
Plumeless thistle	*Carduus acanthoides*	A, T
Smooth distaff thistle	*Carduus baeticus*	A
Welted thistle	*Carduus crispus*	A, T
Musk* thistle	*Carduus nutans*	B
Italian* thistle	*Carduus pycnocephalus*	B
Slender-flowered* thistle	*Carduus tenuiflorus*	B
Smooth distaff thistle	*Carthamus lanatus ssp. creticus (C. baeticus)*	A
Woolly distaff thistle	*Carthamus lanatus*	A, T
Purple starthistle	*Centaurea calcitrapa*	A, T
Diffuse* knapweed	*Centaurea diffusa*	B
Iberian starthistle	*Centaurea iberica*	A, T
Meadow* knapweed	*Centaurea pratensis*	B
Yellow starthistle*	*Centaurea solstitialis*	B, T
Spotted* knapweed	*Centaurea stoebe (C. maculosa)*	B, T
Squarrose knapweed	*Centaurea virgata*	A, T
Rush skeletonweed*	*Chondrilla juncea*	B, T
Canada* Thistle	*Cirsium arvense*	B
Bull* thistle	*Cirsium vulgare*	B
Old man's beard	*Clematis vitalba*	B
Poison hemlock	*Conium maculatum*	B

Field bindweed*	*Convolvulus arvensis*	B
Jubata grass	*Cortaderia jubata*	B
Common crupina (bearded creeper)	*Crupina vulgaris*	B
Japanese dodder	*Cuscuta japonica*	A
Houndstongue	*Cynoglossum officinale*	B
Yellow nutsedge	*Cyperus esculentus*	B
Purple nutsedge	*Cyperus rotundus*	A
Scotch* broom	*Cytisus scoparius*	B
Portuguese broom	*Cytisus striatus*	B, T
Spurge laurel	*Daphne laureola*	B
Cape-ivy	*Delairea odorata*	A, T
Cutleaf teasel	*Dipsacus laciniatus*	B
Paterson's curse	*Echium plantagineum*	A, T
South American waterweed	*Egeria densa (Elodea)*	B
Giant horsetail	*Equisetum telmateia*	B
Spanish heath	*Erica lusitanica*	B
Leafy* spurge	*Euphorbia esula*	B
Myrtle spurge	*Euphorbia myrsinites*	B
Oblong spurge	*Euphorbia oblongata*	A
Japanese (fleece flower) knotweed	*Fallopia japonica (Polygonum c.)*	B, T
Himalayan knotweed	*Fallopia polystachyum (Polygonum p.)*	B, T
Giant knotweed	*Fallopia sachalinensis (Polygonum s.)*	B, T
Goatsrue	*Galega officinalis*	A
French* broom	*Genista monspessulana*	B
Herb Robert	*Geranium robertianum*	B, T
Shiny-leaf geranium	*Geranium lucidum*	B, T
Halogeton	*Halogeton glomeratus*	B
Ivy	*Hedera helix, H. hibernica*	B
Texas blueweed	*Helianthus ciliaris*	A
Giant hogweed	*Heracleum mantegazzianum*	A, T
Orange hawkweed	*Hieracium (Pilosella) aurantiacum*	A, T
Meadow hawkweed	*Hieracium (Pilosella) caespitosum*	B, T
Yellow hawkweed	*Hieracium (Pilosella) floribundum*	A, T
Mouse-ear hawkweed	*Hieracium (Pilosella) pilosella*	A
King-devil hawkweed	*Hieracium (Pilosella) piloselloides*	A
Meadow hawkweed	*Hieracium pratense*	A, T
Hydrilla	*Hydrilla verticillata*	A
Common frogbit	*Hydrocharis morsus-ranae*	A
St. Johnswort *	*Hypericum perforatum*	B
Policeman's helmet	*Impatiens glandulifera*	B
Yellow flag iris	*Iris pseudacorus*	B
Dyers woad	*Isatis tinctoria*	B
Kochia	*Kochia scoparia*	B

Yellow archangel	*Lamiastrum galeobdolon*	B
Perennial peavine	*Lathyrus latifolius*	B
Lens-podded whitetop	*Lepidium chalepensis (Cardaria)*	B
Whitetop (hoary cress)	*Lepidium draba (Cardaria)*	B
Perennial pepperweed	*Lepidium latifolium*	B
Hairy whitetop	*Lepidium pubescens (Cardaria)*	B
West Indian spongeplant	*Limnobium laevigatum*	A
Dalmatian* toadflax	*Linaria dalmatica (L.genista)*	B
Yellow* toadflax	*Linaria vulgaris*	B
Garden yellow loosestrife	*Lysimachia vulgaris*	A, T
Purple loosestrife*	*Lythrum salicaria*	B, T
Spikeweed	*Memizonia pungens*	B
Parrots feather	*Myriophyllum aquaticum*	B
Eurasian watermilfoil	*Myriophyllum spicatum*	B
Matgrass	*Nardus stricta*	A
Yellow floating heart	*Nymphoides peltata*	A
Scotch thistle	*Onopordum acanthium*	B
Taurian thistle	*Onopordum tauricum*	A, T
Small broomrape	*Orobanche minor*	B
African rue	*Peganum harmala*	A
Common reed	*Phragmities australis ssp. australis*	B
Sulfur cinquefoil	*Potentilla recta*	B
Kudzu	*Pueraria lobata*	A, T
Lesser celandine	*Ranunculus ficaria*	B
Creeping yellow cress	*Rorippa sylvestris*	B
Himalayan blackberry	*Rubus armeniacus (R. procerus, R. discolor)*	B
Ravennagrass	*Saccharum ravennae*	A, T
Mediterranean sage*	*Salvia aethiopis*	B
Tansy ragwort*	*Senecio jacobaea*	B, T
Milk* thistle	*Silybum marianum*	B
Silverleaf nightshade	*Solanum elaeagnifolium*	A
Buffalobur	*Solanum rostratum*	B
Johnsongrass	*Sorghum halepense*	B
Smooth cordgrass	*Spartina alterniflora*	A, T
Common cordgrass	*Spartina anglica*	A, T
Dense-flowered cordgrass	*Spartina densiflora*	A, T
Saltmeadow cordgrass	*Spartina patens*	A, T
Spanish broom	*Spartium junceum*	B
Swainsonpea (Austrian peaweed)	*Sphaerophysa salsula*	B
Water soldiers	*Stratiotes aloides*	A
Medusahead rye	*Taeniatherum (Elymus) caput-medusae*	B
Saltcedar*	*Tamarix ramosissima*	B
European water chestnut	*Trapa natans*	A

Puncturevine*	*Tribulus terrestris*	B
Coltsfoot	*Tussilago farfara*	A
Gorse*	*Ulex europaeus*	B
Spiny cocklebur	*Xanthium spinosum*	B
Syrian bean-caper	*Zygophyllum fabago*	A

* Indicates weeds targeted for biocontrol

A-Listed Weed: A weed of known economic importance which occurs in the state in small enough infestations to make eradication or containment possible; or is not known to occur, but its presence in neighboring states make future occurrence in Oregon seem imminent. Recommended action: Infestations are subject to eradication or intensive control when and where found.

B-Listed Weed: A weed of economic importance which is regionally abundant, but which may have limited distribution in some counties. Recommended action: Limited to intensive control at the state, county or regional level as determined on a site specific, case-by-case basis. Where implementation of a fully integrated statewide management plan is not feasible, biological control (when available) shall be the primary control method.

T-Designated Weed: A designated group of weed species that are selected and will be the focus for prevention and control by the Noxious Weed Control Program. Action against these weeds will receive priority. T designated noxious weeds are determined by the Oregon State Weed Board and directs ODA to develop and implement a statewide management plan. T designated noxious weeds are species selected from either the A or B list.

Table 4: Avian inventory

Common Name	Scientific Name	Special Status[1] Fed/State/ORBIC
Acorn woodpecker	*Melanerpes formicivorus*	SOC/CS/List 4
American kestrel	*Falco sparverius*	--/--/--
American robin	*Turdus migratorius*	--/--/--
Barn swallow	*Hirundo rustica*	--/--/--
Bewick's wren	*Thryomanes bewickii*	--/--/--
Brewer's blackbird	*Euphagus cyanocephalus*	--/--/--
Brown-headed cowbird	*Molothrus ater*	--/--/--
Bullock's oriole	*Icterus bullockii*	--/--/--
California quail	*Callipepla californica*	--/--/--
California scrub-jay	*Aphelocoma californica*	--/--/--
California towhee	*Melozone crissalis*	--/--/--
Canada goose	*Branta canadensis*	--/--/--
Cedar waxwing	*Bombycilla cedrorum*	--/--/--
Chipping sparrow	*Spizella passerina*	--/--/List 4
Common raven	*Corvus corax*	--/--/--
Common yellowthroat	*Geothlypis trichas*	--/--/--
Downy woodpecker	*Dryobates pubescens*	--/--/--
European starling	*Sturnus vulgaris*	--/--/--
Grasshopper sparrow	***Ammodramus savannarum***	--/SV,CS/List 2
Green-winged teal	*Anas crecca*	--/--/--
Hairy woodpecker	*Leuconotopicus villosus*	--/--/--
House finch	*Haemorhous mexicanus*	--/--/--

House sparrow	*Passer domesticus*	--/--/--
Killdeer	*Charadrius vociferus*	--/--/--
Lark sparrow	*Chondestes grammacus*	--/--/--
Lazuli bunting	*Passerina amoena*	--/--/--
Lesser goldfinch	*Spinus psaltria*	--/--/--
Mallard	*Anas platyrhynchos*	--/--/--
Mourning dove	*Zenaida macroura*	--/--/--
Northern flicker	*Colaptes auratus*	--/--/--
Northern harrier	*Circus cyaneus*	--/--/--
Northern rough-winged swallow	*Stelgidopteryx serripennis*	--/--/--
Oak titmouse	*Baeolophus inornatus*	BCC/--/--
Peregrine falcon	*Falco peregrinus*	BCC/SV/List 4
Red-tailed hawk	*Buteo jamaicensis*	--/--/--
Red-winged blackbird	*Agelaius phoeniceus*	--/--/--
Ring-necked pheasant	*Phasianus colchicus*	--/--/--
Rock pigeon	*Columba livida*	--/--/--
Savannah sparrow	*Passerculus sandwichensis*	--/--/--
Song sparrow	*Melospiza melodia*	--/--/--
Spotted towhee	*Pipilo maculatus*	--/--/--
Tree swallow	*Tachycineta bicolor*	--/--/--
Turkey vulture	*Cathartes aura*	--/--/--
Western kingbird	*Tyrannus verticalis*	--/--/--
Western meadowlark	*Sturnella neglecta*	--/--/List 4
Western wood-peewee	*Contopus sordidulus*	--/--/--
White-breasted nuthatch	*Sitta carolinensis*	--/--/--

White-tailed kite	*Elanus leucurus*	--/--/List 4
Wilson's warbler	*Cardellina pusilla*	--/--/--
Yellow-breasted chat	*Icteria virens*	SOC/CS/List 4
Yellow-rumped warbler	*Setophaga coronata*	--/--/--
Chipping sparrow	*Spizella passerina*	--/--/--
White-crowned sparrow	*Zonotrichia leucophrys*	--/--/--
Violet-green swallow	*Tachycineta thalassina*	--/--/--

[1]Status Code Definitions:

FEDERAL:

SOC: U.S. Fish and Wildlife Service (USFWS) Species of Concern

BCC: U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern

ORBIC: Oregon Biodiversity Information Center: 1 = taxa that are threatened with extinction or presumed to be extinct throughout their entire range (1-X designating presumed extirpation from Oregon or extinction); 2 = taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon; these are often peripheral or disjunct species which are of concern (when considering species diversity within Oregon's borders, they can be very significant when protecting the genetic diversity of a taxon)—ORBIC regards extreme rarity as a significant threat and has included species which are very rare in Oregon on this list; 3 = taxa for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range; 4 = taxa which are of conservation concern but are not currently threatened or endangered; this includes taxa which are very rare but are currently secure, as well as List 4 contains taxa which are declining in numbers or habitat but are still too common to be proposed as threatened or endangered. While these taxa may not currently need the same active management attention as threatened or endangered taxa, they do require continued monitoring.

Table 5: Vascular plant inventory

Species	Relative Abundance	Status
Achillea millefolium	frequent	
Achnatherum lemmonii	frequent	
Achyrachaena mollis	common	
Acmispon wrangelianus	rare	
Agoseris retrorsa	infrequent	
Allium acuminatum	rare	
Allium amplectens	rare	
Allium sp (leaves only)	frequent	
Alopecurus pretense	partially dominant	
Alyssum alyssoides	infrequent	
Amaranthus albus	rare	
Amelanchier alnifolia	infrequent	
Amsinckia menziesii	frequent	
Anthriscus caucalis	infrequent	
Apocynum androsaemifolium	frequent	
Apocynum cannabinum	rare	
Artemesia douglasii	infrequent	
Asclepias fasiculatum	frequent	
Asclepias speciosa	infrequent	
Athysanus pusillus	rare	
Avena fatua	dominant	
Avena sativa	rare	
Balsamorhiza deltoidea	infrequent	
Blepharipappus scaber	rare	
Brassica nigra	infrequent	
Brassica rapa	partially dominant	
Brodiaea coronaria	frequent	

Brodiaea elegans	infrequent	
Bromus carinatus	infrequent	
Bromus diandrus	infrequent	
Bromus hordeaceus	dominant	
Bromus japonicus	dominant	
Bromus tectorum	dominant	
Bromus vulgaris	frequent	
California macrophylla (Erodium macrophyllum)		SS
Calochortus tolmiei	common	
Calycadenia truncata	rare	
Calystegia occidentalis	common	
Camassia quamash	rare	
Campanula prenanthoides	rare	
Capsella bursa-pastoris	frequent	
Cardamine oligosperma	rare	
Carex densa	frequent	
Carex geyeri	rare	
Carex sp (leaves only)	infrequent	
Carex stipata	rare	
Centaurea solstitialis	dominant	
Cerastium dichotomum	common	
Cerastium glomeratum	frequent	
Cercocarpus betuloides	rare	
Chamaesyce serpyllifolia	rare	
Cichorium intybus	infrequent	
Cirsium arvense	infrequent	NOX
Cirsium cymosum	rare	
Cirsium vulgare	infrequent	NOX
Clarkia gracilis	infrequent	

Clarkia purpurea	infrequent	
Clarkia rhombifolia	infrequent	
Claytonia exigua	rare	
Claytonia parviflora	infrequent	
Claytonia perfoliata	infrequent	
Collinisa parviflora	infrequent	
Collinsia linearis	infrequent	
Collinsia sparsiflora	infrequent	
Collomia grandiflora	rare	
Collomia linearis	infrequent	
Conium maculatum	infrequent	NOX
Conyza canadensis	rare	
Crepis modocensis	frequent	
Crocidium multicaule	infrequent	
Cryptantha intermedia	infrequent	
Cynoglossum grande	rare	
Cynosurus echinatus	frequent	
Cyperus cf esculentus	rare	NOX
Dactylis glomerata	infrequent	
Daucus carrota	frequent	
Daucus pusillus	rare	
Delphinium nuttallianum	infrequent	
Dichelostemma capitatum	common	
Dichelostemma congestum	common	
Dipsacus fullonum	frequent	
Dodecatheon hendersonii	rare	
Dowingia yina	rare	
Draba verna	infrequent	
Echinochloa crus-galli	rare	

Eleocharis acicularis	infrequent	
Eleocharis macrostachya (or palustris?)	infrequent	
Elymus glaucus	infrequent	
Epilobium brachycarpum	common	
Epilobium ciliatum var watsonii	frequent	
Equisetum hyemale	infrequent	
Ericameria nauseosa	rare	
Eriogonum compositum	rare	
Eriophyllum lanatum	frequent	
Erodium cicutarium	dominant	
Erysimum capitatum	rare	
Erythronium hendersonii	frequent	
Eschscholzia californica	rare	
Eurphorbia crenulata	rare	
Festuca roemeri	frequent	
Fraxinus latifolia	rare	
Fritillaria affinis	frequent	
Fritillaria sp (leaves only)	frequent	
Galium aparine	frequent	
Galium bolanderi	rare	
Galium divaricatum	infrequent	
Galium parisiense	dominant	
Geranium dissectum	dominant	
Geranium molle	dominant	
Gilia capitata	rare	
Glyceria sp (leaves only; grazed)	rare	
Gnaphalium palustre	rare	
Hemizonia congesta	rare	
Hieracium albiflorum	rare	

Hieracium scouleri	infrequent	
Holcus lanatus	infrequent	
Hordeum murinum	infrequent	
Horkelia daucifolia	frequent	
Hypericum perforatum	rare	NOX
Juncus effusus	common	
Juncus ensifolius	rare	
Juncus patens	rare	
Koeleria macrantha	infrequent	
Lactuca serriola	frequent	
Lagophylla ramossissima	rare	
Lamium amplexicaule	infrequent	
Lathyrus aphaca	infrequent	
Lathyrus cicera	rare	
Lemna minor	rare	
Lepidium campestre	uncommon	
Leptosiphon bilcolor	rare	
Linum bienne	common	
Lithophragma parviflorum	infrequent	
Lolium perenne	infrequent	
Lomatium californicum	rare	
Lomatium macrocarpum	frequent	
Lomatium nudicaule	infrequent	
Lomatium triternatum	infrequent	
Lomatium utriculatum	dominant	
Lonicera hispidula	infrequent	
Lonicera interrupta	infrequent	
Lotus corniculatus	infrequent	
Lotus micranthus	rare	

Lotus nevadensis	infrequent	
Lupinus albifrons	infrequent	
Lupinus bicolor	rare	
Lupinus cf microcarpus	rare	
Lupinus latifolius	frequent	
Madia citriodora	frequent	
Madia elegans ssp densiflora	infrequent	
Madia elegans ssp vernalis	frequent	
Madia exigua	infrequent	
Madia gracilis	common	
Madia sativa	rare	
Mahonia aquifolium	rare	
Maianthemum stellatum	rare	
Malus fusca	infrequent	
Malus pumila	rare	
Medicago polymorpha	rare	
Medicago sp (leaves only; perhaps M. sativa)	rare	
Melilotus albus	infrequent	
Micropus californicus	infrequent	
Microseris laciniata ssp detlingii	infrequent	
Mimulus guttatus	infrequent	
Montia linearis	rare	
Myosotis discolor	rare	
Myosotis laxa	rare	
Nemophila parviflora	rare	
Olysnium douglasii	infrequent	
Orobanche uniflora	rare	
Osmorhiza berteroi	rare	
Penstemon sp (leaves only)	rare	

Phacelia hastata	infrequent	
Phacelia ramosissima	rare	
Phalaris arundinacea	infrequent	NOX
Phlox gracilis	infrequent	
Phlox speciosa	frequent	
Phoradendron villosum	frequent	
Piperia sp (leaves only)	rare	
Plagiobothrys tenellus	infrequent	
Plantago lanceolata	frequent	
Plectritus congesta	common	
Plectritus macrocera	infrequent	
Poa bulbosa	dominant	
Poa pratensis	infrequent	
Polygonum douglasii	frequent	
Polypogon monspeliensis	rare	
Populus balsamifera ssp trichocarpa	rare	
Portulaca oleracea	infrequent	
Prunus avium	infrequent	
Prunus cerasifolia	infrequent	
Prunus subcordata	common	
Pseudoroegneria spicata	frequent	
Quercus garryana ssp breweri	rare	
Quercus garryana ssp garryana	common	
Quercus kelloggii	infrequent	
Ranunculus austro-oreganus	frequent	SS
Ranunculus orthrhynchus	infrequent	
Ranunculus parviflorus	frequent	
Ranunculus sp (leaves only)	frequent	
Ranunculus uncinatus	frequent	

Ribes inerme var. klamathense	rare	
Rosa canina	common	
Rosa eglantina	infrequent	
Rosa gymnocarpa	rare	
Rubus armenicus	common	NOX
Rubus laciniatus	rare	NOX
Rubus ursinus	infrequent	
Rumex acetosella	infrequent	
Rumex crispus	frequent	
Salix cf lucida	rare	
Salix exigua	rare	
Salix lasiandra var. lasiandra	frequent	
Salix scouleriana	rare	
Sambucus cerulea	rare	
Sanguisorba minor	infrequent	
Sanicula crassicaulis	infrequent	
Scandix penctin-veneris	infrequent	
Selaginella wallacei	rare	
Senecio integerrimus	rare	
Shedonorus arundinaceus	partially dominant	
Silybum marianum	rare	NOX
Solanum dulcamara	rare	
Sonchus asper	infrequent	
Spartium junceum	rare	NOX
Stachys ajugoides	infrequent	
Symphoricarpos albus	infrequent	
Symphoricarpos mollis	frequent	
Taeniatherum caput-medusae	dominant	NOX
Taraxicum officinale	infrequent	

Thinopyrum ponticum	common (highly concentrated in one large area)	
Torilis arvensis	frequent	
Toxicodendron diversiloba	common	
Tragopogon dubius	dominant	
Trifolium albopurpureum	frequent	
Trifolium dubium	infrequent	
Trifolium hirtum	common	
Trifolium subterraneum	rare	
Typha latifolia	rare	
Valerianella locusta	frequent	
Verbascum blatteria	rare	
Veronica americana	infrequent	
Vicia americana	frequent	
Vicia sativa	dominant	
Vicia villosa	dominant	
Vulpia bromoides	infrequent	
Vulpia microstachys	dominant	
Wyethia angustifolia	infrequent	
Yabea microcarpa	rare	
Zigadensus venenosus var venenosus	infrequent	

Figures

Figure 1: Study Area

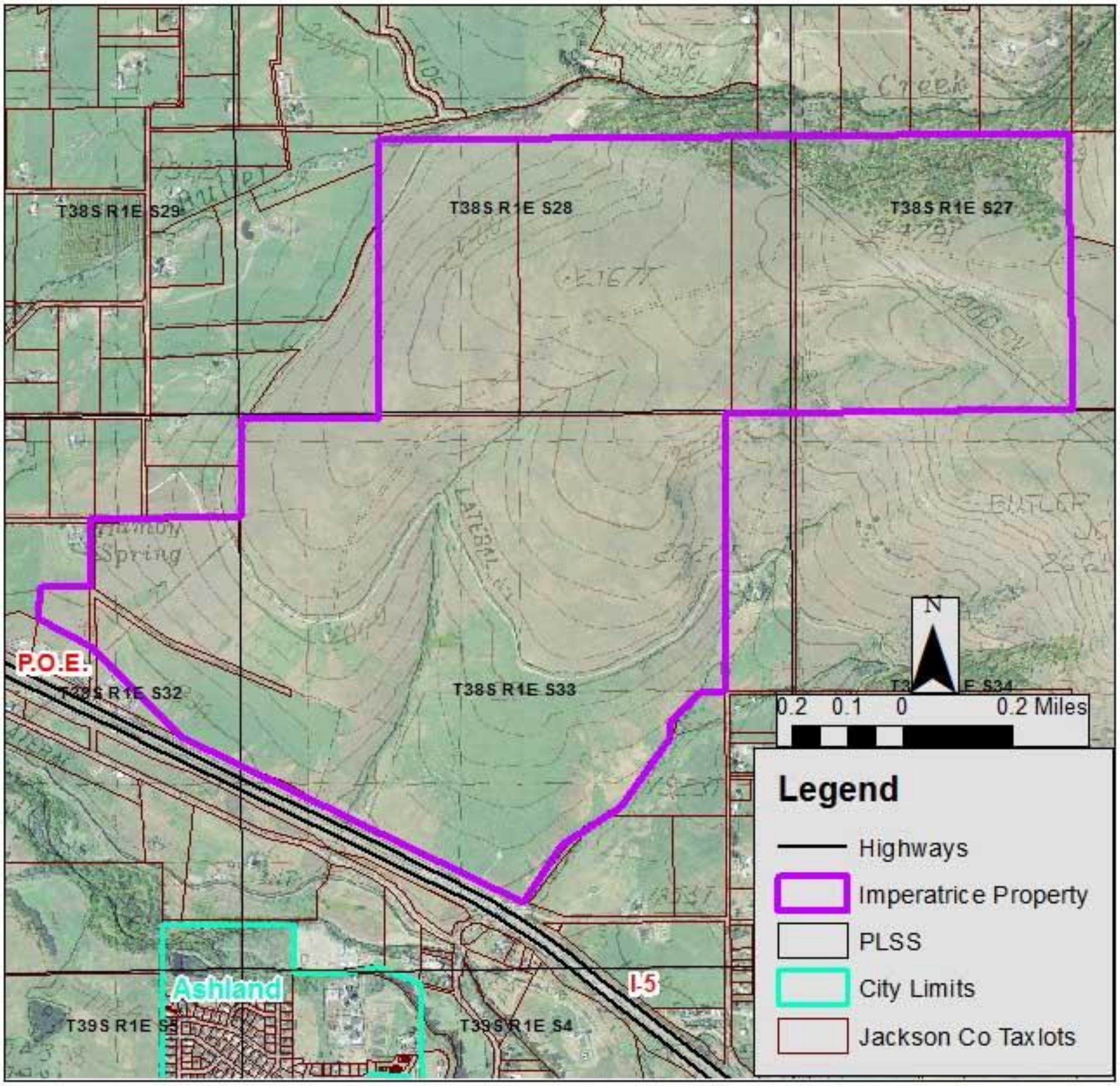


Figure 2: ORBIC Rare Plant Form

OREGON BIODIVERSITY INFORMATION CENTER

RARE PLANT FIELD SURVEY FORM

Please complete all entries in the top section above the heavy line. Please complete as much as possible the more detailed section below the heavy line. You may use the back for comments or additional space. If possible, please attach a map of the location, preferably something of the same quality as a USGS 7.5' map.

Scientific Name: ______________________________

Date of Field Work:__________________ County:______________ Collection: ☐Yes (__________________), ☐No
mo. day year coll # , herbarium

Directions:______________________________

Reporter:______________________________ Phone: ____________________

Address: ______________________________

---

1. **LOCATION** - Attach separate map or sketch a map indicating exact site, scale and proximity to prominent features.
   A. Plant found?______Yes_______No If no, reason:______________________________
   B. Location: T________R________Sec__________ ________1/4 of________1/4 (use back for more TRS)
   C. Source of GPS coordinates (fill one): GPS (make & model__________________) or map (type & scale__________)
   GPS accuracy distance:__________________ ☐Feet or ☐ Meters
   Datum: ☐ NAD27 ☐NAD83 ☐ Other:________. Easting/Longitude____________Northing/Latitude____________
   D. Owner/Manager: ______________________________
2. **SPECIES BIOLOGY**
   A. Phenology:_________% in flower,_________% in fruit,________% in leaf
   B. Population size: Number of plants:__________________Area occupied: ______________________
   C. Age Class:_______% seedlings,_______% immature,_______% 1st year,_______% mature,_______% senescent
3. **HABITAT**
   A. Plant communities/Habitat Description/Associated Species:______________________________
   B. Aspect:_______________(enter compass direction(s) or degrees)
   C. Slope: ☐Slight (0°-20°) ☐Moderate (20°-45°) ☐Extreme (45°+) ☐Vertical
   D. Topographic position: ☐Crest ☐Upper slope ☐Mid-slope ☐Lower slope ☐Bottom
   E. Light: ☐Open ☐Filtered ☐Shaded
   F. Moisture: ☐Inundated ☐Saturated ☐Moist ☐Dry
   G. Elevation range:____________to____________ ☐Feet or ☐ Meters
   H. Substrate/soil: ______________________________
   I. Visible threats/potential disturbance: ______________________________
4. **DETERMINATION** How was plant identified? (choose one or more; please note the source for each choice)
   ☐Keyed in flora ☐Compared with specimen ☐Compared with photo/drawing ☐Identified by someone else ☐Other
   Sources: ______________________________
5. **PHOTOGRAPHS/SLIDES**
   Did you take a photo? ☐Yes (☐Film ☐Digital) ☐ No If yes, may we obtain duplicates at our cost? ☐Yes ☐No

ORBIC-INR / Portland State University / Mail Stop INR / P.O. Box 751 / Portland, Oregon 97201-0751 / 503-725-9950 ph, -9960 fax

Figure 3: ***California macrophylla*** **site locations**

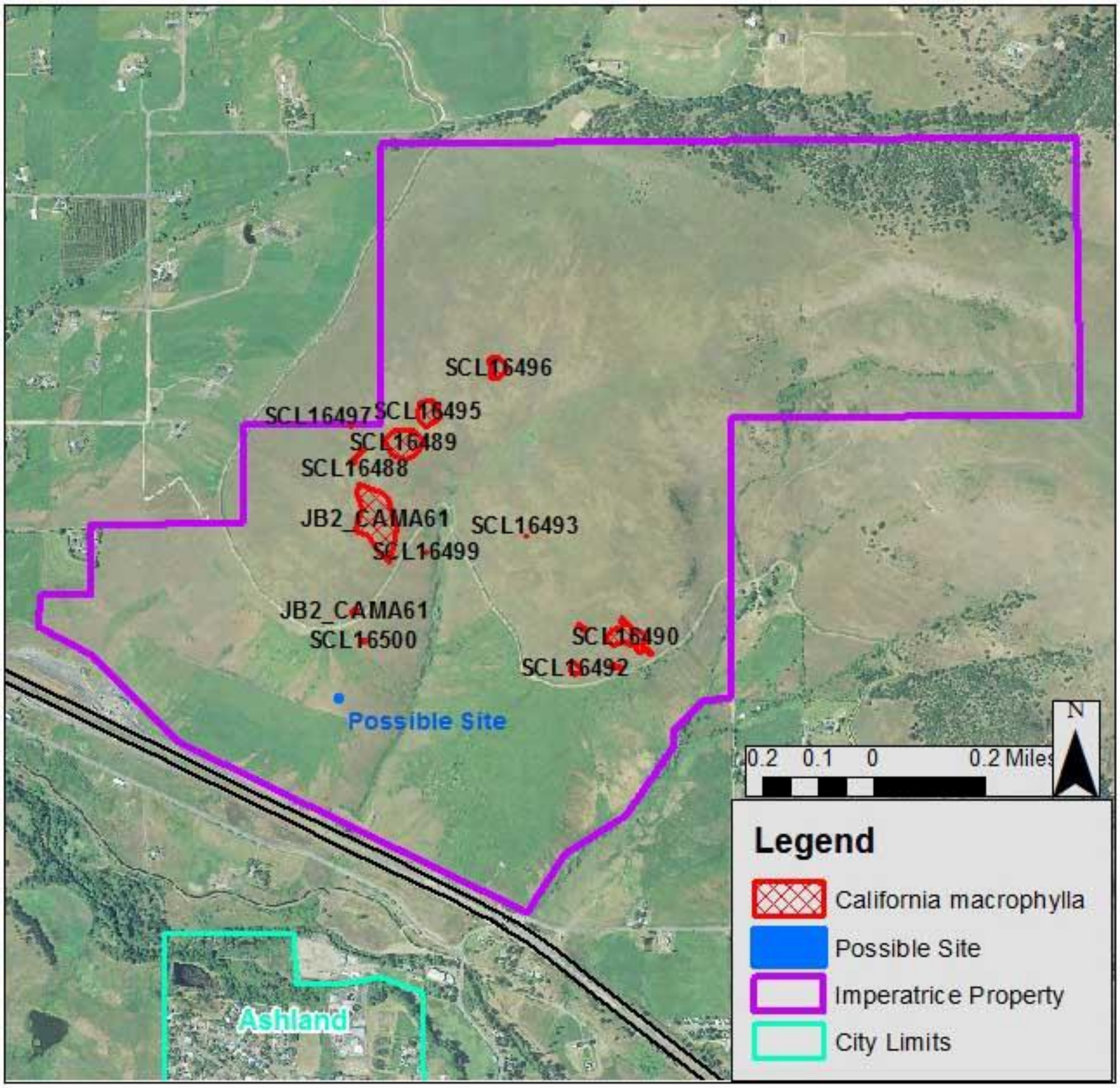


Figure 4: ***California macrophylla*** **specimens**

Plants, with fruit (lower right inset) and flower (bottom center inset)

Figure 5: ***Ranunculus austro-oreganus*** **and** ***Collema quadrifidum*** **site locations**

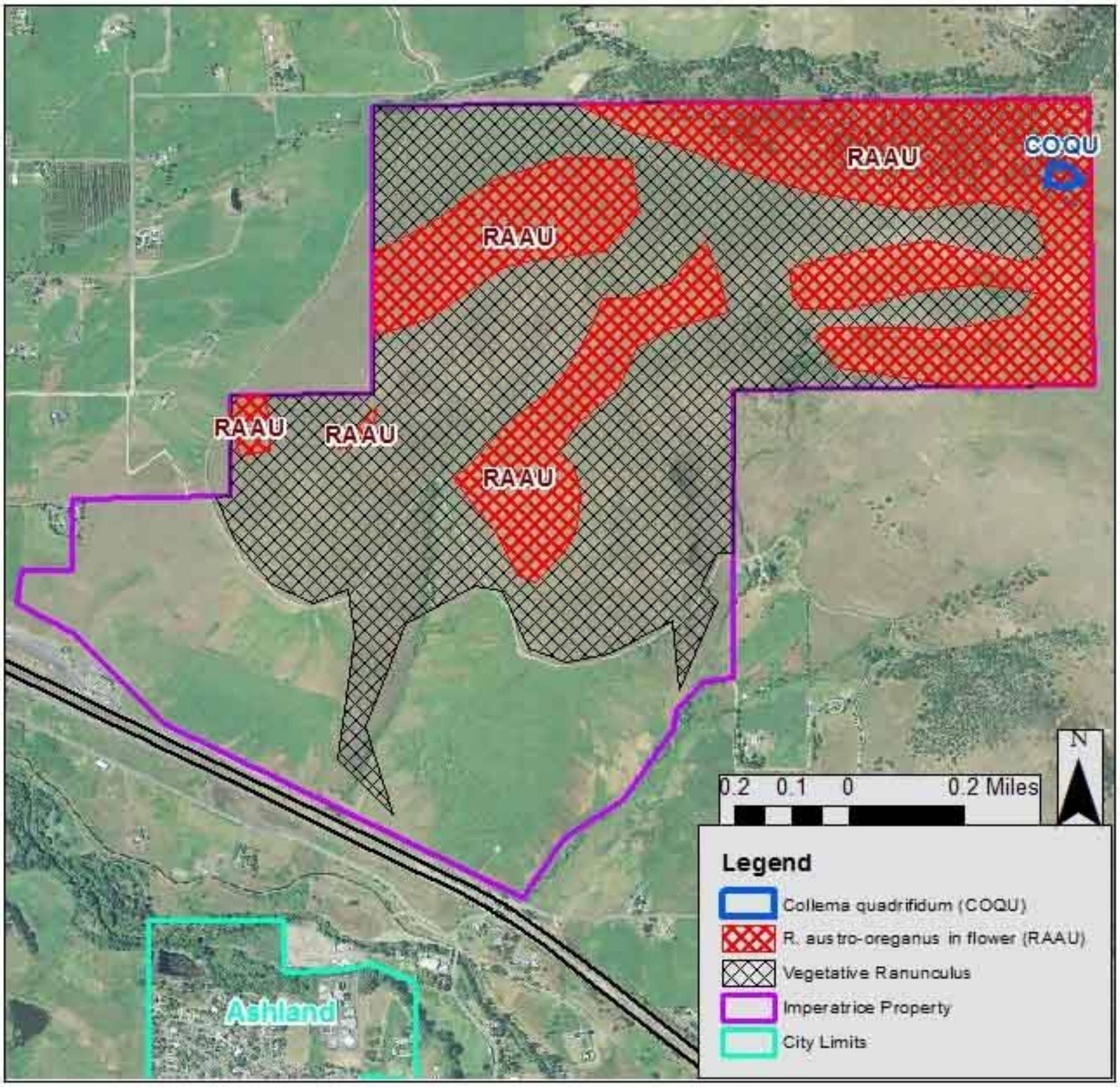
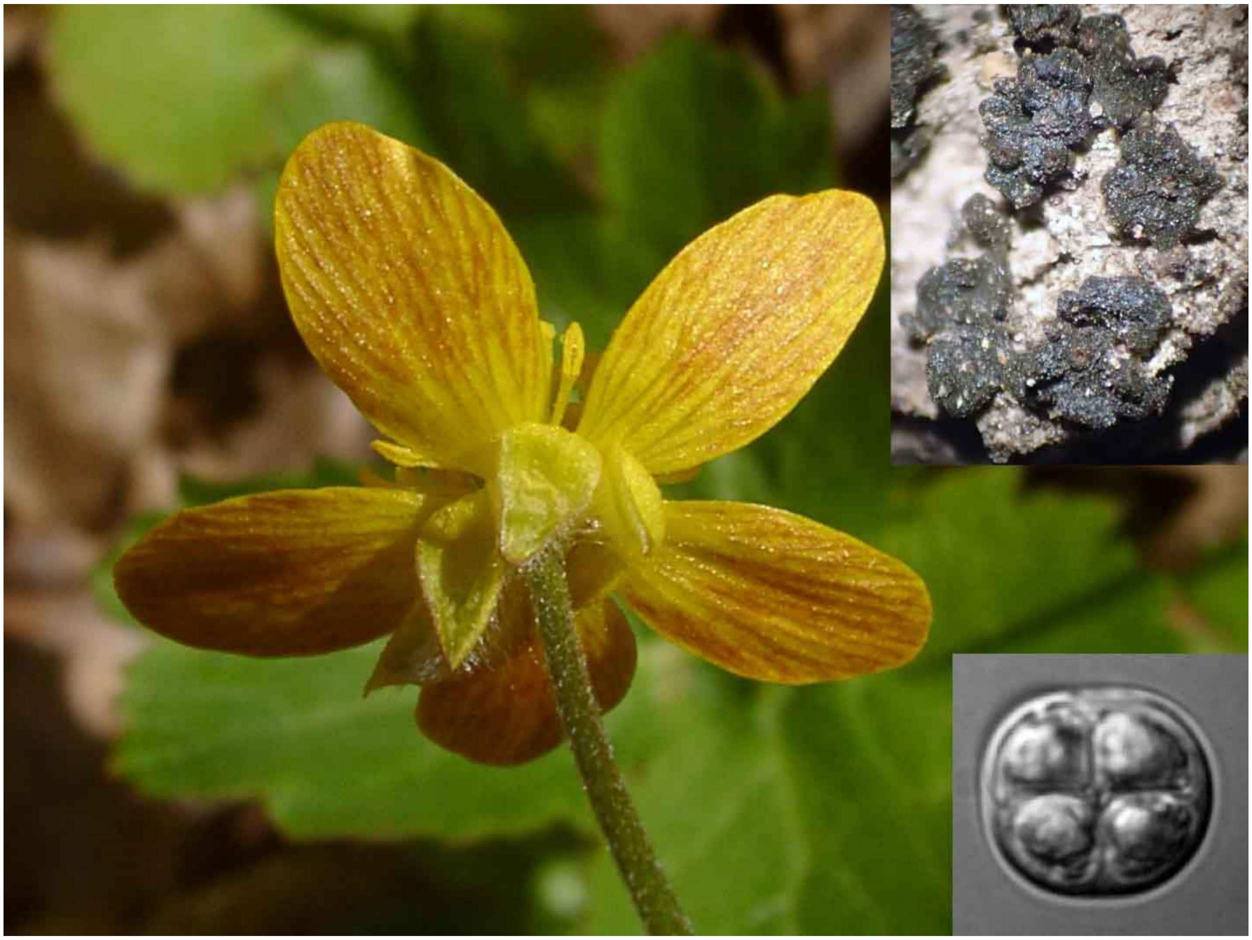


Figure 6: *Ranunculus austro-oreganus* and *Collema quadrifidum* specimens



Ranunculus austro-oreganus **flower (diagnostic petal backs), with** ***Collema quadrifidum*** **thalli (upper right inset) and** ***C. quadrifidum*** **spore (lower right inset)**

Figure 7: Noxious weed locations other than *Centaurea solstitialis* and *Elymus caput-medusae*

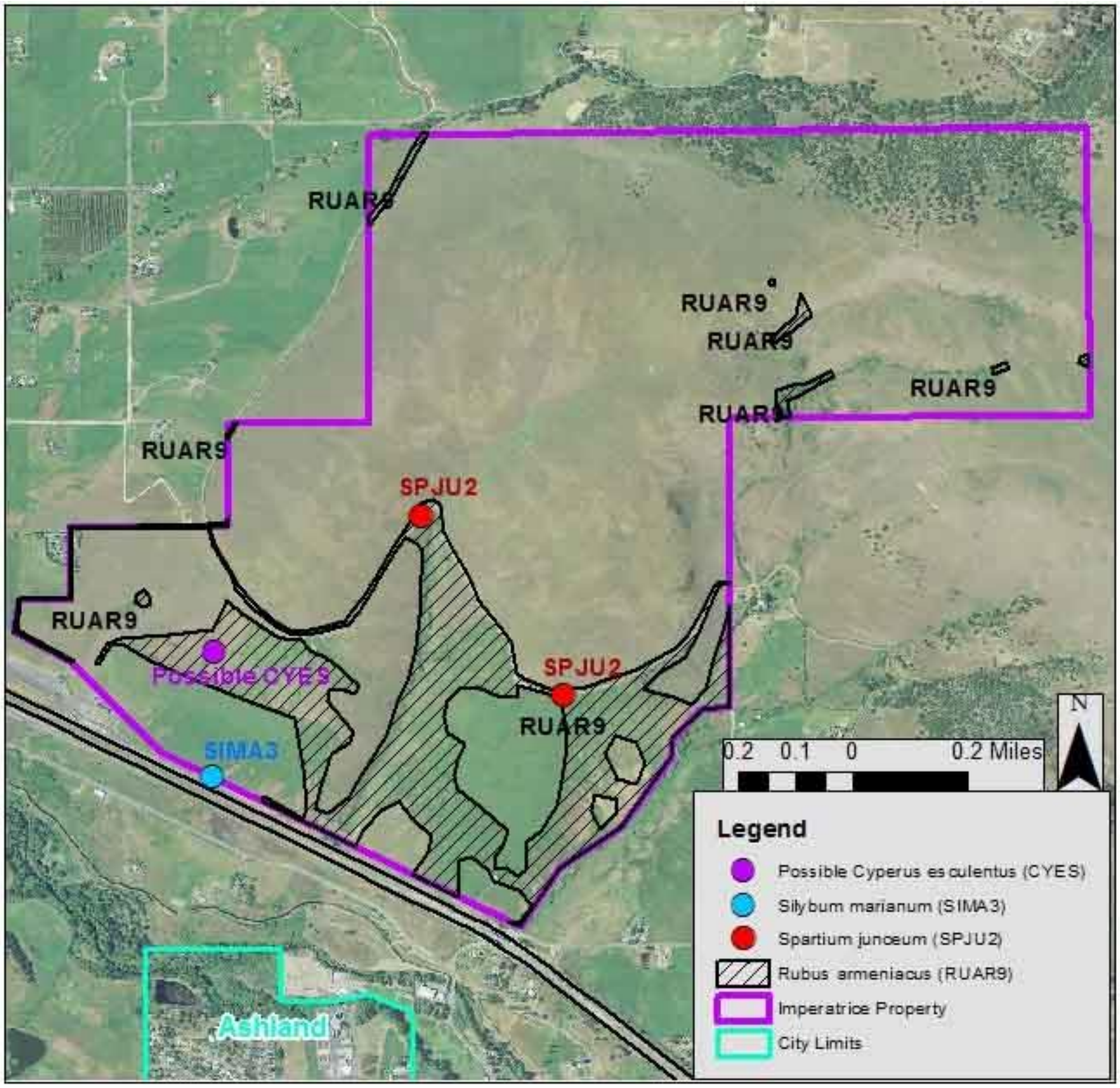


Figure 8: Grasshopper sparrow detections

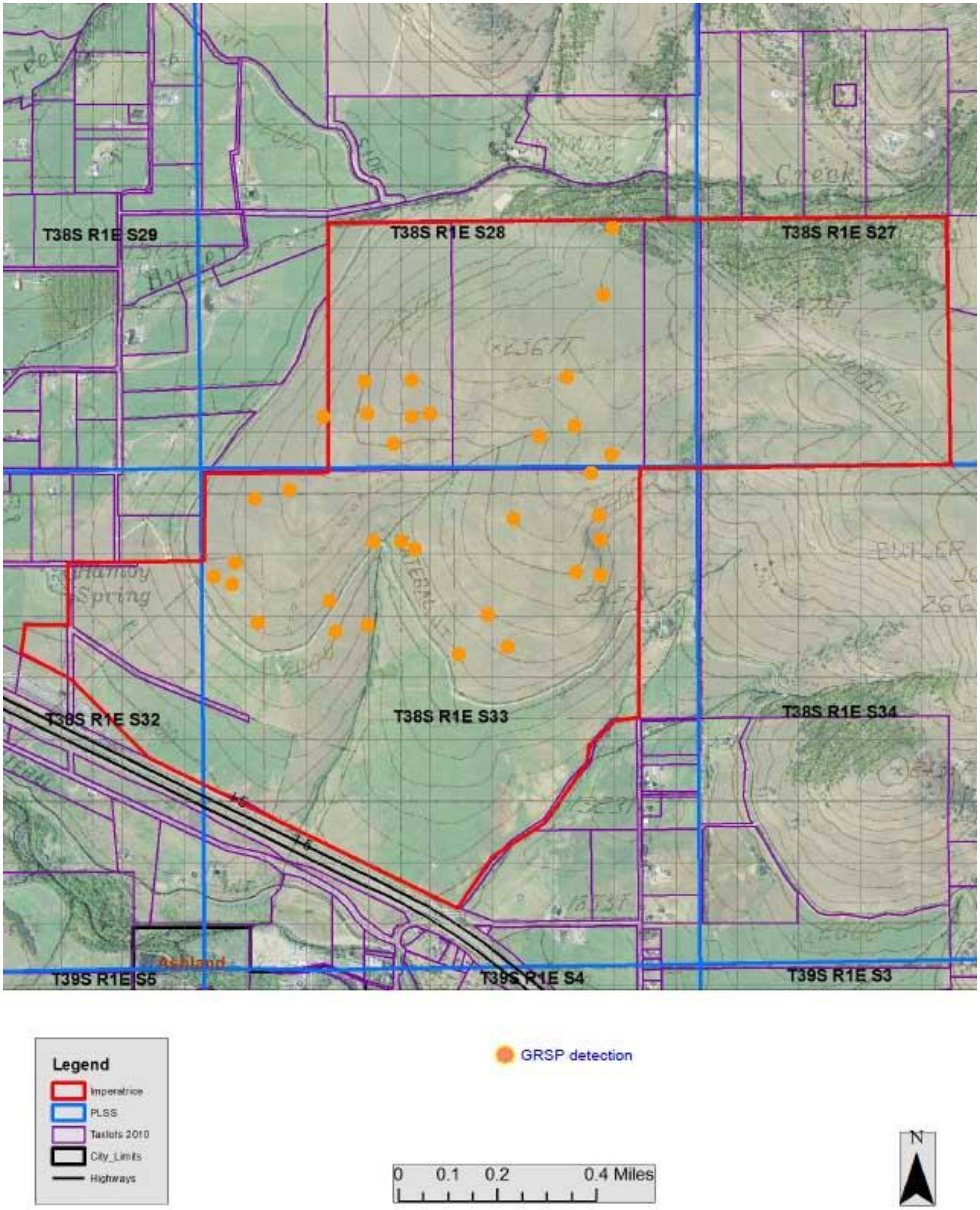


Figure 9: Species of *Phaeocalicium* from the Study Area (micrograph)

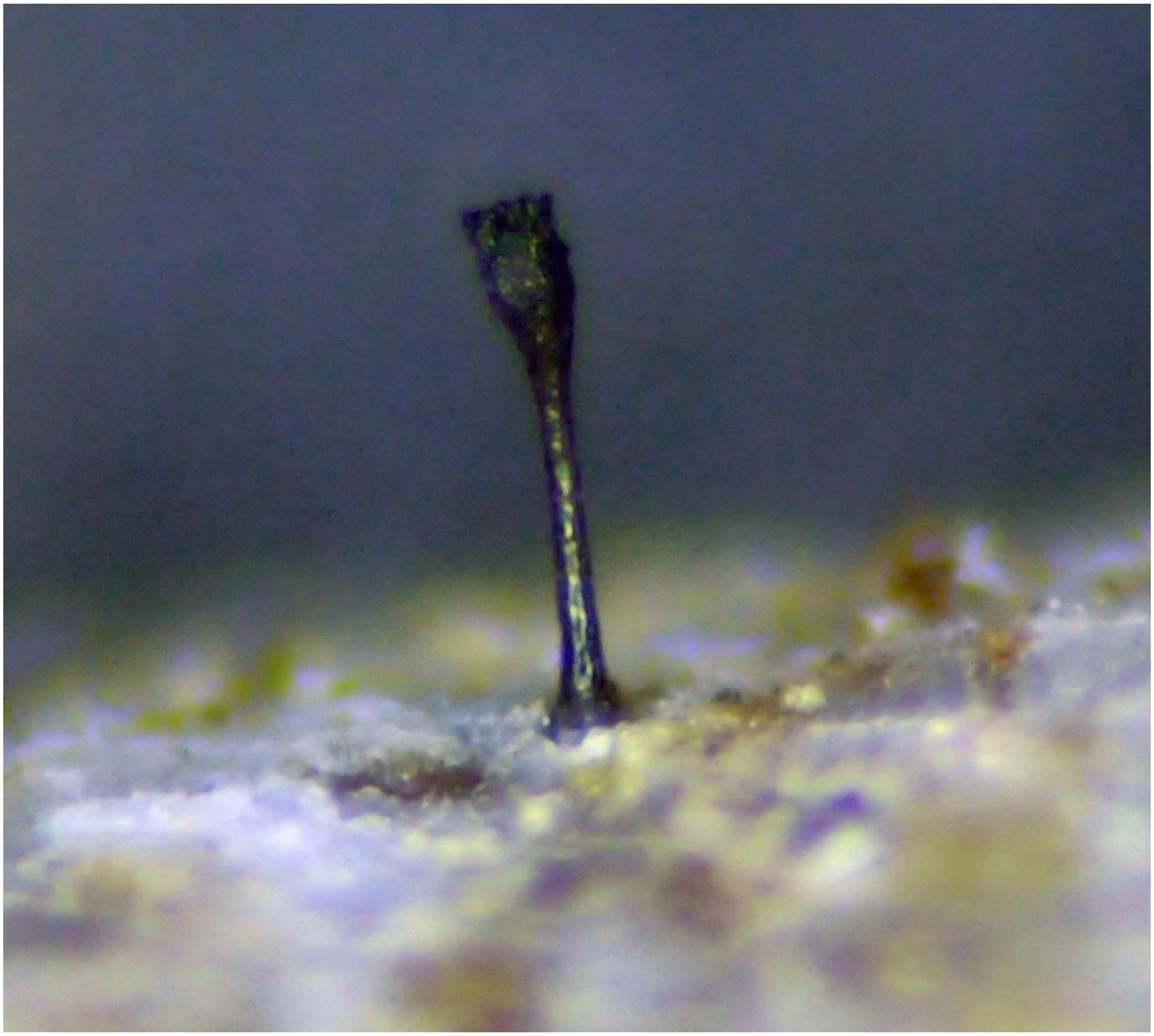


Figure 10: Petrified log

Appendix A: Representative Photos of the Property

Early season view north towards Grizzly Peak (background) from downslope of TID canal

Early season view of the City of Ashland from the Property with Mt Ashland and Ashland Watershed in background

Early season view north towards Grizzly Peak (background) from upslope of TID canal

Early season view of vegetation downslope of TID canal, looking south towards City of Ashland

Oak woodlands at the north end of the Property

Herd of elk, with Bald Mt and Anderson Butte vicinities in far background. (See also photo on front cover page)

Early season view of vegetation upslope of TID canal (yellow flowers are the native *Lomatium utriculatum*)

Looking approximately southeast across the Property, from upslope of the TID canal

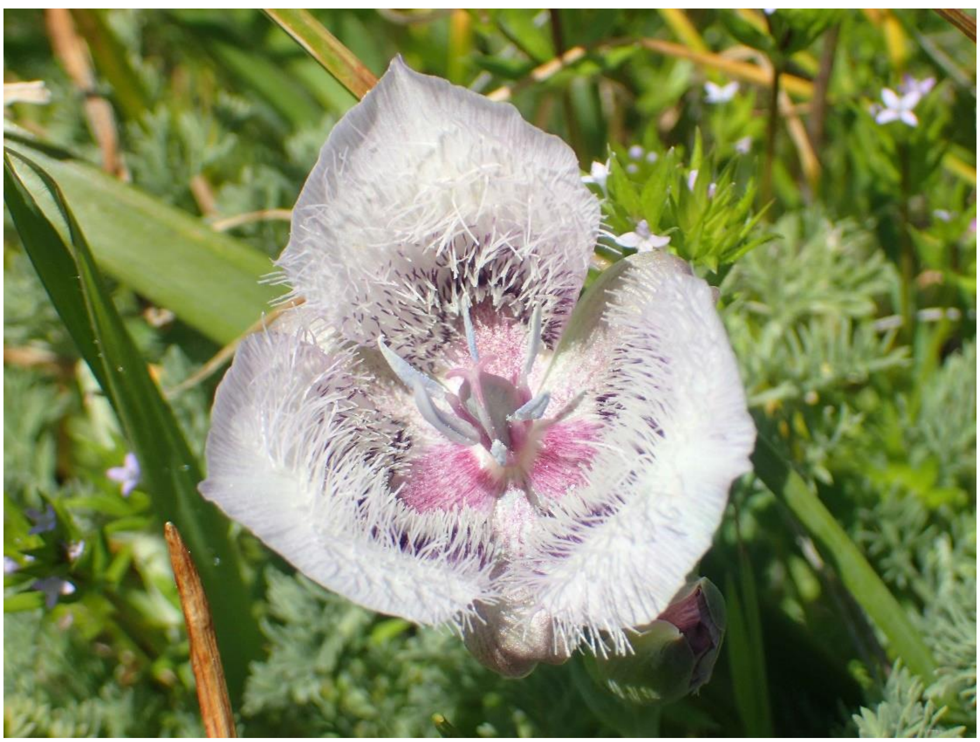
View across Property, with seasonal pond (see 3.1 Current Environment) in background; purple flowers in foreground are *Vicia villosa*

View of powerline and gas pipeline corridors on the Property; the pale strip from top to bottom, just left of center, with OHV tracks, is a *Thinopyrum ponticum* monoculture atop the buried gas pipeline (see 3.3 Noxious Weeds)

Pin flags delineating a *California macrophylla* population; background: controlled burning (smoke) from the Ashland Forest Resiliency project within the Ashland Watershed

Field of the native *Plectritis congesta* (shortspur seablush) in far northwest part of property, with Butler Creek in background

Cement “cistern” on broad ridgeline



The native *Calochortus tolmiei* (Tolmie’s startulip)

Saguisorba minor (salad burnet)

The native *Calystegia occidentalis* (field bindweed)

The native *Leptosiphon bicolor* (babystars)

Note: hi-res versions of the above photos are available upon request

TECHNICAL MEMORANDUM

PO BOX 70413 ■ SPRINGFIELD, OR 97475 ■ PHONE (541)393-3345 ■ FAX (541)505-8917

City of Ashland PV Generation Interconnect Analysis

PREPARED FOR:	Tom McBartlett, Electrical System Manager/City of Ashland, Elec. Dept.
PREPARED BY:	Martin Stoddard, P.E./OS Engineering
COPIES:	Mark Holden/City of Ashland, Elec. Dept. Adam Hanks/City of Ashland, Elec. Dept Jerry Witkowski, P.E./OS Engineering Jiajia Song, Ph.D./OS Engineering
DATE:	January 31, 2017

1.0 <u>EXECUTIVE SUMMARY</u>

1.1 General

This engineering document describes a preliminary review of options and interconnect feasibility for adding a large scale Photovoltaic (PV) generation facility and connecting it into the City's existing electrical distribution system. It is our understanding that the project objective is to install a solar generation system with the capacity to meet approximately 10% of the City's annual energy consumption, which is equivalent to a system with a nameplate capacity of approximately 10 MW. It is also our understanding that the City prefers to interconnect the PV system directly to the City's existing distribution system rather than a transmission interconnection.

This engineering investigation evaluated integrating photovoltaic systems with generation output ranging between 2.5 MW and 10 MW. This range was based on the ability of the City's existing facility capabilities at practical interconnection locations.

The PV site is located approximately 1 mile from nearby City electric distribution facilities and, although the solar array would be constructed on City owned property, the interconnection would be constructed outside the City's existing service territory. Therefore, interconnect construction will require permitting, easements and rights-of-way access.

Presently the City has an exclusive power purchase agreement with the Bonneville Power Administration (BPA) and BPA has a General Transfer Agreement with PacifiCorp. Our review of the interconnect options assumes generation export is not desired and that all energy production from the new system will be utilized by the City. Because of the City's intent to maximize the amount of solar generation and the desire to not export power, the engineering investigation evaluated the estimated PV generation profile with seasonal adjustment against typical seasonal load profiles as a base criteria for establishing maximum interconnect generation capacity.

1.2 PV System Interconnect

Distribution system connected generation can have significant impacts on protection and power quality of an electric distribution system. Therefore, carefully defined protection and control requirements are necessary. This includes output protection and control at the inverter by the PV developer and protection, control and metering at the utility point of common coupling (PCC) by the City.

Multiple interconnection points are available within the City's distribution system. Several of these connection points were evaluated to identify maximum feasible PV capacity. This included remote interconnections at radial taps and connection with main backbone circuits. To maximize PV generation, interconnection with a distribution backbone feeder circuit is necessary. However, due to minimum peak substation loading at certain times of the year, the maximum PV output that can be interconnected to any one substation is limited to 5 MW based on a review of historic load data and estimated generations profiles. To interconnect PV output generation to the extent desired by the City (~10 MW), it will likely be necessary to interconnect with two backbone feeder circuits from two separate substations.

We have assumed the PCC interconnection between the PV system and utility system will be located within the southwest region of the Imperatrice Property, not within the Short-Term Lease area. Leaving the Short-Term Lease property available for other future uses.

We recommend that the City substantiate, through the PV development RFP, that the solar construction project conforms to all applicable industry standards regarding equipment, construction and operation to assure protection of the electric systems normal operation and quality of service to existing customers.

1.3 Comments and Recommendations

Our preliminary analysis and review indicates that the City can achieve the PV generation interconnect desired without excessive deleterious effect to the existing distribution system or violation of existing purchase agreements. However, interconnection to the existing City distribution facilities should be coordinated as stated above and described in greater detail in this memorandum. Where are analysis has concluded a maximum interconnect generation size, it can be assumed that a smaller system can be accommodated thus allowing the City to install PV generation in increments staged, for example, in 1 MW or 2.5 MW output capacities.

To achieve strong interconnection(s) between the PCC and the existing electric distribution system it is recommended that a tie location occur near the vicinity or N Mountain Avenue and E Nevada Street. This location offers connection to a feeder from Ashland Substation, Mountain Avenue Substation, or both to accommodate the full PV build-out capacity of 10 MW. This location should be considered even if the PV facility is built in stages. Other interconnection locations are available and are described elsewhere in this memorandum but to achieve the City's ultimate capacity goal this tie point is the optimal location for the existing system.

To accomplish interconnection between the PV system and the City's existing distribution system we recommend consideration for underground construction to meet the least public resistance. This can be accomplished with both open trench and directional bore construction. If the City intends to have the PV site developed in incremental stages, it is suggested that all underground infrastructure be installed initially, with major equipment installed as needed to meet generation capacity.

If the City is considering having the utility interconnection construction performed by the PV developer it is suggested that construction technical specifications and material standards be assembled and provide to ensure quality construction.

Budgetary pricing has been assembled to expand the City's electric system to interconnect at the PCC with the PV site as described herein. The cost to construct circuit interconnections for a PV facility with capacity ranging between 2.5 MW and 10 MW is estimated to be between $0.9 and $1.5M.

2.0 <u>INTRODUCTION</u>

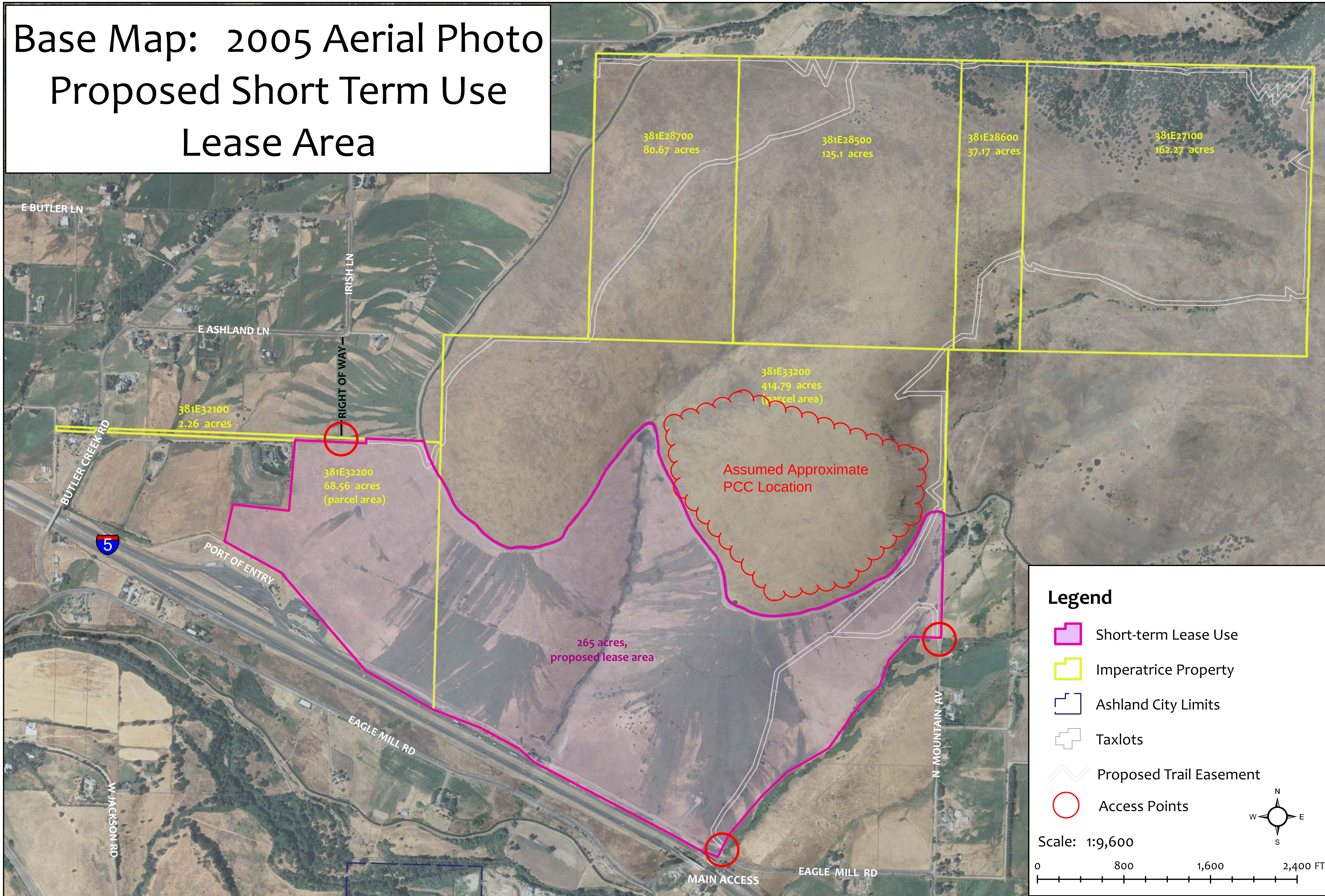
2.1 Overview of the project

The City of Ashland intends to install a PV generation system that can support approximately 10% of its annual energy usage, 17.4M kWh, which the City has determined to be equivalent to approximately 10 MW. The City has explained its preference to interconnect the PV system directly to the City's existing 12.47 kV distribution system, and requested OS Engineering, engineering service contractor for the City, to evaluate the feasibility and impacts of various interconnect options to meet the City's intent. In this study, OS Engineering has developed and assessed three different interconnecting options of the integration of a power generation PV system into existing City of Ashland distribution facilities. Our review includes estimated generation output, system load profiles, power quality considerations, protection, and approximate cost estimates.

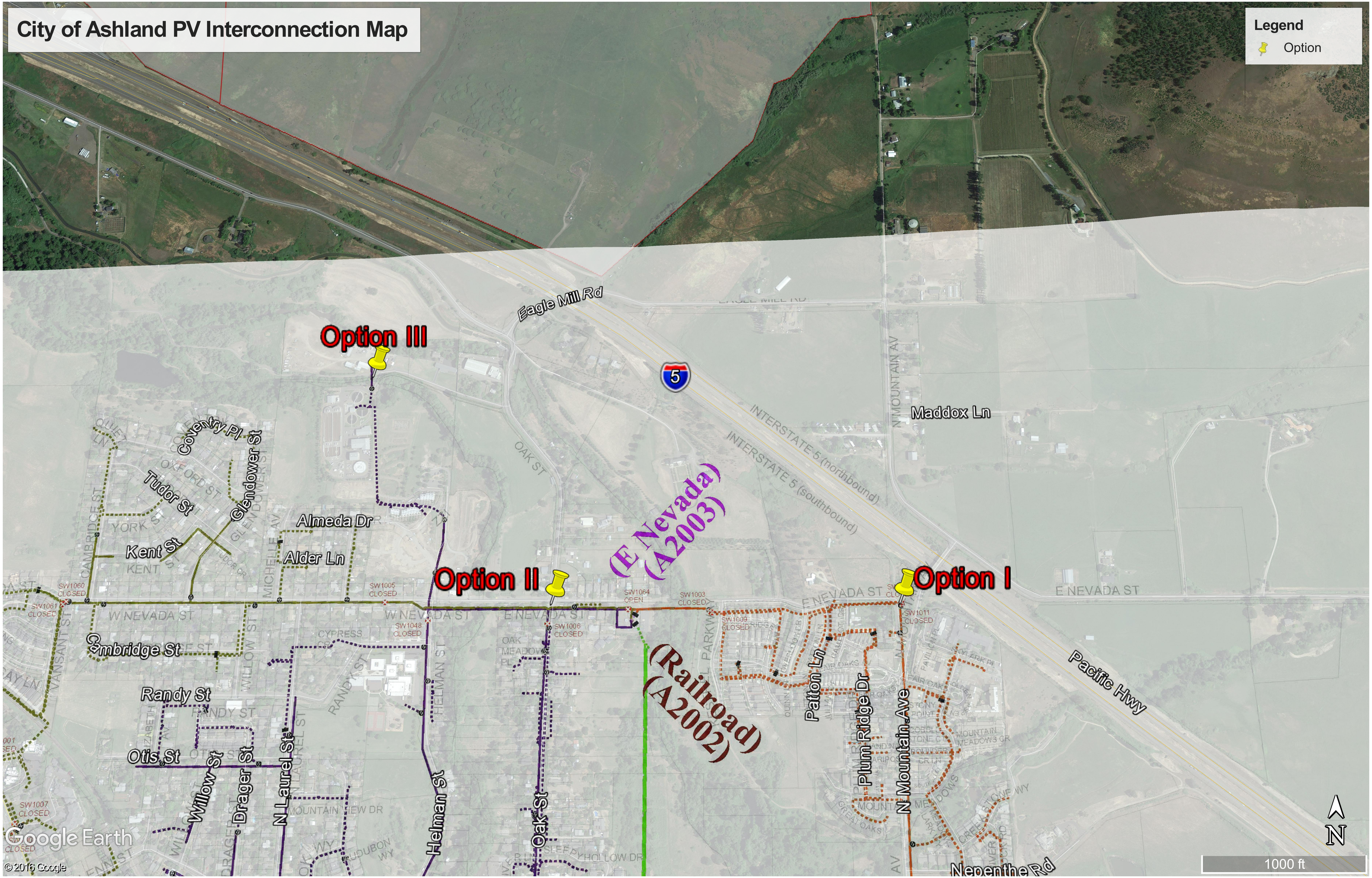
2.2 Map of the project and potential interconnect points

The following two maps show the City of Ashland Imperatrice Property Map 2005, and potential PV Interconnection Points Map, respectively.

Base Map: 2005 Aerial Photo
Proposed Short Term Use Lease Area



City of Ashland PV Interconnection Map



3.0 PV TECHNOLOGY OVERVIEW

Photovoltaics (PV) systems have been well recognized as a promising renewable energy technology and have been growing exponentially worldwide for more than two decades, during which PV technologies evolved in many different aspects, such as flat-plate vs. concentrating, improved materials, higher efficiency, lower costs, etc. During this time, many improvements have been realized in inverter technology, tracking systems, controls, and protection that facilitate PV generation in large scale power production interconnected to transmission and distribution systems. As a preliminary study regarding the City of Ashland PV project, we did not investigate the option of concentrator and different type of PV modules and inverters, but utilized a generic flat-plate PV and inverter combination in order to provide representative PV generation profiles for different mounting configurations based on actual seasonal weather data in the City of Ashland area.

3.1 PV Generation Profile

The City of Ashland 2014 hourly weather data, including solar irradiance (Solar irradiance is the power per unit area received from the Sun in the form of electromagnetic radiation), is available from the NREL National Solar Radiation Database (NSRDB). The database contains satellite-derived data from the Physical Solar Model (PSM) for both typical year data and historical single year data for 1998 through 2014 for locations in the United States. The weather in the Northwest area has a fairly repeatable pattern every year, therefore the 2014 weather data is used to as a typical profile for the City of Ashland.

One of the parameters available in the 2014 weather data is the Global Horizontal Irradiance (GHI). The GHI is the total amount of shortwave radiation received from above by a surface horizontal to the ground. This value is of particular interest to photovoltaic installations and includes both Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHI). DNI is solar radiation that comes in a straight line from the direction of the sun at its current position in the sky. DHI is solar radiation that does not arrive on a direct path from the sun, but has been scattered by molecules and particles in the atmosphere and comes equally from all directions. Figure 1 shows the three profiles for City of Ashland, 2014.

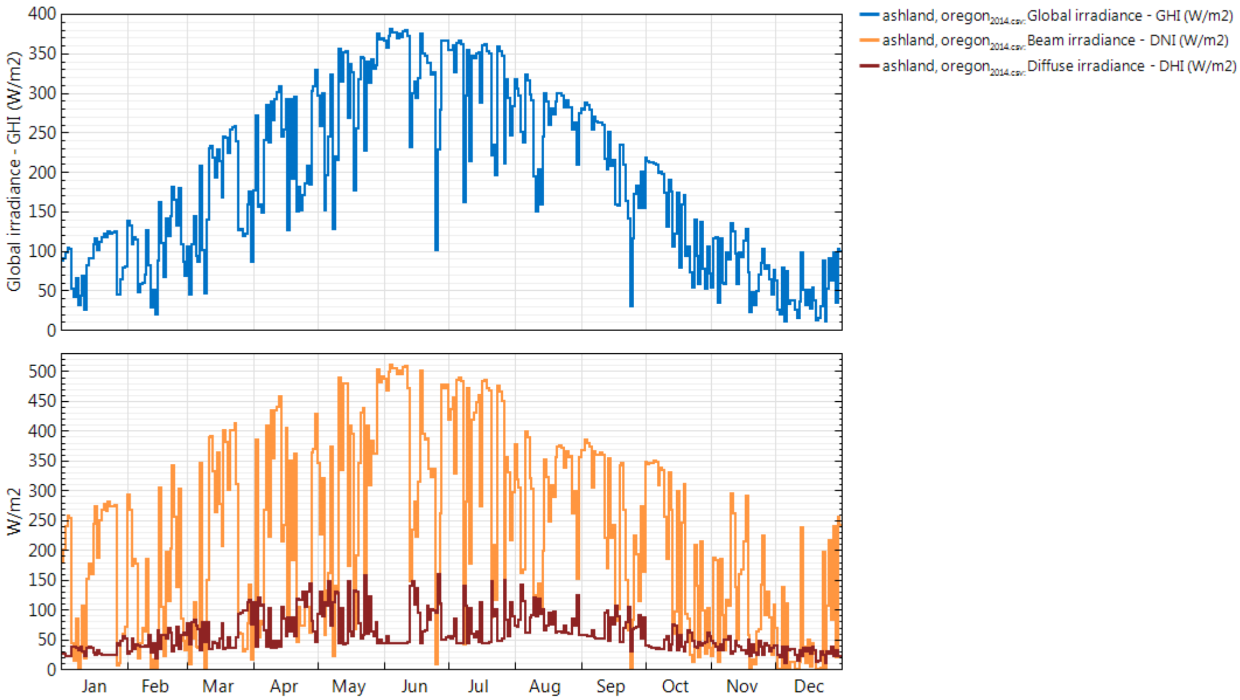


Figure 1: Global Horizontal Irradiance (GHI), Direct Normal Irradiance (DNI), and Diffuse Horizontal Irradiance (DHI) in watts/m^2 in City of Ashland, 2014

Figure 2 shows the daily temperature map throughout the entire year of 2014 in degrees Celsius. The data provides the typical temperature distribution pattern in Pacific Northwest area. Figure 3 illustrates the same data as provided in Figure 1 and 2 but in monthly averages. The left axis and blue line of Figure 3 represents the level of irradiance and the right axis and orange line represent temperature.

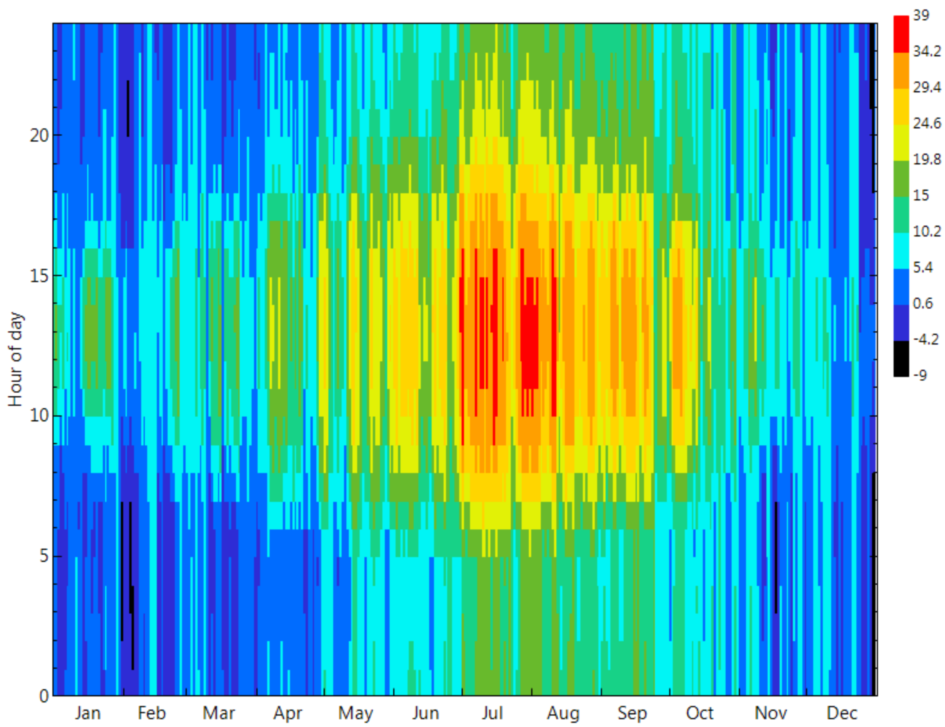


Figure 2: Daily temperature map for City of Ashland, 2014

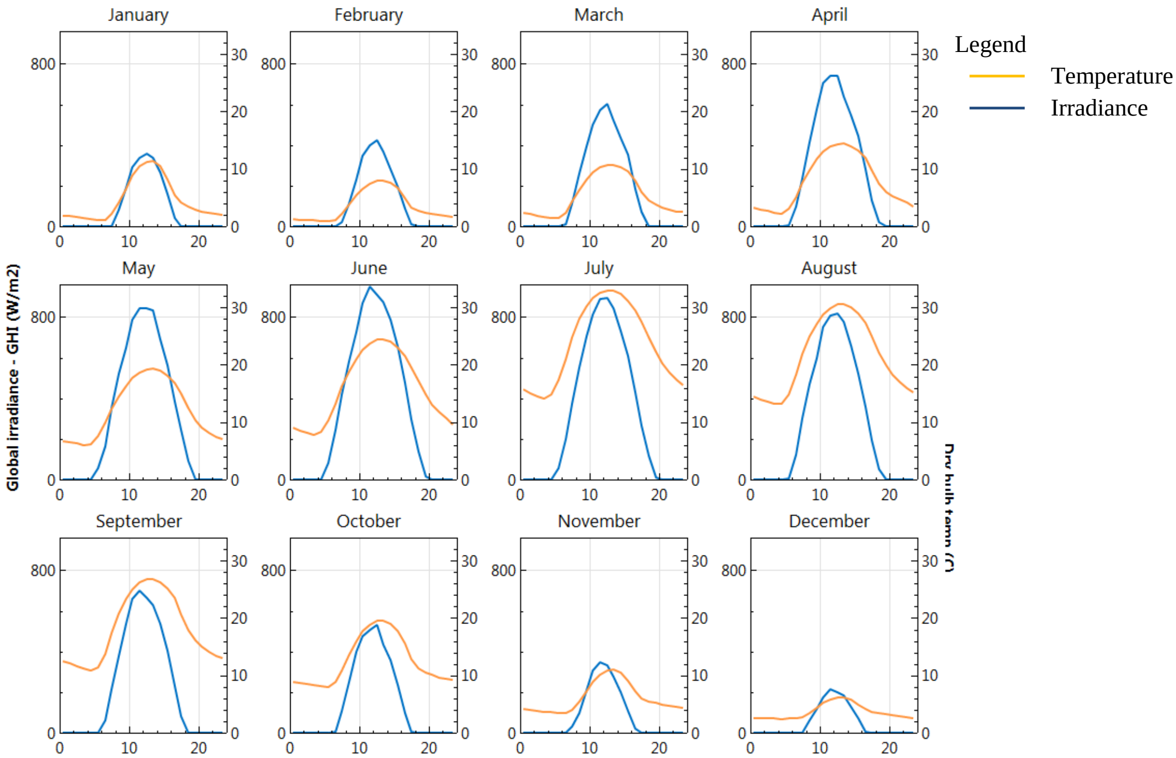


Figure 3: Monthly irradiance and temperature profile for City of Ashland, 2014

With the actual weather data, PV array power outputs can be estimated or simulated using System Advisor Model (SAM) developed by National Renewable Energy Laboratory (NREL) SAM is a tool that is able to facilitate renewable energy integration in both system performance and financial aspects. In this study, a compatible generic combination of flat-plate PV module and inverter is utilized to form a 1 MW grid-connected PV array as an example. Larger size PV arrays can be achieved by increasing the number of modules and inverters, and their power output is essentially scaled up linearly.

PV generation, for the same solar profile, can be maximized/optimized by using technologies such as tracking systems. Tracking systems orient PV panels toward the Sun, which increases the power generating capability significantly. Tracking technologies add complexity and may require extra cost and maintenance and generally is not feasible for most home systems but can provide great benefit to utility scale grid-connected PV arrays. The additional energy production may offset the added cost of the tracking system and the increased generation typically is equivalent to a smaller array for the same overall level of energy production. Figure 4 shows the monthly average power profile using a fix-mount array that is oriented south (180° Azimuth degree) for a 1 MW PV array, while Figure 5 shows a similar monthly power profile using an array with a 2-axis tracking system. As can be seen from these two figures, there is a considerable difference in PV array power output with and without tracking capability. Specifically, with a tracking system, power output of the same PV array can reach the high power region much quicker and maintains at that level longer than PV arrays using fixed-mounting. (Note: Simulation is based on hourly weather data, and no loss and shade is considered for this early phase study.)

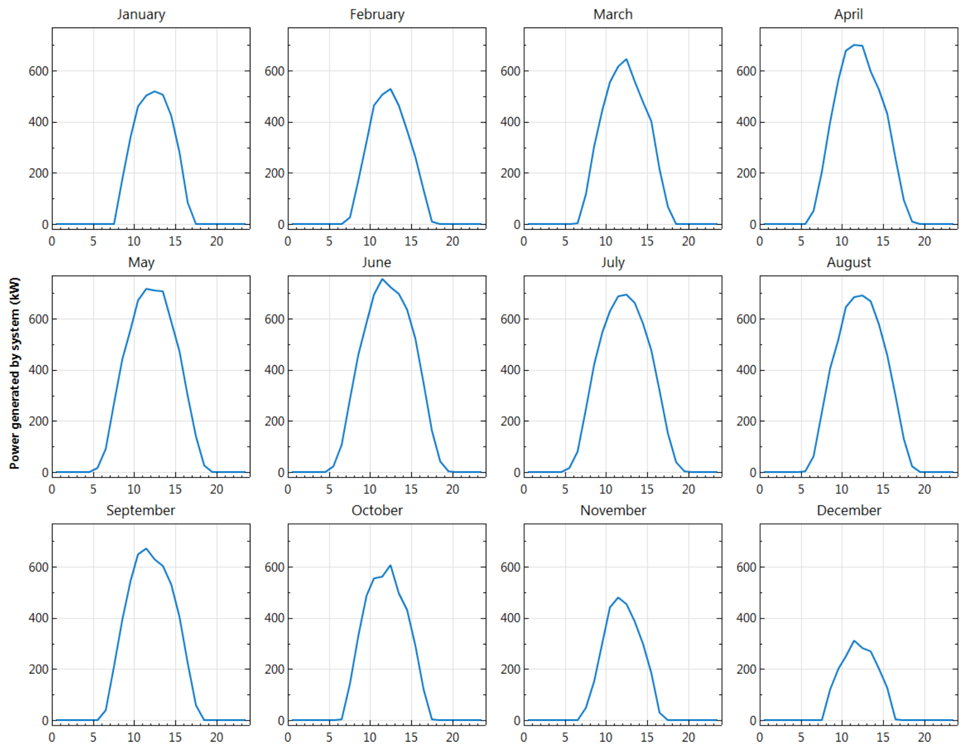


*Figure 4: Monthly average power profile using **fixed-mount** for a 1 MW PV array in City of Ashland, 2014*

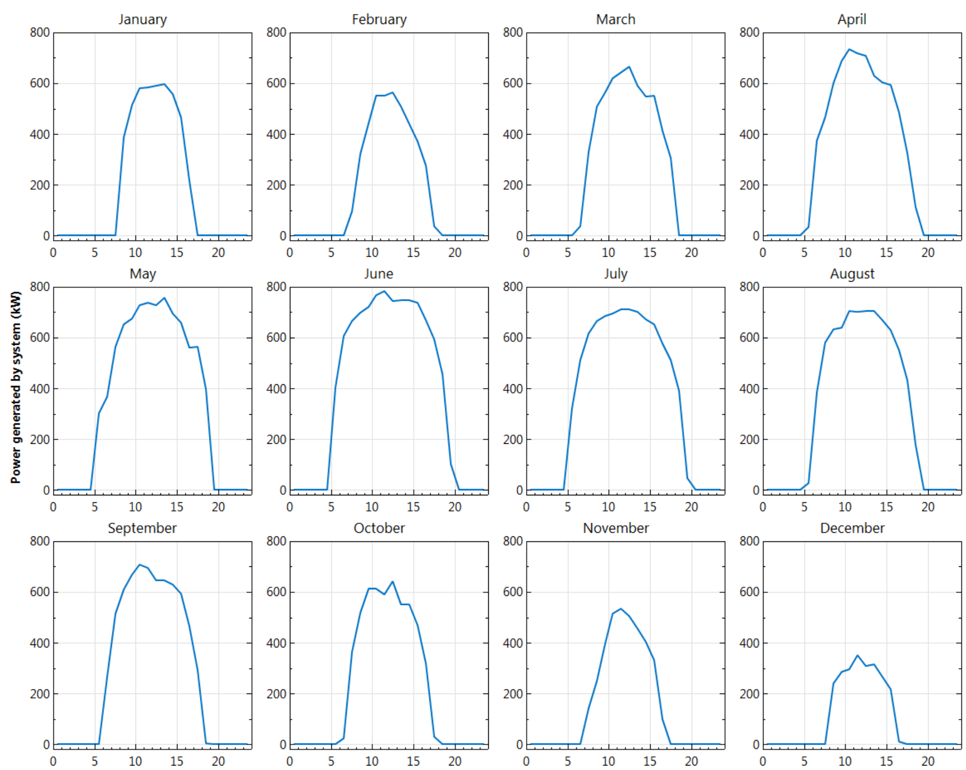


*Figure 5: Monthly average power profile using **2-Axis tracking** for a 1 MW PV array in City of Ashland, 2014*

3.2 System load evaluation

The City of Ashland 2016 metering data from BPA was evaluated and the results shown in below table. The coincident peak demand in 2016 is about 40 MW and occurred during the month of August. The minimum coincident demand is about 10 MW and occurred during the month of June. At peak demand, each substation has about 13 MW of load and, in general, the City's load is typically divided uniformly across the three substations.

Table 1: BPA metering data summary for City of Ashland 2016

Substation	Ashland	Oak Knoll #1	Oak Knoll #2	Oak Knoll East	Mtn Avenue	Total
Meter ID	575	1014	1304	1705	1820	
Demand						
Average Demand	6,333	2,384	2,541	1,905	6,431	**19,594**
Peak Demand	13,200	4,690	5,320	4,040	12,850	**40,100**
Date/Hour	8/19/16 5:00 PM	7/29/16 5:00 PM	12/7/16 7:00 PM	8/19/16 4:00 PM	8/19/16 5:00 PM	
Min Demand	3,510	1,390	0	940	2,900	**8,740**
Date/Hour	4/18/16 4:00 AM	4/11/16 4:00 AM	1/1/16 2:00 AM	1/3/16 12:00 AM	6/12/16 4:00 AM	
Load Factor	0.48	0.51	0.48	0.47	0.50	**0.49**

Coincident Peak Demand	
Maximum	**39,940**
Date	**8/19/16 5:00 PM**
Minimum	**10,295**
Date	**6/12/16 5:00 AM**

To better evaluate how PV power generation affects the metering profile at the point of delivery, four daily profiles in 2016 are selected to represent the Spring light load, Summer peak load, Fall light load, and Winter peak load cases. Those four days are picked according to daily power consumption in each of the four meteorological seasons. The typical PV power profiles in those associated months (monthly average curve as shown in Figure 5) were compared with the selected four daily profiles in the below plots.

PV generation along with other renewable generation are often treated as negative load. The BPA meter data summary in Table 1 shows that the peak load at Ashland substation is approximately 13 MW. However, it does not indicate that this substation can support the integration of as much as 13 MW PV generation because load curves and PV generation curve do not match each other the majority of the time. The four groups of plots in Table 2 demonstrate how daily power consumption patterns in different seasons at Ashland Substation change with the addition of 1 MW or 5 MW. The PV generation is the monthly average data and does not represent actual power output for any given date since the actual daily profile will typically have a significant amount of variation due to weather and operational factors. However, the plot represents a typical trend of power generation for a day in those months, and it provides a sufficient approximation of a typical output profile.

The overlaid plots in Table 2 provide an indication of how much PV generation that can be added to Ashland Substation. It can be seen that Ashland substation can readily integrate a 1 MW PV system connected to any of its feeders without causing power export. It is also found that Ashland substation is safe to have 5 MW PV system integrated to any of its feeders as long as the feeder has sufficient ampacity for the peak generation. Power factor exceeds the 0.97 limit during the summer peak of 2016 due to a large amount of reactive power consumption, presumably by HVAC loads. This is likely to get worse with more active power generation by PV integrated into the system. A further discussion of power factor issues is discussed in Section 4.2. A similar conclusion can be made at the Mountain Avenue Substation as having capacity to integrate as much as 5 MW of PV generation to any of its feeders provided the feeder has sufficient ampacity.

Table 4 shows a group of similar plots indicating the integration of a 10 MW PV system at Ashland Substation. The combined daily curves reach a net negative region at the substation resulting in power export. Similar trends show the same result at Mountain Avenue Substation. To prevent power export, we estimate significant periods of generation curtailment would be necessary with a 10 MW system integrated into one substation. Therefore, we do not recommend the full integration of 10 MW of PV generation to either individual substation.

*Table 2: **Ashland Substation** Daily Power Profile with and without PV Generation, 1 MW or 5 MW*

<table>
<tr>
<th>Daily Power Profile
Spring Minimum, May 15 2016
Ashland Subsation</th>
<th>Daily Power Profile
Summar Maximum, Aug 19 2016
Ashland Subsation</th>
<th>Daily Power Profile
Fall Minimum, Sep 5 2016
Ashland Subsation</th>
<th>Daily Power Profile
Winter Maximum, Dec 18 2016
Ashland Subsation</th>
</tr>
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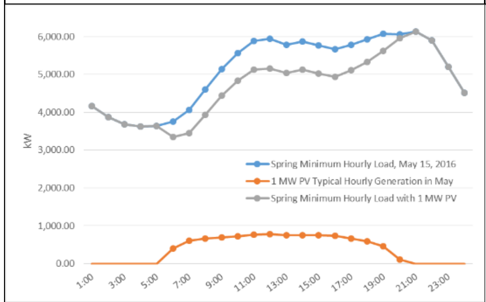
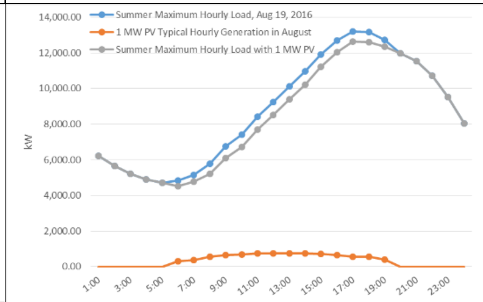
<td>

With 1 MW PV</td>
<td>

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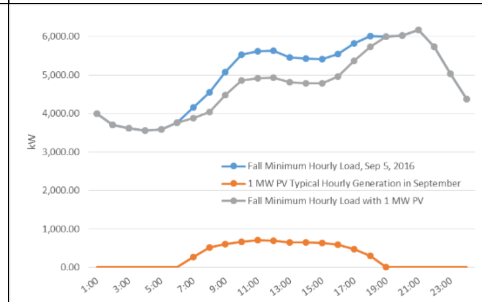
<td>

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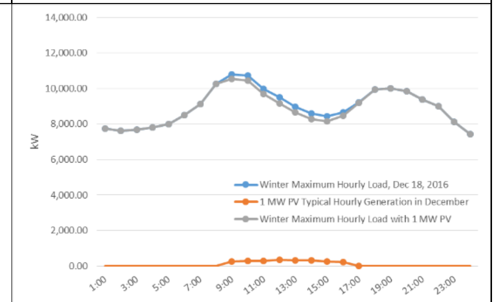
<td>

With 1 MW PV</td>
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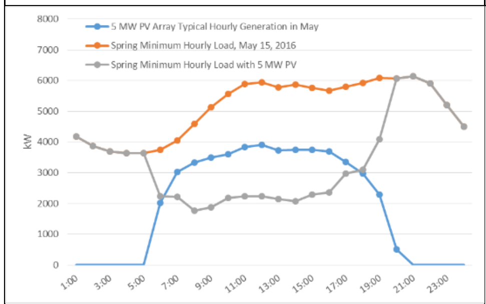
<td>

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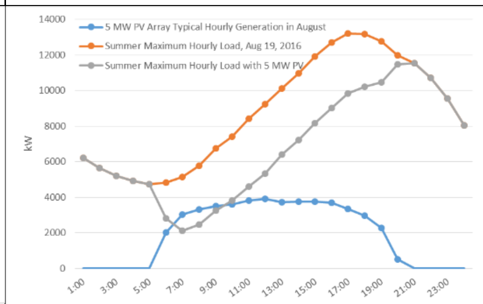
<td>

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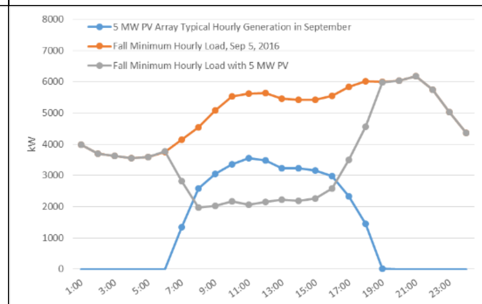
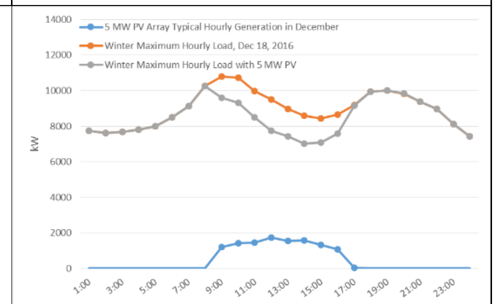
<td>

With 5 MW PV</td>
<td>

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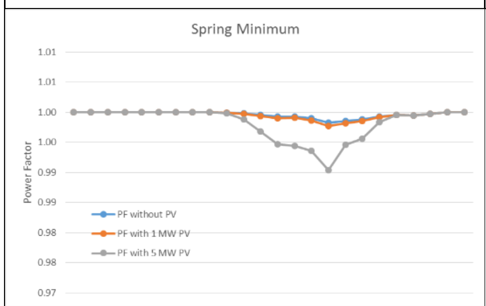
<td>

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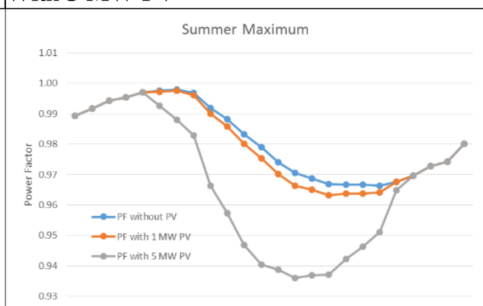
<td>

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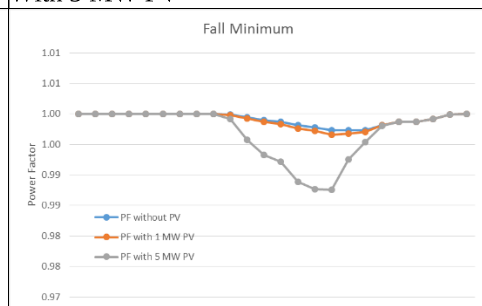
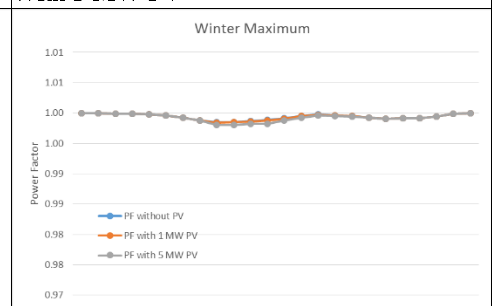
<td>

PF with 1 MW and 5 MW PV</td>
<td>

PF with 1 MW and 5 MW PV</td>
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*Table 3: **Mountain Avenue Substation** Daily Power Profile with and without PV Generation, 1 MW or 5 MW*

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<tr>
<th>Daily Power Profile
Spring Minimum, May 29 2016
Mtn Ave Subsation</th>
<th>Daily Power Profile
Summar Maximum, Jun 6 2016
Mtn Ave Subsation</th>
<th>Daily Power Profile
Fall Minimum, Sep 4 2016
Mtn Ave Subsation</th>
<th>Daily Power Profile
Winter Maximum, Dec 7 2016
Mtn Ave Subsation</th>
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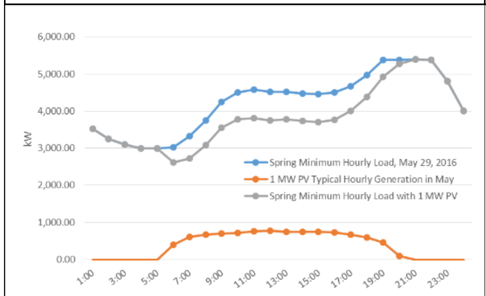
<td>
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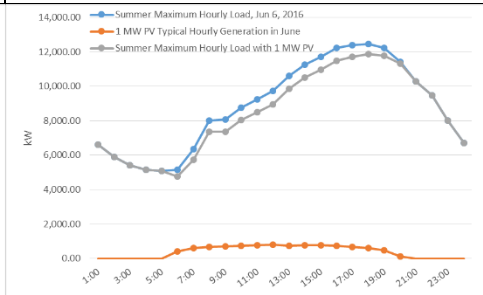
<td>
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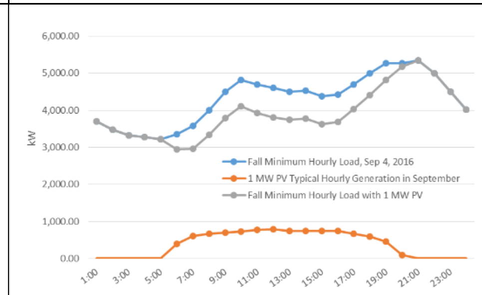
<td>
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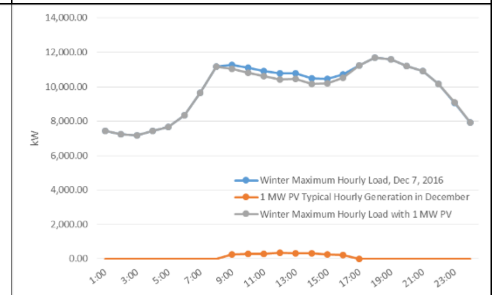
<td>
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<tr>
<td>With 1 MW PV</td>
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<td>With 1 MW PV</td>
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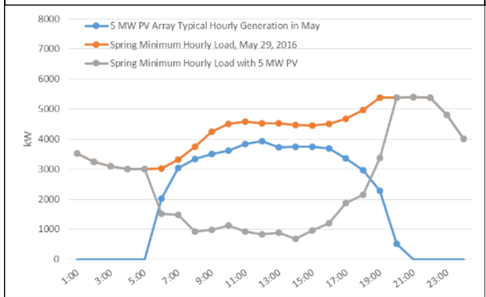
<td>
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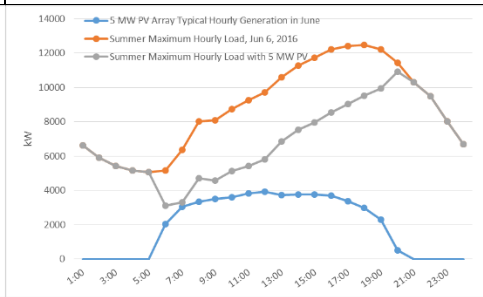
<td>
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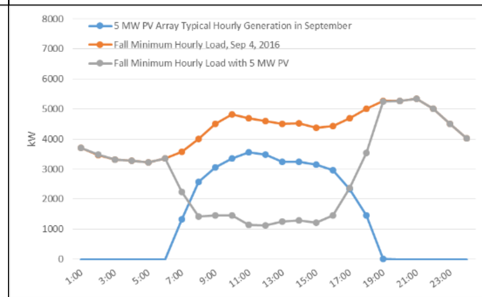
<td>
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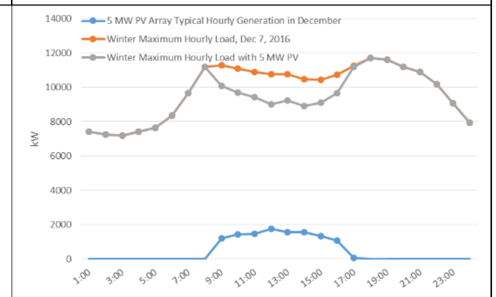
<td>
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<tr>
<td>With 5 MW PV</td>
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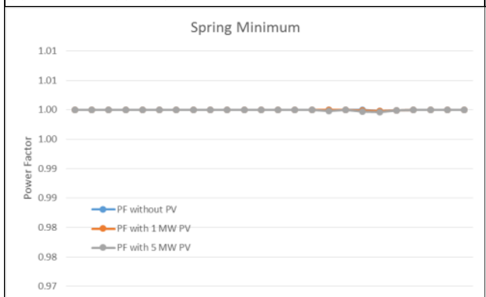
<td>
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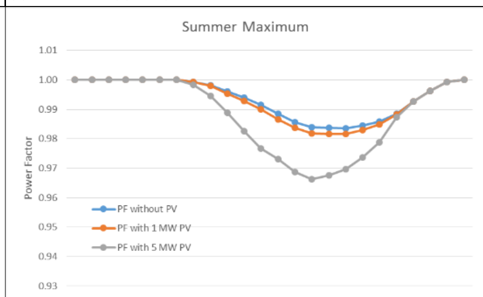
<td>
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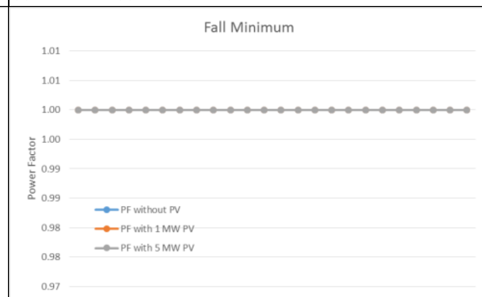
<td>
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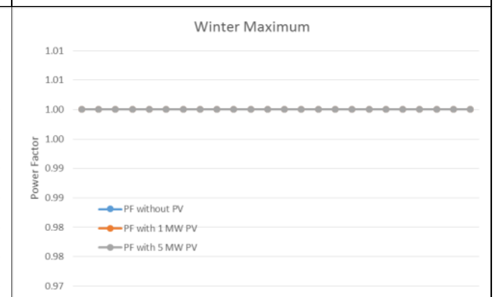
<td>
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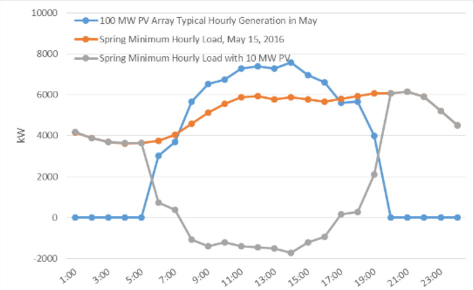
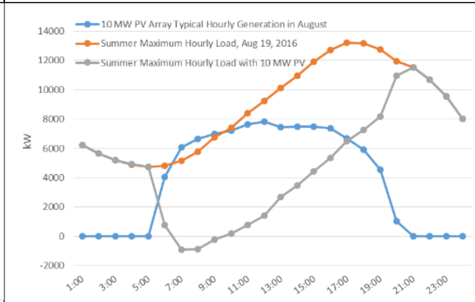
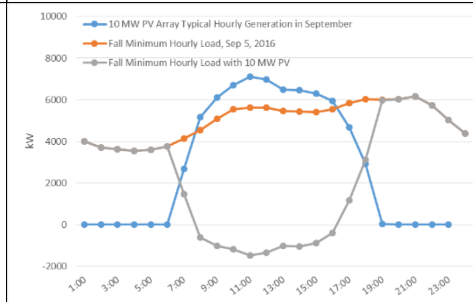
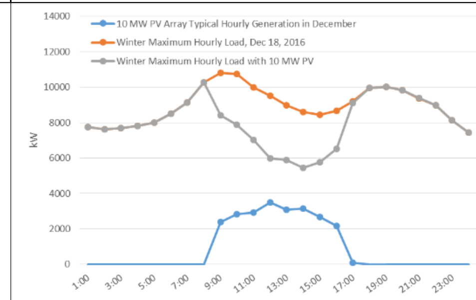
<tr>
<td>PF with 1 MW and 5 MW PV</td>
<td>PF with 1 MW and 5 MW PV</td>
<td>PF with 1 MW and 5 MW PV</td>
<td>PF with 1 MW and 5 MW PV</td>
</tr>
</table>

*Table 4: **Ashland Substation** Daily Power Profile with and without PV Generation, **10 MW***

Daily Power Profile **Spring Minimum, May 29 2016** **Mtn Ave Subsation**	**Daily Power Profile** **Summar Maximum, Jun 6 2016** **Mtn Ave Subsation**	**Daily Power Profile** **Fall Minimum, Sep 4 2016** **Mtn Ave Subsation**	**Daily Power Profile** **Winter Maximum, Dec 7 2016** **Mtn Ave Subsation**
			
With 10 MW PV	With 10 MW PV	With 10 MW PV	With 10 MW PV

3.3 Overview of options for interconnect

Based on the evaluation in Section 4 and Section 5 and geographic proximities, several locations have been identified for interconnection to the City's electric distribution system including:

- Ashland Substation
  - Business Feeder to WWTP radial tap circuit, support for ~2.5 MW.
  - N Main Feeder at Oak St/Nevada St backbone circuit, support for ~5 MW.
  - Business Feeder at Oak St/Nevada St, backbone circuit support for ~5 MW.
  - E Nevada Feeder at N Mountain Rd, backbone circuit, support for ~5 MW.
- Mountain Avenue
  - N Mountain Feeder at N Mountain Rd, backbone circuit support for ~5 MW.

Any of these interconnection points are estimated to be able to support up to approximately 2.5 MW to 5 MW as indicated. To accommodate greater generation, up to approximately 10 MW, would require generation to be split between feeders from different substations. The interconnect locations and construction requirements are summarized below and described greater detail in Section 5.0.

Option I

Strong and recommended distribution interconnection points are near the E Nevada Street and N Mountain Avenue intersection vicinity southwest of the PV point of common coupling (PCC). This location, approximately 1.1 miles from the southwest corner of the PV Imperatrice Property site, allows interconnection to two feeders and different substations. The route from the solar site could be south and west along N Mountain Avenue, then via the I-5 N Mountain Avenue overpass to the electric system interconnections.

At this location good circuit interconnections can tie into one or two existing City of Ashland electric distribution backbone circuits at the PV system primary delivery voltage (12.47 kV). The existing interconnection points available are 1) the N Mountain Feeder served from the Mountain Avenue Substation; and 2) the E Nevada Feeder served from the Ashland Substation with minor switching changes. A generated capacity of up to 5 MW could be delivered to one circuit or up to 10 MW delivered and split between both circuits. The associated PV array interconnection configuration one-line diagrams are shown in Figure 6 for 10 MW capacity and Figure 7 for 5 MW capacity.

In Figures 6, 7, and 8, the PV system is modeled as a cluster of 500 kW PV arrays and 500 kW inverters, with individual step-up transformers having built-in fusing and disconnects for isolation. This is one potential arrangement and is not intended to indicate a technical requirement or preference for the PV system arrangement. However, the arrangement does show our recommendation for the City operated interface at the PCC. As shown, we recommend two switchgear sections with a combination breaker and disconnect switch plus metering as the utility interface to the PV system.

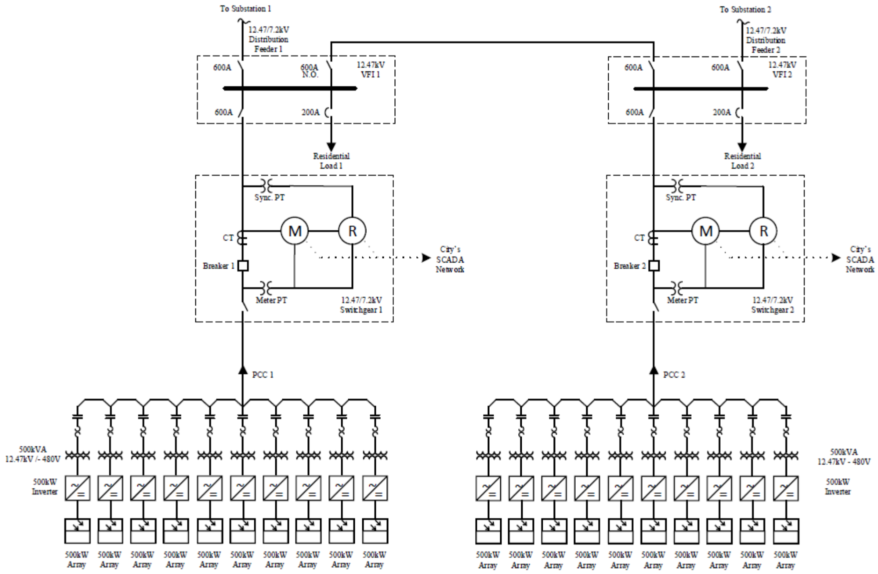


Figure 6: 10 MW PV configuration

Option II

A second interconnection location is a tie between the PV system PCC primary delivery voltage (12.47) and the existing Business Feeder or N Main Feeder served from the Ashland Substation near the intersection of Oak Street and Nevada Street. This tie location is approximately 1.5 miles from the southwest corner of the PV Imperatrice Property site and could be connected by overhead or underground construction. The route from the solar site could be south along N. Mountain Avenue, west along Eagle Mill Road and via the I-5 Eagle Mill overpass south along Oak Street to the Nevada Street interconnect. This interconnection location could accommodate one feeder interconnection up to ~5 MW, whose potential interconnection configuration is shown in Figure 7.

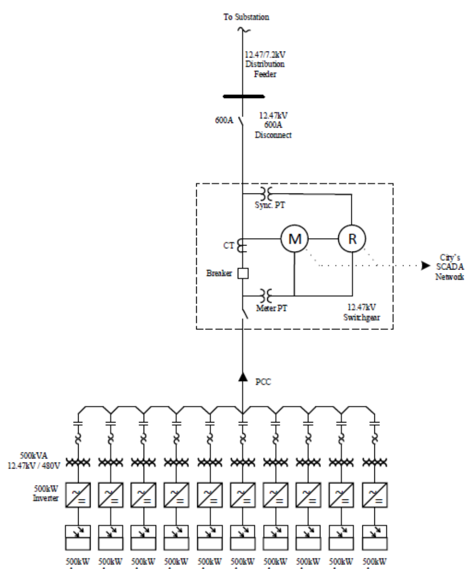


Figure 7: 5 MW PV configuration

Option III

An option to the Case II interconnection description above would be to intercept the circuit feeding the WWTP by extending the line along the Bear Creek Greenway access road from Oak Street. This option would be limited to ~2.5 MW of PV generation. Although the total distance is similar, approximately 1.4 miles, the advantage is a more accessible easement for construction along the Bear Creek Greenway access road which could include open trench and underground bore construction beneath I-5 from the generation site to the circuit interconnect. Figure 8 illustrates a possible interconnecting configuration for a 2.5 MW PV farm.

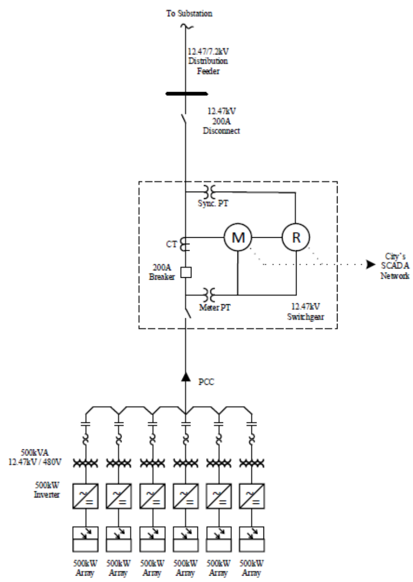


Figure 8: 2.5 MW PV configuration

4.0 ANALYSIS AND SYSTEM REQUIREMENTS

The following assumptions are consistent for all study scenarios unless otherwise noted.

- This study assumed that no major system expansion projects were implemented by the area utility since the *Electrical System 10-Year Planning Study for City of Ashland (by CVO Electrical Systems)*, in 2014.
- This study mainly focused on integrating PV generation into City of Ashland electrical distribution system as proposed by the City, and did not analyze in detail any PPL distribution or transmission interconnections options with BPA, even though they are physically closer to the potential PV sites.

For inverter-based energy resource including PV generation, the following standards and guidelines are recommended as required for the construction of this project:

IEEE Standard 929-2000, "IEEE Recommended Practice for Utility Interface of Photovoltaic (PV) Systems."

IEEE Standard 1547-2003, "IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems."

UL Standard 1741, "Inverters, Converters and Charge Controllers for Use in Independent Power Systems."

4.1 Power flow analysis.

This study included steady state analysis and system response analysis only. Transient and stability analysis was not conducted. A description of the procedures used to complete the analyses is presented below:

a. Development and Description of System Model

The City of Ashland distribution system model was developed in *EasyPower* analysis software according to the 2014 System Planning Study based on the information provided by the City, State, County, BPA and PacifiCorp. Two base cases used in this analysis are shown below:

- Base Case 1A – normal system configuration under peak load conditions, 2013.
- Base Case 1B – normal system configuration under light load conditions, 2013.

(Note: the 2013 model is readily available from the 2014 System Planning Study. Its peak consumption is about 43 MW, which is higher than the 2016 peak demand – 40 MW, however, the light loads for both years are almost the same. It should not make significant differences in this study.)

b. PV Generation Modeling

IEEE Standard 929-2000 requires that PV system should operate at a power factor >0.85 lagging or leading when output is >10% of rating. Modern inverter technologies typically have high efficiency and provide a nearly unit power factor (pf > 0.99) at rated power. Some inverters are able to provide reactive power compensation to the grid by advanced inverter control, to enable PV arrays to participate in grid voltage control and power factor correction. This is briefly discussed in Section 4.1. PV arrays in this study are modeled as PQG type generators and we have assumed that inverters operate at unit power factor (pf = 1) with no reactive power (var) generation. The generator was modeled at the voltage level of the point of the interconnection, and no step-up transformer (GSU) was modeled.

c. Steady State Power Flow Analysis

Power flow analysis was implemented for each of the interconnecting options that have been discussed in this study. More details about the interconnecting options can be found in Section 3.3 and Section 5.

I. Two available interconnecting points near the E Nevada Street and N Mountain Avenue intersection for up to 10 MW:
   - 5 MW, N Mountain feeder served from Mountain Avenue Substation
   - 5 MW, E Nevada feeder served from Ashland Substation

II. Two available interconnecting points near the Nevada Street and Oak Street intersection for up to 5 MW:

- 5 MW, N Main feeder served from Ashland Substation, or
- 5 MW, Business feeder served from Ashland Substation, or
- Split to the above two feeders and not exceed a total of 5 MW

III. Interconnecting with the circuit serving Waste Water Treatment Plant (WWTP) for up to 2.5 MW.

Peak load and light load base cases were evaluated regarding equipment overload and bus voltage violation under both normal and contingency conditions prior to and after the addition of the proposed PV generation. Equipment is evaluated as overloaded if load exceeds its rated capacity, and voltage violation is assessed in accordance with standards established by the American National Standard Institute (ANSI C84.1, Range A), the voltage ranges in Table 5, shown as acceptable voltage or allowable voltage drop, should be maintained throughout the City's electric system. The voltages shown are presented on a 120 volt base, however the percentages indicated apply to any voltage base, for example 12.47/7.2 kV, 480/277 V, etc., as applicable to the specific location.

Table 5: Acceptable voltage levels, City of Ashland

Facility	Acceptable Voltage or Allowable Voltage Drop (Volts)	Acceptable Percentage
Bus voltage range at substation.	122 - 126	102% - 105%
Maximum voltage drop along a distribution feeder.	8	
Voltage range at primary terminals of distribution transformers.	118 - 126	98% - 105%
Maximum voltage drop across distribution transformer and service conductors.	4	
Voltage range at customer meter.	114 - 126	95% - 105%
Voltage range at customers utilization equip.	110 - 126	92% - 105%

Power flow analysis results

Power flow study analysis results are summarized in Table 6 and Table 7. It is shown in Table 6 that no transmission facilities were overloaded and bus voltage did not exceed the acceptable limits in Table 5 in the territory of City of Ashland electrical system at normal system conditions, peak and light load cases, and prior to and after the addition of the PV generation proposed in the three interconnection options.

In the 2014 System Planning Study, system's switching flexibility during outages and abnormal conditions were evaluated. While in this study, two major contingency scenarios significant to this PV integration project are assessed. Specifically, the loss of either the Ashland Substation or Mountain Avenue Substation. Loss of Oak Knoll Substation was not considered in the assessment because the proposed interconnection options do not involve any major feeder served from Oak Knoll Substation.

The scenario involving the loss of Ashland Substation during peak load results in the transformer at Mountain Avenue Substation being heavily overloaded. There are also conditions of overloaded cables and a number of bus voltage violations. More information about this case can be found in the 2014 System Planning Study Section D. From Table 7, it can be concluded that PV generation proposed in three options can actually eliminate or reduce the overload within the system, which is reasonable since renewable energy generation are normally treated as negative load due to its varying characteristic.

Similarly during loss of Mountain Avenue Substation, the transformer at Ashland Substation is significantly overloaded prior to integrating PV generation. However, with proposed PV integration options, the transformer overload is eliminated. From this analysis we conclude that with or without full PV generation integrated to the City's distribution system, no overload or voltage violation was observed for the scenarios reviewed.

*Table 6: Power flow analysis results at **NORMAL** condition for both peak and light base cases*

Condition	Option	Interconnection Points	Peak Load (Base Case 1A)	Light Load (Base Case 1B)
Normal	Pre-Project	No PV generation integrated	No overload and voltage violation	No overload and voltage violation
	I (Up to 10 MW)	5 MW, N Mountain feeder from Mountain Avenue substation	No overload and voltage violation	No overload and voltage violation
		5 MW, E Nevada feeder served from Ashland Substation	No overload and voltage violation	No overload and voltage violation
	II (Up to 5 MW)	5 MW, N Main feeder served from Ashland Substation	No overload and voltage violation	No overload and voltage violation
		OR	---	---
		5 MW, Business feeder served from Ashland Substation	No overload and voltage violation	No overload and voltage violation
	III (Up to 2.5 MW)	2.5 MW Interconnecting with circuit serving (WWTP)	No overload and voltage violation	No overload and voltage violation

*Table 7: Power flow analysis results at **CONTINGENCY** condition (e.g., loss of substation) for both peak and light base cases*

Condition	Option	Interconnection Points	Peak Load (Base Case 1A)	Light Load (Base Case 1B)
Loss of Ashland Substation	Pre-Project	No PV generation integrated	**Significant overload** observed at Mountain Ave Substation transformer and several cables	No overload and voltage violation
	I (Up to 10 MW)	5 MW, N Mountain feeder from Mountain Avenue Substation 5 MW, E Nevada feeder served from Ashland Substation	**No overload** at Mountain Ave Substation transformer, and **much less** overloaded cables observed.	No overload and voltage violation
	II (Up to 5 MW)	5 MW, N Main feeder served from Ashland Substation	**Less overloaded** at Mountain Ave Substation transformer, and **less** overloaded cables observed.	No overload and voltage violation
		OR	---	---
		5 MW, Business feeder served from Ashland Substation	**Less overloaded** at Mountain Ave Substation transformer, and **less** overloaded cables observed.	No overload and voltage violation
	III (Up to 2.5 MW)	2.5 MW Interconnecting with circuit serving (WWTP)	**Less overloaded** at Mountain Ave Substation transformer, and **less** overloaded cables observed.	No overload and voltage violation

Condition	Option	Interconnection Points	Peak Load (Base Case 1A)	Light Load (Base Case 1B)
Loss of Mountain Avenue Substation	Pre-Project	No PV generation integrated	**Significant overload** observed at Ashland Substation transformer, and **no other overload and voltage violation** observed. .	No overload and voltage violation
	I (Up to 10 MW)	5 MW, N Mountain feeder from Mountain Avenue Substation	**No overload** at Ashland Substation transformer, and **no other overload and voltage violation** observed.	No overload and voltage violation
		5 MW, E Nevada feeder served from Ashland Substation		
	II (Up to 5 MW)	5 MW, N Main feeder served from Ashland Substation	**Less overloaded** at Ashland Substation transformer, and **no other overload and voltage violation** observed.	No overload and voltage violation
		OR	---	---
		5 MW, Business feeder served from Ashland Substation	**Less overloaded** at Ashland Substation transformer, and **no other overload and voltage violation** observed.	No overload and voltage violation
	III (Up to 2.5 MW)	2.5 MW Interconnecting with circuit serving (WWTP)	**Less overloaded** at Ashland Substation transformer, and **no other overload and voltage violation** observed.	No overload and voltage violation

In summary, the analysis showed that the addition of the proposed PV generation to the system would not have an adverse impact on the City of Ashland electrical distribution system in steady state power flow analysis. Instead, it could relieve the transformer overload and the potential voltage violations during peak load when there is a loss of either Ashland Substation or Mount Avenue Substation, depending on the level PV generation. In addition, there is no overload and voltage violation observed during light load conditions with or without PV generation integration.

4.2 Power factor

In October 1999 BPA began requiring compliance by its customers to adhere to a 97 percent power factor, an increase from the previous power factor requirement of 95 percent. This compliance is based on a bandwidth established at 25% reactive deadband of monthly real power demand compared to the previous 33% reactive deadband. Consumers must not only conform to a smaller power factor bandwidth but will encounter more rigid penalties for failure to comply. Poor power factors will also be penalized through a ratcheted demand penalty. This penalty will be enforced for a 12-month period, the violation month and the following 11-months after each violation. During this 12-month period BPA metering will continue to monitor for out of range power factors, and if a power factor is incurred that results in a greater penalty a new penalty will be assessed for the next 12 months. This process continues and will repeat until the power factor is in compliance with the penalty criteria at all times.

Figure 9 shows the power factor profile in a day without and with 1 MW or 5 MW PV generation for Ashland Substation, August 19, 2016. Power factor exceeds the 0.97 (97 percent) limit in summer peak

2016 due to large amounts of reactive power consumption, presumably by HVAC load, even without PV generation. This likely results in the City of Ashland having to pay an approximate $1,000 penalty change. However, with more active power generation by PV arrays integrated to the system the overall peak demand during the month is likely to be reduced. With the reactive power demand remaining the same in the system the probability of the peak reactive power exceeding the deadband value (25% of monthly demand peak) and the duration and extent of the reactive power exceeding the deadband are likely to increase.

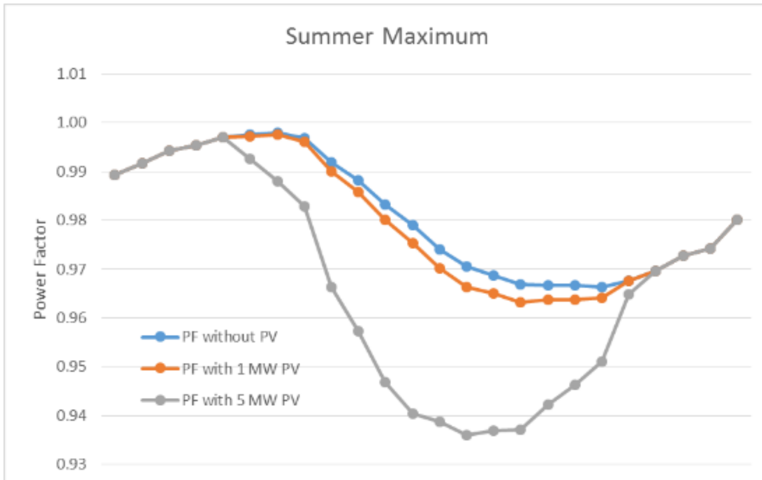


Figure 9: Power factor profile without and with 1 MW or 5 MW PV generation (Operating PF =1) for Ashland Substation, August 19, 2016

Additional considerations for power factor improving/correcting measurements might be required to avoid increased penalties. As mentioned briefly in the introduction, advanced inverter control technology could be utilized to either generate or absorb certain reactive power by adjusting the current phase angle allowing the PV system to participate grid stability control and power quality improvement. A quick example is shown in Figure 10, where the operating power factor of the inverter is set at 0.95 lagging (note, a lagging power factor on a generator is equivalent to a leading power factor on a load). This would produce approximately 30% of total kVA demand as reactive power. The supplied vars would compensate lagging loads in the system reducing the total reactive power requirement from the substation. As can be seen, with inverter power factor at 0.95, the power factor profile at the substation is improved overall. However, the morning var consumption is over compensated and results in leading overall system power factor for 5 MW PV array. Therefore, a dynamic inverter operating power factor could be developed according to an active or simulated Ashland load profile to more closely match compensation with changing load, although this advanced control could impact the system cost. There are additional methods that can help improve power factor as alternatives to the above. These methods are not described here but can be provided by OS Engineering if of interest to the City.

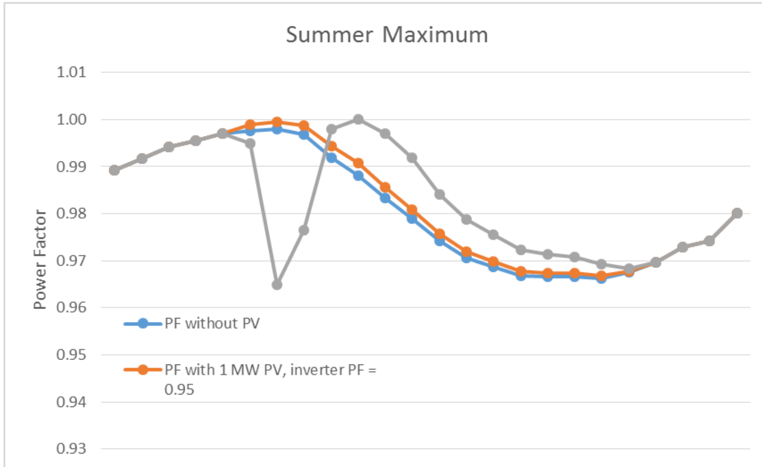


Figure 10: Power factor profile without and with 1 MW or 5 MW PV generation (Operating PF = 0.95) for Ashland Substation, August 19, 2016

4.3 Short circuit capabilities at PCC

A short circuit analysis is required to evaluate the maximum fault current level at the PCC with the addition of the proposed PV generation. This is necessary to determine the adequacy of equipment interrupting capability.

For a grid-tie PV farm, the maximum fault current at PCC consists of three parts:

- Potential fault current contribution from step-up transformers (GSU)
- Fault current contribution form inverter-based PV array
- Fault current from the system.

In this study, the PV array was modeled as a lump generator at the PCC and the GSU was not modeled. In any case, the GSU would not contribute fault current at the PCC for three-phase faults. However, if a Delta-Grounded Wye connected transformer is used as is common for generation interconnects with the PV array connected on the Delta side, the transformer will contribute zero-sequence fault current at the PCC for unbalanced faults (i.e., single-line to ground fault, line to line fault, and double-line to ground fault) due to the circulating current within Delta connection. Taking a Delta-Grounded Wye transformer with z% impedance as an example, the fault current contribution from a single-line to ground fault is $I_f = 3 * V_{LN} / (Z_a + Z_b + Z_0 + 3Z_g)$, where Z_a, Z_b, Z_0, and Zg are the positive sequence, negative sequence, zero sequence, and ground impedances. Assuming a solid ground fault with typical impedance values as an example, a single-line to ground fault is estimated to contribute approximately 1 kA from a 5 MVA transformer.

The second contribution factor from inverter-based PV array is more difficult to quantify mathematically. Unlike synchronous generators or induction motors, inverters do not have a rotating mass component; therefore, they do not develop inertia to carry fault current based on an electro-magnetic characteristics. Power electronic inverters have a much faster decaying envelope for fault currents because the devices lack predominately inductive characteristics that are associated with rotating machines. Research has been done to quantify the fault current from inverter based renewable energy generation, and the general conclusion is that inverter-based distributed energy resource provides insignificant or minimal fault current contribution. The current industry's practice regarding fault current level assessment for setting protective relays has been to apply a "rule of thumb" of 2 times rated continuous current for distributed energy resource. Therefore, assuming the inverter ac voltage is 480V, the maximum fault current contribution at the 12.47kV PCC for a 5 MW PV array is estimated as:

$$5000 / 480 / 1.732 * 2 * (480 / 12470) = 463 \text{ A}$$

The third part is the fault current contributed by the existing distribution system, which can be readily obtained from a short circuit study using computer-based tool. The fault current levels for those proposed interconnection points, from the simulation, are in a range of 3.5 kA to 5 kA for both single-line to ground and three-phase fault.

At PCC, the equipment installed shall have a minimum interrupting rating higher than the summation of the above three parts for both three-phase fault and single-line to ground fault, which should be less than 10 kA due to the insignificance of the first two parts. Detailed calculation can be done when the actual PV technology and size are selected but the result is not expected to exceed the capabilities of existing distribution system equipment.

4.4 Harmonic requirements

Harmonics are omnipresent in electrical distribution systems and can cause a variety of problems. In both IEEE Standard 929 and IEEE Standard 1547, they refer to IEEE Standard 519-1992, which establishes limits for harmonic currents and voltages. The objective of these limits is to limit the maximum individual frequency voltage harmonic to 3% and the total harmonic distortion (THD) to 5%. It also requires that each individual harmonic to be limited to the percentages listed in Table 8. These limits apply to the Point of Common Coupling (PCC) with the utility.

Table 8: Distortion limits as recommended in IEEE Std 519-1992 for six-pulse converters

Odd harmonics	Distortion limit
3^{rd}–9^{th}	< 4.0%
11^{th} – 15^{th}	< 2.0%
17^{th} – 21^{st}	< 1.5%
23^{rd}–33^{rd}	< 0.6%
Above the 33^{rd}	< 0.3%

Note: These requirements are for six-pulse converters and general distortion situations. IEEE Std 519-1992 gives a conversion formula for converters with pulse numbers greater than six.

4.5 Voltage requirements including flicker

Voltage flicker is defined as a voltage variation sufficient in duration to allow visual observation of a change in electric light intensity of an incandescent light bulb. The IEEE curve in Figure 11 showing fluctuations per time period versus borderline of visibility and borderline of irritation is shown below.

The suggested operating criteria is that the magnitude of voltage flicker must be limited to less than 3% and that the frequency of flicker fluctuations be less than the border line of irritation boundary.

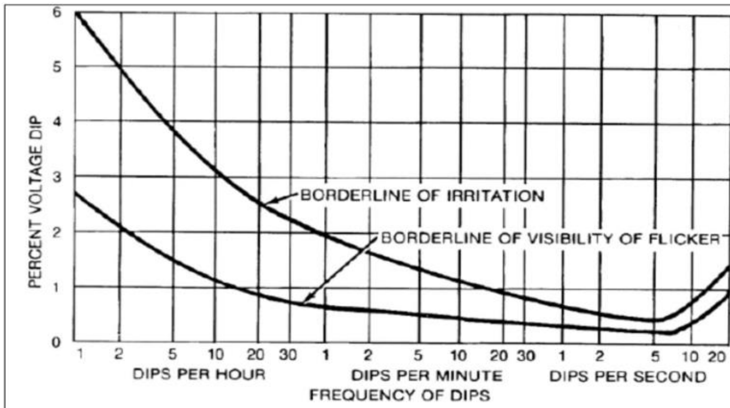


Figure A.1—Flicker tolerance curve from IEEE Std 141-1993/IEEE Std 519-1992

Figure 11: Flicker curve in IEEE Standard 141-193/IEEE Standard 519-1992

Clouds shading adversely impact the output of a PV system. As a cloud shadow passes over a PV system the power output will decrease due to the reduction in sunlight. The change in PV system power output on a distribution circuit may cause a fluctuation of voltage that might be seen by City of Ashland electric customers. This fluctuation would be classified as a voltage flicker.

Additionally, a rapid change in load cannot be compensated by the voltage regulation equipment installed on a distribution system. Most utilities use a typical time delay setting of 60 seconds for substation LTCs and 90 seconds for line voltage regulators. This time delay means that an LTC or voltage regulator will not respond to voltage changes until the voltage has been outside of the bandwidth for as long as 60 to 90 seconds. This helps to control “hunting” of the multiple devices trying to control the voltage.

As a cloud passes over a PV system the output will decrease to a lower value. Given the amount of PV system output reduction due to clouds is not known, the assumption is that it goes to zero and returns to full output once sunlight returns. A semi-transient simulation was implemented by switching on and off of the PV system in both peak load and light load conditions, and no significant voltage drop or flicker was noted in the system analysis.

4.6 Metering requirements

Per FERC *Standardization of Small Generator Interconnection Agreements and Procedures* and BPA *Standard Small Generator Interconnection Procedures* (Attachment N of BPA Open Access Transmission Tariff), any metering necessitated by the use of the Small Generating Facility shall be installed at the Interconnection Customer's expense in accordance with the Transmission Provider's specifications. It also would require that the Interconnection Customer's metering equipment conform to applicable industry rules and operating requirements.

For this project, metering is recommended to be installed at the 12.47kV interconnection/tie point, and shall be connected with the City’s existing SCADA network. Typically, each PV array will have an independent monitoring system, which can be tied with the existing SCADA network if desired.

4.7 Protection requirements, including disconnecting means, relaying, grounding, and prevention of islanding

Proper and safe operation of the installed PV system shall be ensured for both normal and abnormal/emergency conditions. IEEE Standard 929 lists a few import safety and protective function requirements of PV inverters.

a. Response to abnormal utility condition

- Voltage disturbance

VOLTAGE (AT PCC)	MAXIMUM TRIP TIME*
V< 60 (V<50%)	6 CYCLES
60≤V<106 (50%≤V<88%)	120 CYCLES
106≤V≤132 (88%≤V≤110%)	NORMAL OPERATION
132<V<165 (110%<V<137%)	120 CYCLES
165≤V (137%≤V)	2 CYCLES

Note: Trip time refers to the time between the abnormal condition being applied and the inverter ceasing to energize the utility line.

- Frequency disturbance

FREQUENCY (AT PCC)	MAXIMUM TRIP TIME*
<59.3 HZ	6 CYCLES
59.3 - 60.5 HZ (NORMAL)	--
>60.5 HZ	6 CYCLES

- Islanding protection
  Most inverters are nonislanding type inverters to ensure that the inverter ceases to energize the utility line when the inverter is subjected to islanding conditions. However, it is possible that circumstances may exist on a line section that has been isolated from the utility and contains a balance of load and PV generation that would allow continued operation of the PV systems. This is not supported mostly due to its inability to supply demand distortion or non-unity power factor associated with nonlinear loads as well as the inability to resync the system. As such, transfer trips are typically utilized to ensure the generation facility is tripped off-line any time the interconnecting feeder or substation is off-line
- Reconnect after a utility disturbance
  A minimum 5 mins after continuous normal voltage and frequency have been maintained is required before reconnect PV system to the grid.

b. Direct Current Injection

The PV system should not inject dc current > 0.5% of rated inverter output current into the ac interface under either normal or abnormal operating conditions.

c. Grounding

IEEE Standard 929 does not discuss grounding issue in detail, but requires that PV system and interface equipment should be grounded in accordance with applicable codes, including NEC.

d. Manual Disconnect

Manual disconnect switch is required to provide a visible load break from the PV system when the utility determines that the PV site needed to be isolated from the utility during maintenance on utility lines. This switch would only be operated when the utility were operating in the immediate vicinity of the maintenance work. This manual disconnect is shown in all one-line sketches in Figures 6 to 8.

4.8 Control/Communication requirements (curtailment, SCADA data, etc.)

A wide array of options are available for integrating the PV system into the City's existing SCADA system. However, it is common that large scale PV system have integration packages that provide HTML based monitoring via Internet connections. The City will need to consider functional requirements for information desired to be integrated into the utilities system but, as a minimum, the following should be required:

- Transfer trip control from the associated interconnecting substation. This could be network based but dedicated hard wire, fiber, or radio is preferred to ensure reliability
- Curtailment control from the substation to force PV output reduction when substation net load becomes negative
- Active power factor control from the substation. This would allow active compensation of power factor at the substation by controlling PV phase angle similar to compensation with a synchronous generator.

5.0 SYSTEM RECOMMENDATIONS

Due to the potential adverse impact of the solar facility on power quality, as discussed in detail in Section 4, the amount of PV power generation should be limited to approximately 2.5 MW to 5 MW if interconnecting at one location to the City's electric distribution system at medium voltage (12.47 kV). If greater generated capacity is desired we recommend two interconnection locations and different substations.

Should the City determine it feasible to export all solar generated power, the PCC circuit could interconnect with PacifiCorp at the distribution or transmission voltage, but transmission interconnection would require the PV inverter voltage be stepped-up to 115 kV. This type of interconnection complicates matters since the City presently does not own any transmission facilities, does not have bi-directional metering in place to export power, all construction would be out of the Ashland service territory, and will require permitting, acquisition of easements and rights-of-way. In addition the City has an exclusive power purchase agreement with the Bonneville Power Administration (BPA), and BPA has a General Transfer Agreement with PacifiCorp for use of their transmission facilities. These agreements would require re-negotiation to modify.

Based on the evaluation, practical options for interconnection to the City's electric distribution system that are within reasonable distance from the PV property include:

- Ashland Substation
    - Business Feeder to WWTP radial tap circuit, support ~2.5 MW.

    - N Main Feeder at Oak St/Nevada St backbone circuit, support ~5 MW.
    - Business Feeder at Oak St/Nevada St, backbone circuit support ~5 MW.
    - E Nevada Feeder at N Mountain Rd, backbone circuit, support ~5 MW.
- Mountain Avenue
    - N Mountain Feeder at N Mountain Rd, backbone circuit support ~5 MW.

Any of these interconnection options can support up to approximately 2.5 MW or 5 MW as indicated, but to accommodate greater generation up to approximately 10 MW will require connection to feeders from different substations. These interconnect option routes and possible construction are described greater detail below:

5.1 Option I

Strong and recommended distribution interconnection points are near the E Nevada Street and N Mountain Avenue intersection vicinity southwest of the PV point of common coupling (PCC). This location, approximately 1.1 miles from the southwest corner of the PV Imperatrice Property site, allows interconnection to two feeders and different substations. The route from the solar site could be south and west along N Mountain Avenue, then via the I-5 N Mountain Avenue overpass to the electric system interconnections.

At this location good circuit interconnections can tie into one or two existing City of Ashland electric distribution backbone circuits at the PV system primary delivery voltage (12.47 kV). The existing interconnection points available are 1) the N Mountain Feeder served from the Mountain Avenue Substation; and 2) with minor switching changes the E Nevada Feeder served from the Ashland Substation. A generated capacity of up to 5 MW could be delivered to one circuit or up to 10 MW delivered and split between both circuits.

The PV circuit extension from the PCC could either be overhead or underground construction, but is out of the existing City of Ashland service territory. Therefore, permitting, easements and rights-of-way will need to be established as will the I-5 crossing even if bored underground.

It is suggested to accommodate a total PV system capacity of approximately 10 MW and allow for either substation to be out of service with continuous PV generation that two paralleled circuits extend from the PCCs to interconnection ties with the existing electric system. Since an existing single-phase PPL circuit presently exists along N Mountain, construction of a double circuit overhead line on the opposite side of the roadway would likely be considered unsightly and with difficulty to obtain access permits, but undergrounding the circuits, either open trench and/or bore construction, will allow paralleled circuits with little landscape disturbance through the use of vaults as needed to accommodate construction.

With these two points for PV generation delivery the electric distribution system configuration can accommodate a total of approximately 10 MW generation without concern of power export. More details can be found in Section 4.1 - power flow analysis. Should either substation be out of service for any reason, that substation’s feeder circuits and load will be transferred to the substation feeders remaining in service, and will actually make it easier to disperse the total amount of PV generated energy (10 MW).

However, this option requires a major modification where the existing VFI near the E Nevada Street and N Mountain Avenue intersection resides, and it must be replaced by two VFIs to better incorporate a total generation of 10 MW. This increase the total construction cost as indicated in Section 6.

5.2 Option II

A second interconnection location is a tie between the PV system PCC primary delivery voltage (12.47) and the existing Business Feeder or N Main Feeder served from the Ashland Substation near the intersection of Oak Street and Nevada Street. This tie location is approximately 1.5 miles from the southwest corner of the PV Imperatrice Property site and could be connected by overhead or underground construction. The route from the solar site could be south along N Mountain Avenue, west along Eagle Mill Road and via the I-5 Eagle Mill overpass south along Oak Street to the Nevada Street interconnect. However, this construction is out of the existing City of Ashland service territory. Therefore, permitting, easements and rights-of-way will need to be established as will the I-5 crossing even if bored underground. In addition, both PPL transmission and distribution facilities exist along Eagle Mill Road and Oak Street so negotiations will be necessary if joint-use facility construction is a viable option. This interconnection location could accommodate one feeder interconnection up to ~5 MW.

5.3 Option III

An option to the Case II interconnection description above, but only to accommodate one ~2.5 MW interconnection, could be to intercept the circuit serving the WWTP, which would require line extension along the Bear Creek Greenway access road from Oak Street. Although the total distance is similar, approximately 1.4 miles, the advantage is more accessible easement for construction along the Bear Creek Greenway access road which could include open trench and underground bore construction beneath I-5 from the generation site to the circuit interconnect. Again some construction is out of the Ashland service territory, permitting, easements and rights-of-way will need to be established as will the I-5 crossing even if bored underground.

6.0 SYSTEM COST ESTIMATES

Cost estimates have been determined regarding the electrical interconnection. The cost estimates are in US dollars and are based upon typical construction costs in the area for previously performed similar construction. Budgetary pricing for three different capacity PV system interconnection options are summarized in Table 9. The cost estimates for utility construction to interconnect the existing City's electric system to the PV sites point of common coupling (PCC) range between $0.9M to $1.5M. They are budgetary pricing estimates and not detailed take-off construction estimates. Each estimate includes some pricing related to the City's electric staff and administration requirements considered necessary for the PV projects interconnection. The City may want to evaluate these items for accuracy and comment or edit as necessary.

In addition, the estimates show pricing for miscellaneous contractor services which include: permitting, easement and rights-of-way acquisition, survey, erosion sedimentation control (ESC) requirements applicable for the region and any necessary traffic control planning (TCP).

Table 9: Construction Cost Estimate, City of Ashland

	Option I	Option II	Option III
Cost	$1,481,877	$963,707	$876,420

The estimated total cost for the required upgrades using Option I is $1.5M, which is the highest among the three options. This is because Option I as described previously is to integrate a total of 10 MW. It requires two switchgear (one for each 5 MW array) and involves replacing an existing VFI by two VFIs near the E Nevada Street and N Mountain Avenue intersection, while Option II and Option III only need one switchgear and one VFI.

Detailed cost breakdown (i.e., sectionalizing equipment, vaults, conductors, fiber, conduit, connectors, modification, contingency, etc.) can be found in the following three sheets:

- CASE I: PV PCC – ELECTRICAL SYSTEM INTERCONNECT, PV SYSTEM TOTAL GNERATION – 10 MW
- CASE II: PV PCC – ELECTRICAL SYSTEM INTERCONNECT, PV SYSTEM TOTAL GNERATION – 5 MW
- CASE III: PV PCC – ELECTRICAL SYSTEM INTERCONNECT, PV SYSTEM TOTAL GNERATION – 2.5 MW

CITY OF ASHLAND

ASHLAND ELECTRIC CONSTRUCTION COST ESTIMATE

CASE I - PV PCC - ELECTRIC SYSTEM INTERCONNECT
PV SYSTEM TOTAL GENERATION - 10 MW

January 2017 - Work Order #534.100

Description	Quantity	Installed Cost/Unit	WO 534.100 Developer Cost	WO 534.100 CoA Cost
Sectionalizing Equipment:				
PV-PCC-SWGR (3Ø-rly-mtr-SCADA)[1]	2	$125,000	$250,000	$0
VFI (3Ø, 4-way)[1]	2	$32,000	$64,000	$0
VR PadMounted (3Ø, 250-kVA)[1]	2	$36,000	$72,000	$0
Vaults:				
UV-5106-LA[1] (splice vaults)	2	$8,000	$16,000	$0
UV-810-LA[1] (swgr + VRs)	4	$8,000	$32,000	$0
UV-444-LA[1] (comm)	4	$3,200	$12,800	$0
Conductors:				
750-kcmil AL, EPR, 15-kV[1]	0	$11.50 /Ft	$0	$0
500-kcmil AL, EPR, 15-kV[1]	0	$9.25 /Ft	$0	$0
350-kcmil AL, EPR, 15-kV[1]	33480	$7.00 /Ft	$234,360	$0
#4/0 AWG, AL, EPR, 15-kV[1]	0	$5.00 /Ft	$0	$0
Fiber System				
Fiber cable/equipment[1]	1	Lot	$15,000	$0
Conduit Installed				
6" PVC Sch. 40[1] (qty 2)	5020	60 /Ft	$301,200	$0
4" PVC Sch. 40[1]	0	0 /Ft	$0	$0
3" PVC Sch. 40[1]	0	0 /Ft	$0	$0
2" PVC Sch. 40[1] (qty 1)	5020	20 /Ft	$100,400	$0
2.5" Flex Conduit[1]	0	0 /Ft	$0	$0
Bore I-5 Xing (2-6"+1-2")[1]	380	140 /Ft	$53,200	$0
Cable Connectors				
3-Way Junction Module[1]	0	$750	$0	$0
4-Way Junction Module[1]	0	$1,000	$0	$0
Separable Splice (600-Amp)[1]	12	$1,000	$12,000	$0
Elbows (600-Amp)[1]	42	$350	$14,700	$0
Elbows (200-Amp)[1]	6	$175	$1,050	$0
Deadbreak Protective Cap[1]	0	$50	$0	$0
Fault-Current Indicator[1]	12	$150	$1,800	$0
Fused Elbow (200-Amp)[1]	0	$375	$0	$0
Metering and CT's[1]	0	Lot	$0	$0
Miscellaneous Connectors[1]	1	Lot	$2,500	$0
Miscellaneous Contingency[1] (5%)			$59,151	$0
Contractor Mob/Demob/Insur/Survey/ESC/TCP[2]	1	Services	$50,000	$0
Permitting-Easements-Rights-of-Way[2]	1	Services	$50,000	$0
Energization[5]	1	Services	$5,000	$0
Administrative[5] (10%)	1	Lot	$134,716	$0
		TOTAL COST ESTIMATE:	**$1,481,877**	**$0**

Notes:

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[4] This item furnished and installed by City, full cost is included in this estimate.

[5] This effort includes City crew inspection, voltage check and energization coordination with developer.

[5] This item includes City administration, engineering, design and inspection.

[√ - typ rural pri const ~$120/ft multiple conduit, open trench excavation/backfill/compaction/restoration; assume 3 conduits/cables @$135/ft x 5600' = $0.8M + maj equip @$400k + admin/misc @15% = $1.4M]

ASHLAND ELECTRIC CONSTRUCTION COST ESTIMATE

CITY OF ASHLAND

CASE II - PV PCC - ELECTRIC SYSTEM INTERCONNECT
PV SYSTEM TOTAL GENERATION - 5 MW

January 2017 - Work Order #534.100

Description	Quantity	Installed Cost/Unit	WO 534.100 Developer Cost	WO 534.100 CoA Cost
Sectionalizing Equipment:				
PV-PCC-SWGR (3Ø-rly-mtr-SCADA)[1]	1	$125,000	$125,000	$0
VFI (3Ø, 4-way)[1]	1	$32,000	$32,000	$0
VR PadMounted (3Ø, 250-kVA)[1]	1	$36,000	$36,000	$0
Vaults:				
UV-5106-LA[1] (splice vaults)	2	$8,000	$16,000	$0
UV-810-LA[1] (swgr + VRs)	2	$8,000	$16,000	$0
UV-444-LA[1] (comm)	4	$3,200	$12,800	$0
Conductors:				
750-kcmil AL, EPR, 15-kV[1]	0	$11.50 /Ft	$0	$0
500-kcmil AL, EPR, 15-kV[1]	0	$9.25 /Ft	$0	$0
350-kcmil AL, EPR, 15-kV[1]	16740	$7.00 /Ft	$117,180	$0
#4/0 AWG, AL, EPR, 15-kV[1]	0	$5.00 /Ft	$0	$0
Fiber System				
Fiber cable/equipment[1]	1	Lot	$15,000	$0
Conduit Installed				
6" PVC Sch. 40[1] (qty 1)	5020	40 /Ft	$200,800	$0
4" PVC Sch. 40[1]	0	0 /Ft	$0	$0
3" PVC Sch. 40[1]	0	0 /Ft	$0	$0
2" PVC Sch. 40[1] (qty 1)	5020	20 /Ft	$100,400	$0
2.5" Flex Conduit[1]	0	0 /Ft	$0	$0
Bore I-5 Xing (1-6"+1-2")[1]	380	130 /Ft	$49,400	$0
Cable Connectors				
3-Way Junction Module[1]	0	$750	$0	$0
4-Way Junction Module[1]	0	$1,000	$0	$0
Separable Splice (600-Amp)[1]	6	$1,000	$6,000	$0
Elbows (600-Amp)[1]	18	$350	$6,300	$0
Elbows (200-Amp)[1]	0	$175	$0	$0
Deadbreak Protective Cap[1]	0	$50	$0	$0
Fault-Current Indicator[1]	6	$150	$900	$0
Fused Elbow (200-Amp)[1]	0	$375	$0	$0
Metering and CT's[1]	0	Lot	$0	$0
Miscellaneous Connectors[1]	1	Lot	$2,500	$0
Miscellaneous Contingency[1] (5%)			$36,814	$0
Contractor Mob/Demob/Insur/Survey/ESC/TCP[2]	1	Services	$50,000	$0
Permitting-Easements-Rights-of-Way[2]	1	Services	$50,000	$0
Energization[5]	1	Services	$3,000	$0
Administrative[5] (10%)	1	Lot	$87,609	$0
		TOTAL COST ESTIMATE:	**$963,703**	**$0**

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ASHLAND ELECTRIC CONSTRUCTION COST ESTIMATE

CITY OF ASHLAND

CASE III - PV PCC - ELECTRIC SYSTEM INTERCONNECT
PV SYSTEM TOTAL GENERATION - 2.5 MW

January 2017 - Work Order #534.100

Description	Quantity	Installed Cost/Unit	WO 534.100 Developer Cost	WO 534.100 CoA Cost
Sectionalizing Equipment:				
PV-PCC-SWGR (3Ø-rly-mtr-SCADA)[1]	1	$110,000	$110,000	$0
VFI (3Ø, 4-way)[1]	1	$32,000	$32,000	$0
VR PadMounted (3Ø, 114-kVA)[1]	1	$30,000	$30,000	$0
Vaults:				
UV-5106-LA[1] (splice vaults)	2	$8,000	$16,000	$0
UV-810-LA[1] (swgr + VRs)	2	$8,000	$16,000	$0
UV-444-LA[1] (comm)	4	$3,200	$12,800	$0
Conductors:				
750-kcmil AL, EPR, 15-kV[1]	0	$11.50 /Ft	$0	$0
500-kcmil AL, EPR, 15-kV[1]	0	$9.25 /Ft	$0	$0
350-kcmil AL, EPR, 15-kV[1]	0	$7.00 /Ft	$0	$0
#1/0 AWG, AL, EPR, 15-kV[1]	16740	$4.00 /Ft	$66,960	$0
Fiber System				
Fiber cable/equipment[1]	1	Lot	$15,000	$0
Conduit Installed				
6" PVC Sch. 40[1] (qty 1)	0	40 /Ft	$0	$0
4" PVC Sch. 40[1]	5020	40 /Ft	$200,800	$0
3" PVC Sch. 40[1]	0	0 /Ft	$0	$0
2" PVC Sch. 40[1] (qty 1)	5020	20 /Ft	$100,400	$0
2.5" Flex Conduit[1]	0	0 /Ft	$0	$0
Bore I-5 Xing (1-4"+1-2")[1]	380	130 /Ft	$49,400	$0
Cable Connectors				
3-Way Junction Module[1]	0	$750	$0	$0
4-Way Junction Module[1]	0	$1,000	$0	$0
Separable Splice (200-Amp)[1]	6	$800	$4,800	$0
Elbows (600-Amp)[1]	0	$350	$0	$0
Elbows (200-Amp)[1]	18	$175	$3,150	$0
Deadbreak Protective Cap[1]	0	$50	$0	$0
Fault-Current Indicator[1]	6	$150	$900	$0
Fused Elbow (200-Amp)[1]	0	$375	$0	$0
Metering and CT's[1]	0	Lot	$0	$0
Miscellaneous Connectors[1]	1	Lot	$2,500	$0
Miscellaneous Contingency[1] (5%)			$33,036	$0
Contractor Mob/Demob/Insur/Survey/ESC/TCP[2]	1	Services	$50,000	$0
Permitting-Easements-Rights-of-Way[2]	1	Services	$50,000	$0
Energization[5]	1	Services	$3,000	$0
Administrative[5] (10%)	1	Lot	$79,675	$0
		TOTAL COST ESTIMATE:	**$876,420**	**$0**

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[5] This item includes City administration, engineering, design and inspection.

In closing we appreciate the opportunity to provide engineering services to the City of Ashland. If there are any concerns or questions with the information presented herein please contact us at your convenience. In addition, we would gladly be available to meet and discuss our findings.

Preliminary Geotechnical
Investigation and Geohazards Report

Wastewater Treatment Plant Expansion

Ashland, Oregon

Prepared for:

Carollo Engineers

Portland, Oregon

November 13, 1998

Prepared by:

Foundation Engineering, Inc.
Professional Geotechnical Services

Mr. Rob Norton, P.E.
Carollo Engineers
5100 SW Macadam Avenue, Suite 440
Portland, Oregon 97201

November 13, 1998

Wastewater Treatment Plant Expansion
Preliminary Geotechnical Investigation and
Geohazards Report
Ashland, Oregon

Project 98200064

Dear Mr. Norton:

We have completed the requested geotechnical geohazards investigation for the proposed expansion to the Ashland Wastewater Treatment Plant in Ashland, Oregon. This report was released as a draft on September 15, 1998, and forms the basis for the follow-up geotechnical work currently underway. The report has since been updated based on information developed in the Phase II studies. Our investigation was performed in general accordance with the scope of work provided in our proposal to Mr. Greg Humm dated July 20, 1998. Our report includes a description of our work, a discussion of site conditions and conclusions regarding the proposed project development.

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.

Jonathan N. Guido, P.E.
Project Engineer

Frederick G. Thrall, P.E.
Project Manager

JNG/FGT/dl

enclosure

Portland • Salem • Corvallis • Eugene
7420 SW Hunziker Road, Suite A • Portland, Oregon 97223-8252 • Bus. (503) 684-9514 • Fax (503) 598-9343

PRELIMINARY GEOTECHNICAL INVESTIGATION AND GEOHAZARDS REPORT WATER TREATMENT PLANT EXPANSION CITY OF ASHLAND ASHLAND, OREGON

BACKGROUND

The purpose of this preliminary geotechnical investigation is to evaluate the feasibility of the proposed site development and to provide conclusions regarding geohazards, site grading, excavation, and embankment and slope stability at the Ashland Waste Water Treatment Plant expansion site (Figure 1). Our investigation also identifies geotechnical conditions that may affect the siting, design and construction of the planned facilities. Final design of these planned facilities will require additional site-specific field and laboratory investigations, analyses and preparation of geotechnical design recommendations.

We were provided with a set of project development plans (50% submittal plans) for the geotechnical investigation. These plans indicate that the project development would include lower and upper reservoirs (Reservoirs No. 1 and No. 2), ±6 acres and ±22 acres, respectively, and several smaller ancillary lagoons and drying beds along the upper ridges of the site. Grading for the reservoirs would require maximum combined cut and fill depths on the order of ±30 to 60 feet. Other facilities shown on the project plans include a ±1,200-square foot O&M building, pump station, drainage and piping systems, a wastewater conveyance pipeline network, and gravel access roads.

On September 4, 1998, a project meeting was held at Carollo Engineer's Portland office to discuss our findings and preliminary conclusions from our recently completed field investigation. In this meeting, we recommended finished grades be adjusted to limit cut depths to a target of less than 20 feet. This resulted in the decision to replace the upper reservoir (Reservoir No. 2) with a larger, low profile effluent reservoir along the upper ridges of the site. Subsequent consultations with Carollo Engineers resulted in the currently proposed project layout as indicated in the site plan map (Figure 2).

FIELD EXPLORATION

Three boreholes were drilled across the site between August 25 and 27, 1998. The boreholes were drilled with a CME-55, All Terrain Vehicle (ATV) drill rig and mud-rotary (tri-cone bit) equipment. The boreholes were drilled to depths of between 47 and 81½ feet. Samples were obtained at 2½ to 5-foot intervals. Disturbed samples were obtained with a split-spoon (noted as SS on the logs). The Standard Penetration Test (SPT), is run when the split-spoon is driven, and provides an indication of the relative stiffness or density of the foundation soils. Relatively undisturbed tube samples were obtained with a Dames & Moore (D&M) drive sampler (noted as DM on the logs). Undisturbed samples were also collected using thin-walled Shelby tubes. Please note that the penetration resistance noted for the D&M samples on the attached boring logs have been converted to "SPT N-Values."

The boreholes were continually logged during drilling. The final logs (Appendix A) were prepared based on a review of the field logs and an examination of the soil samples in our laboratory. The locations of the borings are shown on Figure 1. The subsurface conditions are discussed below.

One-inch diameter, open-pipe piezometers were installed within each of the three boreholes drilled for the project to monitor ground water levels. The screen sections of the piezometers were backfilled with clean No. 10 to No. 30 size sand and the upper lengths were backfilled with bentonite chips. The construction of each piezometer is indicated on the attached boring logs.

LOCAL GEOLOGY AND TOPOGRAPHY

Literature Review

We reviewed available geologic and seismic publications and maps to determine the local and regional geology, faulting, tectonics and seismicity. Data from our subsurface exploration at the site was interpreted with respect to local geology. This report contains a summary of data collected from various sources. A list of references used to compile the information presented below is provided at the end of this report.

Local Geology

The proposed WWTP is situated northeast of Ashland in the foothills of the Western Cascade Range. The site is located above Bear Creek Valley, an extensive northwest-southeast trending valley that contains the cities of Ashland and Medford. Butler Creek borders the site to the north and the Talent Irrigation District Canal follows the ±2025 foot contour along the hillside within the project area. Hambry Springs is located directly west of the project area.

Local bedrock geology consists of fluvial deposits of well-indurated sandstone, shale and conglomerate of Cretaceous and Eocene Age (Beaulieu and Hughes, 1977; Smith and others, 1982). These fluvial deposits dips gently (±20°) to the northwest. Tertiary-aged basalt and gabbro intrusions cut this older rock north of the project area. Figure 3 contains a geologic map of the site.

The site is located on one of two large, lobe-shaped protrusions along the southwest-facing hillside (Figure 3). This suspicious topography, combined with large depressions bounded by steep, scarp-like slopes has been mapped by Dr. Jad D'Allura of Southern Oregon University as a large, ancient, debris flow (personal communication, August 1998). Our subsurface exploration indicates that this deposit may exceed 80 feet in depth within the project area as no bedrock was encountered in our borings. Rounded, poorly-defined landslide features indicate that the overall flow deposit is currently stable, but isolated areas may be subject to secondary failure without proper precautions.

Several small to moderate size slumps were observed along the eastern boundary of the site during our field investigation in August 1998. A shallow slope failure is also present along the canal near the eastern boundary of the project. These slides are likely marginally stable and may reactivate seasonally during wet-weather periods. Further detailed site reconnaissance and mapping are needed in this area.

Local Faulting

Ancient normal faults parallel Bear Creek Valley ±2.5 miles west and southeast of the site. These faults are not identified as potentially active (Geomatrix, 1995). Geologic mapping conducted in 1982 identifies a concealed fault beneath the site (Smith and others, 1982); however recent mapping in this area has not identified any evidence of nearby faulting (D'Allura, personal communication).

The site is located ±20 miles west of the Sky Lakes Fault Zone. Although the faults in this zone show no evidence of movement in the last ±30,000 years, they still are potentially seismogenic and thus have an activity probability of 0.6 (Geomatrix, 1995). Although there is no indication of current faulting beneath the site, hidden and/or deep-seated active faults could remain undetected. Additionally, recent crustal seismic activity cannot always be tied to observable faults. In the event of a catastrophic earthquake with a large seismic moment, inactive faults could potentially be reactivated.

Geologic Hazards

The potential for secondary landsliding exists at the site based on the nature of the debris-flow deposits and existing evidence of slope instability. This potential is addressed in the section on the ancient debris flow deposit below. Expansive soil conditions are present in the ±2 feet of clay topsoil that mantles the site. Geologic hazards related to flooding and erosion are not applicable to the site.

During our investigation of the debris flow, we noted a larger area of possible slope instability ±200 feet upslope from the recent, moderate-sized slump adjacent to the canal (Figure 4). In this area, an arcuate-shaped slope break encloses a slightly flattened portion of the slope ±400 feet across. No landslide cracking or fresh scarps were observed. Below this flattened portion, the slope becomes oversteepened. The moderate-sized slump that failed into the canal is located in this oversteepened section. The proposed access road alignment is located within ±200 feet upslope from the larger area of potential slope instability.

Evidence of ancient slope instability was encountered along the proposed pipeline alignment between the irrigation canal and the crest of the hill. Acruate-shaped, oversteepened slopes, remnants of an old sag pond in the basin, and irregular topography beyond the base of the slope indicate that a portion of the debris flow slope failed in this area. This secondary failure is undoubtedly ancient based on the presence of a developed soil profile.

Local Seismic History

While crustal earthquakes dominate Oregon's seismic history, only three of the major events reached a Richter magnitude $M_L=6$, with the majority in the $M_L=4$ to 5 range. Table 2 lists $M_L=3.5$ or greater, earthquakes that have occurred within a 50-mile radius of Ashland over the last 150 years.

Table 2. Historic Oregon Earthquakes within 50-mile Radius of Ashland*

Year	Month	Day	Hour	Minute	Latitude	Longitude	Depth (km)	Magnitude
1906	4	23	19	0	42.4	122.4	0	4.3
1953	4	6	18	28	42.4	122.9	0	3.6
1965	10	30	19	15	42.1	122.8	25.0	4.0
1993	9	21	3	17	42.3	122.1	15.7	3.9
1993	9	21	3	29	42.3	122.1	18.5	5.9
1993	9	21	4	16	42.3	122.0	18.1	3.8
1993	9	21	4	34	42.3	122.1	9.2	3.8
1993	9	21	4	37	42.3	122.0	13.9	3.5
1993	9	21	5	45	42.3	122.1	20.5	6.0
1993	9	21	6	14	42.4	122.1	11.0	4.3
1993	9	23	6	21	42.3	122.1	15.6	4.0
1993	9	24	16	53	42.3	122.0	5.5	3.5

*Johnson and others, 1994

A sample of distant strong earthquakes felt in the Ashland area include the following (MM intensities in parentheses): the 1873 Cresent City, California earthquake (IV-V) and the 1993 Klamath Falls earthquakes (V).

DISCUSSION OF SITE CONDITIONS

Site Conditions

The proposed development is located within an undeveloped, ±880 acre parcel, located upslope (northeast) of Interstate I-5, between Eagle Mill Road and Butler Creek Road. The site consists of a grassy hillside meadow with isolated groves of trees and brush that is currently being used to graze livestock. Most of the site is drained by two south-flowing seasonal streams. The site is crossed by the Tangent Irrigation District Canal (El. ±2025 feet) that flows from east to west through the project site. This canal is used to flood irrigate the lower portion of the site that was partially covered with standing water at the time of our field investigation. Several springs were observed along the grassy hillside below this canal. Site elevations range from El. ±1780 feet near the southern corner of the site along Eagle Mill Road to El. ±2400 feet along the upper portion of the developed area near the northeast corner of the site.

Subsurface Conditions

Exploration borings were advanced at three sites (Figure 2). Within the borings, landslide debris flow deposits were encountered to the maximum depths drilled. This finding is consistent with an unpublished geologic map that indicates a large, ancient, debris flow covers most of the site. The debris flow deposits encountered in our borings were quite variable, containing soils ranging from highly plastic, sandy clay to cohesionless, poorly graded gravels. The fine grained soils were damp to moist and stiff to hard, while the coarse grained soils were moist to wet and dense to very dense. Zones of relatively hard drilling indicate that cobbles or gravel layers are present within all our borings. Practical drilling refusal was encountered at Boring BH-1 at a depth of ±47 feet. A complete description of the debris flow materials encountered in our borings is provided on the enclosed boring logs.

Site subsurface conditions were previously explored by Marquess & Associates, Inc. (MAI) in August 1997 by advancing seven backhoe test pits to maximum depths of ±9 feet below existing site grades. MAI's explorations indicate the site is covered by at least ±2 to 9 feet of silty to gravelly clay with moderate to high plasticity. The test pit logs indicate that the site soils contain gravel to cobble-size clasts, and generally become coarser with depth. MAI encountered trenching refusal during test pit exploration.

Ground Water

Ground water was measured at depths of between ±5 and 60 feet in the piezometers installed in our borings on August 28, 1998. The shallow depth of ground water measured at BH-3 is likely influenced by the infiltration of water from the Talent Irrigation District Canal further upslope from this piezometer. Please note that these ground water levels were measured after bailing water out of the piezometers. However, these ground water levels are likely elevated due to the presence of drilling fluid in and around the piezometers, and should not be considered completely accurate.

Several springs were observed across the lower slope of the site, within and around the footprint of Reservoir No. 1. These springs were estimated to be flowing at a constant rate of between 5 and 20 gallons per minute. At the time of our field investigation, the lower slope area was being flood irrigated with canal water, and standing water covered much of the area. It appears likely that the infiltration of canal water into the sloped below the canal, is a significant factor in the development of these springs.

LABORATORY TESTING

Soil samples collected from our three exploration borings were delivered to our Corvallis geotechnical laboratory for testing. The geotechnical laboratory testing program consisted of 15 natural water contents, 4 natural dry density determinations, 3 sieve analyses, and 2 Atterberg limits tests. A hydrometer test was also performed for this investigation. The laboratory test results were used to estimate the soil engineering properties of the site soils, including an estimate of the susceptibility to debris flow. The results of these laboratory tests are presented in Appendix B.

REGIONAL TECTONICS

Western Oregon is located in an area of potential seismic activity. The Juan de Fuca Plate, located off the Oregon coast, is being subducted beneath the North American Plate. This subduction zone may generate earthquakes within the descending plate (intraslab), at the inclined interface between the two plates (interface) and within the upper North American Plate (crustal).

Although crustal and intraslab earthquakes have been detected, no great subduction zone event has occurred in Oregon during the 150 years of recorded earthquakes. Recently discovered tsunami inundation deposits and evidence of episodic subsidence along the Oregon and Washington coasts are thought to have been caused by great seismic events (Peterson and others, 1993). Interface earthquakes have an estimated average return period of 500 years with the last event possibly occurring ±300 years ago (Nelson and others, 1995).

SEISMIC DESIGN

Design Earthquake Parameters

The OSSC, Section 2905, recommends that building sites be evaluated for at least three different earthquakes with the following magnitudes:

Crustal:	$M_W = 6.0$ minimum.
Intraslab:	$M_W = 7.0$ minimum.
Interface:	$M_W = 8.0$ minimum.

We reviewed current seismic information for the Ashland area and defined the design earthquakes for this specific area. The following earthquake magnitudes and distances were selected (Weaver and Shedlock, 1994):

Crustal:	$M_W = 6.0$ to 6.5 at a depth or distance of 6.2 miles from the site.
Intraslab:	$M_W = 7.0$ to 7.5, ±62 miles west of the site at a depth of 28 to 37 miles.
Interface:	$M_W = 8.8$, ±78 miles west of the site at a depth of 11 miles.

Peak Ground Accelerations

Bedrock acceleration coefficients were analyzed from several different literature sources. The ODOT seismic design information provided by Geomatrix indicates a peak ground acceleration of 0.20g (on rock) for the proposed site with a 500-year return period. The 0.3 and 1.0-second spectral accelerations are 0.37g and 0.16g, respectively, assuming 5% damping.

Based on our subsurface investigation, we have characterized the site as being underlain by a stiff soil profile corresponding to a UBC (1997) soil profile type S_D. The seismic Zone Factor (Z) for this site equals 0.30, and the Seismic Coefficients, C_a and C_v, are 0.36 and 0.54. A Near Source Factor of 1.0 is appropriate for the site.

SEISMIC HAZARDS

Liquefaction. There is a low potential for seismically induced liquefaction based on the density and cohesiveness of the soil.

Landslides. The probability of seismically-induced landslides is minimal based on site conditions.

Subsidence. Based on the density of the soil, there is a low potential for subsidence during an earthquake.

Lateral Spreading. There is a low probability of lateral spreading at the site.

Other Seismic Hazards. There is a low potential for ground rupture due to the lack of established faulting beneath the site. Seiche and tsunami inundation at the site at the site are precluded by location.

DISCUSSION AND CONCLUSIONS

Based on the results of our subsurface exploration, laboratory testing and engineering analysis, it is our opinion that the planned site development is feasible from a geotechnical standpoint provided the conclusions and recommendations in this report are incorporated into the project design and construction. The principal site feature affecting the development is the very large, debris flow deposit that underlies most of the site. The presence of younger, smaller slope failures within this larger deposit indicates that the slide materials may locally be prone to instability and failure within deeper excavations for the project development. Therefore, we have recommended that maximum excavations depths be limited to ±20 feet, or less. Additional geotechnical studies will be necessary to support the project final design. Recommendations for geotechnical exploration and analysis will be provided in a separate document.

Our conclusions regarding the ancient debris flow deposit, and other geotechnical conditions effecting site development, are presented in the following sections. Based on our preliminary investigation, we developed the following discussions:

ANCIENT DEBRIS FLOW DEPOSIT

The results of our brief geologic review, exploratory drilling and laboratory testing indicates the site is underlain by a jumbled deposit consisting of a mixture of silty gravel, gravelly clay, clayey silt, clayey gravel, sandy clay, sandy silt, clayey silt, clayey sand, sand, and cobbles. Recent geologic mapping for the site area indicates that these materials are part of a large, ancient debris flow deposit.

The key soil engineering properties which are predictors of relative debris flow stability are soil clay content and the ratio of the "in-place" saturated, water content to measured liquid limit. Our observations and laboratory testing indicates site soils have variable clay contents, ranging from very low to very high percentages, by weight. Deposits with clay contents greater than about 25 percent will not create the conditions required for a debris flow to occur. The calculated ratio of water content at saturation to liquid limit for Sample 2-3 is ±0.5. This is well below the value of 1.0 which typically indicates a debris flow could occur (Turner, and Schuster, 1996). Most of the deposit appears to have a significant percentage of clay. This will be confirmed in future proposed work.

The proposed large scale excavations for the project will cause minor strains in cut slopes. While, debris flows have been triggered with as little as 1% strain (Turner, and Schuster, 1996) we do not expect large scale failures caused by sliding or debris flow mechanisms. However, the proposed cut slope area will likely be composed of highly variable materials which may be subject to localized debris flow and slump failures, depending on the relative position of the cuts and the materials encountered in the cuts. These localized failures can usually be mitigated by keeping the slope areas drained and protected from surface water runoff. This will require that all ponds be lined and that underdrains be installed.

The results of supplemental geotechnical explorations may indicate that certain cut slope areas will require further stabilization by buttressing, replacement, soil amendments, or other types of stabilization treatments. We anticipate that the types of treatments required will be specified prior to construction based on our geotechnical analysis. The lateral extent of the treatments would not be known until the cuts are opened.

SITE GRADING AND EARTHWORK CONSTRUCTION

Wet-Weather Construction

The on-site soils are moisture sensitive and will become soft, weak and practically unworkable during wet weather periods. The surface of the site is covered by plastic clay that will likely not support conventional traffic during wet-weather conditions. Compaction of the fine-grained site soils for embankment construction will not be practical during the winter or when borrow source soils are wet of optimum. The contractor may still experience pumping problems in the summer if the surficial soils have not adequately dried. Therefore, site grading should be scheduled during the dry-weather months, generally May through September. We should be contacted in the event that the work occurs in the winter or late spring so that we can provide additional recommendations for wet weather construction.

We understand that earthwork construction is scheduled to start in May 1999 with site grading planned for the summers of 1999 and 2000. Since site earthworks will remain exposed to precipitation and runoff during the winters of 1999 and 2000, suitable surface drainage improvements and erosion control installations will be required to limit damage to earthworks.

SUITABILITY OF ON-SITE SOILS FOR EARTHWORK MATERIALS

Current plans are to construct the embankments using on-site soil materials. We understand that excavation depths will generate enough earthfill for embankment construction, to roughly balance cut-and-fill volumes for the project. The soils materials within the limits of the planned excavations should be suitable for use as embankment fill. The high plasticity clayey site soils that are predominant within the anticipated cut areas are likely to experience shrinkage and swelling with changes in moisture. To minimize the potential for shrinkage cracks in the pond embankments, these soils should be placed and compacted at moisture contents at or above the optimum value and used in the interior portions of embankments. Silty or clayey soils with a significant percentage of gravel should have relatively high strength characteristics and are most suitable as fill along the outer shells of the embankments. Gravelly soils could either be blended with finer grained soils to create a cohesive gravelly fill for use in site earthworks, or possible used as a coarse granular fill material.

SOIL EXCAVATION CHARACTERISTICS

Excavation to depths up to ±20 feet below site grades is anticipated for site grading. The Standard Penetration Test (SPT) N-values, relative drilling resistance and other data recorded at Borings BH-1, BH-2 and BH-3 indicate that cobbles or dense layers of gravel may be present at shallow depths within the planned development areas. Additionally, shallow trenching refusal was experienced by Marquess & Associates, Inc., (MAI) during excavation of backhoe test pits in 1997. Based on this information, it is our opinion that most site excavation should be feasible using conventional heavy earthmoving equipment. However, any cobbles or zones of dense gravels encountered could require ripping with a larger bulldozer to facilitate excavation.

EMBANKMENT AND SLOPE STABILITY

Effluent Reservoir No. 1

The latest grading plan we reviewed indicates that this reservoir will be about 925 feet in length and 250 feet wide. Reservoir construction will require maximum cut depths and embankment heights of ±14 feet. The deepest cuts for this reservoir are planned along the northwest quadrant of the reservoir. The highest embankment fill will be located at the southeast corner of the reservoir. The toe of this fill will be located within ±50 feet of the crest of the existing cut slope, just east of Interstate I-5. A pump station is planned within the limits of the embankment fill at the west end (uphill end) of the reservoir. An outlet structure is planned at the east end (downhill end) of the reservoir.

The data from Boring BH-3 indicates that the planned reservoir excavations will expose sandy clay to the maximum cut depths. These soils were medium stiff to very stiff at the time of our field investigation in late August 1998 and should perform adequately in temporary cut slopes excavated at inclinations as steep as ±1.5:1 (horizontal: vertical) during dry weather periods. Cut slopes that penetrate zones of perched ground water, wet and/or weak soil layers will likely need to be laid back at flatter inclinations to maintain temporary stability.

The soils underlying the reservoir are generally susceptible to loss of shear strength when subject to wetting and increased moisture contents. Therefore, these soils should be protected from storage water leakage by means of properly designed liner and underdrain systems. These soils could also be subject to loss of strength due to infiltration of surface water runoff. Therefore, adequate surface water drainage improvements are recommend around the reservoir.

Given the potential for the loss of soil shear strength from wetting, relatively flatter final cut slope inclinations will be required to maintain long-term stability. Additionally, a stability blanket or berm, comprised of a coarse granular fill material, may be needed to enhance slope stability. Since the height of the planned cut slope is less than ±20 feet, no benching is currently anticipated. Additional drilled borings, laboratory testing and analyses will be required to prepare recommendations for design of reservoir liner and drainage systems, final cut slope inclinations and any additional slope stabilization measures required.

The available soil data indicate that soft to medium stiff, sandy clay soils are present at shallow depths below the footprint of the reservoir embankment. At the time of our field investigation, the reservoir area was covered by standing water from the upslope canal. Given the presence of softer soils and standing water, it is likely that the surficial soils below most of the embankment foundation area may be relatively weak, and require removal during grading. The depths and limits of the soil removals required for embankment foundation support can be better delineated by advancing additional explorations across the foundation area.

Large Effluent Reservoir

The latest grading plan we reviewed indicates that this pentagon-shaped reservoir will be about ±13 acres in area. Two alternative grading plans have been considered for the reservoir. Plan A includes an interior levee dividing the reservoir into east and west ponds, with different bottom crest and elevations. Alternatively, Plan B assumes a single reservoir with a uniform crest and bottom elevation. We have discussed the relative merits of each reservoir grading plan scheme with you. The advantages of Plan A include providing access for reservoir maintenance and repair and reducing the maximum reservoir cut depths and fill heights. However, the drawback of this plan is that the grading will be more complex and additional benches will be required for access. The principal drawbacks to Plan B are deeper cuts and fills and lack of access to the interior reservoir area (reservoir is over ±1,000 feet wide). However, the elimination of the interior levee reduces the potential for slope instability in the interior of the reservoir where maintenance would be most difficult. Given these relative advantages and drawbacks, Plan B appears to be the better option based on the available data.

The Plan B grading option includes a cut to a depth of 20 feet along the perimeter of the adjacent utility corridor. Additionally, a power line pole appears to be located about 50 feet from the reservoir. The data from Boring BH-1 indicate that the planned reservoir excavations will expose generally damp to moist, stiff to hard, gravelly clay and silt to the maximum cut depths. These soils are also susceptible to loss of shear strength when subject to wetting and increased moisture contents. Therefore, these soils should be protected from storage water leakage by means of properly designed liner and underdrain systems. These soils could also be subject to loss of strength due to infiltration of surface water runoff. Therefore, adequate surface water drainage improvements are recommend around the reservoir.

Additional borings, laboratory testing and engineering will be required to prepare recommendations for design of the reservoir liner and drainage systems, final cut slope inclinations and any additional slope stabilization measures required.

The Plan B grading option also includes construction of a ±1,000-foot long embankment dam up to 35 feet in height. This dam will retain ±13 acres of water with a maximum depth of ±20 feet. The design of this embankment dam will require evaluation of embankment seepage and piping potential, water storage losses, and stability under operating conditions, including maximum storage head levels and rapid water level drawdown. Additionally, the dam will require design of granular slope protection, a seepage cut-off trench and an outlet pipe to allow for reservoir drainage (in accordance with embankment dam practice and Oregon Dam Safety Regulations). Additional borings, test pits, laboratory testing and engineering analysis will be required to prepare recommendations for design of this embankment dam.

Biosolids Lagoons

The latest grading plan we reviewed indicates that the two biosolids lagoons will be located about 100 feet southwest of the toe of the embankment of the large effluent reservoir. The upper and lower lagoons will each be about 500 feet long, 200 feet wide, and 10 feet deep. Construction of the lagoons will require maximum cut depths and embankment heights of ±11.5 feet and 17.5 feet, respectively. The highest embankment fills and deepest cuts are planned for the lower lagoon.

Design of the embankments and cut slopes for the biosolids lagoons will require consideration of the geotechnical issues discussed above for the large effluent reservoir. Additional test pits and borings, laboratory testing and engineering analysis will be required to address these conditions and provide recommendations for design of these proposed embankments and cut slopes.

DRYING BEDS

The latest grading plan we reviewed indicates that the two drying beds will be located about 80 feet northwest of the adjacent biosolids lagoon. The western and eastern beds will each be about 500 feet long, 250 feet wide, and 10 feet deep. Construction of the beds will require maximum cut depths and embankment heights of ±15 feet. The highest embankment fills and deepest cuts are planned for the western drying bed.

Design of the embankments and cut slopes for the drying beds will also require consideration of the geotechnical issues discussed above for the large effluent reservoir. Additional test pits and borings, laboratory testing and engineering analysis will be required to address these conditions and provide recommendations for design of proposed embankments and cut slopes.

GROUND WATER AND SEEPAGE CONSIDERATIONS

We have installed 1-inch diameter, open-pipe, PVC piezometers in Borings BH-1, BH-2 and BH-3 to allow long-term, monitoring of site ground water levels. Initial ground water levels range from ±5 feet deep at BH-3 near the base of the site to ±60 feet deep just above the canal at BH-2. An initial ground water level of ±40 feet was measure near the crest of the site within BH-1. These initial water level readings were taken after bailing the piezometers within a few days after drilling the borings on August 28, 1998. These water levels should not be considered accurate due to the possible presence on drilling fluid in the piezometers. We estimate that any drilling fluid remaining in the borehole should drain within a period of a month of two after drilling. We have made arrangements for an Ashland area representative of Carollo Engineers to make additional readings of the piezometer later this fall, and then at monthly intervals until next summer if possible. This additional data should provide more accurate information regarding the seasonal variations in ground water depths across the site. Additional piezometers will be installed during subsequent geotechnical explorations.

We have reviewed the local water well records for several tax lots along Eagle Mill Road and Mountain Avenue, just east of Reservoir No. 1 and along the lower slope of the site. These records indicate that static ground water levels were measured at depths between 9 to 21 feet during the years 1961 to 1985. The records do not show a seasonal change in static ground water levels. The well data also indicates that the water-bearing stratum is located at a depth of between 75 and 200 feet. Several records indicate that perched water zones are present above this water-bearing stratum.

VARIATION OF SUBSURFACE CONDITIONS, USE OF THIS REPORT AND WARRANTY

The analysis, conclusions and recommendations contained herein are based on the assumption that the soil profiles and the ground water levels encountered in the soil boring are representative of overall site conditions. The above conclusions assume that we will have the opportunity to review final drawings and be present during construction to confirm assumed subsurface conditions. The conclusions also assume we will perform the subsequent geotechnical investigations recommended above. No changes in the enclosed recommendations should be made without our approval. We will assume no responsibility or liability for any engineering judgment, inspection or testing performed by others.

This report was prepared for the exclusive use of Carollo Engineers and their design consultants for the Wastewater Treatment Plant Expansion project in Ashland, Oregon. Information contained herein should not be used for other sites or for unanticipated construction without our written consent. This report is intended for planning and design purposes. Contractors using this information to estimate construction quantities or costs 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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Scale 1:150,000
1 inch represents 2.4 miles

DATE	NOV. 98
DWN.	HG
APPR.	
REVIS.	
PROJECT NO.	98200064

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VICINITY MAP
ASHLAND WWTP EXPANSION

ASHLAND, OREGON

FIGURE NO.
1

FILE NAME: VICINITY

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE 11/9/98 DWN BY GRH DES BY R. THRALL CHK BY PROJECT NO. 98200064

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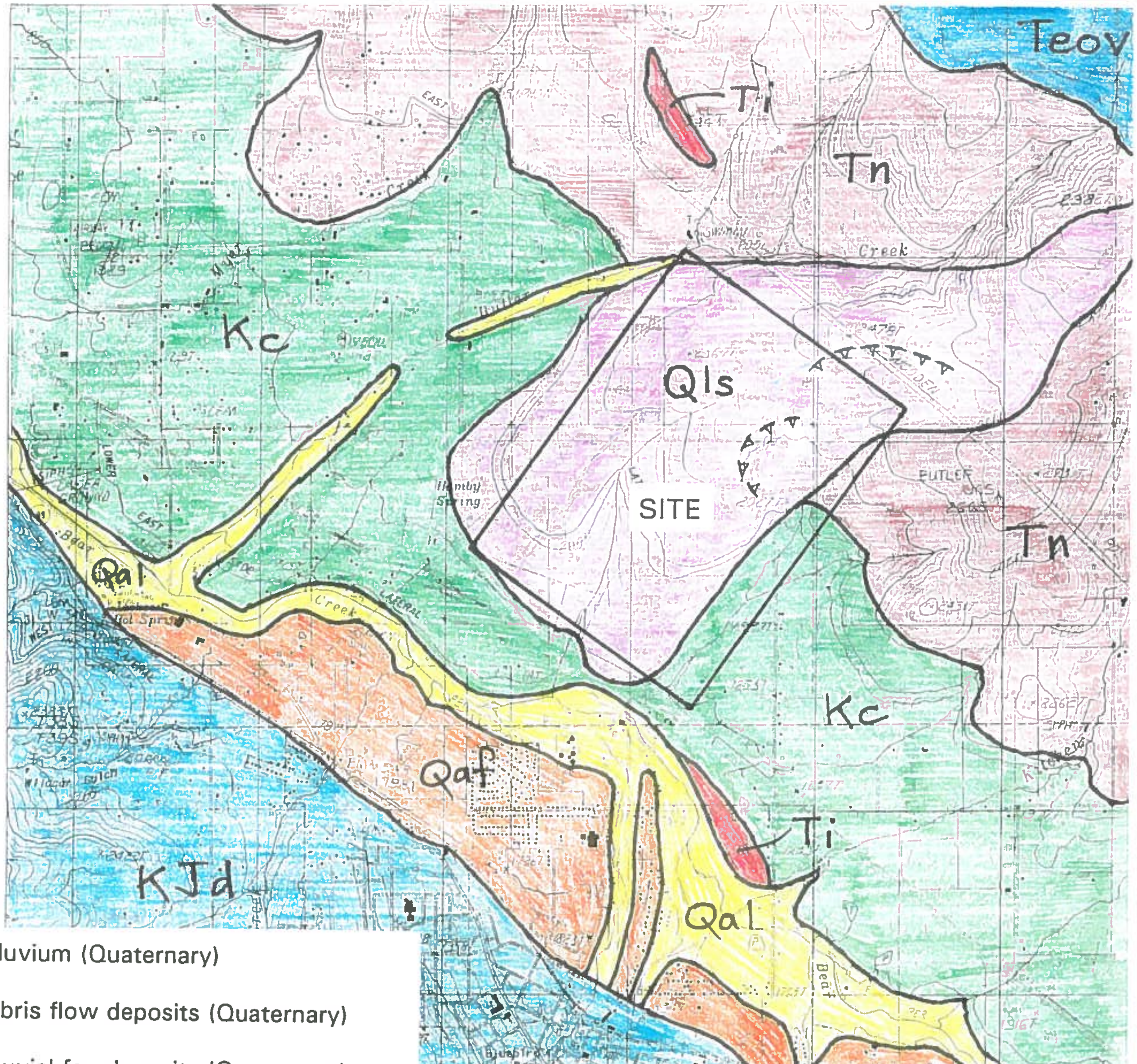
GEOTECHNICAL ANALYSIS
ASHLAND WWTP Expansion
SITE PLAN
ASHLAND OREGON

FIGURE NO.
2

FILE NAME: FIG4.DWG



KEY:

- Qal--Alluvium (Quaternary)
- Qls--Debris flow deposits (Quaternary)
- Qaf--Alluvial fan deposits (Quaternary)
- Ti--Intrusive rock (Tertiary)
- Teov--Volcanic breccias, flows and tuffs (Eocene to Oligocene)
- Tn--Nonmarine conglomerates, sandstones and conglomerates (Eocene)
- Kc--Marine sandstones and conglomerates (Cretaceous)
- JKd--Diorite and granodiorite (Jurassic to Cretaceous)

Geologic map is a simplified compilation of data from several sources including Beaulieu and Hughes, 1977 and Smith and others, 1982.

Ancient secondary landslide scarps

SCALE: 1 mile equals 1.75 inches

DATE NOV. 98
DWN. HG
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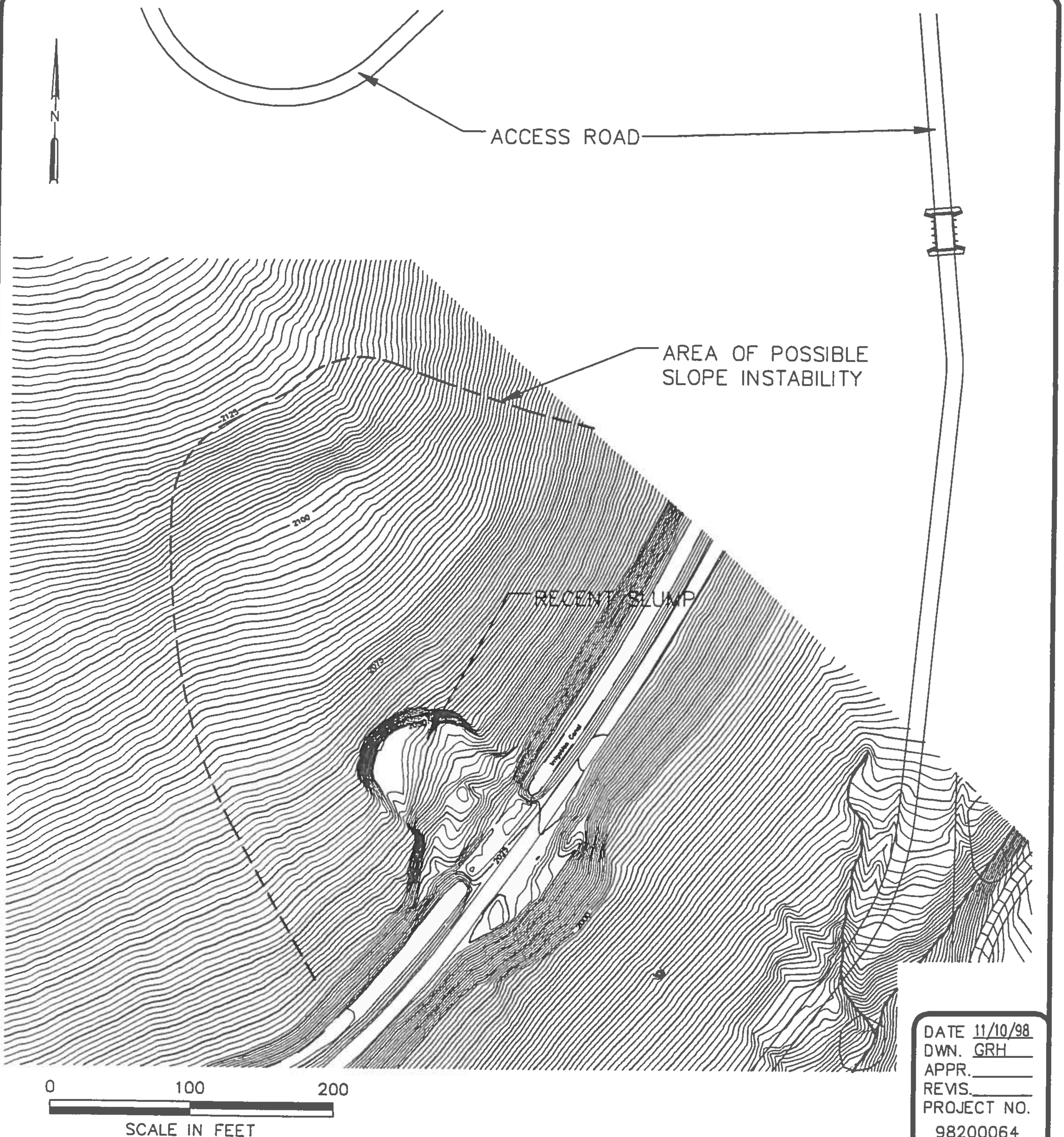
LOCAL GEOLOGY
ASHLAND WWTP EXPANSION

ASHLAND, OREGON

FIGURE NO.
3

FILE NAME: VICINITY



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Secondary Slump Location

Ashland WWTP – Expansion
Ashland Oregon

FIGURE NO.
4

FILE NAME: SLIDE.DWG

Appendix A

Boring Logs

Professional
Geotechnical
Services

Foundation Engineering, Inc.

SYMBOL KEY
FOR
BORING AND TEST PIT LOGS

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, site geology and the results of the laboratory examinations and tests. Our recommendations are based on the contents of the final logs and the information contained therein and and not on the field logs.

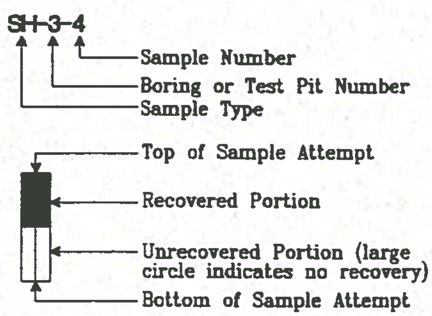
VARIATION IN SOILS BETWEEN TEST PITS AND BORINGS

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



SS – Standard Penetration Test Sample (split-spoon)
SH – Thin-walled Shelby Tube Sample
C – Core Sample
CS – Continuous Sample

▲ Standard Penetration Test Resistance equals the number of blows a 140-lb weight falling 30 in. required to drive a standard split-spoon sampler 1 ft. Practical refusal - 50 or more blows per 5 in. of sampler penetration.

● Water Content (%).

UNIFIED SOIL CLASSIFICATION SYMBOLS

G – Gravel
S – Sand
M – Silt
C – Clay
Pt – Peat

W – Well Graded
P – Poorly Graded
L – Low Plasticity
H – High Plasticity
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 pocket penetrometer devices.

TYPICAL SOIL/ROCK SYMBOLS

Sand
Silt
Clay
Gravel
Basalt
Siltstone

WATER TABLE

▼ Water Table Location

(1/31/94) Date of Measurement

Piezometer Tip Location (if used)

Explanation of Common Terms Used in Soil Descriptions

Field Identification	Cohesive Soils			Granular Soils	
	SPT	Su* Tsf	Term	SPT	Term
Easily penetrated several inches by fist.	0 - 1	<0.125	Very Soft	0 - 4	Very Loose
Easily penetrated several inches by thumb.	2 - 4	0.125 - 0.25	Soft	5 - 10	Loose
Can be penetrated several inches by thumb with moderate effort.	5 - 8	0.25 - 0.50	Medium Stiff (Firm)	11 - 30	Medium Dense
Readily indented by thumb but penetrated only with great effort.	9 - 15	0.50 - 1.0	Stiff	31 - 50	Dense
Readily indented by thumbnail.	16 - 30	1.0 - 2.0	Very Stiff	> 50	Very Dense
Indented with difficulty by thumbnail.	31 - 60	> 2.0	Hard		

* Undrained shear strength

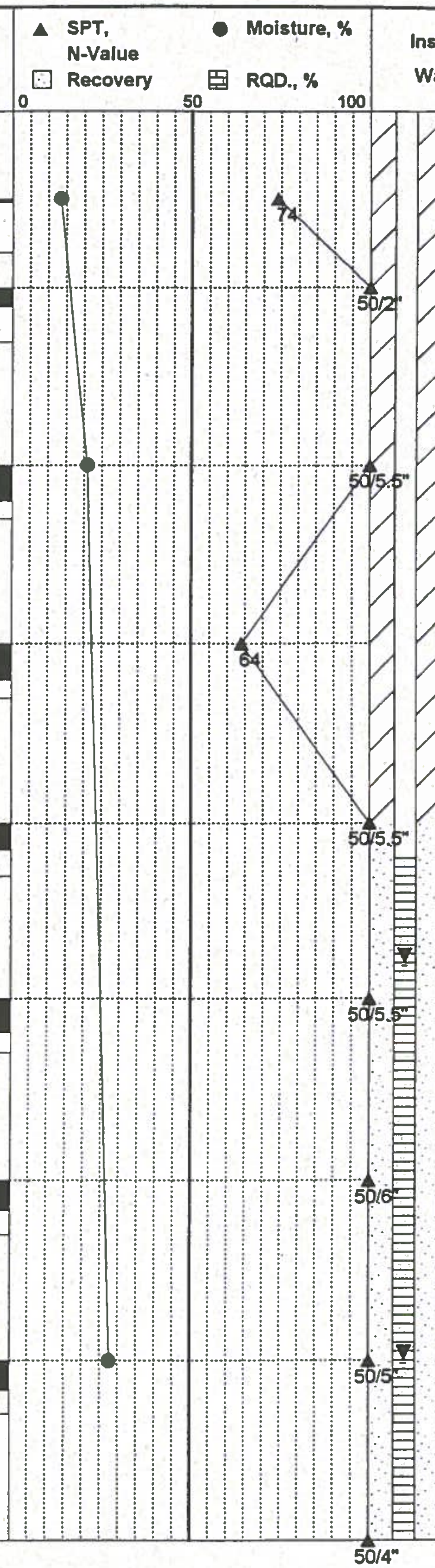
Term	Soil Moisture Field Description
Dry	Absence of moisture. Dusty. Dry to the touch.
Damp	Soil has moisture. Cohesive soils are below plastic limit (BPL) and usually moldable.
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic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

Term	PI	Plasticity Field Test
Nonplastic	0 - 3	Cannot be rolled into a thread.
Low plasticity	3 - 15	Can be rolled into thread with some difficulty.
Medium Plasticity	15 - 30	Easily rolled into thread.
High Plasticity	> 30	Easily rolled and rerolled into thread.

Term	Soil Structure Criteria
Stratified	Alternating layers at least 1 inch thick - describe variation
Laminated	Alternating layers at less than 1 inch thick - describe variation
Fissured	Contains shears and partings along planes of weakness
Slikensides	Partings appear glossy or striated
Blocky	Breaks into lumps - crumbly
Lensed	Contains pockets of different soils - describe variation

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

Depth Feet	Soil and Rock Description and Comments	Elev. Depth 2280	Samples	Installations/ Water Table
0–1	Very hard, gravelly CLAY; some fine sand and angular cobbles, grey mottled brown and white, damp, (Topsoil).	0.0		No monument, (PVC pipe above ground).
3	Hard drilling at 2.5 feet indicates possible cobbles or a gravel layer.		SS-1-1	
5	Very dense, silty GRAVEL; some clay, brown mottled black, red and white, moist, (Debris flow deposit).	2280.0 5.0	DM-1-2	Bentonite chips.
10			DM-1-3	1-inch PVC pipe.
15			DM-1-4	
20			DM-1-5	Sand.
24				(11/6/98)
25			DM-1-6	Field slot, (12-inch spacing).
29	Hard, clayey SILT; some gravel, tan mottled red and brown, damp, medium plasticity, angular fine to medium gravel, (Debris flow deposit). Hard drilling between 29 and 29.5 feet indicates possible cobbles or a gravel layer.	2280.0 29.0		
30			DM-1-7	
35			DM-1-8	(8/28/98)
38–39	Hard drilling between 39 and 40 feet indicates possible cobbles or a gravel layer.			



Project No.: 98200048

Surface Elevation: 2280 feet (Approx.)

Date of Boring: August 25, 1998

Boring Log: BH-1

Ashland WWTP Expansion

Ashland, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth (2280)	Samples	▲ SPT, N-Value ⊡ Recovery ● Moisture, % ⊞ RQD., % (0 – 50 – 100)	Installations/ Water Table
41				DM-1-9	50/4"	Field slot, (12-inch spacing).
42						
43						
44			2280.0 44.0			
45	Very dense, clayey GRAVEL; some fine sand, tan mottled red-brown, grey, yellow and black, moist, rounded fine to medium gravel., (Debris flow deposit). Very hard drilling below 45 feet indicating possible cobbles or boulders. Drilling refusal encountered at 47 feet.			DM-1-10	50/5"	
46						
47			2280.0 47.0			
	BOTTOM OF BORING					

Project No.: 98200048

Surface Elevation: 2280 feet (Approx.)

Date of Boring: August 25, 1998

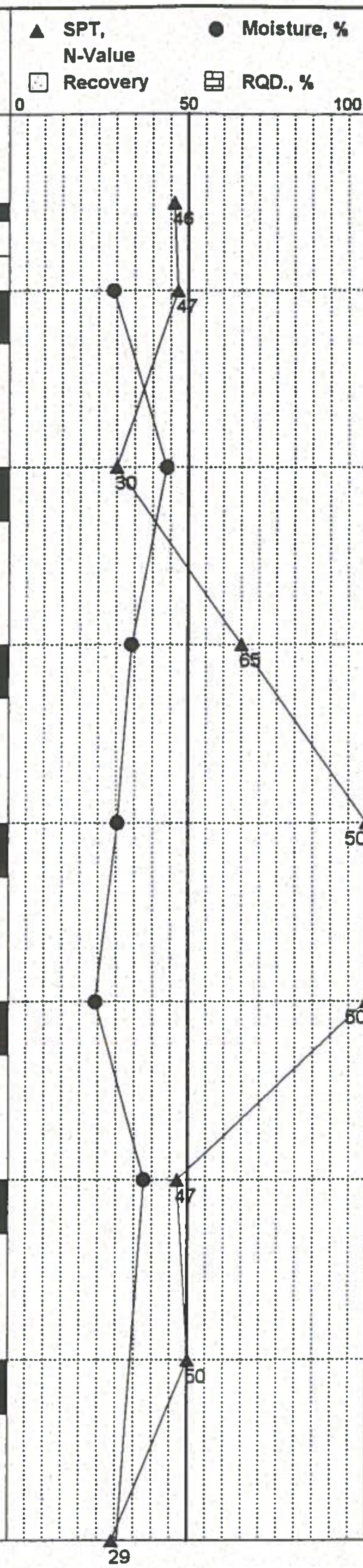
Foundation Engineering, Inc.

Boring Log: BH-1

Ashland WWTP Expansion

Ashland, Oregon

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth 2090	Samples	Installations/ Water Table
0–4	Hard, sandy CLAY; some gravel, dark brown mottled white, red and tan, damp, angular fine to medium gravel, scattered roots, medium to high plasticity, (Topsoil).		0.0	DM-2-1	No monument, (PVC pipe above ground).
4–8	Hard, sandy SILT; some gravel, red mottled grey and white, damp, fine sand and gravel, thin lense of white ash, (Debris flow deposit).		2090.0 / 4.0	DM-2-2	Bentonite chips.
8–18	Hard, becoming very hard, sandy CLAY; some fine gravel, brownish-red mottled tan, damp, (Debris flow deposit). Hard drilling between 8 and 8.5 feet indicating possible cobbles or gravel layer. Uniform, moderate drilling below 8.5 feet.		2090.0 / 8.0	DM-2-3, DM-2-4	1-inch diameter PVC pipe.
18–27.5	Very hard, clayey SILT; some fine sand, trace fine angular gravel, red mottled grey and black, damp, (Debris flow deposit).		2090.0 / 18.0	DM-2-5, DM-2-6	
27.5–40	Medium dense, clayey SAND; trace gravel, red mottled brown, green and white, damp, fine angular gravel, (Debris flow deposit).		2090.0 / 27.5	DM-2-7, SS-2-8	



Project No.: 98200048

Surface Elevation: 2090 feet (Approx.)

Date of Boring: August 26, 1998

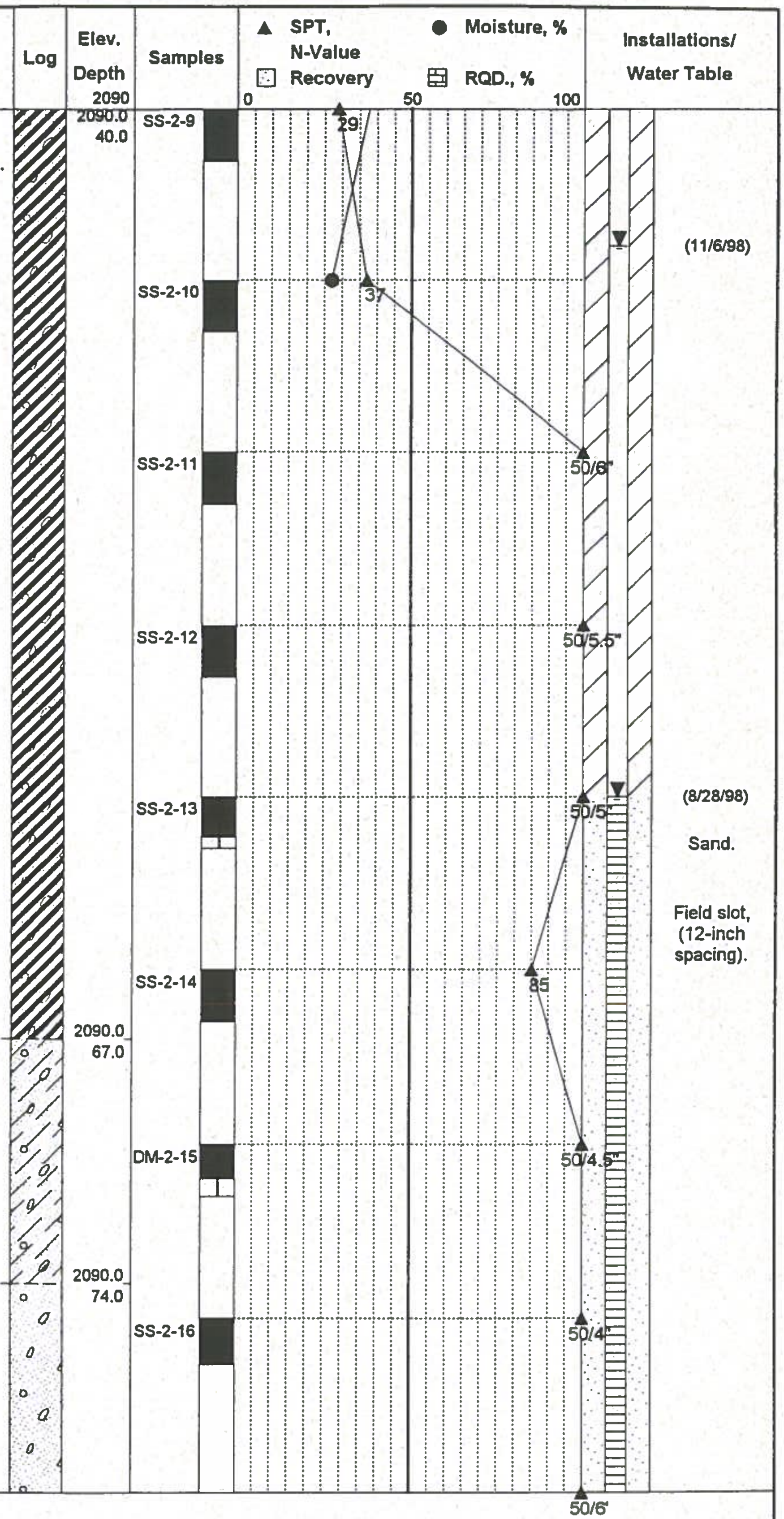
Boring Log: BH-2

Ashland WWTP Expansion

Ashland, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Elev. Depth (2090)	Samples	SPT, N-Value	Installations/ Water Table
40–41	Very stiff, becoming hard, sandy CLAY; some fine gravel, greenish-brown mottled white grey and black, moist, high plasticity, angular to rounded gravel, (Debris flow deposit).	2090.0 40.0	SS-2-9	29	
44					(11/6/98)
45	Soil becomes brown mottled red, white and black below 45 feet.		SS-2-10	37	
49–50	Hard drilling between 49 and 49.5 feet indicates cobbles or a gravel layer. Soil becomes very hard below 50 feet.		SS-2-11	50/6"	
55	Soil becomes more sandy below 55 feet.		SS-2-12	50/5.5"	
57–58	Hard drilling between 57 and 59 feet indicates cobbles or a gravel layer.				
60			SS-2-13	50/5"	(8/28/98) Sand.
63–65					Field slot, (12-inch spacing).
65			SS-2-14	85	
67	Very dense, clayey SAND; some fine to medium gravel, brown mottled green, red and grey, moist, high plasticity fines, angular basaltic gravel, (Debris flow deposit). Very hard drilling between 67 and 69 feet indicating cobbles or a gravel layer.	2090.0 67.0			
70			DM-2-15	50/4.5"	
74	Very dense, SAND; trace fine gravel, greenish-brown, moist to wet, (Debris flow deposit).	2090.0 74.0			
75			SS-2-16	50/4"	
80				50/6'	



Project No.: 98200048

Surface Elevation: 2090 feet (Approx.)

Date of Boring: August 26, 1998

Boring Log: BH-2

Ashland WWTP Expansion

Ashland, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth 2090	Samples	SPT, N-Value / Recovery / Moisture, % / RQD., % (0 50 100)	Installations/ Water Table
81	Very hard, sandy CLAY; some fine gravel, brown mottled red, white and black, (Debris flow deposit).		2090.0 80.0	SS-2-17		
	BOTTOM OF BORING		2090.0 81.5			

Project No.: 98200048

Surface Elevation: 2090 feet (Approx.)

Date of Boring: August 26, 1998

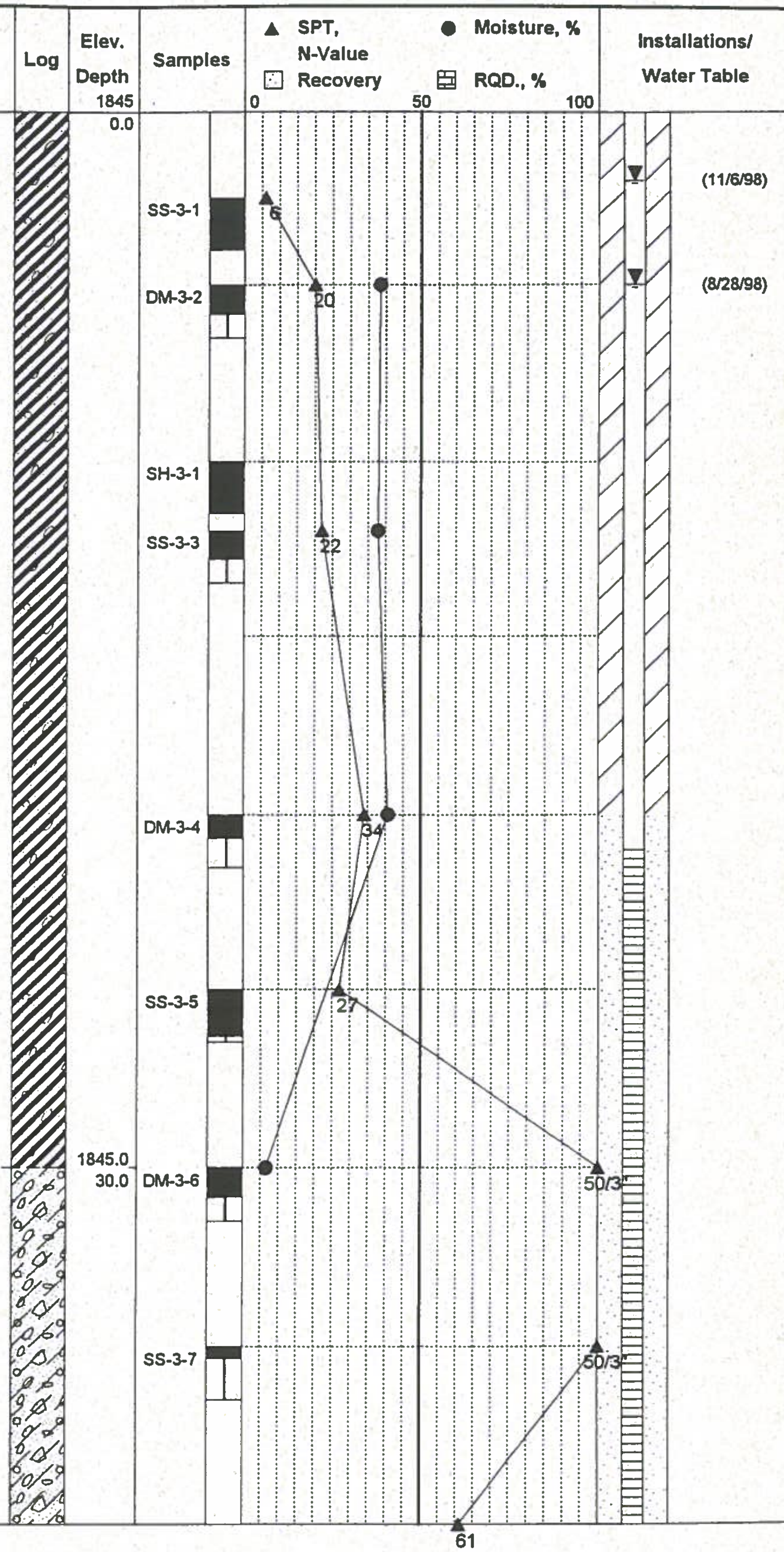
Foundation Engineering, Inc.

Boring Log: BH-2

Ashland WWTP Expansion

Ashland, Oregon

Depth Feet	Soil and Rock Description and Comments
0–4	Medium stiff, sandy CLAY; trace fine gravel, dark brown mottled white, grey and tan, moist, high plasticity, (Debris flow deposit).
5	Soil becomes very stiff below 5 feet.
12	Soil becomes yellow-brown to yellow-grey and mottled white and black below 12 feet.
20	Harder drilling at 19.5 feet indicates possible cobbles or gravel layer. Soil becomes hard below 20 feet. Alternating hard and soft drilling encountered.
25	Soil becomes very stiff below 25 feet.
30	Very dense, clayey GRAVEL; some fine sand, yellow-brown mottled grey, white and black, moist, fine to coarse angular basaltic gravel, (Debris flow deposit).
32	Very hard drilling between 32 to 32.5 feet indicates cobbles or a gravel layer.
35	Soil becomes grey to black below 35 feet. Alternating hard and soft drilling encountered.



Project No.: 98200048

Surface Elevation: 1845 feet (Approx.)

Date of Boring: August 27, 1998

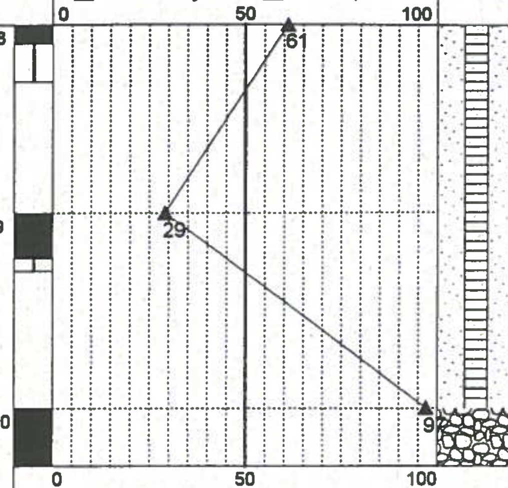
Boring Log: BH-3

Ashland WWTP Expansion

Ashland, Oregon

Foundation Engineering, Inc.

Depth Feet	Soil and Rock Description and Comments	Log	Elev. Depth 1845	Samples	SPT, N-Value / Recovery / Moisture, % / RQD., %	Installations/ Water Table
41				DM-3-8	61	
42	Very stiff, sandy CLAY; trace fine gravel, tan and brown mottled black, moist, high plasticity, (Debris flow deposit).		1845.0 42.0			
43						
44						
45				SS-3-9	29	
46						
47						
48						
49						
50				DM-3-10	9	
51			1845.0 51.5			
	BOTTOM OF BORING					



Project No.: 98200048

Surface Elevation: 1845 feet (Approx.)

Date of Boring: August 27, 1998

Boring Log: BH-3

Ashland WWTP Expansion

Ashland, Oregon

Foundation Engineering, Inc.

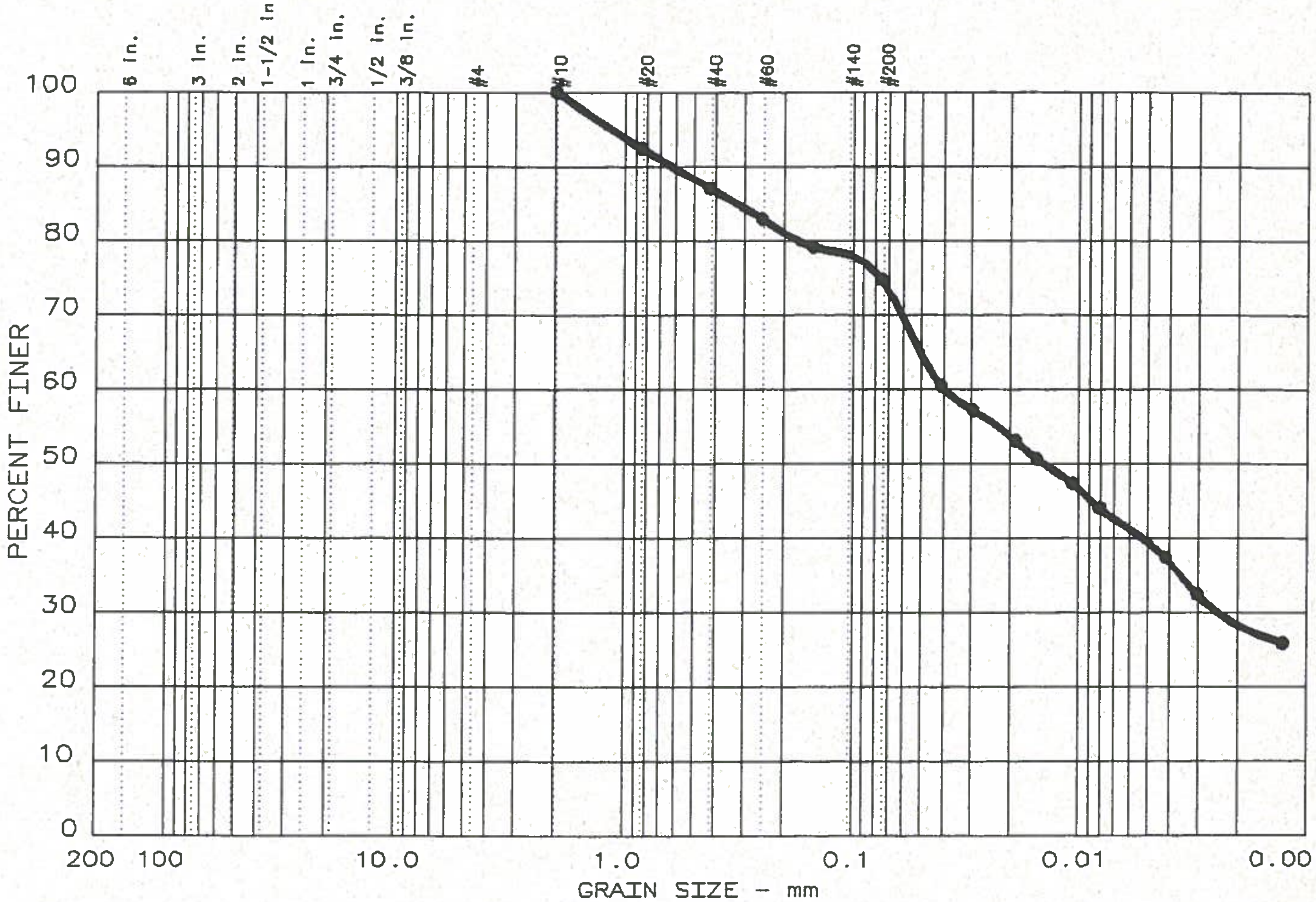
Appendix B

Laboratory Test Results

Professional Geotechnical Services

Foundation Engineering, Inc.

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	8	0.0	0.0	25.3	35.3	39.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	55	30	0.32		0.01	0.002				

MATERIAL DESCRIPTION	USCS	AASHTO
● Light brown, fat clay with sand.	CH	---

Project No.: 98200064

Project: Ashland WWTP

● Location: Ashland, Oregon

Date: 10/25/98

GRAIN SIZE DISTRIBUTION TEST REPORT

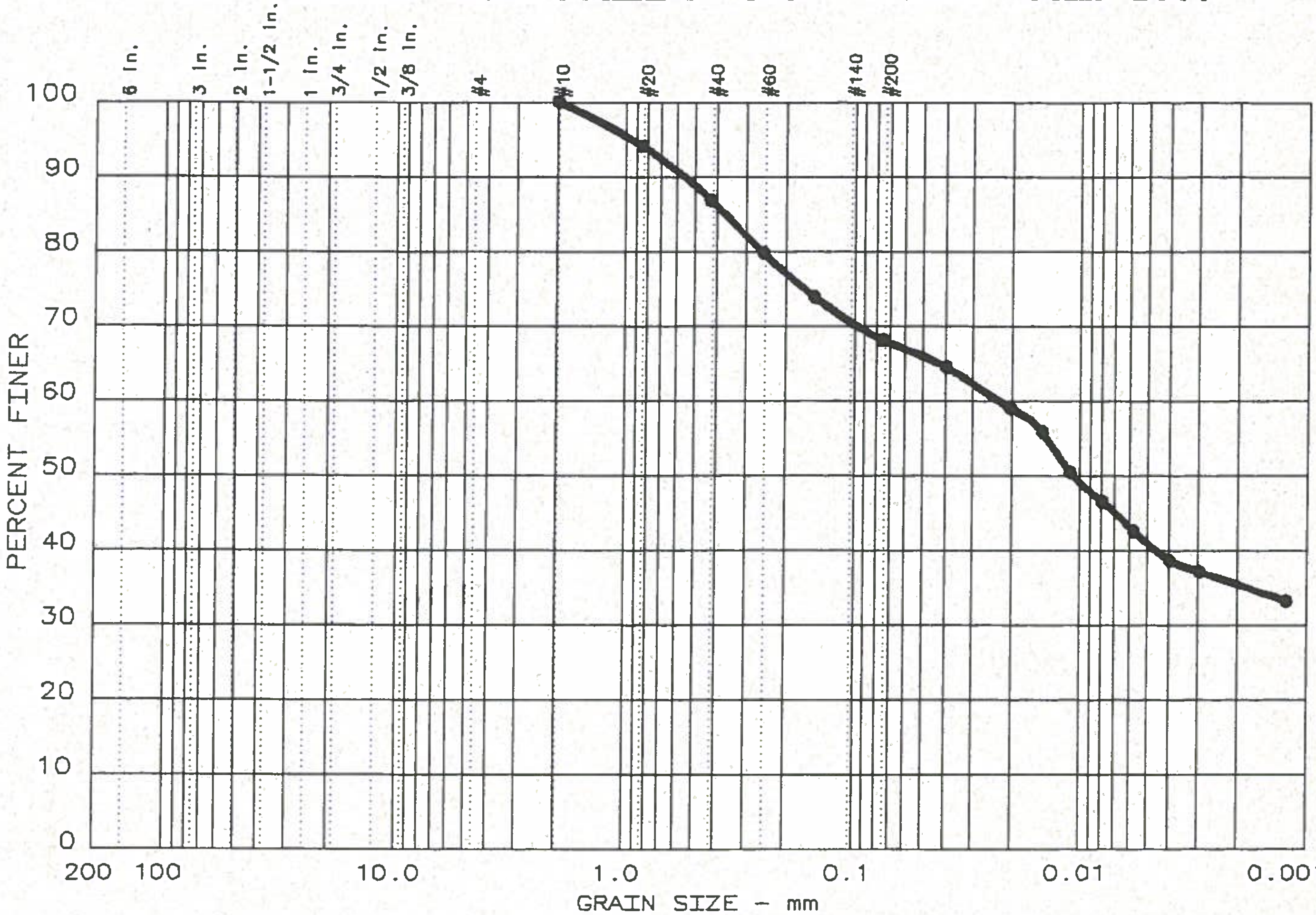
Foundation Engineering, Inc.

Remarks:

Sample: SS-9-6 at 20 to 21.5 feet. Material >#10 sieve is 3-5% w/ max. particle size of 1.75 in

Figure No. 1a

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	0.0	31.9	27.1	41.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	83	52	0.37		0.01					

MATERIAL DESCRIPTION	USCS	AASHTO
● Light brown, fat clay with sand	CH	---

Project No.: 98300064
Project: Ashland WWTP
● Location: Ashland, Oregon

Date: 10/25/98

GRAIN SIZE DISTRIBUTION TEST REPORT

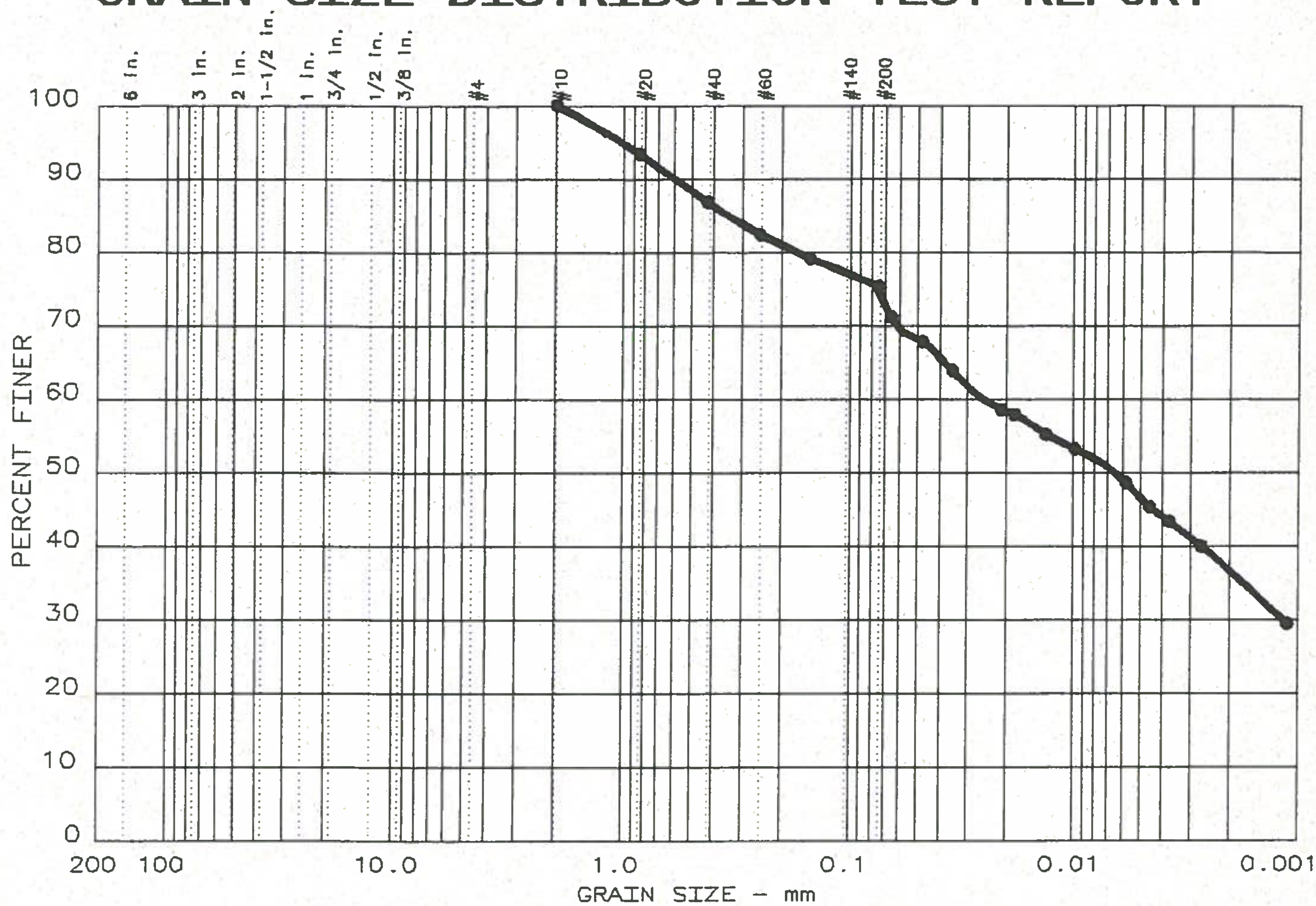
Foundation Engineering, Inc.

Remarks:

Sample: SS-13-4 at 10 to 11.5 feet. Material > #10 sieve is 5% w/ max particle size of 2.5 in.

Figure No. 2a

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	9	0.0	0.0	24.7	28.8	46.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	76	45	0.34		0.01	0.001				

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown, fat clay with sand.	CH	---

Project No.: 98200064
Project: Ashland WWTP
● Location: Ashland, Oregon

Date: 10/26/98

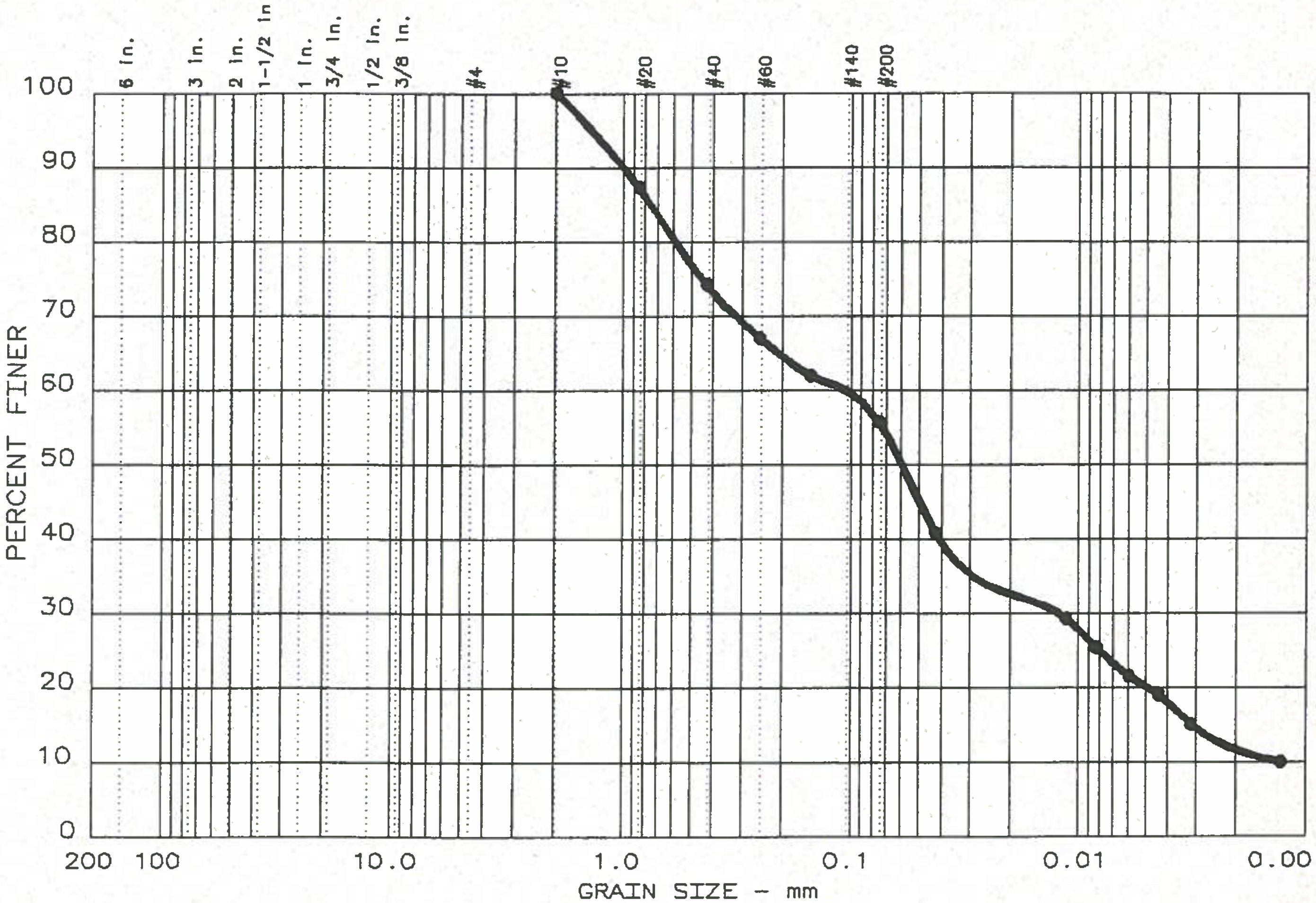
GRAIN SIZE DISTRIBUTION TEST REPORT

Foundation Engineering, Inc.

Remarks:
Sample: SS-14-2 at 5 to 6.5 feet. Material >#10 3-5% w/ max. particle size of 2.5 in.

Figure No. 3a

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	0.0	44.3	35.6	20.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	47	27	0.75	0.11	0.06	0.012	0.0031	0.0013	1.11	82.5

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown, lean clay with sand.	CL	---

Project No.: 98200064
Project: Ashland WWTP
● Location: Ashland, Oregon

Date: 10/26/98

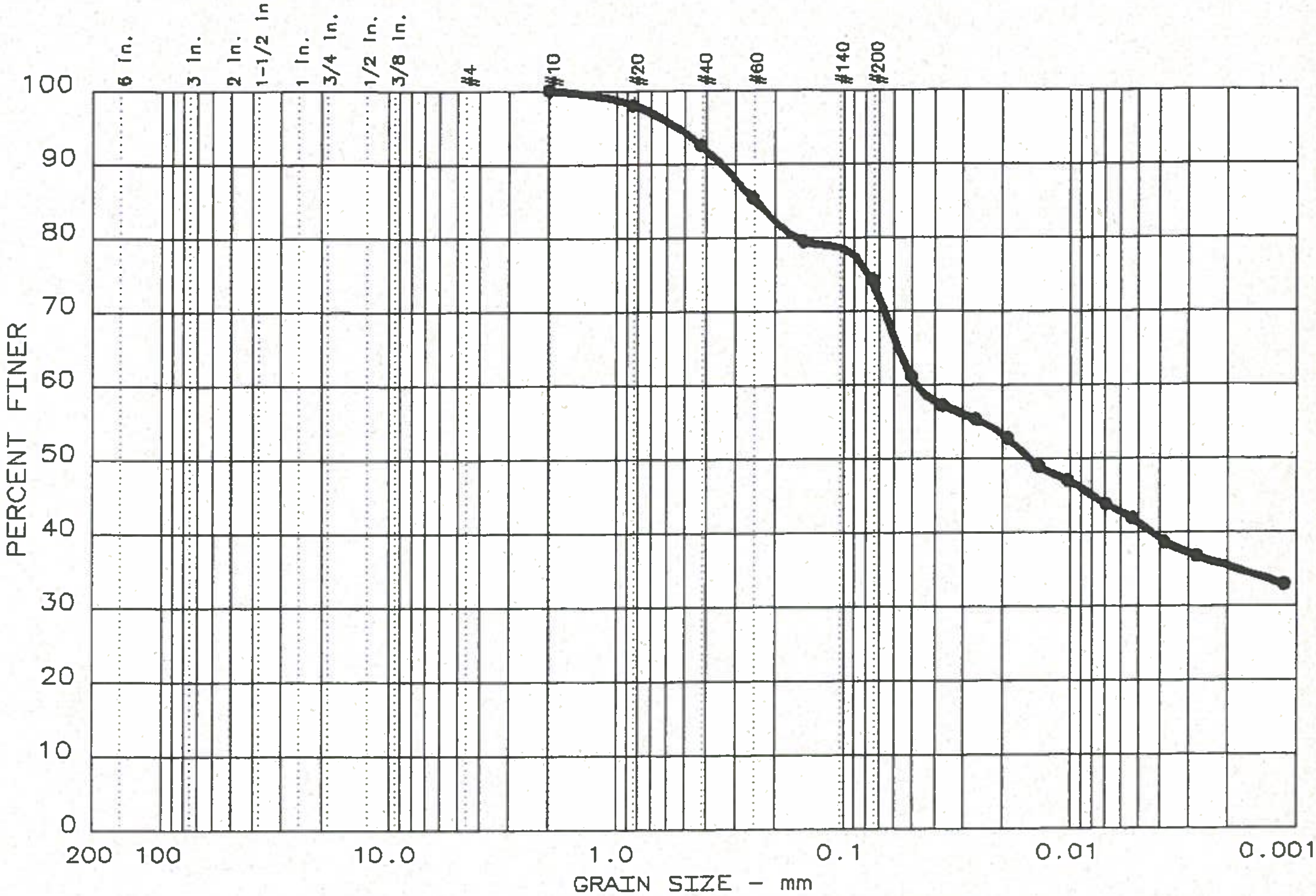
Remarks:
Sample: SS-15-5 at 15 to 16.5 feet. Material >#10 sieve is 1% w/ max. particle size of .75 in.

GRAIN SIZE DISTRIBUTION TEST REPORT

Foundation Engineering, Inc.

Figure No. 4a

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	18	0.0	0.0	25.9	32.8	41.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	71	38	0.24		0.02					

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown, fat clay with silt and sand	CH	---

Project No.: 98200064

Project: Ashland WWTP

● Location: Ashland, Oregon

Date: 10/26/98

GRAIN SIZE DISTRIBUTION TEST REPORT

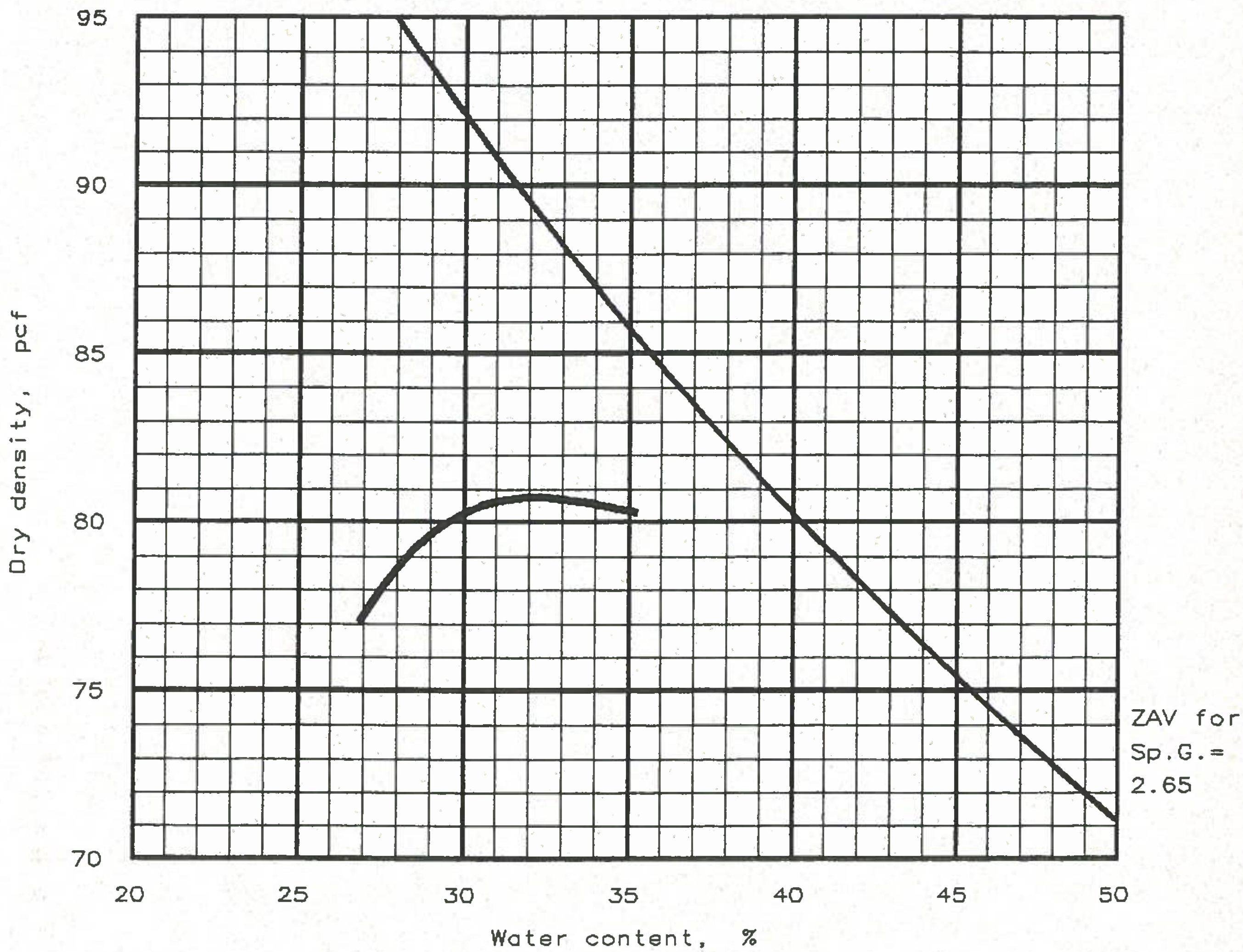
Foundation Engineering, Inc.

Remarks:

Sample: SS-16-6 at 20 to 21.5 feet.

Figure No. 5a

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
---	---	---	21.2 %	2.65	---	---	5.8 %	--- %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 80.5 pcf Optimum moisture = 32.0 %	Light brown silty clay

Project No.: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 10-30-1998

Remarks:

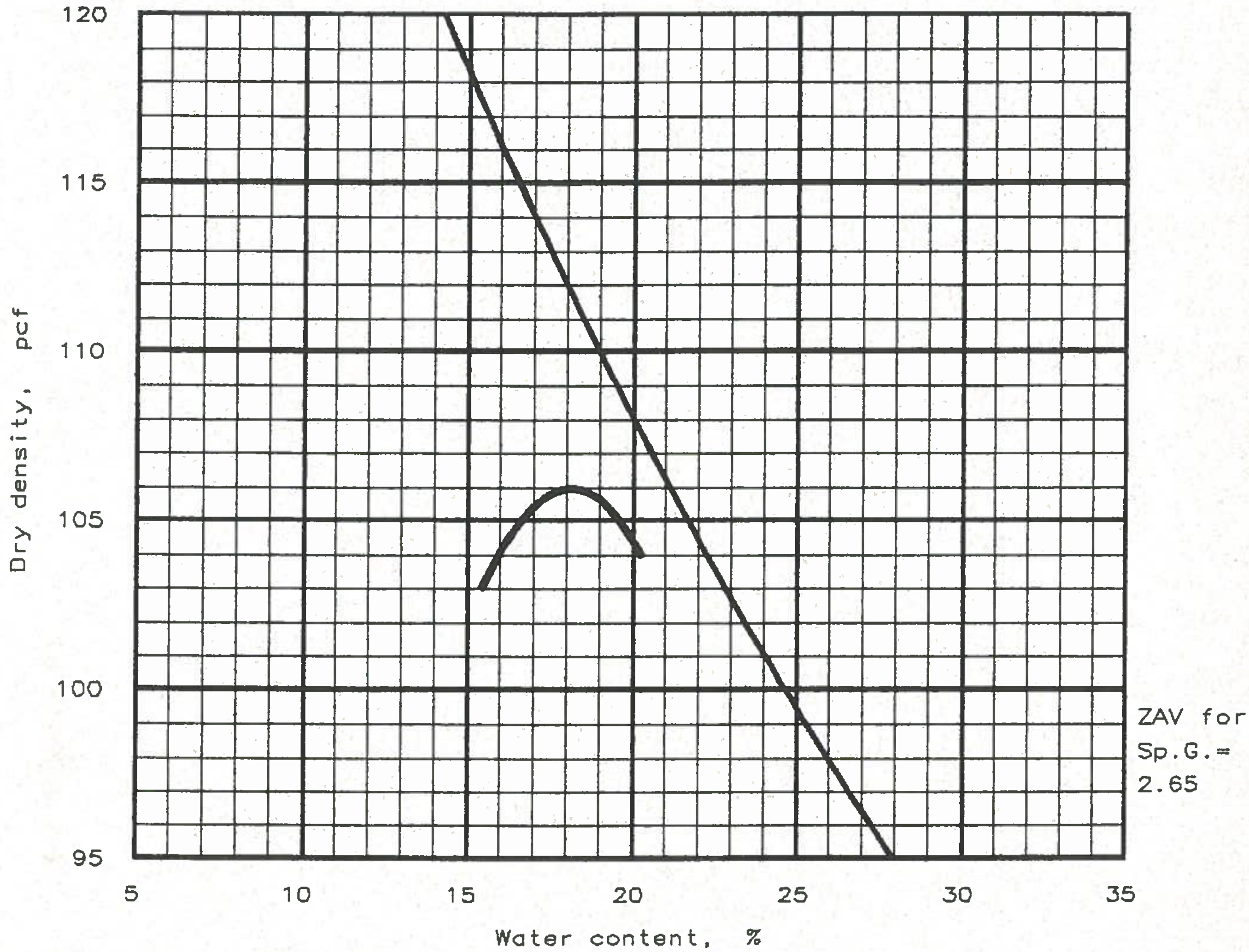
Sample: S-6-1 at 6 to 7 feet.

MOISTURE-DENSITY RELATIONSHIP TEST

Foundation Engineering, Inc.

Fig. No. 6a

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Method C, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
---	---	---	16.0 %	2.65	---	---	--- %	--- %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.0 pcf Optimum moisture = 18.0 %	Light brown, silty weathered rock.

Project No.: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 10-25-1998

Remarks:

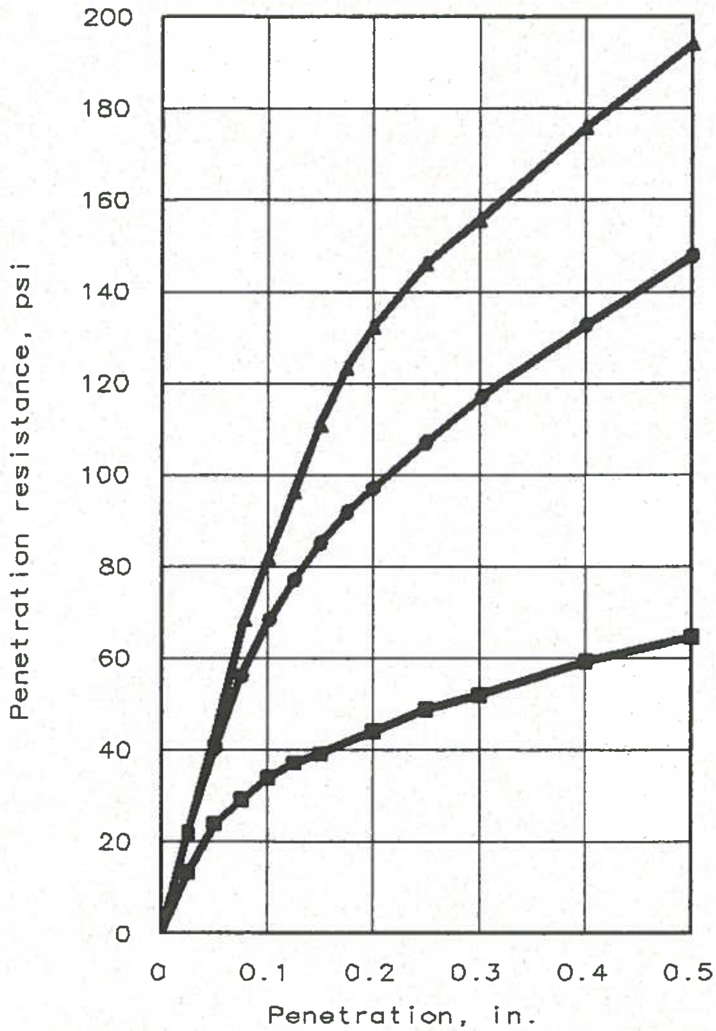
Sample: S-16-1 at 3 to 4 feet.

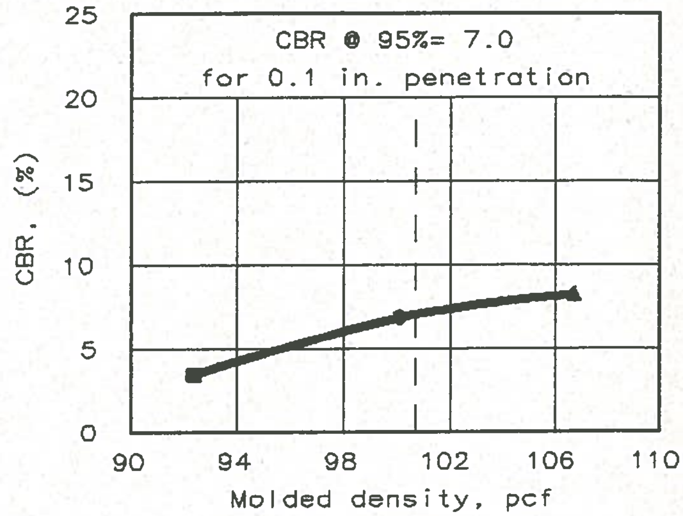
MOISTURE-DENSITY RELATIONSHIP TEST

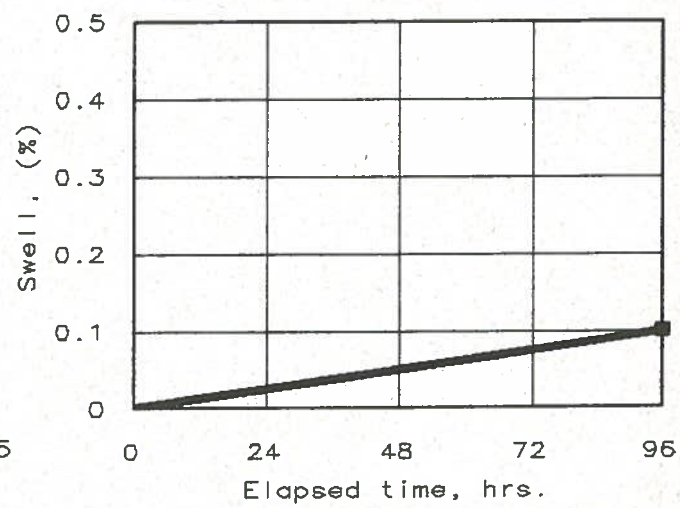
Foundation Engineering, Inc.

Fig. No. 7a

BEARING RATIO TEST REPORT







	Molded			Soaked			CBR, (%)		Lin. Cor.	Pen. Sur.	Swell %
	Dens.	% max	moist	Dens.	% max	moist	0.1"	0.2"			
1 ●	100.1	94.4	18.4%	100.0	94.3	19.5%	6.8	6.5	0	17.5	0.1
2 ▲	106.7	100.7	18.4%	106.6	100.6	19.6%	8.2	8.8	0	17.5	0.1
3 ■	92.4	87.2	18.1%	92.3	87.1	20.5%	3.4	2.9	0	17.5	0.1

MATERIAL DESCRIPTION	USCS	Max. dens.	Opt. w.c.	LL	PI
Light brown, silty weathered rock	---	106.0	18.0	---	---

Project No: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 11/2/98

Test Descr./Remarks:

Surcharge: 17.5 lbs.

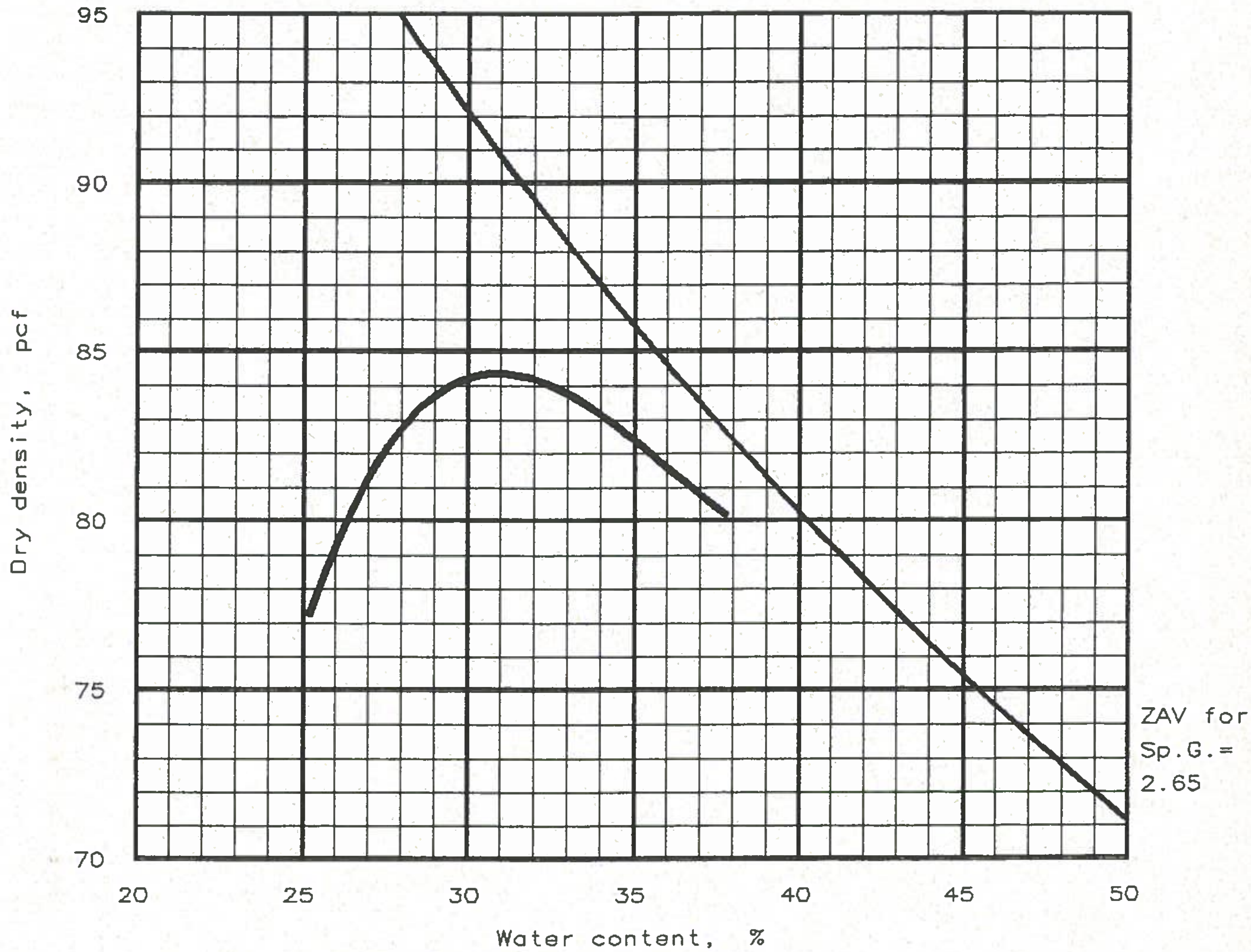
Sample: S-16-1 at 3 to 4 feet.

BEARING RATIO TEST REPORT

Foundation Engineering, Inc.

Fig. No. 7b

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Method B, Standard

Oversize correction applied to final results

Elev/ Depth	Classification USCS	Classification AASHTO	Nat. Moist.	Sp.G.	LL	PI	% > 3/8 in	% < No.200
---	---	---	25.4 %	---	---	---	18.0 %	--- %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 92.5 pcf Optimum moisture = 26.0 %	Brown silty clay with some gravel

Project No.: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 10-26-1998

Remarks:

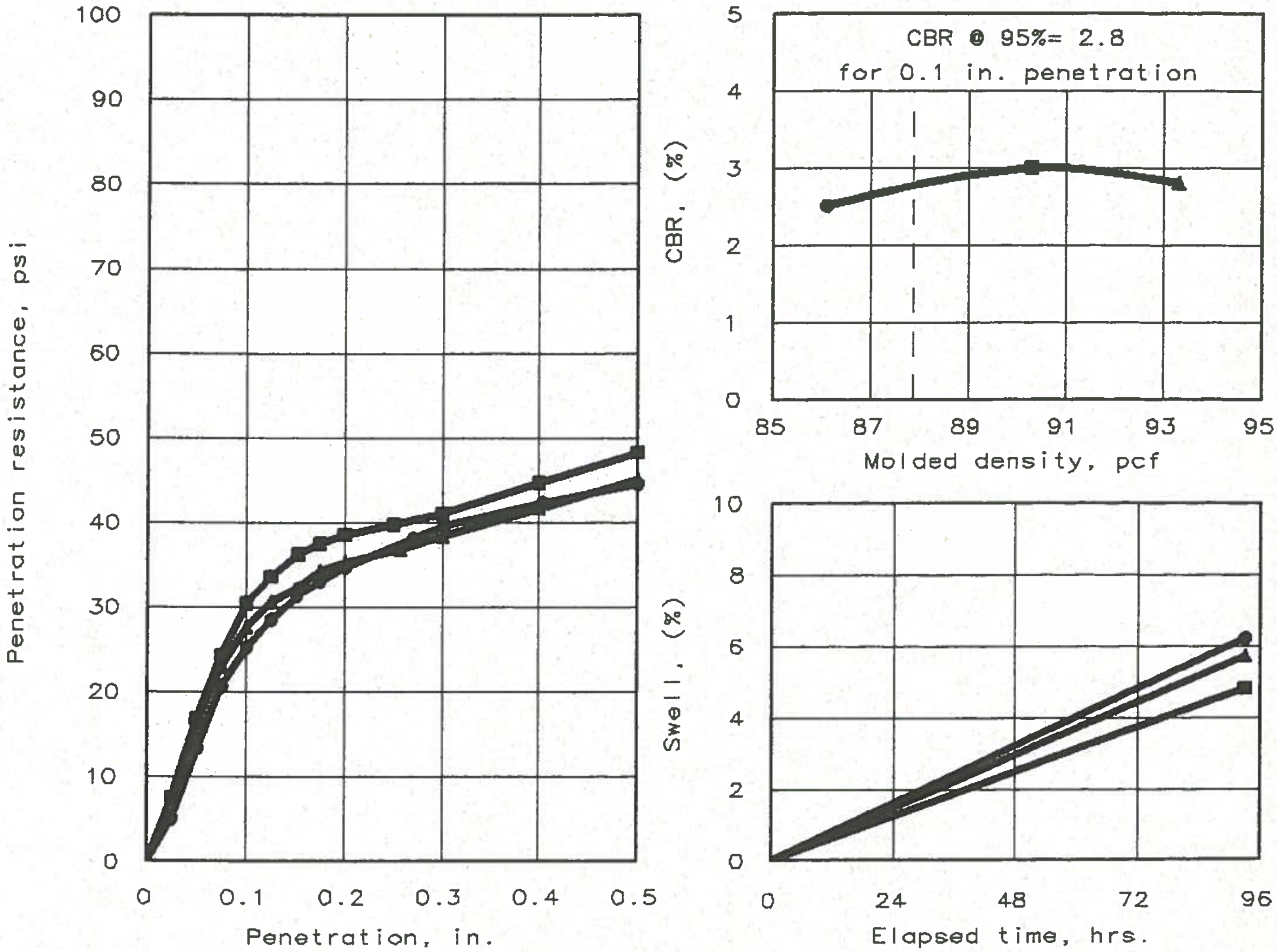
Sample: S-22-1 at 1.5 to 2.5 feet.

MOISTURE-DENSITY RELATIONSHIP TEST

Foundation Engineering, Inc.

Fig. No. 8a

BEARING RATIO TEST REPORT



	Molded			Soaked			CBR, (%)		Lin.	Pen.	Swell
	Dens.	% max	moist	Dens.	% max	moist	0.1"	0.2"	Cor.	Sur.	%
1 ●	86.1	93.1	26.9%	81.1	87.7	50.3%	2.5	2.3	0	17.5	6.2
2 ▲	93.3	100.9	26.9%	88.3	95.5	46.6%	2.8	2.3	0	17.5	5.7
3 ■	90.3	97.6	26.9%	86.2	93.2	47.1%	3.0	2.6	0	17.5	4.8

MATERIAL DESCRIPTION	USCS	Max. dens.	Opt. w.c.	LL	PI
Brown, silty clay with some gravel	---	92.5	26.0	---	---

Project No: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 11/3/98

Test Descr./Remarks:

Surcharge: 17.5 lbs.

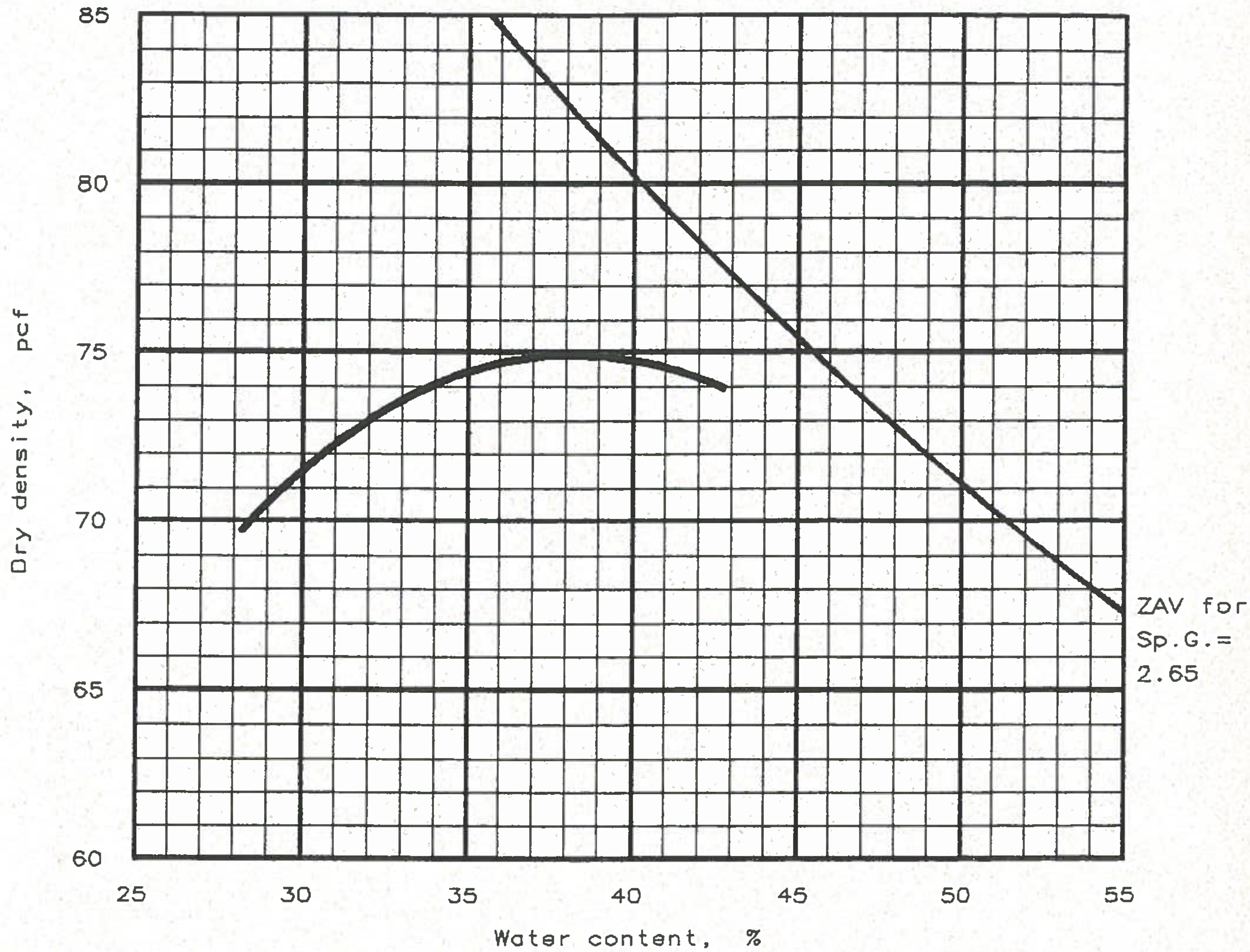
Sample: S-22-1 at 1.5 to 2.5 feet.

BEARING RATIO TEST REPORT

Foundation Engineering, Inc.

Fig. No. 8b

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Method A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
---	---	---	28.7 %	2.65	---	---	< 5 %	--- %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 75.0 pcf Optimum moisture = 38.0 %	Dark brown, clayey silt.

Project No.: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 10-25-1998

Remarks:

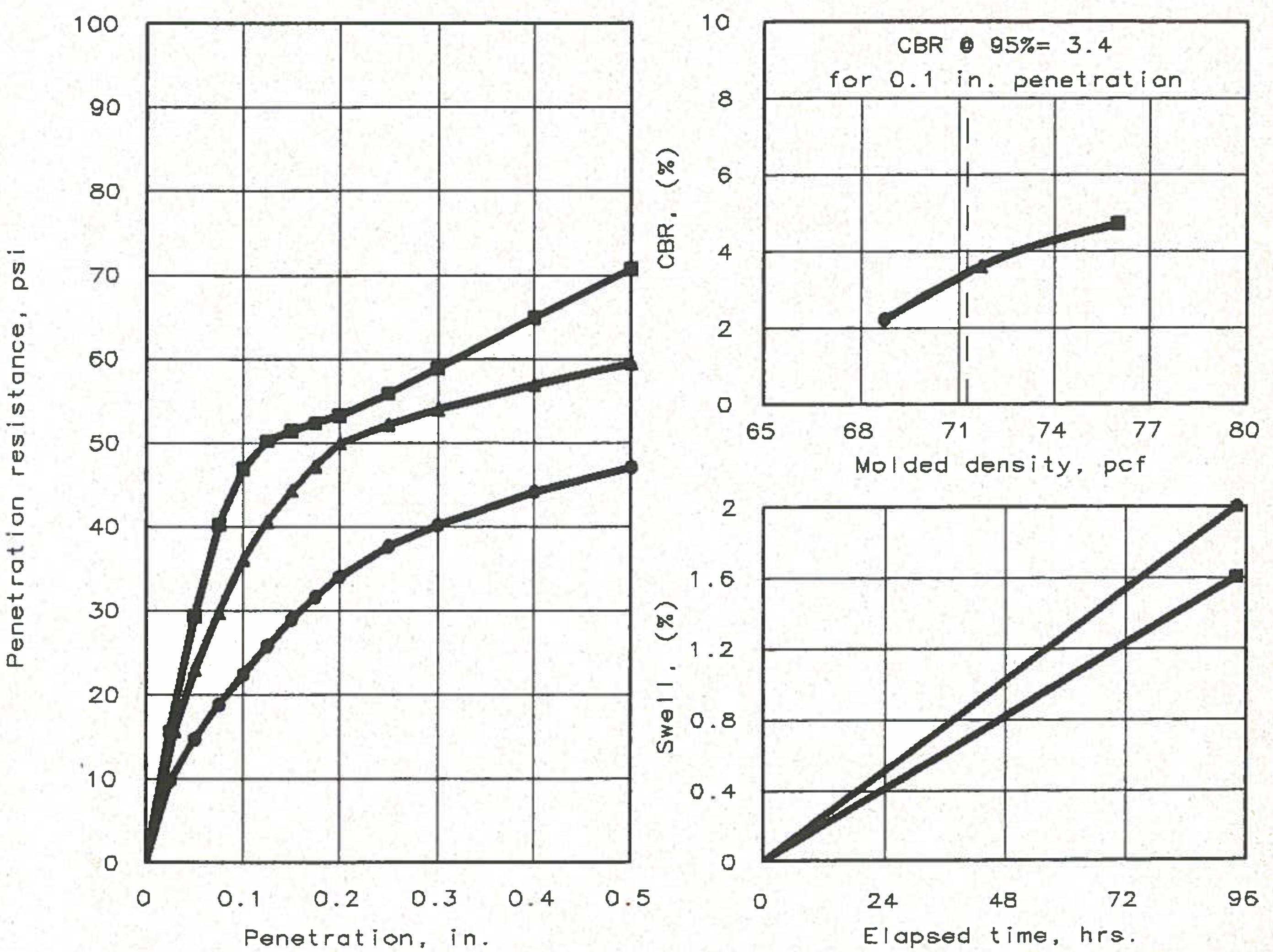
Sample: S-25-1 at 1.5 to 2 feet.

MOISTURE-DENSITY RELATIONSHIP TEST

Foundation Engineering, Inc.

Fig. No. 9a

BEARING RATIO TEST REPORT



	Molded			Soaked			CBR, (%)		Lin.	Pen.	Swell
	Dens.	% max	moist	Dens.	% max	moist	0.1"	0.2"	Cor.	Sur.	%
1 ●	68.7	91.6	37.8%	67.4	89.9	54.6%	2.2	2.3	0	17.5	2.0
2 ▲	71.7	95.6	37.8%	70.3	93.7	49.9%	3.6	3.3	0	17.5	2.0
3 ■	76.0	101.3	37.8%	74.8	99.7	48.4%	4.7	3.5	0	17.5	1.6

MATERIAL DESCRIPTION	USCS	Max. dens.	Opt. w.c.	LL	PI
Dark brown, clayey silt	---	75.0	38.0	---	---

Project No: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 11/2/98

Test Descr./Remarks:

Surcharge: 17.5 lbs.

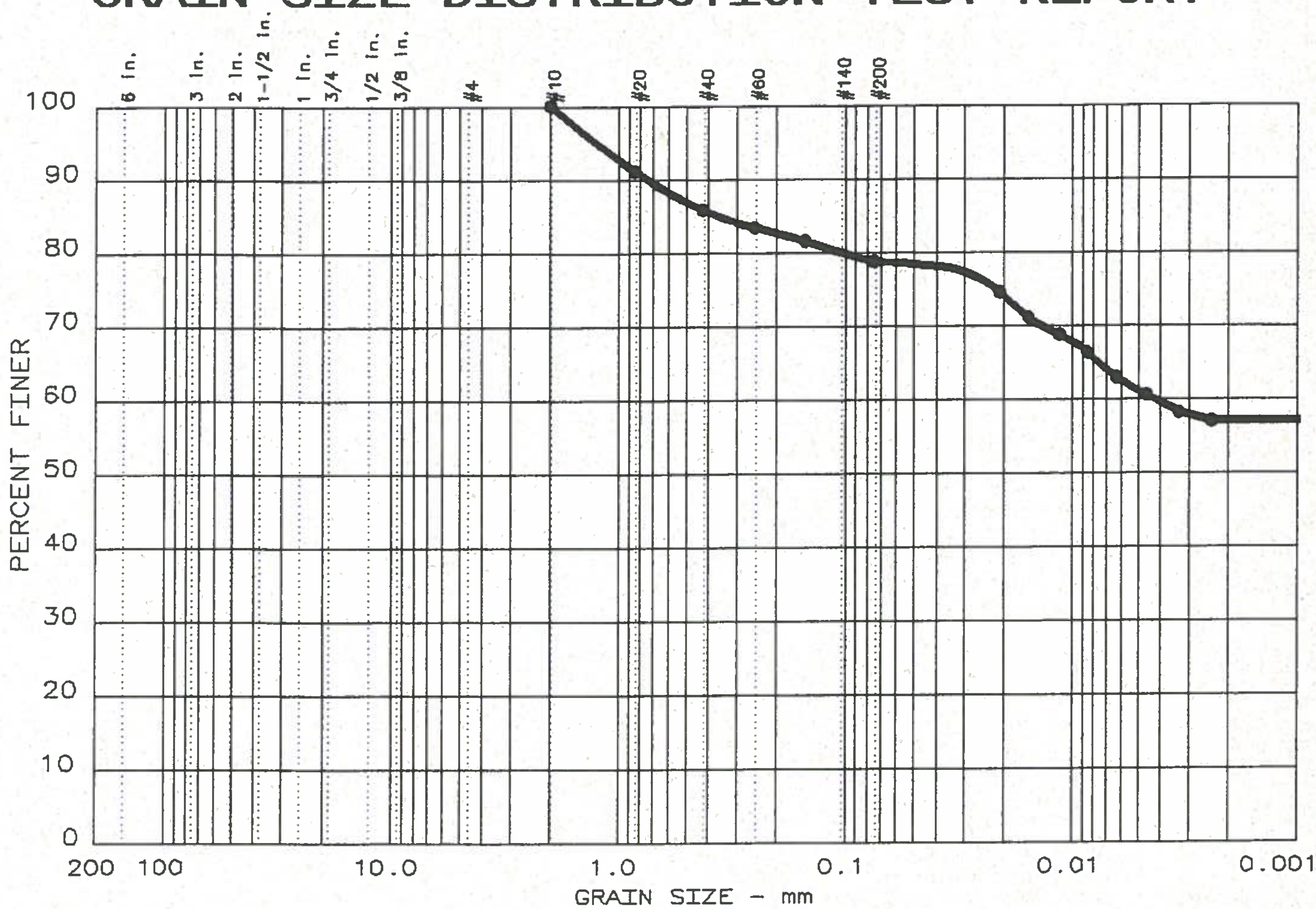
Sample: S-25-1 at 1.5 to 2 feet.

BEARING RATIO TEST REPORT

Foundation Engineering, Inc.

Fig. No. 9b

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	0.0	21.2	17.8	61.0

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	89	64	0.36							

MATERIAL DESCRIPTION	USCS	AASHTO
● Dark brown, sandy clay with silt.	CH	---

Project No.: 98200064
Project: Ashland WWTP
● Location: Ashland, Oregon

Date: 10/25/98

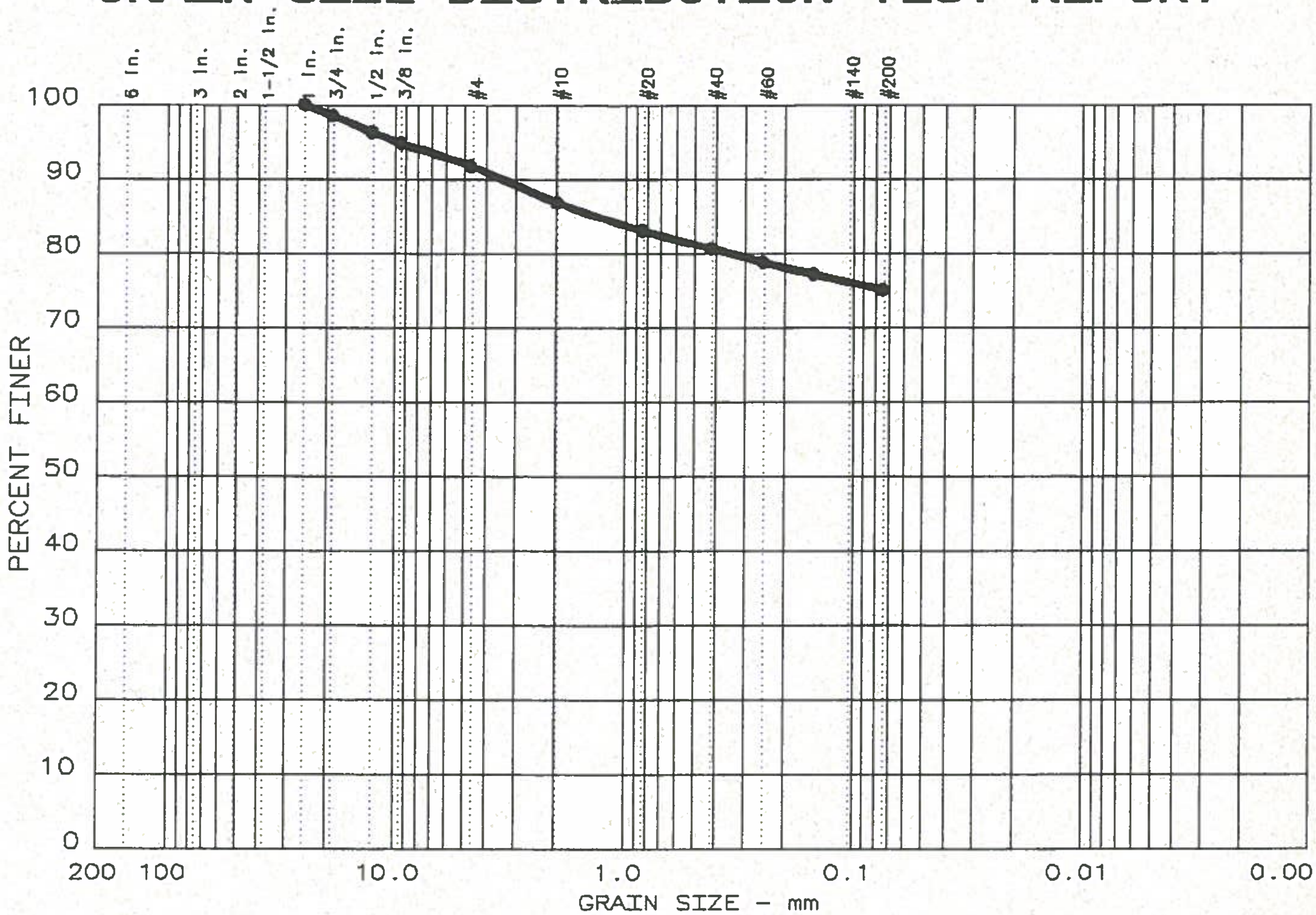
GRAIN SIZE DISTRIBUTION TEST REPORT

Foundation Engineering, Inc.

Remarks:
Sample: S-36-2 at 1.5 to 2 feet.
Material tested: minus #10 sieve

Figure No. 10a

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	8.3	16.7	75.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	89	64	1.36							

MATERIAL DESCRIPTION	USCS	AASHTO
● Dark brown, clay with some sand and gravel.	CH	---

Project No.: 98200064

Project: Ashland WWTP

● Location: Ashland, Oregon

Date: 10/23/98

GRAIN SIZE DISTRIBUTION TEST REPORT

Foundation Engineering, Inc.

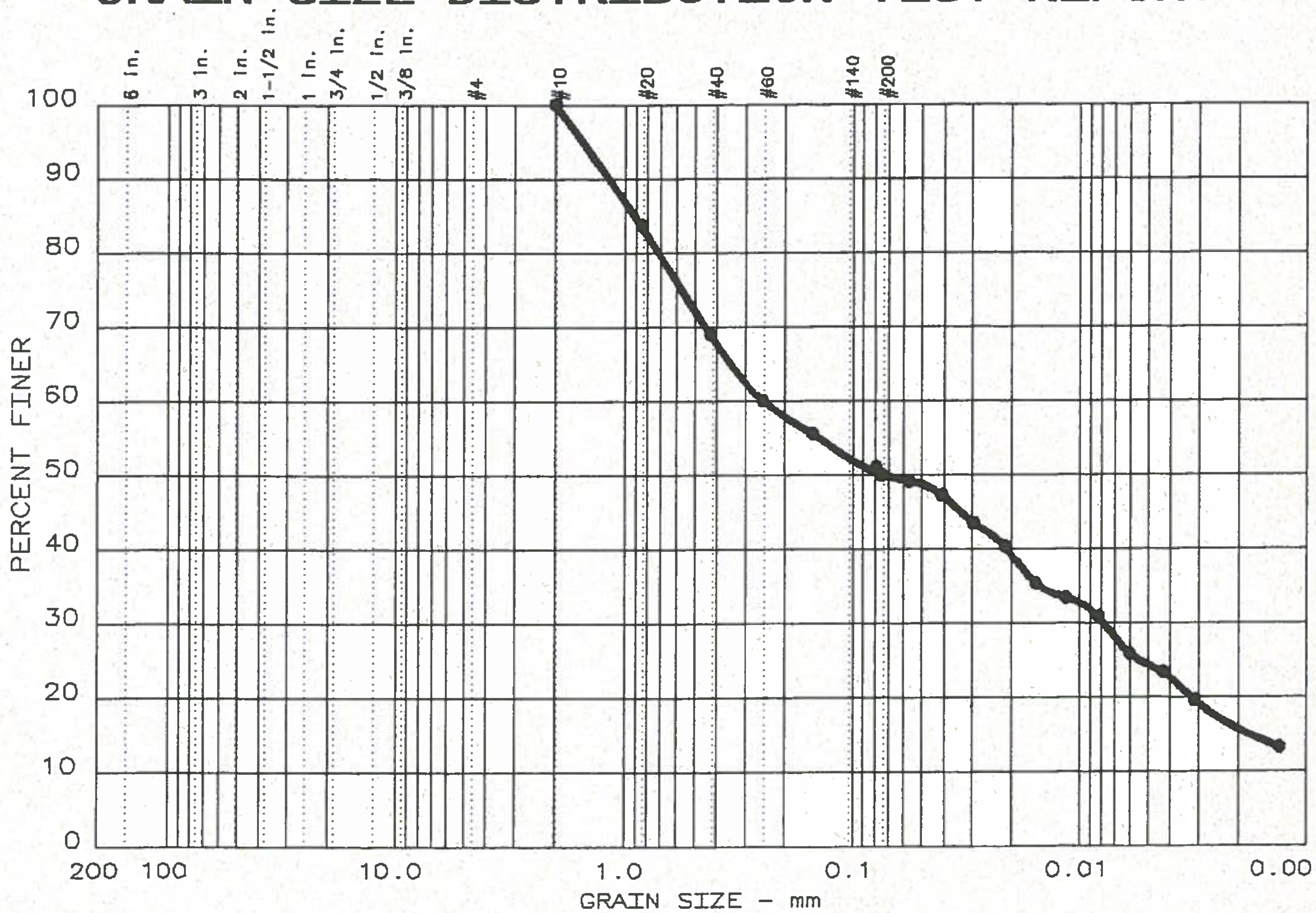
Remarks:

Sample: S-36-2 at 1.5 to 2 feet.

Test: wet sieve

Figure No. 10b

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	0.0	50.1	25.6	24.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	49	20	0.90	0.25	0.07	0.008	0.0018			

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown, silty sand with some clay	SM	---

Project No.: 98200064
Project: Ashland WWTP
● Location: Ashland, Oregon

Date: 10/24/98

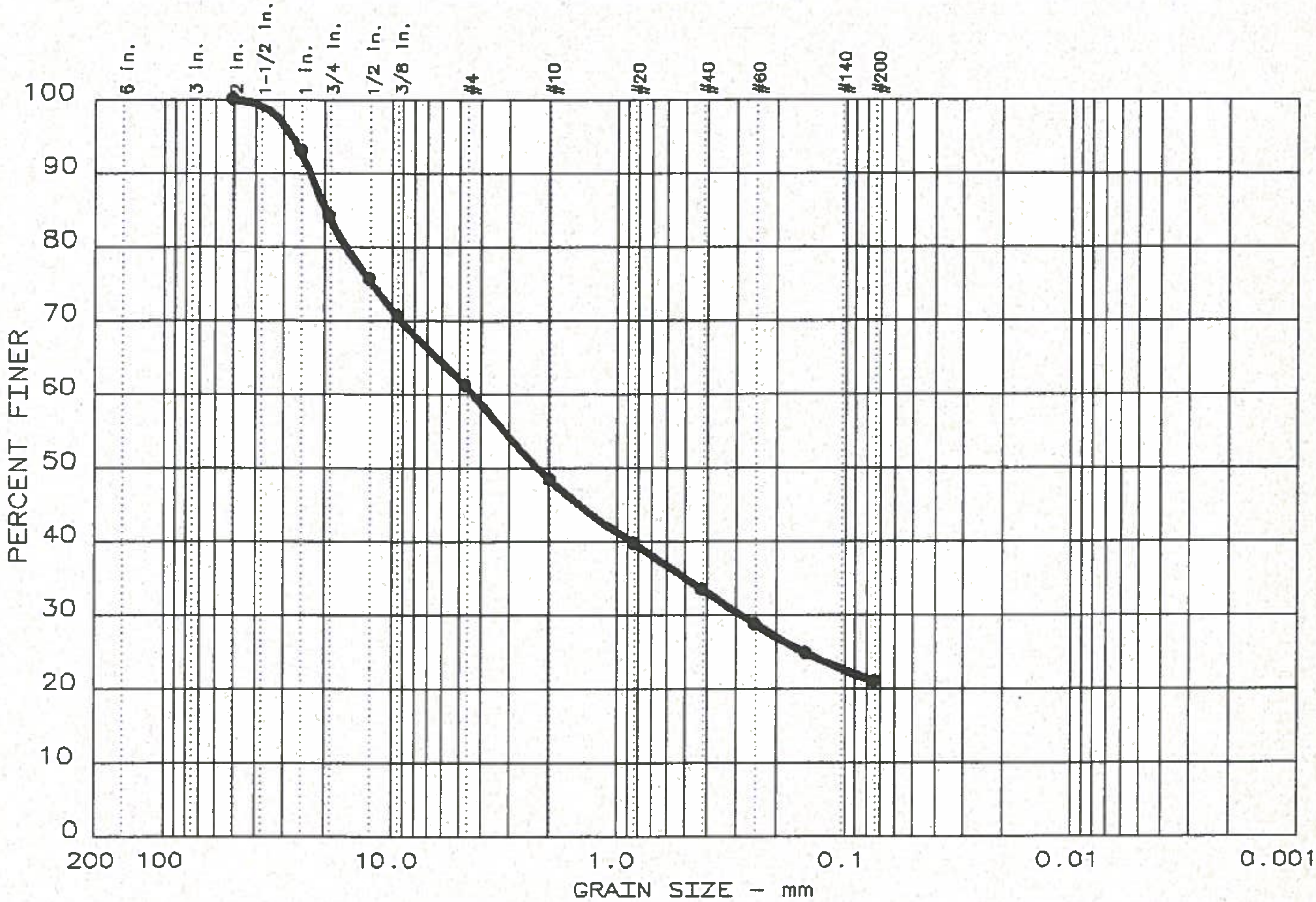
GRAIN SIZE DISTRIBUTION TEST REPORT

Foundation Engineering, Inc.

Remarks:
Sample: S-48-1 at 4.5 to 5.5 feet.
Material tested minus the #10 sieve.

Figure No. 11a

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	38.8	40.2	21.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	49	20	19.61	4.34	2.23	0.287				

MATERIAL DESCRIPTION	USCS	AASHTO
● Brown, silty sand with gravel.	SM	---

Project No.: 98200064
Project: Ashland WWTP
● Location: Ashland, Oregon

Date: 10/23/98

GRAIN SIZE DISTRIBUTION TEST REPORT

Foundation Engineering, Inc.

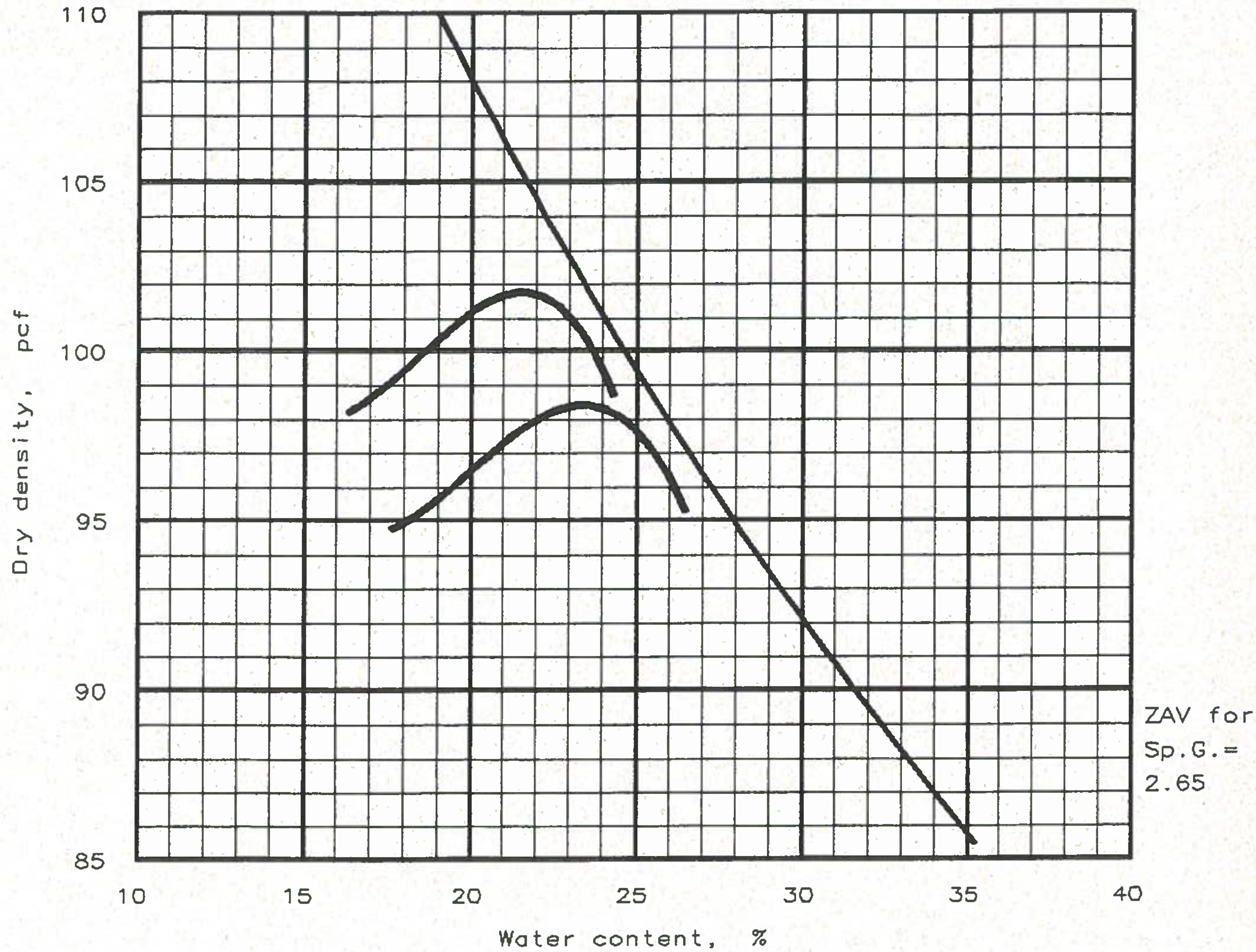
Remarks:

Sample: S-48-1 at 4.5 to 5.5 feet.

Test: wet sieve

Figure No. 11b

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Method C, Standard

Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
---	---	---	19.2 %	2.65	49	20	9.33 %	--- %

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 102.0 pcf Optimum moisture = 21.5 %	98.5 pcf 23.5 %	Brown, silty sand with gravel

Project No.: 98200064

Project: Ashland WWTP

Location: Ashland, Oregon

Date: 10-29-1998

Remarks:

Sample: S-48-1 at 4.5 to 5.5 feet.

MOISTURE-DENSITY RELATIONSHIP TEST

Foundation Engineering, Inc.

Fig. No. 11c

BRAUN ℠
INTERTEC

Braun Intertec Corporation
6032 N. Cutter Circle, Ste. 480
P.O. Box 17126
Portland, Oregon 97217
503-289-1778 Fax: 289-1918

Engineers and Scientists Serving the Built and Natural Environments

November 10, 1998

Project No. EAGX-98-0309
Report No. 08-98-0499

Jonathan Guido
Foundation Engineering
3867 Wolverine St. NE, Suite F-26
Salem, OR 97305

Dear Mr. Guido:

Re: Analysis performed on two (2) soil samples submitted on October 29, 1998, pursuant to your Authorization For Services dated 10/29/98.

Ref: Ashland W.W.T.P.:
Sample #1: S-22-1
Sample #2: S-31-1

Methods: Minimum Soil Resistivity by AASHTO T288-91
Water Soluble Chloride Content in Soil by AASHTO T291-94
Water Soluble Sulfate Content in Soil By AASHTO T290-94
pH by EPA 9045

Max R, Ω·cm = 2360   2700

Analyte	Sample #1	Sample #2
Minimum Resistivity, Ω•cm	300.	750.
Chloride, mg/kg	< 2.	< 2.
Sulfate, mg/kg	90.	40.
pH	8.2	8.5

Sincerely,

Laura Hladky
Laura Hladky
Chemist

Wendy Campbell
Lead Chemist

M E I-Charlton, Inc.
2233 S.W. CANYON ROAD
PORTLAND, OR 97201-2499
(503) 228-9663
FAX (503) 228-4065

ENGINEERS AND SCIENTISTS solving problems through APPLIED RESEARCH, CONSULTING ENGINEERING AND CHEMISTRY

TO: Foundation Engineering
Attention: Jon Guido
7420 SW Hunziker, Suite A
Tigard, OR 97223-8252

CLIENT NO.:

REFERENCE NO.: 6404046

DATE: 6 Nov 1998

SUBJECT: FIVE SOIL SAMPLES; OXIDATION REDUCTION POTENTIALS; RECEIVED 3 NOVEMBER 1998

You asked that MEI-Charlton, Inc. measure the oxidation-reduction potential (E_h) of five soil samples submitted to our laboratory.

We measured E_h values of the samples using American Society for Testing and Materials (ASTM) D 1498 as a guide. Samples were mixed 1:1 with distilled water before measurement. The results of our analyses are summarized in Table I below.

Table I. Results of Analyses

Sample Identification		Method	Oxidation-Reduction Potentials, mV
Project Name: Cowlitz WWTP Project No. 98200043	Site A (BH-3 and BH-4)	ASTM D 1498	660
	Site B (BH-1 and BH-3)	ASTM D 1498	590
	Site C (BH-2)	ASTM D 1498	640
	Site D (BH-6)	ASTM D 1498	630
Project Name: Ashland WWTP Project No. 98200064	Bucket Sample S-22-1	ASTM D 1498	620

Tested on: 4-6 Nov 1998; AAM

If you have questions or need further assistance, please contact us.

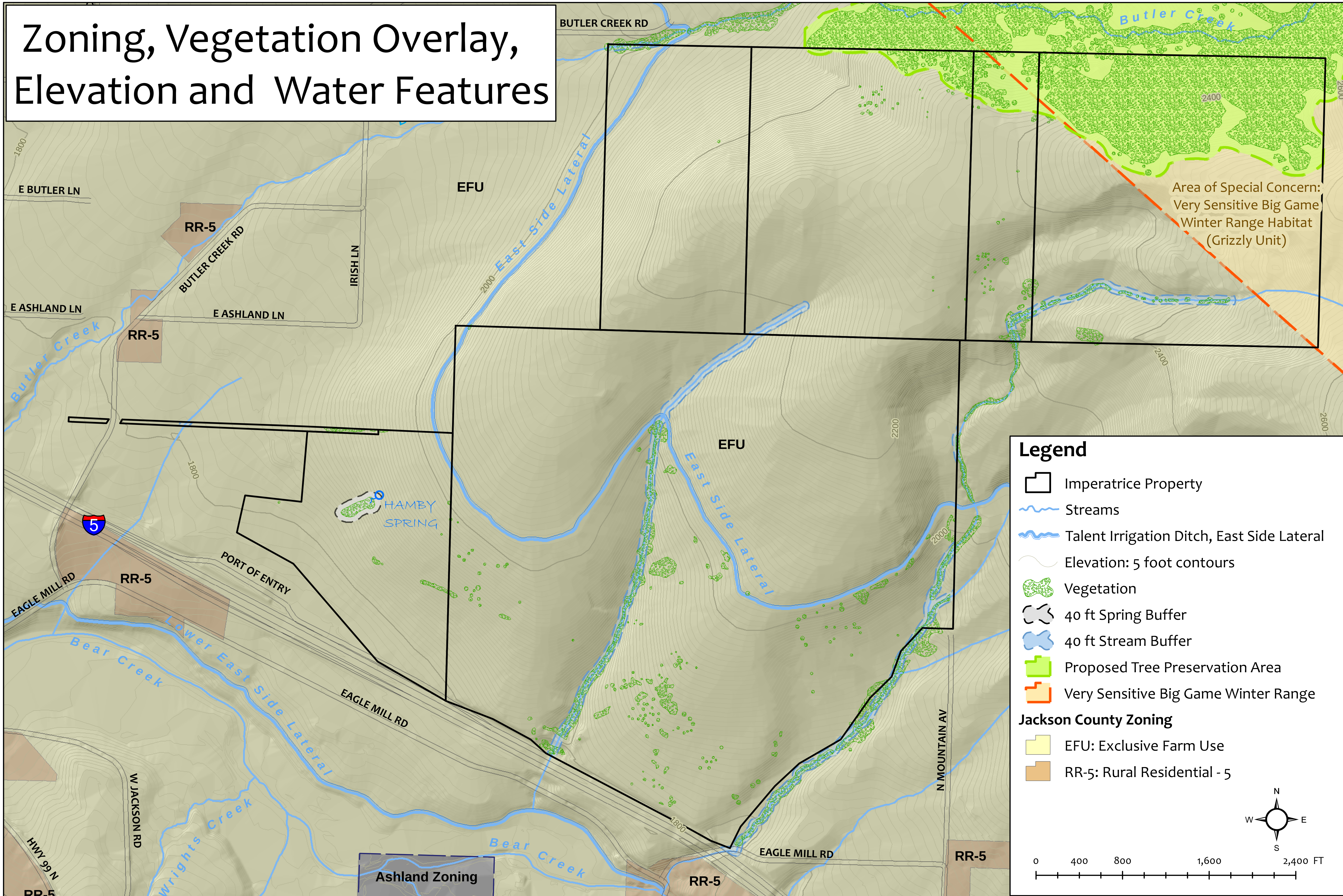
A. Mehrabzadeh

Ahmad A. Mehrabzadeh
Environmental Scientist

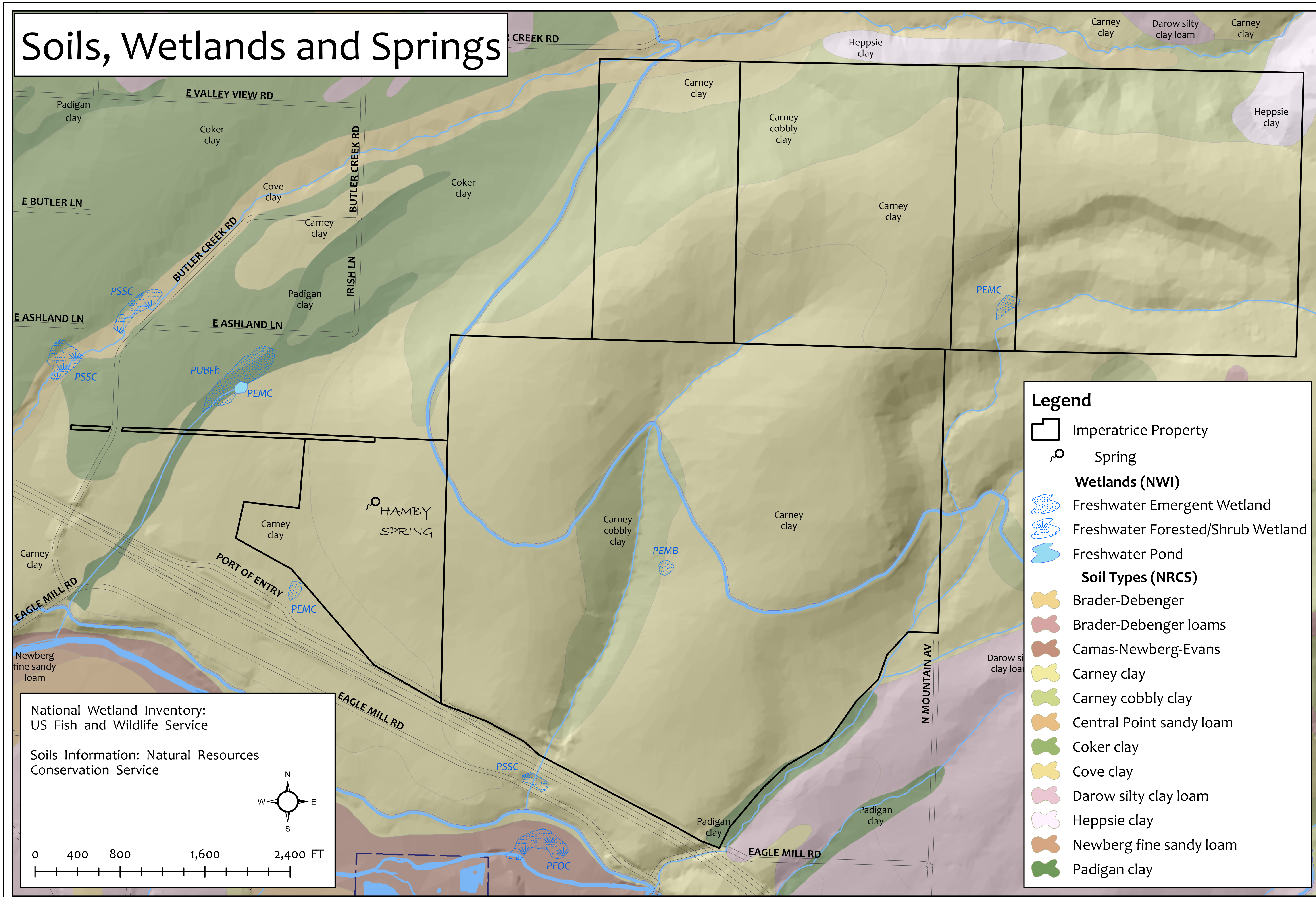
D.G. Chakrapani, PhD, PE
Account Director

AAM:sas
3 copies

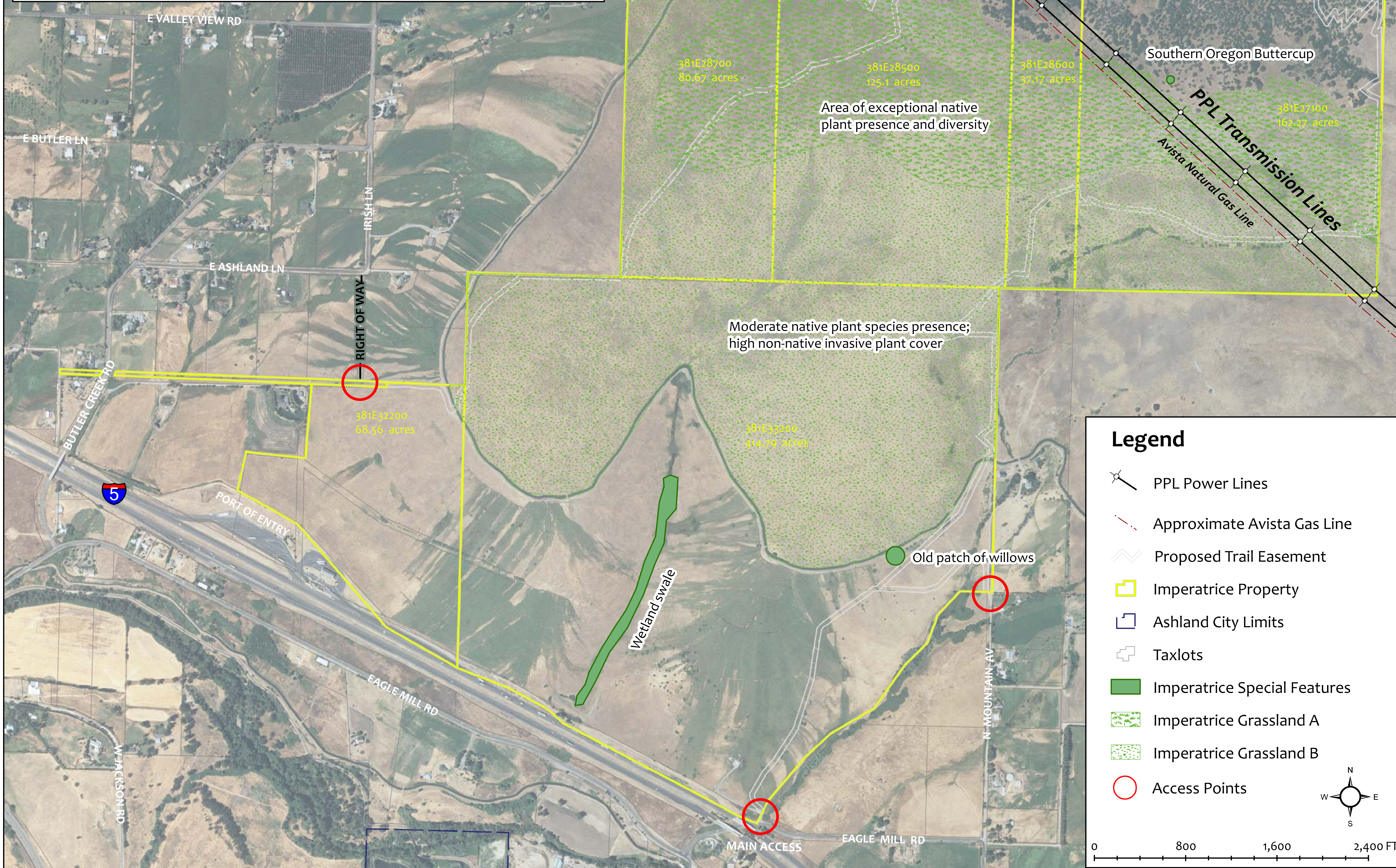
Zoning, Vegetation Overlay, Elevation and Water Features



Soils, Wetlands and Springs



Potential Conservation Values



Base Map: 2005 Aerial Photo, Parcels, PPL and Access Points