GOSEP

GOSEP: Georeferenced Oregon Soil Engineering Properties

USER MANUAL

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This document is based on the O-HELP 3D User Manual, Release v3.0 (Jung and Olsen 2020).

Development Team:
Current Release: Tifong Chin, T. Matthew Evans
Prior Release: Victoria Dutille, T. Matthew Evans, Jaehoon Jung, Michael J. Olsen
School of Civil and Construction Engineering, College of Engineering

Oregon State University

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INTRODUCTION

This is a user manual for the GOSEP (Georeferenced Oregon Soil Engineering Properties) 3D website, which is a user-friendly, web-based 3D geographic information system (GIS) tool to assess Oregon soil engineering properties and geotechnical site investigations, developed with support from the Cascadia Lifelines Program (CLiP, https://cascadia.oregonstate.edu/). The website contains previous boreholes, in situ and laboratory tests of Oregon soils in a powerful 3D web-based interface, which does not require the user to have extensive knowledge of GIS.

BACKGROUND

The Cascadia Subduction Zone (CSZ) is capable of generating a M9.0 earthquake that could greatly damage the built environment in Oregon. Such a powerful and long-lasting earthquake can generate severe ground shaking, landslides, liquefaction-induced ground deformations, fault rupture vertical displacement, tsunamis, etc. These seismic deformations will likely be considerably damaging to foundations, bridges, roadways, pipelines, and other lifelines.

Many of Oregon's lifeline providers, such as public and private entities responsible for transportation, electric and gas utilities, water and wastewater, fuel, airports, and harbors face an aging infrastructure that was built prior to a full understanding of this extreme seismic risk. Before GOSEP, the state of Oregon did not have a comprehensive record of subsurface site explorations that have been performed in the state. Subsurface data provides valuable insight to engineers, geologists and planners to guide decisions about infrastructure hardening, protection, and post-disaster redeployment. GOSEP compiles existing data across projects from all over the state, including monotonic strength, laboratory characterization data, borehole logs, and *in-situ* test results. The database is world viewable and searchable. GOSEP was constructed because, ultimately, more complete data sets facilitate better decision making.

INTENDED AUDIENCE

This tool is designed for engineers, planners, geologists, and others who need this information to help make appropriate decisions. It is assumed that the users have enough knowledge of geotechnical subsurface investigations to understand what the data means and how to use it appropriately. Minimal knowledge of GIS will be needed to work with this web-GIS tool.

Participants in the Project:

Participating organizations in CLiP include: the Oregon Department of Transportation (ODOT), Portland General Electric (PGE), Northwest Natural Gas (NWN), Portland Water Bureau (PWB), Port of Portland (PDX), Eugene Water and Electric Board (EWEB), Bonneville Power Administration (BPA) and Tualatin Valley Water District (TVWD). The Geotechnical research group in the School of Civil and Construction Engineering at Oregon State University manages this

website under the direction of CLiP. Specifically, the following persons from OSU (unless directed otherwise) have worked directly on this project since its inception:

- **Project management**: T. Matthew Evans, Michael Olsen, Armin Stuedlein.
- **WebGIS Version 2.0** (current) development and maintenance: Tifong Chin
- **WebGIS Version 1.0** development and maintenance: Victoria Dutille, Tifong Chin, Jaehoon Jung and Michael Olsen
- **Server support**, maintenance, and administration: Paul Montagne
- **Creation of data layers contained in GOSEP:**
    - **BPA:** Tifong Chin
    - **PDX:** Tifong Chin
    - **ODOT Region 1 Boreholes, ODOT Region 2 Boreholes, ODOT Region 3 Boreholes, ODOT Region 4 and 5 Boreholes:** Victoria Dutille, Tifong Chin
    - **Borehole Database of Oregon (BODO)**: May Shin Lyan, Nicholas Matthews, Ben Leshchinsky, and Michael Olsen.
    - **Geotech2**: Oregon State Facilities
    - **Buck Creek**: Victoria Dutille, Jiayao Wang, Ehsan Yazdani

DISCLAIMER

The Cascadia Lifelines Program (CLiP) and the Geotechnical research group in School of Civil and Construction Engineering at the Oregon State University work to ensure that the information provided on this website is accurate, timely, and useful. The information provided herein is for reference only and is not suitable as the sole source in engineering design and site-specific analysis; instead, it provides a starting point to identify and understand subsurface conditions and approximate locations where previous investigations have been conducted.

CLiP and the Geotechnical research group are not responsible for errors or omissions in information provided on this website. ***Any use of this website or the information available at this website is at your own risk and we will not be responsible for the consequences of your decision to utilize the information.***

Visitors are encouraged to confirm the information contained on this website with other reliable sources and agencies. Use and access to this website or any of the links contained within this website do not create an engineering consultant-client relationship. The linked websites are not under Geotechnical research group's control and the research group does not assume any responsibility or liability for any communication or materials available at such linked websites. Corrections, additions, and updates to this website will be made when necessary or as time permits.

PLATFORM

The web-GIS framework for GOSEP has been designed in ESRI's ArcGIS for Server (i.e., ArcServer) platform. ArcServer enables the use of several of ESRI's base layers, including aerial imagery, topographic maps, and road networks. While the primary interface is the GOSEP webGIS, the data layers may be streamed directly in GIS software. The Appendix contains instructions on how to access the layers.

TOOL FEATURES

Several features and tools in GOSEP (numbered in Figure 1) are defined individually below. GOSEP can simply be accessed via a web browser. (Although please note that some compatibility versions will occur with different browsers. Chrome is currently the preferred browser).

Figure 1: Outline view of the GOSEP website with various feature tools and their screen location.

1. Navigation widgets

The user can zoom in and out with the buttons + − or by using the mouse wheel.

The default navigation mode is always pan . The alternate navigation mode to toggle to is rotate . This allows the user to rotate the view with a mouse drag and pan the view with a right-click and drag gesture.

The Compass widget indicates where north is in relation to the current view rotation or camera heading. Clicking the Compass widget rotates the view to face north (heading = 0).

The Home Widget Quickly return to the map's default starting viewpoint using the Home button widget. The initial default view is the entire State of Oregon.

2. Time Slider

This widget allows the user to be able to visualize temporal data that falls within a time range. For instance, the user can view the data associated with the time range from 2010 to 2014 as shown in Figure 2. The data outside the range is not being shown. Be aware that the starting screen of the GOSEP web app shows all the data in the database; the user needs to select a time range if they want to see time-related data.

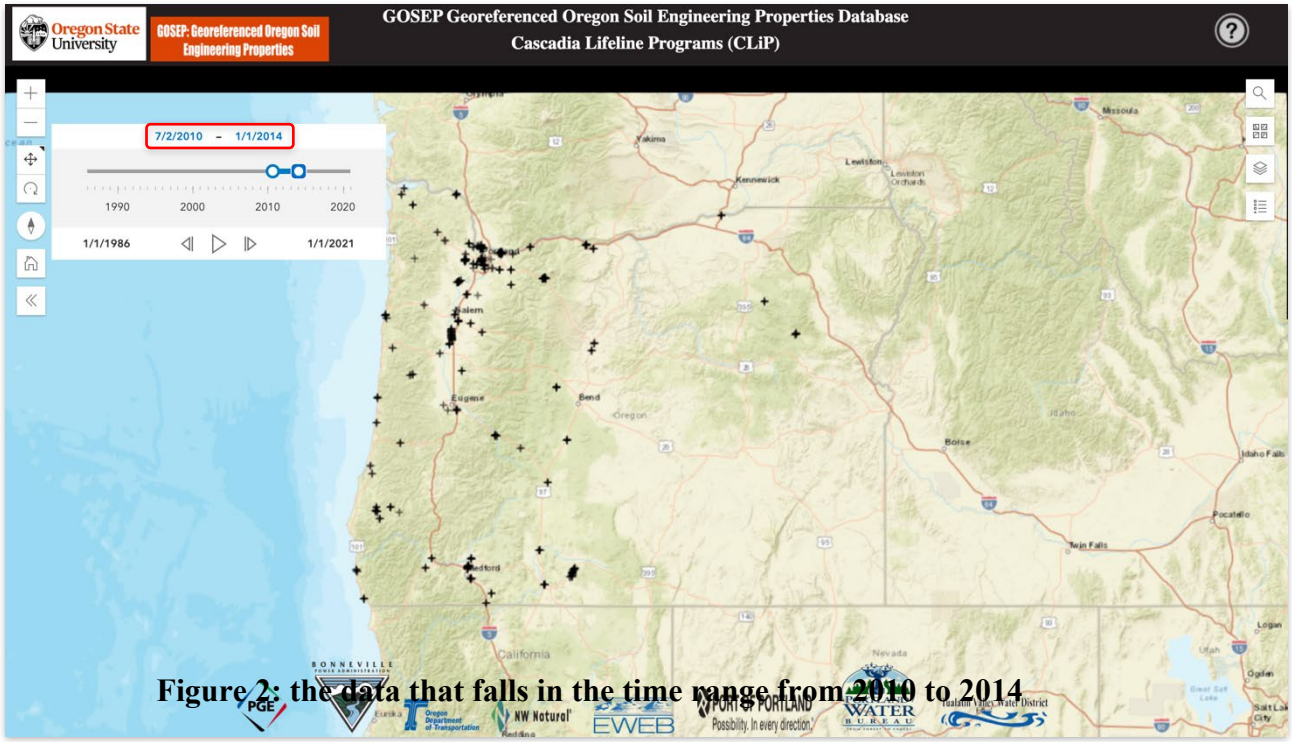

Figure 2: the data that falls in the time range from 2010 to 2014

3. Address Locator

This tool enables the user to search for a specific location by entering either geographic coordinates in longitude, latitude format, or by entering the address for a location of interest. Once the user inputs the search information, the locator will show the place by dropping a black point on the map. A window will then pop up in the map with the latitude and longitude information for that site (see Figure 3).

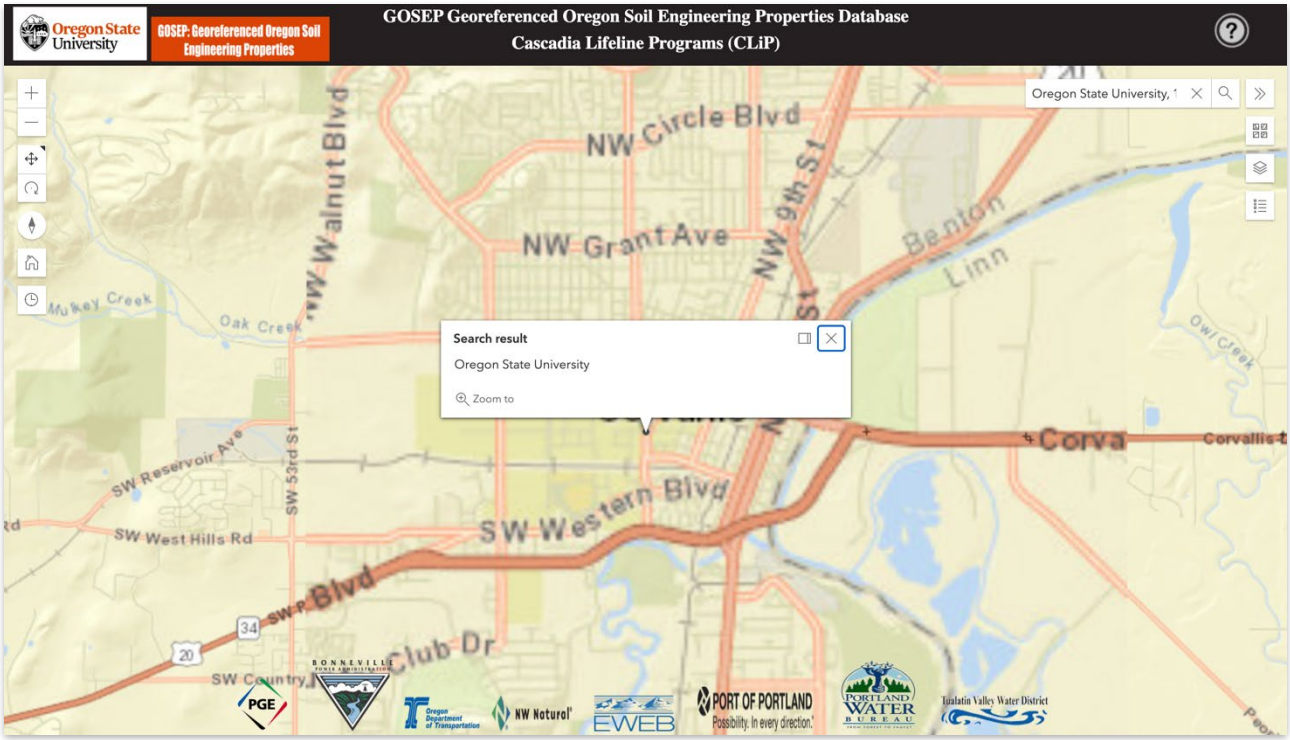

Figure 3: Pop up window representing the selected address, location, or latitude, longitude on the interactive map.

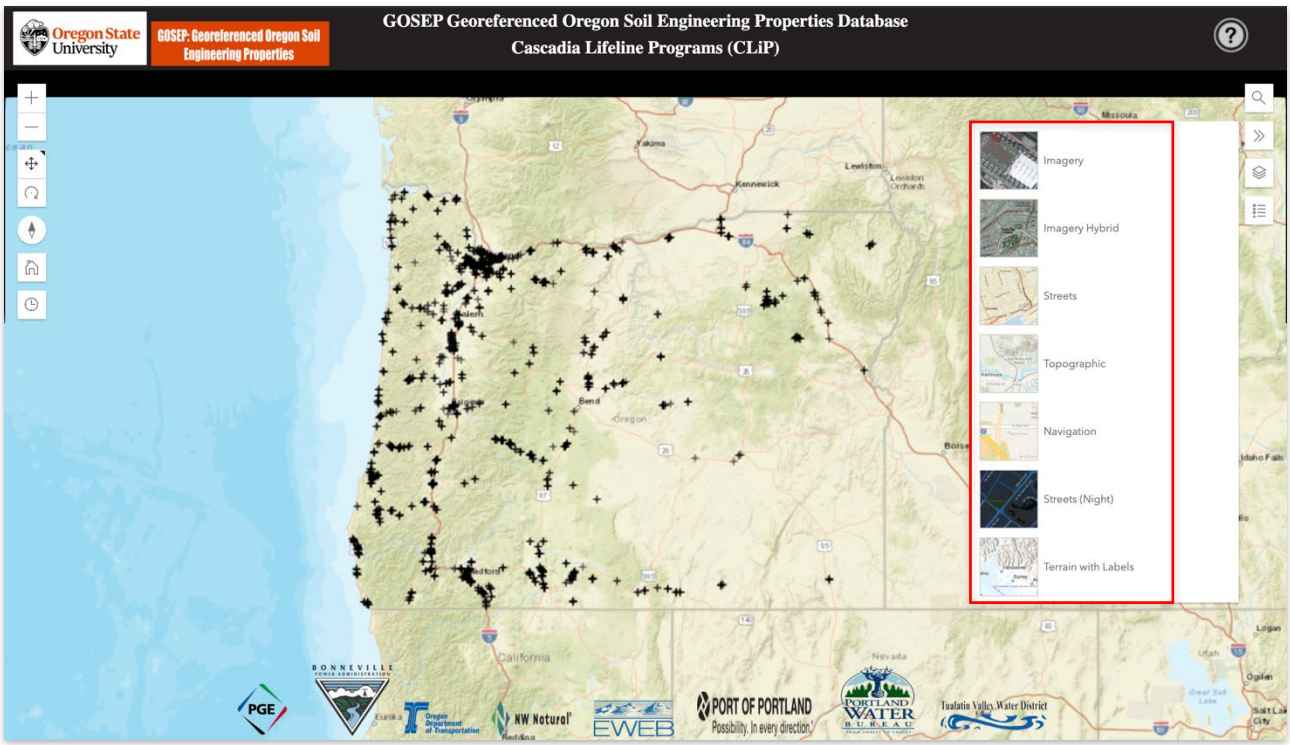

Figure 4: GOSEP database displayed the ESRI base map layers after clicking the base map gallery icon.

4. Base Map Gallery

After selecting this icon, there will be multiple base map layers as illustrated in Figure 4, for example ESRI Streets, Topography, Navigation, Terrain and Labels, and Light Gray Canvas, amongst others. The default base map layer is ESRI Streets, and the user can change the base map layer up to their preference.

5. Layers

When this icon is selected, a list of available layers will show up. Currently, there is only one additional layer, which is the Oregon Geologic Map (obtained from DOGAMI release 6), that the user can switch to. A more detailed discussion of the geologic map is presented below.

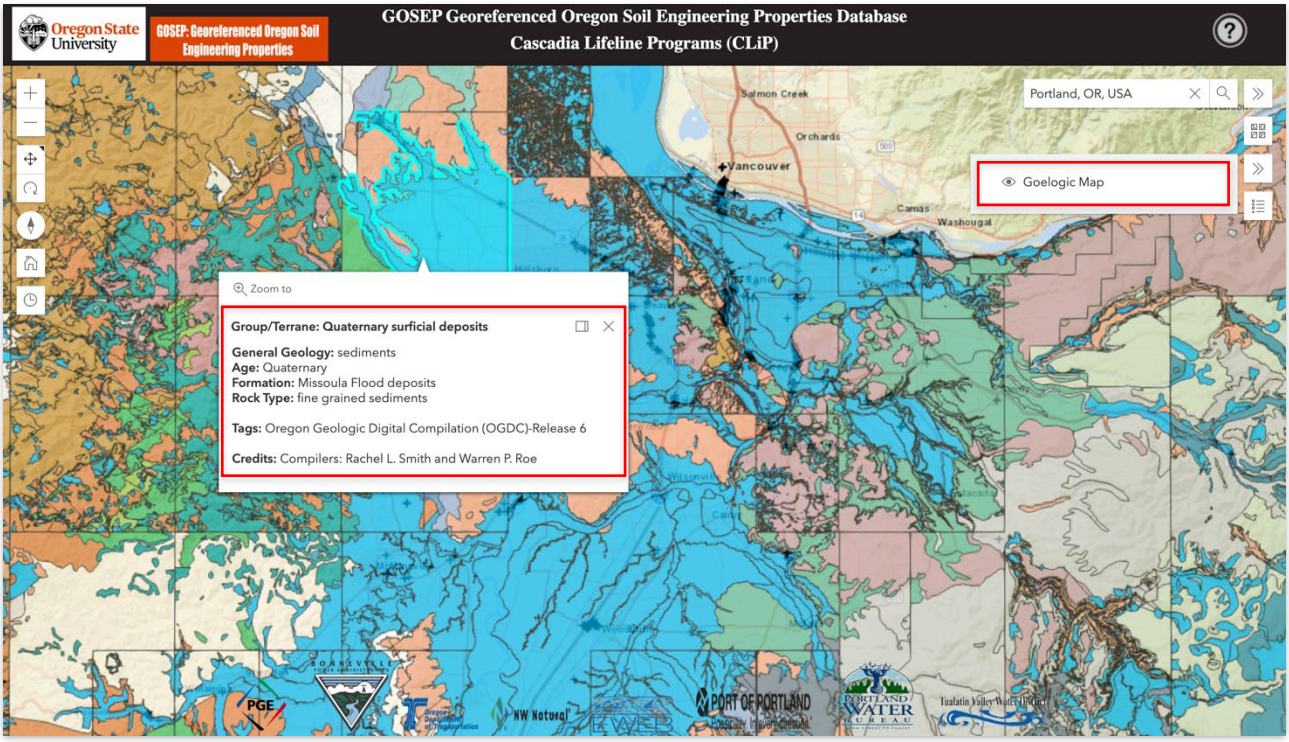

Figure 5: Oregon Geologic Map (DOGAMI release 6)

6. Legend

This widget displays labels and symbols for the layers in the map. Figures 6 and 7 show two different legends—showing the descriptions of the subsurface (e.g. clay, sand, or gravel) for each borehole and showing the Thematic Terrance groups of the Geologic Map (e.g. Astoria group, Applegate group, or Dalles group). The legends will only display the layers that are visible in the view, thus the Geologic Map needs to be enabled first in order to see the corresponding legend. A more detailed discussion of borehole visualization is presented subsequently.

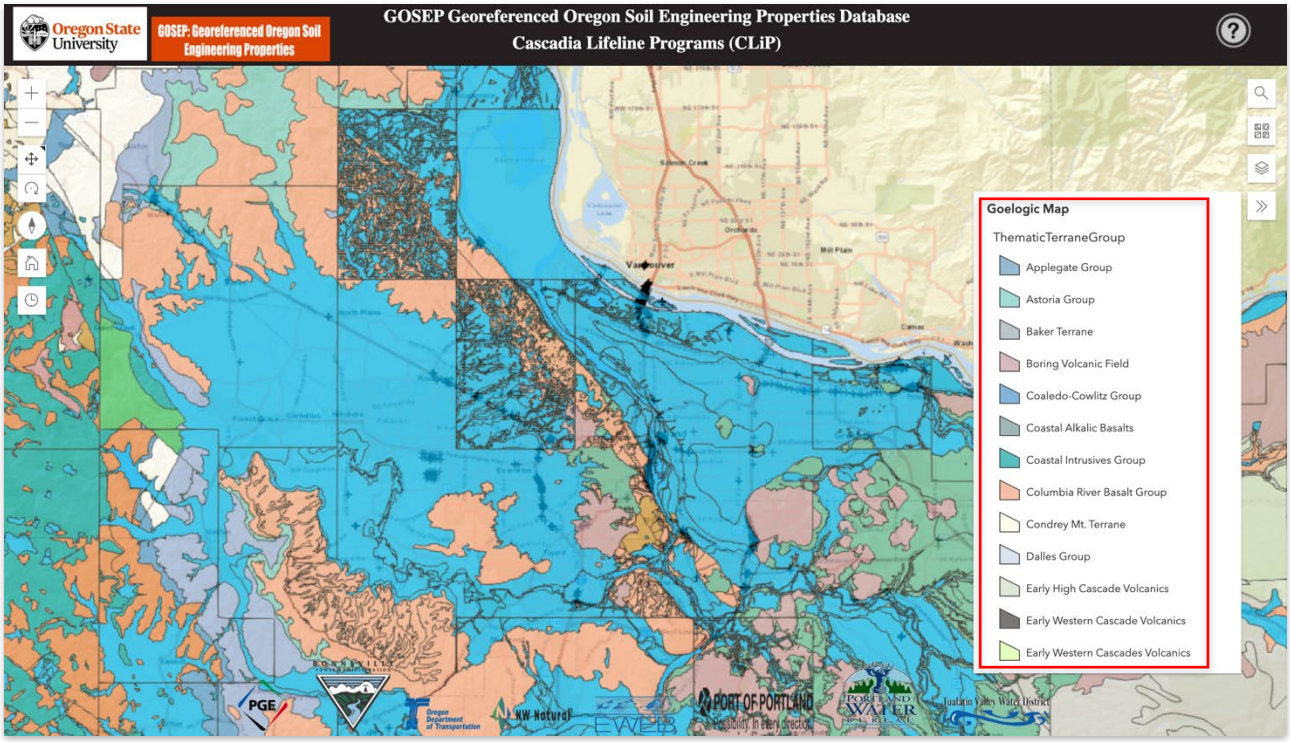

Figure 6: Legend showing the Terrance groups of Oregon Geologic Map

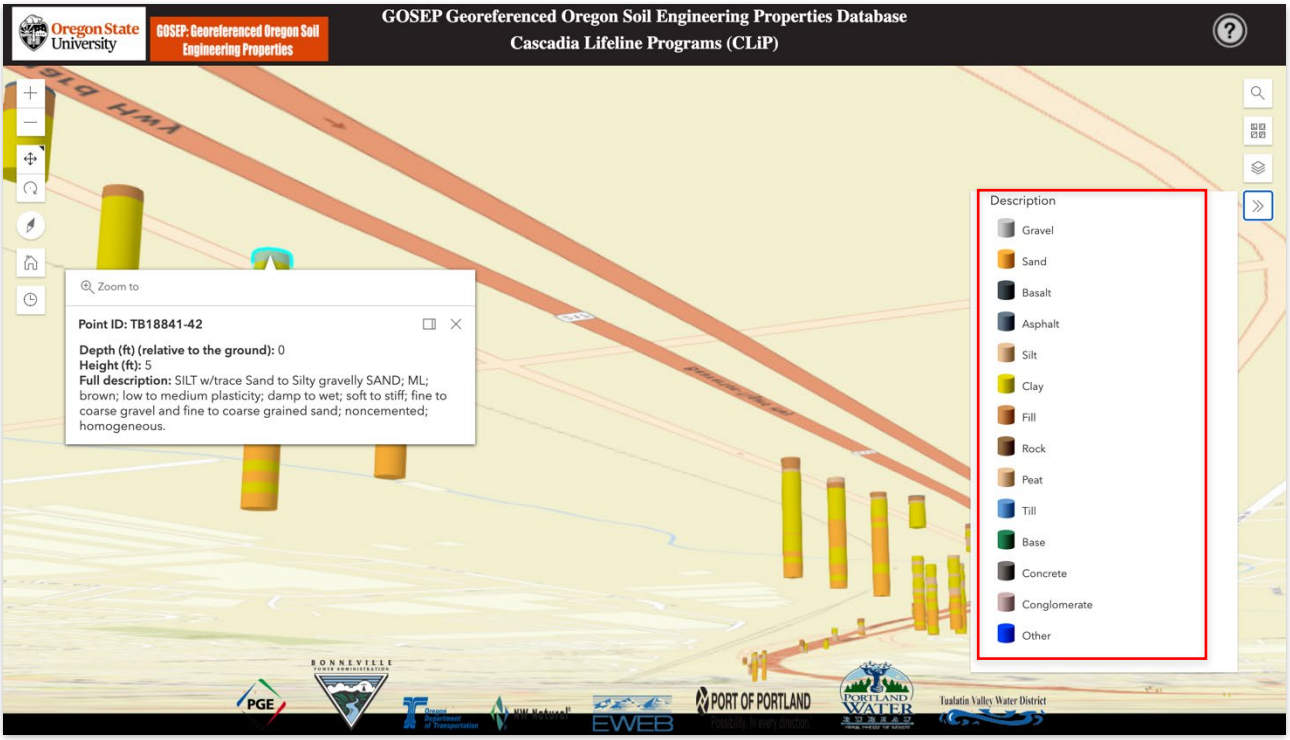

Figure 7: Legend showing the soil types of the subsurface

7. User Manual

Clicking on provides a link to the GOSEP user manual document.

BOREHOLE VISULAIZATION

Each borehole or test site is represented on the ground surface by a black “X”. Clicking on a point will display information related to that point (Figure 8). Information for the borehole or site may be viewed and downloaded by clicking on the “Attachments” link.

The boreholes in the GOSEP database are rendered on the surface as well as below the surface of the scene. You may navigate underneath the base map to view the exact location and depths of drilled boreholes, including subsurface descriptions where soil types are distinguished by colors as shown in Figure 9. To explore features below the surface, you must tilt the view. To tilt below the surface, use the navigation tools, or right click the view and drag the mouse up. Right click and drag the mouse downward to tilt back above the surface. Figure 9 shows the visualization of boreholes beneath the surface. Clicking on each colored segment of the borehole will display a pop-up that shows its relative-to-ground depth, height, and full soil description.

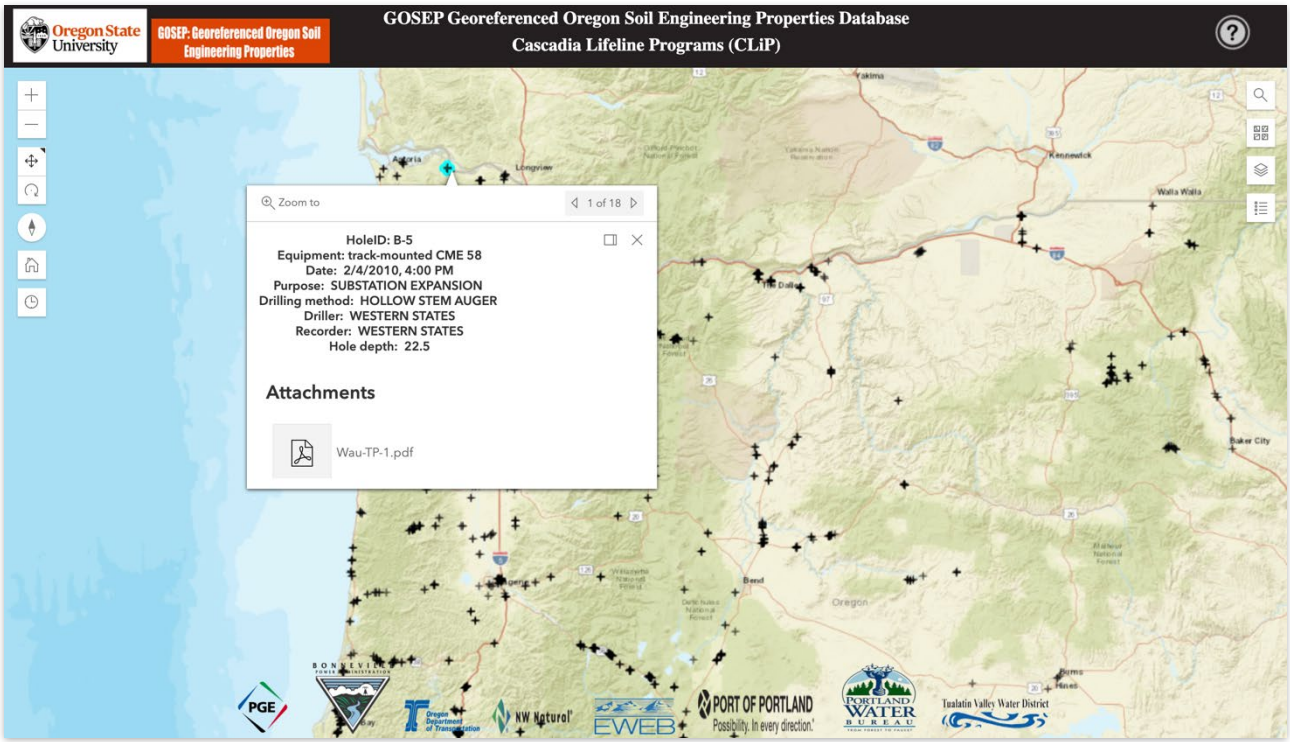

Figure 8: A typical pop-up when a point is selected displaying key information about the borehole

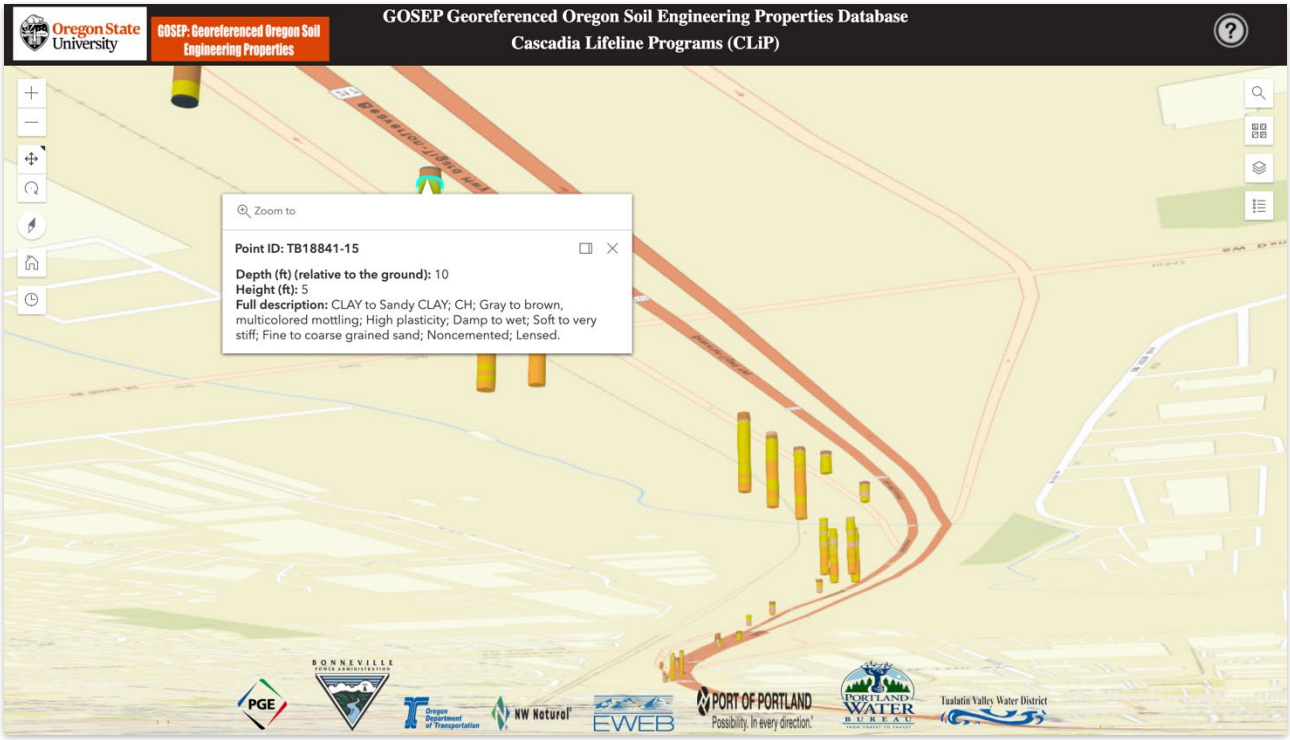

Figure 9: Boreholes along a portion of the Tigard-Beaverton Highway represented beneath the surface.

OREGON GEOLOGIC MAP

The general geology GIS raster layer by the Oregon Department of Geology and Mineral Industries (DOGAMI, release 6) was added as an optional layer to turn off and on so that users can view the boreholes and explorations in relation to general geology. As shown in Figures 5 and 6, the user can switch between the Geologic Map layer and GOSEP layers. The different types of Thematic Terrance groups are distinguished by colors. The user can click on each Terrance group shown on the map, and a pop-up will show up to display its general geology, age, formation, and rock type.

The Geologic Map can be explored by clicking the "non-visible" icon , and it can be disabled by clicking the "visible" icon .

MOBILE DEVICE SUPPORT

GOSEP is available in mobile devices (Figure 10). Note that some features (title, sponsor list.) are not available in a mobile phone due to the limited display space available, so the experience will ordinarily be better in a web browser on a desktop.

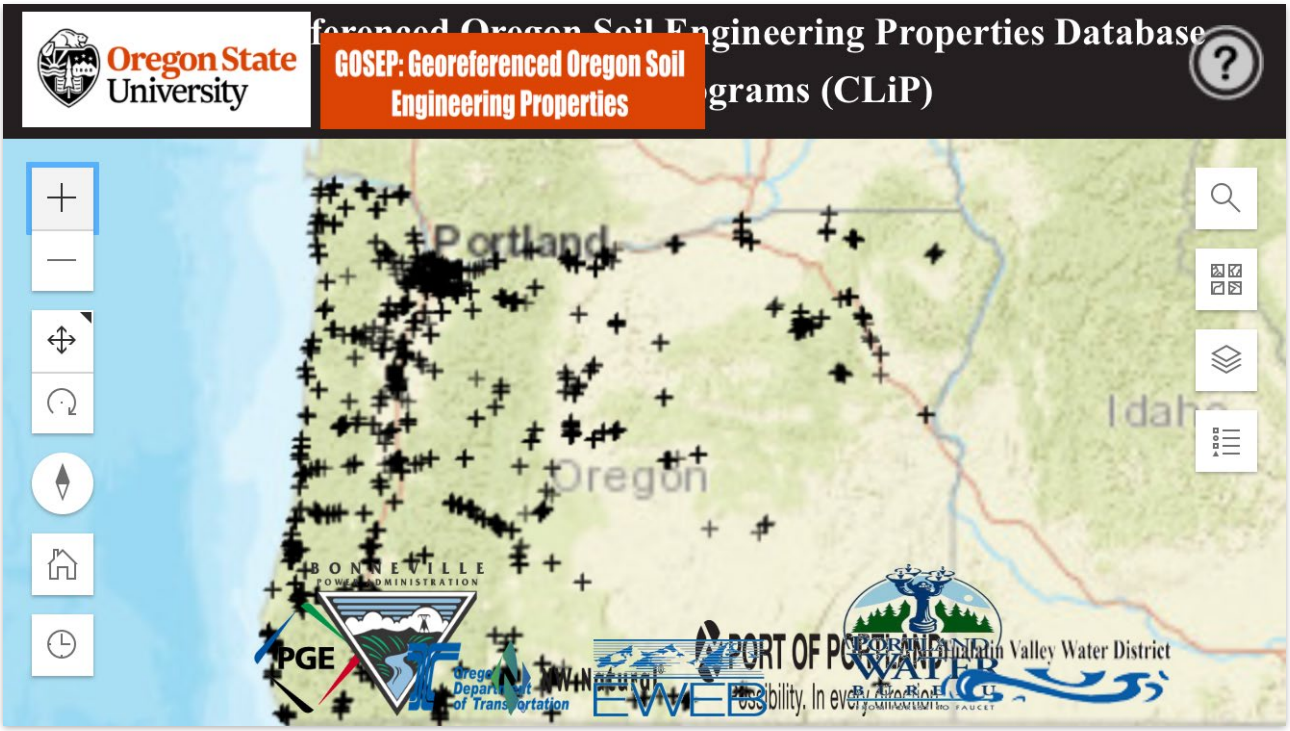

Figure 10: The screen of GOSEP in mobile phone

FUTURE WORK

GOSEP will continue to be updated and expand as more subsurface investigations and research are conducted. BLAMO, Borehole Logging Application Made for Oregon, is a mobile application that has been developed by Oregon State University computer science students. The mobile application is designed to log boreholes in the field electronically, conveniently, and consistently using smart phones. Via BLAMO, engineers and geologists will be able to log borehole information in the field, return to the office and transfer the digital information to a computer to generate electronic borehole logs. The future goal for this work is full GOSEP-BLAMO integration to allow near-real-time database updating. Querying soil surrounding existing boreholes is another future application for GOSEP. The capabilities of the database should be increased to where nearby boreholes can be used to estimate soil properties. Allowing for estimation of surrounding soil properties based on existing boreholes and for interpolation between boreholes will let the user to create subsurface profiles for sites of interest. Interpolating over larger areas can show trends in soil behavior and potential hazardous zones. Real-time generation of charts from borehole data in addition and displaying pictures and videos from the field or of soil samples may be included in the future. The database should also include more advanced laboratory data as it expands.

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APPENDIX

Access to the data:

The data in GOSEP is available for research purposes through the College of Engineering at Oregon State University's ArcGIS web server. To access the mapping data in ESRI's ArcGIS products, follow the steps below to setup the server and to connect to the data:

1. Go to "Arc Catalog".
2. Double-click on "Add ArcGIS Server".
3. In the check box choose "Use GIS services" (Figure 11).

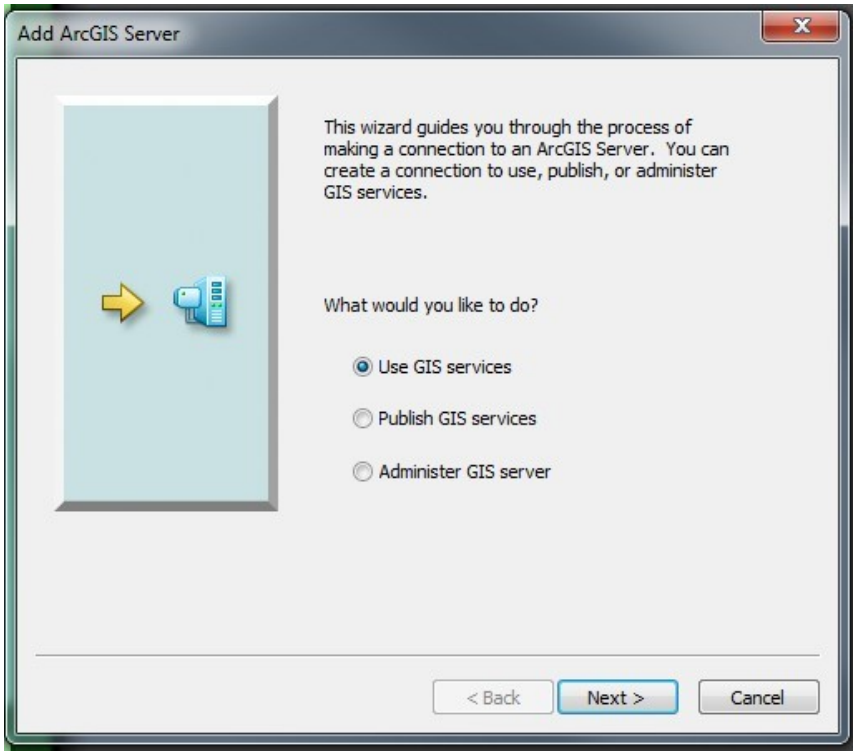

Figure 11: setting up of server step 3

4. Enter the following URL in the server URL box (Figure 12): (https://arcweld.engineering.oregonstate.edu:6443/arcgis/rest/)

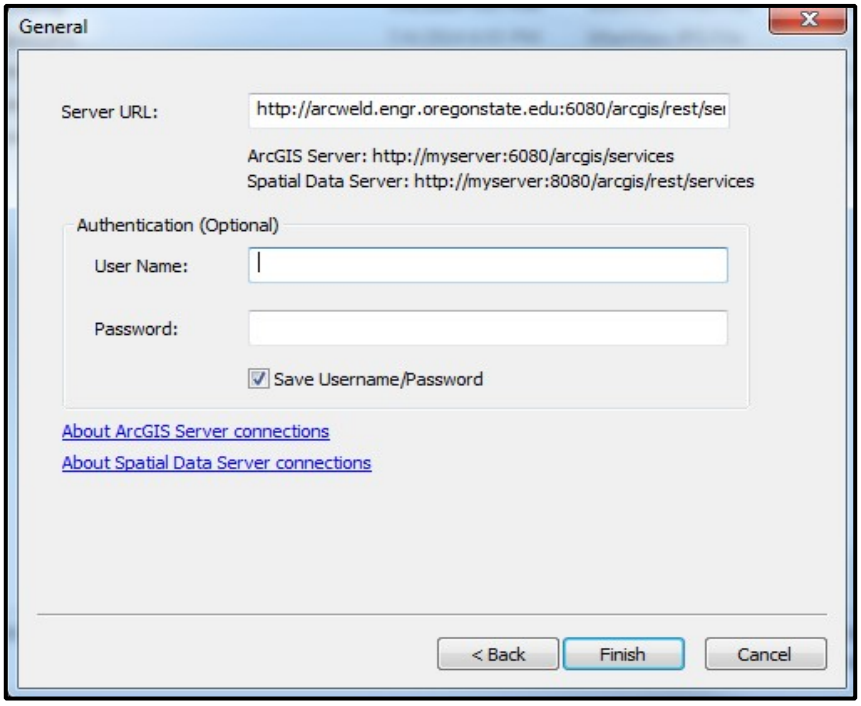

Figure 12: setting up of server step 4

5. No authentication credentials are necessary at this time.
6. Once the server setup is completed, the data becomes visible on the catalog window. Data can be added to ArcMap from Arc Catalog by dragging and dropping the files to the table of contents.

Alternatively, type the following URL into the preferred search engine: https://arcweld.engr.oregonstate.edu:6443/arcgis/rest/services/GOSEP/GOSEPfinal/MapServer. This will bring you to the GOSEP ArcGIS REST Service Directory. From here the GOSEP data layers can be opened in ArcGIS JavaScript, ArcGIS Earth, ArcMap, ArcGIS Explorer, and ArcGIS Online Map Viewer.

The user can click View In: ArcGIS Online Map Viewer to view the data layers in the browser. Once the data has loaded, sign in to your ESRI account, create an account for free, or click "Modify Map" to view the data, enable pop ups, and view related records.

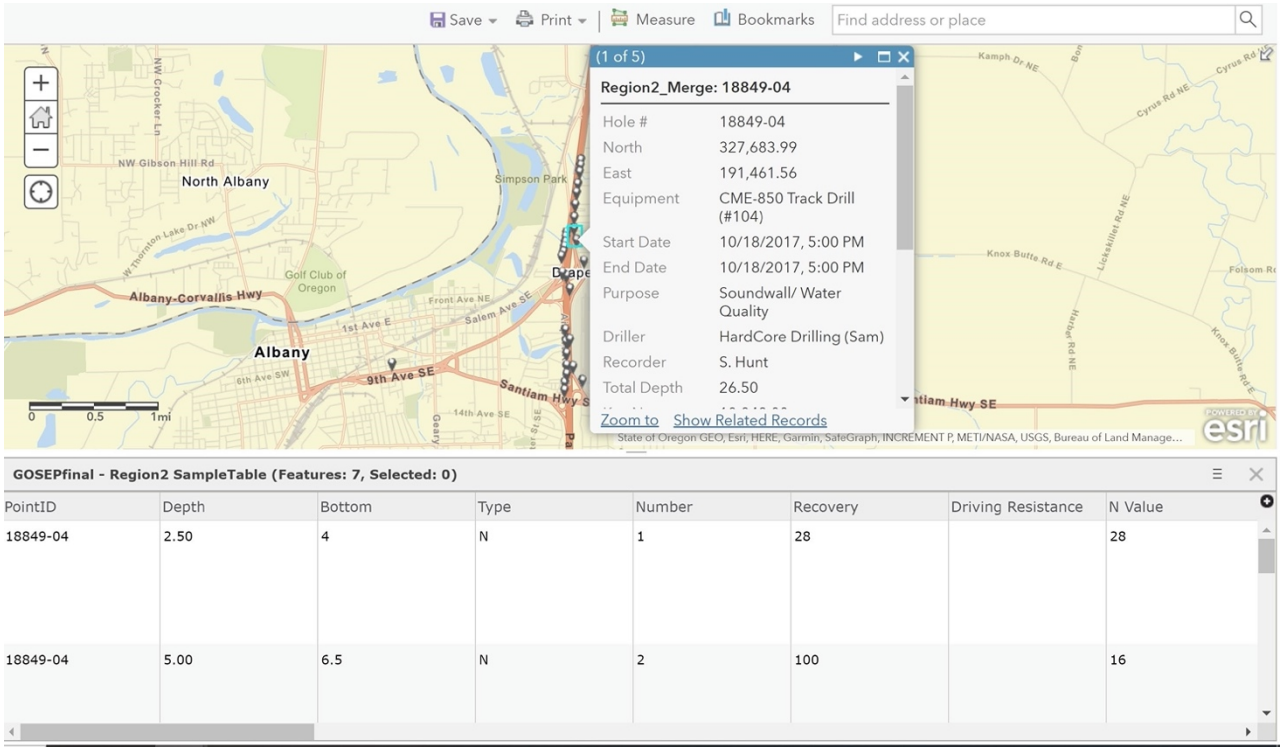

Figure 13: Show Related Records for point data displays soil information with depth of drilling.

Troubleshooting and FAQs:

Please make sure that once you have selected the pin tool on the location of interest, wait for the pop-up window to come up.

Q: The data related to the points is not popping up. What should I do?

A: The preferred browser for GOSEP is GOOGLE CHROME. Try opening the website with the chrome browser and refresh the page. Also, let the page allow pop-ups.

Q: The attachments are not loading. What should I do?

A: If not already using GOOGLE CHROME, try opening the website with the chrome browser and refresh the page. Otherwise, try to right click the attachment link and select “Open link in new tab”.

Q: The home button on the left side of the screen is vanished and features are not working properly. What should I do?

A: Go to the Settings for the CHROME browser and try clearing your “Cookies and Cached images and files”.