EXHIBIT H – Application for Site Certificate

GEOLOGY

OAR 345-021-0010(1)(h)

REVIEWER CHECKLIST

(h) Exhibit H. Information from reasonably available sources regarding the geological and soil stability within the analysis area, providing evidence to support findings by the Council as required by OAR 345-022-0020, including:

Rule Sections	Section	✓
(A) A geologic report meeting the Oregon State Board of Geologist Examiners geologic report guidelines. Current guidelines shall be determined based on consultation with the Oregon Department of Geology and Mineral Industries, as described in paragraph (B) of this subsection.	H.2 Appendix H-1	
(B) A summary of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate methodology and scope of the seismic hazards and geology and soil-related hazards assessments, and the appropriate site-specific geotechnical work that must be performed before submitting the application for the Department to determine that the application is complete.	H.3	
(C) A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions.	H.4	
(D) For all transmission lines, and for all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends (for transmission lines), corners (for transmission lines), and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides, marginally stable slopes or potentially liquefiable soils that could be made unstable by the planned construction or experience impacts during the facility's operation.	H.5	
(E) An assessment of seismic hazards, in accordance with standard-of-practice methods and best practices, that addresses all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection, and an explanation of how the applicant will design, engineer, construct, and operate the facility to avoid dangers to human safety and the environment from these seismic hazards. Furthermore, an explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters. The applicant shall include proposed design and engineering features, applicable construction codes, and any monitoring and emergency measures for seismic hazards, including tsunami safety measures if the site is located in the DOGAMI-defined tsunami evacuation zone.	H.6	

Rule Sections	Section	✓
(F) An assessment of geology and soil-related hazards which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility, in accordance with standard-of-practice methods and best practices, that address all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection. An explanation of how the applicant will design, engineer, construct and operate the facility to adequately avoid dangers to human safety and the environment presented by these hazards, as well as: (i) An explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters. (ii) An assessment of future climate conditions for the expected life span of the proposed facility and the potential impacts of those conditions on the proposed facility.	H.7	

EXHIBIT H – Application for Site Certificate

GEOLOGY

OAR 345-021-0010(1)(h)

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APPENDICES

H.1 INTRODUCTION

Obsidian Solar Center, LLC (Applicant) proposes to construct the Obsidian Solar Center (Facility) in Lake County, Oregon, with an alternating current generating capacity of up to 400 megawatts. Please refer to Exhibit B for Facility layout information and Exhibit C for Facility location information.

Exhibit H addresses seismic hazard risk and potential impacts of the proposed Facility on geologic and soil stability within the analysis area, which the Project Order defines as the area within the site boundary. This exhibit provides the information required by Oregon Administrative Rules (OAR) 345-021-0010(1)(h): *Information from reasonably available sources regarding the geological and soil stability within the analysis area, providing evidence to support findings by the Council as required by OAR 345-022-0020.*

As described in Exhibit B, this Application for Site Certificate (ASC) analyzes the potential impacts from two design scenarios: a stand-alone photovoltaic (PV) solar power generation build-out, and a PV solar power generation plus battery storage build-out. This exhibit analyzes the PV plus battery storage design scenario, which will have greater potential geologic risks than the stand-alone PV scenario due to the larger footprint and inclusion of battery storage enclosures.

Executive Summary

This exhibit presents the results of a preliminary geologic and geotechnical assessment for the proposed Facility and was prepared using information from previously published geologic and seismic studies and site-specific geologic reconnaissance. The data presented in this exhibit demonstrate that construction, operation, and retirement of the Facility will not result in or exacerbate significant geologic or soil-related hazards. Applicant will conduct sub-surface investigation in connection with development of final design and construction planning. Applicant will design and construct the Facility and related or supporting components according to applicable building codes and utility requirements and will implement measures designed to avoid or minimize potential geologic, seismic, or soil-related hazards as necessary. Observed surface geology does not pose any unavoidable geotechnical issues that could not be addressed through standard-of-practice design investigations, analysis, and appropriate Facility layout design.

Proposed Conditions

Applicant proposes the following Site Certificate Conditions of Approval:

1. Applicant will conduct subsurface soil and rock investigations prior to construction of the Facility and during final facility design, including:

    a. Borings sufficient to develop seismic site classification(s) to facilitate engineering studies and site design;
    b. Structure-specific investigations appropriate for the structures and their accompanying loads; and
    c. As recommended by licensed project engineers, soil and rock laboratory tests, such as soil and rock classification and strength testing, electrical resistance, corrosivity, scanning electron microscopy, soil collapsibility, etc.
2. Applicant's final engineering will include geotechnical engineering design for foundations, including seismic design that incorporates detailed site-specific conditions.

H.2 GEOLOGIC REPORT

OAR 345-021-0010(1)(h)(A) *A geologic report meeting the Oregon State Board of Geologist Examiners geologic report guidelines. Current guidelines shall be determined based on consultation with the Oregon Department of Geology and Mineral Industries, as described in paragraph (B) of this subsection.*

Response: A geotechnical/geologic investigations report, meeting the general guidelines in Oregon Department of Geology and Mineral Industries (DOGAMI) Open File Report 00-04 and the Oregon State Board of Geologist Examiners' *Guidelines for Preparing Engineering Geologic Reports* (Second Edition, May 30, 2014), was prepared on behalf of Applicant by geotechnical consultant Cornforth Consultants and is presented in Appendix H-1. At DOGAMI's request, this exhibit and Appendix H-1 refer to both the 2015 and 2018 International Building Code (IBC), which informs the current Oregon Structural Specialty Code (OSSC) (2014), which references IBC 2015, as well as the updated OSSC (2019), which will likely reference IBC 2018.

H.3 CONSULTATION SUMMARY

OAR 345-021-0010(1)(h)(B) *A summary of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate methodology and scope of the seismic hazards and geology and soil-related hazards assessments, and the appropriate site-specific geotechnical work that must be performed before submitting the application for the Department to determine that the application is complete.*

Response: In June 2018, Applicant and its consultant spoke with Ms. Yumei Wang, P.E., of DOGAMI. Following the teleconference, Applicant's consultant and Ms. Wang exchanged electronic communications summarizing the discussion to confirm the consultation and the agreed-upon approach for evaluating seismic risk at the Facility (refer to Appendix H-2).

H.4 DESCRIPTION AND SCHEDULE OF GEOTECHNICAL WORK

OAR 345-021-0010(1)(h)(C) *A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions.*

Response: Existing published information was first reviewed to characterize the current geologic conditions and potential seismic hazards near the Facility site. Applicant's consultant also completed a preliminary geologic and geotechnical reconnaissance within the site boundary between May 29 and 31, 2018. The preliminary site work included a geologic reconnaissance of representative areas within the site boundary; review of available site information such as geologic maps and reports, Oregon Department of Water Resources (n.d.) well log reports, National Resource Conservation Service Soil Survey Geographic Database for Lake County (Soil Survey Staff, NRCS 2017), and U. S. Geological Survey (USGS n.d.) Search Earthquake Catalog; and seismic analyses. A report describing the geological conditions for the area within the site boundary is included in Appendix H-1.

As determined during consultation with DOGAMI, prior to construction and during final facility design, additional subsurface explorations will be completed to confirm the anticipated soil conditions and provide final design recommendations. This approach of postponing the geotechnical explorations until site layout is better known is reasonable due to the broad and variable area under study with associated varying subsurface conditions, the comparatively light loads imparted by the racking systems and solar panels, and the uncertainty regarding where the higher-load structures may be located. Required subsurface work will be as dictated by utility and building code requirements, as well as engineering recommendations as necessary to calculate bearing capacity of the soils, conduct stability analyses, and provide engineering recommendation for construction of the structures.

H.5 GEOTECHNICAL WORK FOR TRANSMISSION LINES AND PIPELINES

OAR 345-021-0010(1)(h)(D) *For all transmission lines, and for all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends (for transmission lines), corners (for transmission lines), and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides, marginally stable slopes or potentially liquefiable soils that could be made unstable by the planned construction or experience impacts during the facility's operation.*

Response: The generation tie (gen-tie) transmission line from the Facility will travel adjacent to Connley Road within the public right-of-way and private easement. Power generated by the Facility will be transmitted to the power grid by a substation located within the site boundary.

Subsurface explorations consisting of test pit excavations and/or borings located at a representative sample of power pole locations along the proposed gen-tie transmission line and corresponding laboratory testing will form the basis of geotechnical work in the gen-tie transmission line corridor. Given its placement and design, construction of the gen-tie transmission line will not create new or exacerbate existing geologic hazards, nor will it cross over any major roadways, railroads, or rivers. The gen-tie transmission line corridor occupies flat terrain with no slope stability hazards. The line will be installed on overhead 70-foot-tall monopoles, anticipated to be spaced approximately 300 feet apart. Liquefaction potential is not known, although records from existing water well logs indicate that static groundwater levels are well below the ground surface. Standard-of-practice geotechnical design efforts and ground improvement measures are anticipated to be sufficient to identify and mitigate potentially liquefiable soils within the transmission corridor.

H.6 SEISMIC HAZARDS ASSESSMENT

OAR 345-021-0010(1)(h)(E) *An assessment of seismic hazards, in accordance with standard-of-practice methods and best practices, that addresses all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection, and an explanation of how the applicant will design, engineer, construct, and operate the facility to avoid dangers to human safety and the environment from these seismic hazards. Furthermore, an explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters. The applicant shall include proposed design and engineering features, applicable construction codes, and any monitoring and emergency measures for seismic hazards, including tsunami safety measures if the site is located in the DOGAMI-defined tsunami evacuation zone.*

Response*:*

Seismic Hazard Assessment. There are no known Quaternary seismic faults traveling through the site boundary (USGS 2014), making the likelihood of surface rupture from a known fault "very low." The presence of mapped faults in the surrounding area (USGS 2014), which introduces an increase in the possibility of concealed faults, increases the likelihood of surface rupture to "low."

Due to the gently sloping topography within the site boundary, the likelihood of seismically induced landslides is low. Additionally, the Facility site is not located near a body of water large enough to develop a significant tsunami wave or seiche. Therefore, there is no risk of tsunami inundation at the site.

Seismic hazard risk in and around the Facility site is considered to be low or very low. There are no known or mapped active faults in the immediate area or within the site boundary. There are two fault zones near the Facility site: the Paulina Marsh Fault Zone (about 4 miles southwest) and the Southeast Newberry Fault Zone (east and west of the site boundary). The faults are believed to have a low probability (1%) of generating potentially damaging ground shaking in any given year (USGS n.d.). Appendix H-3 lists the recorded earthquakes within 50 miles of the site boundary.

Even if ground shaking were to occur within the site boundary, the probability of resulting structural damage is considered low because the seismic hazard potential is relatively low and Facility components will be designed for the seismic potential of the area. The Facility will be designed to sustain no life-threatening structural damage from either the vibrational response of the structure or secondary hazards associated with grand movement or failure (such as landslides, lateral spreading, liquefaction, fault displacement, or subsidence). It is generally assumed that if significant structural damage can be prevented, the risk to human safety will be minimal.

The Facility will be designed for a Maximum Considered Earthquake Event (MConE) in accordance with the International Building Code (IBC) as amended by the OSSC. Based on a preliminary geologic surface reconnaissance, the soil profile within the site boundary can be characterized as variable and any given location could correspond to an IBC Site Class of B, C, D, or E. The Facility site also potentially includes collapsible diatomaceous soil, which may indicate Site Class F and require a site response analysis in accordance with American Society of Structural Engineers 7-16 Section 21.1. Therefore, prior to construction, as part of the design effort, on-site geotechnical subsurface information will be collected as necessary to recommend design parameters for applicable MConE to be considered during final design.

Seismic Disaster Resilience. The Facility will be located over 170 miles from the Cascadia Subduction Zone and will be in the "light" damage zone as defined in the Oregon Resilience Plan, making it inherently resilient to region-wide seismic disaster (OSSPAC 2013). Local seismic resiliency will be provided by adhering to current seismic building codes, which incorporate the latest widely accepted earthquake data and science.

Ground shaking hazards will be addressed using seismic ground response spectra in the design, in general accordance with applicable IBC and OSSC requirements to design structural support elements to avoid failure of the panel support systems. The structural engineer will design the facilities to resist lateral base shear, based on the spectral values and the seismic design category of the structure. If the spectral values are significantly lower than the OSSC values, the code values will be utilized. Seismic activity monitoring will be accomplished by monitoring public seismic data when needed, such as that provided by the U. S. Geological Survey or the Pacific Northwest Seismic Network. On-site seismic monitoring is not warranted.

Based on preliminary geologic surface analysis, the soil profile at the Facility site is variable and subsurface material could range from dense sand and gravel to collapsible diatomaceous silt and clay. Further geotechnical analysis and site characterization will be conducted in connection with final Facility design and engineering. To avoid dangers to human safety and the environment from potential seismic hazards, solar structures will be supported by steel posts; post depth will vary depending on soil conditions but will typically be 7 to 8 feet below the surface. General site topography is gently sloping, without steep slopes. No structures will be built on steep slopes that could be prone to instability, thus avoiding potential danger. The Facility will be designed and constructed to meet or exceed the minimum standards required by the applicable IBC, with current amendments by the OSSC and local agencies.

In the unlikely event of a failure of a solar panel support system (i.e., the racking support system for the solar panels), the risk posed to human safety is considered to be low because not only will the racks be designed to seismic codes, it is also unlikely that operational staff would be beneath any racks that did fail. All battery storage units will be designed to applicable seismic codes, and a potential prolonged loss of climate control would not produce adverse effects due to the flow batteries' electrolytic system being thermally stable with the temperature ranges expected in the Facility vicinity. Collector and substation buildings will be constructed in accordance with engineering and safety requirements mandated by the connecting utility, as applicable.

H.7 GEOLOGY AND SOIL-RELATED HAZARDS ASSESSMENT

OAR 345-021-0010(1)(h)(F) *An assessment of geology and soil-related hazards which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility, in accordance with standard-of-practice methods and best practices, that address all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection. An explanation of how the applicant will design, engineer, construct and operate the facility to adequately avoid dangers to human safety and the environment presented by these hazards, as well as: (i) An explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters. (ii) An assessment of future climate conditions for the expected life span of the proposed facility and the potential impacts of those conditions on the proposed facility.*

Response:

Geology and soil-related hazards. Any potential geological or soil-related hazards within the Facility site boundary that could pose a substantial threat to public safety or jeopardize Facility completion can be addressed through mitigation. Potential geologic and soil-related hazards within the site boundary, in the absence of a seismic event, appear to be the potential for erosion of loose surficial soils, potential for collapse of the wind-blown sand and silt soils, minor flooding in low-lying areas, and the potential for layers of diatomite in the subsurface leading to long-term settlement of high load structures. These are discussed in detail in Appendix H-1. These potential hazards include volcanic eruptions, flooding, evaporates, diatomite, blowing sand, and ground settlement. Hazards with a potential to exist in the geologic setting of the valley include expansive soils, liquefaction, and organic clay. None of these potential hazards are expected to present any danger to human safety or the environment. Many of the Facility components, such as the solar panel racking systems, have relatively low design loads. In locations where there may be higher design load, such as substations or battery storage areas, geotechnical investigations performed during final design will reveal site-specific issues that may need to be addressed.

Integration of Disaster Resilience Design. The proposed Facility will be built on foundations that have been fully investigated and properly designed with comprehensive engineering design efforts to ensure a return to operation as soon as practicable after a major disaster (OSSPAC) 2013). The Oregon Resilience Plan anticipates that facilities located in the Eastern Cascadia Scenario Impact Zone will sustain light damage from a Cascadia Subduction Zone earthquake. As a result, the Resilience Plan includes measures for improving the electrical grid's ability to recover from a regional disaster originating from the west. Solar facilities are inherently resilient to disasters due to less complex generation systems as compared to other technologies, fewer moving parts, and limited or no ignition sources that could be damaged during shaking. In addition, battery storage units will be designed for seismic loading.

The presence of solar and other facilities outside the high-rainfall areas of the Pacific Northwest improves extreme-storm resilience following significant regional storms that may impact other facilities.

An Assessment of Future Climate Conditions and their Impacts. Impacts of climate change in the region may include the following (Dalton et al 2017):

- More common extreme heat events
- Small increases in drought frequency
- Longer fire seasons
- More common storm events
- Altered precipitation patterns influencing rangeland vegetation
- Shifting streamflow seasonality

These potential impacts are not expected to adversely affect the Facility, or they would be mitigated by Facility design and measures (i.e., additional fire breaks from Facility roads or watering for dust abatement). Further, development of renewable energy sources, to the extent that it displaces fossil fuel generation, may have a positive impact on climate conditions. Other factors, such as shifting streamflow seasonality, forest transformation and disturbance, and challenges to fish do not apply to the Facility given its location.

Future climate conditions that impact the region are not expected to negatively affect the Facility.

H.8 REFERENCES

Dalton, Meghan M., Kathie D. Dello, Linnia Hawkins, Philip W. Mote, and David E. Rupp. 2017. *The Third Oregon Climate Assessment Report.* Oregon Climate Change Research Institute, Oregon State University, January 2017. http://www.occri.net/media/1042/ocar3_final_125_web.pdf. Accessed June 2018.

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USGS (United States Geological Survey). n.d. Search Earthquake Catalog. https://earthquake.usgs.gov/earthquakes/search/. Accessed June 2018.

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United States Geological Survey and Idaho Geological Survey. 2014. Quaternary fault and fold database for the United States. https://earthquake.usgs.gov/hazards/qfaults/. Accessed June 2018.

Appendix H-1
Geotechnical Report

August 2, 2018 2693

Ilja Nieuwenhuizen
Ecology and Environment, Inc.
333 SW Fifth Avenue, Suite 600
Portland, Oregon 97204

Preliminary Geological and Geotechnical Summary Report
Obsidian Solar Center
Fort Rock, Oregon

Dear Mr. Nieuwenhuizen,

In accordance with our proposal, we have completed a preliminary geological and geotechnical assessment for the proposed Obsidian Solar Center near Fort Rock, Oregon. This letter report summarizes our findings of the proposed project site.

BACKGROUND

The proposed Obsidian Solar Center is a flexible, large-scale solar power generation and battery storage facility in Lake County, Oregon (Figure 1). The solar arrays will consist of modular panels mounted on a racking system elevated above the ground surface. The racking system will be founded on posts driven 7 to 8 feet below the ground surface (bgs). The locations of the battery storage facilities are unknown at this time. Site-specific designs for battery storage and other facility components s will be developed based on the results of future geotechnical investigations and engineering. The objective of this geologic and geotechnical assessment is to support the Application for Site Certificate for the Energy Facility Siting Council (EFSC). We understand that more detailed site-specific geotechnical studies will be performed as the permitted facility is developed.

SCOPE OF WORK

The preliminary geological and geotechnical assessment for the Obsidian Solar Center included the following tasks:

- Review existing published information on the geologic setting, potential seismic sources, and non-seismic geologic hazards that could have an impact on the site. Provide a summary of this information in the preliminary geologic and geotechnical summary report. Review logs of domestic and irrigation wells installed in the area, and correlate conditions with published geologic information.
- Review published information in the USGS fault database and the seismic hazard maps and summarize seismic hazards at the site. Complete deterministic ground motion studies to attenuate

motions from mapped faults that could generate motions at the site exceeding 0.05g. Review, deaggregate, and evaluate probabilistic seismic hazards to determine the seismic sources most likely to control the design of the facility. Provide a range of possible site classifications and preliminary seismic design parameters, including response spectra.

- Complete a geologic reconnaissance within the site boundary proposed for solar development to map surficial conditions such as rock outcrops, fault traces, boulders and potential obstructions, fill, and other observed geologic features that could impact the design of the facility.
- Summarize information gathered during the geologic review in a geotechnical report that includes: i) the geologic and seismic setting of the site; ii) the geologic site reconnaissance observations; iii) preliminary seismic and geotechnical design recommendations; and iv) an overview of potential geologic and geotechnical issues that could impact design and construction of the proposed facility.
- Prepare Exhibit H, Subsections 1 through 8, for the Application for Site Certificate in accordance with the Oregon Administrative Rules OAR 345-021.

SITE DESCRIPTION

The Facility is located in Township 26 South, Range 16 East (Figure 1). Anthropomorphic features in the area are related to agriculture (irrigation, homes, and storage buildings), small rural community structures, and earthworks related to two-lane paved and unpaved roads. Minor industrial mining activities are or have been carried out in the valley, including a diatomite surface mine about 6 miles south of the Facility and various gravel pits. Fort Rock State Park, about 8 miles northwest of the Facility, is a volcanic vent formed when the area was submerged and later eroded by wave action from the ancestral lake.

The Facility is subdivided into three areas, designated as Areas ‘A’, ‘C’, and ‘D’, and are planned to be tied together with generation tie transmission line corridors.

GEOLOGIC SETTING

The proposed Facility is located in the Fort Rock-Christmas Lake Valley basin in south-central Oregon, approximately 75 miles southeast of the City of Bend. Fort Rock-Christmas Lake Valley is a paleo lake basin that contained an inland sea up to 200 feet deep from the late Pliocene through late Pleistocene time (3.6 million to 12,000 years ago). The basin is about 40 miles long and 25 miles wide (Figures 2 and 3). Fort Rock Basin and adjacent upland areas are within the Great Basin section of the Basin and Range physiographic province (Fenneman, 1931). The Great Basin can be defined on the basis of two geological characteristics: 1) it is a region of block-faulted mountain ranges and intervening valleys; and 2) it is a region of internally-drained topographic basins that have no outlet to the ocean. Topographically, the Great Basin is distinguished by isolated, roughly parallel mountain ranges separated by generally flat desert basins.

Physiographic features typical of the northern Great Basin, as well as transition features associated with the Columbia Plateaus physiographic province are well represented within Fort Rock Basin. Eruptions of basaltic magma occurred along high angle, Basin and Range style faults that trend diagonally northwest to southeast across the basin and adjacent highlands, forming maar volcanoes, cinder cones, and flows within the basin (Heiken, 1971).

Topographic features of the Fort Rock Basin are the result of water deposition, wave and wind action, and volcanism in the highland areas and isolated areas on the basin floor. The elevation of the basin floor at the site is about 4,300 feet and the volcanic uplands in the area rise to elevations exceeding 5,190 feet. The maximum relief in the vicinity of the site is about 890 feet. Due to water, wave, and wind action, local relief on the basin floor rarely exceeds 50 feet; however, volcanic landforms such as eroded cinder cones and volcanic plugs rise through the Quaternary basin sediments as much as 200 feet above the basin floor. Prominent topographic features of the mountain uplands adjacent to the Facility site are high angle fault scarps and volcanic cones, and slopes and surface features comprised of lava. Both of these are typical of Basin and Range physiography is this region. The basin drains internally toward the lowermost parts of the basin. Only three streams within the basin (Buck, Silver, and Bridge Creeks) are perennial.

The basin's weather reflects its Oregon high desert locale and Desert and Steppe climate types. The area's weather averages and extremes are listed in Table 1 below.

Table 1: Fort Rock, Oregon weather records.

Month	Avg. Low (°F)	Avg. High (°F)	Record Low (°F)	Record High (°F)	Avg. Precipitation
January	19°	40°	-38° (1962)	63° (1991)	1.30"
February	22°	45°	-26° (1950)	72° (1995)	1.32"
March	24°	51°	-4° (1993)	78° (1960)	1.04"
April	27°	58°	4° (2005)	84° (1987)	0.89"
May	33°	66°	9° (1964)	95° (1986)	1.25"
June	39°	74°	17° (1962)	99° (1968)	0.86"
	43°	83°	22° (1955)	104° (2002)	0.60"
August	42°	83°	21° (1951)	103° (1961)	0.74"
September	34°	75°	12° (1965)	102° (1955)	0.49"
October	27°	64°	-7° (2002)	90° (1996)	0.70"
November	24°	47°	-23° (1955)	74° (1949)	1.12"
December	18°	40°	-33° (1990)	64° (1956)	1.22"

At the proposed site, the terrain lays flat and is underlain by Quaternary lake bed sediments consisting of lacustrine, fluvial, and eolian deposits. About three miles to the northeast of the Area A is Green Mountain, which is comprised of volcanic cones, subaqueous mafic intrusives, dikes, and multiple generations of basalt flows. Two miles to the northwest of Area A is a volcanic highland (Flatiron Mountain) which is part of the Newberry volcanic field. This area is composed of subaqueous, partly consolidated, palagonitic basalt ejecta formed when basaltic magma rose along a northwest-trending fissure and came into contact with abundant water. The most prominent landform to the south of the Facility is Hayes Butte, a complex of mafic vents with extensive exposures of cinder, scoria, and breccia. Figure 4 presents a portion of the published geologic map of the area (Walker et al., 1967).

Fort Rock-Christmas Lake Valley is a paleo lake basin of a former inland sea that existed in the region from Pliocene through late Pleistocene time. During the Pleistocene and early Holocene, Paleolake Fort Rock encompassed the entire basin. Increased precipitation and a cooler climate in this semiarid environment during the Pleistocene resulted in higher lake levels. At its maximum, the lake filled the basin up to 245 feet deep, with a surface area of over 900 square miles, larger than any modern lake in Oregon. There are four major shorelines of Fort Rock Basin from the paleolake (Freidel, 1994). These shorelines are identified through recording wave-cut and depositional terraces, lagoons, and convex sedimentary deposits such as bars, spits, and beach ridges. These features are seen throughout the basin in canyon walls, wave-washed cliffs, and caves. The elevations of these shorelines from highest to lowest are 4540 feet, 4475 feet, 4450 feet, and 4370 feet.

Approximately 6 miles south of Area A is a former diatomite surface mine that produced crushed diatomite for industrial purposes. Studies of the unit indicated that the diatomaceous units exposed at the site were deposited in the deep, fresh water lake that filled the basin and deposition was periodically interrupted by eruptive events (Colbath and Steele, 1982).

Faulting

Fort Rock Basin has undergone extensive Basin and Range style regional faulting. The basin is disrupted by numerous high-angle normal faults with vertical displacements ranging from a few feet to hundreds of feet (Allison, 1979). Scarps from these faults are conspicuous features of the landscape. Movement along these normal faults has occurred sporadically from early Pliocene to Recent time (Miller, 1984). Faulting trends are indicated by alignment of volcanic eruptive centers and the distribution of younger volcanic units.

Data from the USGS (2014) database of faults in the vicinity and earthquakes within a 50-mile radius of the proposed Facility (Figure 5) illustrate that 1) most fault traces in the area display a north-northwest trend except within the western section, approximately 60 miles west of the site, and within a narrow fault zone northeast of Summer Lake, approximately 30 miles southeast of the Facility. In both of these areas, fault traces tend to bend around to the northeast; 2) Richter scale magnitudes recorded along these faults range from 2.5 (no damage to buildings) to 4.0 (none to minimal damage to buildings) with the larger magnitudes associated with the northeast trending faults located northeast of Summer Lake; and 3) there is a fair amount of moderate earthquake activity and quaternary faults surrounding the area, but no known faults traverse through Facility boundaries.

Groundwater

Groundwater in the Fort Rock Basin occurs under confined, unconfined, and perched conditions. The significant aquifers in the region are the Picture Rock Basalt, the Hayes Butte Basalt, the Paulina Basalt, and the Fort Rock Formation. Perched conditions reflect a system of higher head resulting from underlying units of lower permeability such as the diatomite member and eruptive tuff of the Fort Rock Formation (Miller, 1984). Recharge in the basin originates from precipitation and snow melt. Precipitation enters the water table by downward infiltration in areas where sediment and rock permeabilities are sufficient. Likely areas of significant recharge are Paulina Marsh, south and adjacent to the site, exposures of younger basalt, areas of sand dune deposition, and the basin flanks where perennial and ephemeral streams cross permeable lava outcrops (Miller, 1984). Discharge of ground water from the basin occurs through well withdrawal, evapotranspiration, and possibly subsurface underflow. Well withdrawal is probably the most significant source of ground water discharge in the basin; however, in recent years no long-term water level declines caused by pumping are apparent (Gannett et al., 2010)

Soils

Cornforth Consultants reviewed available soil survey information within the site boundary (Natural Resources Conservation Service, 1999). Figures 6 through 8, prepared with data provided by the U.S. Department of Agriculture (USDA), exhibit mapped soil units for the three mapped areas (A, C, and D) and the gen-tie transmission line corridors along Connley Road. The units are divided into six groups of associated soils units. In general, the mapped soil units consist of eolian lakebed sediments, gravelly terrace deposits, sand dunes, and alluvium or colluvium mantling lava plateaus. Field descriptions recorded during the geologic reconnaissance support this report. Laboratory analysis of soil samples collected in the field are also consistent with the soil units represented on the soil survey map.

GEOLOGIC RECONNAISSANCE

A senior engineering geologist from our firm performed a geologic reconnaissance on May 29 through 31, 2018 of the three subsections (designated as Areas A, C, and D) and the generation tie transmission line corridors along Connley Road currently being considered for the Facility (Figure 3). The reconnaissance entailed examining published maps, aerial photos, and walking the areas within the site boundary. The reconnaissance confirmed the generalized 1:250,000 scale geology previously mapped in the area from available geologic information.

In general, all three areas occupy relatively flat-lying areas with low relief and are reasonably interpreted to be largely underlain by unconsolidated, likely interlayered, fine- to coarse-grained Quaternary sediments. The sediments are composed predominantly of undifferentiated lacustrine and fluvial deposits. The basin and range faulting continually lowers the base of the valley with time, and therefore the lacustrine and fluvial deposits likely extend hundreds of feet into the subsurface. Volcanic deposits are likely to repeatedly interbed with lacustrine and diatomaceous deposits of various thicknesses. Volcanic deposits could include: lava flows of andesite, basalt, and possibly obsidian; subaqueous lava eruptions and maars; and deposits of welded or unwelded tuff. Each of these deposit types have distinct and variable engineering characteristics. On the surface, these units are mapped as '*Lakebed sediments, undifferentiated*' on the site-specific surface geology maps, Figures 9 and 10. On the surface, these units are chiefly composed of sand and silt with varying amounts of clay. Evidence of higher expansive clay content is frequently exhibited by hexagonal mud cracking and remnant soil structures indicating frost heave. Soil deposits with high activity clay minerals are more prone to shrink/swell behavior upon change in moisture content.

Area A

This Area, being the largest of the three parcels, has geologic features not observed in areas C and D. A small area in the extreme northern part of section A is covered by a thin, scoriaceous, basalt flow and forms a bluff with about 30 feet of relief, indicated by *'Tertiary Basalt Flow'* on Figure 9.

Elsewhere, sand- to boulder-sized fragments of basalt were observed sparsely scattered on the ground surface approximately 3,000 and 7,000 feet from the nearest mapped basalt units in the east-central area of Section A. These areas are interpreted be small, localized former eruption areas that corresponded to other, nearby larger subaqueous eruptions (Flatiron Mountain) and flows that may have formed contemporaneously with the ancestral inland sea that once filled the basin. This interpretation is mapped as *'Lakebed Sediments and Basalt Fragments'* on Figure 9.

Large expanses throughout most of Area A contain vegetated and stabilized longitudinal sand dunes mapped as *'Vegetated Dunes'*. The stabilizing vegetation consists of desert grasses, sagebrush, and isolated trees. Where vegetation is absent, the dune sand is subject to accelerated erosion; wind erosion has created numerous scouring depressions in the silt/sand surficial deposits, mapped as *'Deflation Plain, Scattered Dunes'*. The dune morphology has a relative relief of 2 to 5 feet in height and 100 to 300 feet laterally. Dunes elsewhere in the Fort Rock valley have greater relief, on the order of 10 to 15 feet.

Soil samples were collected at select locations in Area A. Sample locations are labeled on Figure 9 and described in Attachment A. Select laboratory index testing was performed on these samples.

Area C

Area C consists largely of stabilized dunes and undifferentiated lakebed sediments (Figure 10). A gravel pit just outside the boundaries of Area C exposes cross-bedded sand and gravel, indicative of fluvial surface deposits. The low ridge that is being mined continues into the Area C boundaries and is mapped as *'Sand and Gravel Terrace'* on Figure 10. This area is the only significant exposure of subsurface conditions observed near or within the site boundary. Based on the nearby gravel pit walls, this unit is a relatively dense sand and gravel unit that can hold near vertical slopes with minor sloughing. Near the north end of gravel pit, a white, weathered welded tuff deposit is exposed in an excavation near the surface.

During the reconnaissance, frequent hexagonal ground cracks and remnant freeze-thaw soil structures were observed between dune forms where dune sand was not present. Burrowing insect mounds would occasionally exhume the white, welded ash unit observed near the gravel pit, indicating that the near surface ash may be laterally extensive across Area C.

Soil samples were collected at select locations in Area C. Sample locations are labeled on Figure 10 and described in Attachment A.

Area D and Gen-tie Corridors

Both Area D and the gen-tie corridors are mapped as *Lakebed Sediments – Undifferentiated.* Sand and silt are present on the surface and clay may be present in the subsurface. Much of the area is disturbed by the construction of Connelly Road and native materials are likely mixed with road base material. Locations of collected soil samples are shown on Figure 10 and described in Attachment A.

LABORATORY TESTING

Surface samples retrieved during the geologic reconnaissance were re-examined in the laboratory to confirm field descriptions and laboratory tests were completed to develop soil index and engineering design properties.

Atterberg Limits

Atterberg plasticity limits, a measure of soil cohesion and sensitivity to water content, were determined on three representative samples. The tests were performed on samples collected from the surface and near-surface soil to classify the plasticity of the fine-grained materials. The tests were performed in general accordance with ASTM D4318. The results are tabulated on Table 2 below and plotted on Figure 11.

Table 2: Atterberg Testing Results

Sample No.	Depth	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
A-9 (A)	Surface	58	33	25
A-9 (B)	Surface	58	37	21
C-2	Surface	80	63	17

Particle-size Distribution Analysis

Particle-size distribution (gradation) tests, a measure of soil particle-size distribution, were completed on eight representative samples obtained from surface and near-surface soil. The tests were performed in general accordance with ASTM D6913. Test results are plotted on Figure 12.

SUBSURFACE CONDITIONS

Generalized subsurface conditions in the three mapped Areas (A, C, and D) currently being considered for the Facility are reflected in water well logs documented in the State of Oregon's well log database. Well logs do not provide the data required for a geotechnical characterization (soil strength, soil and rock engineering classifications, etc.), only general information collected by drill equipment operators during drilling. Since water wells are often deeper than geotechnical borings, well logs are typically most useful for information such as depth-to-bedrock for large sedimentary basins. Nine well logs were reviewed that were within or close to Section A. No well logs were within for Area C, and two well logs were reviewed that were in close proximity of Area D. Well logs were reviewed to obtain information regarding location of the well, static water level at the date of drilling, and materials encountered during advance of the borehole. Subsurface conditions inferred from the well logs for each area are discussed below.

Area A

Well logs for this Area indicate that in general, bedrock deepens and lakebed sediments thicken in a southwesterly direction across the parcel. This is a result of volcanic highlands occupying the areas to the north and to the east of the parcel. Depth to bedrock ranged from within a few feet of ground surface in the north and northeast areas of the section to over 800 feet in the southwestern portion of this Area. Well logs also show that the materials overlying bedrock in this parcel are comprised of alternating layers of fine- and coarse-grained alluvial sediments. Some logs show about 3 feet of top soil underlain by approximately 2 feet of hard pan (caliche), which in turn is underlain by thick sequences of blue, yellow, and red 'clay' or 'stone', and intermittent layers of sand, gravel, pumice, and 'lava rock'.

Thin, water-bearing layers of pumice were also observed to be present within the alluvial sequences. In regard to static piezometric levels, it is not possible to ascertain a general trend for depth-to-water within Area A because the wells were drilled over a time span of 41 years between 1972 and 2013.

Area C

As mentioned above, no well logs were available for Area C. However, two nearby wells indicate depths to volcanic rock as 138 to 225 feet deep, deepening to the north.

Area D

Well logs for Area D indicate that a basalt unit is present at about 90 to 100 feet below the surface, with more sedimentary units below this basalt bed to depths greater than 400 feet. Alluvial sediments overlying bedrock are similar to materials overlying bedrock in Area A. The alluvial sediments consist of alternating layers of brown and gray clay with intermittent zones of sand and gravel and thin, water bearing pumice layers.

GEOLOGY AND SOIL-RELATED HAZARDS ASSESSMENT

An assessment of geology and soil-related hazards which could adversely affect or be aggravated by the construction or operation of the Facility is discussed in this section. Potential geologic hazards present at the site include earthquakes, volcanic eruptions, flooding, ground settlement, expansive soils, liquefaction, salt, organic clay, diatomite, and blowing sand. Each of these potential hazards are discussed below.

Earthquakes

There are two fault zones near the Facility: Paulina Marsh faults and the Southeast Newberry Fault Zone (Figure 5). Additional fault complexes are in the vicinity.

The Paulina Marsh faults are located about 4 miles southwest of the site. According to USGS National Seismic Hazards Maps, these faults have a vertical sense of slip, trend northwest, and dip 50° in a southwest direction. Fault scarp height is measured at 2 meters. Slip rate along the fault trace is estimated to be between 0.2 to 1.0 millimeter per year. The Paulina Marsh fault zone is capable of generating a maximum earthquake magnitude of 6.3; however, the faults are believed to have a low probability (1%) of generating potentially damaging ground shaking in any given year.

The Southeast Newberry Fault Zone lies to the east and west of the site boundary. These faults have a predominantly vertical sense of slip however some faults within the zone display a component of left-lateral strike slip. The faults trend northwest and dip 35-65° in a southwest direction. These faults form small escarpments on Plio-Pleistocene volcanic rocks and Pleistocene and Holocene sediments on the floor of Fort Rock Valley. The most-recent events on at least two faults in the zone, the Viewpoint and Crack-In-The-Ground faults, occurred in the Holocene, or within the last 12,000 years. Slip rate along the fault traces are measured to be estimated 0.2 to 1.0 millimeter per year. The Paulina Marsh fault zone is capable of generating a maximum Richter scale magnitude of 7.0. The faults are believed to have a low probability (1%) of generating potentially damaging ground shaking in any given year.

Volcanic Eruptions

Hazards typically associated with volcanic eruptions include direct blast, mudflows, pyroclastic flows, ash falls, lava flows, and floods. Newberry Volcano, located about 50 miles to the northwest of the site, has been recently active, with widespread Late Pleistocene and Holocene eruptions. The most recent at Newberry Volcano occurred between about 1,450 and 1,250 years ago, and culminated in formation of the Big Obsidian Flow (MacLeod et al., 1995). Jensen (2009) and MacLeod and Sherrod (1988) provide evidence that can be used to infer an active rhyolitic magma chamber beneath Newberry Volcano, and thus, more volcanism is likely to occur in the future.

Flooding

The potential for flooding of geomorphic low-lying areas in the site boundary, such as washes and playas, should be strongly considered. Flooding would most likely be caused by heavy rain associated with severe thunderstorms. Dry channels, ditches and lake beds could fill quickly and the water could have the potential to be strong and violent. Within the site boundaries, localized shallow flooding may occur within the lowest points within Area A. The Federal Emergency Management Agency (FEMA) has not published flood maps for the area containing the Facility.

Ground Settlement

Ground settlement may be caused by many factors, including solution, erosion, earthquakes, volcanism, hydrocompaction (wetting of collapsible soils), and withdrawal of groundwater. On a site specific scale in the site boundary, the greatest potential for ground settlement would probably be a result of hydrocompaction of collapsible soils such as near surface wind-blown silt/sand and withdrawal of groundwater. Settlement could also be caused by structure loads.

Landslides and Steep Slopes

Landslide features and steep slope hazards were not observed within site boundary. Vertical and near vertical gravel pit cuts in bedded sand and gravel are near Area C, but are outside its boundaries.

Expansive Soil

Expansive soils contain minerals such as smectite that are capable of absorbing water into the clay's crystal structure. When clay minerals absorb water, they increase in volume; when water is lost, volume decreases. This volume change can occur annually, with changes in surface conditions (such as slab foundations blocking water and causing desiccation), or even through seasonal changes during the year. This change in volume can exert enough force on a foundation, building, or other structure to cause damage without treatment. At the Facility, the presence of expansive soils in the subsurface has not been evaluated, but desiccation cracks at the ground surface were frequently observed during the field reconnaissance. The potential for deposits of expansive clays certainly exists within the lacustrine sediments underlying the site.

Liquefaction

Soil liquefaction describes a phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid. The phenomenon can be responsible for extensive damage to buildings is most often observed in saturated, loose (low density or uncompacted), sandy soils, such as may be found in the unconsolidated sedimentary deposits underlying the project. At the Facility the occurrence of potentially liquefiable soils cannot be evaluated without geotechnical data from the subsurface. The sedimentary materials reasonably expected to be found here have been liquefied in other similar settings with sufficient shaking.

Evaporite

A dry lake is either a basin or depression that formerly or intermittently contains standing surface water, which dries completely when the rate of evaporation exceeds recharge. A dry lake is also referred to as a playa. Salt minerals, or evaporites, originally dissolved in the water precipitate out and can be left behind on a playa surface, gradually becoming thicker over geologic time. Evaporite can be extremely corrosive to foundations and building materials. The geologic map accompanying this report (Figure 4) illustrates that Quaternary playa deposits (Qp) are present in Fort Rock Valley; consequently, the potential for evaporite to come into contact with buildings constructed at the Facility should be considered. Evaporite can form in metastable configurations that are stable up to some load, but collapse at higher loads. Evaporite can also collapse when saturated under constant load. Soil structure of evaporite deposits, if present beneath higher load structures, could collapse and cause settlement.

Organic Silt and Clay

Organic silts and clays are known to compromise the integrity of building foundations. Organic soils typically contain high water contents and generally have low bearing capacity, low shear strength, and have high rates of secondary compression. Organic soils, if present, could be associated with ancestral marshes that may have been near former shorelines

Diatomite

Diatomite is the white or off-white remains of microscopic siliceous skeletons of fresh-water algae (diatoms) deposited in former lakes. It occurs in Fort Rock and Christmas Valley and is exposed in some of the dry washes in the area. During site-specific geologic reconnaissance of the three Facility parcels (A, C, and D), diatomite was found to be present on the surface in Area A. Diatomite has the potential for collapsing under high foundation loads. In the nearby La Pine basin, a railroad overpass for Highway 97 had to be halted during construction due to excessive and still-ongoing settlement due to the collapse of diatomite deep in the subsurface (ODOT, 2018). Settlement was triggered by loads associated with the approach embankment fills. Diatomite has many characteristics of very soft clays and is problematic from a development standpoint primarily due to its low undrained shear strength and high compressibility.

Diatomite dust is a silica hazard which requires precautions to prevent people in the work place from breathing the dust.

Blowing Sand

Eolian, or wind-deposited, sediments occur within the site boundary. These deposits consist of reworked fine alluvium, which has been picked up by strong winds and redistributed primarily as fine sands that now form sand dunes and sand fields at the site. Engineering nuisances associated with sand dune deposits include sand deposition, wind erosion, and collapsible soils.

SITE SEISMICITY

Site Classification

Based on the site classification procedure for seismic design outlined in ASCE 7-16 Section 20 and the wide-ranging soil types observed in the geologic reconnaissance, site classes B through E could reasonably be encountered in the site boundary. Dense granular materials were observed in Area C, clays were observed in Area A, and loose sand is at the surface and likely buried in the lakebed deposits. Also, considering the size of Area A, multiple site classifications may be present within that area alone given the variable conditions observed. Two of the samples tested had a Plasticity Index (PI) greater than 20, suggesting the potential for Site Class E. The site also potentially includes collapsible diatomaceous clay, which suggests the potential for Site Class F. Site Class F site classification would require a site response analysis in accordance with ASCE 7-16 Section 21.1.

Seismicity

There are number of mapped faults in the region that are believed to have produced large earthquakes within the last 1.6 million years. There have been 13 reported earthquakes since 1991 within a 50 mile radius of the site with a minimum magnitude of 2.5, at a rate of just over 2 per year. The maximum recorded earthquake magnitude is 3.8, centered approximately 24.5 miles to the southeast and occurred in April 1999.

Local crustal faults and the Cascadia Subduction Zone (CSZ) interface fault are the two principle seismic sources capable of generating strong ground motions at the site. The crustal fault sources identified are those occurring on known, unknown, buried, or random faults in the area. The CSZ seismic events result from the Juan de Fuca tectonic plate subducting (sliding) beneath the North American continental tectonic plate. CSZ interface events occur as a result of sliding between the two plates. Table 3 identifies and characterizes the seismic sources capable of generating a peak bedrock acceleration of at least 0.05g at the site. Mean peak bedrock accelerations for crustal sources were calculated using the average of all five enhanced Next Generation Attenuation West 2 (NGA-West 2) relationships (Abrahamson et al., 2014; Boore et al., 2013; Campbell and Bozorgnia, 2014; Chiou and Youngs, 2014; Idriss, 2014). The peak acceleration estimated for the CSZ interface even was calculated using the averaged, mean plus one standard deviation ground motions from published methodologies (Addo and McCann, Jr, 2012; Atkinson and Boore, 2003; Atkinson and Macias, 2009; Zhao et al., 2006).

Table 3: Dominant Seismic Sources (Bedrock Accelerations).

Source	MCE	Minimum Distance (km)	Mean Peak Acceleration (g)
Southeast Newberry Fault Zone	7.2	6.9	0.32
Paulina Marsh Faults	6.3	19	0.10
Random Event	6.5	10	0.21
CSZ Interface Event	9.0	240	0.08

As shown in the table, the Southeast Newberry Fault Zone is likely to control ground motions at the site for potential seismic sources.

The period ranges for which the spectral accelerations of MCE events exceed the design spectrum using the 2014 and anticipated 2019 OSSC (based on 2018 IBC) are shown in Table 4 (see also Figures 13 through 16). As part of final design studies, borings should be completed to determine subsurface conditions and proper seismic site classification. The surface geologic reconnaissance indicates that subsurface materials could range from shallow bedrock for a small portions of Area A, dense sand and gravel, loose saturated sand related to dunes and lakebed deposits, thick sequences of silt and clay, to collapsible diatomaceous silt and clay. General site topography is gently sloping without steep, marginally stable slopes. Without subsurface information, it is unknown whether amplification of ground motions is expected, and whether the design ground motions would be greater than those of the MCE ground motions.

Table 4: Seismic Ground Motions for Various Site Classifications.

MCE Event	Site Class	Period Range Exceeding 2014 OSSC Design Spectrum (sec)	Period Range Exceeding Anticipated 2019 OSSC Design Spectrum (sec)
SE Newberry	B	0 to 1.38	0 to 2.79
	C	0 to 1.25	0 to 1.37
	D	0 to 3.87	0 to 3.45
	E	0 to 3.36	0 to 3.48
	F	Requires site response analysis	
Random Crustal	B	0.13 to 0.23	0.09 to 0.31
	C	0.12 to 0.32	0.13 to 0.30
	D	0.13 to 0.51	0.09 to 0.55
	E	0.08 to 0.64	0.11 to 0.59
	F	Requires site response analysis	

Without subsurface information, the potential for liquefaction, lateral spreading, or ground motion amplification from a seismic event is unknown. Due to the gently sloping topography of the site, the likelihood of seismically-induced landslides is very low.

Mapped spectral accelerations at the site based on the 2012/15 International Building Code (2,475-year return period, 0.2s Sa and 1.0s Sa) are 0.821g and 0.302g, for short (S_S) and 1-second (S_1) period motions, respectively. Based on a preliminary geologic surface reconnaissance, the soil profile at the site is variable and any given location could correspond to an IBC site class of B, C, D, or E. The maximum considered earthquake ground motions at the site, S_{MS} and S_{M1} are shown in Table 5.

Table 5: Maximum Considered Earthquake Ground Motions for IBC 2012/2015.

Site Class	**S_{MS} (g)**	**S_{M1} (g)**
B	0.821	0.302
C	0.880	0.453
D	0.962	0.543
E	0.915	0.844
F	Requires site response analysis	

Mapped spectral accelerations at the site based on 2018 IBC (2,475-year return period, 0.2s Sa and 1.0s Sa) are 0.756g and 0.289g, for short (S_S) and 1-second (S_1) period motions, respectively. Based on a preliminary geologic surface reconnaissance, the soil profile at the site is variable and any given location could correspond to an IBC site class of B, C, D, or E. The maximum considered earthquake ground motions at the site, S_{MS} and S_{M1} are shown in Table 6.

Table 6: Maximum Considered Earthquake Ground Motions for IBC 2018.

Site Class	S_{MS} (g)	S_{M1} (g)
B	0.680	0.231
C	0.907	0.433
D	0.905	0.584
E	0.983	0.825
F	Requires site response analysis	

PRELIMINARY GEOTECHNICAL DESIGN CONSIDERATIONS

In our opinion, there are not sufficient data at present to develop foundation design or seismic response design recommendations for structures. The site developer should design any foundation support systems and ground treatment measures for the Facility during final design following the collection of subsurface information at the relevant locations. The exploration plan could utilize field geophysical testing, conventional drilling and sampling, laboratory program, and engineering analyses to appropriately characterize the variable geologic materials expected within the site boundary. Various exploration methods would be appropriate once additional structure details are determined for the solar panel rack foundation system, and the location and loads of battery storage facilities, concrete equipment pads, switchyards, and access roads are determined.

Observed soil conditions should be considered when locating structures with higher loads such as battery storage facilities. Locating such structures on areas with shallow bedrock or dense sands and gravels would help to minimize foundation costs and improve foundation performance, especially over the long-term.

We appreciate the opportunity to be of assistance on this preliminary phase of the Facility. If you have any questions, please contact us at 503-452-1100.

Sincerely,

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Attachment A: Soil Classification of Surface Samples

Atterberg Test Samples			
Sample ID	**USCS Name**	**Cornforth Soil Classification Name**	**Comments**
A-9	Elastic Silt (MH)	Diatomaceous clayey SILT	Displays rapid dilatancy - not to be expected with an MH, dilatancy possibly affected by diatoms, very high dry strength, strong 10% HCL reaction
A-9	Elastic Silt (MH)	Diatomaceous clayey SILT	Displays rapid dilatancy - not to be expected with an MH, dilatancy possibly affected by diatoms, very high dry strength, strong 10% HCL reaction
C-2	Elastic Silt (MH)	Slightly clayey SILT	Material is a weathered welded ash, displays slow dilatancy and is hard to roll, very strong dry strength, weak 10% HCL reaction
Grain Size Analysis (Mechanical) Samples			
Sample ID	**USCS Name**	**Cornforth Soil Classification Name**	**Comments**
A-2	Well graded GRAVEL with sand and silt (GW-GM)	Silty sandy GRAVEL	Gravels are gap graded with predominantly coarse gravel and fine sand and silt, components are reworked volcanics, grain coatings display strong 10%HCL reaction
A-4	Well graded SAND with silt (SW-SM)	Diatomaceous very sandy SILT with trace gravel	Gravels composed of wind faceted (polished) black basalt grains, material is composed predominantly of pink yellow, angular, diatomaceous fragments
A-6	Elastic SILT with sand (MH)	Diatomaceous sandy SILT with trace gravel	Material is composed predominantly of pink yellow, angular, diatomaceous fragments
A-8	Well graded SAND (SW)	Slightly silty SAND	Eolian, frosted very well rounded grains, uniform texture, composed of fine black and dark brown volcanic grains, contains minor fine grassy organics
C-1	Well graded SAND (SW)	Slightly gravelly SAND with trace silt	Coarse-grained volcanic sand, grain coatings display weak 10% HCL reaction, washes fast
D-1	Silty SAND (SM)	Silty SAND	Fine-grained volcanic sand, organic-rich (fine grasses)

T-1	Silty SAND (SM)	Silty SAND with trace gravel	Medium-grained volcanic sand, organic-rich (fine grasses)
T-3	Silty SAND (SM)	Silty SAND with trace gravel	Medium-grained volcanic sand, organic-rich (fine grasses)
Manual-Visual Classification of Soil Samples			
Sample ID	**USCS Name**	**Cornforth Soil Classification Name**	**Comments**
A-1	Poorly graded SAND with silt (SP-SM)	Slightly silty SAND	Fine-grained, pumiceous, volcanic sand
A-3	Well graded SAND with silt (SW-SM)	Slightly silty SAND	Fine to coarse-grained, pumiceous, volcanic sand
A-5	Well graded SAND with silt (SW-SM)	Slightly silty SAND with trace fine gravel	Loamy, pumiceous, volcanic sand, gravels are basaltic
A-7	Silty SAND (SM)	SAND with silt	Loamy, pumiceous, silty, volcanic sand
C-4	Well graded SAND with silt (SW-SM)	Slightly silty SAND	Loamy, pumiceous, volcanic sand, gravels are basaltic
D-2	Well graded SAND with silt (SW-SM)	Slightly silty SAND	Fine to coarse volcanic sand, gravels composed of subrounded fragments of reworked volcanic sand
T-2	Well graded SAND with silt (SW-SM)	Slightly silty SAND	Loamy, pumiceous, volcanic sand

Limitations in the Use and Interpretation of this Geotechnical Report

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross-sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

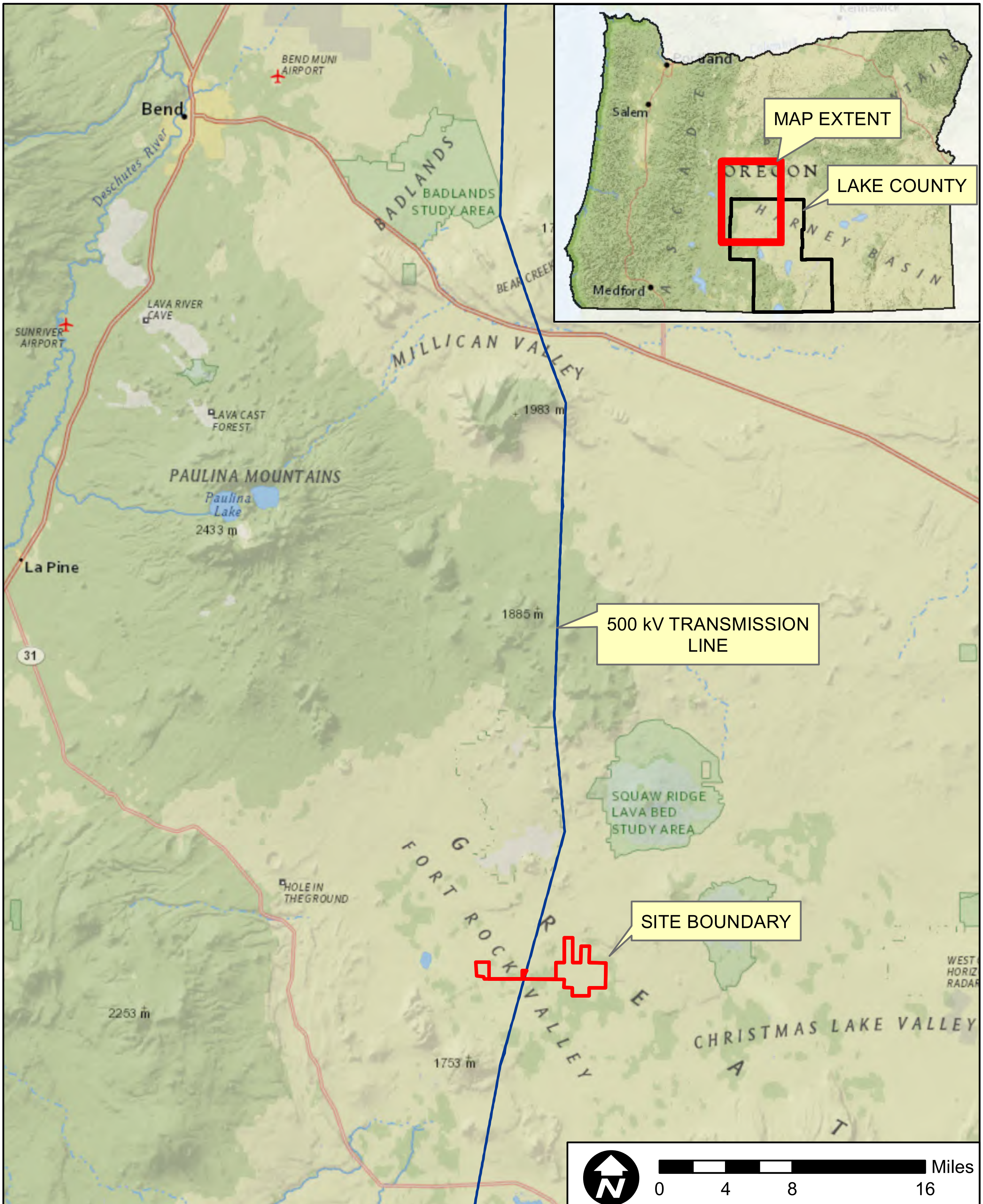
The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.



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VICINITY MAP

OBSIDIAN SOLAR CENTER
CHRISTMAS VALLEY, OREGON

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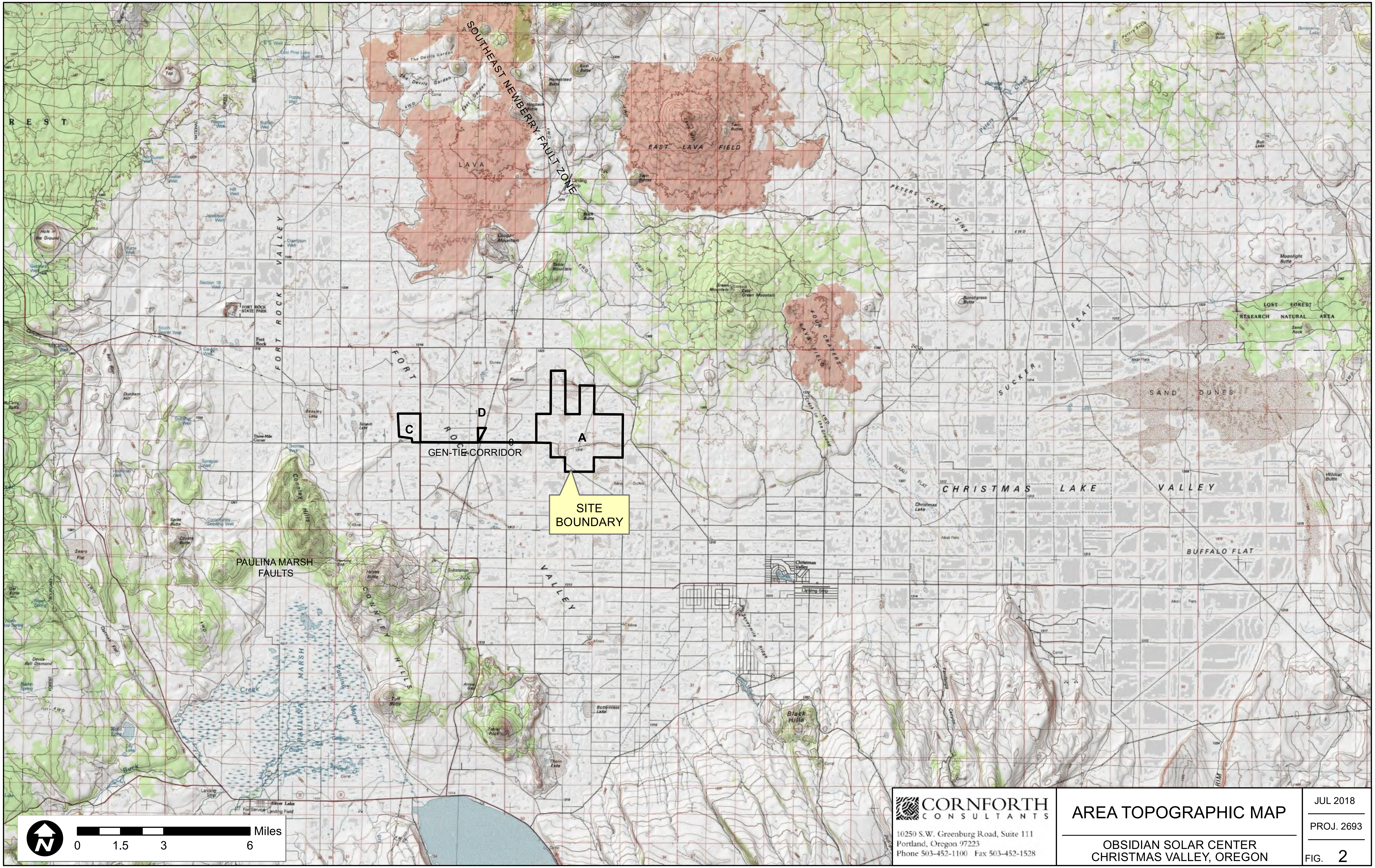
PROJ. 2693

FIG. 1



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AREA TOPOGRAPHIC MAP

OBSIDIAN SOLAR CENTER
CHRISTMAS VALLEY, OREGON

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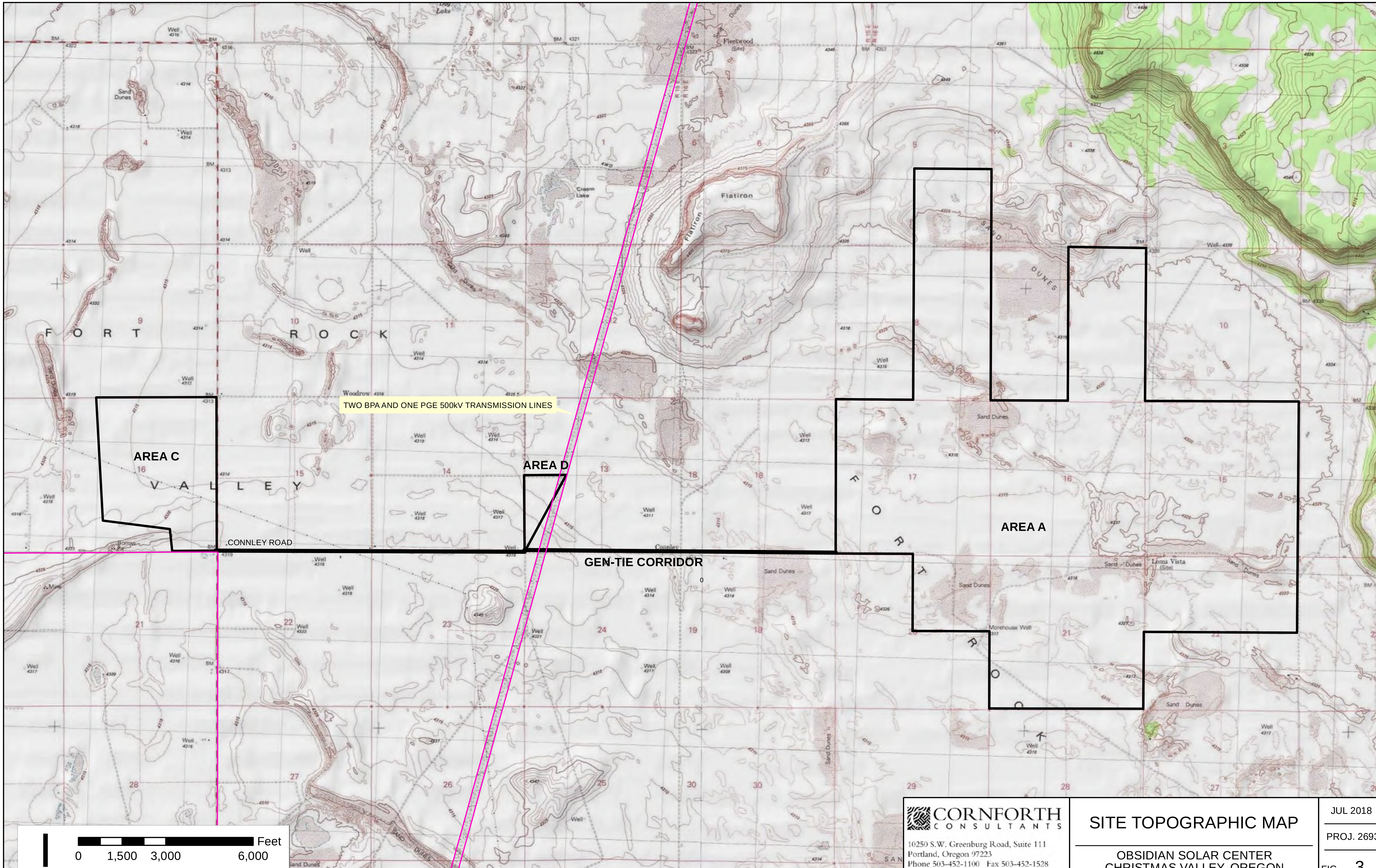
FIG. 2



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SITE TOPOGRAPHIC MAP

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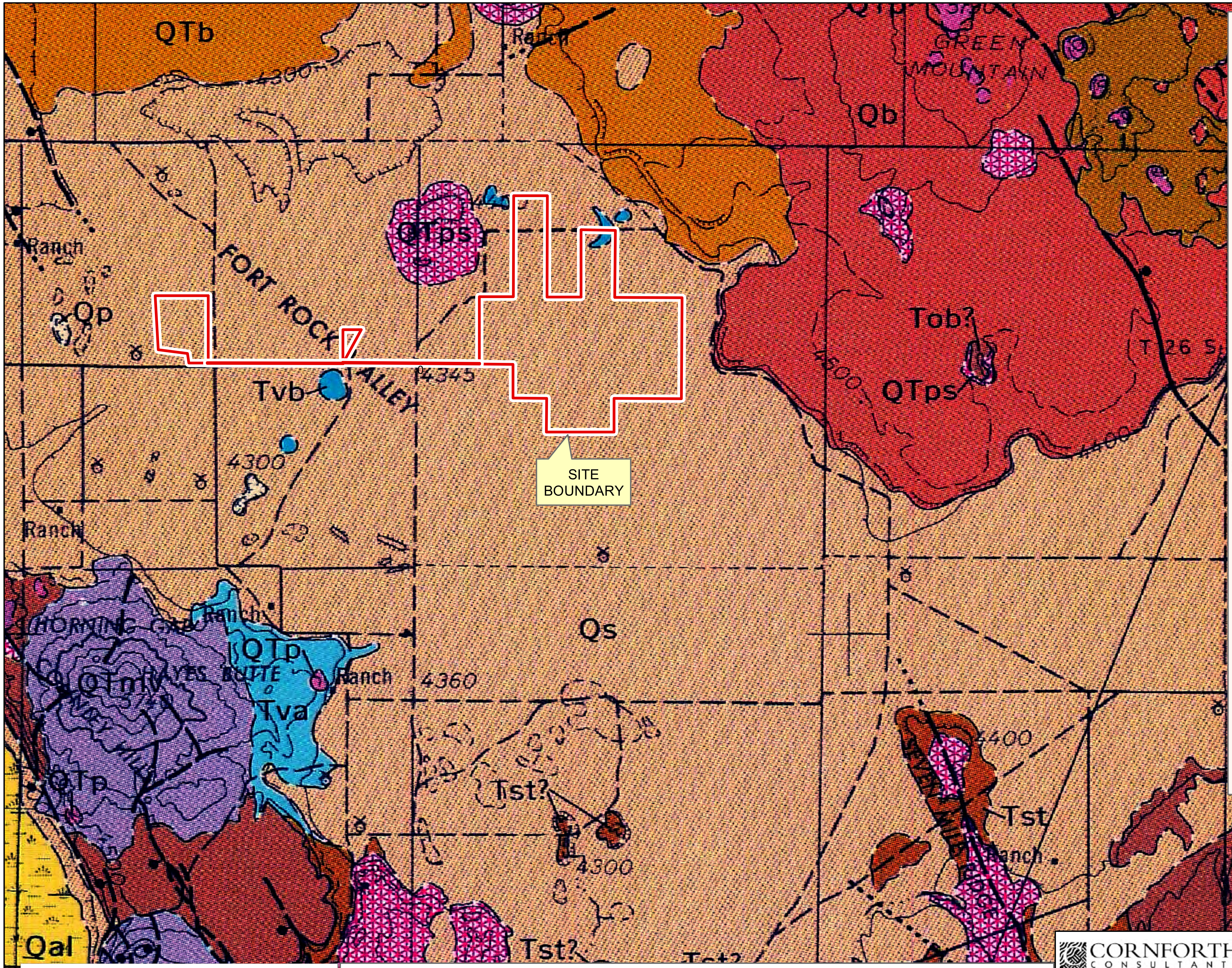
FIG. 3



LEGEND

GEOLOGIC UNITS IN AND NEAR SITE BOUNDARY

Qsb | Qs | Qb

Sedimentary rocks and basalt flows

Qs, *lacustrine, fluviatile, and aeolian tuffaceous sedimentary rocks, some ash-fall deposits, an ash flow tuff on northwest edge of area, and unconsolidated ash, pumice, clay, sand, silt, and gravel. Locally contains discontinuous layers of poorly consolidated pebbly conglomerate. In places contains Pleistocene mammalian fossils and remains of birds and fish (Elftman, 1931; Allison, 1941). Includes some post-pluvial (altithermal?) aeolian deposits composed largely of silt and pumice fragments. Correlative, in part, to "valley fill" of Piper, Robinson, and Park (1939) and to Pliocene and Pleistocene "sedimentary deposits" of Walker (1963) and Walker and Repenning (1965)*

QTp | QTps

Pyroclastic rocks of basaltic cinder cones

QTp, *subareal deposits of unconsolidated, reddish, fine to coarse scoriaceous basaltic ejecta. Some cones modified by erosion to low, rounded hills with slopes of cindery red soil that contains sparse bombs and bomb fragments. Age, Miocene (?), Pliocene, and Pleistocene or Recent*

QTps, *subaqueous deposits of partly consolidated yellowish-brown palagonitized basaltic ejecta; occur as palagonitic tuff and breccia cones and rings surrounding maare and, in a few places, as tuff ridges*

QTb

Basalt flows

Mostly diktytaxitic basalt, commonly vesicular or scoriaceous, but locally dense or platy; generally nonporphyritic; only slightly deformed with dips generally less than 5°. Includes early shield-forming basalt flows of Newberry Volcano (Williams, 1935, p. 259). Age, late Pliocene and Pleistocene

Tva | Tvb

Volcanic rocks

Tva, *thin, commonly platy, locally scoriaceous andesite and dacite (?) flows. Age, Pliocene (?)*

Tvb, *thin, discontinuous basalt flows*

0 4,000 8,000 16,000 Feet

SOURCE: RECONNAISSANCE GEOLOGIC MAP OF THE EAST HALF OF THE CRESCENT QUADRANGLE LAKE, DESCHUTES, AND CROOK COUNTIES, OREGON
WALKER, PETERSON, GREEN, 1967, USGS MAP I-493, 1:250,000

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VICINITY GEOLOGY MAP

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CHRISTMAS VALLEY, OREGON

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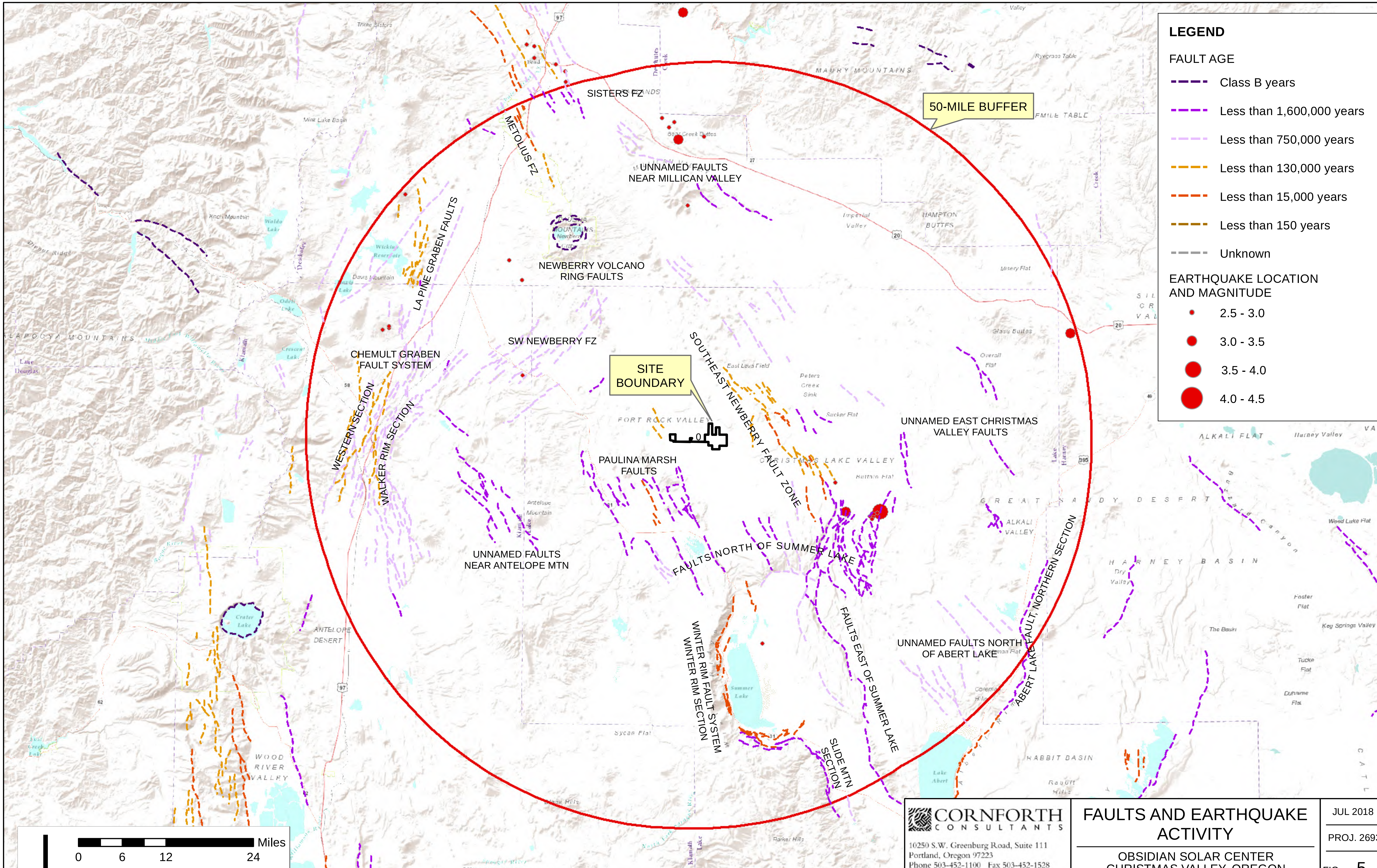
FIG. 4



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FAULTS AND EARTHQUAKE ACTIVITY

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CHRISTMAS VALLEY, OREGON

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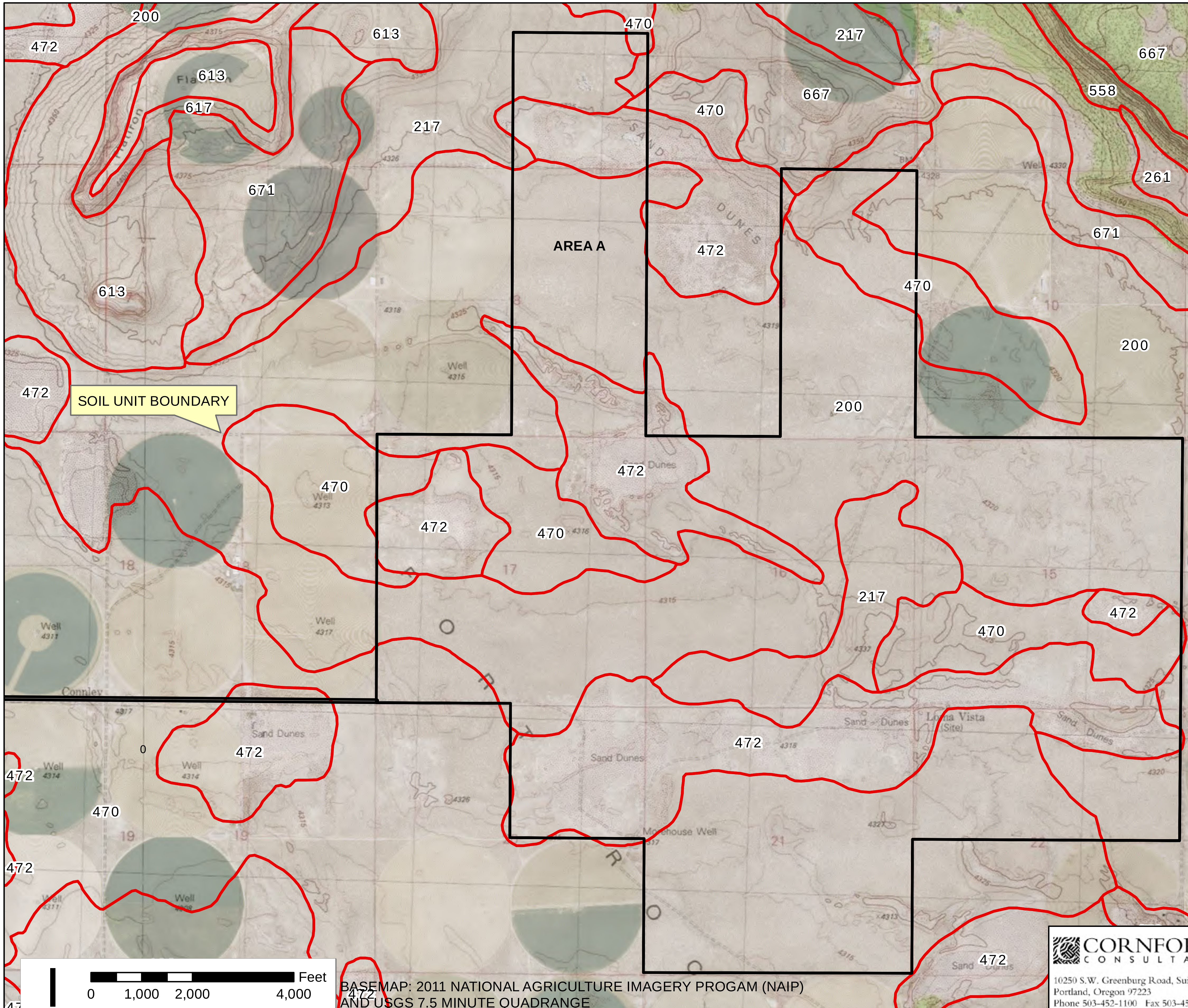
FIG. 5



BASEMAP: 2011 NATIONAL AGRICULTURE IMAGERY PROGAM (NAIP) AND USGS 7.5 MINUTE QUADRANGE

AREA SOIL UNITS

200 - Abert ashy loamy sand, 0-2% slopes
Lakebed deposits comprised of eolian deposits derived from volcanic ash over lacustrine deposits derived from mixed volcanic rock and volcanic ash. Very deep to bedrock, 18-30% clay content, LL:15-40, PI: NP-20. USCS: SM, SP-SM, CL.

217 - Bonnick-Fort Rock complex, gravelly, ashy loamy sand, 0-2% slopes
Lake terrace deposits comprised of pumiceous ash and volcanic ash over lacustrine deposits derived from mixed volcanic rock such as basalt or tuff. Very deep to bedrock, 2-10% clay content, LL:0-35, PI: NP-15. USCS: SP-SM, SP, SP-SC.

470 - Morehouse ashy loamy fine sand, 0-2% slopes
472 - Morehouse ashy loamy fine sand, 2-20% slopes
Dune on lakebed deposits comprised of volcanic ash and eolian sand derived from mixed volcanic rock over lacustrine deposits. Very deep to bedrock, 3-10% clay content, LL:0-35, PI: NP-15. USCS: CL, SC-SM, SP-SM, SM

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SOIL SURVEY MAP - AREA A

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CHRISTMAS VALLEY, OREGON

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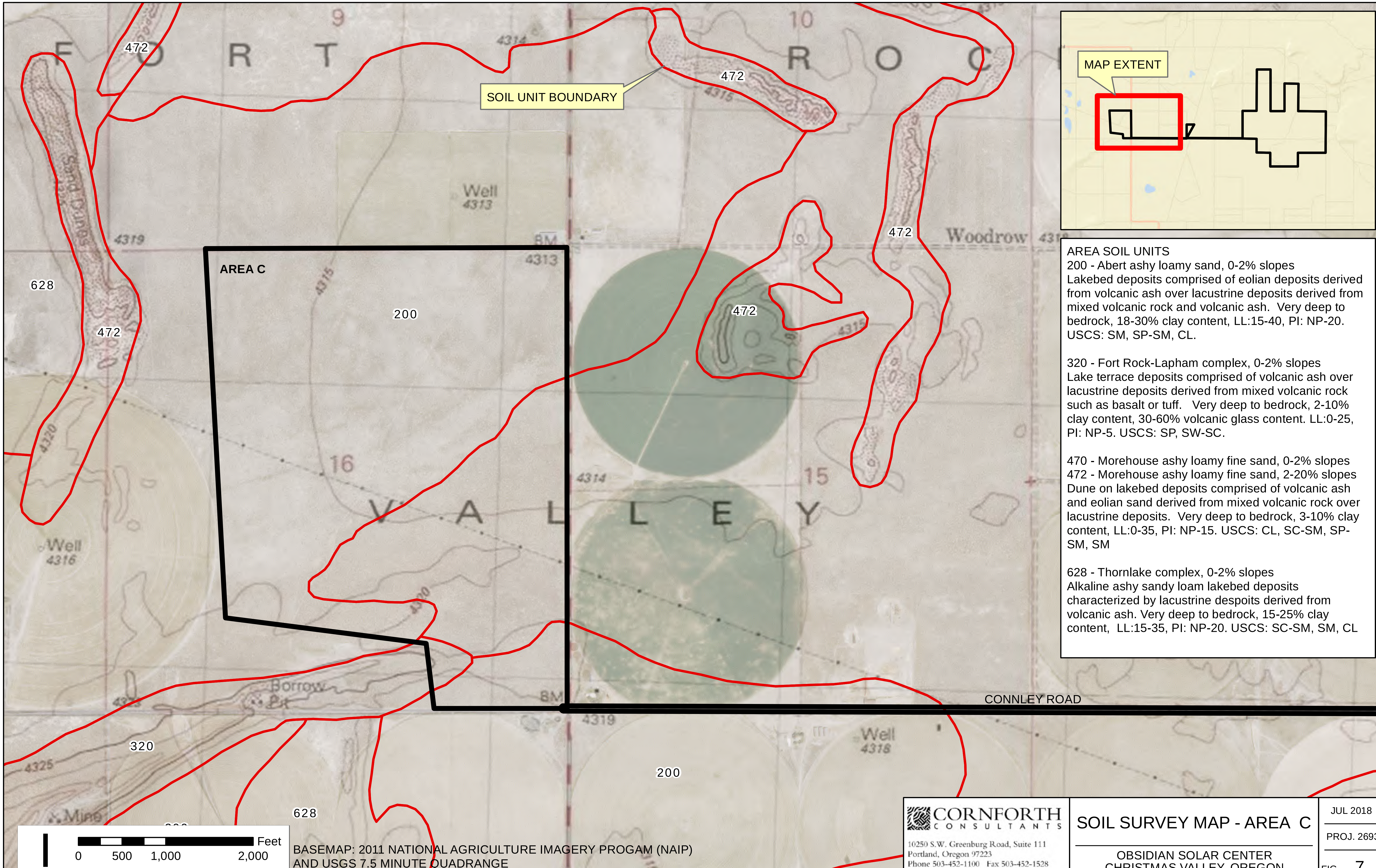
FIG. 6



AREA SOIL UNITS

200 - Abert ashy loamy sand, 0-2% slopes
Lakebed deposits comprised of eolian deposits derived from volcanic ash over lacustrine deposits derived from mixed volcanic rock and volcanic ash. Very deep to bedrock, 18-30% clay content, LL:15-40, PI: NP-20. USCS: SM, SP-SM, CL.

320 - Fort Rock-Lapham complex, 0-2% slopes
Lake terrace deposits comprised of volcanic ash over lacustrine deposits derived from mixed volcanic rock such as basalt or tuff. Very deep to bedrock, 2-10% clay content, 30-60% volcanic glass content. LL:0-25, PI: NP-5. USCS: SP, SW-SC.

470 - Morehouse ashy loamy fine sand, 0-2% slopes
472 - Morehouse ashy loamy fine sand, 2-20% slopes
Dune on lakebed deposits comprised of volcanic ash and eolian sand derived from mixed volcanic rock over lacustrine deposits. Very deep to bedrock, 3-10% clay content, LL:0-35, PI: NP-15. USCS: CL, SC-SM, SP-SM, SM

628 - Thornlake complex, 0-2% slopes
Alkaline ashy sandy loam lakebed deposits characterized by lacustrine despoits derived from volcanic ash. Very deep to bedrock, 15-25% clay content, LL:15-35, PI: NP-20. USCS: SC-SM, SM, CL

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SOIL SURVEY MAP - AREA C

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CHRISTMAS VALLEY, OREGON

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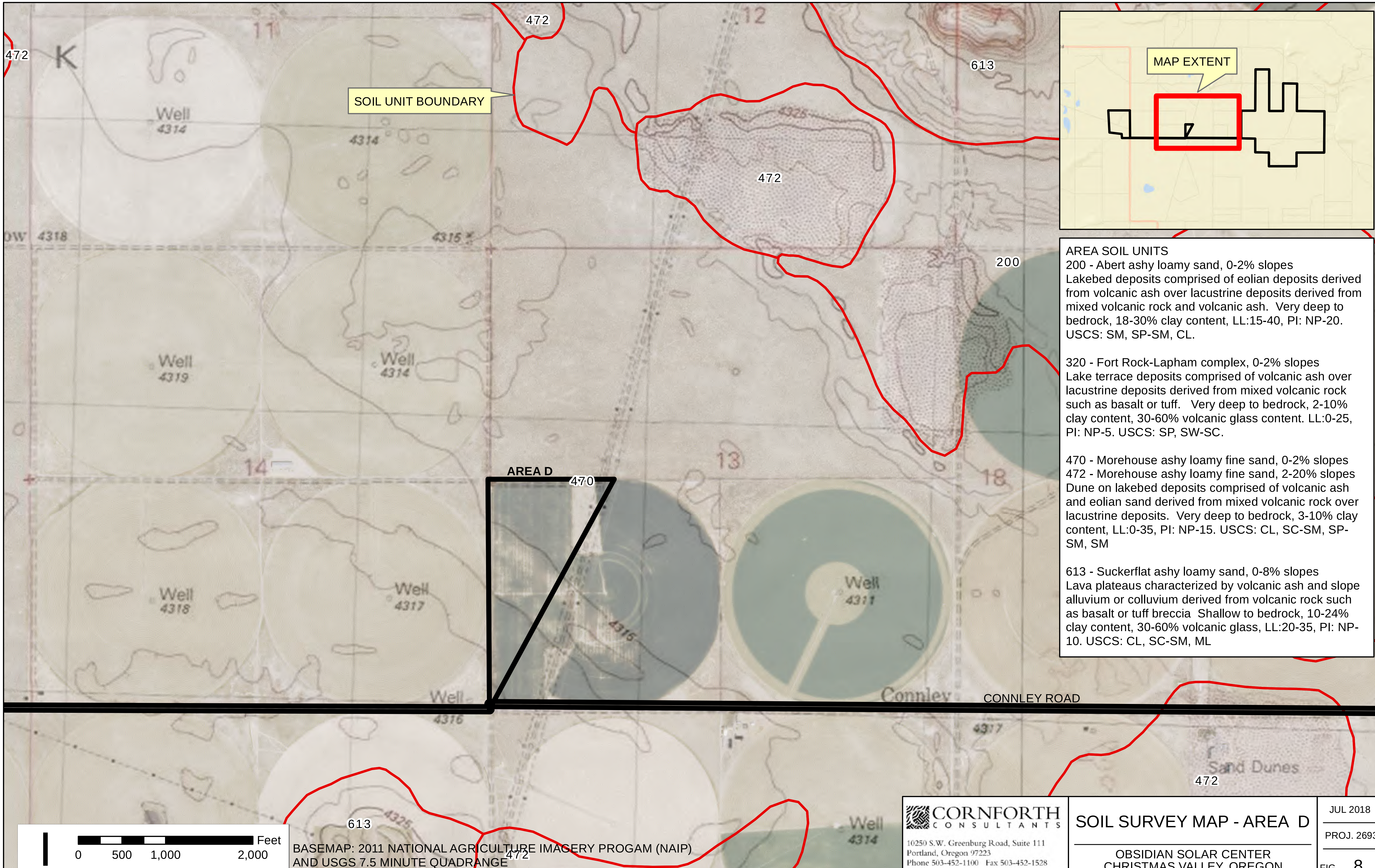
FIG. 7



AREA SOIL UNITS

200 - Abert ashy loamy sand, 0-2% slopes
Lakebed deposits comprised of eolian deposits derived from volcanic ash over lacustrine deposits derived from mixed volcanic rock and volcanic ash. Very deep to bedrock, 18-30% clay content, LL:15-40, PI: NP-20. USCS: SM, SP-SM, CL.

320 - Fort Rock-Lapham complex, 0-2% slopes
Lake terrace deposits comprised of volcanic ash over lacustrine deposits derived from mixed volcanic rock such as basalt or tuff. Very deep to bedrock, 2-10% clay content, 30-60% volcanic glass content. LL:0-25, PI: NP-5. USCS: SP, SW-SC.

470 - Morehouse ashy loamy fine sand, 0-2% slopes
472 - Morehouse ashy loamy fine sand, 2-20% slopes
Dune on lakebed deposits comprised of volcanic ash and eolian sand derived from mixed volcanic rock over lacustrine deposits. Very deep to bedrock, 3-10% clay content, LL:0-35, PI: NP-15. USCS: CL, SC-SM, SP-SM, SM

613 - Suckerflat ashy loamy sand, 0-8% slopes
Lava plateaus characterized by volcanic ash and slope alluvium or colluvium derived from volcanic rock such as basalt or tuff breccia Shallow to bedrock, 10-24% clay content, 30-60% volcanic glass, LL:20-35, PI: NP-10. USCS: CL, SC-SM, ML

BASEMAP: 2011 NATIONAL AGRICULTURE IMAGERY PROGAM (NAIP) AND USGS 7.5 MINUTE QUADRANGE

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SOIL SURVEY MAP - AREA D

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CHRISTMAS VALLEY, OREGON

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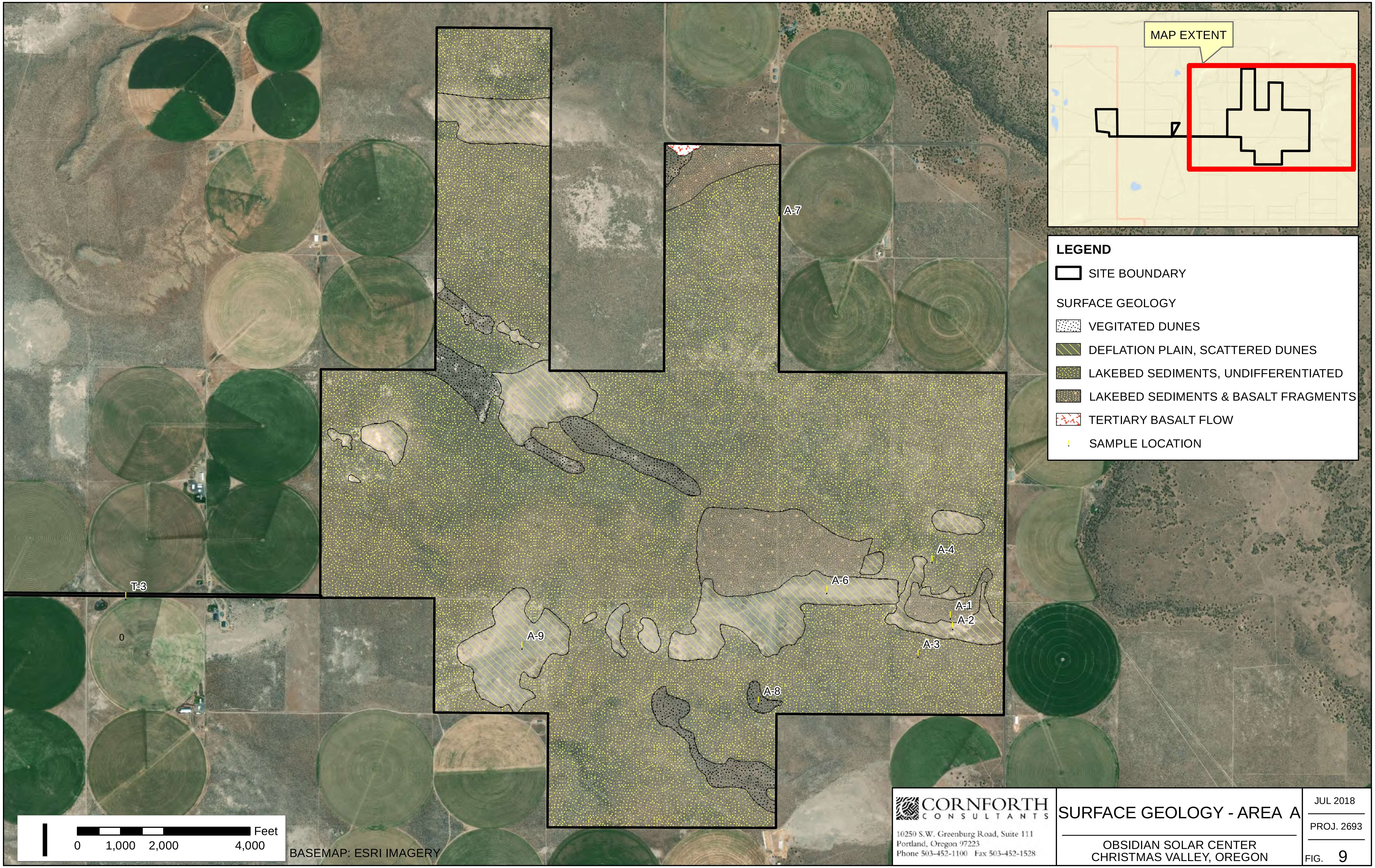
FIG. 8



MAP EXTENT
LEGEND
SITE BOUNDARY
SURFACE GEOLOGY
VEGITATED DUNES
DEFLATION PLAIN, SCATTERED DUNES
LAKEBED SEDIMENTS, UNDIFFERENTIATED
LAKEBED SEDIMENTS & BASALT FRAGMENTS
TERTIARY BASALT FLOW
SAMPLE LOCATION
A-7
A-4
A-6
A-1
A-2
A-3
A-9
A-8
T-3
0
Feet
0 1,000 2,000 4,000
BASEMAP: ESRI IMAGERY
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SURFACE GEOLOGY - AREA A
OBSIDIAN SOLAR CENTER
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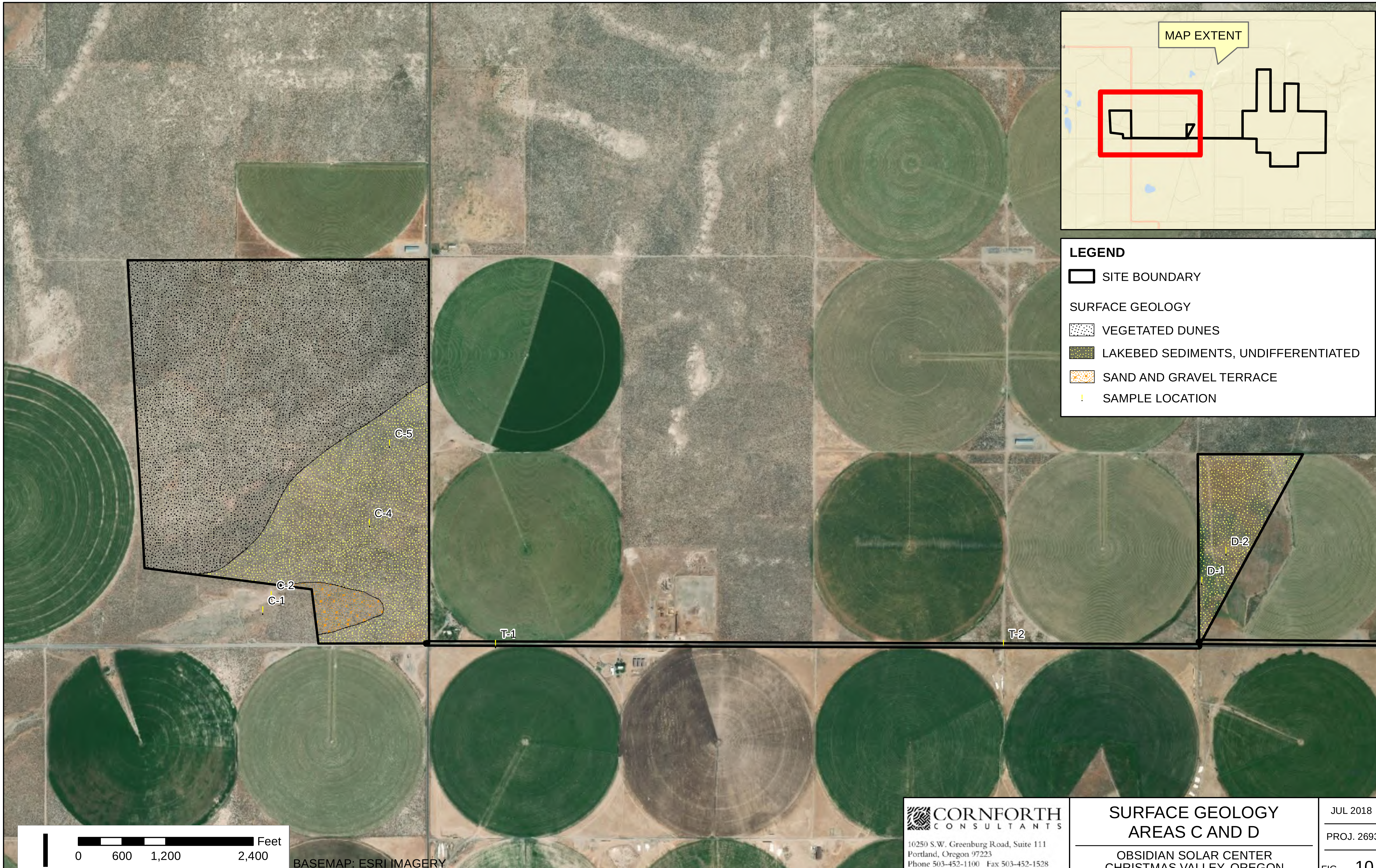
FIG. 9



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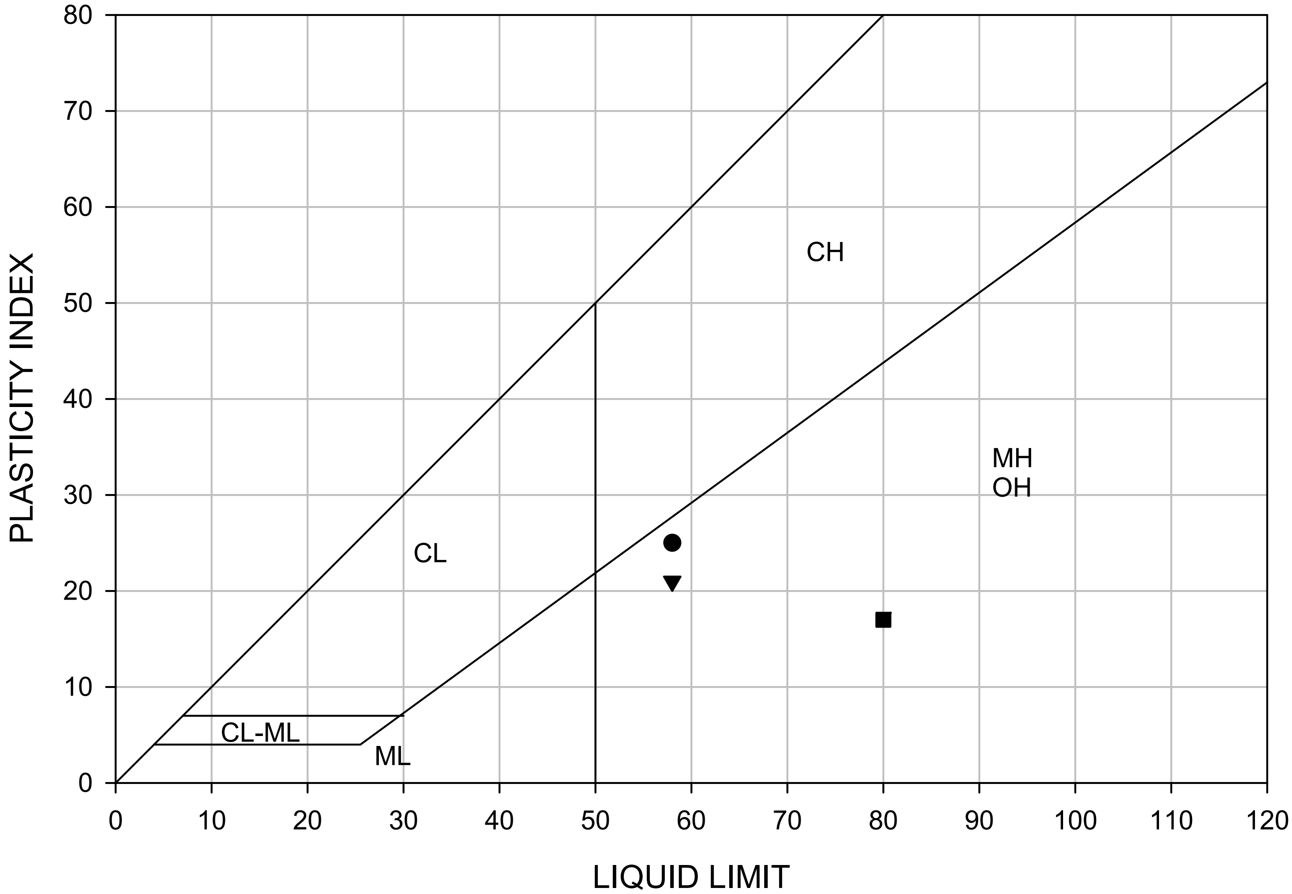
SURFACE GEOLOGY
AREAS C AND D

OBSIDIAN SOLAR CENTER
CHRISTMAS VALLEY, OREGON

JUL 2018

PROJ. 2693

FIG. 10



Symbol	Sample No.	Depth
●	A-9 (A)	Surface
▼	A-9 (B)	Surface
■	C-2	Surface

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PLASTICITY CHART

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CHRISTMAS VALLEY, OREGON

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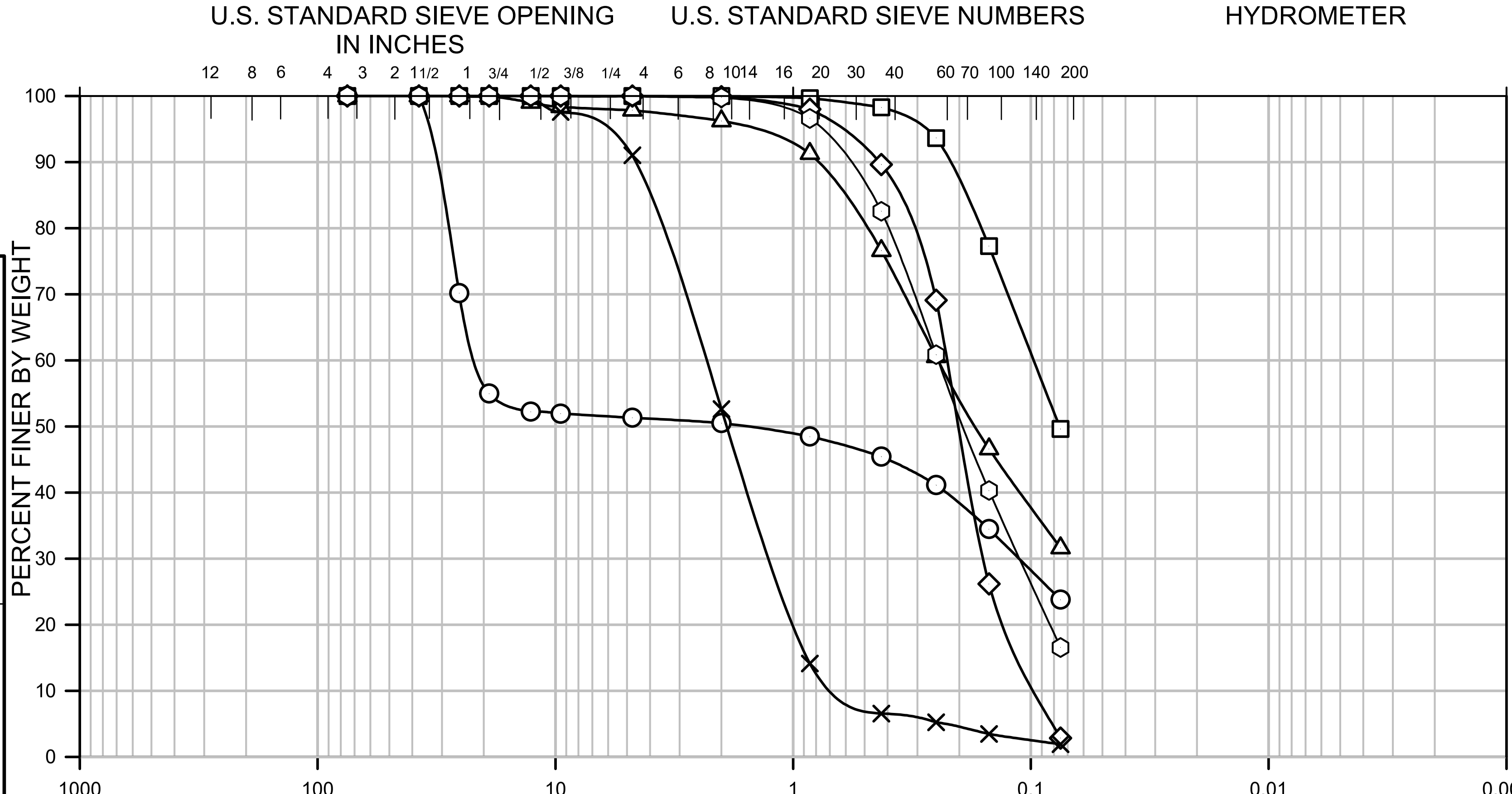
FIG. 11



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

Symbol	Sample No.	Depth	Classification	Nat W%	LL	PL	PI
○	A-2	Surface	Well-graded GRAVEL with sand and silt (GW-GM)	6	-	-	-
△	A-4	Surface	Well-graded SAND with silt (SW-SM)	13	-	-	-
□	A-6	Surface	Clayey SILT with sand (MH)	22	-	-	-
◇	A-8	Surface	Well-graded SAND (SW)	6	-	-	-
×	C-1	Surface	Well-graded SAND (SW)	4	-	-	-
⬡	D-1	Surface	Silty SAND (SM)	3	-	-	-

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GRADATION GRAPH

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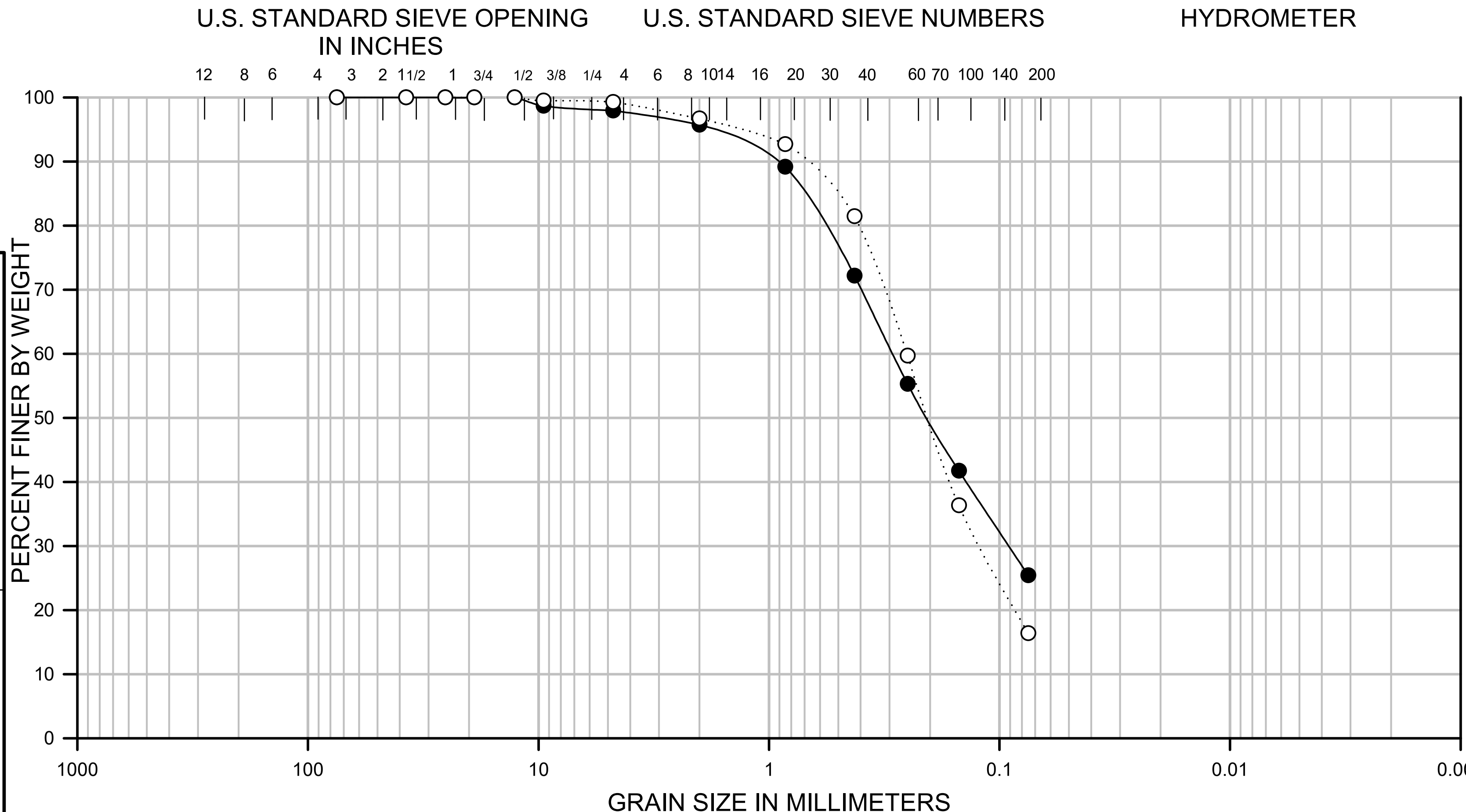
FIG. 12A



COBBLES	GRAVEL		SAND			FINES	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay

Symbol	Sample No.	Depth	Classification	Nat W%	LL	PL	PI
●—	T-1	Surface	Silty SAND (SM)	10	-	-	-
···○···	T-3	Surface	Silty SAND (SM)	6	-	-	-
					-	-	-
					-	-	-
					-	-	-
					-	-	-

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GRADATION GRAPH

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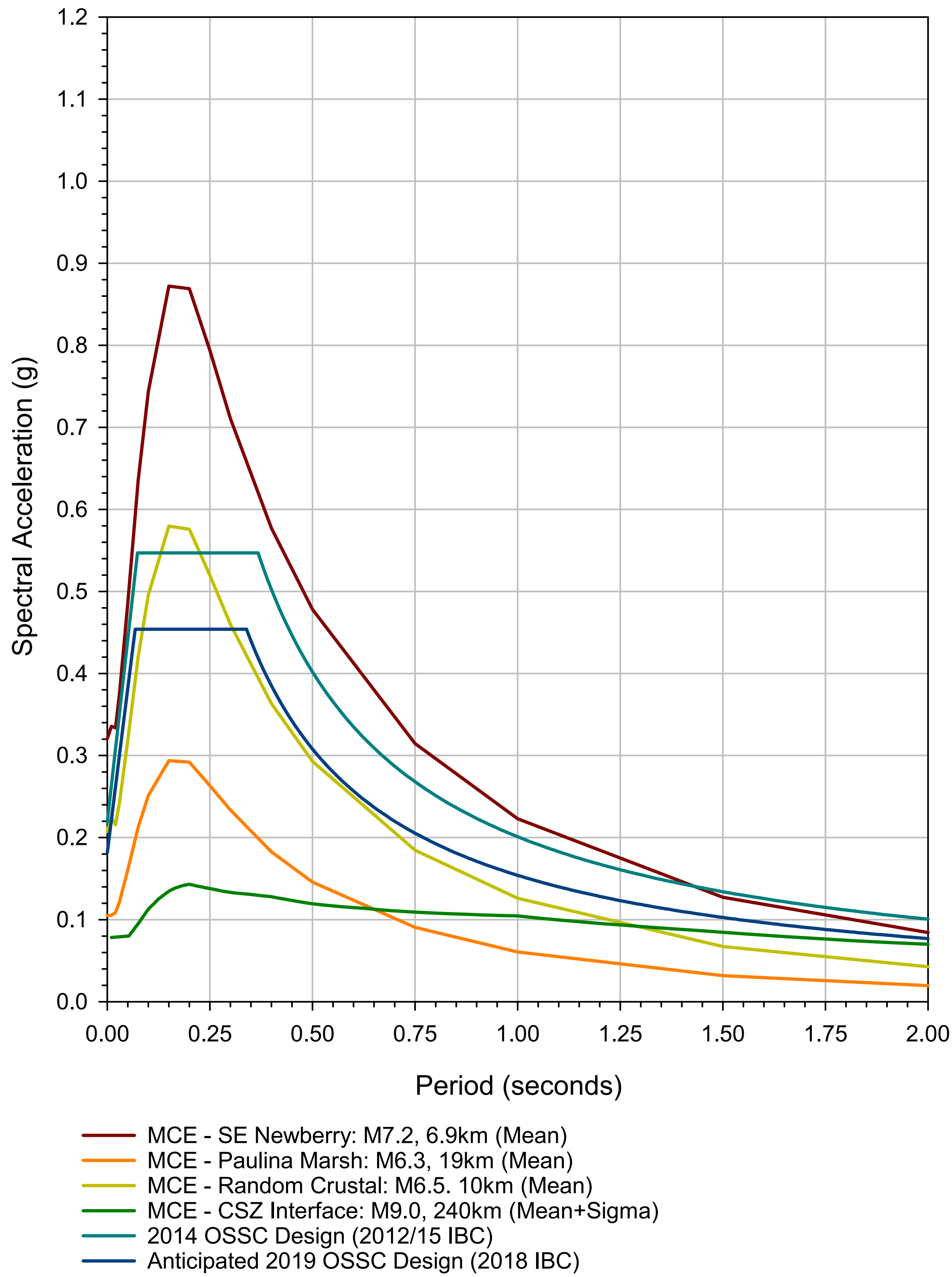
FIG. 12B



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MCE RESPONSE SPECTRA
SITE CLASS B

OBSIDIAN SOLAR CENTER
CHRISTMAS VALLEY, OREGON

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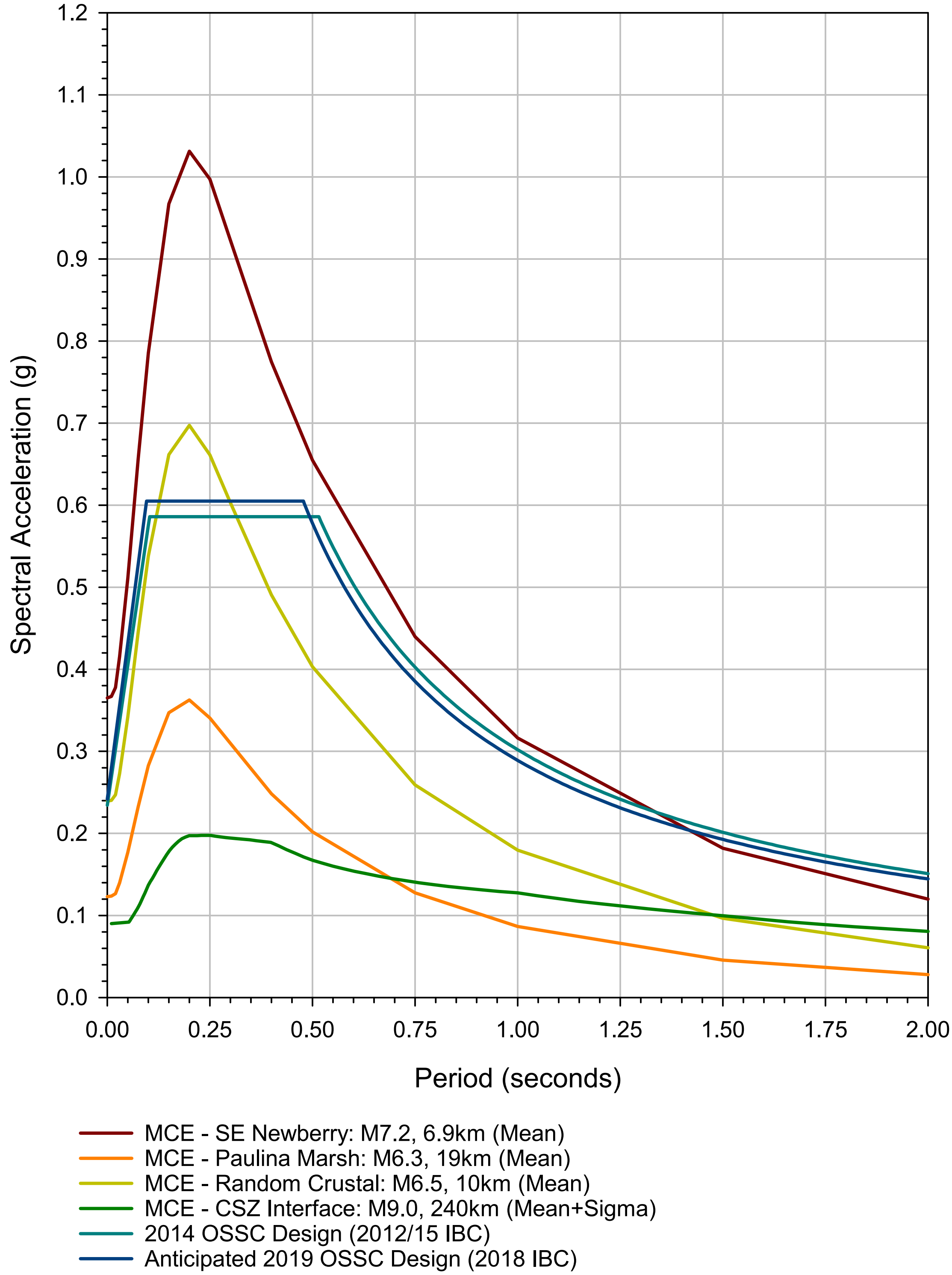
FIG. 13



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MCE RESPONSE SPECTRA
SITE CLASS C

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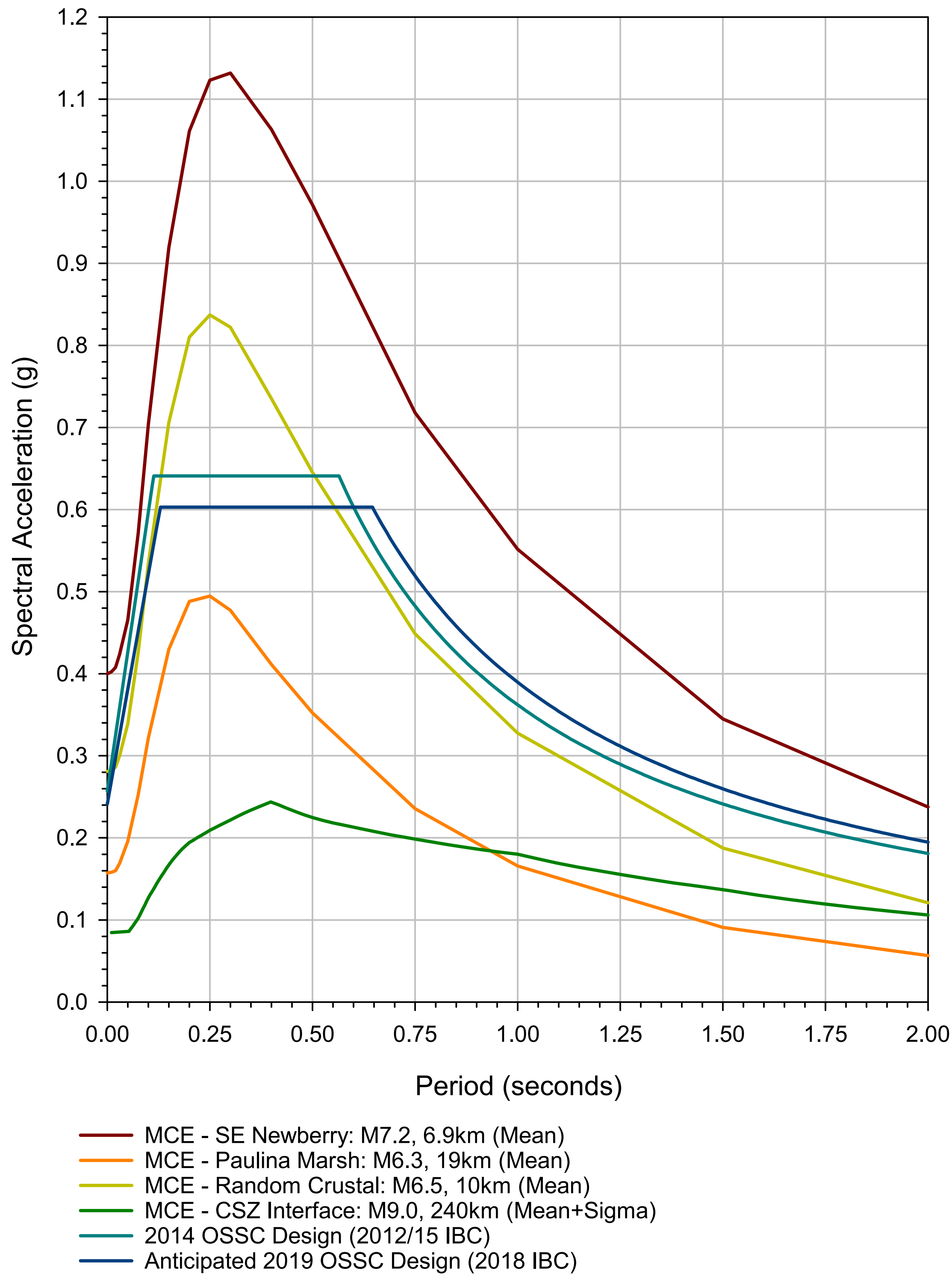
FIG. 14



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MCE RESPONSE SPECTRA SITE CLASS D

OBSIDIAN SOLAR CENTER
CHRISTMAS VALLEY, OREGON

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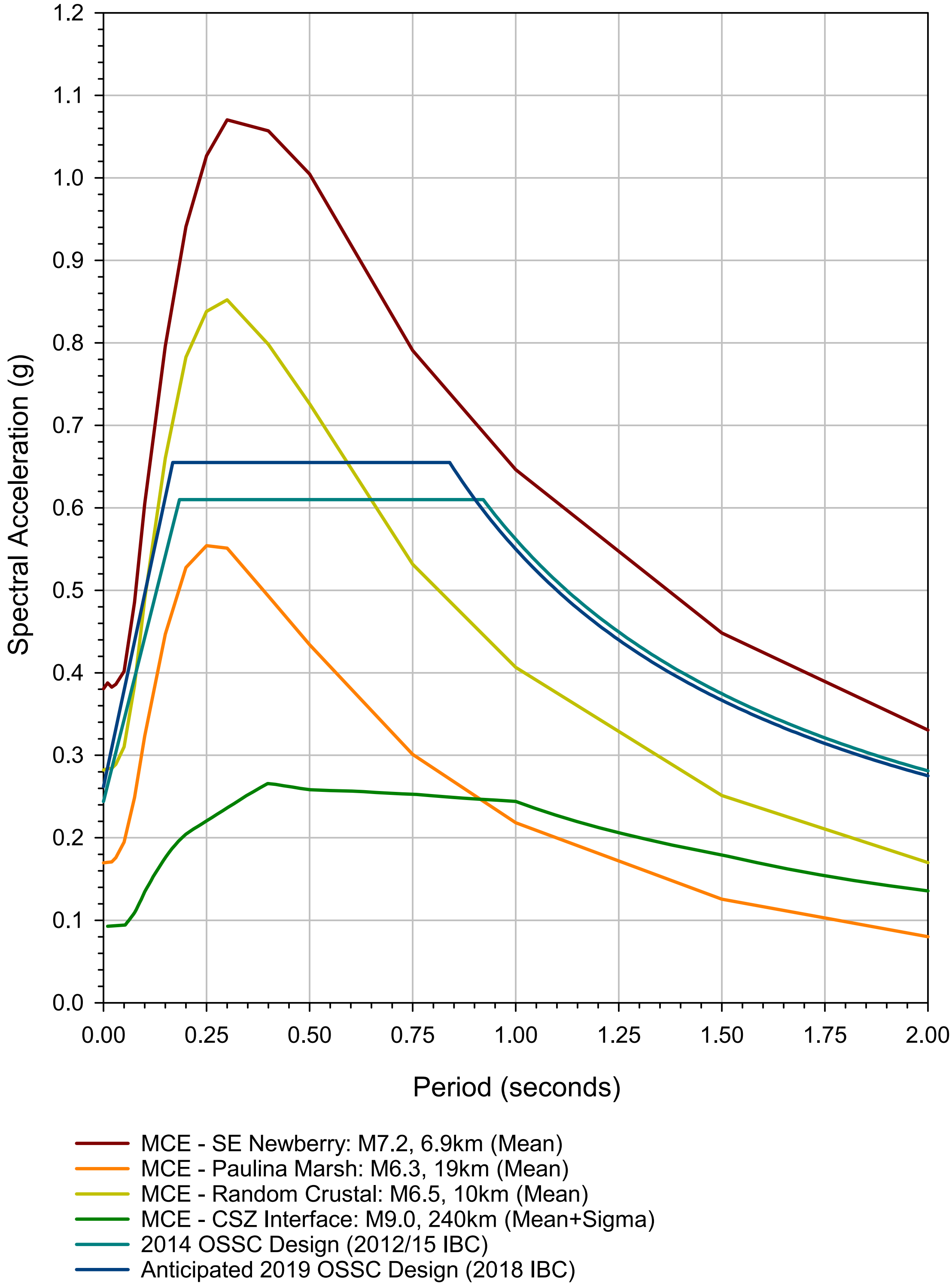
FIG. 15



CORNFORTH CONSULTANTS 10250 S.W. Greenburg Road, Suite 111 Portland, Oregon 97223 Phone 503-452-1100 Fax 503-452-1528	MCE RESPONSE SPECTRA SITE CLASS E OBSIDIAN SOLAR CENTER CHRISTMAS VALLEY, OREGON	JUL 2018 PROJ. 2693 FIG. 16

Appendix H-2
Oregon Department of Geology and Mineral Industries (DOGAMI) Correspondence with Applicant

Darren Beckstrand, Cornforth Consultants

From: WANG Yumei * DGMI <Yumei.WANG@oregon.gov>
Sent: Tuesday, June 12, 2018 11:14 AM
To: Nieuwenhuizen, Ilja
Cc: Michelle Slater; elainealbrich@dwt.com; Darren Beckstrand, Cornforth Consultants; TARDAEWETHER Kellen * ODOE; WANG Yumei * DGMI
Subject: RE: Obsidian Solar Center - Summary of Consultation Call with DOGAMI on June 6, 2018

Hi Ilja,

DOGAMI agrees with your below summary notes of our June 6, 2018 consultation with the below 6 comments (in red).

If you have any questions, please let me know. Thanks.

Yumei

Yumei Wang, P.E. | Geotechnical Engineer
Oregon Department of Geology and Mineral Industries (DOGAMI)
800 NE Oregon Street, Suite 965, Portland, Oregon 97232
Office: (971) 673-1551 | Mobile: (503) 913-5749
yumei.wang@oregon.gov | www.oregongeology.org

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From: Nieuwenhuizen, Ilja [mailto:INieuwenhuizen@ene.com]
Sent: Friday, June 08, 2018 3:58 PM
To: WANG Yumei * DGMI <Yumei.WANG@oregon.gov>
Cc: Michelle Slater <mslater@obsidianrenewables.com>; elainealbrich@dwt.com; Darren Beckstrand, Cornforth Consultants <dbeckstrand@CornforthConsultants.com>
Subject: Obsidian Solar Center - Summary of Consultation Call with DOGAMI on June 6, 2018

Hi Yumei,

Thank you for taking the time on June 6, 2018, to discuss the proposed Obsidian Solar Center (OSC) and confirm Obsidian Solar Center, LLC's (the Applicant's) approach for the OSC geological analysis and Exhibit H of the EFSC Application for Site Certificate (ASC). This email summarizes the call and confirms DOGAMI's acceptance of the Applicant's approach.

Project Description

As described on the call, the Applicant is proposing to design, construct, and operate an up to 600 megawatt (MW) photovoltaic solar power generation facility in the Christmas Valley area of Lake County, Oregon. Ecology and Environment, Inc., along with their subcontractor Cornforth Consultants, Inc. (Cornforth), are preparing the technical studies and analysis needed for Exhibit H of the preliminary ASC. The Applicant is considering several design and technology options for the OSC, including the option to include battery storage technology. The current OSC site boundary is approximately 7,000 acres to allow for flexibility in final designs.

Facility components include solar arrays—rows of photovoltaic solar panels (or modules) mounted on racks and tracking systems—that are supported by galvanized steel posts approximately 4 feet above ground level; post depth will vary depending on soil conditions, but is often ~~4 to 5~~ YW comment 1: during our consultation, the Applicant stated 5-7 ft feet deep. In addition, the facility would include one main substation at the point of interconnection with an existing 500-kilovolt (kV) transmission line, up to four smaller collector substations, inverter pads, at least one operation & maintenance building, a 115 kV transmission line to deliver electricity to the main substation, and, potentially, battery storage buildings.

Battery storage is a newer technology that many renewable developers are considering when designing wind and solar projects. If the Applicant opts to add battery storage to the OSC, the Applicant proposes to use flow technology batteries, not lithium batteries. Flow batteries would consist of cell stacks with large polymer tanks on either side that contain water-based electrolyte fluid. The electrolyte fluid would be non-toxic, non-flammable, and thermally stable YW comment 2: this is unclear to me and does not capture the discussions in our consultation. During our consultation, the Applicant said that temperature control of the battery storage building with cooling and insulation would be necessary. If cooling is needed as part of being "thermally stable", please explain that in the forthcoming Exhibit H. Include proposed actions for power outages. Conversely, if no temperature control is needed, please explain that. Each battery storage unit would have secondary spill containment. The batteries would be housed in enclosures (steel-framed or wood-framed buildings up to approximately 30 feet tall each) in either a distributed layout with a low number of batteries per enclosure, or a concentrated layout with many or all batteries in one or several enclosures.

Applicant's Proposed Geotechnical Approach for Exhibit H

The Applicant presented the following approach for Exhibit H to DOGAMI:

- Cornforth will review available seismic, geologic, and soil data regarding the Christmas Valley area, the area within and around the specific facility site, and Lake County generally.
- Cornforth will perform a geologic reconnaissance of the site to collect information to confirm and develop the site description, site characterization based on surface features and reasonable expectations of subsurface conditions and materials, and assessment of exposed geologic features. No borings or other subsurface exploration will be conducted at this time. YW comment 3: during our consultation, we discussed seismic analyses using a range of estimated soil conditions, which is necessary due to the absence of actual subsurface soil property data. Also, DOGAMI commented that subsurface explorations including borings would be needed at a later date as part of the EFSC process.

Applicant's Proposed Geotechnical Approach for Pre-Construction

The Applicant presented the following approach for pre-construction work and concepts for site certificate conditions to DOGAMI:

- The Applicant will comply with the most current International Building Code (IBC) as modified by the current Oregon Structural Specialty Code (OSSC) and local building codes in effect at the time of construction. At this time, the most current codes are IBC 2018 and OSSC 2014, but it appears that the OSSC may be updated prior to construction (e.g., in late 2018 or in 2019). The applicable building and electrical codes are designed to ensure minimization of risk of hazards to human and environmental assets. In addition, the main substation (at the point of interconnection) would be required to comply with all geotechnical requirements issued by the electric utility, which are micro-site specific and consistent with applicable and specific electrical and building codes.
- Using the final facility design (when the precise locations of the substations, battery enclosures, and/or other facility components are determined), the Applicant will comply with applicable utility and code

requirements, including any required subsurface investigations. YW comment 4: Does the final facility design include the foundation design? According to DOGAMI, the final foundation design cannot be completed without any subsurface exploration.

- The Applicant expects that compliance with these codes, including subsurface evaluations as directed by the regulated utility, will be included as conditions of approval in the site certificate. YW comment 5: DOGAMI, as part of the EFSC process, may find that additional subsurface evaluations that have not been directed by the regulated utility may be necessary.

Applicant's Understanding of DOGAMI's Feedback

The Applicant appreciates DOGAMI's questions and discussion during the call and confirms the following takeaways:

- The Exhibit H geotechnical study will use state guidelines, which is the state's standard of practice.
- It is acceptable for the Applicant to defer borings and other subsurface exploration until later, once the final facility design has been completed. YW comment 6: Refer to the above YW comments 3 and 4.
- The June 6 call constitutes the Applicant's required consultation with DOGAMI for the preliminary ASC and Exhibit H. The Applicant provided DOGAMI with an email and memorandum prior to the call to inform the discussion and documents the discussion with this email.
- In Exhibit H, the Applicant will address the potential impacts on the facility (and project resilience) that may result from natural disasters or future climate conditions, including, but not limited to, drought, flooding, etc.

Thank you again for your time. If I have not captured our discussion and understanding correctly, please let me know. Obsidian looks forward to continued coordination with DOGAMI as the project moves forward.

Regards,
Ilja

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Appendix H-3
Recorded Earthquakes Within 50 Miles

USGS EARTHQUAKE ARCHIVES OUTPUT

50 mile radius circle search

Site Location			
Latitude:	43.309	Longitude:	-120.829

*Distances calculated using Haversine formula (RE = 3958.756 mi)

Date	Latitude N	Longitude W	Depth (mi)	Magnitude	*Radial Distance
10/26/15	43.529	-121.723	5.8	2.9	47.4
10/24/15	43.532	-121.723	0.7	2.8	47.4
12/25/13	43.229	-120.505	7.0	2.7	17.2
10/14/04	42.909	-120.702	1.4	2.5	28.4
07/20/01	43.525	-121.740	6.5	2.6	48.1
10/10/99	43.155	-120.405	4.5	2.6	23.9
05/06/99	43.160	-120.402	17.4	2.9	23.8
05/01/99	43.166	-120.405	18.6	2.5	23.5
04/28/99	43.166	-120.400	20.9	2.5	23.8
04/28/99	43.168	-120.391	22.3	3.0	24.1
04/28/99	43.171	-120.382	22.1	3.8	24.5
04/27/99	43.161	-120.411	14.6	3.0	23.4
09/20/91	43.171	-120.477	18.6	3.3	20.2