BEFORE THE PUBLIC UTILITY COMMISSION

OF THE STATE OF OREGON

PCN 6

Petition for a Certificate of Public Convenience and Necessity

PORTLAND GENERAL ELECTRIC COMPANY

REDACTED Direct Testimony of

Kevin Putnam
Dan Nuñez
Matt Gordanier

April 17, 2024

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I. Introduction

Q. Please state your name, business address, and present position with Portland General Electric (PGE or the Company).

A. My name is Kevin Putnam. My business address is 121 SW Salmon Street, Portland, OR 97204. I am currently employed by PGE as Senior Director of Engineering & Design.

My name is Dan Nuñez. My business address is 121 SW Salmon Street, Portland, OR 97204. I am currently employed by PGE as Senior Manager Wildfire Planning & Analytics.

My name is Matt Gordanier. My business address is 121 SW Salmon Street, Portland, OR 97204. My current position at PGE is Senior Principal Transmission Line Design Engineer in the Operations & Planning Engineering Department. My previous position, up until April of 2024, was as the Manager, Transmission Engineering/Line Design Engineering.

Q. Mr. Putnam, briefly describe your educational background and relevant licenses or certificates.

A. I received a Bachelor of Science (BS) in Electrical Engineering from the University of Idaho in 2002. I am a licensed Professional Engineer in the State of Oregon (License # 88665PE).

Q. Mr. Putnam, please describe your work experience.

A. My career as an engineer began at PacifiCorp where I worked for almost 17 years. At PacifiCorp, I worked in substation engineering and field operations management. In my last role at PacifiCorp as Director of Field Engineering, I was responsible for overseeing field engineers, performing transmission and distribution (T&D) system planning, and providing operational support.

Since January 2019, I have worked in various roles at PGE. From January 2019 to November 2019, I was Manager of Planning, Scheduling, and Line Dispatch and from November 2019 to May 2020, I was Senior Manager for Line Design and Crew Coordination. In both of these roles I was responsible for T&D line operations crew coordination and T&D performance and support.

From May 2020 to May 2022, I was Director of Utility Operations. In this capacity, I was responsible for line design, T&D line operations crew coordination, and T&D performance and support.

From May 2022 to November 2023, I was Senior Director of Compliance & Utility Operations. At this role, I was responsible for utility asset management, line design, T&D line operations crew coordination, vegetation management, wildfire and resiliency, business continuity and emergency management, and T&D performance and support.

From November 2023, I have been employed at PGE as the Senior Director of Engineering & Design. In this role I am responsible for grid asset engineering, power supply engineering, standards engineering, maintenance and system health engineering, line design, geographic information system (GIS), survey, and asset management analytics.

Q. Mr. Nuñez, briefly describe your educational background and relevant licenses or certificates.

A. I received a BS in Structural Engineering from California Polytechnic State University-San Luis Obispo in 2010. I am a certified project management professional, and I am certified with the Institute of Asset Management. I am an Engineer in Training with the National Society of Professional Engineers – California (Credential ID 138030).

Q. Mr. Nuñez, please describe your work experience.

A. I worked at the Bonneville Power Administration (BPA) from June 2009 to July 2021 in various positions, including Project Engineer, Business Analyst, and Asset Management Risk & Strategy. At BPA, I helped develop a risk methodology for Reliability Compliance for all dimensions of applicable regulatory standards, including Western Electricity Coordinating Council (WECC), North American Electric Reliability Corporation (NERC), and Federal Energy Regulatory Commission standards. I was further responsible for developing a holistic enterprise risk methodology, program, process, and policy for BPA's entire transmission portfolio. This included developing industry leading asset management programs from strategy to operations, long-term and short-term planning that delivers on best value decision making, risk-based planning for regulatory (NERC/WECC) compliance risk, and environmental compliance policy, strategy, risk management, and life cycle costs. In addition, I developed a tool to automate quantifying wildfire risk for all assets that are location and asset specific for prioritizing replacements, maintenance, and inspections.

I joined PGE in 2021 to lead and manage the Company's Wildfire Planning & Analytics department. This includes developing Capital/Maintenance plans as well as managing PGE's wildfire risk mitigation strategy and targets. I currently Chair the Risk

Chapter of the International Wildfire Mitigation Consortium, a collective body of utilities worldwide focused on wildfire learnings and best practices.

Q. Mr. Gordanier, briefly describe your educational background and relevant licenses or certificates.

A. I have a BS in Civil Engineering from Oregon State University, and I am a Registered Professional Civil Engineer in Oregon.

Q. Mr. Gordanier, please describe your work experience.

A. Prior to my career at PGE, I was employed at Power Engineers, Inc. from 2008 to 2012 as a Transmission Design Engineer where I was involved in all aspects of 12-kilovolt (kV) to 500-kV transmission line design for new lines, relocations, upgrades and rating/up-rating. I designed transmission lines that utilized a variety of structure types including lattice towers, custom steel poles, concrete poles, wood poles, and steel wood pole equivalents. I was also responsible for foundation designs, including drilled pier, direct embed, and guy and anchor systems.

From 2012 to 2016, I was employed at PGE as a Project Engineer in Transmission Engineering & Specialized Design where I developed and/or managed the detail design for large capital T&D projects, facilitated the acquisition of permits, and provided both office and field support to resolve issues that arose during construction and to ensure the project was completed per technical, budgetary, and operational requirements. In this role, I also performed as a maintenance engineer on issues that arose on existing T&D infrastructure and was responsible for triaging issues and overseeing and coordinating line crews for repair.

Beginning in 2016, I was employed at PGE where I manage a department of engineers to design and engineer capital T&D projects, develop construction packages, and support execution on construction for planned capital T&D projects while attaining excellent quality and service. This responsibility has included developing detailed scope and cost estimates for proposed capital T&D projects and requirements.

Starting in April of 2024 I took a position within PGE as a Senior Principal Transmission Line Design Engineer in the Operations & Planning Engineering Department. My current role is to provide technical engineering support for T&D construction and maintenance projects and the related project teams. I also perform initial routing studies, identify project constraints and easement needs, and develop sequencing plans between related projects, as well as support the development of designs for new construction, upgrades and maintenance projects for overhead transmission, and overhead and underground distribution facilities.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of our testimony is to explain the design specifications and standards for construction of PGE's proposed overhead, 115-kilovolt (kV) transmission line totaling 7.4 miles in length and located in Clackamas and Washington Counties, between the existing Rosemont and Wilsonville Substations (the Rosemont-Wilsonville Line). We also explain how the Rosemont-Wilsonville Line will be constructed, operated, and maintained to meet or exceed all applicable safety standards, as well as all applicable federal, state, and local laws, regulations, and ordinances.

II. Project Design and Compliance with Safety Standards

A. Design of the Rosemont-Wilsonville Line

Q. Please describe the design of the Rosemont-Wilsonville Line.

A. The Rosemont-Wilsonville Line is a 115-kV line composed of monopole structures, which will be built by adopting a combination of approaches to maximize the use of existing rights-of-way. These approaches include converting single-circuit transmission line into double-circuit transmission line, rebuilding existing distribution lines to support both distribution and transmission lines located on the same pole/structure, and repurposing part of an existing transmission line. The new construction portion of the line starts at Rosemont Substation and double-circuits with the existing Meridian-Rosemont 115-kV line until the roundabout at Borland Road, which is a distance of approximately 1.4 miles. From Borland Road the new construction portion of the line then transitions to the installation of new 115-kV structures along the existing Rosemont-Mossy Brae 13-kV distribution feeder right-of-way for approximately 0.3 miles. New structures will be constructed for the next 0.3 miles for the Interstate 205 Freeway crossing where there are not currently any electrical lines. Next, new 115-kV structures will again utilize the existing Meridian-Meridian 13 and Wilsonville-Boeckman 13-kV distribution rights-of-way for approximately 3.0 miles. Finally, the line will tie into the repurposed, existing McLoughlin-Wilsonville 115-kV line for 2.4 miles until it connects to the Wilsonville Substation.

Q. What are the components of a transmission line?

A. The basic components of a transmission line are the structures/poles, conductors, insulators, guying with anchors, foundations to support the structures, and transmission and communication cables.

Q. What are the structure materials and measurements for the Rosemont-Wilsonville Line?

A. The poles for the Rosemont-Wilsonville Line will be made of either wood or steel. The average height above ground for the single circuit structures will be 85 feet and the average height above ground for the double circuit structures will be 110 feet. The side-clearance from the wires to the trees will be a minimum of 10 feet. Please see the diagram attached as Exhibit PGE/301.

Q. What type of conductor is used or will be used for the transmission line?

A. The existing portions of the line contain **Begin Highly Protected/**[redacted]**/End Highly Protected** All Aluminum Conductor (AAC) "Arbutus" conductor, which is capable of carrying **Begin Highly Protected/**[redacted]**End Highly Protected**, and **Begin Highly Protected/**[redacted]**/End Highly Protected** Aluminum Conductor Steel Reinforced "Drake" conductor, which is capable of carrying **Begin Highly Protected/**[redacted]**End Highly Protected**. The new construction portion of the line will utilize **Begin Highly Protected/**[redacted]**End Highly Protected** Aluminum Conductor Steel Supported (ACSS) "Drake" conductor, which is capable of carrying **Begin Highly Protected/**[redacted]**End Highly Protected** at a 40-degree Celsius ambient temperature and is the **Begin Highly Protected/**[redacted]**/End Highly Protected** projects in PGE's service territory (except in the case of **Begin Highly Protected/**[redacted]**End Highly Protected** lines, which may require larger **Begin Highly Protected/**[redacted]**End Highly Protected** ACSS conductors).

Q. Does the use of different types of conductors for different portions of the project impact the rating for the Rosemont-Wilsonville Line?

A. Yes, the overall rating of the Rosemont-Wilsonville Line will be limited to the lowest rated AAC portion of the line, which is **Begin Highly Protected/**[redacted]**End Highly Protected**.

Q. Why did PGE choose to install ACSS conductor on the new sections?

A. As a general matter, ACSS conductor is the current minimum standard for PGE construction of **Begin Highly Protected/**[redacted]**/End Highly Protected**. While the overall rating of the Rosemont-Wilsonville Line will be limited to that of the lowest AAC rated conductor on the line (**Begin Highly Protected/**[redacted]**/End Highly Protected**), PGE determined the installation of ACSS conductor on the new sections is appropriate due to the relatively small marginal cost increase of ACSS versus AAC, versus the significantly higher cost of having to reconductor these new sections of line at a later date to accommodate future load growth past the ten-year outlook (as well as avoiding the disturbance to customers that subsequent construction along Stafford Road would have due to temporary outages, periodic traffic interruptions, and possible vegetation removal).

Q. How did PGE determine the appropriate size for the Rosemont-Wilsonville Line?

A. After establishing the need for the line, as discussed in the direct testimony of Dr. Ian Beil, PGE studied modeled load growth over a ten-year outlook and determined that a

115-kV line would meet the expected growth over this time period.[1] PGE's ten-year power flow analysis conducted in 2024 indicates that once the Rosemont-Wilsonville Line and the McLoughlin-Tonquin 115-kV line are constructed, there will be sufficient capacity on both of these lines to avoid any further reconductors through 2034.[2]

B. Compliance with Safety Standards

1. Applicable Standards and Guidelines for Project Design and Safety and PGE Compliance

Q. What are the guidelines or standards for design of the transmission infrastructure involved in the Rosemont-Wilsonville Line?

A. Overhead transmission lines have been in existence since 1889 (the first transmission line built in North America was constructed and operated by PGE between Oregon City and downtown Portland), and many codes and regulations govern the design and operation of transmission lines. Safety, reliability, and electrical performance are all incorporated into the design of transmission lines. Several notable standards include the: (1) American Concrete Institute 318—*Building Code Requirements for Structural Concrete*, (2) American National Standards Institute standards (for material specifications), (3) American Society of Civil Engineers (ASCE) Manual No.74—Guidelines for Electrical Transmission Line Structural Loading, (4) National Electrical Safety Code (NESC), (5) Occupational Safety and Health Administration 29 CFR 1910.269 (for worker safety requirements), (6) National Fire Protection Association 780—*Guide for Improving the Lightning Performance of Transmission Lines*; (7) American Association of State Highways and Transportation Officials guidelines and

[1] PGE/100, Beil/38.
[2] PGE/100, Beil/35-36; *see also* Tonquin Power Flow Results Update (Highly Protected PGE/106, Beil/1-2).

policies for accommodating utilities within highway and freeway rights-of-way; and (8) Federal Aviation Administration standards and guidelines. NESC provides for minimum guidelines and industry standards for safeguarding persons from hazards arising from the construction, maintenance, and operation of electric supply and communication lines and equipment.

Q. What PGE Transmission & Distribution (T&D) Standards must the transmission line design adhere to?

A. The Rosemont-Wilsonville Line will adhere to the following PGE T&D Standards:

- LD20020—*General Loading Requirements for Overhead Lines*, which provides the basic loading requirements set by NESC for PGE transmission and distribution lines (attached as Protected Exhibit PGE/302);
- LD20030—*Overhead Conductor Loading Requirements*, which identifies mechanical loading criteria and design tension limits that will ensure effective long-term operation of overhead conductors to reduce the effects of aeolian vibration and ensure compliance with the NESC (attached as Protected Exhibit PGE/303);
- LD20055—*Grades of Construction, Load Factors, and Strength Factors*, which provides information on the use of load factors and strength factors in the design and maintenance of the PGE distribution and transmission system (attached as Protected Exhibit PGE/304);
- LD29002—*Vertical Clearance of Wires, Conductors, and Aboveground Cables to Roadway, Rail, or Water Surfaces*, which meets or exceeds the minimum vertical clearances of wires, conductors, aboveground cables to roadway, rail, or water surfaces to ground required by NESC 232 (attached as Protected Exhibit PGE/305);
- LD29003—*Clearance Between Wires, Conductors, and Cables Carried on Different Support Structures*, which meets or exceeds the minimum clearance where crossings are made on different support structures required by NESC 233 (attached as Protected Exhibit PGE/306);
- LD29004—*Clearance of Wires, Conductors, Cables, and Equipment from Buildings, Bridges, Rail Cars, Swimming Pools, and Other Installations*, which meets or exceeds the minimum clearances in the NESC (attached as Protected Exhibit PGE/307);

- LD29005—*Clearance for Wires, Conductors, and Cables Carried on the Same Support Structure*, which meets or exceeds minimum horizontal and vertical clearances at the supporting structure and at midspan required by NESC 235 (attached as Protected Exhibit PGE/308); and
- LD29006—*Climbing Space and Working Space*, which meets or exceeds the climbing space and working space dimensions identified in NESC 236 and 237 (attached as Protected Exhibit PGE/309).

Q. Is the Rosemont-Wilsonville Line designed to meet all of these standards?

A. Yes.

Q. Is the Rosemont-Wilsonville line designed to withstand severe weather conditions?

A. Yes. PGE has studied the loading impacts for a variety of different severe weather scenarios and has designed the line to account for loading associated with these different weather cases.

Q. Please summarize the weather cases the transmission line structures are designed to withstand.

A. The weather parameters for each load case include ambient temperature, wind pressure, and radial ice. The parameters for each load case are summarized below.[3]

[3] Protected PGE/302, Putnam-Nuñez-Gordanier/7.

Protected Table 1: Summary of Un-Factored Weather Load Cases

LOAD CASE	TEMPERATURE (°F)	WIND (MPH)	RADIAL ICE THICKNESS (IN)
NESC District Loading (Rule 250B)	15	40	0.25
NESC Extreme Wind (Rule 250C)	60	85	0.0
NESC Extreme Ice with Concurrent Wind (Rule 250D)	15	30**	1.0**
PGE Extreme Wind *	[redacted]	[redacted]	[redacted]
PGE Extreme Ice *	[redacted]	[redacted]	[redacted]

* These load cases are not required per the NESC
** Based on defined geographic areas
*** For all steel structures over 60 feet and not in High Fire Risk Zone
**** All areas designated as medium loading

Q. What are the relevant factors for the load cases discussed above?

A. In addition to the varying weather conditions listed above, each load case also requires overload factors to ensure structure reliability, serviceability, and safety requirements are maintained. The overload factors are broken into three categories for each vector component of a given load as Longitudinal, Transverse, and Vertical. The transverse load factor is further broken into two subcategories under the NESC District Loading (Rule 250B) load case to account for wire tension and wind on wire loads. A summary of the load factors by load case is provided below.[4]

[4] Protected PGE/304, Putnam-Nunez-Gordanier/3-5.

Protected Table 2: Load Factors by Load Case

LOAD CASE	LONGITUDINAL	TRANSVERSE		VERTICAL
NESC District Loading (Rule 250B)	1.65	Wire Tension 1.65	Wind on Wire 2.5	1.5
NESC Extreme Wind (Rule 250C), Wood Poles	1.0	1.0		1.0
NESC Extreme Wind (Rule 250C), Steel Poles*	1.1	1.1		1.1
NESC Extreme Ice with Concurrent Wind (Rule 250D), Wood Poles	1.0	1.0		1.0
NESC Extreme Ice with Concurrent Wind (Rule 250D), Steel Poles*	1.1	1.1		1.1
PGE Extreme Wind, Wood Poles**	[redacted]			
PGE Extreme Wind, Steel Poles**				
PGE Extreme ICE, Wood Poles**				
PGE Extreme ICE, Steel Poles**				

* The 1.1 overload factor for steel is higher than NESC required overload factor of 1.0.
** These load cases are not required per NESC.

Q. Does the design of the Rosemont-Wilsonville Line comply with all the above structural strength requirements?

A. Yes. As discussed above, the Rosemont-Wilsonville Line design will adhere to PGE's T&D Standards. These T&D Standards include all the loading requirements (shown above), which meet or exceed NESC loading requirements, and are based on loading conditions appropriate for PGE's service territory. Accordingly, the design of the line will comply with all the above structural strength requirements.

Q. Are there guidelines or standards for the design and installation of transmission line foundations?

A. Yes. For designing and installing transmission line foundations, the Company follows PGE's Concrete Drilled Pier Foundation Specification (attached as Protected Exhibit

PGE/310) and the Direct Embed Foundation Specification (attached as Protected Exhibit PGE/311). PGE's Concrete Drilled Pier Foundation Specification provides requirements for concrete strength and mix design, steel reinforcing bars, anchor bolt placement, casings, concrete mixing and placement, finishing, testing, logging, temperature and weather during construction and installation, as well as site restoration. PGE's Concrete Drilled Pier Foundation Specification complies with various industry and agency standards and guidelines, including the Specifications for Concrete Aggregates, American Society for Testing and Materials (ASTM) C33; Oregon Department of Transportation (ODOT) Standard Construction Specification 02020 (Water); Standard Specification for Chemical Admixtures for Concrete, ASTM C494; Standard Specification for Air-Entraining Admixtures for Concrete, ASTM C260; Standard Test Method for Slump of Portland Cement Concrete, ASTM C143; Standard Specification for Sheet Materials for Curing Concrete, ASTM C171; etc.

The Company's Direct Embed Foundation Specification provides requirements for excavation (including shaft type, drilling, etc.), backfill material size and strength, casings, pole embedment, as well as site restoration. The corrugated metal pipe casings under this standard must conform with Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe, ASTM A929.

Q. Are the transmission line foundations designed to comply with these requirements?

A. Yes. All foundation designs and installations for the Rosemont-Wilsonville Line will be in compliance with the PGE drilled pier and direct embedded foundation specifications.

Q. What seismic design standards apply to the design of transmission line structures and foundations for the Rosemont-Wilsonville Line?

A. Per the 2018 ASCE published paper titled "Seismic Effects on Transmission Lines and Their Major Components," inertial earthquake loading is not commonly taken into account in the design of the transmission structure itself due to satisfactory performance of transmission lines observed in historical earthquake events.[5] Case studies show that the majority of damage to transmission towers during earthquakes is due to geotechnical hazards such as liquefaction, lateral spreading, and earthquake-induced landslides and rockfall.[6] The 2018 study highlighted that the majority of the electrical utilities surveyed do not consider inertial seismic loading and many associated geotechnical hazards in design of new or retrofitting of existing transmission structures; rather, transmission line tower strengths are controlled by the traditional loading requirements discussed above such as extreme wind, ice and wind, unbalanced longitudinal loads, etc.[7] The conclusion of the study matches PGE's previous project experience with regards to analyzing structures, i.e., inertial loading of transmission line structures does not control the structural design of transmission lines because other loading conditions and standards control the structure design.

However, geotechnical hazards can affect structure ***foundations***, and therefore the design of foundations should take such conditions into account. For this reason, PGE commissioned a geotechnical study by a third-party consultant, GRI, and the study included considerations for seismic design with respect to the transmission structure

[5] Leon Kempner Jr. *et al.*, *Seismic Effects on Transmission Lines and Their Major Components* at 132 (2018) (PGE/312, Putnam-Nuñez-Gordanier/1).
[6] PGE/312, Putnam-Nuñez-Gordanier/3.
[7] PGE/312, Putnam-Nuñez-Gordanier/11.

foundations. GRI used the Oregon Structural Specialty Code (OSSC) to develop seismic parameters for the transmission tower foundations.[8] The OSSC is based on the International Building Code and incorporates recommendations for seismic design from the ASCE document 7-16, Minimum Design Loads for Building and Other Structures (ASCE 7-16). The ASCE 7-16 seismic-hazard levels are based on a Risk-Targeted Maximum Considered Earthquake (MCER). The ground motions associated with the probabilistic MCER represent a targeted risk level of 1 percent in 50 years probability of collapse in the direction of maximum horizontal response.

Q. Did the Company identify any geologic hazards that would pose a risk to the transmission line structures?

A. Based on the subsurface conditions, the Company identified a risk for earthquake-induced slope instability and/or lateral spreading along the banks of the Tualatin River near the proposed Rosemont-Wilsonville Line.[9] The risk of earthquake-induced instabilities along the remaining portions of the Rosemont-Wilsonville Line is low.

Q. How does PGE intend to mitigate earthquake-induced risk of slope instability and lateral spreading along the banks of the Tualatin River?

A. Given the risk identified, PGE designed the line so that none of the transmission line towers are placed in identified areas of risk, including along the banks of the Tualatin River.

Q. Has the Company included a declaration affirming that it will adhere to the applicable Public Utility Commission of Oregon (Commission) rules and other

[8] GRI, *Geotechnical Design Report Portland General Electric: PGE Tonquin 115-kV Transmission Line Rosemont-Wilsonville Segment* at 10-15 (Aug. 9, 2022) (PGE/313, Putnam-Nuñez-Gordanier/10-15).
[9] PGE/313, Putnam-Nuñez-Gordanier/15.

applicable safety standards for construction operation and maintenance of the transmission line?

A. Yes, the declaration of Kevin Putnam is attached as Exhibit PGE/314. The Rosemont-Wilsonville Line will be constructed, operated, and maintained to meet or exceed all applicable NESC standards, as well as all applicable federal, state, and local laws, regulations, and ordinances.

Q. Does the Company's construction contractor maintain safety protocols?

A. Yes. The Company's construction contractor, Henkels & McCoy West, LLC (HMW), has implemented safety policies and procedures for Subcontractor Safety Reviews and provides all Subcontractors with General Orientation Training.[10] HMW also provides compliance guidance and an awareness of HMW safe work practices.[11] Every subcontractor identified must adhere to HMW's Handbook for Contractors. The Project Safety Manager will aid the Project Team with Job Hazard Analysis, Incident Investigations, routine audits, and inspections. They will provide training and act as subject matter experts in various daily/weekly meetings and provide routine audits, inspections and aid in Safety Coaching and Observation (SCO) Process / SCO system.

HMW is prepared and ready to work closely with PGE to ensure safety for pedestrians, vehicles, and abutting property for all crossings on this project. There are numerous locations along the Rosemont-Wilsonville Line that will require careful coordination, preparation, and planning to manage and navigate the traffic along busy roadways, including Stafford Road. HMW will also provide and execute a communication plan, which will include emergency response planning.

[10] *See* HMW, *Safety and Security* (PGE/315, Putnam-Nuñez-Gordanier/1).
[11] PGE/315, Putnam-Nuñez-Gordanier/1.

HMW and its subcontractors will communicate with local jurisdictions, businesses, and residential customers and landowners to provide adequate notification and coordination for all construction activities. HMW will further review and comply with all applicable permit conditions regarding work hour restrictions and construction commencement notification, traffic control plan approvals and understandings, work procedures, and property coordination during all phases of work. Proper setups, signage, and notifications will be met for this project. Any/all outages will be scheduled in advance and customers will be contacted by the HMW General Foreman. HMW will work with the PGE project team to ensure compliance and that customers' expectations are met.

Q. Has PGE reviewed HMW's safety protocols?

A. Yes. PGE reviewed HMW's safety protocols to ensure that the protocols were at least equivalent to PGE's safety protocols. For example, PGE requires a Jobs Hazard Analysis (JHA). HMW has its own forms and process for the JHA that PGE reviewed and verified meets or exceeds PGE's JHA process.

2. <u>Other Safety Measures</u>

Q. Did the Company identify any other safety measures that will apply to the Rosemont-Wilsonville Line?

A. Yes. PGE also has in place a Commission-approved Wildfire Mitigation Plan, a Vegetation Clearance Policy and vegetation management protocols, and a Traffic Control Plan.

Q. Are Wildfire Mitigation Plans required by the Commission?

A. Yes. In accordance with OAR 860-300-0020, the Commission requires the annual filing of the Wildfire Mitigation Plan. The Commission's rules require that the Wildfire Mitigation Plan includes, among other things, discussion of areas that are subject to a heightened risk of wildfire,[12] the means of mitigating wildfire risk that reflects a reasonable balancing of mitigation costs with the resulting reduction of wildfire risk,[13] preventative actions and programs to minimize the risk of utility facilities causing wildfire,[14] protocols for the de-energization of power lines and modifications to power system operations to mitigate wildfires,[15] the procedures, standards, and time frames to carry out vegetation management,[16] ignition inspection programs,[17] and communication and coordination with Public Safety Partners, such as fire safety.[18]

Q. Please describe PGE's Wildfire Mitigation Plan.

A. Consistent with the Commission's rules, the Wildfire Mitigation Plan includes PGE's Wildfire Risk Mitigation Assessment, provides wildfire risk mitigation guidance to PGE through operating protocols, public safety power shutoff (PSPS) events, asset management and inspections, vegetation management, community engagement, public awareness and outreach, and research and development. The Wildfire Mitigation Plan includes identification of high fire risk zones (HFRZ) within the Company's service territory, specific system operation protocols during fire season, wildfire prevention strategies, ignition prevention inspections, and vegetation management requirements.

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[12] OAR 860-300-0020(1)(a).
[13] OAR 860-300-0020(1)(b).
[14] OAR 860-300-0020(1)(c).
[15] OAR 860-300-0020(1)(e).
[16] OAR 860-300-0020(1)(h).
[17] OAR 860-300-0020(1)(k).
[18] OAR 860-300-0040.

Q. Did the Commission approve PGE's 2023 Wildfire Mitigation Plan?

A. Yes. Following extensive review with the Commission's Safety Staff, the Commission approved PGE's 2023 Wildfire Mitigation Plan on June 26, 2023.[19]

Q. Has PGE filed a 2024 Wildfire Mitigation Plan?

A. Yes. The Company filed its 2024 Wildfire Mitigation Plan on December 29, 2023.[20]

Q. Has the Commission approved PGE's 2024 Wildfire Mitigation Plan yet?

A. Not yet. The Commission is currently reviewing PGE's 2024 Wildfire Mitigation Plan. Pursuant to ORS 757.963(5), the Company anticipates that the Commission will complete its review of the 2024 Wildfire Mitigation Plan no later than June 26, 2024.

Q. Has PGE analyzed the potential fire risk relating to electric transmission infrastructure?

A. Yes. PGE has thoroughly analyzed the wildfire risk in its service territory, including the proposed route for the Rosemont-Wilsonville Line. Throughout its service territory, PGE has expanded its situational awareness capabilities to identify circumstances in which there is a higher probability of a transmission-related ignition. PGE's situational awareness capabilities include installing new remote automated weather stations and artificial-intelligence (AI)-enhanced, ultrahigh-definition Pano cameras to automatically notify PGE and fire agencies when a fire is detected.[21] As discussed in more detail below, although the Rosemont-Wilsonville Line is not in an HFRZ, once complete the transmission line will be subject to and operate in compliance with all

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[19] *In re Portland Gen. Elec. Co., 2023 Wildfire Protection Plan*, Docket UM 2208, Order No. 23-221 (June 26, 2023); *see also* Docket UM 2208, 2023 Wildfire Mitigation Plan (Dec. 21, 2022), *available at* https://edocs.puc.state.or.us/efdocs/HAQ/um2208haq12626.pdf (PGE/316) [hereinafter, "2023 Wildfire Mitigation Plan"].
[20] Docket UM 2208, PGE 2024 Wildfire Mitigation Plan (Dec. 29, 2023) (PGE/317) [hereinafter, "2024 Wildfire Mitigation Plan"].
[21] PGE/317, Putnam-Nuñez-Gordanier/7.

applicable provisions of PGE's Commission-approved Wildfire Mitigation Plan, including annual assessments to determine for inclusion in an HFRZ in coordination and consultation with Public Safety Partners.

Q. How has PGE's investment in weather stations improved the Company's wildfire safety?

A. PGE's network currently consists of 82 weather stations providing weather data at a granular level, which informs PGE's assessment of operational hazards and improves situational awareness.[22] PGE's strategically-located weather stations also provide data on which the Company relies in evaluating the potential for PSPS events.[23] PGE will be installing five new remote automated weather stations (RAWS) (two of the five have already been placed into service) and deploying its four mobile weather stations, as needed, across PGE service territory.[24]

Q. Please describe PGE's investments in AI-enhanced cameras.

A. In a partnership with the Electric Power Research Institute, PGE installed a network of connected, intelligent fire detection cameras equipped with AI beginning in 2021.[25] These ultra-high-definition camera systems give PGE a 360-degree fire detection triangulation capability across its service area, accurate to within 100 yards. The Pano AI platform's machine learning algorithms automate fire detection, awareness, and notifications, helping expand and improve regional fire detection resources. These real-time data feeds and predictive capabilities allow PGE to proactively manage risks,

[22] PGE/317, Putnam-Nuñez-Gordanier/15-16. PGE had placed 80 weather stations into service at the time it filed its 2024 Wildfire Mitigation Plan. The Company has since completed two additional stations.
[23] PGE/317, Putnam-Nuñez-Gordanier/16.
[24] PGE/317, Putnam-Nuñez-Gordanier/46.
[25] PGE/317, Putnam-Nuñez-Gordanier/37.

enable a faster emergency response by fire suppression agencies, and minimize the spread of fires.

Additionally, these investments have benefited other organizations concerned with fire response. As of October 2023, 46 fire/emergency/communications agencies are actively using PGE's network of cameras, with more than 140 users and alert subscribers.[26] The agencies making use of PGE's camera network include response agencies operating near the proposed route for the Rosemont-Wilsonville Line, including Tualatin Valley Fire & Rescue, the Clackamas Fire District, & Oregon Department of Forestry.[27] These cameras have proven to be an essential asset for PGE, as well as the many fire agencies and emergency service leaders to whom PGE has granted access and real-time alerts. Feedback from these users, often fire department chiefs themselves, has been consistently positive.[28] There are now numerous detections on named fires, sometimes up to two hours before traditional detection methods like satellite and 911 calls. PGE's efforts have proven so successful that Energy Insurance Mutual, Ltd. (EIM) invited PGE to present at EIM's new Risk Community webinar series to share information regarding PGE's wildfire mitigation with other risk management organizations.

Q. Please describe HFRZs as relevant to PGE's Wildfire Mitigation Plan.

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[26] PGE/317, Putnam-Nuñez-Gordanier/38.

[27] *See* PGE/316, Putnam-Nuñez-Gordanier/36-37.

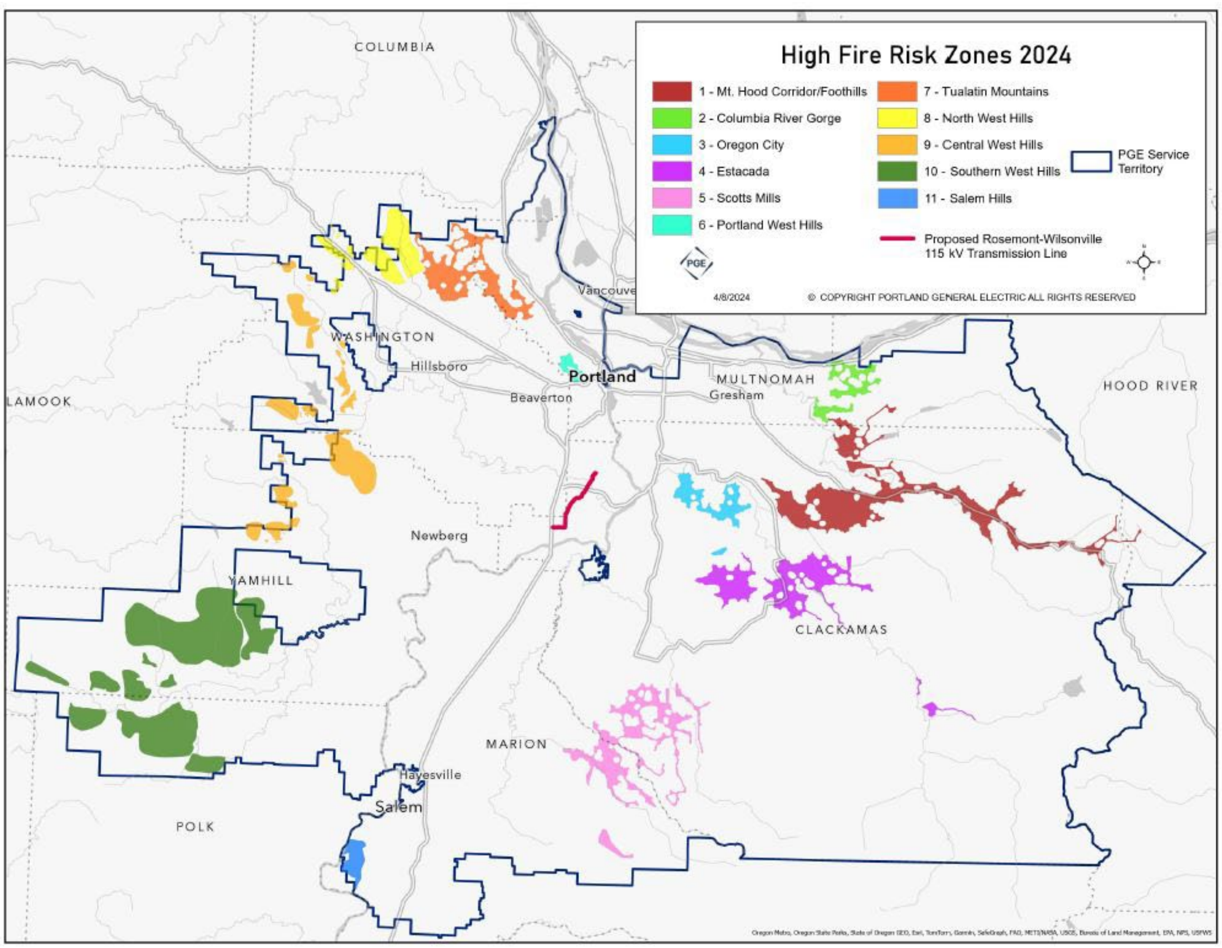
[28] *See, e.g.*, Daisy Caballero, KGW8, *PGE to Add More AI Cameras, Including One in Timberline Lodge on Mount Hood, to Detect Wildfires* (July 20, 2023), *available at* https://www.kgw.com/article/news/local/wildfire/pge-ai-cameras-wildfire-detection-portland-pano/283-54ba0057-5d83-4010-9882-fc5e17c6af25 (last visited Apr. 17, 2024) ("'I really do truly believe that it's a game changer for the fire service,' said Phil Schneider, division chief for Clackamas Fire Dist. 1. 'We're getting early detection, we only run off of time and if we can lessen the time to get to that scene it's going to be a good outcome.'") (PGE/318, Putnam-Nuñez-Gordanier/2).

A. HFRZs are areas within PGE's service territory where the Company has identified increased risks associated with utility-caused wildfire ignition.[29] This increased risk results from various factors, including vegetation, terrain, meteorology, population density, and development in the Wildland-Urban Interface.

Q. Is the proposed route for the Rosemont-Wilsonville Line located within an HFRZ?

A. No. PGE has identified 11 HFRZs in its service territory, which are shown below in Figure 1. The proposed Rosemont-Wilsonville Line route is not within any of the HFRZ and is located approximately 7.8 miles from the closest HFRZ.

Figure 1: PGE Service Territory HFRZs



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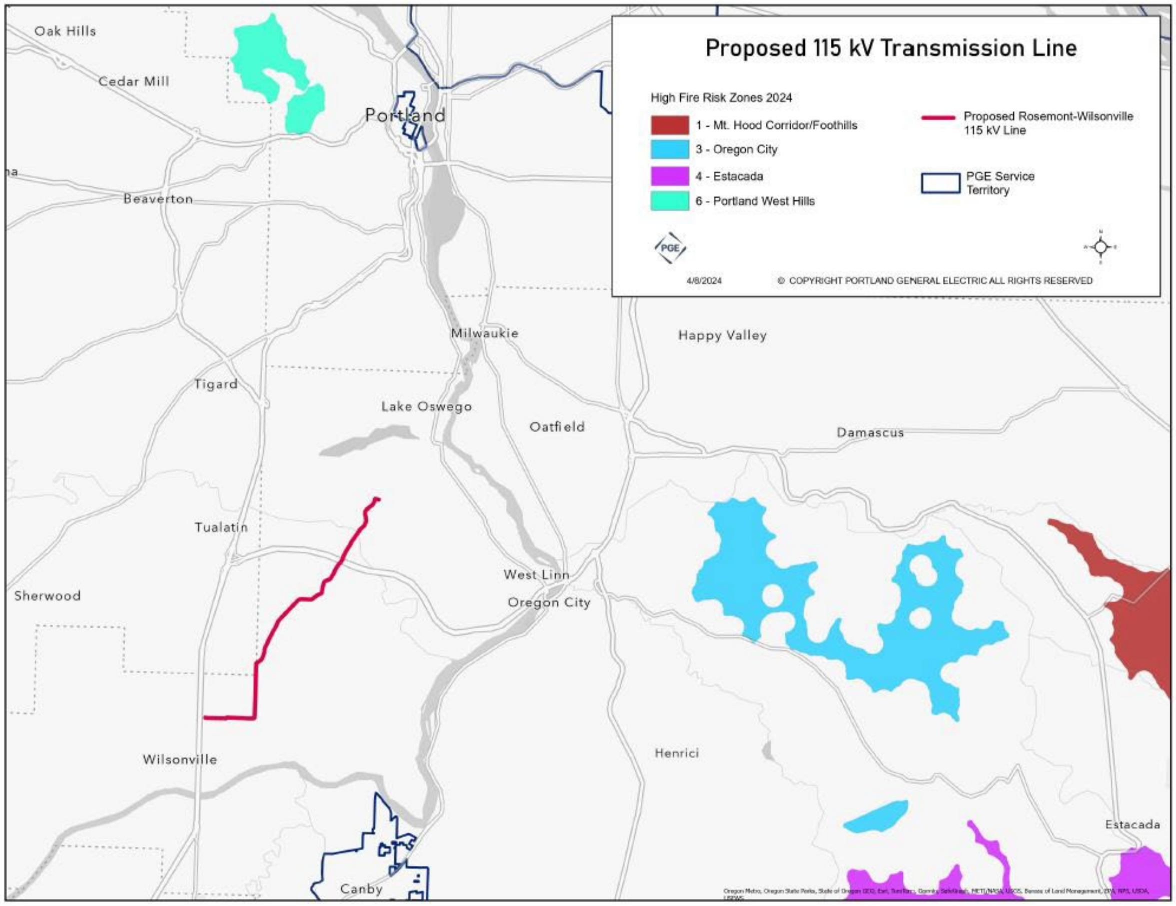
[29] PGE/317, Putnam-Nuñez-Gordanier/35.

Figure 2: PGE Service Territory HFRZs Near Rosemont-Wilsonville Line



Q. How frequently does PGE review and update HFRZs identified in the Wildfire Mitigation Plan?

A. As part of its annual update process for the Wildfire Mitigation Plan, PGE performs an annual review of HFRZ, which may result in adding new areas to existing zones, adding new zones, or removing areas previously identified as HFRZ. New areas within existing HFRZ and new zones are evaluated based on conditions, including input from fire authorities, forestry authorities, egress models, observed fire behavior, and location of critical infrastructure and resources.

Q. Will the fire risk prevention protocols contained within PGE's Wildfire Mitigation Plan apply to the Rosemont-Wilsonville Line route even though that route is not located within an HFRZ?

A. Yes, as I noted above. PGE recognizes that ignition potential is not limited to only the areas within the HFRZ boundaries. While certain components of the Wildfire Mitigation Plan are specific to HFRZs, many of the fire mitigation actions apply throughout the entirety of PGE's service territory and may be implemented outside the HFRZs if warranted by the circumstances (e.g., fire weather conditions). These mitigation actions include PSPS and vegetation management protocols.

Q. You state above that the Rosemont-Wilsonville Line would be subject to PGE's PSPS protocols. What is a PSPS?

A. The Commission defines a PSPS as "a proactive de-energization of a portion of a Public Utility's electrical network, based on the forecasting of and measurement of extreme wildfire weather conditions."[30] As a last-resort safety measure to protect people, property, and public areas, PGE will proactively turn off power when conditions threaten the ability to operate the grid safely.

Q. How does PGE identify the need for PSPS events?

A. PGE uses meteorological, outage data, fuel data, and predictive analytics to make risk-informed decisions regarding PSPS events and curtailment decisions. PGE monitors forecasts before and during fire season. The Company also monitors its own data from PGE weather stations strategically located throughout the service area and can make its own forecasts as soon as seven days ahead. PGE has dedicated meteorologists on

[30] OAR 860-300-0010(8).

staff to monitor forecasts and make curtailment decisions during PSPS events. PGE's meteorologists forecast seven days out, and in 2023 were able to successfully predict red flag warning conditions days ahead of the National Weather Service.

Q. Has PGE implemented PSPS events before?

A. Yes. In September 2022, critical fire weather conditions led to a PGE PSPS.[31] The peak number of customer meters out due to the PSPS was approximately 35,000.[32] To restore service following the PSPS, PGE deployed nearly 500 operational personnel, including 112 PGE contractors and mutual assistance crew members. As required by Commission regulations,[33] PGE included this event in its annual PSPS Report. PGE did not initiate any PSPS events in 2023, and therefore did not submit an annual PSPS report in 2023.[34]

Q. Was the PSPS limited to HFRZs?

A. No. In that case, fire weather conditions led to de-energization in seven Preventative Outage Areas in addition to all HFRZs.

Q. You have discussed operational conditions that PGE implements throughout its service territory. Does PGE modify its operating conditions during fire season?

A. Yes. At the start of fire season, PGE implements operational changes to reduce the risk that PGE infrastructure and operations could become ignition sources.[35] These operational changes include manually blocking the automatic test-energization of

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[31] *In re Investor-Owned Utilities Public Safety Power Sutt Off (PSPS) Reports*, Docket UM 2268, PGE 2022 Public Safety Power Shutoff (PSPS) Annual Report at 9 (Dec. 30, 2022), *available at* https://apps.puc.state.or.us/edockets/edocs.asp?FileType=HAA&FileName=um2268haa9441.pdf&DocketID=23578&numSequence=3 (PGE/319, Putnam-Nuñez-Gordanier/10).
[32] PGE/319, Putnam-Nuñez-Gordanier/13.
[33] OAR 860-300-0070(1).
[34] Docket UM 2268, PGE 2023 Public Safety Power Shutoff (PSPS) Annual Report (Dec. 22, 2023), *available at* https://apps.puc.state.or.us/edockets/edocs.asp?FileType=HAQ&FileName=um2268haq325792023.pdf&DocketID=23578&numSequence=4.
[35] PGE/317, Putnam-Nuñez-Gordanier/42.

circuits following temporary faults, such as momentary tree branch contacts and lightning strikes with no damage. During heightened fire risk conditions, when a fault occurs, breakers can instantaneously trip to turn off circuits for faster de-energization to minimize ignition risk. Additionally, when a fault occurs during fire season, PGE patrols the downstream circuit before re-energizing to verify that the cause of the fault has been cleared. While the Wildfire Mitigation Plan specifically requires these actions within the HFRZ, the Company may implement similar operational changes outside the HFRZ when the Company's modeling indicates that an area is experiencing heightened fire risk conditions.

Q. While PGE takes certain actions to reduce the probability of a transmission line igniting a fire, what actions does the Company take in the event an ignition occurs?

A. PGE closely monitors active wildfires in or near its distribution service area and generation asset areas in Oregon and Washington. As a fire expands in size and complexity, PGE contacts the appropriate agency-incident management team to offer PGE resource assistance at the incident command post. This strategy aims to enhance interoperability, share information, and promote collaboration with Public Safety Partners, utility peers, and state, Tribal, and local emergency managers to achieve shared objectives to serve the community and affected customers.[36]

Q. In addition to these actions mitigating the probability of fire ignition during operation of the Rosemont-Wilsonville Line, will PGE also implement procedures reducing the possibility of fire ignition during construction?

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[36] PGE/317, Putnam-Nuñez-Gordanier/44.

A. Yes. PGE provides annual wildfire operations and safety training to employees and contractors who will be working in the field during fire season to reduce ignition risk and maintain a safe working environment. Participants receive training that has historically covered topics such as fire suppression tools and equipment required during fire season,[37] basic suppression tactics, operational practices, and ignition reporting requirements.

Q. You also stated above that PGE follows vegetation management protocols to mitigate fire ignition risk. What are PGE's vegetation management protocols?

A. Outside of HFRZs, PGE's Routine Vegetation Management (RVM) involves cyclical patrols and removal of encroaching vegetation.[38] Under its RVM program, PGE inspects about one-third of its overhead distribution assets annually. RVM activities are ongoing year-round.

Q. What role does vegetation management play in reducing the probability of an ignition relating to the project?

A. Approximately 85 percent of ignitions identified by PGE resulted from contact with a foreign object, with trees and tree limbs comprising the majority. Vegetation management reduces the likelihood of foreign object contact, and for that reason is a key component of reducing the probability of a contact-related ignition.

Q. Do any standards govern PGE's vegetation management?

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[37] For purposes of the Wildfire Mitigation Plan, fire season is defined as "Period(s) of the year during which wildland fires are most likely to occur, spread, and affect resources sufficient to warrant organized fire management activities." PGE/317, Putnam-Nuñez-Gordanier/11. PGE declares the beginning and end of its fire season based on current and forecasted weather, drought status/timing and intensity, fuel availability and flammability, agency posture, and regional fire activity. PGE/317, Putnam-Nuñez-Gordanier/42. PGE bases its decisions on data and information from multiple sources and considers State and Tribal fire season declarations within its service area. *Id.*

[38] PGE/317, Putnam-Nuñez-Gordanier/73-74.

A. Yes. PGE performs cyclic patrols and trims vegetation to comply with applicable minimum conductor vegetation clearance standards, OAR 860-024-0016.

Q. What are those minimum conductor vegetation clearance standards?

A. For a 115-kV transmission line like the Rosemont-Wilsonville Line, OAR 860-024-0016(4)(b) requires that the Company maintain vegetation clearances of at least 7.5 feet under reasonably anticipated operational conditions. However, PGE follows a trimming cycle of three years and will trim vegetation to a clearance of 20 feet during its cyclical vegetation to prevent any growth from encroaching on these minimum clearances before PGE returns to trim vegetation again in the next cycle.[39] Additionally, larger vegetation clearances will reduce the likelihood of vegetation contact during adverse weather events, such as high winds.

Q. What does PGE inspect for on the cyclic patrols?

A. PGE inspectors evaluate all vegetation adjacent to PGE facilities both within and outside rights-of-way for sufficient clearance to avoid necessitating off-cycle pruning, and take into consideration vegetation species, growth habits, strength, and overall tree health.

Q. What actions do inspectors take when they identify concerning vegetation?

A. PGE inspectors create project-specific work layouts for vegetation contractors to complete while moving through the system and performing RVM activities. During the three-year standardized maintenance cycle, PGE vegetation contractors trim identified trees to PGE specifications to comply with OAR Division 24 Safety Standard, and American National Standards Institute A300 and OSHA Z133 guidelines.

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[39] PGE, *Vegetation Clearance Policy and Specifications* at 3 (Dec. 2020) (Protected PGE/320, Putnam-Nuñez-Gordanier/3).

Q. Are there other applicable clearance requirements that will apply to the Rosemont-Wilsonville Line?

A. Yes. In addition to the Commission's clearance requirements, because the Rosemont-Wilsonville Line will involve co-locating the transmission conductors on the same towers as distribution and other non-PGE utility lines, PGE will construct the line in accordance with PGE's T&D Standard LD29005, which meets or exceeds NESC 235.[40] T&D Standard LD29005 includes both minimum horizontal and vertical clearances between conductors. Horizontally, T&D Standard LD29005 requires that the project conductors **Begin Protected/**[redacted]**End Protected**. Vertically, the transmission conductors will **Begin** [redacted]**End Protected** from the PGE distribution lines below them.[41] These horizontal and vertical clearance requirements reduce the probability of conductor clash, which is one of the possible mechanisms in which powerlines can cause an ignition.

Q. You mentioned above that PGE's standardized vegetation maintenance occurs on a three-year schedule. Are there other scheduled inspections for the Rosemont-Wilsonville Line?

A. Yes. In addition to the standardized vegetation management, several other PGE programs include inspections of the Rosemont-Wilsonville Line, including the Company's Transmission Patrol Procedure, its Facilities Inspection and Treatment to the National Electrical Safety Code (FITNES) Program, and its Ignition Prevention Inspections (and Corrections).

Q. What is the Transmission Patrol Procedure?

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[40] Protected PGE/308.

[41] Protected PGE/308, Putnam-Nuñez-Gordanier/1-2.

A. The Transmission Patrol Procedure provides instructions for patrolling all active PGE 57-kV through 500-kV transmission lines. A copy of the Transmission Patrol Procedure is attached as Protected Exhibit PGE/321.

Q. What types of patrols are included in PGE's Transmission Patrol Procedure?

A. The Transmission Patrol Procedure details PGE's Air Patrol, Vehicle Patrol, and Ground Patrol.

Q. What does PGE assess in its Air Patrol inspections?

A. Air Patrols are intended to identify right-of-way, structure, insulator, and conductor issues.

Q. How frequently does the Company conduct its Air Patrols?

A. In general, 115-kV lines like the Rosemont-Wilsonville Line are inspected by Air Patrols annually.

Q. What is the purpose of the Vehicle Patrols?

A. Vehicle Patrols are intended to identify all issues found in Air Patrols, but also include more information about pole condition, grounding, and other observations not possible by air.

Q. How frequently does the Company conduct its Vehicle Patrols?

A. In general, all lines shall have an annual Vehicle Patrol.

Q. What are Ground Patrols?

A. Ground Patrols are a fully comprehensive inspection and are intended to find all exceptions visible at each structure.

Q. How does a Ground Patrol differ from a Vehicle Patrol?

A. A Ground Patrol may be conducted by using a vehicle or all-terrain vehicle but will differ from a Vehicle Patrol in that each structure is accessed and inspected at a distance of no more than 20 feet from the base of the structure. Additionally, in an effort to promote public safety, a Ground Patrol will also include proactive corrective actions of specific items that can be corrected by the patrolman at the time of the patrol, such as removing step bolts that are below 8 feet from the ground.

Q. How frequently does the Company conduct its Ground Patrols?

A. In general, all lines shall have a Ground Patrol every five years. Lines that have very good access and, therefore, get good Vehicle Patrols may be removed from the Ground Patrol schedule.

Q. What is the FITNES Program you mentioned above?

A. FITNES includes criteria for inspections to ensure that the Company's patrols include: (1) a pole structure review and fumigation of wooden utility poles; (2) a detailed, visual NESC inspection (to include measurements where appropriate) and inventory of electric and communications facilities; and (3) a visual inspection of PGE's facilities to identify specific types of equipment or environmental conditions (i.e., avian protection, leaching poles, etc.). A copy of PGE's FITNES Inspection Criteria is attached as Protected Exhibit PGE/322.

Q. Will these inspection protocols overlap?

A. Given the various inspection protocols, some inspection overlap may occur. Where overlaps occur, efforts are made to either combine activities or stagger their intervals to achieve efficiencies where feasible.

Q. If PGE identifies any concerns on its transmission lines during these inspections, when will the Company make any necessary repairs?

A. The frequency of repairs will vary depending on the concern to be remedied. The timeframe for making repairs is driven by priority and risk of each issue identified and is defined with PGE's Transmission and Distribution Hazard Classifications and Overhead Hazard Matrix documents. Imminent hazards, such as a broken transmission tower or conductor, are addressed immediately.

Q. Will PGE follow a Traffic Control Plan when constructing the Rosemont-Wilsonville Line?

A. Yes. PGE follows ODOT's *Oregon Temporary Traffic Control Handbook* and the Company's Traffic Control Plan for the Rosemont-Wilsonville Line includes: (1) Diagram 320, which covers total closure of one lane of a two-lane, two-way roadway; and (2) Diagram 620, which covers work within an intersection when normal traffic control must be interrupted.[42] Under Diagram 320, during total lane closures, PGE and its contractors must ensure the presence of flaggers, cones, and signage with differing requirements under specified conditions. For example, flaggers are required at each approach if any of the following conditions exist: (1) night operations; (2) workspace is over 200 feet in length; (3) sight distance is less than 750 feet from each approach through the land closure; and (4) traffic volumes are greater than 400 Average Daily Traffic. In addition, cones must be used to outline the workspace when curves or other roadway alignments prevent clear direction for the motorists to pass the workspace

[42] *See* ODOT, *Oregon Temporary Traffic Control Handbook for Operations of Three Days or Less* at 84-85, 118-19 (Sept. 2016) (PGE/323, Putnam-Nuñez-Gordanier/91-92, 126-27); PGE Traffic Control Plan for the Rosemont-Wilsonville Line (Protected PGE/324, Putnam-Nuñez-Gordanier/1-4).

safely. Cones along the workspace are also recommended when posted speeds are 45 mph or greater, when working under heavy traffic, or when travel lanes are narrower than 11 feet. The length between the "Flagger Ahead" signs from each approach must not exceed one mile. Extended queue signing must also be used when traffic queues extend beyond the initial advance warning sign.

Under Diagram 620, PGE must ensure that traffic signals are turned off at the intersection as well as the presence of flaggers and signs that must follow certain spacing and buffer lengths based on certain conditions. For example, flaggers can only be a maximum of 100 feet from the intersection. While there should generally be one flagger for each approach, one flagger may control two adjacent approaches if sight distance, low volumes on side roads, and flagger position allows for safe operation and clear direction to motorists. One flagger may also be used for low traffic intersections where there are fewer than 400 vehicles entering per day. In addition, sign spacing and buffer lengths are dependent on posted speed at the intersection. For example, for a posted speed limit of 35 mph, the spacing between signs must be 350 feet with a buffer length of 125 feet.

Q. Does this conclude your testimony?

A. Yes.

List of Exhibits

PGE Exhibit	**Description**
PGE/301	Typical Structure Specifications
PGE/302 **P**	LD20020 – General Loading Requirements for Overhead Lines T&D Standard
PGE/303 **P**	LD20030 – Overhead Conductor Loading Requirements T&D Standard
PGE/304 **P**	LD20055 – Grades of Construction, Load Factors, and Strength Factors T&D Standard
PGE/305 **P**	LD29002 – Vertical Clearance of Wires, Conductors, and Aboveground Cables T&D Standard
PGE/306 **P**	LD29003 – Clearance Between Wires, Conductors, and Cables Carried on Different Support Structures T&D Standard
PGE/307 **P**	LD29004 – Clearance of Wires, Conductors, Cables, and Equipment from Buildings, Bridges, Rail Cars, Swimming Pools, and Other Installations T&D Standard
PGE/308 **P**	LD29005 – Clearance of Wires, Conductors, Cables, and Equipment from Buildings, Bridges, Rail Cars, Swimming Pools, and Other Installations T&D Standard
PGE/309 **P**	LD29006 – Climbing Space and Working Space T&D Standard
PGE/310 **P**	Concrete Drilled Pier Foundation Specification
PGE/311 **P**	Direct Embed foundation Specification
PGE/312	Leon Kempner Jr. et al., Seismic Effects on Transmission Lines and Their Major Components (2018)
PGE/313	GRI, Geotechnical Design Report PGE Tonquin 115-kV Transmission Line Rosemont-Wilsonville Segment (Aug. 9, 2022)
PGE/314	Declaration of Kevin Putnam
PGE/315	HMW Safety Overview
PGE/316	PGE's 2023 Wildfire Mitigation Plan

PGE/317	PGE’s 2024 Wildfire Mitigation Plan
PGE/318	Daisy Caballero, KGW8, PGE to Add More AI Cameras, Including One in Timberline Lodge on Mount Hood, to Detect Wildfires (July 20, 2023)
PGE/319	2022 PSPS Annual Report
PGE/320 **P**	Vegetation Clearance Policy and Specifications (Dec. 2020)
PGE/321 **P**	PGE’s Transmission Patrol Procedure
PGE/322 **P**	Facilities Inspection and Treatment to the National Electrical Safety Code (FITNES) Program
PGE/323	ODOT’s Oregon Temporary Traffic Control Handbook (2016)
PGE/324 **P**	Traffic Control Plan

P – Protected Information

PGE/301

Typical Structure Specifications

PGE

TONQUIN SUBSTATION PROJECT
TYPICAL STRUCTURE SPECIFICATIONS

SINGLE CIRCUIT PROPOSED STRUCTURES

Visualizations are for discussion purposes only.
Final design is subject to change pending public, engineering, and regulatory review.

PGE An Oregon kind of energy.℠

PGE

TONQUIN SUBSTATION PROJECT
TYPICAL STRUCTURE SPECIFICATIONS

DOUBLE CIRCUIT PROPOSED STRUCTURES

Visualizations are for discussion purposes only. Final design is subject to change pending public, engineering, and regulatory review.

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PGE/302 – PGE/311

contain protected information

and are subject to

General Protective Order 23-132

PGE/312

Leon Kempner Jr. et al., Seismic Effects on Transmission Lines and Their Major Components (2018)

Seismic Effects on Transmission Lines and Their Major Components

Leon Kempner Jr., Ph.D., P.E., M.ASCE[1]; Scott Schlechter, P.E., G.E.[2]; and Asim Haldar, Ph.D., P.Eng.[3]

[1]Principal Structural Engineer, Bonneville Power Administration, TEL-TPP-3, PO Box 61409, Vancouver, WA 98666. E-mail: lkempnerjr@bpa.gov
[2]Assoicate, Geotechnical Resources, Inc., 9725 SW Beaverton-Hillsdale Hwy., Suite 140, Beaverton, OR 97005-3364. E-mail: sschlecther@gri.com
[3]Technical Advisor, CEATI International, 1010 Sherbrooke St. West, Suite 2500, Montreal, QC, Canada H3A 2R7. E-mail: asim.haldar@ceati.com

ABSTRACT

Transmission lines and their major components are critical infrastructure for electrical power transmission. The state-of-the-art for the design of transmission line structures is commonly governed by wind/ice combinations and broken wire loads. However, earthquake effects are not commonly considered in transmission line structural design, even in high risk seismic areas. This paper presents information from a CEATI project, 2017, to investigate the seismic performance of transmission line structures. A survey conducted as part of this project shows that the majority of utilities do not consider seismic loading and associated geotechnical hazards in the design of new or retrofitting existing transmission line structures. This paper reviewed numerous case histories regarding the seismic performance of transmission line structures that documented the primary source of damage to transmission lines as a result of geotechnical-related seismic hazards.

INTRODUCTION

Transmission line structures are a vital component of the lifeline system that transport high-voltage electric power over intermediate to long distances from power generating stations to distribution centers. Major components of transmission lines include towers, foundations, insulators, conductors, and ground wires. The design of transmission line structures are typically governed by national or regional codes such as National Electrical Safety code [NESC 2017], Canadian Electrical Code CSA 22.3 [CSA 2010], International Electrotechnical Commission [IEC 2003], and California General Order 95 [GO95 1997]. These codes specify that the main design loads for transmission structures consist of conductor weights and environmental loads, such as wind and ice or a combination of both, acting on the cables and towers. In some cases, loads due to cable breakages and ice-shedding effects are also considered in design of the transmission line structures. However, these codes do not consider the seismic effects even though serious damage to transmission lines and their major components has been documented in numerous case histories in recent and past earthquakes. For example, during the 1994 Northridge earthquake in California transmission towers experienced a wide range of damage, ranging from bent members that were easily replaced to severe footing displacements resulting in collapse of two towers [Kuhn 1997, Hall 1995]. Similarly, the 1995 Kobe earthquake in Japan led to extensive damage of power infrastructure, which included 38 high-voltage transmission lines, 446 distribution lines, and many transmission towers [Liu & Tang 2012]. These case histories demonstrate the need for evaluation of the seismic effects in design of transmission line structures and foundations especially in high seismic areas. This paper examines the performance of transmission line structures in historical seismic events and the mechanism of seismic load transfer to both transmission structure and foundation, including soil-structure-interaction (SSI) effects and soil liquefaction

LITERATURE REVIEW

In the USA, transmission line towers are generally designed in accordance with National Electrical Safety Code [NESC 2017] and American Society of Civil Engineers Manual of Practice No. 74 [ASCE 2009]. In regard to consideration of earthquake loading, the NESC states in Section 250.4, “The structural capacity provided by meeting the loading and strength requirements of Sections 25 and 26 provides sufficient capability to resist earthquake ground motions.” Similarly, ASCE-74 states in Section 3.6, “Transmission structures need not be designed for ground-induced vibrations caused by earthquake motions because, historically, transmission structures have performed well under earthquake events, and transmission structure loadings caused by wind/ice combinations and broken wire forces exceed earthquake loads.”

The Canadian high-voltage transmission line standard, Design Criteria of Overhead Transmission Lines [CSA 2010] follows the basic criteria of the International Electrotechnical Commission Design Criteria for Overhead Transmission Lines [IEC 2003]. IEC 60826 specifically states that earthquake loads are not covered in this loading standard and gives no other guidance. It can be assumed that this means that CSA C22.3 also does not have any seismic load criteria.

The European Standard, EN 50341-1 [EN 2000] provides a general comment regarding seismic loads in Annex C, Section C.4. This section starts with the following statement: “Since wind loadings are usually the more determining factor on lattice type overhead line towers.” The Standard states that seismic loads may lead to additional loading forces in very active seismic zones. It then lists some of the parameters that determine a seismic load such as natural period of vibration; site-structure resonance; and height, weight, and mass distribution of the support structure. The standard does state that the frequency of the support is higher than that of the conductors and the dynamic load from the conductors is not significant to the structure and vice versa. The annex does mention that ground acceleration due to earthquakes may influence the design of rigid and heavy concrete structures.

The European Standard, Eurocode 8: Design of Structures for Earthquake Resistance – Part 6: Towers, Masts, and Chimneys [EN 2005] provide some guidelines for transmission tower seismic analysis in Section 7.5: Special Rules for the Design of Electrical Transmission Towers. Annex F, Electrical Transmission Towers, states that wire support structures (transmission, distribution, and substation) are typically controlled by wind loads, often combined with ice loads, or by unbalanced longitudinal loads. The seismic design situation generally does not control their design, except when it includes high ice loads. The document also states that earthquake performance of these structures has demonstrated that seismic loads can be resisted based on traditional wire support structure loads. It additionally states that damage to these structures is often due to large displacements of the foundations as the result of landslides, ground fracture or liquefaction and that these effects normally lead to local structural failure or damage, without a complete loss of the integrity and the function of the structure. Section 4.2.2.(2) of EN 1998-6 states that the model used to determine seismic loads should include as a minimum at least three consecutive towers so that the cable mass and stiffness is representative of the conditions of the central tower. Section 7.5 states that the cable tension effects caused by the relative movement of two adjacent towers are accounted for by assuming the towers move statically in the most adverse direction. The assumed relative displacement should be equal to twice the design ground displacements under the assumption that the towers are fixed at their base.

The Indian Standard, Use of Structural Steel in Overhead Transmission Line Towers – Code of Practice, Part 1 Materials, Loads and Permissible Stresses, Foreword [IS 1995], states the occurrence of earthquake and maximum wind pressure is an unlikely loading scenario. However, in earthquake prone areas, the design of towers/foundations shall be checked for earthquake forces corresponding to no wind and minimum temperature in accordance with “Criteria for Earthquake Resistant Design of Structures” [IS 1995]. This document provides the structure importance category and parameters for determining the input ground motions for the evaluation of the towers, but provides no transmission line modelling guidance.

A literature review has indicated that transmission line systems may still incur structural damage or may fail due to the earthquake inertial loading, particularly in areas of low wind and ice design loads and high seismicity [El-Attar 1997]. In high seismic zones damage to transmission line components was observed during the 2007 Kashiwazaki [2012], 2008 Wenchuan [Tang 2014] and 2011 Tohoku [Eidinger et al. 2012] earthquakes. However, as noted in the European Standard, the most common damage to transmission lines results from earthquake-induced ground failures, which affect the tower foundations [Hall 1995, Tang & Schiff 2007, Tang 2014, Eidinger et al. 2012, Schiff 1991, Tohma et al, 1996, Roche et al, 1997, Uzarski & Arnold 2001, Eidinger & Tang 2012, Kazamaa & Noda 2012, Tang & Eidinger 2013, Eidinger el at. 2014, Kwasinski et al. 2014]. The tower foundation failures are mainly the result of seismically induced slope instability, landslides, liquefaction-induced settlement (i.e., excessive vertical settlement at support structures, and differential settlement between the supporting structures), and lateral spreading. In addition, the earthquake damage to transmission line systems can occur in the form of surface fault rupture offsetting the towers and their footings [Eidinger & Tang 2012, Kwasinski et al. 2014, Youd el at. 2000, EERI 1992], rock falls and debris flows from adjacent slopes impacting the tower members [Tang 2014, Eidinger & Tang 2012], tsunami inundation [Eidinger et al. 2012, Kazamaa & Noda 2012], and tower pull-down due to the failure of a neighboring tower [Hall 1995, Roche et al, 1997, Tang & Eidinger 2013]. The majority of case histories reviewed suggest that, in the absence of geotechnical hazards, transmission lines commonly experienced relatively minimal damage or no damage during moderate to large earthquakes [Comartin 1995, Schiff 1998, Eidinger 2001, Lund & Sepponen 2003, Tang 2013].

CASE HISTORIES

The following presents a brief discussion of case histories and highlighting the seismic damage to transmission lines and their major components.

1994 Northridge Earthquake, Los Angeles: The Northridge earthquake originated about 30 km west-northwest of downtown Los Angeles with an epicenter beneath Northridge. The moment magnitude of the earthquake was Mw 6.7 with duration of strong shaking ranging from 10 to 12 seconds [6]. Several recorded accelerations within 25 km of the epicenter indicated a peak ground acceleration values as high as 0.9 g [6].

The Northridge earthquake caused extensive damage to a number of electrical facilities in the greater Los Angeles area. In general, transmission towers experienced a wide range of damage ranging from bent members that were easily replaced to severe footing displacements resulting in collapse of two towers [Kuhn 1997, Hall 1995]. The two collapsed transmission towers carried four 230 kV and six 66 kV conductors, respectively. These towers were located near the top of a ridge or edge of a steep slope, and their collapse was triggered by seismically induced slope movements that created relative movement and failure of the foundation. The collapse of the 66 kV tower resulted in broken conductors which initiated the collapse of four adjacent 66 kV towers. The initiating collapse of the 66 kV tower was caused by differential displacement of the foundation with one of the piers moving 12 in. laterally and 2 in. vertically downward relative to the others. The earthquake also caused tilting of six 220 kV towers as a result of footing failure caused by landslides [Roche et al. 1997]. Differential landslide movement caused damage to bracing members in over 70 additional towers [Kuhn 1997, Hall 1995].

1995 Hyogo-Ken Nanbu Earthquake, Japan: This earthquake was assigned a magnitude of 7.2 by the Japan Meteorological Agency (JMA), which is equivalent to Mw of 6.9 and produced a surface rupture with an average horizontal displacement of 1 to 1.5 meters [Comartin et al. 1995]. The duration of the strong ground shaking was short, typically less than 10 to 15 seconds; however, it exhibited high peak accelerations with a maximum of 0.84g recorded in central Kobe [EQE 1995]. The earthquake resulted in widespread ground failure primarily because of liquefaction throughout the strongly shaken Kobe-Osaka region [EQE 1995]. The overall performance of transmission lines and its major components was relatively good [Shinozuka 1995]. Table 1 summarizes damage to the transmission line and its major components. It is important to note however, that these damages did not significantly disrupt the operation of the transmission lines [Shinozuka 1995].

Table 1: Transmission line damage, 1995 Hyogo-Ken Nanbu Earthquake

Voltage	Lines damaged	Towers slightly damaged	Conductors damage	Insulators broken
275 kV	-	2	-	13
154 kV	3	1	-	26
77 kV	7	16	1	3
22 kV	-	1	2	-

1999 Chi-Chi Earthquake, Taiwan: The Chi-Chi earthquake had a magnitude Mw 7.6 and induced strong ground shaking for about 20 to 30 seconds. The earthquake induced thousands of landslides in the mountainous region around the epicenter, resulting in failures of large numbers of transmission lines and towers. Table 2 provides a summary of transmission line and tower damage mechanisms observed after the earthquake [Shih 1999]. It should be noted that the transmission towers were generally designed for typhoon wind loading with a speed of 61.9 m/s [Brunsdon et al. 2000]. The 345 kV tower collapsed when support for two of the tower legs was lost due to an earthquake-induced landslide [Brunsdon et al. 2000].

Table 2: Transmission line damage, 1999 Chi-Chi Earthquake [Shih 1999]

Voltage	Lines	Towers					
	Damaged	Collapsed	Tilted	Deformed	Footing Failure	Footing Displ.	Total
345 kV	28	1	9	55	271	19	355
161 kV	30	9	4	9	131	4	157
69 kV	21	3	16	3	64	2	83

2001 Gujarat Earthquake, India: The magnitude Mw 7.7 earthquake produced strong ground shaking which devastated the region and caused substantial damage to lifelines [Eidinger

2001]. The earthquake resulted in a widespread liquefaction and slope failures. However, there were few towers affected by the liquefaction and slope failures [Jain et al. 2002].

2008 Wenchuan Earthquake, China: This earthquake was a Mw 7.9. Landslides commonly displaced tower foundations on the order of 10s (or 100s) of feet in the mountainous region impacted by the earthquake. Numerous transmission towers failed due to landslide induced ground/foundation displacement or rock fall (boulder) impact. One tower (Tower No.13 in Guangyuan) collapse was reportedly due to inertial loading [Tang 2014]. However, personal communication with a researcher at Tonji University suggest that the cause of failure for this particular tower is unknown or unidentified [Xie 2015]. A 200 km roadway survey, conducted by the American Society of Civil Engineers Technical Council on Lifeline Earthquake Engineering investigation team, estimated that 1 in 100 towers failed due to a landslide. In several instances, landslide induced collapse of one tower resulted in pull-down failure of an adjacent tower [Tang 2014].

2010 Maule Earthquake, Chile: The Mw 8.8 Maule earthquake struck the west coast region of Maule in central-southern Chile. This earthquake was an interplate subduction event along the boundary of the Nazca plate and the South American plate with a rupture zone estimated to be about 600 km in length [Evans & McGhie 2011]. The earthquake generated strong ground shaking that lasted for approximately three minutes. The mainshock was closely followed by a destructive tsunami and more than 200 aftershocks of magnitude 6 or higher in the first week after the main event [Tang & Eidinger 2013]. The damage to transmission lines were limited to the collapse of three 154 kV towers at a river crossing near the mouth of the Bio River in the Concepción area [Tang & Eidinger 2013]. All three towers were supported on piles extended above the river to keep them above flood stage. The collapse of one of the towers was attributed to liquefaction failures on one side of the tower. The failure photos also indicate the piles failed structurally above grade. Two adjacent towers were pulled down by the first tower failure.

2010 to 2011 Christchurch Earthquake Sequence, New Zealand: The Christchurch Earthquake Sequence consisted of a series of three large earthquakes near the City of Christchurch in 2010 to 2011. The sequence includes the initial magnitude Mw 7.1 Darfield earthquake on September 4, 2010, and Mw 6.3 and 6.0 earthquakes on February 22 and June 13 of 2011, respectively. The peak ground acceleration recorded during the September 2010 event was between 0.5 g and 0.9 g near the epicentral region. During the February 2011 event, the recorded motions indicated a peak acceleration of 0.5 g and 0.9 g in the central business district and the Port Hills area (southeast of the central business), respectively [Eidinger & Tang 2012]. A number of transmission towers were affected following the September 2010 event and the majority of the damage was caused by surface rupture, rock fall, liquefaction induced settlement and lateral spreading causing towers tilting, conductor sagging and insulators being pulled out of alignment. The fault rupture from the September event generated a zone with about 4 meters of offset which crossed two single circuit 220kV transmission lines, the Benmore-Islington (BEN-ISL-A) and the Roxburgh-Islington (ROX-ISL-A), and resulted in unbalanced conductor sags on either side of the fault [Eidinger & Tang 2012]. Soil liquefaction caused tilting of four 220 kV towers due to differential settlement of footings of the steel lattice towers. Liquefaction-induced damaged was not documented for the 66 kV, 33 kV and 11 kV lines; however, a few insulators were damaged on the 33 kV and 11 kV overhead lines [Kwasinski et al. 2014].

The 2011 earthquakes had relatively modest impact on transmission systems. Although liquefaction (i.e., evidenced by sand boils approximately 4 in to 12 in deep) was observed in close proximity to many of the 220 kV steel lattice transmission towers, tower operations were not compromised and damage was limited to several cases of secondary braces bowing from differential leg displacement [Kwasinski et al. 2014]. And, in one case, damage to a 66 kV transmission tower was observed in the Port Hills area due to rock fall that impacted the secondary members of the tower [Kwasinski et al. 2014].

Table 3: Type of transmission tower damage
(✓= Yes, ✗ = No, NA = Information not available)

Year	Earthquake	Moment Magnitude, Mw	Tower collapse	Tower tilt	Member damage	Conductor damage
1989	Loma Prieta, California [Schiff 1998]	6.9	✗	✗	✗	✗
1990	Philippines [Schiff 1991]	7.8	✓	NA	NA	✓
1992	Landers and Big Bear, California [EERI 1992]	7.4 and 6.5	✗	✓	✓	✗
1993	Guam [Comartin 1995]	8.1	✗	✗	✗	✗
1994	Northridge, California [Hall 1995, Roche et al. 1997]	6.7	✓	✓	NA	✓
1995	Hyogoken-Nanbu (Kobe), Japan [Tohma et al. 1996]	6.9	✗	✗	✓	✓
1999	Chi-Chi, Taiwan [Uzarski & Arnold 2001]	7.6	✓	✓	✓	✓
1999	Kocaeli, Turkey [Youd et al. 1996]	7.4	✗	✓	✗	✗
2001	Gujarat, India [Eidinger 2001]	7.7	✗	✗	✗	✗
2001	El Salvador [Lund & Sepponen 2003]	7.6	✗	✗	✗	✗
2001	Molise, Italy [Rasulo et al. 2000]	5.9	✗	✗	✗	✗
2007	Kashiwazaki, Japan [Tang & Schiff 2007]	6.7	✗	✓	✓	✓
2008	2008 Wenchuan, China [Tang 2014]	7.9	✓	NA	✓	✓
2009	West Sumatra, Indonesia [Tang 2013]	7.6	✗	✗	✗	✗
2010	Maule, Chile [Tang & Eidinger 2013]	8.8	✓	NA	NA	✓
2010-11	Christchurch Earthquake Sequence, New Zealand [Eidinger & Tang 2012, Kwasinski et al. 2014]	7.1,6.3, and 6.0	✗	✓	✓	✓
2011	Tohoku, Japan [Eidinger et al. 2012, Kazamaa & 2012]	9.0	✓	NA	NA	✓
2018	Lushan, China [Eidinger 2014]	6.6	✓	✗	✗	✗

Table 4: Relative contribution of Geologic Hazards to the damage to transmission structures due to historical earthquakes
(H = High, M = Moderate, L = Low, N = None, NA = Information not available)

Year	Earthquake	Mw	Landslide	Rockfall	Liquefaction	Lateral spreading	Fault rupture	Tsunami inundation
1989	Loma Prieta, CA [Schiff 1998]	6.9	N	N	N	N	N	N
1990	Philippines [Schiff 1991]	7.8	**H**	N	**H**	NA	N	N
1992	Landers and Big Bear, CA [EERI 2002]	7.4 and 6.5	N	N	N	N	**H**	N
1993	Guam [Comartin 1995]	8.1	N	N	N	N	N	N
1994	Northridge, CA [Hall 1995, Roche 1997]	6.7	**H**	N	N	N	N	N
1995	Hyogoken-Nanbu (Kobe), Japan [Tohma et al. 1996]	6.9	**H**	N	N	N	N	N
1999	Chi-Chi , Taiwan [Uzarski & Arnold 2001]	7.6	**H**	N	N	N	N	N
1999	Kocaeli, Turkey [Youd et al. 2000]	7.4	N	N	N	N	**H**	N
2001	Gujarat , India [Eidinger 2001]	7.7	N	N	N	N	N	N
2001	El Salvador [Lund & Sepponen 2003]	7.6	N	N	N	N	N	N
2002	Molise, Italy [Rasulo et al. 2000]	5.9	N	N	N	N	N	N
2007	Kashiwazaki, Japan [Tang & Schiff 2007]	6.7	**H**	N	N	N	N	N
2008	Wenchuan, China [Tang 2014]	7.9	**H**	**H**	N	N	N	N
2009	West Sumatra, Indonesia [Tang 2013]	7.6	N	N	N	N	N	N
2010	Maule, Chile [Tang & Eidinger 2013]	8.8	N	N	**H**	N	N	N
2010 - 11	Christchurch Sequence, NZ [Eidinger & Tang 2012, Kwasinski et al. 2014]	7.1, 6.3, and 6.0	N	**M**	**H**	NA	L	N
2011	Tohoku, Japan [Eidinger et al. 2012, Kazamaa & Noda 2012]	9.0	**M**	N	N	N	N	**H**
2013	Lushan, China [Eidinger et al. 2014]	6.6	**H**	N	N	N	N	N

2011 Tohoku Earthquake, Japan: The Tohoku earthquake is one of the strongest and longest duration (approximately 6 minutes) earthquakes recorded worldwide. The earthquake had a moment magnitude of Mw 9.0 and was a result of thrust faulting on the subduction zone interface plate boundary between the Pacific and North American Plates [EERI 2011]. The earthquake occurred along the Pacific Coast of Tohoku on March 11, 2011. A peak ground acceleration (PGA) as high as 2.7 g was recorded during this earthquake (i.e., at K-Net Tsukidate station). The earthquake was immediately followed by a catastrophic, large-scale tsunami that inflicted a wide-range of damage to transmission infrastructure and the Fukushima Daiichi nuclear power plant [EERI 2011]. The earthquake resulted in damage to approximately 32 conductors/insulators and the collapse of 42 high voltage steel lattice towers. All of the tower collapses, except two, were attributed to tsunami inundation that impacted the transmission towers with floating cars, containers, and other types of debris [Eidinger et al. 2012]. The remaining two tower failures were caused by landslides.

2013 Lushan Earthquake, China: The magnitude Mw 6.6 earthquake occurred on an adjacent fault segment to the one that ruptured during the 2008 Wenchuan earthquake [Eidinger et al. 2014]. This earthquake was a smaller magnitude event than the 2008 Wenchuan earthquake and significantly less damage to the electrical transmission system was observed. Hundreds of towers in the earthquake affected region were located on mountain ridge lines where it was estimated that they experienced PGA's from 0.25 g to 0.70 g. However, the ASCE Technical Council on Lifeline Earthquake Engineering investigation team did not observe significant damage to transmission towers other than the one transmission tower collapse, which was likely due to a landslide [Eidinger et al. 2014].

Summary of Types and Causes of Seismic Damage to Transmission Line Structures

The brief discussion of seven case histories on the seismic performance of transmission lines and their major components have highlighted that the primary source of seismic damage are due to geologic hazards such as rock fall, liquefaction, lateral spreading, landslide and fault rupture, and tsunami. A number of case histories showed extensive damage to transmission towers located on the edge of steep slopes due to ridge shattering. There was only reported case of a tower collapse potentially due to inertial loading, which occurred during the 2008 Wenchuan earthquake, but this conclusion is unsubstantiated. It should be noted that most of these case histories lack information on the soil conditions and foundation types.

A summary of the types and causes of damage from historical earthquakes is provided in Table 3, noting the type of tower damage during a larger group of earthquakes. Since almost all of the earthquake damage has been caused by geologic hazards rather than inertial loading, Table 4 has been developed to summarize the relative contribution of geologic hazards to the tower damage.

Based on historic earthquake performance of transmission line structures, and literature review, it has been demonstrated that the seismic vulnerability of transmission structures to inertia loads due to ground motion do not control their design. Traditional extreme loads (wind, ice, unbalance tensions, etc.) provide adequate structural capacity for earthquake events. Evaluating transmission line structure for seismic criteria is not a simple task. They are a distributed infrastructure of multiple structure configurations (varying heights, body and leg extensions, etc.) in a complex linear system (varying spans lengths, line angles, conductors, etc.) distributed along a varying terrain. The conductor system(s) can act as a mass damper to reduce inertia loading affects. For special transmission line configurations, such as a major river-crossing, it may be possible to simplify modelling assumptions for seismic evaluation in high seismic zones, wherein the conductor span slack should be adequate to accommodate the relative movement of the towers. This is important for the rare cases when the span(s) are dead-end at both tower connections.

GEOTECHNICAL SEISMIC DESIGN CONSIDERATIONS

The literature review completed as part of this project indicates almost all of the seismic damage to transmission lines and their major components are due to geotechnical related seismic hazards. These seismic hazards include strong ground shaking, surface fault rupture, seismically induced ground deformation (liquefaction, lateral spread, settlement, and slope failure), landslide, rockfalls and secondary effects such as tsunamis debris inundation. In this regard, local site conditions such as soil characteristics, groundwater, and topography are all key factors in the performance of transmission structures. For instance, the presence of saturated, loose, granular soil deposits adjacent to a water body may result in liquefaction and lateral spreading during a design level earthquake. Alternatively, transmission lines located on the tops of hills and ridges suffer more intense damage due to the risks associated with seismically triggered ridge-top shattering, landslides, and rockfalls. The literature review and survey (not provided in this paper) of practice indicates that the inertial loading of towers is rarely evaluated or a controlling design case. In general, the potential for geotechnical seismic hazards needs to be considered and assessed in design and construction of transmission lines and their major components in order to achieve desirable seismic performance. The geotechnical hazards from landslides, rockfalls, and tsunami debris inundation in general can be addressed with site selection and/or protective structures. Liquefaction, lateral spreading, and subsequent differential settlement can also be addressed with foundations design and soil mediation. Because of the limitation of this paper, and the available published resources for foundation engineering, only a brief discussion on liquefaction evaluation is presented.

Transmission Structures Response to Liquefaction-Induced Foundation Movements

The liquefaction-induced ground deformations resulting from earthquakes have been identified as a potential source of significant damage to transmission lines and their major components (e.g., 154 kV tower collapse during 2010 Maule earthquake, 220 kV towers tilting during 2010 and 2011 Christchurch earthquakes). The ground deformation can take various forms and is often excessive, non-uniform and involves large permanent vertical displacements (settlement) and lateral displacements commonly resulting in large cracks and fissures in the ground. Transmission structures supported on shallow foundations located above or in liquefiable soil deposits where the ground is level can also experience excessive settlement due to bearing capacity failure and soil densification. Transmission structure foundations extending completely through liquefiable soils, such as piles or drilled shafts, can be damaged from the deformations and stresses to which they are subjected as a result of a loss of axial and lateral support, as well as downdrag from settlement of the surrounding soils. In sloping ground close to waterways (e.g. river banks, streams), where there is gentle or abrupt grade change, transmission structures can be subjected to lateral forces and displacements due to the tendency of the liquefied soil stratum and overlying layers to undergo lateral deformation in the down-slope direction. In general, the overall procedure for analyzing transmission structures subjected to liquefaction-induced deformation involves the following evaluation steps:

1. **Site and soil characterization:** includes interpretation of local geology, review of historical records with respect to liquefaction, subsurface investigation (CPT, SPT and shear wave velocity data) and laboratory testing,
2. **Select the seismic hazard level and determine the design earthquake(s***)*: includes selection of the appropriate deterministic or probabilistic seismic hazard level identified by the governing design code and/or agency-specific design standard for the type and importance of transmission structure. If a probabilistic method is to be used, identify the significant contributing seismic sources at the site and determine the appropriate earthquake parameters (e.g., peak ground acceleration, PGA and earthquake magnitude, Mw),
3. **Liquefaction triggering analysis**: conducted to determine whether soil layers are going to liquefy during a particular earthquake,
4. **Liquefaction-induced ground deformation**: estimated for a free-field level ground or sloping ground condition,
5. **Impacts of liquefaction on transmission structure foundations**: includes loss of bearing capacity of shallow foundations, and large lateral loads on deep foundations which might affect the integrity of the foundation,
6. **Impacts of liquefaction on transmission structures:** includes coordination between the structural and geotechnical engineer to evaluate foundation displacements (vertical, horizontal, or rotation). The foundation displacements or soil loads can be applied as boundary conditions in the structural analysis model to determine if the demand on system components (conductors, ground wire, support structure, etc.) exceeds their capacities and if the structural displacement results in additional demands that exceed the capacity of the foundations.

SUMMARY OF SEISMIC RISK MITIGATION MEASURES BY UTILITIES

Almost all of the seismic damage to transmission towers has been associated with ground failures that affect tower foundations. Therefore, the seismic risk mitigation measures by utilities are generally focused on tower foundation upgrade and/or ground improvement. For instance, BC Hydro upgraded the foundation of some of its towers by replacing timber piles with concrete filled steel pipe piles which can accommodate large seismically induced deformations [Good et al. 2009]. A number of utilities have used foundation interconnecting bracing to reduce the seismic damage to their towers since the foundation bracing has the potential to resist the differential movement of the footings [Good et al. 2009]. Another widely used seismic risk mitigation measure is ground improvement. A ground improvement berm or zone of densified soil can be built around a tower site to reduce the potential for occurrence of liquefaction and flow sliding [Good et al. 2009]. Commonly used ground improvement methods include stone columns, deep soil mixing (DSM), non-structural timber displacement piles, compaction grouting, and blast densification. For instance, recently the Bonneville Power Administration (BPA) identified four locations along the Columbia and Willamette Rivers near Portland, where existing transmission crossings may be vulnerable to seismic damage, and is considering implementing mitigation measures such as use of deep soil mix (DSM) grids or stone columns to control seismic-induced lateral displacements, piles to control post-cyclic settlements, and connecting the individual tower leg footings with grade beams to restrict foundation movements [Beaty et al. 2014]. Similarly, BC Hydro implemented a ground improvement program for several of their critical river crossing towers to seismically upgrade the towers and reduce the risk of liquefaction induced lateral deformations [Good et al. 2009].

CONCLUSIONS

The results of this study indicate that inertial earthquake loading is not commonly taken into account in transmission tower structural design due to satisfactory performance of transmission lines observed in historical earthquake events. Case histories reviewed shows that the majority of damage to transmission towers during earthquakes is due to geotechnical hazards such as liquefaction, lateral spreading, and earthquake induced landslides and rockfall. The study has highlighted that the majority of the electrical utilities surveyed do not consider inertial seismic loading and many associated geotechnical hazards in design of new or retrofitting of existing transmission structures; transmission line tower strengths are controlled by traditional loads such as extreme wind, ice and wind, unbalanced longitudinal loads, etc. The results of the CEATI project indicate that it is important to consider seismic geotechnical hazards when siting a transmission line. Foundation performance during a seismic event is important to the reliability of the transmission line. At present, there are no established target acceptable deformations for transmission line structures at varying seismic hazard levels. The use of performance-based design guidelines has become the standard of practice for other industries such as transportation, port facilities, and some building applications. These performance-based design guidelines typically outline acceptable deformations or performance levels for selected hazard levels and can vary based on the importance of the structures. Although the inertial loading of transmission line towers may not control the structural design of transmission lines, the associated geotechnical hazards can control the design of foundations and performance of structures if not considered. Therefore, it is recommended especially in areas of high seismicity, that the Utility establish and/or utilize guidelines that define geotechnical and structural performance objectives for their transmission line structures at selected design level earthquake(s). At a minimum, the guidelines should provide: 1) a definition for typical design-level earthquakes, 2) an outline for seismic assessment/design of transmission line towers, 3) seismic performance objectives of transmission towers and foundations, 4) transmission tower foundation displacement limits due to seismically induced ground deformations, 5) earthquake-induced landslide assessment and mitigation strategies, and 6) discussion of seismic vulnerabilities of rigid post insulators, lack of wire slack, etc. due to non-inertial loads.

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GRI, Geotechnical Design Report PGE Tonquin 115-kV

Transmission Line Rosemont-Wilsonville Segment (Aug. 9 2022)

Geotechnical Design Report Portland General Electric

PGE Tonquin 115-kV Transmission Line

Rosemont-Wilsonville Segment

West Linn to Wilsonville, Oregon

August 9, 2022

Prepared for

Portland General Electric
Line Design Engineering
3700 SE 17th Avenue
Portland, OR 97202

Prepared by

GRI

16520 SW Upper Boones Ferry Road, Suite 100
Tigard, OR 97224-7661
(503) 641-3478 | www.gri.com

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1 INTRODUCTION

As requested, GRI is providing geotechnical services for design of the proposed Portland General Electric (PGE) Tonquin 115-kV Transmission Line project. The PGE Tonquin project has been divided into three phases: the Rosemont-Wilsonville Segment, the Mcloughlin-Tonquin Segment, and the Sherwood-Wilsonville Segment. The investigation summarized in this report focuses on the Rosemont-Wilsonville Segment. Investigations for the other two phases are being completed under separate work scopes and will be addressed in separate reports. The project alignment for the Rosemont-Wilsonville Segment is shown on the Vicinity Map, Figure 1. All figures referenced in this report are included in Appendix A, Geotechnical Data Report.

The purpose of our services was to evaluate the subsurface conditions at transmission line pole locations selected by you and provide design recommendations for new foundations. Our services to date have included a review of available subsurface and geologic information for the site and surrounding area, coordination and completion of subsurface explorations, geotechnical analysis and design, and preparation of a Geotechnical Data Report and this Geotechnical Design Report.

2 PROJECT DESCRIPTION

Information provided by PGE indicates the new Rosemont-Wilsonville Segment transmission line system will be supported with steel poles at selected locations along the approximately 7.5-mile-long transmission line system. Each of the steel poles will be supported on a deep foundation that may consist of a drilled pier or direct-embedment steel pole. Based on information from PGE, we understand that drilled pier foundations may range from 5 feet to 8 feet in diameter and range in depth from 18 feet to 40 feet. Geotechnical information was requested by PGE at 14 locations along the proposed alignment, with the following northing and easting coordinates:

R-W Boring 1: North 5026417.96, East 524209.29

R-W Boring 2: North 5026006.34, East 523906.66

R-W Boring 3: North 5025457.60, East 523878.37

R-W Boring 3A: North 5025242.06, East 523686.70

R-W Boring 4: North 5025100.80, East 523601.11

R-W Boring 5: North 5024657.15, East 523340.07

R-W Boring 5A: North 5024175.20, East 523084.07

R-W Boring 6: North 5024014.54, East 523003.69

R-W Boring 7: North 5022888.97, East 522321.74

R-W Boring 8: North 5022687.07, East 521587.06

R-W Boring 9: North 5021807.43, East 520815.68

R-W Boring 10: North 5020278.93, East 520079.25

ADSS Boring 1: North 5018285.18, East 520072.25

ADSS Boring 2: North 5018229.72, East 518373.49

3 GEOTECHNICAL DATA REPORT

Subsurface materials and conditions at the site were investigated between May 23 and June 10, 2022, with the 14 borings identified above. The boring locations were selected in consultation with PGE to provide specific subsurface information on where new transmission line poles will be located. Detailed descriptions of the field investigation, including equipment, methods, and procedures, and the laboratory testing program are provided in the Geotechnical Data Report dated July 1, 2022, attached as Appendix A.

4 SUBSURFACE CONDITIONS

4.1 Soil and Bedrock

For discussion purposes, the soils and bedrock encountered during our investigation have been grouped into the following units based on their physical characteristics and engineering properties. Generally listed as they were encountered from the ground surface downward, the units are:

a. PAVEMENT
b. FILL
c. LOESS
d. ALLUVIUM
e. RESIDUAL SOIL
f. DECOMPOSED BASALT
g. COLUMBIA RIVER BASALT

The following paragraphs provide a description of the materials encountered in the borings and a discussion of the anticipated groundwater conditions along the project alignment. It is noted because the project spans approximately 7.5 miles, each exploration did not necessarily encounter all the units identified above. Due to the geologic variability along the project alignment, we separated the borings into the following zones with similar characteristics. The cross streets listed with the geologic zones indicate the approximate boundaries of the zones at their intersections with either Stafford Road or Boeckman Roads.

- Upper Stafford Road (B-1, B-2): Rosemont Road – Johnson Road
- Tualatin River Crossing (B-3, B-3A, B-4, B-5) Johnson Road – Borland Road
- I-205 Crossing (B-5A, B-6): Borland Road – Trail Road
- Lower Stafford Road (B-7, B-8, B-9, B-10): Trail Road – 65th Avenue
- Boeckman Road (ADSS B-1, ADSS B-2): Stafford Road – Parkway Avenue

Due to site access constraints, most borings were located within the roadway along Stafford Road or Boeckman Road adjacent to the proposed pole locations in areas readily accessible to drilling equipment. Therefore, it should be acknowledged that the subsurface conditions disclosed in the borings may be different from those at the actual pole locations.

a. PAVEMENT

With the exception of borings B-5A and B-6 that were drilled off the I-205 ramp shoulders and B-7 that was drilled within an older, gravel-surfaced roadway alignment, the borings were completed in areas surfaced with pavement. Pavement section thicknesses encountered within the other borings ranged from about 15 inches to 28 inches thick and included various combinations of asphalt concrete (AC), portland cement concrete (PCC), and crushed rock base course. The thickness and composition of the pavement sections are noted on the boring logs, Figures 1A through 14A of the Geotechnical Data Report (Appendix A).

b. FILL

Tualatin River Crossing (B-3, B-3A, B-4, B-5). Fill was encountered in each boring, extending below the road pavement sections to depths ranging from 3.5 feet to 25 feet. The fill has the greatest thickness in the two borings (B-3A and B-4) on either side of the Stafford Road bridge crossing the Tualatin River. The fill consists of variable soils including silts, sands, gravels, and cobbles. Standard Penetration Test (SPT) N-Values recorded in the fill typically indicated stiff to very stiff or dense to very dense conditions within the unit. Field vane measurements on a relatively undisturbed Shelby-tube sample collected from B-4 indicated medium-stiff to stiff conditions within the fine-grained fill. Drilling fluid loss was noted at about 8.5 feet in B-4.

I-205 Crossing (B-5A, B-6). Borings near the Stafford Road crossing over I-205 were located adjacent to the highway exit/entrance ramps. Fill comprising the ramp embankments was encountered from the ground surface to a depth of about 12.5 feet in B-5A and 15 feet in B-6. The fill consists of silt with variable amounts of clay and trace sand and gravel or silty clay to clayey silt with trace sand and occasional gravels. SPT N-Values recorded in the unit indicate the relative consistency ranges from medium stiff to stiff.

Lower Stafford Road (B-7, B-8, B-9, B-10). Fill consisting of silty gravel with some sand to cobbles was encountered in B-7, extending from the ground surface to a depth of about 3 feet. Fill was not encountered in the other borings (B-8 through B-10) beneath the pavement sections.

c. LOESS

Upper Stafford Road (B-1, B-2). Loess was encountered in B-2 beneath the pavement section from a depth of about 1.5 feet to 9 feet. This unit consists of silt with trace clay and fine-grained sand. SPT N-Values recorded in the loess indicate a stiff relative consistency.

d. ALLUVIUM

Tualatin River Crossing (B-3, B-3A, B-4, B-5). Alluvial soils were encountered beneath the fill in the Tualatin River Crossing borings, extending to depths ranging from 51.5 feet to 56.5 feet where the borings were terminated in the unit. The alluvium generally consists of silt, sandy silt, sand, and silty sand with varying amounts of clay, gravel, and organics consisting of fine roots or wood debris. Stratified 1- to 6-inch-thick interbeds of these materials were commonly observed throughout the unit. A 5-foot-thick layer of clay was encountered at 45 feet in B-4. SPT N-Values in this stratum suggests soft to stiff relative consistencies and medium dense to dense relative densities. Field vane measurements on relatively undisturbed Shelby-tube samples at various depths typically indicated medium stiff to very stiff conditions in the fine-grained layers.

I-205 Crossing (B-5A, B-6). The fill beneath the I-205 approach embankments is underlain by alluvium extending below the bottom of the explorations at depths ranging from 51.5 feet to 53.5 feet. The alluvium generally consists of clay, silt, sandy silt, sand, and silty sand with various amounts of secondary silt, sand, clay, gravel, and organics consisting of fine roots or wood debris. Soft and loose conditions were generally encountered in boring B-5A relative to B-6, with a layer of loose silty sand extending from a depth of about 25 feet to 40 feet.

Lower Stafford Road (B-7, B-8, B-9, B-10). Alluvium was encountered below the pavement section to a depth of about 10 feet in B-10. This unit consists of silt with trace clay and fine-grained sand. SPT N-Values recorded in this unit indicate stiff relative consistency.

Boeckman Road (ADSS B-1, ADSS B-2). Alluvium was encountered beneath the pavement section to a depth of 40 feet in ADSS B-1 and to the maximum depth explored in ADSS B-2 of 51.5 feet. The unit typically consists of clay, silty clay, silt, clayey silt, and/or silty sand with various amounts of secondary clay, silt, and sand. SPT N-values recorded in the alluvium suggest the relative consistency ranges from medium to very stiff and the relative density ranges from very loose to medium dense.

e. RESIDUAL SOIL

Residual soils are soils that have decomposed in place from a parent bedrock formation to a soil-like consistency. Where encountered, the residual soil was distinguished from the decomposed basalt unit as it is more soil-like, while the decomposed basalt typically has a more rock-like structure and/or texture.

Upper Stafford Road (B-1, B-2). Residual soil was encountered in B-1 below the pavement section to a depth of 5 feet. The unit consists of very stiff, medium to high plasticity clay. Residual soil was not encountered in B-2.

Lower Stafford Road (B-7, B-8, B-9, B-10). Residual soil was encountered below the pavement section to a depth of about 8 feet in B-8 and underlies the alluvium in B-10 from a depth of about 10 feet to 13.5 feet. The residual soil generally consists of clay with trace to some sand and scattered to trace gravel.

Boeckman Road (ADSS B-1, ADSS B-2). Residual soil consisting of medium-stiff to very-stiff clay with variable silt and sand content was encountered below the alluvial soils in ADSS B-1, extending from a depth of about 40 feet to the bottom of the boring at 51.5 feet. Residual soil was not encountered in ADSS B-2.

f. DECOMPOSED BASALT

Upper Stafford Road (B-1, B-2). The residual soil in B-1 and the loess in B-2 are underlain by decomposed basalt to depths of 12.5 feet and 25 feet, respectively. The decomposed basalt has typically weathered to clayey or silty sand with gravel to sandy, silty gravel with trace clay. SPT N-Values recorded in the decomposed basalt indicate medium dense to very dense relative densities.

Lower Stafford Road (B-7, B-8, B-9, B-10). Decomposed basalt was encountered in each of the Lower Stafford Road borings at various depths. In B-7, the fill was underlain by decomposed basalt from a depth of about 3 feet to 17.5 feet. In B-8 and B-9, the residual soil was underlain by decomposed basalt at depths ranging from about 7.5 feet to 8 feet and extended to the maximum depths explored in these borings of about 50 feet. In B-10, decomposed basalt was observed underlying the residual soil at a depth of about 13.5 feet and extending to 17.5 feet. The decomposed basalt typically consists of sand or gravel with variable amounts of secondary clay, silt, sand, and gravel. A 5-foot-thick layer of silt with some sand was observed in B-9. SPT N-Values in the unit suggests the relative density typically ranges from medium dense to very dense.

g. COLUMBIA RIVER BASALT

Upper Stafford Road (B-1, B-2). Columbia River Basalt was observed underlying the Decomposed Basalt at depths of about 12.5 feet in B-1 and 25 feet in B-2. Both borings were advanced approximately 10 feet into the unit using rock coring techniques before terminating the boring. The unit consists of fresh to moderately weathered basalt with a relative hardness ranging from medium hard to very hard (R3 to R5). Continuous rock coring obtained sample runs with rock quality designations ranging from 34% to 90%. Laboratory uniaxial compressive (qu) strengths on selected lengths of the rock core ranged from about 16,400 pounds per square inch (psi) to 17,650 psi.

Lower Stafford Road (B-7, B-8, B-9, B-10). Columbia River Basalt was encountered underlying the Decomposed Basalt at a depth of 17.5 feet in borings B-7 and B-10. Both borings were advanced approximately 10 feet into the unit using rock coring techniques before terminating the boring. The unit consists of slightly to moderately weathered basalt with a relative hardness ranging from medium hard to very hard (R3 to R5). Continuous rock coring obtained sample runs with rock quality designations ranging from 0% to 40%.

4.2 Groundwater

The borings were advanced using mud-rotary drilling methods, which make it difficult to acquire an accurate measurement of the groundwater level during and following drilling. Information provided by the U.S. Geological Survey groundwater map of the Portland area (Snyder, 2008) and our experience in the vicinity of the project suggests static groundwater levels are typically greater than 50 feet below the ground surface along the majority of the proposed alignment. However, due to variations in topography and subsurface conditions, the depths to groundwater are expected to vary significantly between individual pole locations, with shallower groundwater conditions present in lower-lying areas and in locations in close proximity to rivers and other drainages, as discussed below.

At the Tualatin River crossing, groundwater is expected to mirror the elevation of the river level, typically at about an elevation of 110 feet to 120 feet at the highest. At boring B-3A, located above and north of the river, the corresponding static groundwater level is expected to be at a depth greater than 50 feet below the ground surface. At B-4, located at a lower elevation south of the river, we estimate the static high groundwater will be at a depth of approximately 25 feet below the ground surface. At B-5, located above and south of B-4, we estimate high groundwater could be at a depth of approximately 35 feet below the ground surface.

Based on our previous experience and available data near the Boeckman Road area, we anticipate static groundwater levels could rise to within about 25 feet to 30 feet of the ground surface.

Groundwater depths across the project alignment will generally be highest during the wettest portion of the year, typically from late Fall to late Spring. In addition, localized perched groundwater conditions may develop at shallower depths, particularly where less permeable fine-grained soils are present. For example, we encountered perched groundwater conditions within about 5 feet to 10 feet of the ground surface in previous explorations near Boeckman Road. In general, during the wet season, it should be anticipated that perched groundwater conditions could develop at or near the ground surface where the site is underlain by low-permeable fine-grained soils or bedrock.

5 GEOTECHNICAL DESIGN RECOMMENDATIONS

5.1 General

The geotechnical explorations completed for this project indicate the subsurface conditions vary considerably along the length of the alignment. Fill is locally present beneath the ground surface at some locations along the alignment, with the deepest fill encountered at highway approach embankments adjacent to bridges. Beneath the fill or directly beneath the ground surface, the explorations encountered subsurface units that typically include shallow to somewhat deep alluvial deposits and basalt ranging from residual soil to intact bedrock. To aid the team in design of the project, we identified five generalized areas along the proposed alignment based on geologic similarities, including 1) Upper Stafford Road (B-1 and B-2), 2) Tualatin River Crossing (B-3, B-3A, B-4, and B-5), 3) I-205 Crossing (B-5A and B-6), 4) Lower Stafford Road (B-7 through B-10), and 5) Boeckman Road (ADSS B-1 and ADSS B-2). It should be acknowledged that these groupings are based on relatively limited subsurface information, and the actual conditions may vary considerably between the individual boring locations, as well as between the borings and actual pole locations.

Information provided by PGE indicates the new transmission line structures will be supported by drilled piers and/or direct embedment steel poles. We anticipate the preferred foundation type(s) will be selected by PGE based on the axial (i.e., compressive or uplift) and lateral loading and resistance requirements. We understand the drilled-pier foundations may range from 5 feet to 8 feet in diameter and range in depth from 18 feet to 40 feet. We anticipate the drilled-pier foundations will consist of reinforced concrete supporting the steel transmission poles, whereas the direct embedded steel poles will be backfilled in place with structural fill or possibly grout. Recommended soil parameters for evaluating the proposed foundation types are provided in the following sections of this report. Primary geotechnical considerations are also summarized below for earthwork and construction of possible work pads and access roads.

5.2 Seismic Considerations

5.2.1 Seismic Criteria

We anticipate the 2019 Oregon Structural Specialty Code (OSSC) will be used to develop seismic parameters for the transmission line structures. The 2019 OSSC is based on the International Building Code (IBC) and incorporates recommendations for seismic design from the American Society of Civil Engineers (ASCE) document 7-16, *Minimum Design Loads for Building and Other Structures* (ASCE 7-16). The ASCE 7-16 seismic-hazard levels are based on a Risk-Targeted Maximum Considered Earthquake (MCE_R). The ground motions associated with the probabilistic MCE_R represent a targeted risk level of 1% in 50 years probability of collapse in the direction of maximum horizontal response. In general, these risk-targeted ground motions are developed by applying adjustment factors of directivity and risk coefficients to the 2% probability of exceedance in 50 years, or a 2,475-year return-period hazard level. The risk-targeted probabilistic values are also subject to a deterministic limit.

The ASCE methodology uses two bedrock spectral response mapped acceleration parameters, S_S and S_1, corresponding to periods around 0.2 second and 1.0 second to develop the MCE_R response spectrum. To establish the ground-surface MCE_R spectrum, these mapped bedrock spectral parameters are adjusted for site class using the short- and long-period site coefficients, F_a and F_v, in accordance with Section 11.4.3 of ASCE 7-16, which includes new seismic site coefficients to adjust the mapped values for soil properties.

5.2.2 Recommended Seismic Design Parameters

Due to the length of the alignment, we used the general geologic segments discussed in Section 4 of this report (Subsurface Conditions) to evaluate the recommended seismic design parameters. Site classes for each zone were determined based on the results of the subsurface explorations. The ASCE 7-16 S_S and S_1 mapped spectral response acceleration parameters were determined at each approximate latitude and longitude from the USGS National Seismic Hazard Map.

Due to the S_1 acceleration parameter being greater than or equal to 0.2 g, Section 11.4.8 of ASCE 7-16 requires a ground-motion hazard analysis for Site Class D locations unless the seismic response coefficient, C_s is determined in accordance with Exception 2 of Section 11.4.8 of ASCE 7-16. Assuming the seismic response coefficient, C_s is determined in accordance with Exception 2 of Section 11.4.8 of ASCE 7-16, the site coefficients F_a and F_v were determined from code-tabulated values.

The design-level response spectrum is calculated as two-thirds of the ground-surface MCE_R spectra. The recommended MCE_R- and design-level spectral-response parameters for the Site Class conditions are provided below in Table 5-1.

Table 5-1: RECOMMENDED SEISMIC DESIGN PARAMETERS (2019 OSSC/ASCE 7-16)

Geologic Segment	Mapped Parameters				Recommended Values							
	Latitude	Longitude	S_S (g)	S_1 (g)	Site Class	F_a	F_v	S_{MS} (g)	S_{M1} (g)	S_{DS} (g)	S_{D1} (g)
Upper Stafford Road	45.3882	-122.6925	0.86	0.39	C	1.20	1.50	1.03	0.58	0.69	0.39
Tualatin River Crossing	45.3791	-122.3984	0.85	0.39	D	1.16*	1.91*	0.99	0.74	0.66	0.49
I-205 Crossing	45.3697	-122.7061	0.85	0.38	D	1.16*	1.92*	0.98	0.74	0.66	0.49
Lower Stafford Road	45.3529	-122.7299	0.83	0.38	C	1.20	1.50	1.00	0.57	0.67	0.38
Boeckman Road	45.3169	-122.7555	0.82	0.38	D	1.17*	1.92*	0.96	0.73	0.64	0.49

Note: *Exception 2 of Section 11.4.8 should be considered when evaluating base shear calculations in Section 12.8

S_{MS} = MCE_R 0.2-Sec Period Spectral Response Acceleration
S_{M1} = MCE_R 1.0-Sec Period Spectral Response Acceleration
S_{DS} = Design-Level 0.2-Sec Period Spectral Response Acceleration
S_{D1} = Design-Level 1.0-Sec Period Spectral Response Acceleration

5.2.3 Liquefaction/Cyclic Softening

Liquefaction. "Liquefaction" is the process by which loose, saturated granular materials, such as clean sand and, to a somewhat lesser degree, non-plastic and low-plasticity silts, temporarily lose stiffness and strength during and immediately after a seismic event. This degradation in soil properties may be substantial and abrupt, particularly in loose sands. Liquefaction occurs as seismic shear stresses propagate through saturated soil and distort the soil structure, causing loosely packed groups of particles to contract or collapse. If drainage is impeded and cannot occur quickly, the collapsing soil structure causes the pore-water pressure to increase between the soil grains. If the pore-water pressure becomes sufficiently large, the intergranular stresses become small, and the granular layer temporarily behaves as a viscous liquid rather than a solid. After liquefaction is triggered, there is an increased risk of settlement, loss of bearing capacity, lateral spreading, and/or slope instability, particularly along waterfront areas. Liquefaction-induced settlement occurs as the elevated pore-water pressures dissipate and the soil consolidates after the earthquake.

Cyclic Softening. "Cyclic softening" is a term that describes a relatively gradual and progressive increase in shear strain with load cycles and is more common within fine-grained soils. Excess pore pressures may increase due to cyclic loading but generally do not approach the total overburden stress. Shear strains accumulate with additional loading cycles, but an abrupt or sudden decrease in shear stiffness is not typically expected. Settlement due to post-seismic consolidation can occur, particularly in lower-plasticity silts. Large shear strains can develop, and strength loss related to soil sensitivity may be a concern.

Analysis Methods. The potential for liquefaction and/or cyclic softening is typically estimated using a simplified method that compares the cyclic shear stresses induced by the earthquake (demand) to the cyclic shear strength of the soil available to resist these stresses (resistance). Estimates of seismically induced stresses are based on earthquake magnitude (M_W) and peak ground acceleration (PGA). The cyclic resistance of soils is dependent on several factors, including the number of loading cycles, relative density, confining stress, plasticity, natural water content, stress history, age, depositional environment (fabric), and composition. The cyclic resistance of soils is evaluated using in-situ testing in conjunction with laboratory index testing but may also include monotonic and cyclic laboratory strength tests. For sand-like soils, the cyclic resistance is typically evaluated using SPT N-values or CPT tip-resistance values normalized for overburden pressures and corrected for factors that influence cyclic resistance, such as fines content. For clay-like soils, the cyclic resistance is typically evaluated using estimates of the undrained shear strength, overconsolidation ratio, and sensitivity or directly from cyclic laboratory tests.

The potential for liquefaction and/or cyclic softening at the site was evaluated using the simplified method based on procedures recommended by Idriss and Boulanger (2008) with subsequent revisions (2014). Per ASCE 7-16 guidelines, our evaluation included the Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for site class effects (PGA_M). The USGS National Seismic Hazard Mapping Project was used to determine the contributing MCE_G hazard level earthquake magnitude associated with the mean PGA spectral period associated with the 2,475-year return-period hazard level. The results of our analyses are discussed in terms of the general geologic segments identified in Section 4.

Upper Stafford Road. Explorations for the Upper Stafford Road segment (B-1 and B-2) encountered relatively shallow bedrock, with the overlying soil units being comprised primarily of stiff to very stiff or medium dense to very dense residual soil and/or decomposed basalt. Furthermore, static groundwater is expected at a depth greater than 50 feet. Therefore, liquefaction is not considered a risk for the conditions disclosed in these borings.

Tualatin River Crossing. Explorations for the Tualatin River Crossing segment (B-3, B-3A, B-4, and B-5) encountered somewhat variable subsurface conditions and estimated groundwater depths. The borings drilled north of the river (B-3 and B-3A) are at higher surface elevations and static groundwater depths for B-3 and B-3A are estimated to be greater than 50 feet. Furthermore, the alluvial sandy soils encountered in B-3 and B-3A generally appear to increase in relative density with depth. Therefore, the risk of liquefaction is considered low for the soil profiles disclosed in B-3 and B-3A.

Higher groundwater levels are anticipated in B-4 and B-5, with static groundwater depths estimated to be the range of about 25 feet to 35 feet. The soils encountered in B-5 below the anticipated groundwater depth include medium-dense grading to dense silty sand that has a low risk for liquefaction. However, in B-4, a zone of soft to medium-stiff sandy silt and loose silty sand was encountered from a depth of about 25 feet to 45 feet, which poses a risk for liquefaction. We evaluated the liquefaction risk for the B-4 profile assuming seismic loading parameters with PGA_M equal to 0.47g and associated earthquake magnitude, M, equal to 7.74. The results of our analysis suggest a high risk of liquefaction associated with the 2,475-year return-period hazard level. Furthermore, we estimated associated free-field liquefaction-induced settlements in the range of approximately 5 inches to 7 inches.

<u>I-205 Crossing</u>. Explorations for the I-205 Crossing segment (B-5A and B-6) encountered fill over deeper alluvial deposits, similar to the Tualatin River Crossing segment. However, static groundwater depths are anticipated to be greater than 50 feet below the ground surface within this portion of the alignment. Furthermore, the soils encountered in these explorations typically become stiff to hard near the bottom of B-5A and B-6. Therefore, the risk of liquefaction is considered low for the soil profiles disclosed in these borings.

<u>Lower Stafford Road</u>. Explorations for the Lower Stafford Road segment (B-7 through B-10) generally encountered stiff to hard fine-grained soils or medium dense to very dense coarse-grained soils representing residual soil and/or decomposed basalt. Moderately to slightly weathered basaltic bedrock was also encountered in B-7 and B-10 below a depth of about 17.5 feet. Static groundwater is also expected to be deeper along this portion of the alignment. Therefore, the liquefaction risk is low for the conditions disclosed in these borings.

<u>Boeckman Road</u>. Explorations for the Boeckman Road segment (ADSS B-1 and ADSS B-2) encountered a profile with deeper alluvium that includes interstratified layers of silty sand, silt, silty clay, and clay. Static groundwater is anticipated to be as shallow as about 25 feet to 30 feet below the ground surface. We evaluated the liquefaction risk for the ADSS B-1 and ADSS B-2 profiles assuming seismic loading parameters with PGA_M equal to 0.46g and M equal to 7.89. The results of our analysis suggest modest risk of liquefaction associated with the 2,475-year return-period hazard level for the sandy soils in ADSS B-1 from a depth

of approximately 30 feet to 40 feet and in ADSS B-2 from a depth of approximately 25 feet to 30.5 feet. The associated free-field liquefaction-induced settlements are estimated to be on the order of about 1 inch to 2 inches.

5.2.4 Other Seismic Hazards

Based on the subsurface conditions disclosed by our explorations, a review of the site topography, and a review of previous GRI investigations and other available literature, we anticipate there is a risk for earthquake-induced slope instability and/or lateral spreading along the banks of the Tualatin River near the proposed project alignment. The area associated with the highest anticipated risk is closest to boring B-4, near the south riverbank, and may include portions of the north riverbank. Full assessment of the slope instability risk along the riverbank would require additional explorations closer to the river that we anticipate are outside of PGE's right-of-way. Studies by others for the bridge crossing the Tualatin River at I-205 estimated slope instabilities and movement extending approximately 100 feet from the edge of the river up the banks. This estimate may be reasonable for the current project site given the similar subsurface conditions. However, additional explorations would be required to complete an evaluation specific to this site.

The risk of earthquake-induced instabilities along the remaining portions of the Rosemont-Wilsonville alignment is low. The risk of damage by a tsunami and/or seiche along any portion of the alignment is absent.

The USGS maps the Canby-Molalla Fault at the intersection of SW Stafford Road and SW Trail Road, approximately 1,650 feet southwest of boring location B-6 (Personius et al., 2002). As a best management practice and consistent with U.S. West Coast jurisdictions with fault management regulations, we recommend no structural development occur within at least 50 feet of the mapped Canby-Molalla Fault trace.

5.3 Generalized Subsurface Profiles

For this report, the explorations shown on Figure 2 were used to develop generalized subsurface profiles for geotechnical design of the foundations, which are provided in Tables 5-2 through 5-6 below. The profiles are grouped based on the general geologic segments discussed above including Upper Stafford Road, Tualatin River Crossing, I-205 Crossing, Lower Stafford Road, and Boeckman Road.

The generalized subsurface profiles are intended for use in axial- and lateral-load analyses of the foundations and reflect the general subsurface conditions encountered in the explorations included in the Geotechnical Data Report, Appendix A. It should be noted that subsurface variations along the transmission line alignments and between the boring locations exist, which can affect the axial and lateral performance of the engineered steel poles and drilled-pier foundations. Due to the variability of the depth, thickness, and type of subsurface materials, the generalized profiles in Tables 5-2 through 5-6 that results in the lowest axial and lateral capacities should be used for evaluating drilled-pier foundations and/or direct embedment poles located between adjacent boring locations.

Table 5-2: UPPER STAFFORD ROAD (B-1, B-2) GENERALIZED SUBSURFACE PROFILES

Soil and Rock Units	Depth Range, feet	
	Boring B-1	Boring B-2
Stiff SILT (Loess)	N/E	0 to 9
Very Stiff CLAY (Residual Soil)	0 to 5	N/E
Medium Dense SAND (Decomposed Basalt)	5 to 7.5	9 to 17.5
Very Dense SAND or GRAVEL (Decomposed Basalt)	7.5 to 12.5	17.5 to 25
Fresh to Mod. Weathered, R3 to R5 BASALT (Columbia River Basalt)	12.5+	25+

Note: N/E = Not Encountered

Table 5-3: TUALATIN RIVER CROSSING (B-3, B-3A, B-4, B-5) GENERALIZED SUBSURFACE PROFILES

Soil Units	Depth Range, feet			
	Boring B-3	Boring B-3A	Boring B-4	Boring B-5
Dense GRAVEL or COBBLES (Coarse-grained Fill)	0 to 4	N/E	0 to 8.5	0 to 3.5
Very Stiff SILT, some Sand (Fine-grained Fill)	N/E	0 to 10	8.5 to 25	N/E
Stiff Sandy SILT to Medium Dense Silty SAND (Alluvium)	4+	10 to 45	N/E	N/E
Medium Stiff Sandy SILT (Alluvium)	N/E	N/E	N/E	3.5 to 20
Medium Stiff Sandy SILT to Loose Silty SAND (Alluvium)	N/E	N/E	25 to 45	N/E
Medium Stiff to Stiff SILT or CLAY (Alluvium)	N/E	N/E	45+	N/E
Medium Dense to Dense Silty SAND (Alluvium)	N/E	45+	N/E	20 to 35
Medium Dense to Dense Silty SAND below GWT (Alluvium)	N/E	N/E	N/E	35+

Note: N/E = Not Encountered; GWT = Groundwater Table

Table 5-4: I-205 CROSSING (B-5A, B-6) GENERALIZED SUBSURFACE PROFILES

Soil Units	Depth Range, feet	
	Boring B-5A	Boring B-6
Stiff to Very Stiff SILT or CLAY (Fine-grained Fill)	0 to 12.5	0 to 15
Medium Stiff to Stiff SILT or CLAY (Alluvium)	12.5 to 25	15 to 25
Very Loose to Loose Silty SAND (Alluvium)	25 to 40	N/E
Stiff to Hard Sandy SILT or Dense Silty SAND (Alluvium)	N/E	25+
Stiff CLAY (Alluvium)	40+	N/E

Note: N/E = Not Encountered

Table 5-5: LOWER STAFFORD ROAD (B-7, B-8, B-9, B-10) GENERALIZED SUBSURFACE PROFILES

Soil Units	Depth Range, feet			
	Boring B-7	Boring B-8	Boring B-9	Boring B-10
Stiff SILT, up to some Clay (Alluvium)	N/E	N/E	N/E	0 to 10
Stiff to Very Stiff CLAY (Residual Soil or Decomp. Basalt)	N/E	0 to 8	0 to 7.5	10 to 13.5
Medium Dense to Dense Silty SAND or Sandy SILT (Decomposed Basalt)	0 to 10	8 to 40	7.5 to 30	N/E
Very Dense Silty SAND or GRAVEL (Decomposed Basalt)	10 to 17.5	40+	30+	13.5 to 17.5
Fresh to Mod. Weathered, R3 to R5 BASALT (Columbia River Basalt)	17.5+	N/E	N/E	17.5+

Note: N/E = Not Encountered

Table 5-6: BOECKMAN ROAD (ADSS B-1, ADSS B-2) GENERALIZED SUBSURFACE PROFILES

Soil Units	Depth Range, feet	
	ADSS B-1	ADSS B-2
Medium-Stiff to Stiff SILT to Clayey SILT (Alluvium)	0 to 16	0 to 7.5
Loose Silty SAND (Alluvium)	N/E	7.5 to 12.5
Stiff SILT or CLAY (Alluvium)	16 to 25	12.5 to 25
Medium-Dense Silty SAND (Alluvium)	25 to 30	N/E
Medium-Dense Silty SAND, (Alluvium) *Possible Liquefaction*	30 to 40	25 to 30.5
Stiff to Very Stiff CLAY or SILT (Alluvium or Residual Soil)	40+	30.5 to 50
Medium-Dense to Dense Silty SAND (Alluvium)	N/E	50+

Note: N/E = Not Encountered

5.4 Foundation Recommendations

5.4.1 LPILE Analysis Parameters

Lateral structural loads generally can be resisted by the structural strength of the drilled pier or embedded pole in bending. We understand the drilled pier and direct-embedded foundations will be evaluated using the computer software LPILE, developed by Ensoft, Inc., of Austin, Texas. Recommended input parameters for the soil units are provided in Tables 5-7 through 5-11 below. The lateral resistance within the top 2 feet of each pier and direct-embedment pole should be neglected if soil disturbance near the ground surface during installation is a concern. Soil parameters satisfying both static and seismic loading conditions are provided for most soil units. Different static and seismic parameters are provided for the soil units where liquefaction risk has been identified.

Table 5-7: LPILE PARAMETERS FOR UPPER STAFFORD ROAD (B-1, B-2) GENERALIZED SUBSURFACE PROFILES

			Soil Properties				
Soil or Rock Unit	LPILE Soil/Rock Type	Condition	γ', pcf	c, psf	ε_{50}	K, pci	ϕ', deg.
Stiff SILT (Loess)	Sand (Reese)	Static & Seismic	115	N/A	N/A	50	32
Very Stiff CLAY (Residual Soil)	Stiff Clay without Free Water	Static & Seismic	115	2,000	0.005	N/A	N/A
Medium Dense SAND (Decomposed Basalt)	Sand (Reese)	Static & Seismic	120	N/A	N/A	125	34
Very Dense SAND or GRAVEL (Decomposed Basalt)	Sand (Reese)	Static & Seismic	130	N/A	N/A	250	42
				Rock Properties			
				E_r, psi	q_u, psi	RQD, %	k_{rm}
Fresh to Mod. Weathered, R3 to R5 BASALT (Columbia River Basalt)	Strong Rock	Static & Seismic	150	N/A	2,500	N/A	N/A

Notes:

1. Subsurface units interpreted based on the conditions disclosed in borings B-1 and B-2.
2. Static groundwater is assumed at a depth greater than 50 feet below the ground surface.
3. Rock uniaxial compressive strength, q_u, of 2,500 psi is below the q_u values indicated from laboratory tests but is the maximum recommended value in LPILE for Strong Rock.

Table 5-8: LPILE PARAMETERS FOR TUALATIN RIVER CROSSING (B-3, B-3A, B-4, B-5) GENERALIZED SUBSURFACE PROFILES

Soil Unit	LPILE Soil Type	Condition	Soil Properties				
			γ', pcf	c, psf	ε_{50}	K, pci	ϕ', deg.
Dense GRAVEL or COBBLES (Coarse-grained Fill)	Sand (Reese)	Static & Seismic	125	N/A	N/A	225	38
Very Stiff SILT, some Sand (Fine-grained Fill)	Sand (Reese)	Static & Seismic	115	N/A	N/A	100	33
Stiff Sandy SILT to Medium Dense Silty SAND (Alluvium)	Sand (Reese)	Static & Seismic	115	N/A	N/A	100	33
Medium Stiff Sandy SILT (Alluvium)	Sand (Reese)	Static & Seismic	110	N/A	N/A	75	32
Medium Stiff Sandy SILT to Loose Silty SAND (Alluvium)	Sand (Reese)	Static	55	N/A	N/A	50	32
	Soft Clay	Seismic		300	0.050	N/A	N/A
Medium Stiff to Stiff SILT or CLAY (Alluvium)	Stiff Clay without Free Water	Static & Seismic	55	1,000	0.010	N/A	N/A
Medium Dense to Dense Silty SAND (Alluvium)	Sand (Reese)	Static & Seismic	120	N/A	N/A	150	36
Medium Dense to Dense Silty SAND below GWT (Alluvium)	Sand (Reese)	Static & Seismic	60	N/A	N/A	90	36

Notes:

1. Subsurface units interpreted based on the conditions disclosed in borings B-3, B-3A, B-4, and B-5.
2. Static groundwater is assumed at a depth below the ground surface of approximately 25 feet in B-4 and 35 feet in B-5. Static groundwater is assumed to be greater than 50 feet below the ground surface in B-3 and B-3A.

Table 5-9: LPILE PARAMETERS FOR I-205 CROSSING (B-5A, B-6) GENERALIZED SUBSURFACE PROFILES

Soil Unit	LPILE Soil Type	Condition	Soil Properties				
			γ′, pcf	c, psf	ε 50	K, pci	ϕ′, deg.
Stiff to Very Stiff SILT or CLAY (Fine-grained Fill)	Stiff Clay without Free Water	Static & Seismic	115	1,500	0.007	N/A	N/A
Medium Stiff to Stiff SILT or CLAY (Alluvium)	Stiff Clay without Free Water	Static & Seismic	115	1,250	0.007	N/A	N/A
Very Loose to Loose Silty SAND (Alluvium)	Sand (Reese)	Static & Seismic	110	N/A	N/A	50	30
Stiff to Hard Sandy SILT or Dense Silty SAND (Alluvium)	Sand (Reese)	Static & Seismic	120	N/A	N/A	140	35
Stiff CLAY (Alluvium)	Stiff Clay without Free Water	Static & Seismic	115	1,500	0.007	N/A	N/A

Notes:

1. Subsurface units interpreted based on the conditions disclosed in borings B-5A and B-6.
2. Static groundwater is assumed at a depth greater than 50 feet below the ground surface.

Table 5-10: LPILE PARAMETERS FOR LOWER STAFFORD ROAD (B-7, B-8, B-9, B-10) GENERALIZED SUBSURFACE PROFILES

Soil or Rock Unit	LPILE Soil/Rock Type	Condition	Soil Properties				
			γ', pcf	c, psf	ε_{50}	K, pci	ϕ', deg.
Stiff SILT, up to some Clay (Alluvium)	Stiff Clay without Free Water	Static & Seismic	115	1,500	0.007	N/A	N/A
Stiff to Very Stiff CLAY (Residual Soil or Decomp. Basalt)	Stiff Clay without Free Water	Static & Seismic	115	1,500	0.007	N/A	N/A
Medium Dense to Dense Silty SAND or Sandy SILT (Decomposed Basalt)	Sand (Reese)	Static & Seismic	120	N/A	N/A	140	35
Very Dense Silty SAND or GRAVEL (Decomposed Basalt)	Sand (Reese)	Static & Seismic	130	N/A	N/A	250	42
				Rock Properties			
				E_r, psi	q_u, psi	RQD, %	k_{rm}
Fresh to Mod. Weathered, R3 to R5 BASALT (Columbia River Basalt)	Strong Rock	Static & Seismic	150	N/A	2,500	N/A	N/A

Notes:

1. Subsurface units interpreted based on the conditions disclosed in borings B-7, B-8, B-9, and B-10.
2. Static groundwater is assumed at a depth greater than 50 feet below the ground surface.
3. Rock uniaxial compressive strength, q_u, of 2,500 psi is below the q_u values indicated from laboratory tests but is the maximum recommended value in LPILE for Strong Rock.

Table 5-11: LPILE PARAMETERS FOR BOECKMAN ROAD (ADSS B-1, ADSS B-2) GENERALIZED SUBSURFACE PROFILES

Soil Unit	LPILE Soil Type	Condition	Soil Properties				
			γ', pcf	c, psf	ε_{50}	K, pci	ϕ', deg.
Medium Stiff to Stiff SILT to Clayey SILT (Alluvium)	Stiff Clay without Free Water	Static & Seismic	115	1,000	0.010	N/A	N/A
Loose Silty SAND (Alluvium)	Sand (Reese)	Static & Seismic	115	N/A	N/A	75	32
Stiff SILT or CLAY (Alluvium)	Stiff Clay without Free Water	Static & Seismic	120	2,000	0.005	N/A	N/A
Medium Dense Silty SAND (Alluvium)	Sand (Reese)	Static & Seismic	55	N/A	N/A	75	34
Medium Dense Silty SAND, (Alluvium) *Possible Liquefaction*	Sand (Reese)	Static	55	N/A	N/A	75	34
	Soft Clay	Seismic		500	0.050	N/A	N/A
Stiff to Very Stiff CLAY or SILT (Alluvium or Residual Soil)	Stiff Clay without Free Water	Static & Seismic	55	2,000	0.005	N/A	N/A
Medium Dense to Dense Silty SAND (Alluvium)	Sand (Reese)	Static & Seismic	60	N/A	N/A	90	36

Notes:

1. Subsurface units interpreted based on the conditions disclosed in borings ADSS B-1 and ADSS B-2.
2. Static groundwater is assumed at a depth below the ground surface of approximately 25 feet.

5.4.2 Axial Resistance Parameters

The static axial resistances for the drilled piers and embedded poles were evaluated using methods discussed in the Federal Highway Administration (FHWA) publication FHWA-NHI-18-024, *Drilled Shafts: Construction Procedures and LRFD Design Methods*. The design method estimates axial (i.e., compression or uplift) resistances based on the estimated soil parameters and the properties of the drilled pier or direct-embedded pole.

Our analysis assumed the foundations would derive their axial resistance from skin friction that develops along the sides of the foundation and end-bearing resistance at the base of the foundation. End-bearing resistances for drilled piers and direct-embedded poles are calculated in the same manner. However, skin friction for a direct-embedded pole may be different than a drilled pier, depending on the backfill conditions. For a direct-embedded pier where the annulus is backfilled with concrete or grout, the skin friction developed between the backfill material and the foundation soil will be similar to the skin friction developed along a drilled pier. However, for direct-embedded poles where the annulus is backfilled with soil, the skin friction will be the lesser of the frictional resistance developed between the pole and the backfill material or the backfill material and the native soils.

To evaluate the skin friction for direct-embedded poles backfilled with soil, we assumed the backfill material would consist of relatively clean granular fill, compacted to a relative density that is at least medium dense. Therefore, it is assumed care will be taken to compact the backfill in lifts. If compaction is not practical and the fill is placed in a loose condition, or different backfill materials are used (e.g., fine-grained fills), this will result in lower skin-friction resistance and the values provided in this report should be modified accordingly.

The nominal (unfactored) static skin friction and end-bearing resistances for each soil unit are tabulated in Tables 5-12 through 5-16 below to evaluate axial capacities for drilled piers and direct-embedded poles. Axial resistances within the upper 5 feet of the soil profiles should be neglected when calculating skin-friction resistances for the foundation elements.

Table 5-12: NOMINAL UNIT STATIC AXIAL RESISTANCE VALUES FOR UPPER STAFFORD ROAD (B-1, B-2) GENERALIZED SUBSURFACE PROFILES

	Nominal Unit Skin-Friction Resistance, psf		Nominal Unit End-Bearing Resistance, psf
Soil Unit	Drilled Pier or Direct-Embedded Pole with Concrete or Grout Backfill	Direct-Embedded Pole with Granular Soil Backfill	Drilled Pier or Direct-Embedded Pole
Stiff SILT (Loess)	600	400	18,000
Very Stiff CLAY (Residual Soil)	900	300	12,000
Medium Dense SAND (Decomposed Basalt)	1,300	600	20,000
Very Dense SAND or GRAVEL (Decomposed Basalt)	3,200	700	42,000
Fresh to Mod. Weathered, R3 to R5 BASALT (Columbia River Basalt)	30,000	900	100,000

Note:

1. End-bearing for drilled piers or direct-embedded poles set in R3 to R5 basaltic bedrock will be dictated by the structural capacity of the foundation element.

Table 5-13: NOMINAL UNIT STATIC AXIAL RESISTANCE VALUES FOR TUALATIN RIVER CROSSING (B-3, B-3A, B-4, B-5) GENERALIZED SUBSURFACE PROFILES

Soil Unit	Nominal Unit Skin-Friction Resistance, psf		Nominal Unit End-Bearing Resistance, psf
	Drilled Pier or Direct-Embedded Pole with Concrete or Grout Backfill	Direct-Embedded Pole with Granular Soil Backfill	Drilled Pier or Direct-Embedded Pole
Dense GRAVEL or COBBLES (Coarse-grained Fill)	600	300	27,000
Very Stiff SILT, some Sand (Fine-grained Fill)	1,000	500	20,000
Stiff Sandy SILT to Medium-Dense Silty SAND (Alluvium)	1,600	900	15,000
Medium Stiff Sandy SILT (Alluvium)	800	600	9,000
Medium Stiff Sandy SILT to Loose Silty SAND (Alluvium)	1,300	900	See Note 1
Medium Stiff to Stiff SILT or CLAY (Alluvium)	600	600	8,000
Medium-Dense to Dense Silty SAND (Alluvium)	2,500	1,000	24,000
Medium-Dense to Dense Silty SAND below GWT (Alluvium)	3,000	1,000	36,000

Note:

1. Setting the base of a drilled pier or direct-embedded pole with the layer of Medium Stiff Sandy SILT to Loose Silty SAND is not recommended as this layer is prone to liquefaction under design-level seismic loads.

Table 5-14: NOMINAL UNIT STATIC AXIAL RESISTANCE VALUES FOR I-205 CROSSING (B-5A, B-6) GENERALIZED SUBSURFACE PROFILES

Soil Unit	Nominal Unit Skin-Friction Resistance, psf		Nominal Unit End-Bearing Resistance, psf
	Drilled Pier or Direct-Embedded Pole with Concrete or Grout Backfill	Direct-Embedded Pole with Granular Soil Backfill	Drilled Pier or Direct-Embedded Pole
Stiff to Very Stiff SILT or CLAY (Fine-grained Fill)	800	450	10,000
Medium Stiff to Stiff SILT or CLAY (Alluvium)	700	700	10,000
Very Loose to Loose Silty SAND (Alluvium)	1,000	1,000	4,000
Stiff to Hard Sandy SILT or Dense Silty SAND (Alluvium)	3,600	1,000	42,000
Stiff CLAY (Alluvium)	800	800	12,000

Table 5-15: NOMINAL UNIT STATIC AXIAL RESISTANCE VALUES FOR LOWER STAFFORD ROAD (B-7, B-8, B-9, B-10) GENERALIZED SUBSURFACE PROFILES

Soil Unit	Nominal Unit Skin-Friction Resistance, psf: Drilled Pier or Direct-Embedded Pole with Concrete or Grout Backfill	Nominal Unit Skin-Friction Resistance, psf: Direct-Embedded Pole with Granular Soil Backfill	Nominal Unit End-Bearing Resistance, psf: Drilled Pier or Direct-Embedded Pole
Stiff SILT, up to some Clay (Alluvium)	800	400	10,000
Stiff to Very Stiff CLAY (Residual Soil or Decomposed Basalt)	800	400	10,000
Medium Dense to Dense Silty SAND or Sandy SILT (Decomposed Basalt)	2,200	600	42,000
Very Dense Silty SAND or GRAVEL (Decomposed Basalt)	4,000	800	42,000
Fresh to Mod. Weathered, R3 to R5 BASALT (Columbia River Basalt)	30,000	900	100,000

Note:

1. End-bearing for drilled piers or direct-embedded poles set in R3 to R5 basaltic bedrock will be dictated by the structural capacity of the foundation element.

Table 5-16: NOMINAL UNIT STATIC AXIAL RESISTANCE VALUES FOR BOECKMAN ROAD (ADSS B-1, ADSS B-2) GENERALIZED SUBSURFACE PROFILES

Soil Unit	Nominal Unit Skin-Friction Resistance, psf		Nominal Unit End-Bearing Resistance, psf
	Drilled Pier or Direct-Embedded Pole with Concrete or Grout Backfill	Direct-Embedded Pole with Granular Soil Backfill	Drilled Pier or Direct-Embedded Pole
Medium Stiff to Stiff SILT to Clayey SILT (Alluvium)	650	400	6,500
Loose Silty SAND (Alluvium)	750	600	7,500
Stiff SILT or CLAY (Alluvium)	950	800	18,000
Medium Dense Silty SAND (Alluvium)	1,600	900	35,000
Medium Dense Silty SAND, (Alluvium) *Possible Liquefaction*	1,600	900	Note 1
Stiff to Very Stiff CLAY or SILT (Alluvium or Residual Soil)	950	950	18,000
Medium Dense to Dense Silty SAND (Alluvium)	3,000	1,000	30,000

Note:

1. Setting the base of a drilled pier or direct-embedded pole with the layer of Medium Dense Silty SAND with possible liquefaction is not recommended as this layer is prone to liquefaction and excessive settlement under design-level seismic loads.

5.4.3 Foundation Settlement

Vertical movement is required for mobilization of skin-friction resistance along the length of the foundation element and end-bearing resistance at the base. Full mobilization of skin-friction resistance typically develops with less than one-half inch of movement, while end-bearing resistance can require significantly greater settlement and is dependent on the size (e.g., diameter) of the foundation. We understand that PGE designers plan to apply a factor of safety of 2.0 to the nominal (i.e., ultimate) resistances recommended in this report. We further understand the axial loads applied to the transmission pole foundations are typically small compared to the ultimate resistances estimated for the foundation soils. Therefore, we anticipate relatively small settlements (e.g., one-half inch or less) under static loading conditions or temporary loads such as the design wind loads. However, we should provide a more comprehensive settlement evaluation if the vertical loads are expected to approach the allowable end-bearing resistances calculated based on the values provided in Tables 5-12 through 5-16.

As noted above in Section 5.2.3, liquefaction-induced settlements associated with design-level earthquake loads were estimated to be on the order of 5 inches to 7 inches for the B-4 soil profile and approximately 1 inch to 2 inches for the ASDD B-1 and ADSS B-2 profiles. To mitigate liquefaction-induced settlements, the foundation elements need to be set deep enough below the liquefaction-prone soil layers to resist downdrag loads imparted from the settling soils. If mitigation of the potential settlement under seismic loads is necessary, GRI should be engaged to evaluate downdrag loads and the necessary deep foundation lengths. Additional subsurface data may be required to fully evaluate the B-4 profile.

5.4.4 Corrosion Considerations

We evaluated the corrosion potential of the near-surface soil at each of the boring locations by completing chloride, sulfate, oxidation-reduction potential, pH, and soil resistivity testing. The results of the testing are summarized in Figure 24A, included in the appended Geotechnical Data Report. The conclusions and recommendations provided are based on the California Department of Transportation (Caltrans) Corrosion Guidelines, Version 3.2. A minimum resistivity value for soil and/or water less than 1,000 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion. The samples tested had a minimum resistivity value of 3,763 ohm-cm or greater. For structural elements, a site is considered to be corrosive if the pH is 5.5 or less, chloride concentration is 500 parts per million (ppm) or greater, or sulfate concentration is 1500 ppm or greater. All samples tested had a pH of 5.9 or greater, sulfate concentrations less than 84 ppm, and chloride concentrations less than 45 ppm. Based on Caltrans recommendations and the laboratory test results, the on-site soils are not considered corrosive. This information should be provided to contractors and material suppliers who will construct materials buried or in contact with the ground at the site.

6 GEOTECHNICAL CONSTRUCTION CONSIDERATIONS

6.1 General

Construction of the transmission line poles and foundations may require granular work pads and haul roads in currently undeveloped areas. The following sections provide a discussion of earthwork considerations associated with such efforts.

6.2 Site Preparation

The ground surface within all areas to receive structural fill should be stripped of existing vegetation, surface organics, and loose surface soils or fill. All trees, brush, and surficial organic material should be removed from within the limits of the proposed improvements. Excavations required to remove unsuitable soils, brush, and trees should be backfilled with structural fill. Organic strippings should be disposed of offsite or stockpiled on site for use in landscaped areas.

Following stripping or excavation to design elevation, a qualified geotechnical engineer or an engineering geologist should evaluate the exposed subgrade. Proof rolling with a loaded dump truck may be part of this evaluation. Any soft areas or areas of unsuitable material disclosed by the evaluation should be overexcavated to firm material and backfilled with structural fill. Due to the presence of moisture-sensitive, fine-grained soils near the ground surface, it should be anticipated that some overexcavation of the subgrade may be required.

6.3 Earthwork

Fine-grained soils mantle a significant portion of the project alignment. These soils are moisture sensitive and perched groundwater may approach the ground surface during the wet winter months and following periods of sustained precipitation. Therefore, in our opinion, earthwork can be completed most economically during the dry summer months, typically extending from June to mid-October. It has been our experience the moisture content of the upper few feet of soils with a high-fines content will decrease during extended warm, dry weather. However, below this depth, the moisture content of the soil tends to remain relatively unchanged and well above the optimum moisture content for compaction. As a result, the contractor must use construction equipment and procedures that prevent disturbance and softening of the subgrade soils. To minimize disturbance of the moisture-sensitive soils, site work can be completed using track-mounted equipment. Excavations should be finished using a smooth-edged bucket to produce a firm, undisturbed surface. It may also be necessary to construct granular haul roads and work pads concurrently with excavation to minimize subgrade disturbance. If the subgrade is disturbed during construction, soft, disturbed soils should be overexcavated to firm soil and backfilled with structural fill.

6.4 Temporary and Permanent Slopes

Final grading where work pads are planned should provide positive drainage of surface water away from adjacent properties and slopes to reduce the potential for erosion and ponding. The subgrade should be sloped to a minimum 0.5% slope to aid drainage. Permanent cut and fill slopes should be no steeper than 2H:1V (Horizontal to Vertical) and protected with vegetation to reduce the risk of surface erosion due to rainfall.

6.5 Foundation Construction

The design criteria presented above assume that drilled piers supporting the proposed transmission line poles will be installed in accordance with Section 00512 of the current

Oregon Department of Transportation *Standard Specifications for Construction* (ODOT SSC). Installation of direct-embedded poles should follow similar guidelines for foundation excavation, as well as other guidelines indicated by the pole manufacturer.

In some locations, excavations for the drilled piers or direct-embed poles could extend below the static groundwater level or below zones of perched groundwater, and there is a risk that caving and running overburden soils may be encountered during foundation excavation. Therefore, the use of full-depth, temporary casing meeting the requirements of ODOT SSC Section 00512.43 should be specified, as needed, to reduce the risk of caving conditions that will affect the installation of the foundations. Drilling slurry meeting the requirements of ODOT SSC Section 00512.43 may also be considered for drilled piers in lieu of casing. If temporary casing is used, excavation in advance of the casing tip should not exceed 5 feet and hydrostatic pressure inside and outside the casing should be consistent throughout the excavation. For drilled pier construction, the pier excavation should be cleaned, the reinforcing cage set (if applicable), and the concrete placed in as short a time sequence as possible, and preferably on the same day. The concrete should be placed using tremie methods, maintaining the concrete at least 5 feet above the outlet of the tremie pipe. Temporary casing should be removed as the concrete is placed and permanent casing should not be allowed.

7 DESIGN REVIEW AND CONSTRUCTION SERVICES

We welcome the opportunity to review and discuss construction plans and specifications for this project as they are being developed. In addition, GRI should be retained to review all geotechnical-related portions of the plans and specifications to evaluate whether they are in conformance with the recommendations provided in our report. To observe compliance with the intent of our recommendations, the design concepts, and the plans and specifications, it is our opinion all construction operations dealing with earthwork, retaining walls, foundations, and pile installations should be observed by a GRI representative. Our construction-phase services will allow for timely design changes if site conditions are encountered that are different from those described in our report. If we do not have the opportunity to confirm our interpretations, assumptions, and analyses during construction, we cannot be responsible for the application of our recommendations to subsurface conditions different from those described in this report.

8 LIMITATIONS

This report has been prepared to aid the project team in the design of the Rosemont-Wilsonville segment of the Tonquin 115kV Transmission Line. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to earthwork and design and construction of the transmission line. In the event any changes in the design and location of the project elements as outlined in this report are planned, we should be given the opportunity to review the changes and modify or reaffirm the conclusions and recommendations of this report in writing.

The conclusions and recommendations in this report are based on the data obtained from the subsurface explorations at the locations shown on Figure 2 and other sources of information discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged variations in subsurface conditions may exist between exploration locations. This report does not reflect variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions differ from those encountered in the explorations, we should be advised at once so we can observe and review these conditions and reconsider our recommendations where necessary.

Submitted for GRI,

Jonathan C. Huffman, PhD, PE, GE	Nathan M. Villeneuve, C.E.G.
Associate	Project Geologist

This document has been submitted electronically.

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APPENDIX A

Geotechnical Data Report

Geotechnical Data Report
Portland General Electric
PGE Tonquin 115-kV Transmission Line
Rosemont - Wilsonville Segment

West Linn to Wilsonville, Oregon

July 1, 2022

Prepared for

Portland General Electric
Line Design Engineering
3700 SE 17th Avenue
Portland, OR 97202

Prepared by

GRI
16520 SW Upper Boones Ferry Road, Suite 100
Tigard, OR 97224
(503) 641-3478 | www.gri.com

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FIGURES

Appendices

1 INTRODUCTION

As requested, GRI is providing geotechnical services for design of the proposed Portland General Electric (PGE) Tonquin 115-kV Transmission Line project. The PGE Tonquin project has been divided into three phases: the Rosemont – Wilsonville Segment, the Mcloughlin – Tonquin Segment, and the Sherwood – Wilsonville Segment. This report focuses on the Rosemont – Wilsonville Segment, while detailed information for the other segments is provided in separate reports. The project for the alignment Rosemont – Wilsonville Segment is shown on the Vicinity Map, Figure 1.

The purpose of our services was to evaluate the subsurface conditions at selected transmission line pole locations and provide design recommendations for new foundations. Our services to date have included a review of available subsurface and geologic information for the site and surrounding area, subsurface explorations, laboratory testing, and preparation of this Geotechnical Data Report. A Geotechnical Design Report will be produced at a later date to provide a summary of engineering analyses and recommendations for foundation design and construction. This Geotechnical Data Report summarizes our subsurface investigation, equipment, methods, and procedures, as well as provides boring logs, laboratory test results, and geologic profile cross sections.

2 PROJECT DESCRIPTION

Information provided by PGE indicates the new Rosemont – Wilsonville Segment transmission line system will be supported with steel poles at selected locations along the approximately 7.5-mile-long transmission line system. Each of the steel poles will be supported on a deep foundation that may consist of a drilled pier or direct-embedment steel pole. Drilled pier foundations may range from 5 feet to 8 feet in diameter and range in depth from 18 feet to 40 feet. Geotechnical information has been requested by PGE at 14 locations along the proposed alignment, with the following northing and easting coordinates:

R-W Boring 1: North 5026417.96, East 524209.29

R-W Boring 2: North 5026006.34, East 523906.66

R-W Boring 3: North 5025457.60, East 523878.37

R-W Boring 3A: North 5025242.06, East 523686.70

R-W Boring 4: North 5025100.80, East 523601.11

R-W Boring 5: North 5024657.15, East 523340.07

R-W Boring 5A: North 5024175.20, East 523084.07

R-W Boring 6: North 5024014.54, East 523003.69

R-W Boring 7:	North 5022888.97, East 522321.74
R-W Boring 8:	North 5022687.07, East 521587.06
R-W Boring 9:	North 5021807.43, East 520815.68
R-W Boring 10:	North 5020278.93, East 520079.25
ADSS Boring 1:	North 5018285.18, East 520072.25
ADSS Boring 2:	North 5018229.72, East 518373.49

3 SITE DESCRIPTION

3.1 General

The proposed select pole locations for the new transmission line will be installed along an approximately 7.5-mile alignment adjacent to SW Stafford Road between Rosemont Road and Boeckman Road and at the intersection of Boeckman Road and SW Parkway Avenue. The alignment traverses variable site conditions consisting of woodlands, the Interstate 205 (I-205) corridor, the Tualatin River, agricultural fields, and residential and commercial properties.

3.2 Geology

The geologic conditions vary along the project alignment. Published geologic mapping indicates portions of the alignment are mantled with coarse-grained and fine-grained catastrophic flood deposits, locally referred to as Missoula Flood Deposits, consisting of stratified clay, silt, sand, gravel, and cobble soils. Other portions of the alignment are underlain by various members of the Columbia River Basalt Group. Where the upper surface of the Columbia River Basalt is present near the ground surface, it is typically severely weathered (Madin 2004). The geologic mapping is generally consistent with the subsurface conditions encountered in our explorations, as discussed in more detail below.

4 SUBSURFACE INVESTIGATION, EQUIPMENT, AND PROCEDURES

4.1 Borings

Subsurface materials and conditions at the site were investigated between March 23 and June 10, 2022, with 14 borings, designated B-1 through B-3, B-3A, B-4, B-5, B-5A, B-6 through B-10, ADSS B-1 and ADSS B-2. As noted above, the boring locations were selected in consultation with PGE to provide specific subsurface information on where new transmission line poles will be located. The approximate boring locations are identified in Figure 1.

Borings B-1 through B-5, B-7 through B-10, ADSS B-1, and ADSS B-2 were advanced from the paved roadway surface using a CME 75 truck-mounted drill rig provided and operated by Western States Soil Conservation, Inc. (WSSC), of Hubbard, Oregon. A vacuum trailer provided and operated by WSSC was used ahead of the drilling from the paved roadway surface to confirm underground utilities were not present at each of the roadway boring locations. Borings B-5A and B-6 were advanced from the grass shoulder surface using a track-mounted CME 850 drill rig provided and operated by WSSC. All borings were advanced using mud-rotary drilling and wireline rock core drilling techniques, as needed. The borings were advanced to depths ranging from about 20 feet to 56.5 feet below existing site grades. Where coreable bedrock was encountered, the borings extended at least 10 feet into the coreable rock.

4.2 Sampling

Disturbed and undisturbed soil samples were obtained from the borings at 2.5-foot intervals of depth in the upper 20 feet and at 5-foot intervals below this depth. Disturbed soil samples were obtained using a split-spoon sampler. The standard penetration test (SPT) was completed while obtaining disturbed soil samples. This test is performed by driving a 2-inch-outside-diameter, split-spoon sampler or a larger, 3-inch-outside-diameter California-modified split-spoon (CMS) sampler into the soil at a distance of 18 inches using the force of a 140-pound hammer dropped 30 inches. The number of blows required to drive the sampler the last 12 inches is known as the Standard Penetration Resistance, or SPT N-value. Similarly, the number of blows required to drive the CMS the last 12 inches is denoted as the SPT N*-value. The SPT N- and N*-values provide a measure of the relative density of granular soils and the relative consistency of cohesive soils. Split-spoon samples obtained from the borings were placed in airtight plastic bags and returned to our laboratory for further classification and testing. Relatively undisturbed samples were collected by pushing a 3-inch-outside-diameter Shelby tube into the soil at a maximum distance of 24 inches using the hydraulic ram of the drill rig. The soil exposed at the end of the Shelby tube was examined and classified in the field. After classification, the tubes were sealed with rubber caps and returned to our laboratory for further examination and testing. Where sufficiently hard rock was encountered, wireline triple-tube rock core barrel sampling was completed. Rock coring runs were limited to a maximum length of 5 feet.

4.3 Subsurface Profiles

Subsurface profiles at each boring location were developed based on the individual soil stratigraphy encountered. The soils and rock encountered were combined into geologic units based on origin and estimated engineering properties. The subsurface profiles are provided on Figures 2 through 15. Each profile indicates the interpreted geologic soil or rock unit, sampling type, and SPT N- or N*-values.

4.4 Boring Logs

Logs of the borings are provided on Figures 1A through 14A. Photographs of the rock cores retained in core boxes are provided on Figures 15A through 17A. Each log presents a summary of the various types of materials encountered in the boring and notes the depths at which the materials and/or characteristics of the materials change. To the right of the summary, the numbers and types of samples are indicated. Farther to the right, SPT

N- and N*-values are shown graphically, along with the natural moisture contents, Torvane and field vane shear-strength values, Atterberg limits, and percent passing the No. 200 sieve, where applicable. The terms and symbols used to describe the materials encountered in the borings are defined in Tables 1A and 2A, and on the attached legend.

5 LABORATORY TESTING

5.1 General

The samples obtained from the borings were examined in our laboratory, where the physical characteristics of the samples were noted, and the field classifications modified where necessary. At the time of classification, the natural moisture content of each sample was determined. Additional testing included Torvane or vane shear strength measurements on fine-grained soils, dry unit weight measurements, Atterberg limits determinations, grain-size analyses, a one-dimensional consolidation test, unconfined compressive strength tests for rock core samples, and corrosivity testing. The following sections describe the testing program in more detail. A summary of the laboratory test results for the natural moisture contents, dry unit weights, Atterberg limits, and percent fines content is also provided in Table 3A.

5.2 Natural Moisture Content

Natural moisture content determinations were made in conformance with ASTM International (ASTM) D2216. The results are summarized on Figures 1A through 14A and in Table 3A.

5.3 Grain-Size Analysis

5.3.1 Washed-Sieve Method

To assist in classification of the soils, samples of known dry weight were washed over a No. 200 sieve. The material retained on the sieve was oven dried and weighed. The percentage of material passing the No. 200 sieve was then calculated. The results are summarized on Figures 1A through 14A, where applicable, and in Table 3A.

5.4 Undrained Shear Strength

5.4.1 Torvane Shear Strength

The undrained shear strength of cohesive fine-grained soils within selected Shelby-tube samples was estimated using a Torvane shear device in conformance with ASTM D4648. The Torvane is a hand-held apparatus with vanes that are inserted into the soil. The torque required to fail the soil in shear around the vanes is measured using a calibrated spring. The results of the Torvane shear-strength tests are summarized on Figures 1A through 14A, where applicable.

5.4.2 Laboratory Vane Shear Test

The undrained shear strength of cohesive fine-grained soils within selected Shelby-tube samples was estimated using a vane shear device in general conformance with ASTM D2573. The vane shear device is a hand-held apparatus with vanes that are inserted into the soil. The torque required to fail the soil in shear around the vanes is measured using a calibrated spring. The results of the vane shear-strength tests are summarized on Figures 1A through 14A, where applicable.

5.5 Undisturbed Unit Weight

The unit weight, or density, of undisturbed soil samples was determined in the laboratory in conformance with ASTM D2937. The results are summarized on Figures 1A through 14A, where applicable, and in Table 3A.

5.6 Atterberg Limits

Atterberg limits testing was performed on samples of soil in conformance with ASTM D4318. The test results are summarized on the Plasticity Charts Figures 18A through 20A, Figures 1A through 14A, where applicable, and in Table 3A.

5.7 One-Dimensional Consolidation

One-dimensional consolidation testing was performed in accordance with ASTM D2435 on a relatively undisturbed soil sample obtained from boring ADSS B-1 at a depth of about 13.3 feet. The test provides data on the compressibility of the fine-grained soils. Test results are summarized on Figure 21A in the form of a curve showing effective stress versus percent strain. The initial dry unit weight and moisture content of the samples are also shown on the figures.

5.8 Unconfined Compression Rock-Strength

Unconfined compressive rock-strength testing was completed by Cooper Testing Labs, Inc. of Palo Alto, California. Unconfined compressive strength testing of rock core samples was performed in accordance with ASTM D7012-D on intact rock core samples obtained from borings B-1 at a depth of about 12.5 feet and boring B-2 at a depth of about 26 feet. The test provides data on the compressive strength and elastic moduli of intact rock core specimens in uniaxial compression. Test results are summarized on Figures 22A and 23A.

5.9 Soil Corrosivity

Soil corrosivity testing was completed by Cooper Testing Labs, Inc. of Palo Alto, California. The corrosivity testing suite included Resistivity (100% saturated) testing in accordance with ASTM G57, pH testing in accordance with ASTM G51, Chloride testing in accordance with ASTM D4327, Sulfate testing in accordance with ASTM D4327, Sulfide testing using lead acetate paper, and Redox Potential / ORP in accordance with ASTM G200. Test results are summarized on Figure 24A.

6 LIMITATIONS

This data report has been prepared to aid the client in the design of this project. The scope is limited to the specific project and locations described within this report. Our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the foundations that will support the proposed transmission line poles. Design recommendations for the foundations are not included in this report and will be provided in a forthcoming design report. In the event that any changes in the locations of the structures as outlined in this report are planned, we should be given the opportunity to review the changes and modify or reaffirm the conclusions and recommendations of this report in writing.

In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged that variations in soil conditions may exist between exploration locations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions differ from those encountered in the explorations, we should be advised at once so we can observe and review these conditions and reconsider our recommendations where necessary.

Submitted for GRI,

Jonathan C. Huffman, PhD, PE, GE
Associate

Nathan M. Villeneuve, CEG
Project Geologist

This document has been submitted electronically.

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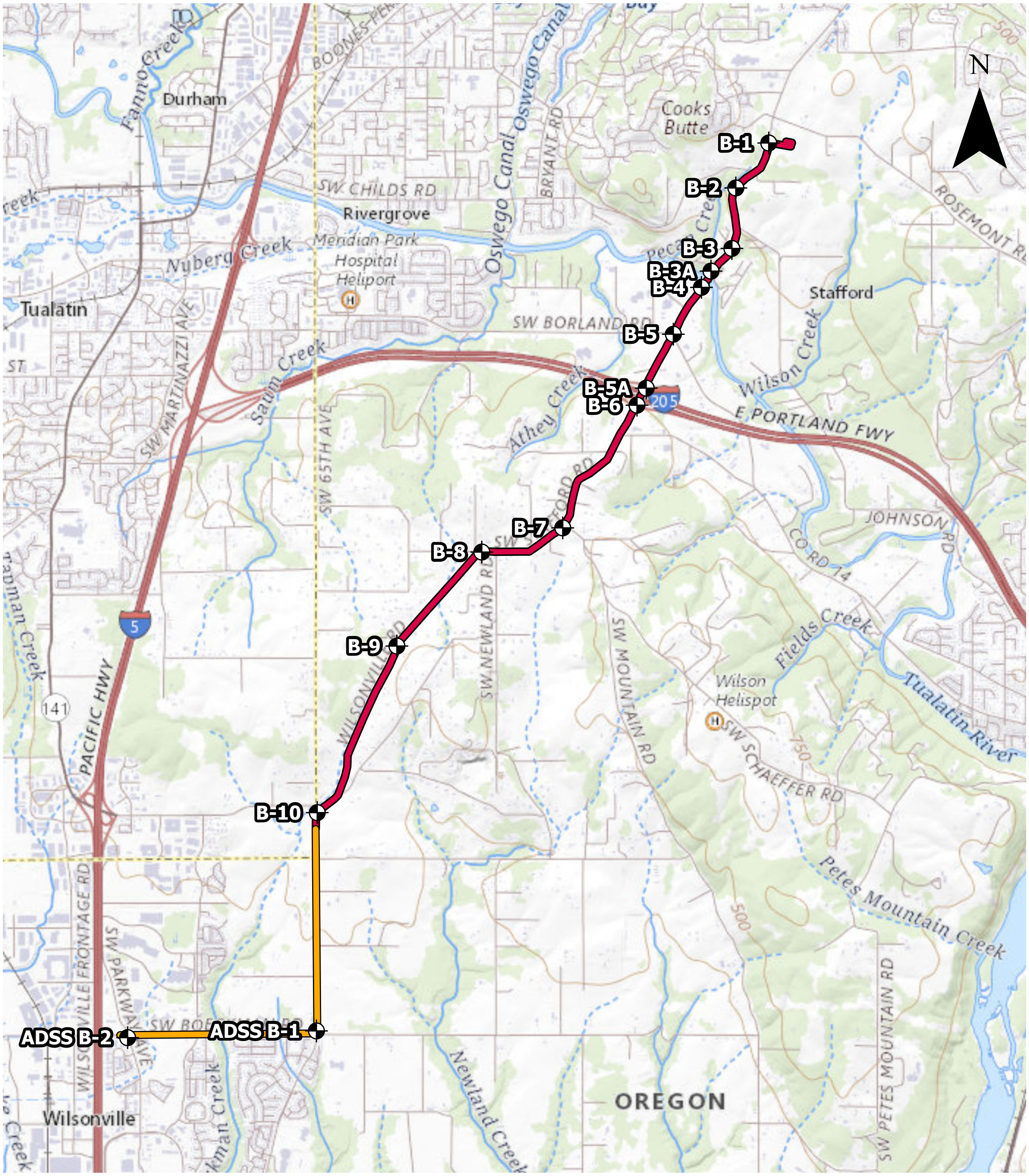


BORING COMPLETED BY GRI
ROSEMONT-WILSONVILLE SEGMENT
ADSS SEGMENT

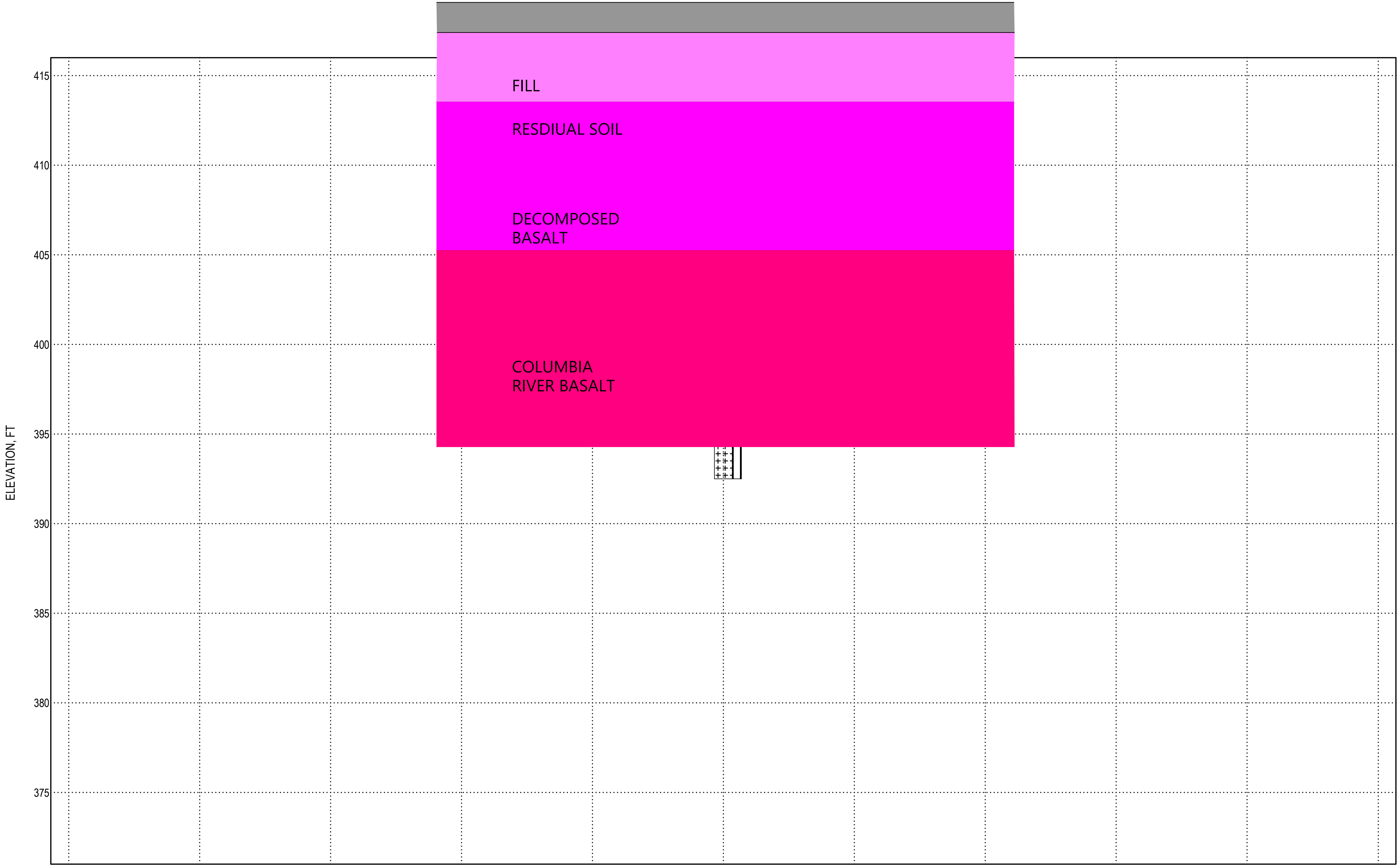
0 0.5 1 1.5 2
Miles

GRI

PORTLAND GENERAL ELECTRIC
PGE TONQUIN 115-KV TRANSMISSION LINE
ROSEMONT-WILSONVILLE SEGMENT

VICINITY MAP

JUL. 2022 | JOB NO. 6658-A | FIG. 1



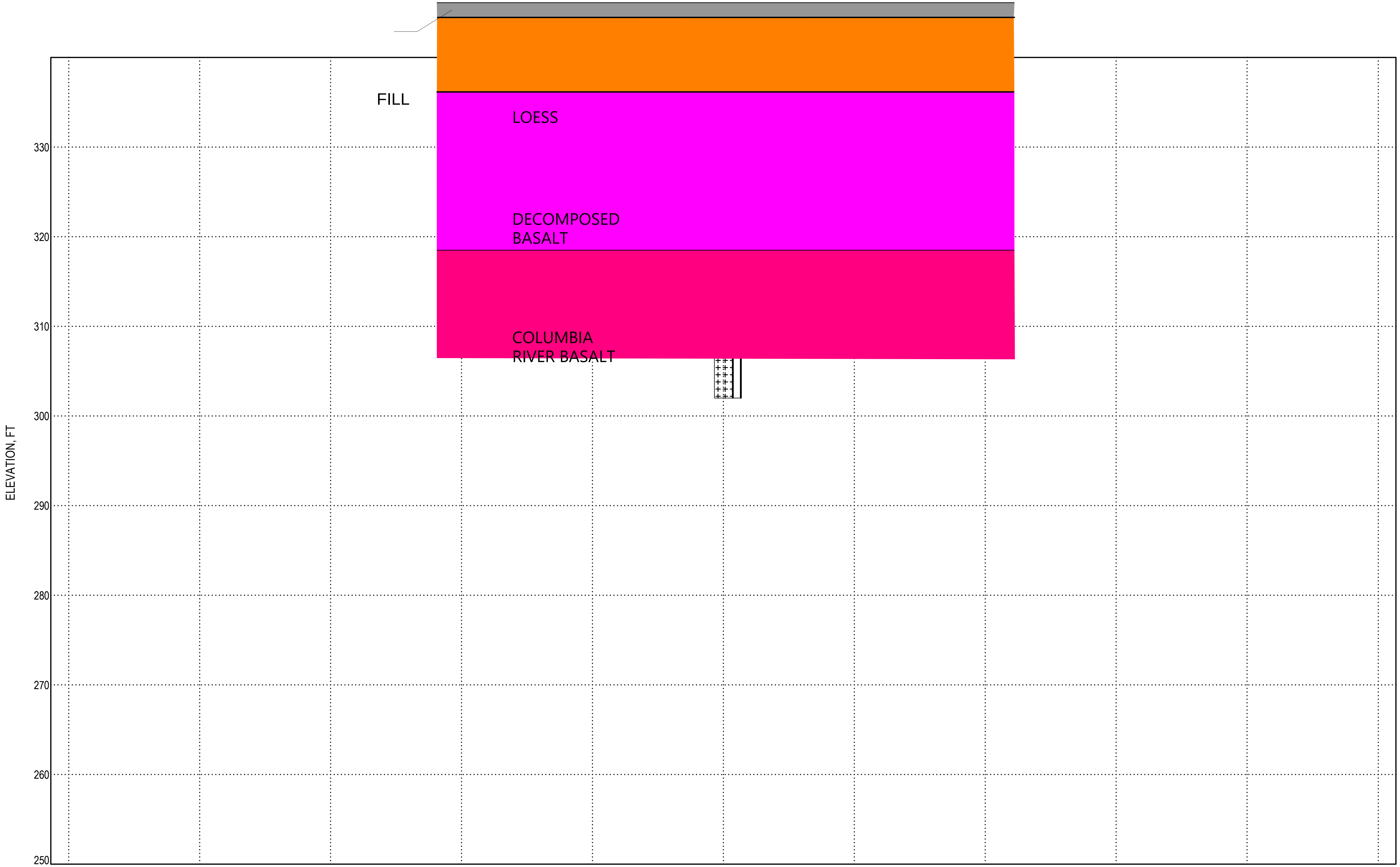
LEGEND

16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE

ASPHALT
CONCRETE
CLAY
Clayey SAND
Sandy GRAVEL
BASALT

GRI B-1 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 2



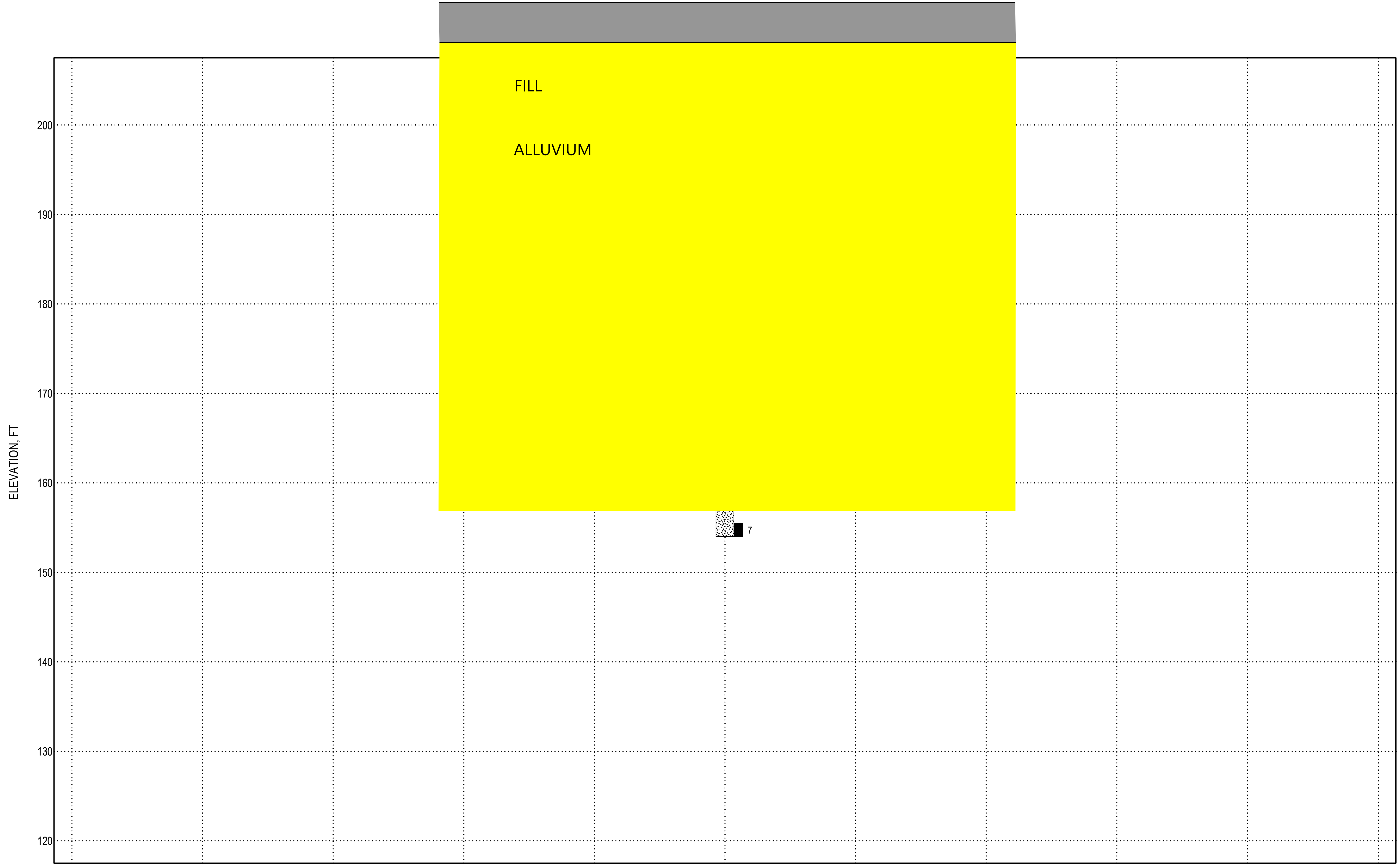
LEGEND

16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE

ASPHALT
CONCRETE
SILT
Silty SAND
BASALT

GRI B-2 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 3



LEGEND

16 ■ SPT SAMPLE AND N VALUE

32* ■ 3-IN. SAMPLE AND N* VALUE

U □ UNDISTURBED SAMPLE

□ ROCK CORE

□ GRAB SAMPLE

ASPHALT

CONCRETE

FILL

SILT

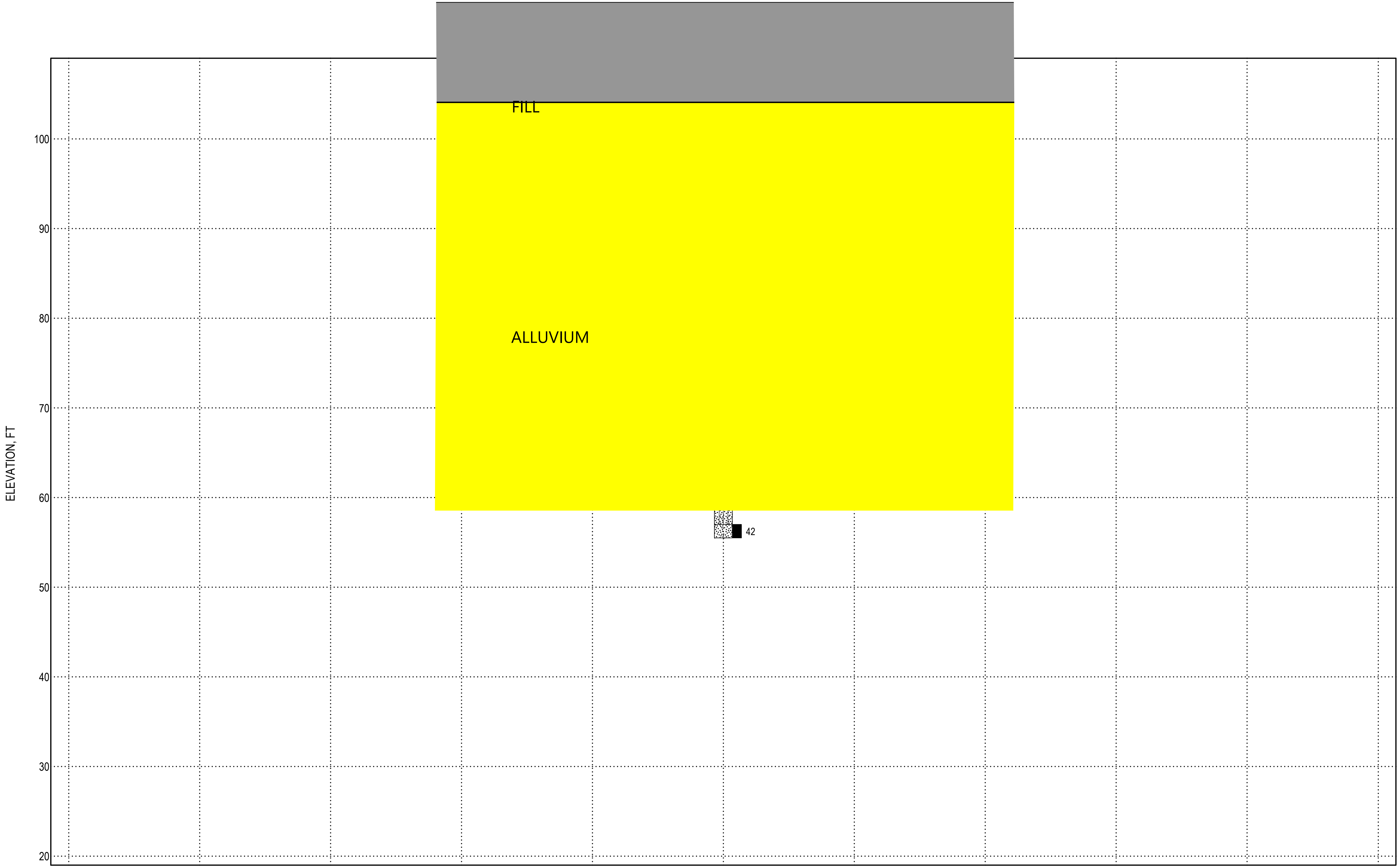
Sandy SILT

Silty SAND

SAND

GRI B-3 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 4

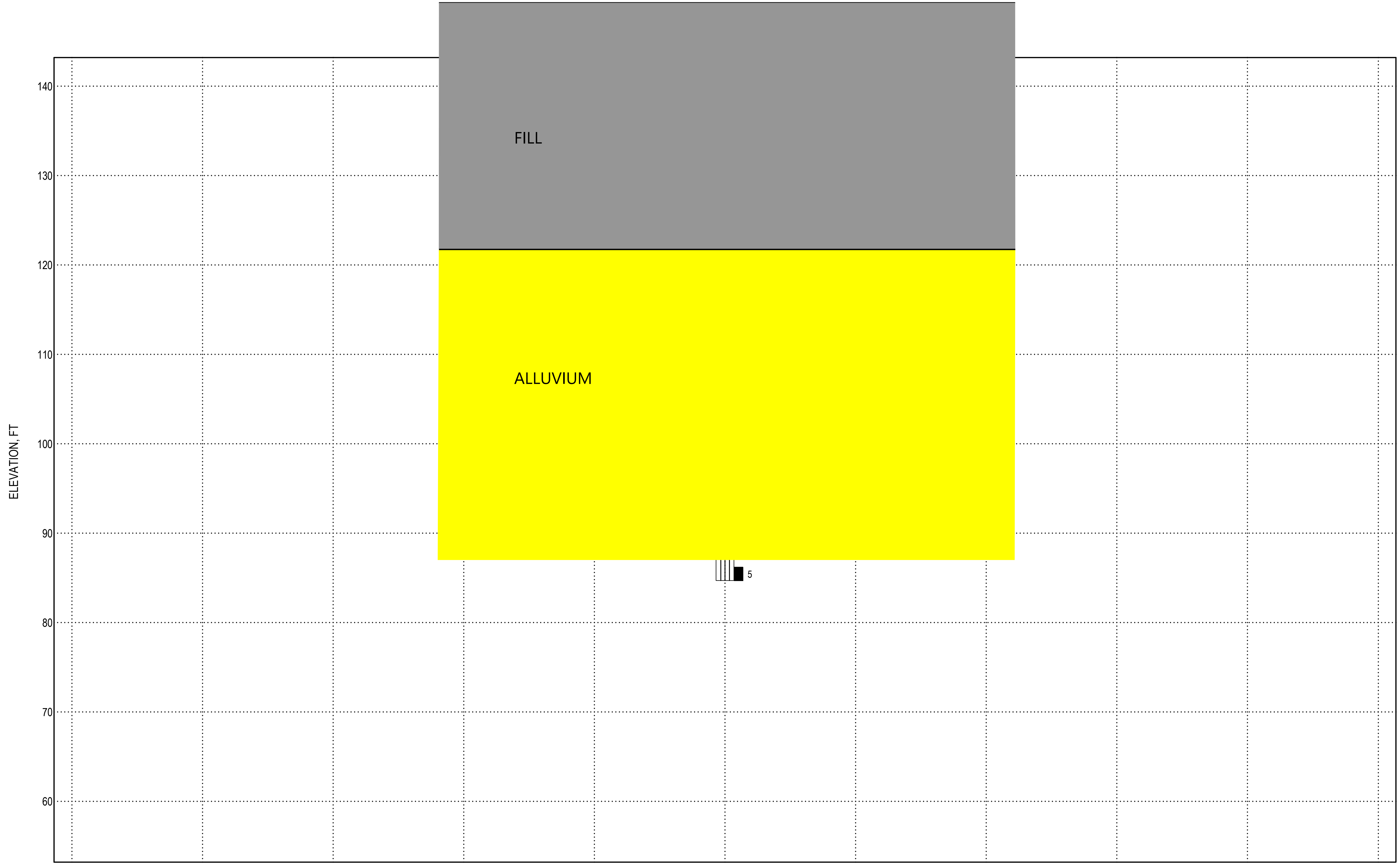


LEGEND

16 SPT SAMPLE AND N VALUE
32* 3-IN. SAMPLE AND N* VALUE
U UNDISTURBED SAMPLE
ROCK CORE
GRAB SAMPLE
ASPHALT
Silty SAND
GRAVEL
SAND
FILL
SILT
Sandy SILT

GRI B-3A PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 5



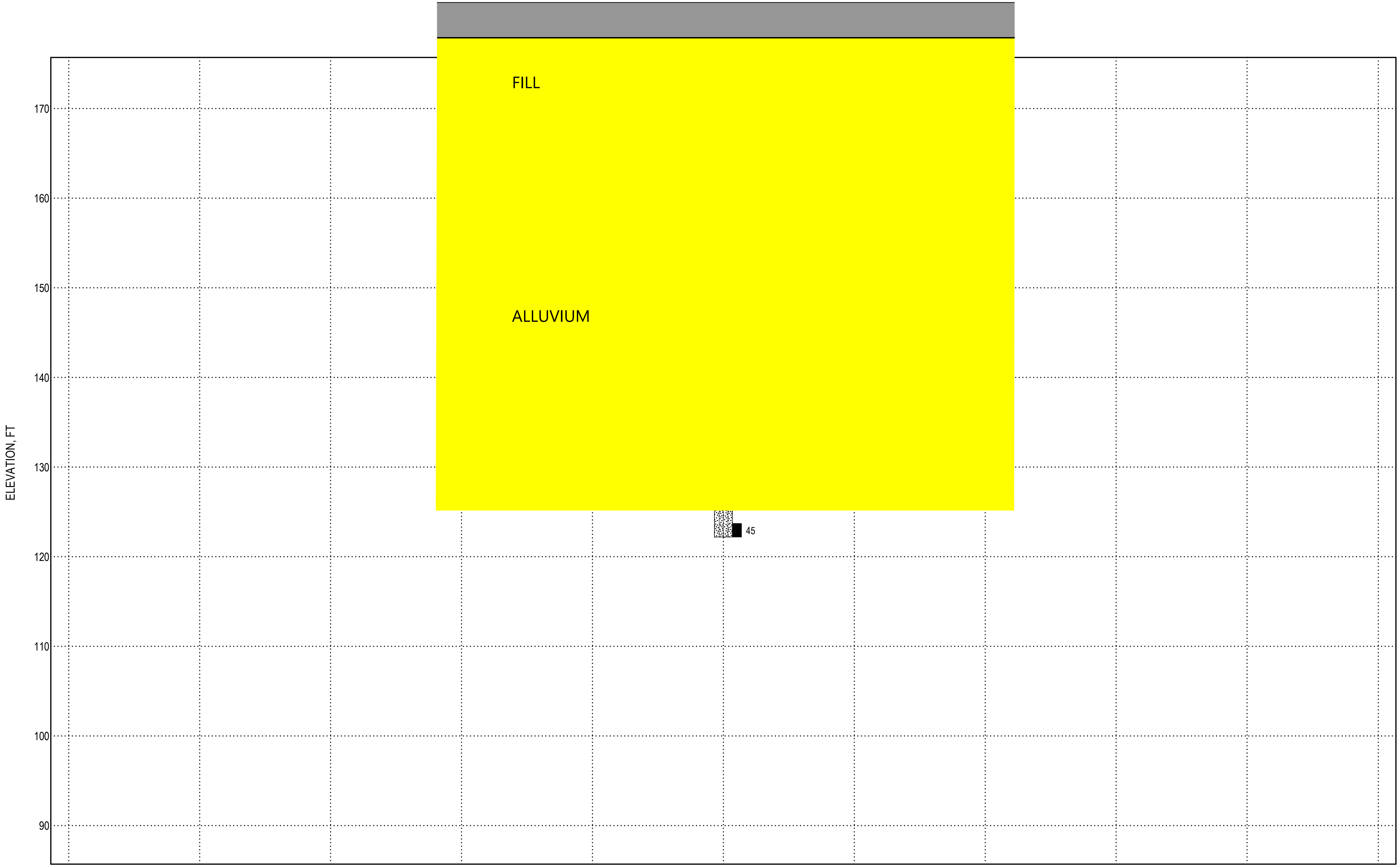
LEGEND

16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE

ASPHALT
Silty SAND
GRAVEL
CLAY
FILL
SILT
Sandy SILT

GRI B-4 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 6



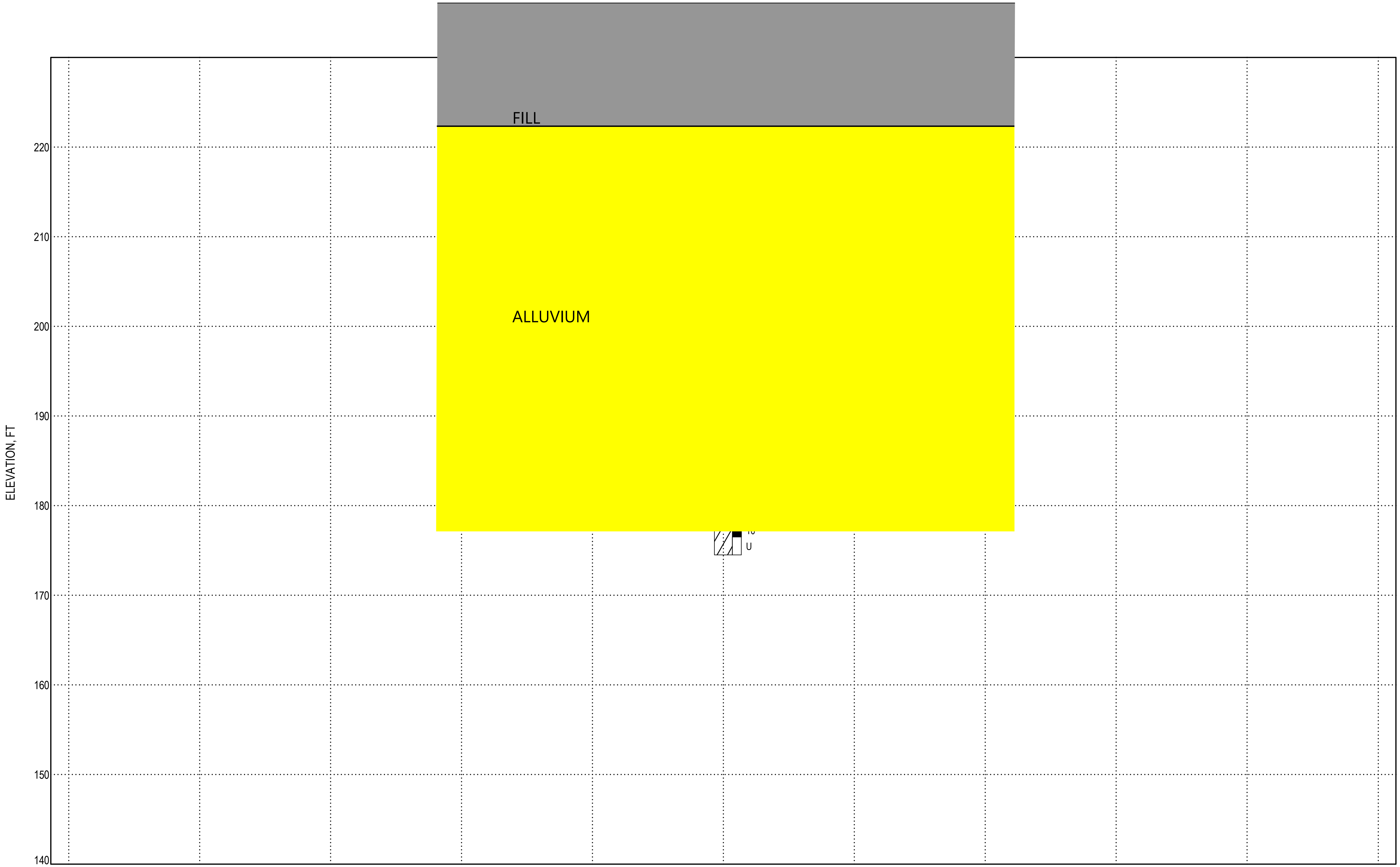
LEGEND

16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE

ASPHALT
Sandy SILT
GRAVEL
Silty SAND
FILL
SILT

GRI B-5 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 7



LEGEND

16 ■ SPT SAMPLE AND N VALUE

32* ■ 3-IN. SAMPLE AND N* VALUE

U □ UNDISTURBED SAMPLE

□ ROCK CORE

□ GRAB SAMPLE

FILL

CLAY

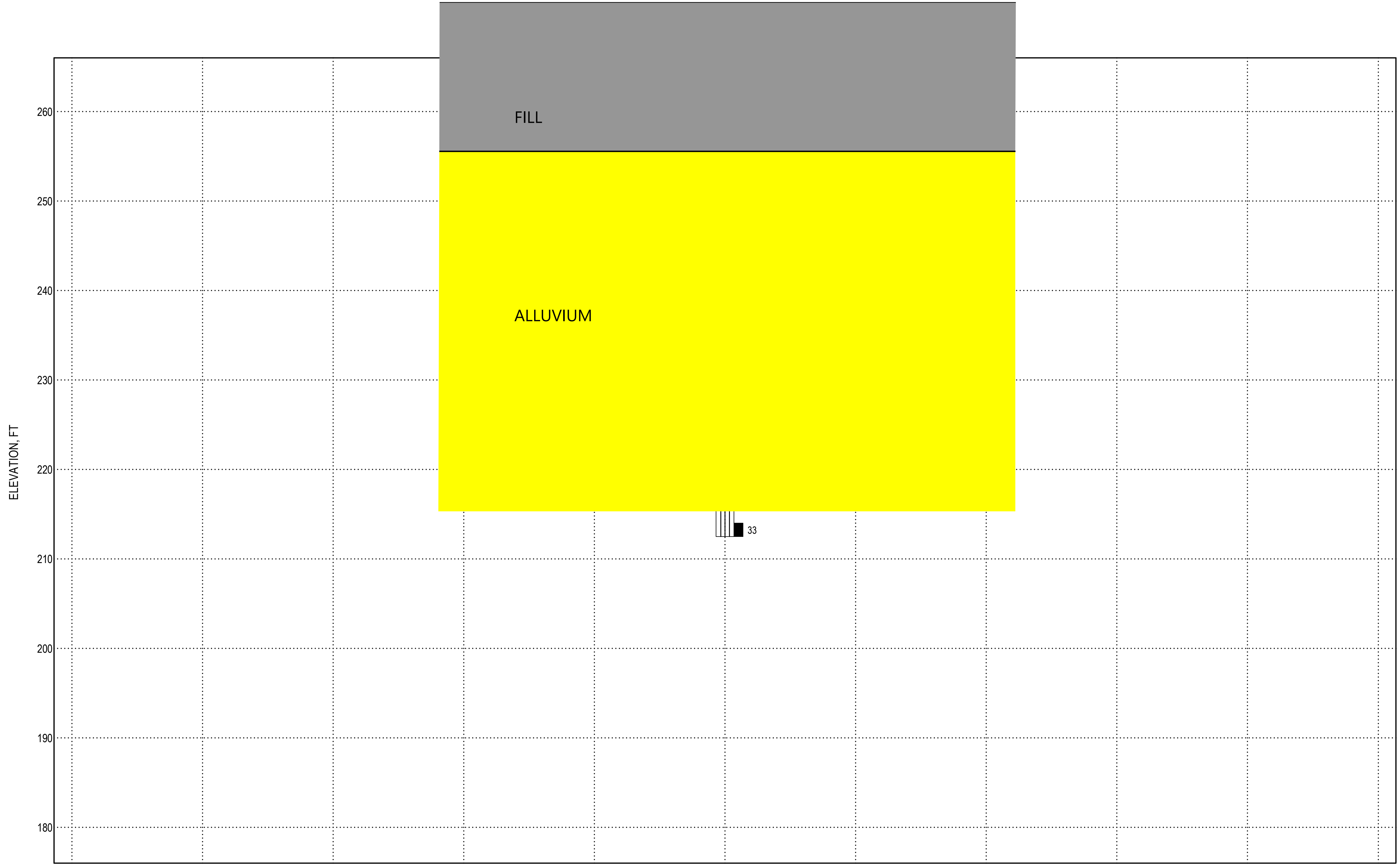
SILT

Silty SAND

SAND

GRI B-5A PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 8

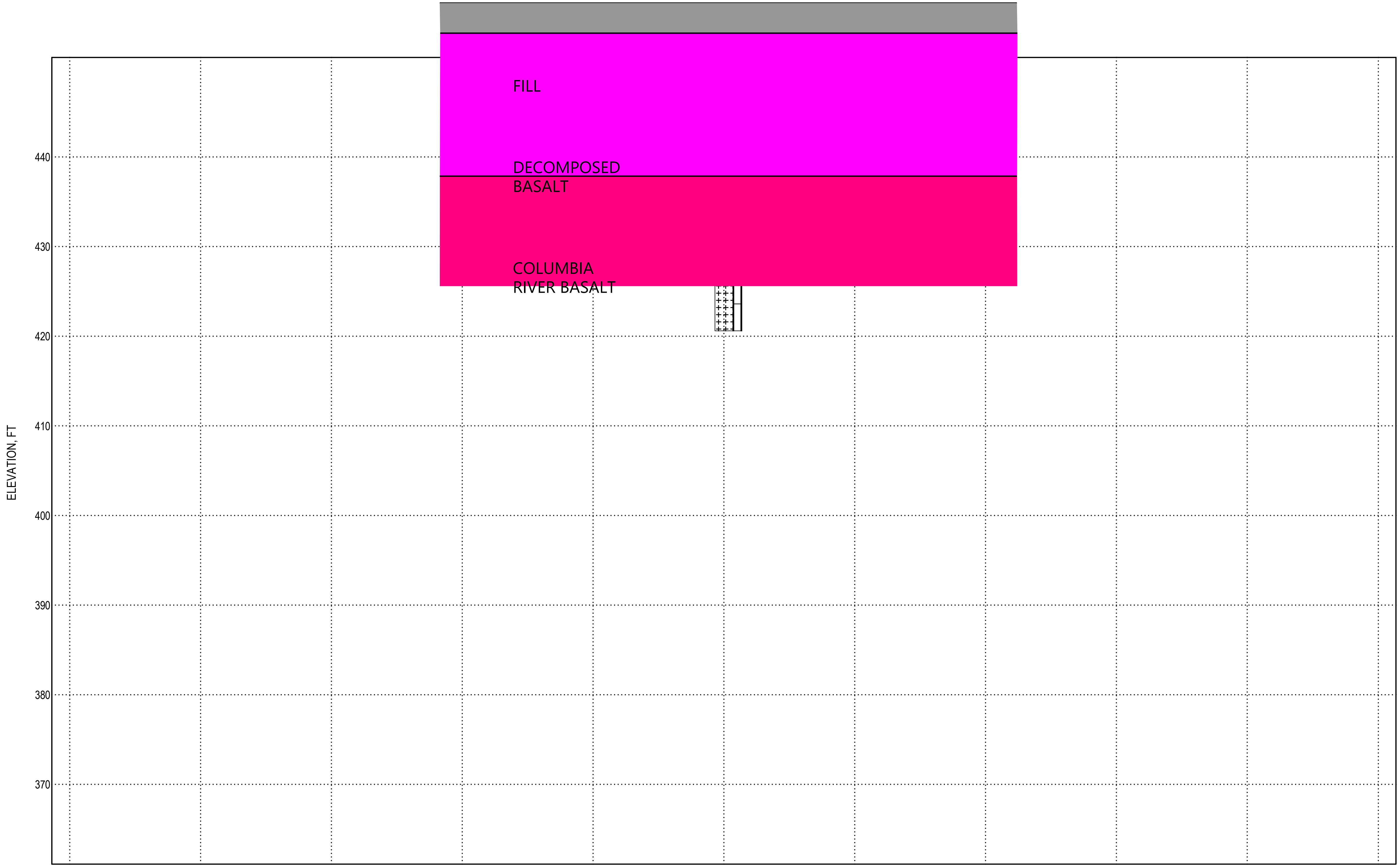


LEGEND

16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE
FILL
Silty SAND
SILT
CLAY
Sandy SILT

GRI B-6 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 9

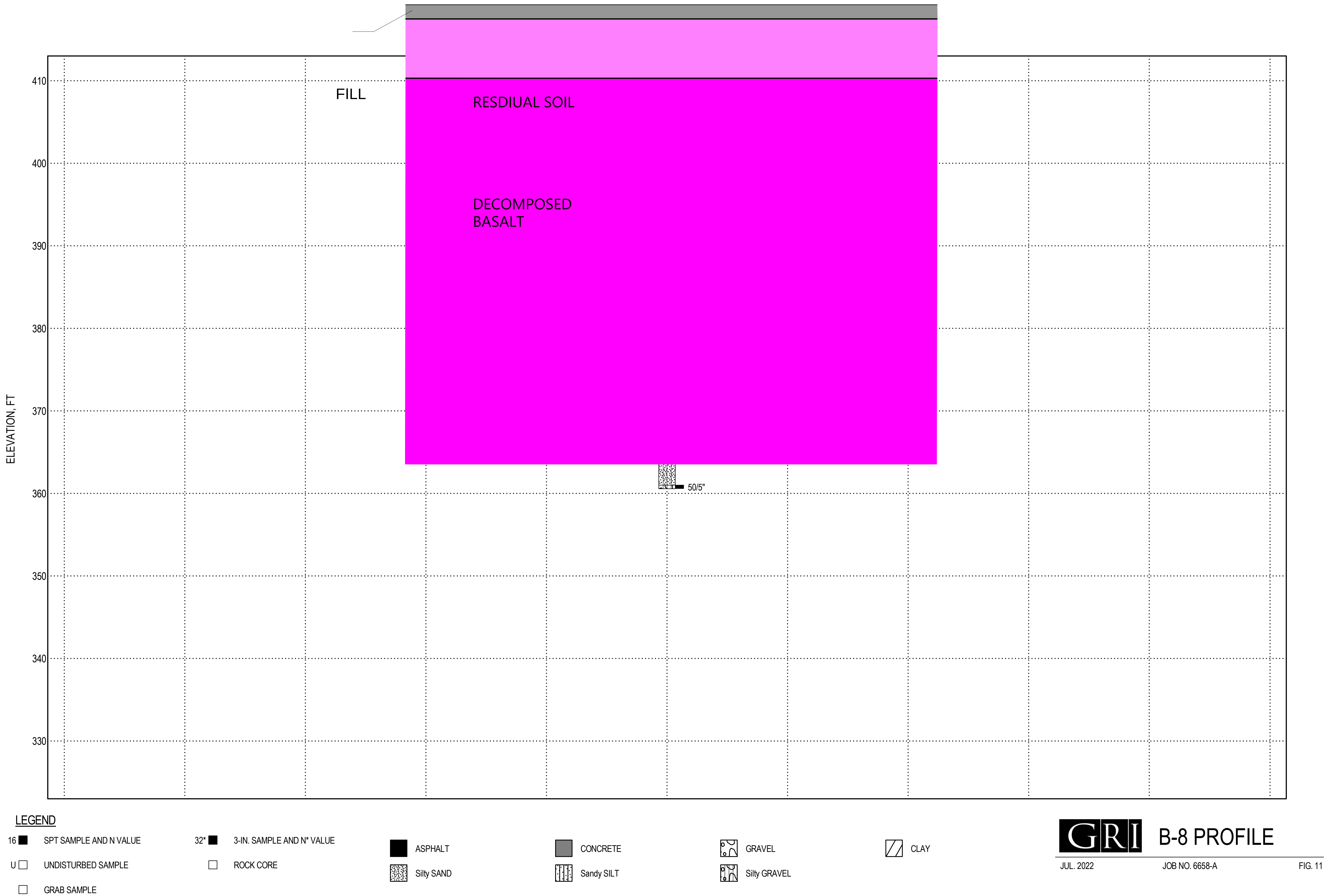


LEGEND

16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
FILL
Silty SAND
BASALT
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE

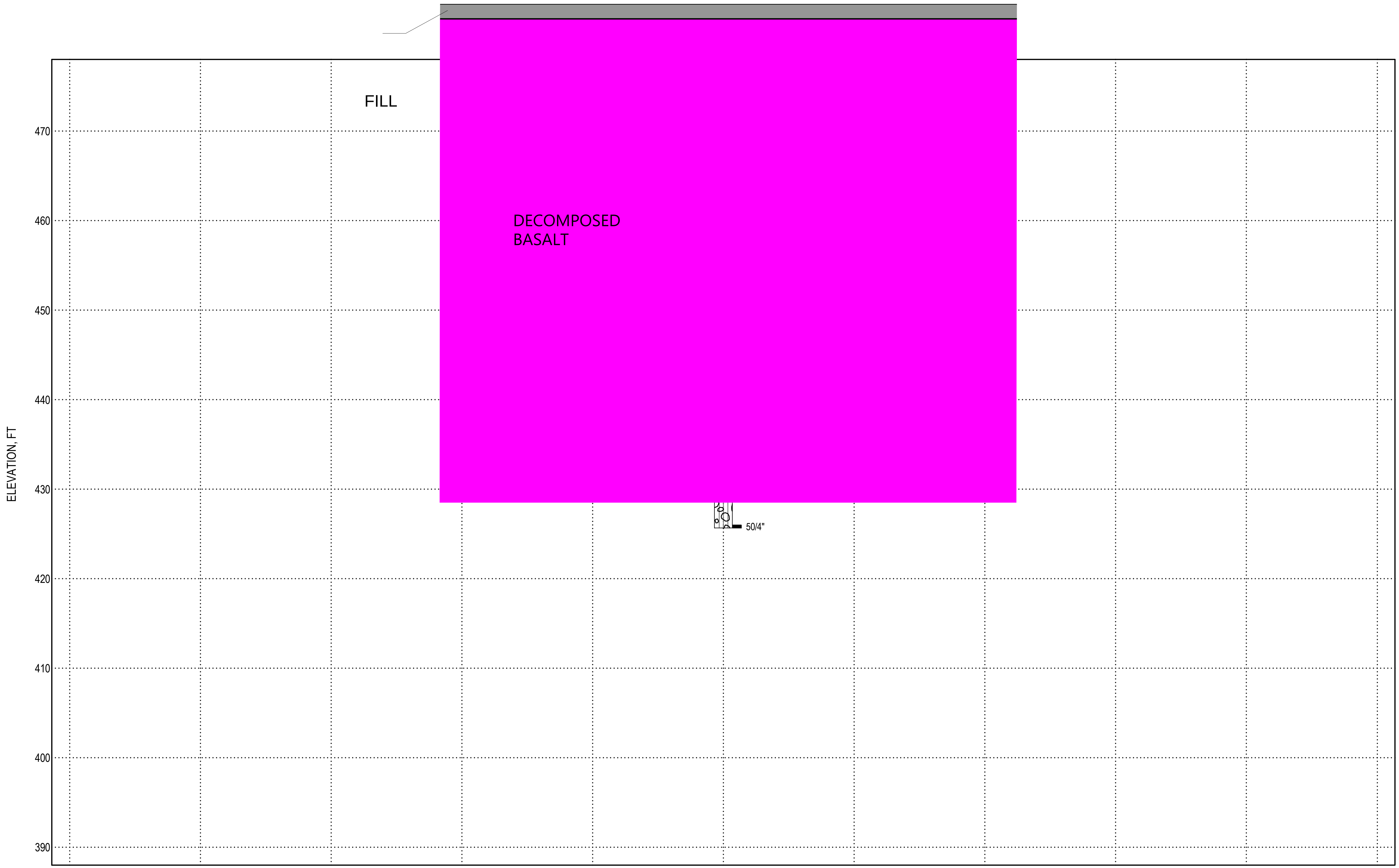
GRI B-7 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 10



GRI B-8 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 11



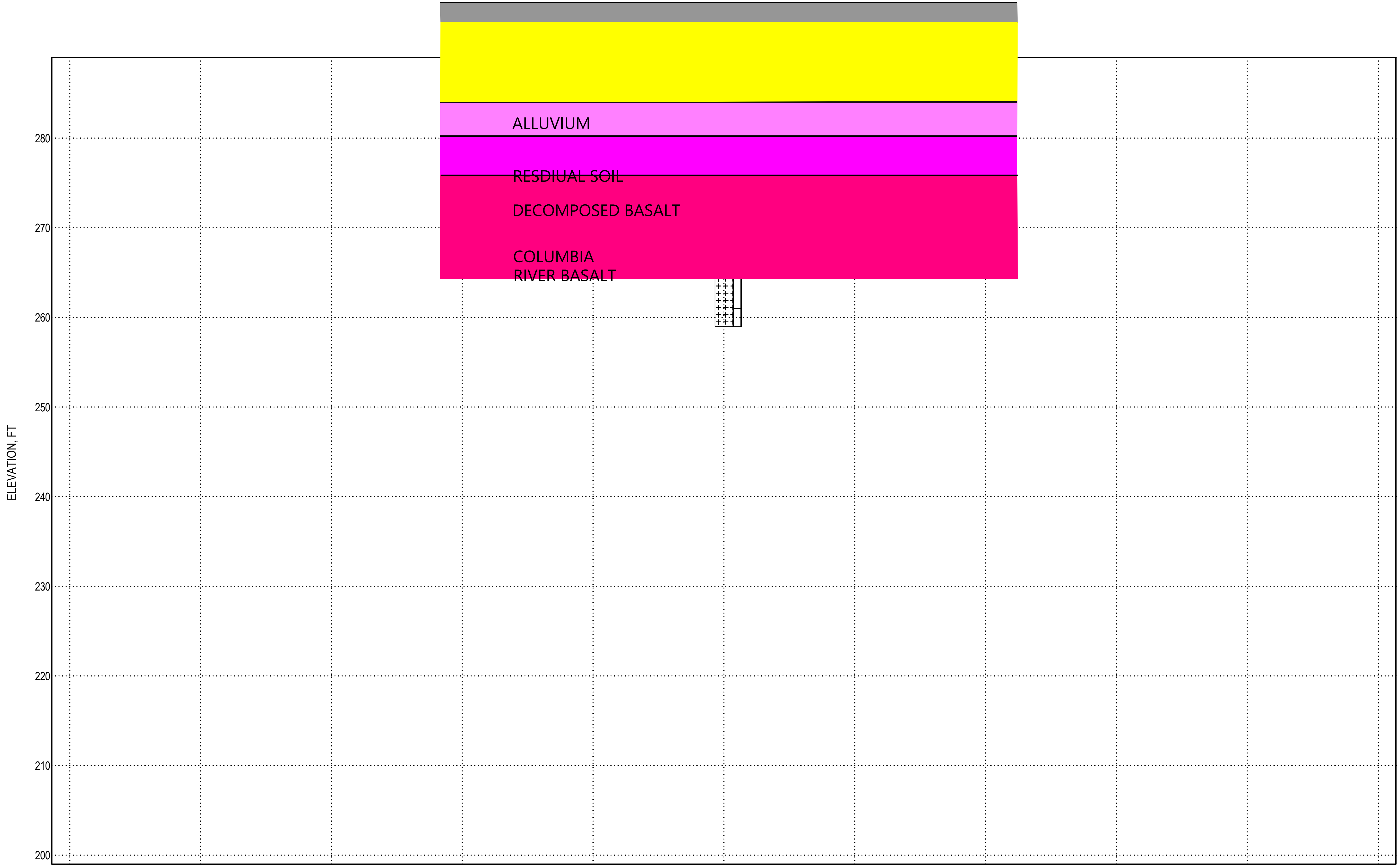
LEGEND

16 SPT SAMPLE AND N VALUE
32* 3-IN. SAMPLE AND N* VALUE
U UNDISTURBED SAMPLE
ROCK CORE
GRAB SAMPLE

ASPHALT
CONCRETE
CLAY
Silty SAND
SILT
Silty GRAVEL

GRI B-9 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 12



LEGEND

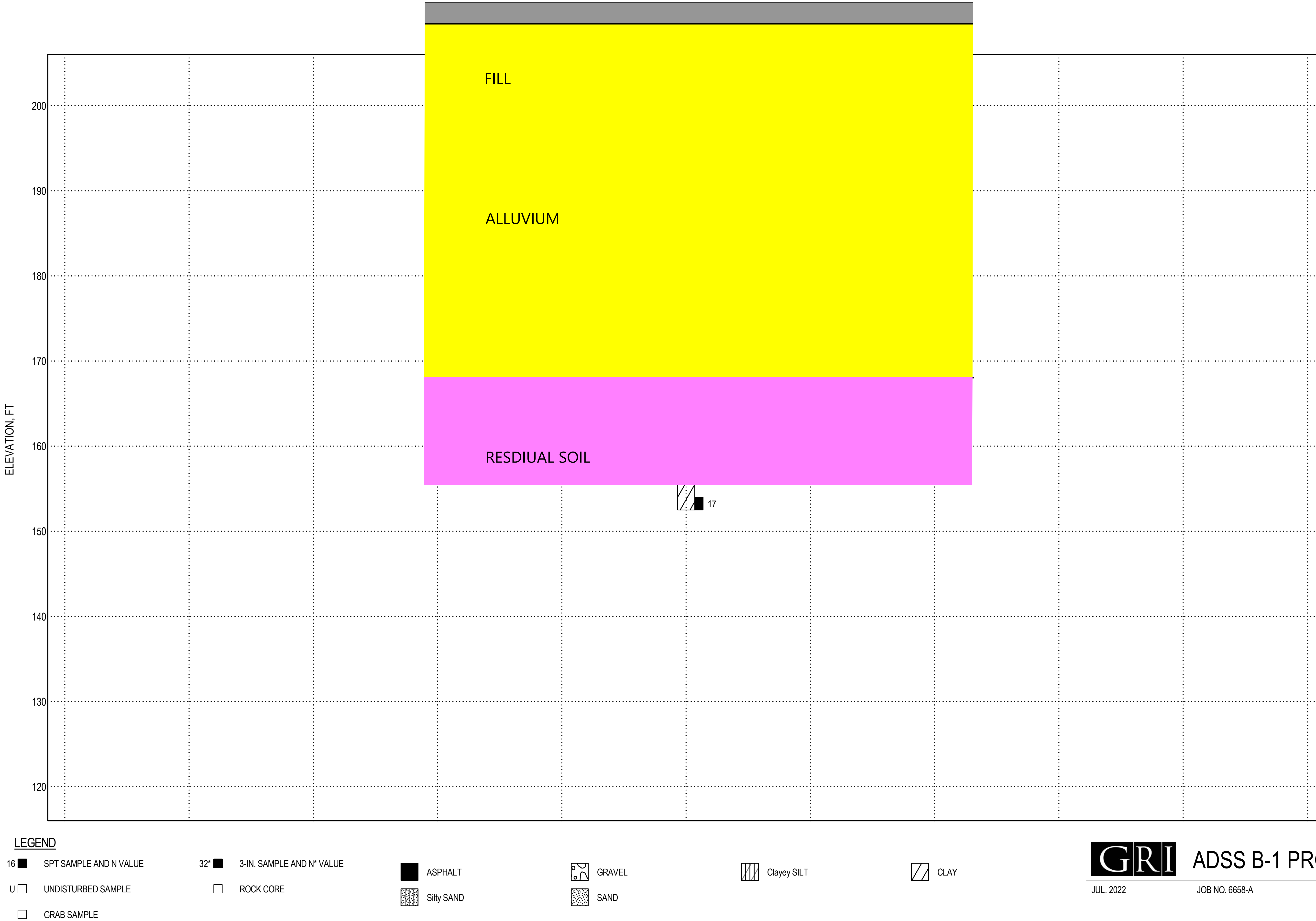
16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE

ASPHALT
Silty SAND
GRAVEL
BASALT
SILT
CLAY

GRI

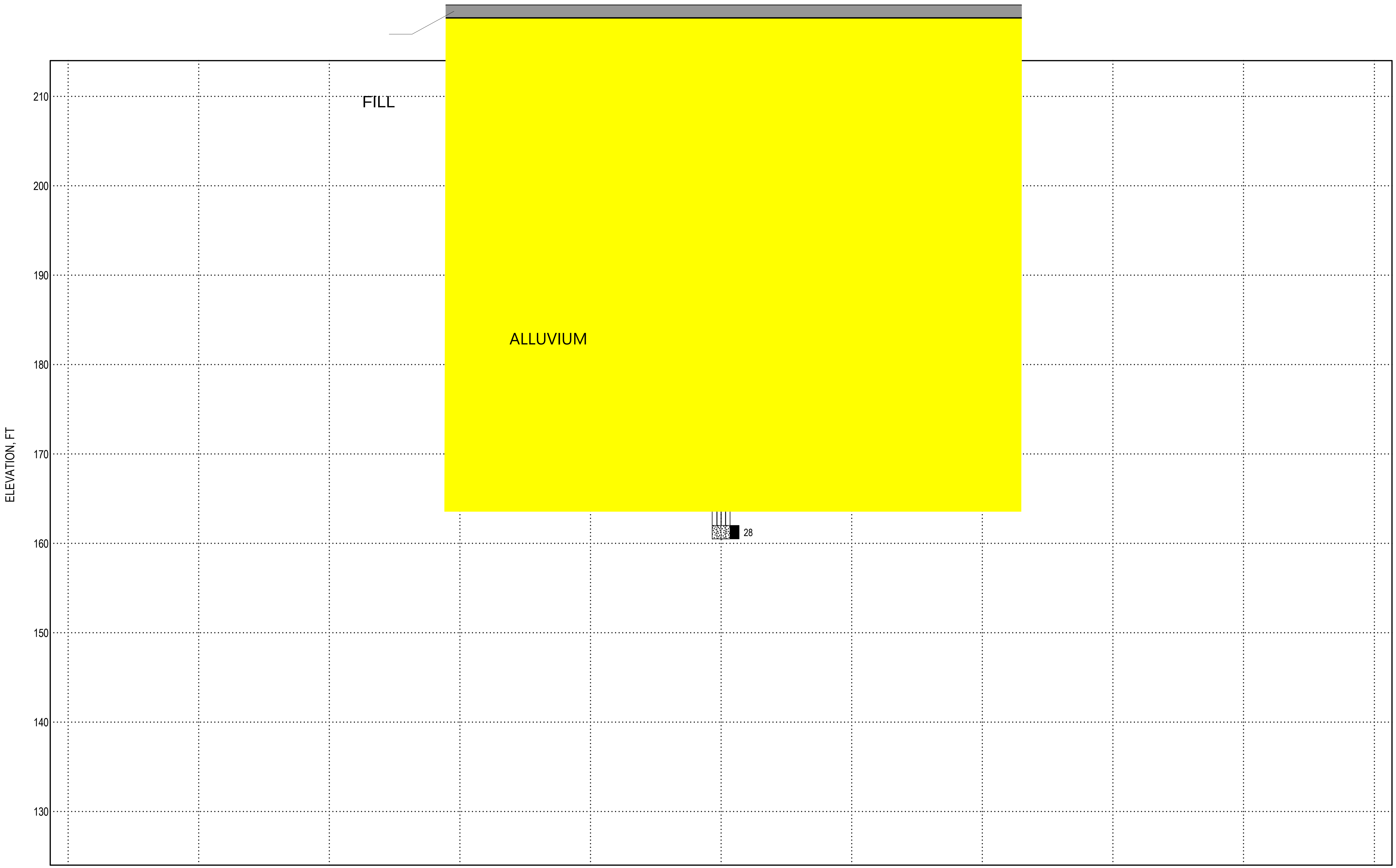
B-10 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 13



GRI ADSS B-1 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 14



LEGEND

16 ■ SPT SAMPLE AND N VALUE
32* ■ 3-IN. SAMPLE AND N* VALUE
U □ UNDISTURBED SAMPLE
□ ROCK CORE
□ GRAB SAMPLE
CONCRETE
Silty CLAY
GRAVEL
CLAY
SILT
Silty SAND

GRI

ADSS B-2 PROFILE

JUL. 2022 JOB NO. 6658-A FIG. 15

APPENDIX A

Field Explorations and Laboratory Testing

Table 1A

GUIDELINES FOR CLASSIFICATION OF SOIL

Description of Relative Density for Granular Soil

Relative Density	Standard Penetration Resistance (N-values) blows/ft	California-Modified Penetration Resistance (SPT N*-values), blows/ft
Very Loose	0 - 4	0 – 11
Loose	4 - 10	11 – 26
Medium Dense	10 - 30	26 – 74
Dense	30 - 50	74 – 120
Very Dense	over 50	Over 120

Description of Consistency for Fine-Grained (Cohesive) Soils

Consistency	Standard Penetration Resistance (N-values) blows/ft	Torvane or Undrained Shear Strength, tsf
Very Soft	0 - 2	less than 0.125
Soft	2 - 4	0.125 - 0.25
Medium Stiff	4 - 8	0.25 - 0.50
Stiff	8 - 15	0.50 - 1.0
Very Stiff	15 - 30	1.0 - 2.0
Hard	over 30	over 2.0

Grain-Size Classification

Boulders:
>12 in.

Cobbles:
3-12 in.

Gravel:
¼ - ¾ in. (fine)
¾ - 3 in. (coarse)

Sand:
No. 200 - No. 40 sieve (fine)
No. 40 - No. 10 sieve (medium)
No. 10 - No. 4 sieve (coarse)

Silt/Clay:
Pass No. 200 sieve

Modifier for Subclassification

Adjective	Primary Constituent SAND or GRAVEL	Primary Constituent SILT or CLAY
	Percentage of Other Material (By Weight)	
trace:	5 - 15 (sand, gravel)	5 - 15 (sand, gravel)
some:	15 - 30 (sand, gravel)	15 - 30 (sand, gravel)
sandy, gravelly:	30 - 50 (sand, gravel)	30 - 50 (sand, gravel)
trace:	<5 (silt, clay)	*Relationship of clay and silt determined by plasticity index test*
some:	5 - 12 (silt, clay)	
silty, clayey:	12 - 50 (silt, clay)	

Table 2A

GUIDELINES FOR CLASSIFICATION OF ROCK

Relative Rock Weathering Scale

Term	Field Identification
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric.
Slightly Weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric. Decomposition extends up to 1 in. into rock.
Moderately Weathered	Rock mass is decomposed 50% or less. Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Predominantly Decomposed	Rock mass is more than 50% decomposed. Rock can be excavated with geologist's pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock "fabric" may be evident. May be reduced to soil with hand pressure.

Relative Rock Hardness Scale

Term	Hardness Designation	Field Identification	Approximate Unconfined Compressive Strength
Extremely Soft	R0	Can be indented with difficulty by thumbnail. May be moldable or friable with finger pressure.	< 100 psi
Very Soft	R1	Crumbles under firm blows with point of a geology pick. Can be peeled by a pocket knife and scratched with fingernail.	100 - 1,000 psi
Soft	R2	Can be peeled by a pocket knife with difficulty. Cannot be scratched with fingernail. Shallow indentation made by firm blow of geology pick.	1,000 - 4,000 psi
Medium Hard	R3	Can be scratched by knife or pick. Specimen can be fractured with a single firm blow of hammer/geology pick.	4,000 - 8,000 psi
Hard	R4	Can be scratched with knife or pick only with difficulty. Several hard hammer blows required to fracture specimen.	8,000 - 16,000 psi
Very Hard	R5	Cannot be scratched by knife or sharp pick. Specimen requires many blows of hammer to fracture or chip. Hammer rebounds after impact.	> 16,000 psi

RQD and Rock Quality

Relation of RQD and Rock Quality	
RQD (Rock Quality Designation), %	Description of Rock Quality
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 - 100	Excellent

Terminology for Planar Surface		
Bedding	Joints and Fractures	Spacing
Laminated	Very Close	< 2 in.
Thin	Close	2 in. – 12 in.
Medium	Moderately Close	12 in. – 36 in.
Thick	Wide	36 in. – 10 ft
Massive	Very Wide	> 10 ft

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
ADSS B-1	S-1	5.0	199.0	37	--	--	--	--	Clayey SILT
	S-2	7.5	196.5	34	--	--	--	--	Clayey SILT
	S-3	10.0	194.0	33	--	30	7	--	Clayey SILT
	S-4	13.0	191.0	35	89	--	--	--	Clayey SILT
	S-4	14.0	190.0	36	--	--	--	89	Clayey SILT
	S-5	15.0	189.0	36	--	--	--	--	Clayey SILT
	S-6	17.5	186.5	34	--	59	33	88	CLAY
	S-7	20.0	184.0	37	--	--	--	--	CLAY
	S-8	25.0	179.0	49	--	--	--	33	Silty SAND
	S-9	30.0	174.0	32	--	--	--	13	SAND
	S-10	35.0	169.0	35	--	--	--	--	SAND
	S-11	40.0	164.0	32	--	33	13	70	CLAY
	S-12	45.0	159.0	32	--	--	--	--	CLAY
	S-13	50.0	154.0	33	--	--	--	--	CLAY
ADSS B-2	S-1	5.0	207.0	29	--	--	--	--	SILT
	S-2	7.5	204.5	31	--	--	--	--	Silty SAND
	S-3	10.0	202.0	31	--	--	--	42	Silty SAND
	S-4	12.5	199.5	30	--	29	7	71	Silty CLAY
	S-5	15.0	197.0	33	--	--	--	92	Silty CLAY
	S-5	15.5	196.5	35	90	--	--	--	Silty CLAY
	S-6	17.0	195.0	31	--	--	--	--	CLAY
	S-7	20.0	192.0	32	--	68	39	85	CLAY
	S-8	25.0	187.0	37	--	--	--	41	Silty SAND
	S-9	30.0	182.0	45	--	--	--	92	Silty SAND
	S-10	35.0	177.0	44	--	--	--	--	CLAY
	S-11	40.0	172.0	43	--	--	--	--	CLAY
	S-12	45.0	167.0	55	--	63	24	91	SILT
	S-13	50.0	162.0	24	--	--	--	24	Silty SAND
B-1	S-1	2.5	412.5	24	--	57	32	--	CLAY
	S-2	5.0	410.0	40	--	--	--	32	Clayey SAND
	S-3	7.5	407.5	24	--	--	--	16	Sandy GRAVEL
B-2	S-1	5.0	333.0	31	--	--	--	87	SILT
	S-2	7.5	330.5	31	--	--	--	--	SILT
	S-3	10.0	328.0	46	--	--	--	45	Silty SAND
	S-4	12.5	325.5	50	--	--	--	--	Silty SAND
	S-5	15.0	323.0	56	--	--	--	45	Silty SAND
	S-6	17.5	320.5	39	--	--	--	24	Silty SAND
	S-7	20.0	318.0	38	--	--	--	--	Silty SAND
B-3	S-1	5.0	200.5	36	--	--	--	--	SILT
	S-2	7.5	198.0	35	--	--	--	--	SILT

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
B-3	S-3	10.0	195.5	33	--	37	10	84	SILT
	S-4	13.0	192.5	33	83	--	--	--	SILT
	S-4	13.8	191.8	30	--	--	--	84	SILT
	S-5	15.0	190.5	27	--	--	--	60	Sandy SILT
	S-6	17.5	188.0	28	--	--	--	66	Sandy SILT
	S-7	20.0	185.5	29	--	--	--	--	Sandy SILT
	S-8	25.0	180.5	21	--	--	--	46	Silty SAND
	S-9	30.0	175.5	28	--	--	--	--	Sandy SILT
	S-10	35.0	170.5	25	--	--	--	42	Silty SAND
	S-11	40.0	165.5	30	--	--	--	--	Sandy SILT
	S-12	43.5	162.0	18	--	--	--	5	SAND
	S-12	44.0	161.5	27	92	--	--	--	SAND
	S-12	44.3	161.3	27	--	--	--	55	SAND
	S-12	44.5	161.0	23	--	--	--	27	SAND
	S-13	45.0	160.5	18	--	--	--	18	SAND
	S-14	50.0	155.5	32	--	--	--	--	SAND
B-3A	S-1	5.5	101.5	24	--	--	--	77	FILL
	S-2	7.5	99.5	22	--	--	--	--	FILL
	S-3	10.0	97.0	23	--	--	--	59	Sandy SILT
	S-4	13.0	94.0	25	93	--	--	--	Silty SAND
	S-4	13.8	93.3	22	--	--	--	48	Silty SAND
	S-5	15.0	92.0	16	--	--	--	37	Silty SAND
	S-6	17.5	89.5	20	--	--	--	--	SAND
	S-7	20.0	87.0	28	--	--	--	56	Sandy SILT
	S-8	25.0	82.0	32	--	--	--	--	Sandy SILT
	S-9	28.5	78.5	19	--	--	--	26	Silty SAND
	S-9	29.0	78.0	24	95	--	--	--	Silty SAND
	S-10	30.0	77.0	26	--	--	--	--	Silty SAND
	S-11	35.0	72.0	25	--	--	--	31	Silty SAND
	S-12	40.0	67.0	29	--	--	--	73	SILT
	S-13	45.0	62.0	28	--	--	--	22	Silty SAND
	S-14	50.0	57.0	26	--	--	--	--	SAND
B-4	S-2	7.5	133.7	27	--	--	--	--	FILL
	S-3	10.0	131.2	24	--	--	--	--	FILL
	S-4	12.5	128.7	21	--	--	--	78	FILL
	S-5	15.0	126.2	23	--	--	--	--	FILL
	S-6	18.0	123.2	24	104	--	--	--	FILL
	S-6	18.5	122.7	21	--	--	--	74	FILL
	S-7	19.5	121.7	26	--	--	--	--	FILL
	S-8	25.0	116.2	36	--	--	--	68	Sandy SILT

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
B-4	S-9	30.0	111.2	36	--	--	--	--	Sandy SILT
	S-10	33.5	107.7	32	92	--	--	--	Sandy SILT
	S-10	34.0	107.2	33	--	--	--	60	Sandy SILT
	S-11	35.0	106.2	34	--	--	--	57	Sandy SILT
	S-12	40.0	101.2	37	--	--	--	48	Silty SAND
	S-13	45.0	96.2	62	--	47	15	97	CLAY
	S-14	50.0	91.2	54	--	--	--	95	SILT
	S-15	55.0	86.2	54	--	--	--	--	SILT
B-5	S-1	2.5	171.2	29	--	--	--	--	FILL
	S-2	5.0	168.7	34	--	--	--	68	Sandy SILT
	S-3	7.5	166.2	34	--	--	--	--	SILT
	S-4	10.0	163.7	32	--	--	--	--	SILT
	S-5	12.5	161.2	30	--	--	--	64	Sandy SILT
	S-6	15.0	158.7	30	--	--	--	78	SILT
	S-7	17.5	156.2	30	--	--	--	--	SILT
	S-8	20.0	153.7	25	--	--	--	38	Silty SAND
	S-9	25.0	148.7	25	--	--	--	--	Silty SAND
	S-10	30.0	143.7	21	--	--	--	17	Silty SAND
	S-11	35.0	138.7	21	--	--	--	--	Silty SAND
	S-12	40.0	133.7	23	--	--	--	22	Silty SAND
	S-13	45.0	128.7	21	--	--	--	--	Silty SAND
	S-14	50.0	123.7	27	--	--	--	23	Silty SAND
B-5A	S-1	2.5	225.5	32	--	--	--	--	FILL
	S-2	5.0	223.0	26	--	--	--	--	FILL
	S-3	7.5	220.5	29	--	37	12	90	FILL
	S-5	12.5	215.5	34	--	--	--	--	SILT
	S-6	15.0	213.0	35	--	--	--	86	SILT
	S-7	17.5	210.5	36	--	--	--	--	SILT
	S-9	22.0	206.0	39	--	--	--	74	SILT
	S-11	30.0	198.0	32	--	--	--	49	Silty SAND
	S-12	35.0	193.0	30	--	--	--	--	SAND
	S-13	40.0	188.0	39	--	--	--	--	CLAY
	S-14	45.0	183.0	31	--	--	--	86	CLAY
	S-15	50.0	178.0	31	--	--	--	--	CLAY
	S-16	52.0	176.0	69	60	--	--	--	CLAY
	S-16	52.5	175.5	68	--	--	--	99	CLAY
B-6	S-1	2.5	261.5	29	--	--	--	--	FILL
	S-2	5.0	259.0	30	--	--	--	--	FILL
	S-3	7.5	256.5	32	--	--	--	--	FILL
	S-4	10.0	254.0	32	--	--	--	--	FILL

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information				Moisture	Dry Unit	Atterberg Limits		Fines	
Location	Sample	Depth, ft	Elevation, ft	Content, %	Weight, pcf	Liquid Limit, %	Plasticity Index, %	Content, %	Soil Type
B-6	S-5	12.5	251.5	28	--	--	--	--	FILL
	S-6	15.0	249.0	34	--	36	10	90	SILT
	S-7	18.0	246.0	36	85	--	--	--	SILT
	S-7	19.0	245.0	38	--	--	--	82	SILT
	S-8	20.0	244.0	39	--	--	--	--	CLAY
	S-9	25.0	239.0	43	--	--	--	62	Sandy SILT
	S-10	30.0	234.0	42	--	--	--	--	Sandy SILT
	S-11	35.0	229.0	34	--	--	--	--	SILT
	S-12	40.0	224.0	37	--	--	--	--	SILT
	S-12	41.0	223.0	26	--	--	--	--	Silty SAND
	S-13	45.0	219.0	39	--	--	--	74	SILT
	S-14	50.0	214.0	34	--	--	--	--	SILT
B-7	S-1	3.0	446.1	42	--	--	--	22	Silty SAND
	S-2	5.0	444.1	25	--	--	--	--	Silty SAND
	S-3	7.5	441.6	32	--	--	--	--	Silty SAND
	S-4	10.0	439.1	22	--	--	--	--	Silty SAND
	S-5	12.5	436.6	31	--	--	--	29	Silty SAND
B-8	S-1	5.0	406.0	32	--	--	--	85	CLAY
	S-2	7.5	403.5	29	--	--	--	--	CLAY
	S-3	10.0	401.0	40	--	--	--	26	Silty SAND
	S-4	12.5	398.5	41	--	--	--	--	Silty SAND
	S-5	15.0	396.0	47	--	--	--	--	Silty SAND
	S-6	17.5	393.5	40	--	--	--	36	Silty SAND
	S-7	20.0	391.0	29	--	--	--	--	Silty SAND
	S-8	25.0	386.0	41	--	--	--	--	Sandy SILT
	S-9	30.0	381.0	63	--	78	30	66	Sandy SILT
	S-10	35.0	376.0	51	--	--	--	--	Sandy SILT
	S-11	40.0	371.0	44	--	--	--	32	Silty SAND
	S-12	45.0	366.0	27	--	--	--	26	Silty SAND
B-9	S-1	5.5	470.5	31	--	--	--	--	CLAY
	S-2	7.5	468.5	48	--	--	--	--	Silty SAND
	S-3	10.0	466.0	44	--	--	--	24	Silty SAND
	S-4	12.5	463.5	38	--	--	--	--	Silty SAND
	S-5	15.0	461.0	43	--	--	--	--	Silty SAND
	S-6	17.5	458.5	41	--	--	--	36	Silty SAND
	S-7	20.0	456.0	54	--	--	--	--	SILT
	S-8	25.0	451.0	57	--	--	--	--	Silty SAND
	S-9	30.0	446.0	33	--	--	--	26	Silty SAND
	S-10	35.0	441.0	35	--	--	--	--	Silty SAND
	S-11	40.0	436.0	23	--	--	--	--	Silty SAND

Table 3A

SUMMARY OF LABORATORY RESULTS

Sample Information						Atterberg Limits			
Location	Sample	Depth, ft	Elevation, ft	Moisture Content, %	Dry Unit Weight, pcf	Liquid Limit, %	Plasticity Index, %	Fines Content, %	Soil Type
B-9	S-12	45.0	431.0	20	--	--	--	17	Silty GRAVEL
	S-13	50.0	426.0	18	--	--	--	--	Silty GRAVEL
B-10	S-1	5.0	282.0	32	--	--	--	--	SILT
	S-2	7.5	279.5	35	--	--	--	--	SILT
	S-3	10.0	277.0	36	--	53	29	78	CLAY
	S-4	12.5	274.5	41	--	--	--	--	CLAY

BORING AND TEST PIT LOG LEGEND

SOIL SYMBOLS

Symbol	Typical Description
	LANDSCAPE MATERIALS
	FILL
	GRAVEL; clean to some silt, clay, and sand
	Sandy GRAVEL; clean to some silt and clay
	Silty GRAVEL; up to some clay and sand
	Clayey GRAVEL; up to some silt and sand
	SAND; clean to some silt, clay, and gravel
	Gravelly SAND; clean to some silt and clay
	Silty SAND; up to some clay and gravel
	Clayey SAND; up to some silt and gravel
	SILT; up to some clay, sand, and gravel
	Gravelly SILT; up to some clay and sand
	Sandy SILT; up to some clay and gravel
	Clayey SILT; up to some sand and gravel
	CLAY; up to some silt, sand, and gravel
	Gravelly CLAY; up to some silt and sand
	Sandy CLAY; up to some silt and gravel
	Silty CLAY; up to some sand and gravel
	PEAT

BEDROCK SYMBOLS

Symbol	Typical Description
	BASALT
	MUDSTONE
	SILTSTONE
	SANDSTONE

SURFACE MATERIAL SYMBOLS

Symbol	Typical Description
	Asphalt concrete PAVEMENT
	Portland cement concrete PAVEMENT
	Crushed rock BASE COURSE

SAMPLER SYMBOLS

Symbol	Sampler Description
	2.0 in. O.D. split-spoon sampler and Standard Penetration Test with recovery (ASTM D1586)
	Shelby tube sampler with recovery (ASTM D1587)
	3.0 in. O.D. split-spoon sampler with recovery (ASTM D3550)
	Grab Sample
	Rock core sample interval
	Sonic core sample interval
	Push probe sample interval

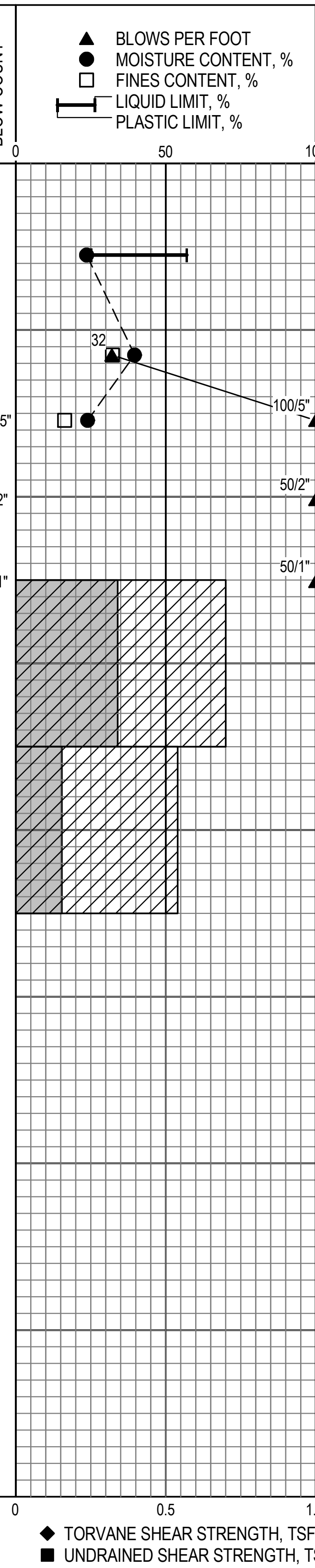
INSTALLATION SYMBOLS

Symbol	Symbol Description
	Flush-mount monument set in concrete
	Concrete, well casing shown where applicable
	Bentonite seal, well casing shown if applicable
	Filter pack, machine-slotted well casing shown where applicable
	Grout, vibrating-wire transducer cable shown where applicable
P	Vibrating-wire pressure transducer
	1-in.-diameter solid PVC
	1-in.-diameter hand-slotted PVC
	Grout, inclinometer casing shown where applicable

FIELD MEASUREMENTS

Symbol	Typical Description
▽	Groundwater level during drilling and date measured
▼	Groundwater level after drilling and date measured
	Rock/sonic core or push probe recovery (%)
	Rock quality designation (RQD, %)

DEPTH, FT	CLASSIFICATION OF MATERIAL (Surface Elevation: 421.0 ft [±] (NAVD88))	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
0	Asphalt concrete PAVEMENT (10-1/4 inches) over portland cement CONCRETE (8 inches)	419.5 / 1.5			Vacuum-excavated from surface to 4.5 feet
	CLAY, brown to orange, very stiff (Residual Soil)		S-1		
5	Clayey SAND, trace to some silt and gravel, brown-orange mottled dark gray, medium dense, fine to coarse grained, contains cobbles (Decomposed Basalt)	416.0 / 5.0	S-2	7 10 22	Switched to mud rotary drilling at 4.5 feet
	Sandy, silty GRAVEL, trace clay, gray-brown mottled orange, very dense, fine- to coarse-grained sand, angular gravel (Decomposed Basalt)	413.5 / 7.5	S-3	100/5"	
10	---trace silt below 10 feet		S-4	50/2"	
	BASALT, trace vesicles, gray-brown, slightly weathered, R3 to R5, 0-10°, 55°, 70° joints, very close to close, open joints with iron oxide staining, aphanitic (Columbia River Basalt)	408.5 / 12.5	S-5	50/1"	Switched to HQ coring at 12.5 feet
15			C-1		
	---slightly to moderately weathered, 0-10°, 30°, 70° joints below 17.5 feet				
20			C-2		
	(5/27/2022)	398.5 / 22.5			
25					
30					
35					
40					



Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 5/27/22	**GPS Coordinates:** 45.3908° N -122.6908° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 81%
Note: See Legend for Explanation of Symbols	

GRI

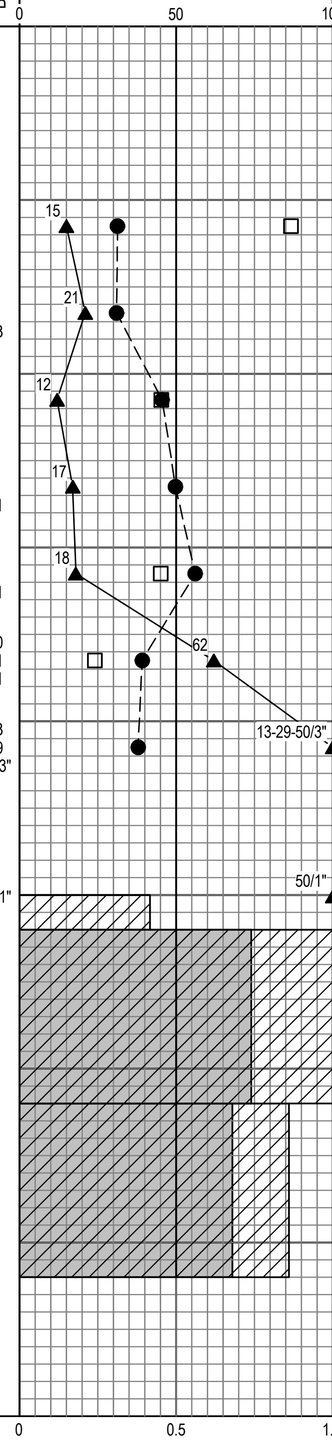
BORING B-1

JUL. 2022 JOB NO. 6658-A FIG. 1A

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	Surface Elevation: 330.0 ft [±] (NAVD88)				
0	Asphalt concrete PAVEMENT (10 inches) over portland cement CONCRETE (7-1/2 inches)	328.5 / 1.5			Vacuum-excavated from surface to 5 feet
	SILT, trace clay and fine-grained sand, brown, stiff (Loess)				
5			S-1	3 6 9	Switched to mud rotary drilling at 5 feet
			S-2	6 8 13	
9	Silty SAND, some clay, trace angular gravel, dark brown-orange mottled gray, medium dense, fine to coarse grained (Decomposed Basalt)	321.0 / 9.0			
10			S-3	4 6 6	Driller reports occasional gravel zones from 10 feet to 12.5 feet
			S-4	4 6 11	
15	---trace clay, gray-orange mottled dark gray below 15 feet		S-5	6 7 11	Driller reports alternating soft and hard zones from 15 feet to 17.5 feet
	---some angular gravel, gray-brown mottled dark gray, very dense, friable below 17.5 feet		S-6	10 21 41	
20	---trace gravel below 20 feet		S-7	13 29 50/3"	
25	BASALT, some vesicles, gray, fresh to slightly weathered, R3 (Columbia River Basalt)	305.0 / 25.0	S-8 / C-1	50/1"	Switched to HQ coring at 25 feet
	---trace vesicles, fresh, R3 to R5, 10-20°, 70°, 85-90° joints, very close to close joints, aphanitic below 26 feet		C-2		
30	---some vesicles, 0-5° and 70° joints, close to moderately close joints below 31 feet		C-3		
35					
36	(5/26/2022)	294.0 / 36.0			
40					

GRAPHIC LOG — INSTALLATION — SAMPLE TYPE

▲ BLOWS PER FOOT
● MOISTURE CONTENT, %
□ FINES CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %



◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 5/26/22	**GPS Coordinates:** 45.3872° N -122.6945° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 81%
Note: See Legend for Explanation of Symbols	

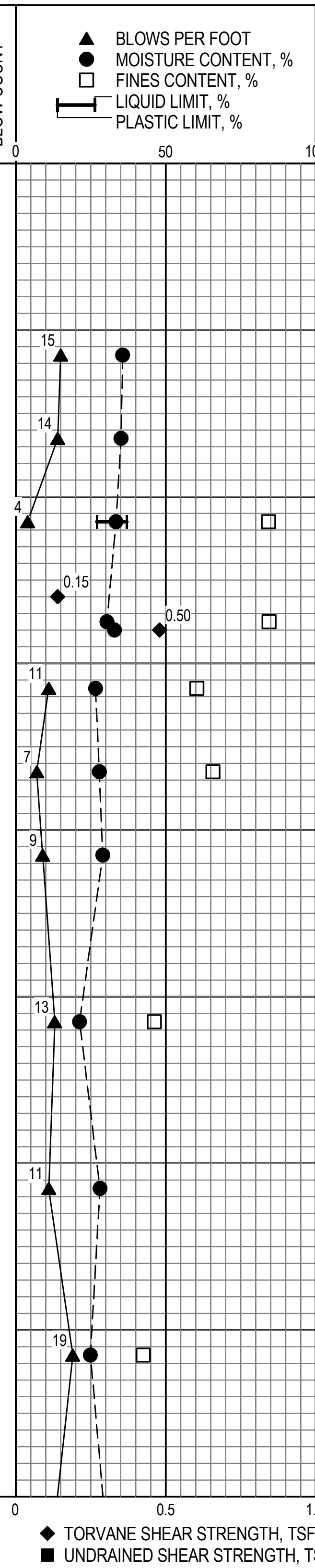
GRI

BORING B-2

JUL. 2022 JOB NO. 6658-A FIG. 2A

Surface Elevation: 204.0 ft [±] (NAVD88)

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	Asphalt concrete PAVEMENT (13 inches) over portland cement CONCRETE (6-1/2 inches)				Vacuum-excavated from surface to 5 feet
	COBBLES, some silt, clay and gravel, gray to dark brown, subangular (Fill)	202.4 / 1.6			
	SILT, trace fine-grained sand, light brown, stiff (Alluvium)	200.0 / 4.0			
5			S-1	1 5 10	Switched to mud rotary drilling at 5 feet
	---light brown to orange below 7.5 feet		S-2	5 7 7	
10	---some fine-grained sand below 10 feet		S-3	3 1 3	Field Vane = 0.9 tsf at 13 feet
			S-4		Dry Density = 83 pcf
15	---sandy, light brown below 15 feet		S-5	4 5 6	
	---light brown, medium stiff below 17.5 feet		S-6	3 3 4	
20	---stiff below 20 feet		S-7	3 4 5	
25	Silty SAND, light brown, medium dense (Alluvium)	179.0 / 25.0	S-8	5 6 7	
30	Sandy SILT, light brown, stiff, fine-grained sand, stratified beds of silty sand to sandy silt (Alluvium)	174.0 / 30.0	S-9	5 5 6	
35	Silty SAND, light brown to brown, medium dense, fine to medium grained, contains 1- to 6-inch-thick stratified beds of silt, silty sand and sand (Alluvium)	169.0 / 35.0	S-10	5 8 11	
40		164.0			



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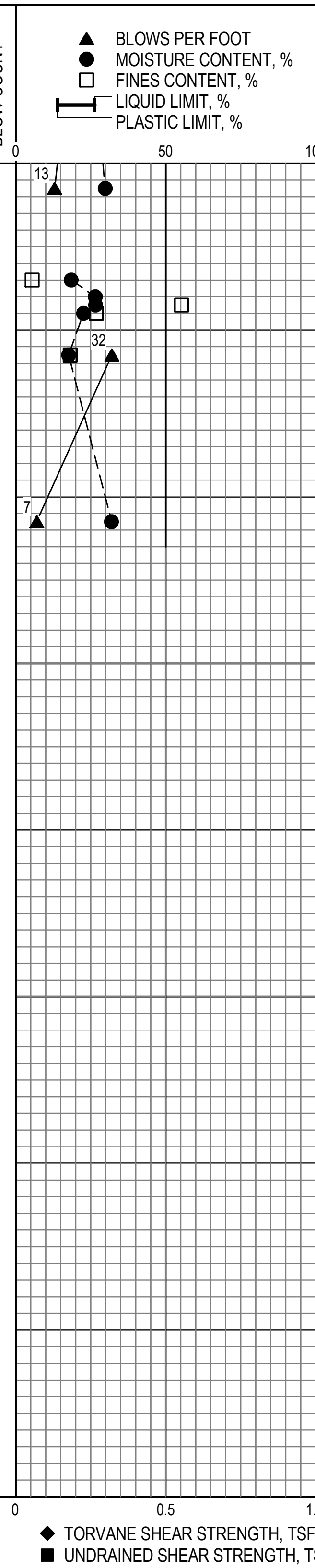
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 5/25/22	**GPS Coordinates:** 45.3822° N -122.6951° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 81%
Note: See Legend for Explanation of Symbols	

GRI

BORING B-3

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 204.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Sandy SILT, light brown and gray, stiff, fine- to medium-grained sand, contains stratified beds of silt, silty sand and sand (Alluvium)	40.0		S-11		8 7 6	
45		SAND, some silt to silty, light brown to brown, loose, fine to medium grained, contains stratified beds of silt, silty sand and sand (Alluvium) ---dense below 45 feet	161.0 / 43.0		S-12 S-13		9 15 17	Dry Density = 92 pcf
50		---brown, loose, fine grained, contains 2- to 6-inch-thick stratified beds of silt, silty sand and sand below 50 feet	152.5 / 51.5		S-14		4 4 3	
		(2/25/2022)						
55								
60								
65								
70								
75								
80								



GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

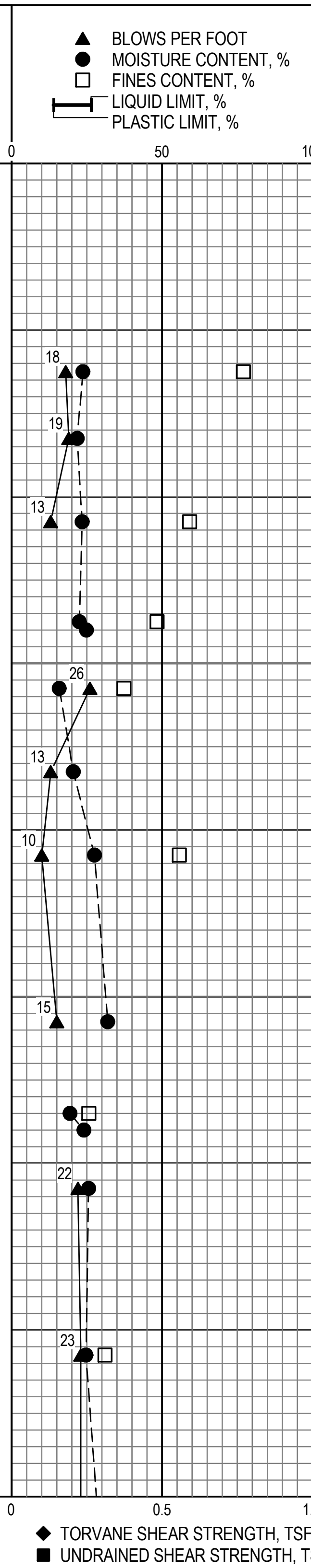
GRI

BORING B-3

JUL. 2022 JOB NO. 6658-A FIG. 3A

Surface Elevation: 170.0 ft [±] (NAVD88)

Depth, ft	Classification of Material	Elevation, ft / Depth, ft	Sample No.	Blow Count	Comments and Additional Tests
0	Asphalt concrete PAVEMENT (6-1/4 inches) over crushed rock BASE COURSE (12-3/4 inches)				Vacuum-excavated from surface to 5.5 feet
2	SILT, some fine-grained sand, light brown, very stiff (Fill)	168.0 / 2.0			
			S-1	5 9 9	Switched to mud rotary drilling at 5.5 feet
			S-2	7 9 10	
10	Sandy SILT, light brown, medium dense, fine-grained sand (Alluvium)	160.0 / 10.0	S-3	5 6 7	
13	Silty SAND, light brown to brown, medium dense, fine to medium grained (Alluvium)	157.0 / 13.0	S-4		Dry Density = 93 pcf
			S-5	9 12 14	
	---some silt below 17.5 feet		S-6	6 7 6	
20	Sandy SILT, light brown to brown to orange, stiff, fine-grained sand, contains 2-inch-thick stratified beds of silt (Alluvium)	150.0 / 20.0	S-7	6 5 5	
25	---fine- to medium-grained sand, contains 3-inch-thick stratified beds of silt below 25 feet		S-8	5 7 8	
28	Silty SAND, light brown to brown to orange, medium dense, fine to medium grained (Alluvium)	142.0 / 28.0	S-9		Dry Density = 95 pcf
			S-10	7 9 13	
35	---brown, contains isolated laminated bed of silt below 35 feet		S-11	8 10 13	



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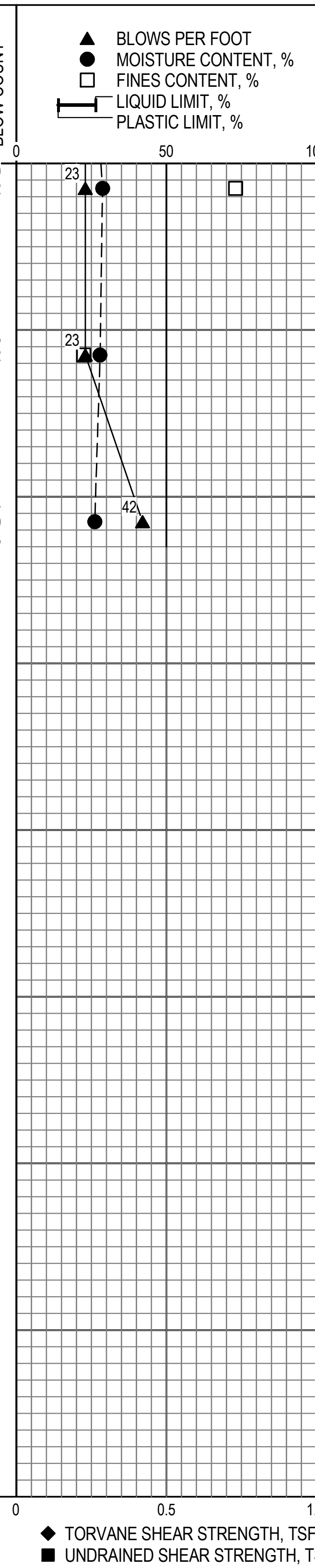
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 5/24/22	**GPS Coordinates:** 45.3803° N -122.6976° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 81%
Note: See Legend for Explanation of Symbols	

GRI

BORING B-3A

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT
	Surface Elevation: 170.0 ft [±] (NAVD88)			
	SILT, some fine-grained sand, light brown to orange, very stiff (Alluvium)		S-12	10 12 11
45	Silty SAND, light brown to orange, medium dense, fine grained (Alluvium)	125.0 / 45.0	S-13	13 12 11
50	---trace to some silt, brown to orange, dense below 50 feet	118.5 / 51.5	S-14	14 19 23
	(5/24/2022)			
55				
60				
65				
70				
75				
80				

INSTALLATION | SAMPLE TYPE | COMMENTS AND ADDITIONAL TESTS

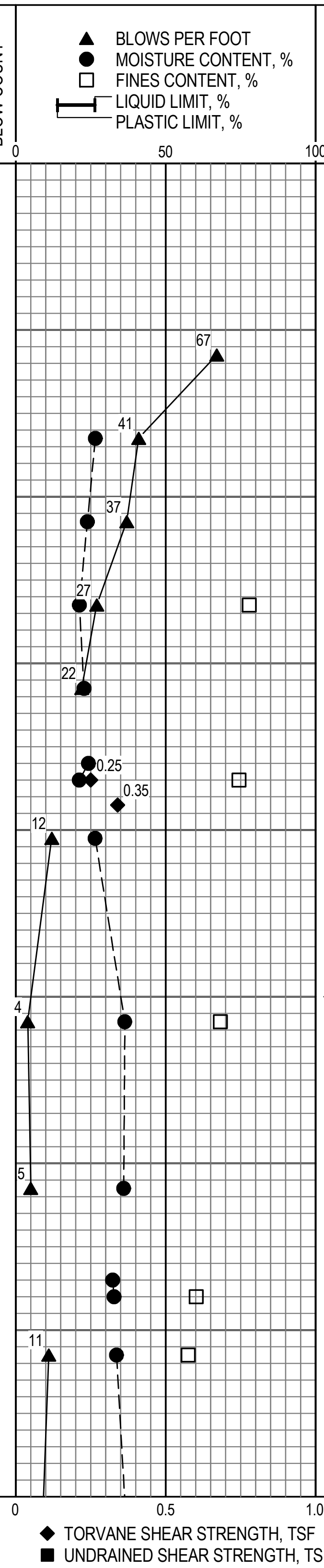


GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

GRI BORING B-3A

JUL. 2022 JOB NO. 6658-A FIG. 4A

DEPTH, FT	CLASSIFICATION OF MATERIAL (Surface Elevation: 140.0 ft [±] (NAVD88))	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
0	Asphalt concrete PAVEMENT (6-3/4 inches) over crushed rock BASE COURSE (18 inches)				Vacuum-excavated from surface to refusal on cobbles at 3 feet
	GRAVEL, some silt and fine- to coarse-grained sand, gray-brown, very dense, subangular to angular gravel, contains cobbles (Fill)	137.9 / 2.1			Switched to mud rotary drilling at 3 feet
5			S-1	11 27 40	
			S-2	29 26 15	Lost approximately 75 gallons of drilling fluid at 7.5 feet
	SILT, some fine-grained sand, light brown, very stiff, contains fine roots and organics (Fill)	131.5 / 8.5			
10			S-3	11 16 21	Driller notes occasional scattered gravel from 10 feet to 12.5 feet
	---light brown to light gray below 12.5 feet		S-4	8 12 15	
15	---light brown below 15 feet		S-5	6 9 13	
	---trace clay, brown mottled gray, medium stiff below 17.5 feet		S-6		Dry Density = 104 pcf
	---trace subrounded gravel, light brown to light gray below 19.5 feet				Field Vane = 0.34 tsf at 19 feet
20			S-7	5 5 7	Driller notes smooth drilling with a couple isolated gravels below 21 feet
25	Sandy SILT, gray, soft to medium stiff, fine-grained sand, contains fine roots and organics (Alluvium)	115.0 / 25.0	S-8	2 2 2	▽25.0 ft (5/23/2022) Roots observed in cuttings from 25 feet to 30 feet
30	---medium stiff, contains wood debris below 30 feet		S-9	5 2 3	
	---trace clay, brown to orange, medium stiff to stiff, contains 2- to 3-inch-thick stratified beds of silty sand, organics absent below 33 feet		S-10		Dry Density = 92 pcf Wood debris observed in cuttings at 33 feet
35			S-11	2 3 8	
40		100.0			



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Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 5/23/22	**GPS Coordinates:** 45.3791° N -122.6986° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in.
Note: See Legend for Explanation of Symbols	**Energy Ratio:** 81%

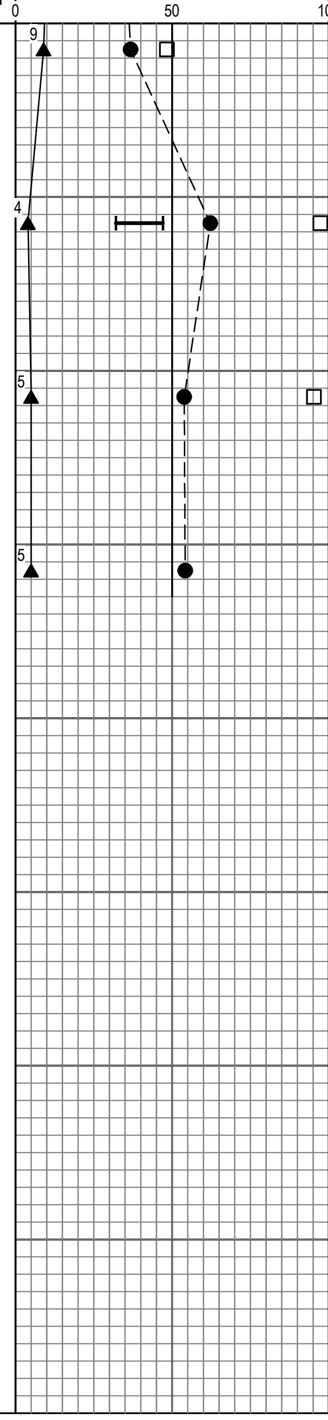
GRI

BORING B-4

JUL. 2022 JOB NO. 6658-A FIG. 5A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL **Surface Elevation:** 140.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Silty SAND, light brown, loose, fine grained, contains 2- to 6-inch-thick stratified beds of silty sand and silt (Alluvium)	40.0		S-12		4 4 5	Driller notes gravels from 43.5 feet to 45 feet
45		CLAY, light brown, soft to medium stiff (Alluvium)	95.0 / 45.0		S-13		7 2 2	Driller notes softer drilling from 45 feet to 50 feet
50		SILT, some clay, gray, medium stiff (Alluvium)	90.0 / 50.0		S-14		2 2 3	Driller notes about 6-inch-thick zones of chatter below 50 feet
55					S-15		2 2 3	
		(5/23/2022)	83.5 / 56.5					
60								
65								
70								
75								
80								

▲ BLOWS PER FOOT
● MOISTURE CONTENT, %
□ FINES CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %



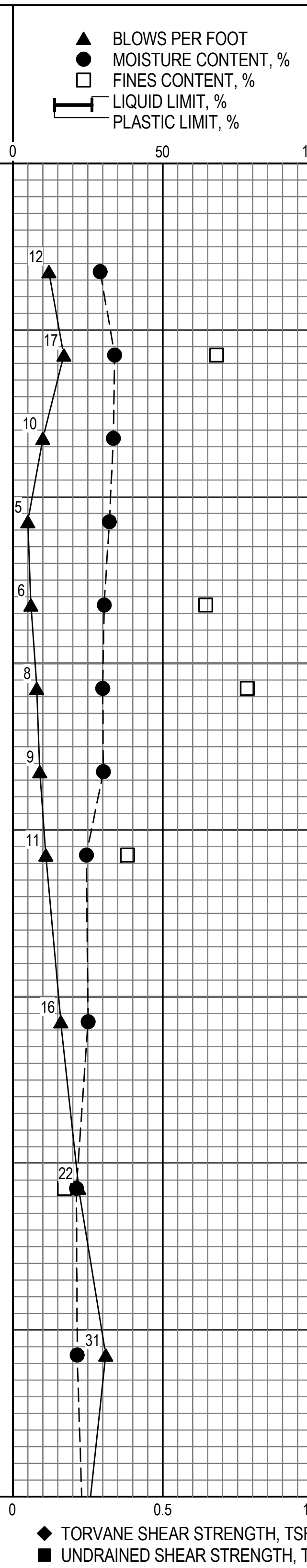
◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

GRI

BORING B-4

DEPTH, FT	CLASSIFICATION OF MATERIAL (Surface Elevation: 184.0 ft [±] (NAVD88))	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	Asphalt concrete PAVEMENT (4-1/2 inches) over crushed rock BASE COURSE (23-1/2 inches)				Vacuum-excavated from surface to 2.5 feet
	GRAVEL and COBBLES, some silt and sand, gray-brown, medium dense, subrounded (Fill)	181.7 / 2.3	S-1	11, 5, 7	Switched to mud rotary drilling at 2.5 feet
	SILT, trace fine-grained sand, brown, stiff (Alluvium)	180.5 / 3.5			
5	---sandy below 5 feet		S-2	6, 9, 8	
	---trace to some fine-grained sand, light brown below 7.5 feet		S-3	5, 5, 5	
10	---some fine-grained sand, medium stiff below 10 feet		S-4	3, 2, 3	
	---sandy, brown to light brown, contains 2- to 6-inch-thick stratified beds of silty sand and silt below 12.5 feet		S-5	2, 3, 3	
15	---some fine-grained sand, brown, medium stiff to stiff, contains 3-inch-thick stratified beds of silty sand below 15 feet		S-6	4, 3, 5	
	---stiff, contains 5-inch-thick stratified beds of silty sand below 17.5 feet		S-7	2, 3, 6	
20	Silty SAND, light brown to brown, medium dense, fine grained (Alluvium)	164.0 / 20.0	S-8	5, 5, 6	
25			S-9	7, 7, 9	
30	---brown-gray, medium dense below 30 feet		S-10	7, 11, 11	Driller notes coarse-grained sand or gravel from 32 feet to 33 feet
35	---dark brown to gray, dense below 35 feet		S-11	15, 17, 14	∇35.0 ft (5/31/2022)
40					



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Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 5/31/22	**GPS Coordinates:** 45.3752° N -122.7019° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 78%
Note: See Legend for Explanation of Symbols	

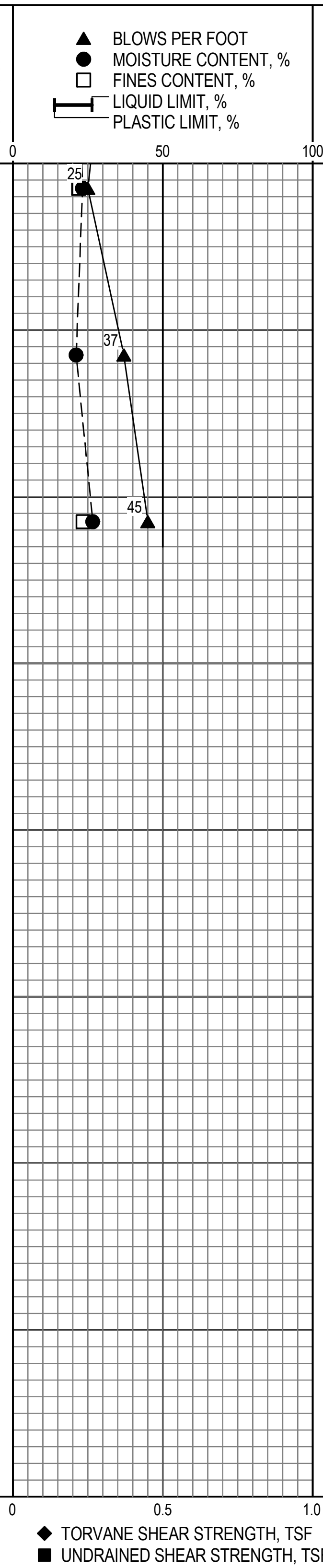
GRI

BORING B-5

JUL. 2022 JOB NO. 6658-A FIG. 6A

GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 184.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Silty SAND, dark brown to gray, medium dense, contains 2-inch-thick isolated silt bed at 40 feet (Alluvium)			S-12		12 14 11	Driller notes occasional soft zones from 42 feet to 45 feet
45		---dense below 45 feet			S-13		19 22 15	
50			132.5 / 51.5		S-14		15 19 26	
		(5/31/2022)						
55								
60								
65								
70								
75								
80								



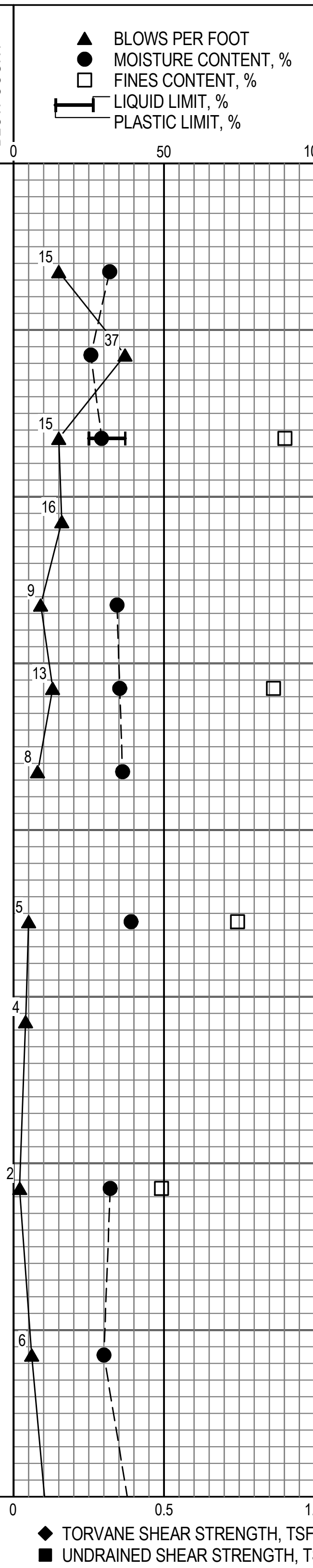
GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

GRI

BORING B-5

JUL. 2022 JOB NO. 6658-A FIG. 6A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Surface Elevation: 232.0 ft [±] (NAVD88)						
		SILT, trace fine-grained sand, light brown-orange, stiff (Fill)						
		---sandy below 3.5 feet			S-1		6 6 9	
5		---some clay, trace to some subangular to angular gravel, trace fine-grained sand, brown-gray, very stiff below 6 feet			S-2		3 12 25	Drill rig chatter from 5.5 feet to 6 feet
		Silty CLAY to clayey SILT, trace fine-grained sand, light brown to gray, stiff to very stiff (Fill)	224.5 / 7.5		S-3		4 6 9	Driller reports smoother driller below 7.5 feet
10		---gray to dark brown, contains wood debris and organics below 10 feet			S-4		8 6 10	
		SILT, trace clay and fine-grained sand, gray to light brown to orange, stiff, contains fine roots and organics (Alluvium)	219.5 / 12.5		S-5		1 3 6	
15		---some fine-grained sand below 15 feet			S-6		4 6 7	
		---medium stiff to stiff below 17.5 feet			S-7		3 4 4	
20					S-8			
		---light brown to orange, medium stiff, stratified beds of silty sand and silt below 22 feet			S-9		5 3 2	
25		Silty SAND, light brown to orange, very loose, fine grained (Alluvium)	207.0 / 25.0		S-10		1 2 2	
30					S-11		1 1 1	
35		---trace silt, loose below 35 feet			S-12		3 3 3	
40								



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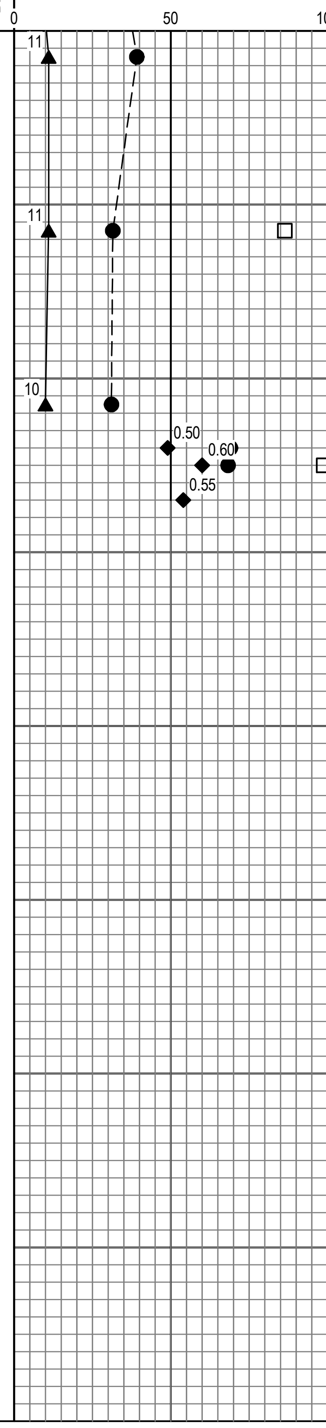
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/9/22	**GPS Coordinates:** 45.3707° N -122.7051° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 850 Track-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 72%
Note: See Legend for Explanation of Symbols	

GRI

BORING B-5A

JUL. 2022 JOB NO. 6658-A FIG. 7A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL **Surface Elevation:** 232.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	▲ BLOWS PER FOOT ● MOISTURE CONTENT, % □ FINES CONTENT, % LIQUID LIMIT, % PLASTIC LIMIT, % (0 – 50 – 100)	COMMENTS AND ADDITIONAL TESTS
		CLAY, some silt, trace fine- to medium-grained sand, light gray to brown-orange, stiff (Alluvium)			S-13		4 5 6	11	
45		---trace silt, gray mottled light brown-orange below 45 feet			S-14		4 6 5	11	
50					S-15		3 5 5	10	
		---light gray mottled brown, medium stiff to stiff, sand absent below 51.5 feet			S-16			0.50, 0.60, 0.55	Dry Density = 60 pcf Field Vane = 0.76 tsf at 53.5 feet
		(6/9/2022)	178.5 / 53.5						
55									
60									
65									
70									
75									
80									

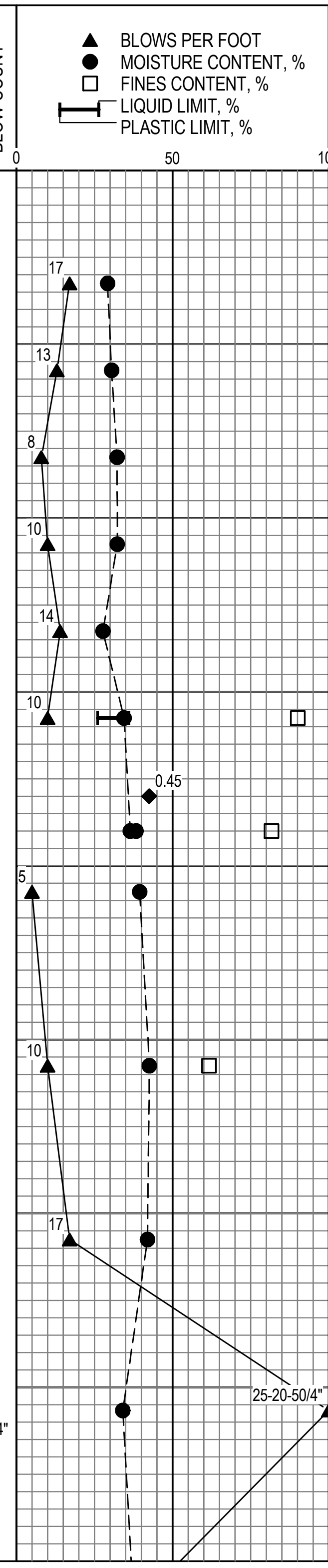


◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

Surface Elevation: 268.0 ft [±] (NAVD88)

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
0	SILT, some clay, trace fine- to medium-grained sand and gravel, light brown-gray, stiff (Fill)				
			S-1	4 8 9	
5	---contains occasional fine roots, gravel absent below 5 feet		S-2	4 6 7	
	---medium stiff to stiff below 7.5 feet		S-3	1 4 4	
10	---gray-brown, stiff, contains wood debris and organics below 10 feet		S-4	3 5 5	
			S-5	5 7 7	
15	SILT, some clay, trace fine-grained sand, gray to light brown-orange, stiff (Alluvium)	253.0 / 15.0	S-6	5 5 5	
	---some fine-grained sand, trace clay, light gray-brown mottled brown, medium stiff below 18 feet		S-7		Dry Density = 85 pcf
20	CLAY, some fine- to coarse-grained sand, trace silt, brown-gray mottled dark gray, medium stiff (Alluvium)	248.0 / 20.0	S-8	1 2 3	Field Vane = 0.66 tsf at 20 feet
25	Sandy SILT, trace clay, brown-orange, stiff, contains laminated to stratified beds of silt and minor silty sand and clay (Alluvium)	243.0 / 25.0	S-9	4 5 5	
30	---light brown to brown-orange, very stiff below 30 feet ---some fine- to coarse-grained sand and subrounded to subangular gravel below 31 feet		S-10	2 5 12	
35	---some fine- to medium-grained sand, contains stratified beds of silt, sand, and gravel below 35 feet		S-11	25 20 50/4"	
40					



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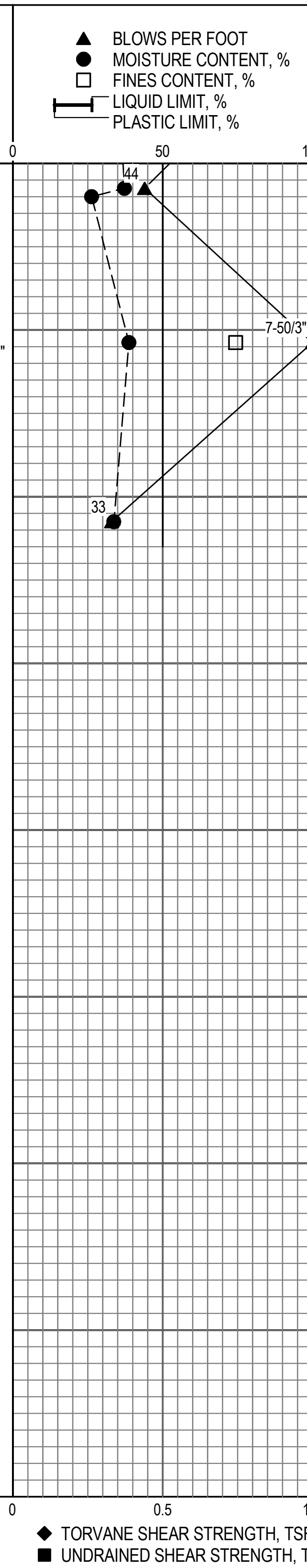
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/10/22	**GPS Coordinates:** 45.3693° N -122.7063° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 850 Track-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in.
Note: See Legend for Explanation of Symbols	**Energy Ratio:** 72%

GRI

BORING B-6

JUL. 2022 JOB NO. 6658-A FIG. 8A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 268.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		SILT, trace clay and fine- to medium-grained sand, light brown to brown-orange, hard, contains stratified beds of silt, sand and gravel (Alluvium)	227.0 / 41.0		S-12		10 17 27	
		Silty SAND, some subrounded gravel, gray, dense, fine to coarse grained (Alluvium)						
45		SILT, some fine- to coarse-grained sand, trace clay and angular gravel, gray, hard	223.0 / 45.0		S-13		7 50/3"	
50		---clayey, brown-orange, dense, fine- to medium-grained sand below 50 feet			S-14		9 18 15	
		(6/10/2022)	216.5 / 51.5					
55								
60								
65								
70								
75								
80								



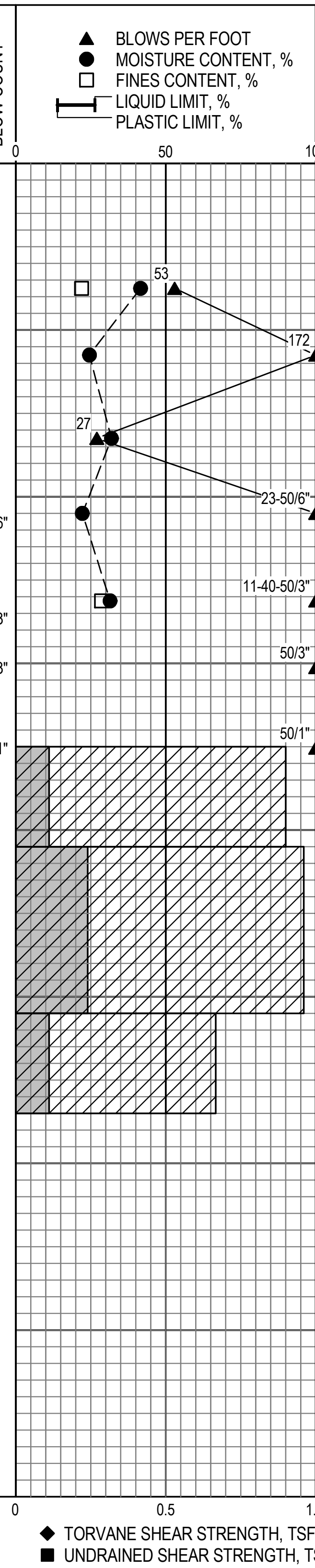
GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

GRI

BORING B-6

JUL. 2022 JOB NO. 6658-A FIG. 8A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Surface Elevation: 450.0 ft [±] (NAVD88)						
		Silty GRAVEL, some sand, trace clay, gray-brown, dense, subrounded (Fill)	448.0 / 2.0					Vacuum-excavated from surface to 2.5 feet
		COBBLES (Fill)	447.0 / 3.0					Switched to mud rotary drilling at 2.5 feet
		Silty gravelly SAND, trace clay, brown-orange mottled dark gray, medium dense, contains relict rock structure (Decomposed Basalt)			S-1		12 16 37	
5		---very dense below 5 feet			S-2		52 90 82	
		---medium dense below 7.5 feet			S-3		11 13 14	
10		---very dense below 10 feet			S-4		23 50/6"	
		---some gravel, gray mottled yellow-orange, friable below 12.5 feet			S-5		11 40 50/3"	
15		---gravelly below 15 feet			S-6		50/3"	
		BASALT, trace vesicles, gray-brown, slightly to moderately weathered, R3 to R5, 0-10°, 30°, and 60°-90° joints, very close to close, open joints with 1mm to 4mm of iron oxide and clay infill, aphanitic (Columbia River Basalt)	432.5 / 17.5		S-7		50/1"	Switched to HQ coring at 17.5 feet
20		---some vesicles, red-brown to gray, moderately to predominantly decomposed, R0 to R3 below 20.5 feet			C-1			
					C-2			
25		---red to gray, moderately weathered, R2 to R3 below 25.5 feet			C-3			
		(6/1/2022)	421.5 / 28.5					
30								
35								
40								



GRI DATA TEMPLATE.GDT 8/4/22
GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

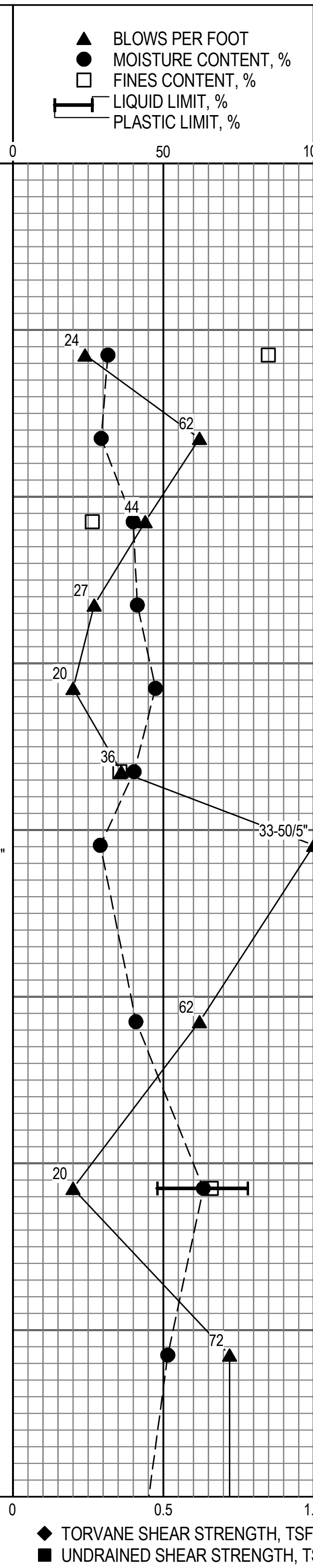
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.	
Date Started: 6/1/22	**GPS Coordinates:** 45.3592° N -122.7149° W (WGS84)	
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 78%	
Note: See Legend for Explanation of Symbols		

GRI

BORING B-7

JUL. 2022 JOB NO. 6658-A FIG. 9A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 401.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Asphalt concrete PAVEMENT (10 inches) over portland cement CONCRETE (5 inches) over crushed rock BASE COURSE (3 inches)	399.5 / 1.5					Vacuum-excavated from surface to 5 feet
		CLAY, trace silt and fine-grained sand, dark brown-orange mottled dark gray, stiff (Residual Soil)						
5					S-1		7 11 13	Switched to mud rotary drilling at 5 feet
		Silty SAND, some clay, light gray to brown-orange mottled dark gray, medium dense, fine grained (Decomposed Basalt)	393.0 / 8.0		S-2		8 24 38	
10		---trace clay, gray-brown mottled red-brown, fine to coarse grained below 10 feet			S-3		13 21 23	
		---trace gravel, light gray-yellow mottled dark gray below 12.5 feet			S-4		6 11 16	Driller notes occasional chatter from 12.5 feet to 22 feet
15					S-5		7 9 11	
		---dense below 17.5 feet			S-6		10 15 21	
20		---very dense below 20 feet			S-7		33 50/5"	Driller reports firmer drilling at 22 feet but not coreable
25		Sandy SILT to silty SAND, trace clay, dark gray mottled white, yellow and rust, hard, fine- to coarse-grained sand (Decomposed Basalt)	376.0 / 25.0		S-8		18 22 40	Driller indicates alternating soft and firm zones about 12 inches to 18 inches thick
30		Sandy SILT, trace clay, light brown, very stiff, fine-grained sand (Decomposed Basalt)	371.0 / 30.0		S-9		12 11 9	
35					S-10		11 25 47	
40								



(CONTINUED NEXT PAGE)

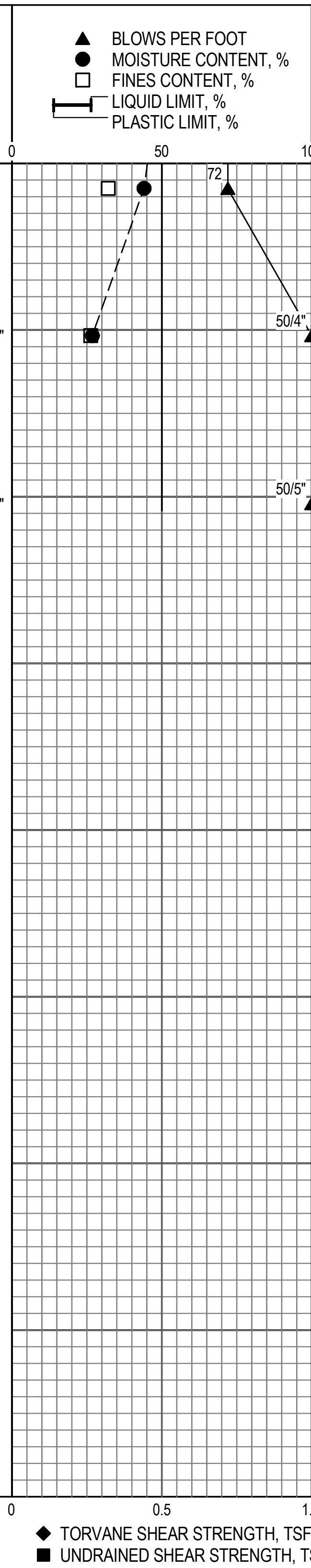
Logged By: J. Heidgerken	Drilled by: Western States Soil Conservation, Inc.
Date Started: 6/2/22	GPS Coordinates: 45.3572° N -122.7244° W (WGS84)
Drilling Method: Mud Rotary Equipment: CME 75 Truck-Mounted Drill Rig Hole Diameter: 5 in.	Hammer Type: Auto Hammer Weight: 140 lb Drop: 30 in. Energy Ratio: 78%
Note: See Legend for Explanation of Symbols	

GRI

BORING B-8

JUL. 2022 JOB NO. 6658-A FIG. 10A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 401.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Silty SAND, trace clay and gravel, gray-orange mottled yellow, very dense, fine to coarse grained (Decomposed Basalt)			S-11		20 27 45	
								Driller reports harder drilling at 43.5 feet
45		---gravelly below 45 feet			S-12		50/4"	
50		Silty GRAVEL, some fine- to coarse-grained sand, trace clay, gray, very dense (Decomposed Basalt) (6/2/2022)	351.0 / 50.0 350.6 / 50.4		S-13		50/5"	
55								
60								
65								
70								
75								
80								



GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

GRI

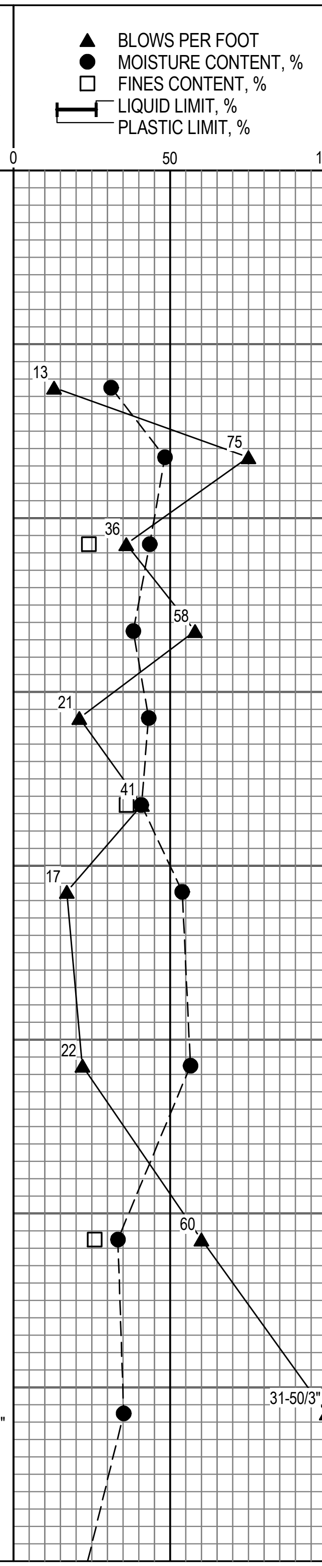
BORING B-8

JUL. 2022 JOB NO. 6658-A FIG. 10A

CLASSIFICATION OF MATERIAL

Surface Elevation: 470.0 ft [±] (NAVD88)

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
0	Asphalt concrete PAVEMENT (10-1/2 inches) over portland cement CONCRETE (6-3/4 inches)	468.6 / 1.4			Vacuum-excavated from surface to 4.5 feet
	CLAY, trace silt and fine- to medium-grained sand, dark brown-orange, stiff (Residual Soil)				
5					Switched to mud rotary drilling at 4.5 feet
	---trace gravel below 6.5 feet		S-1	3, 5, 8	
	Silty SAND, trace clay and subangular to angular gravel, gray-brown mottled dark gray, dense, fine to coarse grained (Decomposed Basalt)	462.5 / 7.5	S-2	23, 35, 40	
10			S-3	7, 18, 18	
	---very dense below 12.5 feet		S-4	6, 25, 33	
15	---medium dense below 15 feet		S-5	8, 8, 13	
	---dark gray to gray mottled brown-orange, very dense, fine-grained sand below 17.5 feet		S-6	9, 16, 25	
20	SILT, some fine- to coarse-grained sand, dark brown-orange, very stiff (Decomposed Basalt)	450.0 / 20.0	S-7	4, 7, 10	
25	Silty SAND, some gravel, trace clay, dark brown, medium dense, fine to medium grained (Decomposed Basalt)	445.0 / 25.0	S-8	6, 9, 13	
30	---brown-gray mottled dark gray below 30 feet		S-9	36, 39, 21	
35	---trace gravel, very dense below 35 feet		S-10	31, 50/3"	
40					



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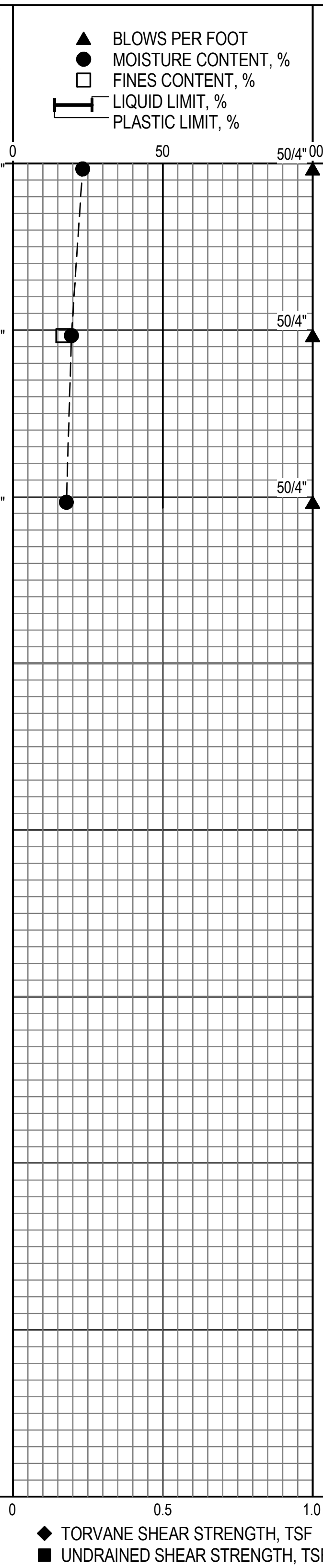
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/2/22	**GPS Coordinates:** 45.3494° N -122.7344° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in.
Note: See Legend for Explanation of Symbols	**Energy Ratio:** 78%

GRI

BORING B-9

JUL. 2022 JOB NO. 6658-A FIG. 11A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 470.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Silty SAND, some gravel to gravelly, trace clay, brown-gray mottled dark gray, very dense, fine to medium grained (Decomposed Basalt)			S-11		50/4"	
45		Silty sandy GRAVEL, trace clay, gray-brown, very dense, fine- to coarse-grained sand, angular gravel (Decomposed Basalt)	425.0 / 45.0		S-12		50/4"	
50		(6/3/2022)	419.7 / 50.3		S-13		50/4"	
55								
60								
65								
70								
75								
80								



GRI DATA TEMPLATE.GDT 8/4/22 GRI BORING LOG (GPS)

GRI

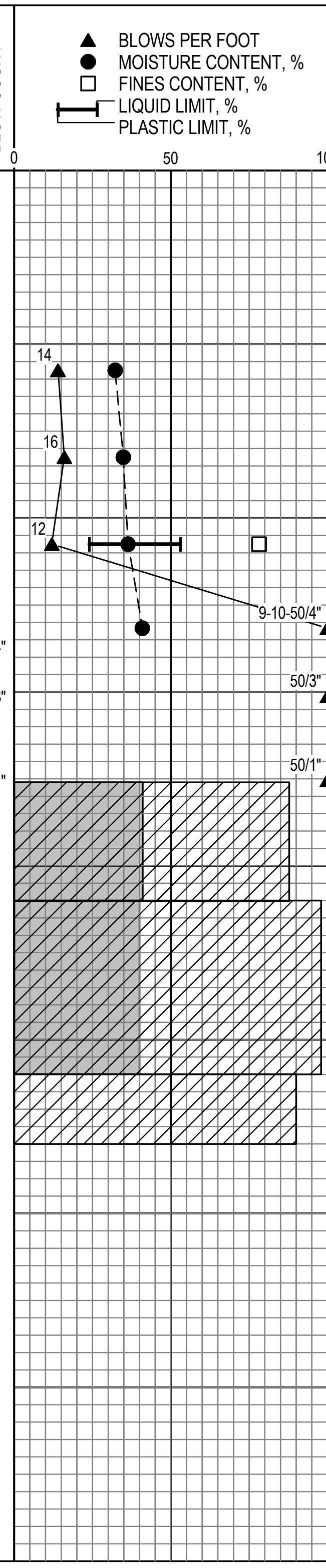
BORING B-9

JUL. 2022 JOB NO. 6658-A FIG. 11A

DEPTH, FT | GRAPHIC LOG | **CLASSIFICATION OF MATERIAL** | ELEVATION, FT / DEPTH, FT | INSTALLATION | SAMPLE NO. | SAMPLE TYPE | BLOW COUNT

Surface Elevation: 286.0 ft [±] (NAVD88)

Classification of Material	Elevation, ft / Depth, ft	Sample No.	Blow Count	Comments and Additional Tests
Asphalt concrete PAVEMENT (11-1/2 inches) over crushed rock BASE COURSE (12-1/2 inches)	284.0 / 2.0			Vacuum-excavated from surface to 5 feet
SILT, trace clay and fine-grained sand, light brown, stiff (Alluvium)		S-1	3, 5, 9	Switched to mud rotary drilling at 5 feet
---trace to some clay, dark brown below 8.5 feet	276.0 / 10.0	S-2	5, 6, 10	
CLAY, some fine- to medium-grained sand, trace silt, dark brown-orange, stiff, contains scattered rounded gravel (Residual Soil) ---some sand, trace gravel, very stiff below 12.5 feet	272.5 / 13.5	S-3; S-4	3, 5, 7; 9, 10, 50/4"	
Silty gravelly SAND, trace clay, gray-brown, very dense (Decomposed Basalt)	268.5 / 17.5	S-5; S-6	50/3"; 50/1"	Switched to HQ coring at 17.5 feet
BASALT, trace vesicles, gray-brown, slightly weathered, R3 to R5, 0°-20°, 70° to 90° joints, very cose to close, open joints, aphanitic (Columbia River Basalt) ---some vesicles, gray to brown to orange, slightly to moderately weathered, 0°, 10°-30° joints, open to healed joints with clay infill and iron-oxide staining below 24 feet ---very close-spaced joints below 26 feet	258.0 / 28.0	C-1; C-2; C-3		
(6/6/2022)				



COMMENTS AND ADDITIONAL TESTS

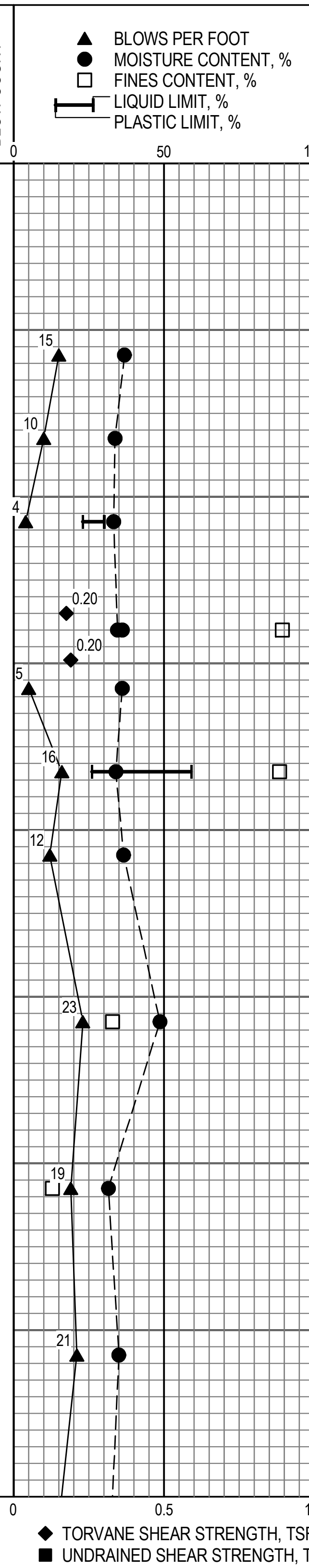
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.	
Date Started: 6/6/22	**GPS Coordinates:** 45.3356° N -122.7437° W (WGS84)	
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 78%	
Note: See Legend for Explanation of Symbols		

GRI

BORING B-10

JUL. 2022 JOB NO. 6658-A FIG. 12A

DEPTH, FT	CLASSIFICATION OF MATERIAL **Surface Elevation:** 230.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	Asphalt concrete PAVEMENT (9-1/2 inches) over crushed rock BASE COURSE (17-1/2 inches)					Vacuum-excavated from surface to 5 feet
	Clayey SILT, trace fine-grained sand, light brown, stiff (Alluvium)	227.8 / 2.3				
5				S-1	4, 6, 9	Switched to mud rotary drilling at 5 feet
	---medium stiff below 7.5 feet			S-2	5, 5, 5	
10	---soft to medium stiff below 10 feet			S-3	1, 2, 2	
				S-4		Dry Density = 89 pcf
15				S-5	3, 2, 3	Field Vane = 0.53 tsf at 15 feet
	CLAY, some silt, trace fine-grained sand, light brown to light gray mottled dark gray, medium stiff (Alluvium) ---trace silt, brown-orange to dark gray, very stiff, contains isolated 2- to 3-inch-thick stratified beds of brown-orange silt below 17.5 feet	214.0 / 16.0		S-6	4, 8, 8	
20	---trace fine- to medium-grained sand, gray to dark gray, stiff below 20 feet			S-7	4, 5, 7	
25	Silty SAND, gray, medium dense, fine-grained (Alluvium)	205.0 / 25.0		S-8	5, 10, 13	
30	---some silt to silty, brown-orange below 30 feet			S-9	8, 8, 11	
35				S-10	10, 11, 10	
40						



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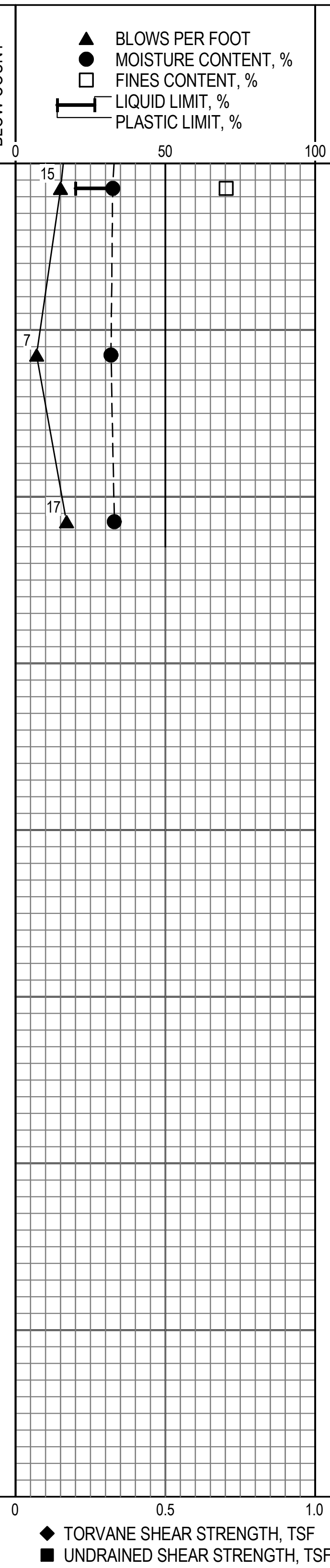
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/7/22	**GPS Coordinates:** 45.3178° N -122.7437° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 78%
Note: See Legend for Explanation of Symbols	

GRI

ADSS B-1

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 230.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		CLAY, some fine- to coarse-grained sand to sandy, some silt, brown-orange to light gray, stiff to very stiff (Residual Soil)			S-11	I	6 5 10	
45		---light gray mottled orange-brown, medium stiff, silt and sand absent below 45 feet			S-12	I	2 3 4	
50		---trace fine- to medium-grained sand, dark brown to red, very stiff below 50 feet	178.5 / 51.5		S-13	I	5 7 10	
		(6/7/2022)						
55								
60								
65								
70								
75								
80								

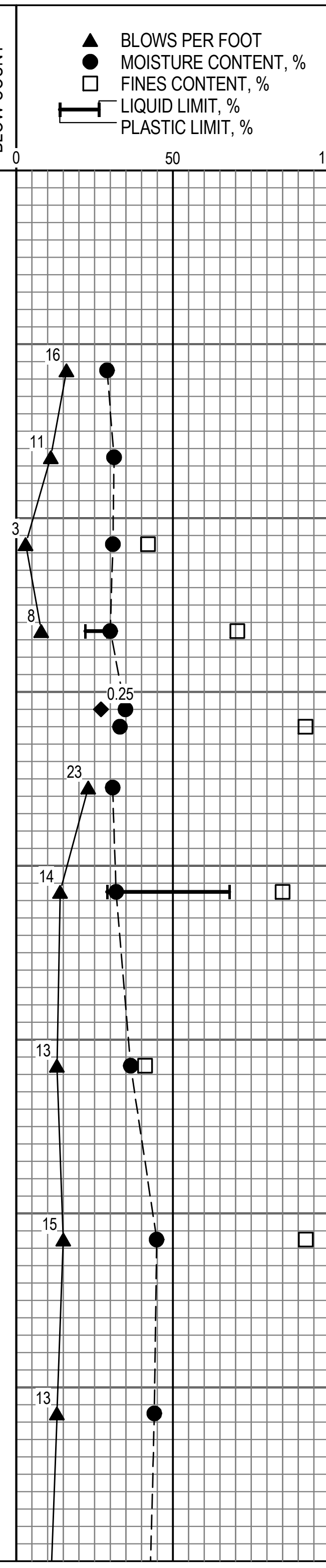


GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

GRI **ADSS B-1**

JUL. 2022 JOB NO. 6658-A FIG. 13A

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	Surface Elevation: 220.0 ft [±] (NAVD88)				
0	Portland cement CONCRETE (8 inches) over crushed rock BASE COURSE (7 inches)	218.8 / 1.3			Vacuum-excavated from surface to 5 feet
	SILT, some fine-grained sand, light brown, stiff (Alluvium)				
5			S-1	8 7 9	Switched to mud rotary drilling at 5 feet
	Silty SAND, brown, very loose to loose, fine grained (Alluvium)	212.5 / 7.5	S-2	4 4 7	
10			S-3	1 2 1	
	Silty CLAY, some fine-grained sand to sandy, brown-gray, medium stiff to stiff (Alluvium)	207.5 / 12.5	S-4	1 3 5	
15	---trace fine-grained sand, gray below 15 feet		S-5		Dry Density = 90 pcf Field Vane = 1.09 tsf at 16.5 feet
	---trace silt, dark gray, very stiff below 17 feet		S-6	7 9 14	
20	---trace to some fine-grained sand, gray below 20 feet		S-7	4 6 8	
25	Silty SAND, trace clay, light brown to brown-orange, medium dense, fine grained, contains 1- to 4-inch-thick stratified beds of sand, silty sand, silt, and minor clay (Alluvium)	195.0 / 25.0	S-8	6 6 7	
30	CLAY, some silt, trace fine-grained sand, brown-orange to light gray, stiff to very stiff (Alluvium)	189.5 / 30.5	S-9	6 7 8	
35	---trace silt, light gray mottled brown-orange, stiff, sand absent below 35 feet		S-10	5 5 8	
40					



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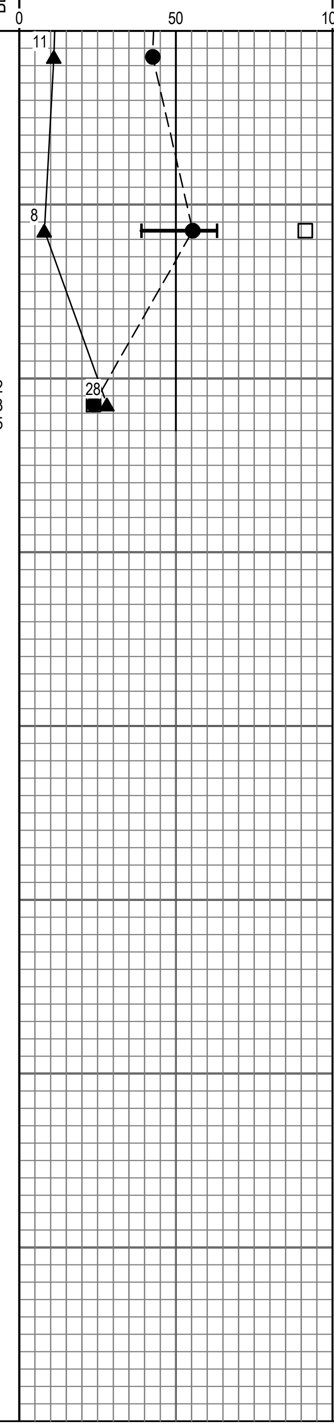
Logged By: J. Heidgerken	**Drilled by:** Western States Soil Conservation, Inc.
Date Started: 6/8/22	**GPS Coordinates:** 45.3172° N -122.7659° W (WGS84)
Drilling Method: Mud Rotary **Equipment:** CME 75 Truck-Mounted Drill Rig **Hole Diameter:** 5 in.	**Hammer Type:** Auto Hammer **Weight:** 140 lb **Drop:** 30 in. **Energy Ratio:** 78%
Note: See Legend for Explanation of Symbols	

GRI

ADSS B-2

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 220.0 ft [±] (NAVD88)	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		CLAY, trace silt, light gray mottled brown-orange, stiff (Alluvium)			S-11		4 5 6	
45		SILT, some clay, trace fine-grained sand, light gray mottled light orange-brown, medium stiff to stiff (Alluvium)	175.0 / 45.0		S-12		2 3 5	
50		Silty SAND, brown-orange, medium dense, fine grained (Alluvium)	170.0 / 50.0		S-13		12 13 15	
		(6/8/2022)	168.5 / 51.5					
55								
60								
65								
70								
75								
80								

▲ BLOWS PER FOOT
● MOISTURE CONTENT, %
□ FINES CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %



◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

GRI BORING LOG (GPS) GRI DATA TEMPLATE.GDT 8/4/22

GRI

ADSS B-2

JUL. 2022 JOB NO. 6658-A FIG. 14A

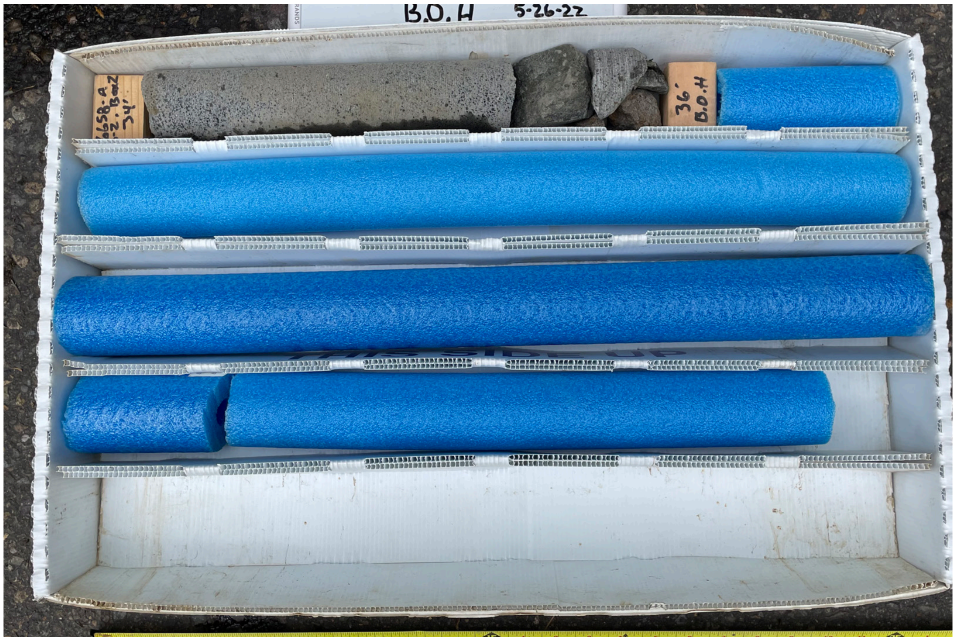
BORING B-1, 12.5 FEET TO 22.5 FEET

BORING B-2, 25 FEET TO 36 FEET

GRI

ROCK CORE PHOTOGRAPHS

JUL. 2022 JOB NO. 6658-A FIG. 15A



BORING B-2, 25 FEET TO 36 FEET

BORING B-7, 17.5 FEET TO 28.5 FEET

GRI

ROCK CORE PHOTOGRAPHS

JUL. 2022 | JOB NO. 6658-A | FIG. 16A

BORING B-10, 17.5 FEET TO 28 FEET

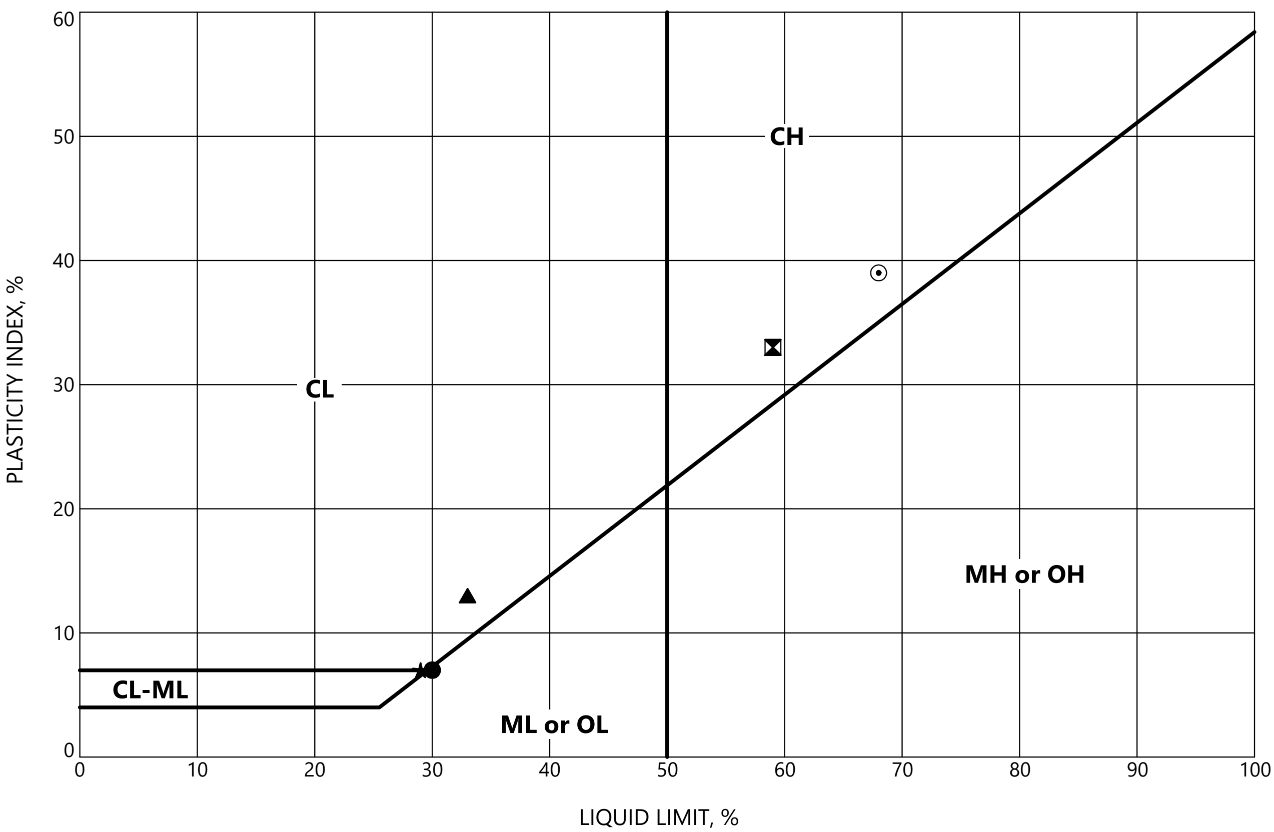
GRI

ROCK CORE
PHOTOGRAPHS

JUL. 2022 JOB NO. 6658-A FIG. 17A

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
ML	INORGANIC CLAYEY SILTS TO VERY FINE SANDS OF SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
MH	INORGANIC SILTS AND CLAYEY SILT
CH	INORGANIC CLAYS OF HIGH PLASTICITY



	Location	Sample	Depth, ft	Classification	LL	PL	PI	MC, %
●	ADSS B-1	S-3	10.0	Clayey SILT, trace fine-grained sand, light brown (Alluvium)	30	23	7	33
⧗	ADSS B-1	S-6	17.5	CLAY, trace silt and fine-grained sand, brown-orange to dark gray (Alluvium)	59	26	33	34
▲	ADSS B-1	S-11	40.0	CLAY, some silt and fine- to coarse-grained sand, brown-orange to light gray (Residual Soil)	33	20	13	32
★	ADSS B-2	S-4	12.5	Silty CLAY, some fine-grained sand, brown-gray (Alluvium)	29	22	7	30
⊙	ADSS B-2	S-7	20.0	CLAY, trace silt, gray (Alluvium)	68	29	39	32

GRI

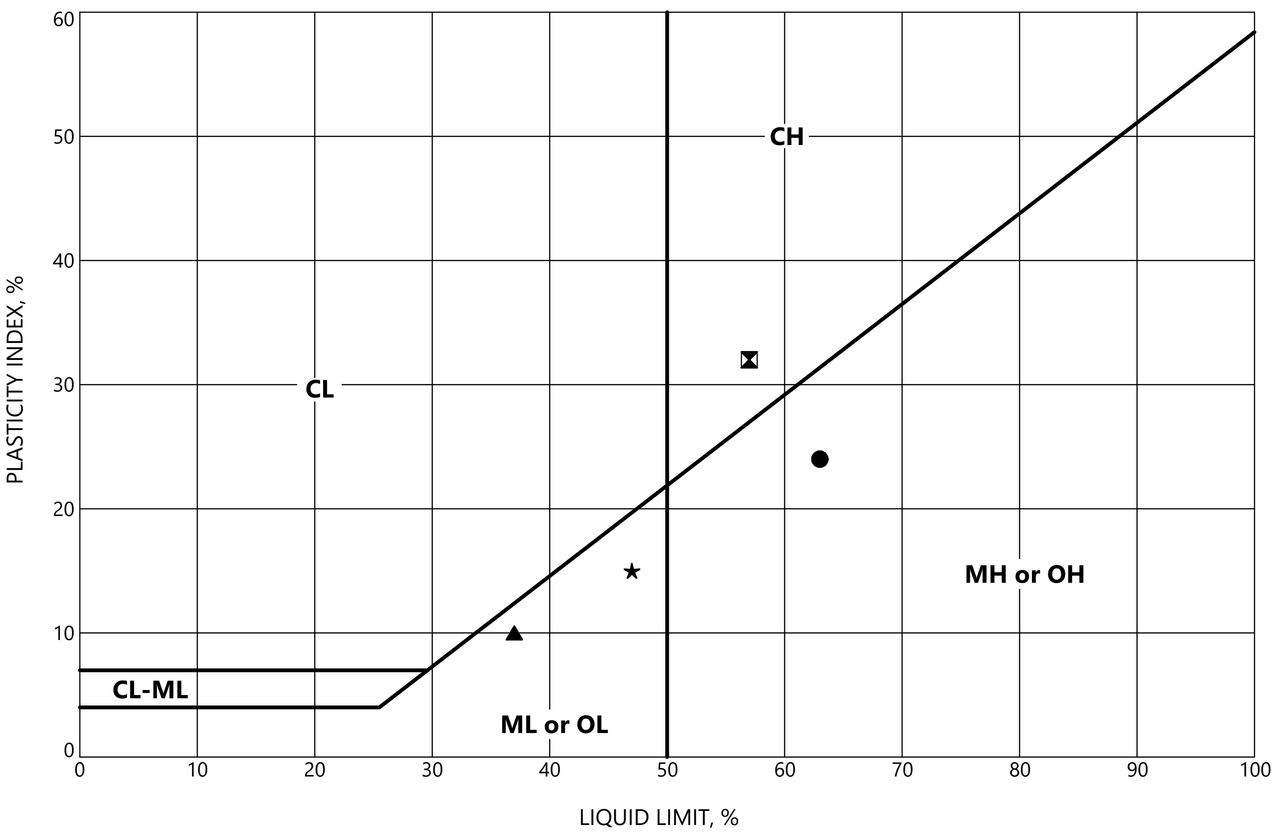
PLASTICITY CHART

JUL. 2022 JOB NO. 6658-A FIG. 18A

ATTERBERG-PLASTICITY 5 PER PAGE GRI DATA TEMPLATE.GDT 6/27/22

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
ML	INORGANIC CLAYEY SILTS TO VERY FINE SANDS OF SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
MH	INORGANIC SILTS AND CLAYEY SILT
CH	INORGANIC CLAYS OF HIGH PLASTICITY



	Location	Sample	Depth, ft	Classification	LL	PL	PI	MC, %
●	ADSS B-2	S-12	45.0	SILT, some clay, trace fine-grained sand, light gray-orange (Alluvium)	63	39	24	55
⧗	B-1	S-1	2.5	CLAY, brown to orange (Residual Soil)	57	25	32	24
▲	B-3	S-3	10.0	SILT, trace to some fine-grained sand, light brown to orange (Alluvium)	37	27	10	33
★	B-4	S-13	45.0	CLAY, light brown (Alluvium)	47	32	15	62

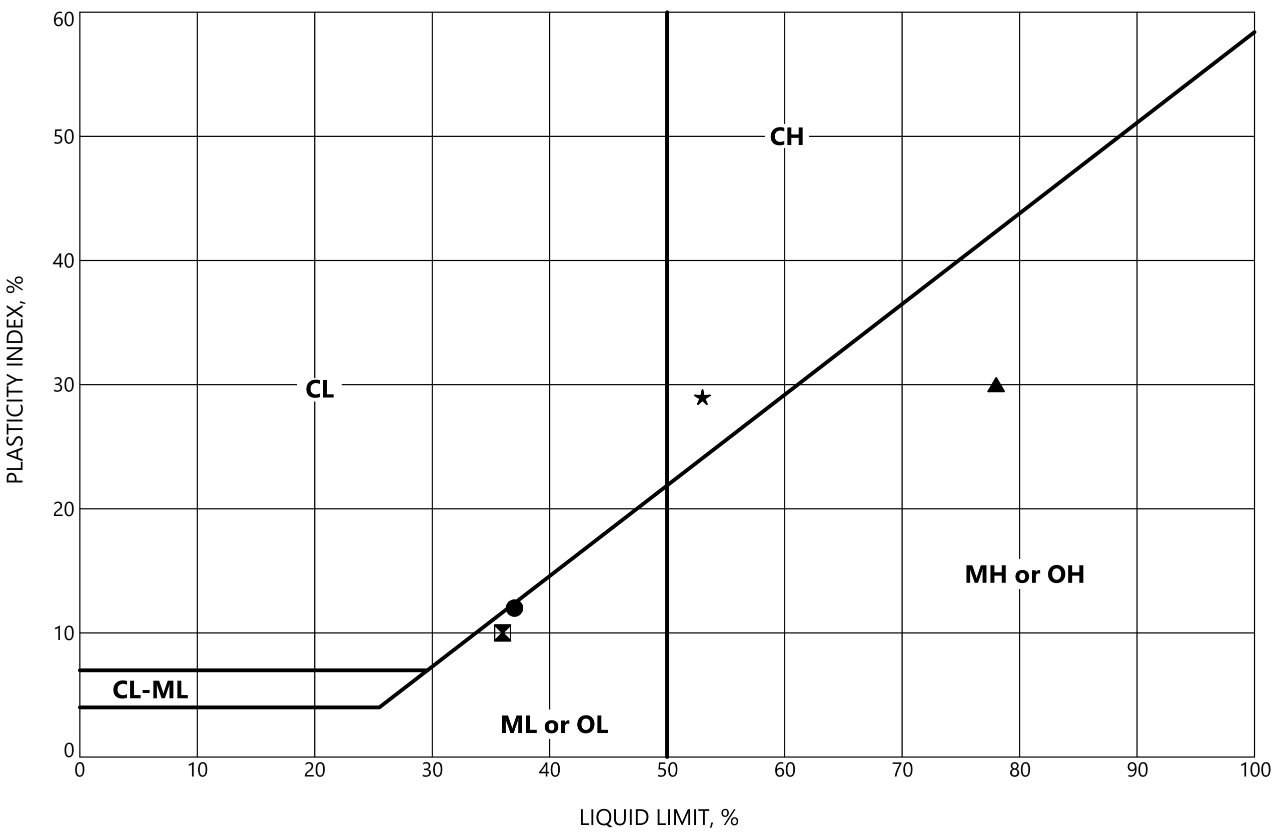
ATTERBERG-PLASTICITY 4 PER PAGE GRI DATA TEMPLATE.GDT 6/27/22

GRI

PLASTICITY CHART

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
ML	INORGANIC CLAYEY SILTS TO VERY FINE SANDS OF SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE-GRAINED SOIL GROUPS
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
MH	INORGANIC SILTS AND CLAYEY SILT
CH	INORGANIC CLAYS OF HIGH PLASTICITY



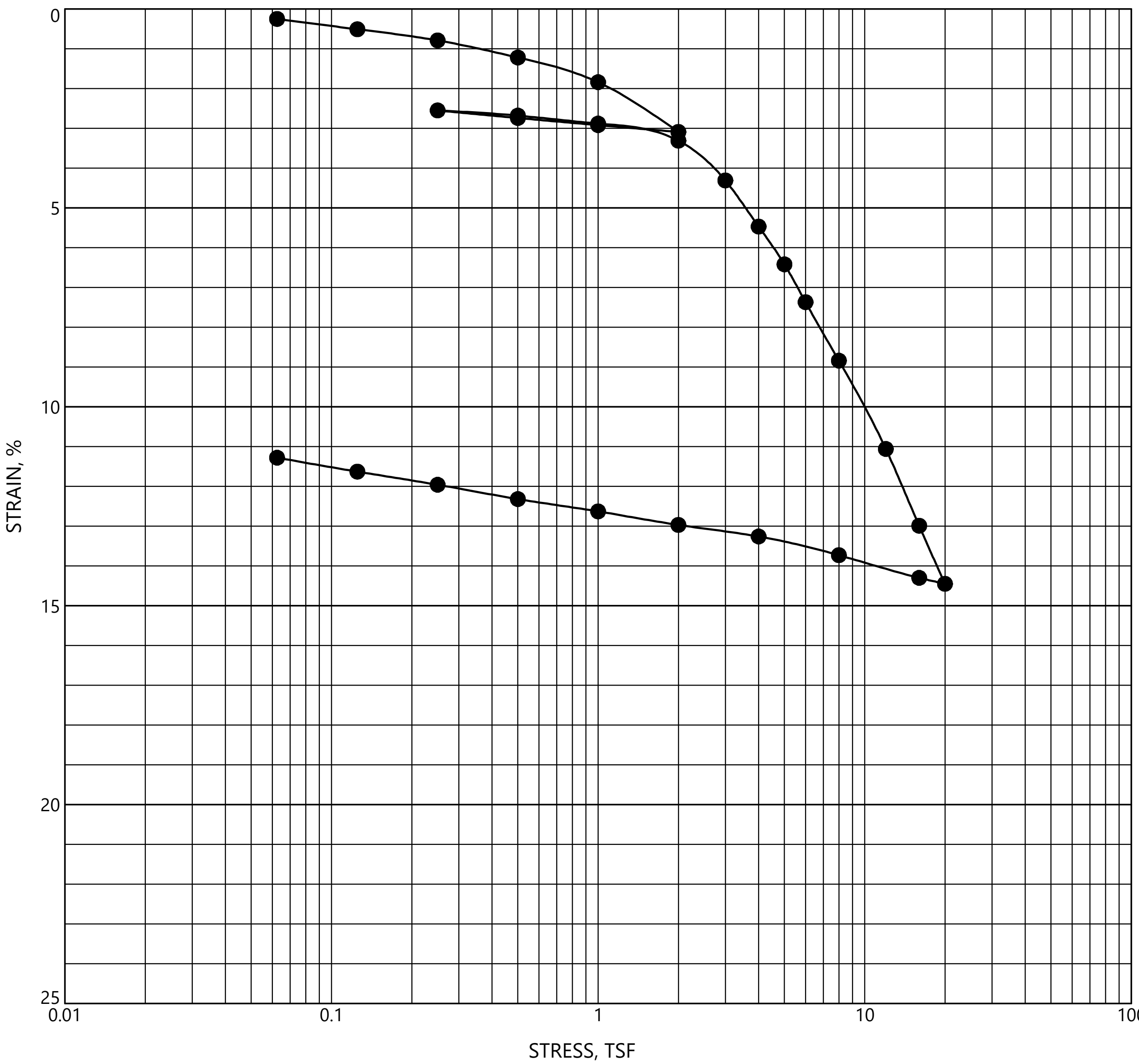
	Location	Sample	Depth, ft	Classification	LL	PL	PI	MC, %
●	B-5A	S-3	7.5	Silty CLAY to clayey SILT, trace fine-grained sand, light brown to gray (Fill)	37	25	12	29
⧗	B-6	S-6	15.0	SILT, some clay, trace fine-grained sand, gray to light brown-orange (Alluvium)	36	26	10	34
▲	B-8	S-9	30.0	Sandy SILT, trace clay, light brown, fine-grained sand (Alluvium)	78	48	30	63
★	B-10	S-3	10.0	CLAY, trace silt and fine-grained sand, dark brown-orange (Residual Soil)	53	24	29	36

ATTERBERG-PLASTICITY 4 PER PAGE GRI DATA TEMPLATE.GDT 6/27/22

GRI

PLASTICITY CHART

JUL. 2022 JOB NO. 6658-A FIG. 20A



	Location	Sample	Depth, ft	Classification	Initial γ_d, pcf	Initial MC, %
●	ADSS B-1	S-4	13.3	SILT, trace fine-grained sand, light brown (Alluvium)	88	35

GRI

CONSOLIDATION TEST

COOPER TESTING LABORATORY

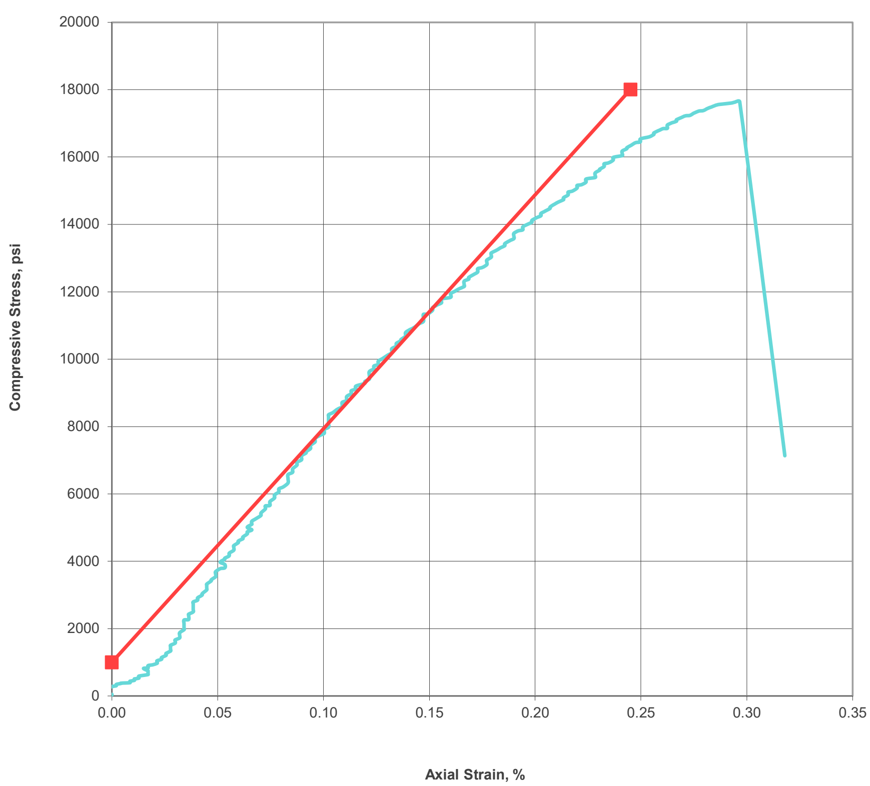
Unconfined Compressive Strength and Young's Modulus of Rock Core (ASTM D7012D)

CTL Job No.:	823-047	Boring:	B-1	Date:	6/20/2022
Client:	GRI	Sample:	C-1	By:	PJ
Project Name:	PG&E Rosemont-Wilsonville Transmission	Depth,ft.:	12.5	Checked:	DC
Project No.:	6658-A				

Visual Description: Gray Rock
Moisture Condition at Test: Sample was washed and in a moist state.
Test Temperature, (°C): Ambient
Remarks:

Sample Height, in.	4.69
Sample Diameter, in.	2.33
Height / Diameter	2.0
Sample Area, in^2	4.27
Wet Density, pcf	162.8
Dry Density, pcf	155.2
Moisture Content, %	4.9
Strain Rate, % / min	0.24

Unconfined Compressive Strength (psi)	**17637**
Young's Modulus (E) (psi)	**6,940,000**



GRI

UNCONFINED COMPRESSIVE STRENGTH
AND YOUNG'S MODULUS OF ROCK CORE

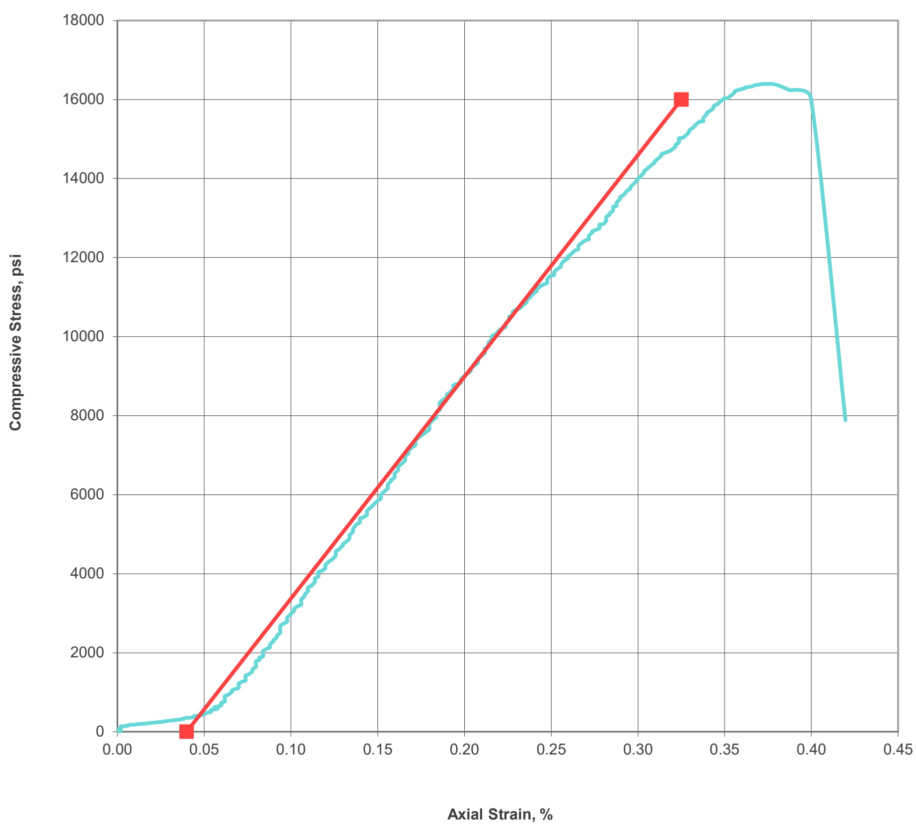
COOPER TESTING LABORATORY

Unconfined Compressive Strength and Young's Modulus of Rock Core (ASTM D7012D)

CTL Job No.:	823-047	Boring:	B-2	Date:	6/20/2022
Client:	GRI	Sample:	C-2	By:	PJ
Project Name:	PG&E Rosemont-Wilsonville Transmission	Depth,ft.:	26	Checked:	DC
Project No.:	6658-A				

Visual Description: Gray Rock
Moisture Condition at Test: Sample was washed and in a moist state.
Test Temperature, (°C): Ambient
Remarks:

Sample Height, in.	5.00	Unconfined Compressive Strength (psi)	16393
Sample Diameter, in.	2.33		
Height / Diameter	2.2		
Sample Area, in^2	4.25		
Wet Density, pcf	147.8	Young's Modulus (E) (psi)	5,610,000
Dry Density, pcf	141.6		
Moisture Content, %	4.4		
Strain Rate, % / min	0.25		



GRI

UNCONFINED COMPRESSIVE STRENGTH AND YOUNG'S MODULUS OF ROCK CORE

COOPER TESTING LABORATORY

Corrosivity Tests Summary

CTL # 823-044 **Date:** 6/22/2022 **Tested By:** PJ **Checked:** PJ
Client: GRI **Project:** PGE Rosemont - Wilsonville Trans. Line **Proj. No:** 6658-A
Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP		Sulfide	Moisture	Soil Visual Description
			As Rec.	Min	Sat.	mg/kg	mg/kg	%		(Redox)		Qualitative	At Test	
						Dry Wt.	Dry Wt.	Dry Wt.		E_H (mv)	At Test	by Lead	%	
Boring	Sample, No.	Depth, ft.	ASTM G57	Cal 643	ASTM G57	ASTM D4327	ASTM D4327	ASTM D4327	ASTM G51	ASTM G200	Temp °C	Acetate Paper	ASTM D2216	
B-1	S-2	5	-	-	6,834	5	26	0.0026	6.3	517	22	Negative	40.0	Dark Yellowish Brown Sandy CLAY w/ Gravel
B-2	S-2	7.5	-	-	5,724	4	16	0.0016	6.1	541	22	Negative	29.1	Yellowish Brown CLAY w/ Sand
B-3	S-2	7.5	-	-	3,763	3	32	0.0032	5.8	562	24	Negative	32.4	Dark Yellowish Brown SILT
B-3A	S-2	7.5	-	-	4,880	2	74	0.0074	6.5	540	24	Negative	20.2	Brown SILT
B-4	S-3	10	-	-	3,574	11	84	0.0084	6.5	522	24	Negative	23.5	Dark Olive Brown SILT
B-5	S-3	7.5	-	-	8,031	4	23	0.0023	5.9	555	22	Negative	33.8	Dark Olive Brown SILT w/ Sand
B-5A	S-1	2.5	-	-	4,550	6	15	0.0015	7.3	583	24	Negative	28.2	Brown CLAY w/ Sand
B-6	S-1	2.5	-	-	4,256	45	31	0.0031	7.2	497	23	Negative	27.5	Dark Yellowish Brown CLAY w/ Sand, trace Gravel
B-7	S-2	5	-	-	7,907	4	11	0.0011	6.3	569	22	Negative	22.8	Dark Yellowish Brown Sandy CLAY w/ Gravel
B-8	S-2	7.5	-	-	5,300	17	10	0.0010	5.6	579	22	Negative	39.4	Olive Brown Sandy CLAY w/ Gravel
B-9	S-2	7.5	-	-	6,380	11	10	0.0010	6.3	610	24	Negative	41.7	Dark Yellowish Brown Sandy CLAY w/ Gravel
B-10	S-2	7.5	-	-	5,301	2	8	0.0008	6.6	623	24	Negative	36.1	Dark Yellowish Brown CLAY
ADSS B-1	S-2	7.5	-	-	3,993	8	25	0.0025	7.1	615	24	Negative	32.3	Dark Yellowish Brown CLAY w/ Sand
ADSS-B-2	S-2	7.5	-	-	4,946	5	12	0.0012	7.3	585	24	Negative	29.8	Dark Yellowish Brown SILT w/ Sand

GRI

CORROSIVITY TEST RESULTS

PGE/314

Declaration of Kevin Putnam

BEFORE THE PUBLIC UTILITY COMMISSION OF OREGON

PCN 6

In the Matter of PORTLAND GENERAL ELECTRIC COMPANY'S Petition for Certificate of Public Convenience and Necessity.	**DECLARATION OF KEVIN PUTNAM**

I, Kevin C. Putnam, declare under penalty of perjury under the laws of the State of Oregon:

1. My name is Kevin C. Putnam and I am currently employed by Portland General Electric Company (PGE or the Company) as Senior Director of Engineering & Design. I have been working for PGE since January 2019, and have been employed as the Senior Director of Engineering & Design since November 2023.

2. I received a Bachelor of Science in Electrical Engineering from the University of Idaho in 2002.

3. I am a licensed Professional Engineer in the State of Oregon (License # 88665PE).

4. My career as an engineer began at PacifiCorp where I worked for almost 17 years. At PacifiCorp, I worked in substation engineering and field operations management. In my last role at PacifiCorp as Director of Field Engineering, I was responsible for overseeing field engineers, performing transmission and distribution (T&D) system planning, and providing operational support.

5. Since January 2019, I have worked in various roles at PGE. From January 2019 to November 2019, I was Manager of Planning, Scheduling, and Line Dispatch and from November 2019 to May 2020, I was Senior Manager for Line Design and Crew Coordination. In both of these

roles I was responsible for T&D line operations crew coordination and T&D performance and support.

6. From May 2020 to May 2022, I was Director of Utility Operations. In this capacity, I was responsible for line design, T&D line operations crew coordination, and T&D performance and support.

7. From May 2022 to November 2023, I was Senior Director of Compliance & Utility Operations. At this role, I was responsible for utility asset management, line design, T&D line operations crew coordination, vegetation management, wildfire and resiliency, business continuity and emergency management, and T&D performance and support.

8. From November 2023, I have been employed at PGE as the Senior Director of Engineering & Design. In this role I am responsible for grid asset engineering, power supply engineering, standards engineering, maintenance and system health engineering, line design, and geographic information system (GIS), survey, and asset management analytics.

9. As planned, the Tonquin Project will repurpose the existing McLoughlin-Wilsonville 115-kV line into a Rosemont-Wilsonville 115-kV line (the Rosemont-Wilsonville Line) and a McLoughlin-Tonquin 115-kV line, requiring the building of new overhead transmission for approximately 5.0 miles along the Rosemont-Wilsonville segment.

10. The Rosemont-Wilsonville Line will satisfy the Public Utility Commission of Oregon's safety criteria, because it will be constructed, operated, and maintained to meet or exceed all applicable National Electrical Safety Code standards, as well as all applicable federal state and local laws, regulations, and ordinances.

11. PGE has extensive experience constructing, operating, and maintaining transmission lines in Oregon in a safe and reliable manner for more than 130 years. The Company operates and maintains 1,613 circuit miles of sub-transmission/transmission lines (including generation lead

lines) ranging from 57-kV through 500-kV in its service territory. In particular, PGE maintains over 550 circuit miles of 115-kV transmission lines like the proposed Rosemont-Wilsonville Line in its designated service territory. In addition to its 115-kV transmission lines, in the past five years the Company has developed 25 circuit miles of high-voltage transmission ranging from 57-kV to 230-kV system-wide.

Pursuant to ORS 162.055(4), I hereby declare that the above statement is true to the best of my knowledge and belief, and that I understand it is made for use as evidence before the Public Utility Commission of Oregon and is subject to penalty for perjury.

SIGNED this 15 day of April, 2024, at Portland, Oregon.

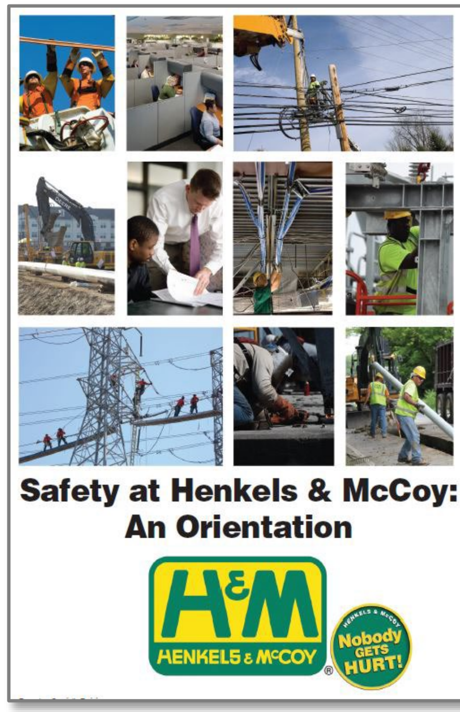
Signed: Kevin Putnam

Kevin Putnam
Portland General Electric Company
Senior Director, Engineering & Design

PGE/315

HMW Safety Overview

Safety and Security



With a current TRIR (Total Recordable Incident Rate) of 1.19 and Dart (Days Away/Restricted or Transfer) Rate of 0.68, safety is fundamental value embraced by every member of the H&M team. We believe a strong safety culture begins with visible safety leadership. Our policy through leadership, training, and application of our behavior-based management (Safety Coaching and Observation Process – or – SCO system and many others) are designed to integrate Health & Safety (H&S) fully into our projects. Site Specific Safety Plans are created for each project and are reviewed by a qualified Safety Officer, as well as reviewed daily prior to field activities. We also make sure all our subcontractors have effective H&S Programs. We are determined not to rest upon past successes but use it as a foundation for continual improvement in making us truly World-class.

H&M has implemented policies, procedures for Subcontractor Safety Reviews and provide all Subcontractors a General Orientation Training. We provide compliance guidance and an awareness of H&M safe work practices. Every subcontractor identified must adhere to H&M's Handbook for Contractors. The Project Safety Manager will aid the Project Team with Job Hazard Analysis, Incident Investigations, routine audits, and inspections. They will provide training and act as subject matter experts in various daily/weekly meetings and provide routine audits, inspections and aid in our Safety Coaching and Observation Process / SCO system.

To ensure a proactive, strong safety culture of continuous improvement, prior to the start of any work 'Site Safety Kick-off' meetings are conducted. Attendance is mandatory for everyone, prior to them being allowed to proceed with work activities. And training is repeated as needed when new project team members (H&M and Subcontractors) are brought on-board. At a minimum the Kick-off will include:

- Energized Substation Training
- Grounding/EPZ
- Rigging/Picking
- Fall Protection
- Site Specific Emergency Response / Emergency Action Plan
- Conductor Operations
- Subcontractors
- Environmental

At H&M we perform our "Subcontractor Orientation" and explain the importance of H&M's Safety Culture and Safety Management Approach – including Safety Contacts, Felt Leadership, Safety Coaching Observations (SCOs), Incident Investigations, Work Practices, Communications / Activities / Involvement (Lessons Learned, Safety Bulletins, Project Safety Meetings, and the Project Safety Team), the Bradley Curve, as well as Safe Driving Principles and Site Requirements.

Based on our employee's or our subcontractor's scope of work and job position – new and refresher specialized trainings are provided to 'affected personnel'. These topics may occur at any time during the project and include:

- 100% Fall Protection
- Bucket Truck Operation / Rescue
- Confined/Enclosed Space Evaluations, Monitoring and Permits
- Crane / Digger Derrick Operation / Certification
- Crane Training/Qualification with Rigging and Steel Erection / Demolition Measures
- Environmental Standards and Reporting
- Excavation, Trenching and Shoring
- Fall Protection / Ladders / Aerial Lifts
- General Housekeeping
- Grounding/EPZ
- Hazard Communication (Chemical Safety)
- Heavy Equipment Operations (Off Road)
- Incident/Event Reporting
- Job Briefings / Tail Boards
- Job Planning/Job Briefing
- Locating Underground Facilities-Damage Prevention/USA Dig Tickets/Gold Shovel Std.'s
- Minimum Approach Distance (MAD)
- Outage Protocols
- Personal Protective Equipment
- Safety & Quality Audits/Reviews/Inspections
- Substation Jobsite Working Rules & MAD in Substation Environments
- Subcontractor General Requirements
- Substance Abuse
- Use of Mobile Devices
- Work Area Protection / Pedestrian Traffic Control

Safety Leadership and Project Safety Meetings

H&M's Safety Programs are in continuous practice every day. The Project Manager, Superintendent, General Foremen and Foremen are the mentors to their teams and play a critical role in assessing worker needs and qualifications. Reinforcement is in quality Job Briefings and in the First Line Supervisor's routine involvement throughout the day and in daily, weekly, and monthly safety meetings.

The Job Briefing Procedure is a standard at H&M, and one in which our subcontractors will participate. The Foremen is responsible for completing the written Job Briefing Sheet and conducting a verbal discussion of project work and job assignments. A new Job Brief is required each day and at change in worksite location.

The Job Briefs provide for a written Job Hazard Analysis (JHA) where the entire crew participates in identifying exposures/hazards prior to the start of work. The verbal discussion and hazard identification process ensures everyone on the work team is fully aware of the anticipated hazards of the work; and they aided in identifying risks and mitigation measures. The crews learn and participate in the division of duties. Each crew member learns their role in abating risk and in protecting one another.

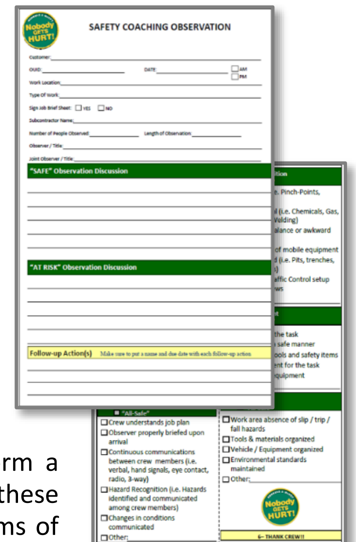
The Foremen is responsible for briefing subcontractors and visitors – all who arrive at the worksite will be briefed and sign the Job Brief Sheet. Every week the Project Manager/Superintendent holds an "All Hands" Safety Stand-up Meeting. This occurs on all H&M projects and ranges from 15 - 30 minutes in duration (subcontractors are included). The weekly "All-hands" meetings serve to reinforce H&M's commitment to follow safe work practices. The Project Manager and Site Safety Professional typically review the following:

- Safety incidents that have occurred in the company/region/subcontractors during the last week
- Safety incident at our competitors or customers when the safety message or incident is critical or pertains directly to project work or personal safety
- Weekly safety messages designated by the corporation and our customer
- Near Miss / Good Catch Report – within the project, region, and corporation
- Leading and Lagging Safety Indicators (including Safety Coaching Observations)

- H&M's West Region Safety Recognition Program Rewards Celebrations

Project Safety Meetings are held at least monthly to promote open communications between management and the work force. Sometimes known as an Area Safety Teams (or ASTs) the Project Manager along with the Project Safety Manager and volunteers from Operations (the Craft) meet to discuss safety issues related to the work or desired changes in the way the work may be conducted.

The Project Safety Team will review Near Miss / Close Call / Good Catch Reports and gathered leading indicators in Safety Coaching Observations (SCOs)and Work Site Audits. They will help determine what actions and activities require management attention.



It is not uncommon for the Project Safety Team or the region to call for a Safety Stand-Up Meeting to conduct additional training or review an issue to stem a negative trend and enhance worker safety. Meeting minutes are kept and shared in bulletin board postings to elevate employee concerns or issues to the West's Region Executive Safety Team (West REST).

Another key to developing a total team safety culture on Henkels & McCoy-led projects is the incorporation of Safety Coaching Observations (SCOs) and Work Site Audits. The Project Safety Team is directly involved in the reviews of SCOs, incident reporting, audits, and inspections.

The Site Safety Manger performs safety audits and inspections, and all members of H&M Management (Foremen level to senior management) are expected to perform a prescribe number of SCO's each month. Henkels & McCoy believes conducting these activities provides management the opportunity for non-routine meetings with teams of workers – we believe the most effective way to deliver a "Felt" safety message is through an informal, non-threatening discussion – to make someone aware of a safety concern in a non-judgmental, non-threatening way. The SCO process:

- Establishes and reinforces safe work practices through a positive discussion
- Increases participation with all employees
- Prevent injuries and property loss
- Raises safety awareness and increase hazard recognition with all employees
- Identifies weaknesses and strengths in safety systems
- Motivates people to think safely and work safely
- Affords continuous safety improvement by utilizing trend analysis and shared results

*A full Site-Specific Safety Plan (SSSP) will be developed and submitted upon award.

*H&M's previous 36-month OSHA Logs can be found accompanying this proposal.

Rosemont-Wilsonville 115kV – Scope overview

- The Rosemont-Wilsonville project will consist of a new transmission line segment with distribution underbuild (approximately 4.5 miles long) to be built between the BPA Keeler-Oregon City 230 kV, and PGE McLoughlin-Wilsonville 115 kV lattice tower line (just South of 65th Ave and Stafford Rd) and running North to SW Borland Road adjacent to SW Stafford Road. This new segment crosses over the I-205 freeway. A new double-circuit transmission line segment (approximately 1.5 miles long) on steel poles with distribution underbuilt will be built between SW Borland Road and the PGE Rosemont Substation located on Rosemont Rd. This segment of the Rosemont-Wilsonville line will cross over the Tualatin River. The existing alignment of Rosemont–Meridian 115 kV transmission line will be utilized for the new double-circuit transmission line.
- All mainline existing distribution circuits will be replaced in the Rosemont–Wilsonville scope of work except for south of the 230 kV lattice tower line. Distribution taps will be transferred.

Key Safety Notes:
H&M will work to protect all major crossings on the project. General Foreman reserves the right to determine the guard structure/support system to be utilized at each crossing location. H&M will provide a wire stringing plan for each major section on the project.

H&M is prepared and ready to work closely with PGE and BPA for all BPA crossings on this project. We have a good rapport with their key team members which should result in timely and agreeable planning, scheduling, and coordination to accommodate our milestone achievements.

There are numerous locations along the project that will take careful coordination, preparation, and planning to manage and navigate the traffic along busy roadways including Stafford Rd. H&M and our subcontractors will work with the local jurisdictions to comply with permit hours, TCP approvals, and property coordination during all phases of work. Proper setups, signage, and notifications will be met for this project.

A carefully planned and well executed communication plan will be essential on this project. Handheld radios, board radios, and emergency response planning will be detailed and outlined at our project kick-off training and at each evening tailboard. PGE and any other parties involved will be invited to our meetings and have full visibility on our day-to-day (and night) activities and communications plan. H&M will communicate with local jurisdictions any businesses, and residential customers to provide adequate notification and coordination for all construction activities. We will review and comply with all provided permitting for work hours and construction commencement notification, TCP understandings, and work procedures. Any/all outages will be scheduled in advance and customers will be contacted by the H&M General Foreman. We will work with the PGE project team to ensure compliance and that customers' expectations are met.

H&M will utilize bucket trucks, line trucks, cranes, dump trucks, drill rigs, 1-ton pickups, vacuum excavation trucks, wire pulling equipment, etc. to install new transmission structures and string in new 115kV Transmission conductors with distribution underbuild. H&M crews will also wreck out old structures when able and/or after all communications have been transferred. We will submit all critical task plans prior to the start of each section, including but not limited to access plans, critical lift plans, and wire stringing plans.

PGE/316

PGE’s 2023Wildfire Mitigation Plan

December 21, 2022

Via Electronic Filing

Public Utility Commission of Oregon
Attention: Filing Center
P.O. Box 1088
Salem, OR 97308-1088

RE: AR 638 – Rulemaking for Risk-based Wildfire Protection Plans and Planned Activities Consistent with Executive Order 20-04 / UM 2208 – PGE's Wildfire Protection Plan

Dear Filing Center:

Please find attached the Portland General Electric Company ("PGE") 2023 Wildfire Mitigation Plan (WMP) which is being submitted as required per Oregon Administrative Rule 860-300-0002(2).

PGE continues to evolve its approach to mitigating the risk of wildfires in response to changing conditions. For example, we slightly expanded a few of our High Fire Risk areas and reduced one as well due to continued refinements made to our 2022 risk analysis. In addition, PGE will continue to expand its situational awareness capabilities through new Pano-AI camera installations and weather stations. These efforts are in addition to the operational changes that occur during fire season, capital investments to harden our system and our inspection and vegetation management activities. PGE anticipates that our WMP will continue to evolve as our risk assessment and wildfire mitigation capabilities expand.

PGE appreciates Staff's efforts to establish permanent rules regarding utilities' wildfire mitigation plans. PGE looks forward to the review of the 2023 WMP. Please direct all formal correspondence and requests to the following email address: pge.opuc.filings@pgn.com.

Respectfully Submitted,
/s/ W. M. Messner

William M. Messner
Director Wildfire Mitigation & Resiliency

Portland General Electric

2023 Wildfire Mitigation Plan

Revision Version: 1.0

Release Date: 12/22/2022

This Wildfire Mitigation Plan (WMP) contains statements that relate to future plans, objectives, expectations, performance, and events. These forward-looking statements represent PGE's estimates and assumptions as of December 1, 2022; because PGE is continually updating its wildfire data, information included in the WMP reflects the data available at the time of publication. Furthermore, the estimated costs and schedules contained herein are subject to certain uncertainties including delays in supply chain and increased supply costs, nonperformance of counterparties and employee work factors. PGE assumes no obligation to update or revise any forward-looking statement as a result of new information, future events, or other factors.

These forward-looking statements are not a guarantee of future performance, and any such forward-looking statements are subject to risks and uncertainties which may be difficult to predict or are beyond PGE's control. As a result, actual results may differ materially from those projected in the forward-looking statements.

1. Executive Summary

PGE's Wildfire Mitigation & Resiliency (WM&R) organization plans and implements the Wildfire Mitigation Program (Program), developing and coordinating wildfire mitigation activities across the company. The company's approach to wildfire mitigation continues to evolve in response to both global climate change, which is fueling landscape-altering wildfire events worldwide, and to the wildfire rules recently issued by the Oregon Public Utility Commission (OPUC). PGE's goal is to improve regional safety by reducing the risk that PGE's electric utility infrastructure could cause a wildfire, while limiting the impacts of Public Safety Power Shutoff (PSPS) events and other mitigation activities on customers and increasing the resiliency of PGE assets to wildfire damage.

In compliance with OPUC rules governing wildfire protection plans, the Wildfire Mitigation Plan (WMP) describes PGE's approach to wildfire risk mitigation and guides the company's Program.

The WMP presents PGE's approach to risk modeling, which is the foundation of the Program. The risk model, referred to as the "Wildfire Risk Mitigation Assessment," provides guidance for the major Program focus areas: operating protocols, PSPS events, asset management and inspections, vegetation management, Public Safety Partner and community engagement, public awareness and outreach, and research and development.

For 2023, the updated Wildfire Risk Mitigation Assessment resulted in PGE maintaining its 10 existing High Fire Risk Zones (HFRZs) with some minor refinements. HFRZs are areas within PGE's service territory where vegetation, terrain, meteorological patterns, and wildland-urban interface considerations increase the risks associated with wildfire. PGE implements specific inspection and maintenance, vegetation management, and operational actions within these HFRZs during and in preparation for PGE's declared Fire Season for improved ignition prevention and safety.

In addition, PGE continues to expand its situational awareness capabilities, including measures such as installing new remote automated weather stations and artificial intelligence (AI)-enhanced ultra-high-definition cameras (Pano AI cameras) to automatically notify PGE and its Public Safety Partners when they detect a fire, in real time. PGE will continue to invest in mitigations to reduce wildfire risk throughout our system.

However, factors beyond PGE's control, including rising costs and other supply chain issues, changing weather patterns driven by climate change, and competition for limited contract resources for vegetation management and inspections, will continue to impact delivery of PGE's Program in 2023. Investor-owned utilities, the OPUC, and other stakeholders must strive to achieve a reasonable balance between affordable electricity rates and meaningful wildfire risk reduction.

At PGE, wildfire-related planning, mitigation, and research are year-round endeavors. PGE may update this WMP and the Program throughout the year to address new findings, data, and analysis. PGE will continue to work collaboratively with Public Safety Partners, Tribes, local communities, and other key stakeholders to prioritize the safety of people, property, and public spaces.

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Glossary and Acronyms

AAR: After-Action Review

AGOL: ArcGIS Online

ANSI: American National Standards Institute

APPA: American Public Power Association

AWRR: Advanced Wildfire Risk Reduction

Blue-Sky/Grey-Sky Events: During Blue-Sky events, a utility executes normal daily operations with no natural disasters or other disruptive events. A Grey-Sky event refers to an operating day or days in which a utility faces severe weather or other incident which causes reliability concerns, and all hands are on deck to respond to the incident.

BPA: Bonneville Power Administration

CBO: Community-Based Organization

CEOP: Corporate Emergency Operations Plan

CIMT: Corporate Emergency Management Team

CPC: Climate Prediction Center

CRC: Community Resource Center

DEI: Diversity, Equity & Inclusion

EAC: Equivalent Annual Cost

ECC: Emergency Coordination Center

EEI: Edison Energy Institute

EEMT: Energy Emergency Management Team

EFD: Early Fault Detection

EOC: Emergency Operations Center

EPRI: Electric Power Research Institute

ESCC: Electricity Subsector Coordinating Council

ESF-12: Refers to Emergency Support Function-12 and indicates the Public Utility Commission of Oregon's role in supporting the State Office of Emergency Management for energy utilities' issues during an emergency, per OAR 860-300-0002(1).

FAQ: Frequently Asked Question

FDRA: Fire Danger Rating Area

Fire Season: Period(s) of the year during which wildland fires are most likely to occur, spread, and affect resources sufficiently to warrant organized fire management activities

Fire Weather: Weather conditions that influence fire ignition, behavior, and suppression

FITNES: Facilities Inspection & Treatment to National Electrical Safety Code

GIS: Geographic Information System

High Fire Risk Zone (HFRZ): Geographic areas at elevated risk of wildfire ignition identified by PGE in its risk-based WMP

HSEEP: Homeland Security Exercise & Evaluation Program

IAM: Institute of Asset Management

IAP: Incident Action Plan

ICP: Incident Command Post

IMT: Incident management Team

IRWIN: Integrated Reporting of Wildland Fire Information

IWRMC: International Wildfire Risk Mitigation Consortium

ISO: International Organization for Standardization

LCES: Lookouts, Communications, Escape Routes, and Safety Zones

LiDAR: Light Detection & Ranging

Local Community: Any community of people living, or having rights or interests, in a distinct geographical area, per OAR 860-300-0002(2)

Local Emergency Management: Refers to city, county, and Tribal emergency management entities, per OAR 860-300-0002(3)

NICC: National Interagency Coordination Center

NIFC: National Interagency Fire Center

NIMS: National Incident Management System

No-Test Policy: PGE will disable auto-reclosing and not manually close-in a faulted circuit

NRECA: National Rural Electric Cooperative Association

NWCC: Northwest Coordination Center

NWS: National Weather Service

OAR: Oregon Administrative Rule

ODF: Oregon Department of Forestry

ODHS: Oregon Department of Human Services

ODOT: Oregon Department of Transportation

OH: Overhead (transmission or distribution circuit)

OJUA: Oregon Joint Use Association

O&M: Operations and Maintenance

OPUC: Public Utility Commission of Oregon

P1: Hazard/danger tree

P2: A tree that poses a grow-in or fall-in threat and displays arboricultural defect that poses risk to PGE facilities

PGE: Portland General Electric

PMO: PGE's Project Management Office

PSA: Predictive Service Area

PSPS: Public Safety Power Shutoff

Public Safety Partners*:* Includes the ESF-12, Local Emergency Management, and Oregon Department of Human Services (ODHS), per OAR 860-300-0002(6)

QA/QC*:* Quality Assurance/Quality Control

RAWS: Remote Automated Weather Station

Red Flag Warning*:* A term used by the National Weather Service to alert forecast users of an ongoing or imminent critical fire weather pattern. Red Flag Warnings will be issued whenever a geographical area has been in a dry spell for a week or two, or for a shorter period, if before spring green-up or after fall color, the National Fire Danger Rating System (NFDRS) is high to extreme, and all of the following weather parameters are forecasted to be met:

- Ten-hour fuels (moisture content of small vegetation that take only about 10 hours to respond to changes in moisture conditions) of 8 percent or less
- A sustained wind average 15 mph or greater.
- Relative humidity less than or equal to 25%.
- A temperature of greater than 75 degrees Fahrenheit.

In some states, dry lightning and unstable air are criteria. A Fire Weather Watch may be issued prior to the Red Flag Warning.

ROW: Right-of-way

RSE*:* Risk-Spend Efficiency

RVM: Routine Vegetation Management

SB: Senate Bill

SCADA: Supervisory Data Control & Acquisition

SEL: Schweitzer Engineering Laboratories

SME: Subject Matter Expert

Supervisory Control and Data Acquisition (SCADA)*:* The control system architecture comprising computers, networked data communications and graphical user interfaces (GUI) for high-level process supervisory management, while also comprising other peripheral devices like programmable logic controllers (PLC) and discrete proportional-integral-derivative (PID) controllers to interface with process plant or machinery.

Striking Distance*:* A term used to describe a tree that has the potential to impact PGE powerlines and other equipment.

T&D*:* Transmission and Distribution

Tier 1 Risk: Describes an area where there is not an elevated or extreme risk of wildfires.

Tier 2 (Elevated) Risk*:* Describes an area where there is an elevated risk (including likelihood and potential impacts on people and property) of utility-associated wildfires.

Tier 3 (Extreme) Risk*:* Describes an area where there is an extreme risk (including likelihood and potential impacts on people and property) of utility-associated wildfires.

Tribes: this term is used collectively to describe PGE's Tribal partners, including the Confederated Tribes of the Grande Ronde, Confederated Tribes of Warm Springs, *Confederated* Tribes of the Umatilla Indian Reservation, and Confederated Tribes of Siletz Indians.

UAM: PGE's Utility Asset Management program

USDOE: United States Department of Energy

USFS: United States Forest Service

Utility-Identified Critical Facilities: the facilities identified by PGE within its service territory that have the potential to threaten life safety or disrupt essential socioeconomic activities if their services are interrupted. Communications facilities and infrastructure are considered Critical Facilities.

Wildfire Risk Mitigation Assessment: a PGE program that models and assesses a wide range of potential wildfire-related risk factors to inform PGE's operational and financial decision-making.

WMP: Wildfire Mitigation Plan

WM&R: PGE's Wildfire Mitigation & Resiliency organization

2. Introduction

This WMP describes PGE's wildfire prevention and mitigation efforts and PGE's planned activities to prevent utility-caused wildfire ignition events. The WMP incorporates internal and external lessons learned from the 2022 Fire Season and describes PGE's wildfire preparedness and response activities for 2023.

The success of the Program relies on the active participation of a broad spectrum of internal and external stakeholders under the direction of PGE's WM&R organization. The foundation of the Program is PGE's Wildfire Risk Mitigation Assessment and Risk Spend Efficiency calculations, used to develop and guide Program activities and wildfire mitigation investments. Based on industry benchmarking and findings from its Wildfire Risk Mitigation Assessment, PGE believes that the frequency of utility-caused ignition events can be reduced through:

- Inspection and maintenance of poles and equipment
- Engineering of reliable systems that experience fewer events that result in spark failure modes (potential ignitions)
- System hardening
- Effective vegetation management
- Situational awareness and operational readiness
- Operational changes during Fire Season, including the use of system protection devices such as electronic reclosers
- Effective use of PSPS to prevent utility-caused ignitions during Red Flag Warning meteorological events.

PGE will review its Fire Season operations and wildfire mitigation preparedness and response actions on an annual basis and update the WMP as needed. PGE will also update the WMP as required to comply with applicable regulatory requirements or changes in laws or regulations. If PGE substantively updates the plan outside of the annual submission cycle, PGE will refile the WMP with the OPUC and post the most current version of the WMP on PGE's website.

Some of the most important changes made for the 2023 WMP include the ongoing evolution of PGE's Wildfire Risk Mitigation Assessment in partnership with PGE's Public Safety Partners (please refer to Section 6.2, Updates to 2023 Wildfire Risk Mitigation Assessment, for additional details). PGE also expanded its situational awareness capabilities by adding 22 Pano AI fire detection cameras covering all 10 of PGE's HFRZs. Over 30 fire agencies have direct access to this technology, potentially improving response time to fires in the areas they serve. In addition, PGE's weather station network now consists of 52 stations providing weather data at a micro level, allowing for more precisely informed PSPS decision-making. PGE continues to move forward with non-expulsion fuse installation and other ignition prevention investments, such as tree wire and undergrounding projects. Other capital improvements include the expanded use of intelligent reclosers to reduce the number of customers impacted by PSPS events.

Lastly, in September 2022, PGE executed a PSPS event in all 10 of PGE's pre-designated HFRZs. This decision was not taken lightly, as it directly impacted customers across the PGE service territory. PGE observed damage to PGE assets from limbs and trees, indicating that the PSPS likely prevented wildfire ignitions within the PGE HFRZs during a period of extreme fire potential conditions, with Red Flag Warnings in effect from the Cascade Range to the Coast Range. Please refer to Appendix 8 (Summary of Input from Public Safety Partners and Lessons Learned Captured During the 2022 Fire Season) for lessons learned and recommendations from the PSPS event, tabletop exercises, and collaboration with PGE's Public Safety Partners.

3. Purpose and Scope

PGE's WMP is designed to provide strategic direction for the programs and activities that seek to mitigate the potential for PGE equipment, facilities, or activities to become wildfire ignition sources, and to guide PGE's compliance with all applicable laws and regulations, including the OPUC's wildfire rules. In constructing the WMP, PGE observed the following key principles:

- Prioritize public and employee safety
- Act to reduce the risk of wildfire ignitions from PGE assets
- Provide effective guidance to inform PGE's Fire Season operations
- Guide PGE's system hardening activities, increasing resistance to wildfire impacts through a systematic, risk-based approach to identifying and prioritizing system hardening and resiliency activities
- Communicate and collaborate with industry peers and Public Safety Partners, Emergency Support Function 12 (ESF-12), local emergency managers, Oregon Department of Human Services, local communities and community-based organizations, counties, Federal, Tribal, State and local governments, operators of PGE-identified critical facilities, and customers
- Maintain reliable electric service, and
- Implement PSPS events with efficiency, when necessary, and with broad public awareness.

4. Operating Environment and Service Territory

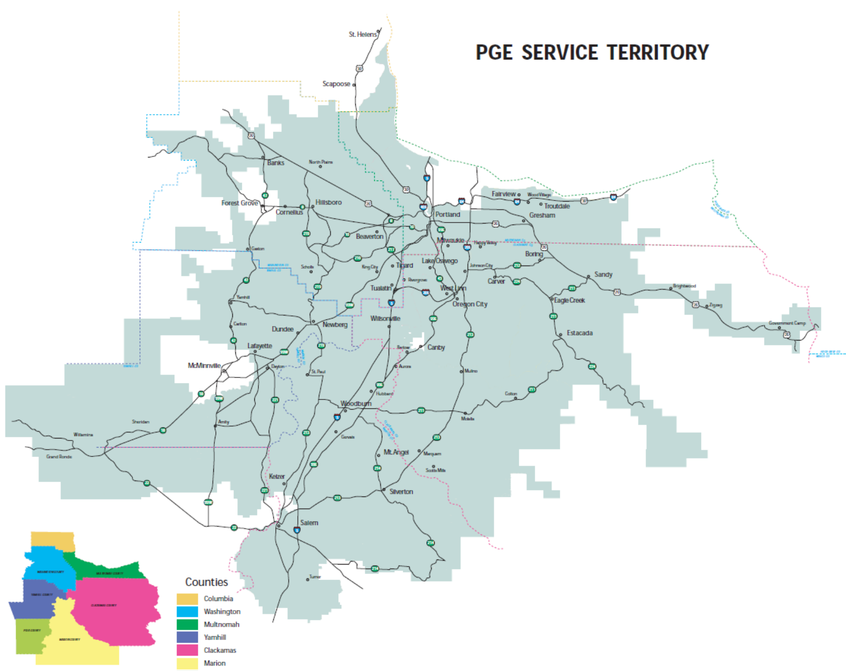
4.1 Operating Environment

Global climate change continues to alter the Pacific Northwest climate in ways that are difficult to model and predict. This reality will drive continuous evaluation and modification of PGE's WMP for the foreseeable future. In addition, the effects of climate change on California and resulting wildfires have increasingly pulled West Coast wildfire mitigation resources to the south, intensifying competition for available fire suppression, inspection, and vegetation management resources in the Pacific Northwest.

4.2 PGE Service Territory – Overview

PGE's service territory is distributed over 4,000 square miles in a combination of forested, mountainous, urban, and suburban environments. Much of the eastern and western portions of PGE's service area are forested, particularly in the Mt. Hood corridor along Highway 26, in the foothills of the Coast Range, and south toward Estacada. While the majority of PGE's service territory is located within the most densely populated area of the state, PGE's managed right-of-way (ROW) contains more than 2.2 million trees, with millions more off-ROW trees. In managing off-ROW conditions, PGE must coordinate with multiple neighboring utilities that interconnect to our system, including the Bonneville Power Administration (BPA), PacifiCorp, West Oregon Electric Cooperative, Wasco Electric Cooperative, Consumers Power, Inc., Forest Grove Light & Power, and McMinnville Water and Light.

Figure 1: PGE Service Territory



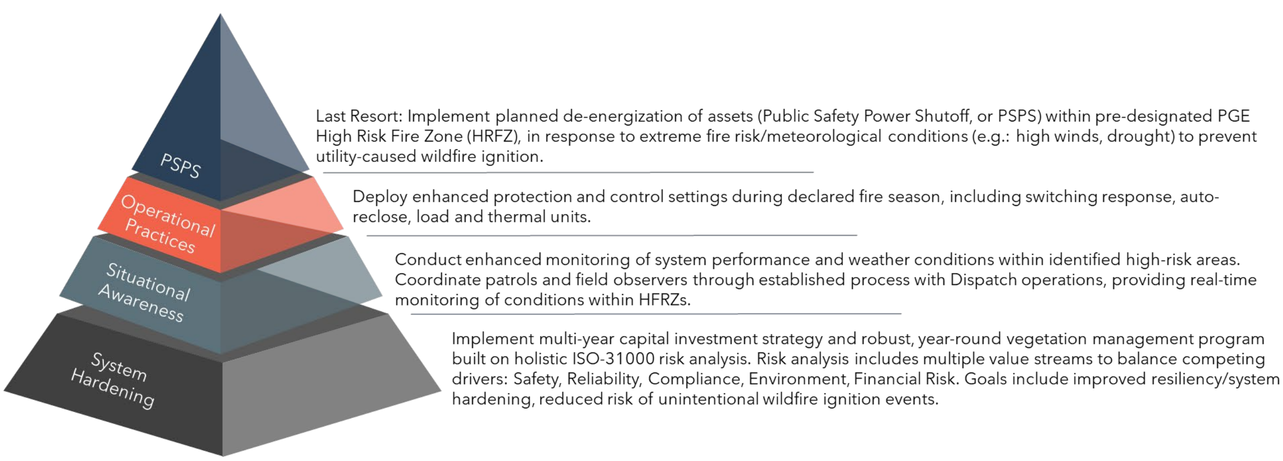
5. Wildfire Risk Mitigation Program Overview

PGE's primary wildfire risk mitigation objective is to reduce the risk of ignition from PGE assets, while limiting the impacts of specific mitigation activities, such as PSPS events, on customers. The Program can be broken down into the following four risk mitigation approaches and associated objectives:

- **PSPS:** Identify areas of heightened wildfire threat (HFRZs) within the PGE service territory and mitigate the risk of PGE-caused wildfire ignition in those areas through planned de-energizations (PSPS events) during periods of extreme fire risk.
- **Operational Practices:** Implement operational system settings, including protection systems (e.g., reclosers), line and vegetation maintenance, and using a risk-informed protection strategy to reduce risk of ignitions.
- **Situational Awareness:** Improve PGE's wildfire-related risk management and situational awareness capabilities.
- **System Hardening:** Implement a systematic, risk-informed approach to identify and prioritize system hardening, and resiliency measures to reduce the likelihood of ignitions caused by utility assets and protect PGE assets from damage.

The following figure provides a visual representation of PGE's multi-layered approach to wildfire risk mitigation:

Figure 2: PGE's Wildfire Risk Mitigation Hierarchy



PGE strives to find cost-effective ways to maximize wildfire risk reduction by applying risk assessment modeling to guide mitigation strategies. The purpose of this work is to deliver highest risk reduction per dollar spent on mitigation. Wildfire Risk Mitigation Assessment methodologies and mitigation measures are discussed in more detail in Section 6 of the WMP.

6. Wildfire Risk Assessment and Mitigation Activities

6.1 Risk Assessment Overview

PGE uses a multi-phase wildfire risk assessment program to:

- Annually identify and refine the boundaries of the HFRZs within the PGE service territory
- Quantify the likelihood that individual PGE assets could contribute to ignition of large wildfires (>100 hectares for fires in timber; >400 hectares for fires in grass or rangeland), map their location, and apply a consequences model to determine where a potential wildfire ignition would be most significant.

The annually updated HFRZ assessment enables PGE to identify the highest-risk areas within its service territory (HFRZs are discussed in Section 7, below) and prioritize wildfire mitigation actions. The model results are a key input to the development of PGE's 2023 WMP. In addition, PGE evaluates wildfire risk across PGE transmission and generation assets outside of our service territory (refer to Appendix 9, PGE Wildfire Risk Assessment Overview & Process, for additional details).

Assessment results allow PGE to evaluate susceptibility to the natural and human factors that could contribute to electric asset-caused wildfire ignitions and provide data-driven guidance for PGE's Program. A technical overview of PGE's fire behavior modeling, a component of the wildfire risk approach, is provided in Appendix 9.

6.2 Updates to 2023 Wildfire Risk Mitigation Assessment

PGE aims to improve its Wildfire Risk Mitigation Assessment methodologies through engagement with external experts, as well as through internal controls and feedback loops across the organization.

PGE engages external agencies in the validation of existing variables and development of new variables and inputs for consideration in the risk assessment process. In 2022, this engagement included workshops and field site visits with Oregon Department of Forestry (ODF), U.S. Forest Service (USFS), and local fire agencies to look at fire agency response times to ignition events and assess how vegetation and access conditions influence fire growth potential. In addition, PGE hosted virtual technical working sessions with local fire districts (Clackamas Fire District, Tualatin Valley Fire District, Multnomah County Fire District) and ODF to learn about anticipated fire response times, watershed boundaries, and detection probabilities. These engagements and variables directly informed PGE's 2023 reassessment of the HFRZ geographical boundaries as described in Section 7 of the WMP.

Through an internal post-Fire Season lessons learned process, PGE refined its Wildfire Risk Mitigation Assessment methodologies by introducing new variables layered onto the existing assessment framework. For 2023, these additional variables include:

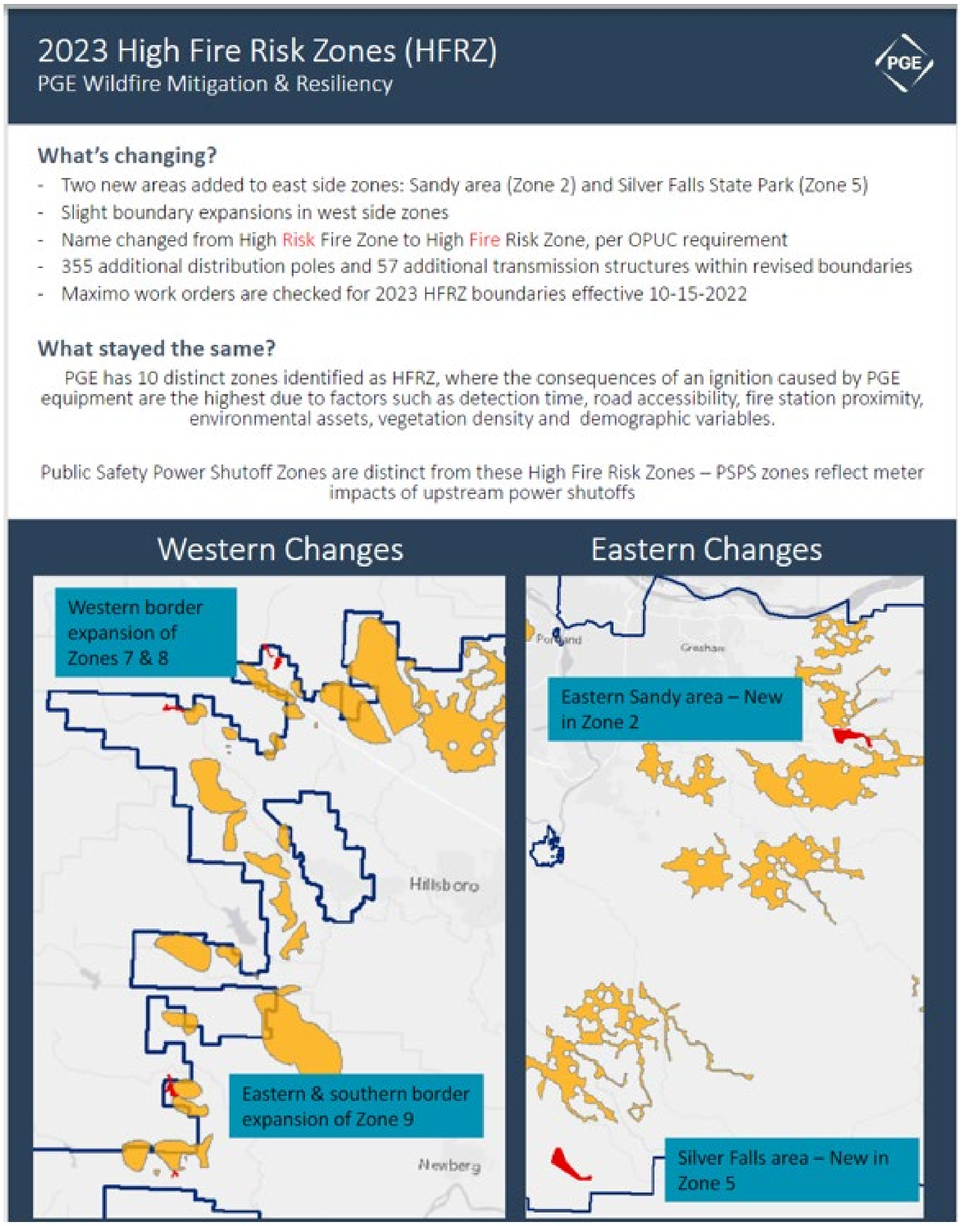
- Access/egress road density
- Detection probability

- Social vulnerability (including poverty, vehicle access, English as a second language considerations)
- Fire response time/proximity to emergency response (modelled at 10 and 15 minutes).

PGE continues to investigate improvements to data sets and analytical techniques to evolve its Wildfire Risk Mitigation Assessment methodologies and integrate fire risk into PGE's overall asset and risk management portfolios. Over the past two years, PGE has made the following changes to its baseline Wildfire Risk Mitigation Assessment:

- Began the development of a four-year wildfire risk mitigation roadmap, laying out planned mitigation activities through fiscal year 2025
- Increased the number of individual weather scenarios used to model baseline and seasonal wildfire risk (see the Wildfire Simulation Section of Appendix 9 for further details) to 216 scenarios, increasing model confidence
- Introduced new spatial variables to PGE's GIS-based wildfire risk mapping through virtual technical work sessions with local fire districts and the OPUC, including fire detection probability and estimated response time.

Figure 3: Geographic Differences Between PGE's 2022 and 2023 HFRZs



6.3 Wildfire Risk Categories

PGE's Wildfire Risk Mitigation Assessment methodologies consider baseline and seasonal wildfire risk, risk to residential areas served by PGE, and risks to generation facilities, substations, and powerlines owned by PGE. PGE uses these assessments to inform wildfire mitigation strategies that provide location-specific reliability and resiliency benefits. This holistic risk assessment approach helps PGE align specific mitigations to risk reduction areas, and to benefit a broad spectrum of regional stakeholders.

PGE seeks to align mitigation measures to risk across PGE's Program, from design and operational standards to construction practices, vegetation management, training, utility asset management, and capital investment.

6.3.1 Baseline Wildfire Risk

PGE calculates baseline equipment risk in terms of ignition probability (the annual likelihood that a given piece of equipment could cause a wildfire ignition given its type, age, condition, and location) and the consequences of ignition. These consequences evaluate how a wildfire ignited at a specific location may burn, as well as the potential magnitude of the damage it may cause. In most cases, probability values vary with age and condition of the asset, increasing as equipment ages.

6.3.2 Seasonal Wildfire Risk

Seasonal risk is integral to PGE's Wildfire Risk Mitigation Assessment. PGE's assessment of seasonal wildfire risk leverages the consequences modelled from the 216 fire weather scenarios referenced in Appendix 9. PGE also accounts for climate change variability in seasons by leveraging fuel ecology and wildfire studies for the Willamette Valley and Oregon[1]. For additional details regarding how PGE models seasonal wildfire risk, please refer to Appendix 9.

6.3.3 Risk to Residential Areas

PGE understands that ignition potential is not limited by HFRZ boundaries and models ignition points as a grid across the entire PGE footprint. PGE assesses risk to residential areas in the fire behavior models described in Appendix 9. PGE's modeling includes high-density locations as well as adjusted burn probabilities. A key factor in risk-informed decision-making is the recognition that detection probability and fire response time as a function of roads/access varies with population density.

6.3.4 Risk to PGE Equipment

PGE protects equipment and facilities within its HFRZs with established wildfire design and construction standards (e.g., replacement of wood poles with ductile iron as poles located in HFRZs that are damaged, replaced as part of non-wildfire projects, or reach end-of-life). In future iterations of PGE's Wildfire Risk Mitigation Assessment methodology, risk to PGE equipment will also be considered, as PGE adds the capability to assess which items of equipment are most likely to be damaged if a fire occurs in a given area. PGE is developing the tools required to factor information of this granularity into its Wildfire Risk Mitigation Assessment process.

[1] Studies included in PGE's Wildfire Risk Mitigation Assessment include Climate Change Increases Risk of Extreme Rainfall Following Wildfire in the Western United States (Touma, Stevenson et al 2022); Changing Wildfire, Changing Forests: the Effects of Climate Change on Fire Regimes and Vegetation in the Pacific Northwest, USA (Halofsky, Peterson and Harvey, 2020); Impacts of Climate Change on Fire Regimes and Carbon Stocks of the U.S. Pacific Northwest (Rogers et al 2011).

6.3.5 Georisk

In addition to the risk categories above, PGE models geographic wildfire risk (georisk). Georisk represents wildfire risk due to vegetation encroachment on the conductor, and/or animal contact impacting the components of the structure. Georisk is distinct from asset risk, which is defined as risk due to failed equipment. This information has been integrated into PGE's Strategic Asset Management Structures Model (Structures Model), a component of PGE's Wildfire Risk Mitigation Assessment methodology that allows PGE to evaluate wildfire risk at a more precise level.

PGE inputs asset and georisk data in to the Pyrologix[2] fire physics engine to create simulated probabilistic models that assess fire risk by location, for both long-term planning and real-time decision support. As discussed in Section 6.2, PGE continues to refine variables in coordination with external agencies. This collaboration has led PGE to add new variables for consideration in its ongoing risk analysis processes. These variables include remote sensing both LiDAR and high-definition imagery, wildfire spread distributions and situational awareness variables.

The following table details the data sources for the various inputs PGE uses to assess georisk, as well as the proposed cadence of updates to these data sources.

[2] Pyrologix is a Missoula-based wildfire threat assessment research firm that provides utility wildfire risk assessment, hazard and risk assessment, stochastic wildfire simulation, fuel treatment prioritization, fuel inventory and management, and exposure analysis modeling and analysis services.

Table 1: Georisk Modeling Data Sources and Cadence of Updates

Data Sources	Inputs	Cadence of Updates
Wildfire Modeling	Fire Propagation and Fire Behavior	Annual review • Affirm/update Subject Matter Expert (SME) assumptions/updated failure data • Landfire (geospatial layering program) calibration through Pyrologix proprietary adjustments • Flame Height • Energy Release Component (ERC) (real-time through 72 hours out) • Fuel Moisture (measured at 1hr/10hr/100hr) (real time through 72 hours out) • Live Fuel Moisture Hourly/real time • Fire Response Time • Flame Intensity • Detection Probability
	Elevation Data	Annual/semi-annual review • Affirm/update SME assumptions/updated failure data • National Survey Data • USGS • LiDAR
	Meteorological Data	Annual/semi-annual review • National weather data • PGE weather stations (Real Time)
	Burn Probability	Annual review • Affirm/Update SME assumptions/updated failure data • Landfire calibration through Pyrologix proprietary adjustments

6.4 Risk Assessment Methodologies: Data Quality & Review Frequency

PGE Wildfire Risk Mitigation Assessment methodologies include multiple statistical models that use a variety of data sources to identify the areas of highest wildfire risk within PGE's service territory. PGE's methodology is consistent with the ISO-31000 Monitoring & Review structure, which provides internal controls to enhance confidence while still considering the dynamic nature of risk.

PGE's quality assurance and quality control (QA/QC) process for finalized Asset Risk models identifies the cadence of updates and required review tasks. Required QA/QC tasks include review and affirmation of existing or updated data, subject matter expert (SME) assumptions, review of mathematical formulas, and variance testing of updates to confirm that updates are reasonable.

The following table describes the cadence of updates for the inputs used in PGE's annual wildfire risk assessment process:

Table 2: Update Cadence for Key Modeling Inputs

Data Sources	Inputs	Cadence of Updates
Annual Probability of Asset Failure	Weibull failure curve parameters	Annual review • Affirm/update SME assumptions/updated failure data
	Health indexing	Annual review • Incorporate condition data (as available)
	Demographics from database	Periodic updates as data becomes available-GIS/Maximo
	GIS data for components on structures	Annual update to address reconfiguration/replacement
Annual Probability of Asset-Caused Ignition	Probability of equipment related outage is source of ignition	Annual review • Affirm/update SME assumptions
	Probability of equipment in violation of PGE patrol/inspection guidelines	Annual review • Incorporate inspection data (as available) • Incorporate updated SME assumptions
	Equipment multipliers	Annual review • Affirm/update SME assumptions
Ignition Data	Tracking PGE caused ignitions by failure mode/driver	Weekly review • Propagates into all wildfire risk processes

Data Sources	Inputs	Cadence of Updates
Intervention Costs	Capital cost estimates for wildfire mitigation	Annual review • Affirm/update SME assumptions
Consequence of Wildfire	The wildfire consequence model developed by Pyrologix identifies structures in burnable locations and estimates the expected consequence of a large fire (i.e., min 400 hectare) started at each location.	Periodic updates as required
Predictive Outage Model	Weather data & outages to understand outage correlation with storms/wind	Annual review Machine learning model will be continuously learning with annual updates

6.5 Wildfire Risk-Based Decision-Making

Climate change will continue to increase wildfire threats, requiring continual adaptation of asset management and other routine business practices. This challenging reality, combined with PGE's responsibility to maintain reliable electric service, requires a careful balance between often-competing interests and system requirements. As the complexity of this analysis increases with each passing year, PGE continues to be guided by the industry best practice of risk-informed decision-making (selecting mitigation projects based on estimated risk reduction value). As defined by Institute of Asset Management (IAM) criteria encompassed in International Organization for Standardization (ISO) 55000 standards, value is a function of lifecycle costs, performance and, ultimately, risk; Figure 4 illustrates this relationship.

Figure 4: The Value Equation

PGE factors in changing environmental conditions, impacts to the public and the environment, QA/QC on data quality, and new data sources to iterate and develop its wildfire risk mitigation strategy. PGE follows the ISO-31000 risk framework in evolving its Wildfire Risk Mitigation Assessment methodologies, and leverages both IAM and ISO concepts in value quantification to calculate Risk Spend Efficiency (RSE) across PGE's Program. This concept allows PGE to factor risk, lifecycle costs, and performance into a single process to provide guidance to understand and possibly estimate the effectiveness of mitigation measures. Lifecycle costs are represented in the equivalent annual cost (EAC) denominator.

Figure 5: The Risk Spend Efficiency Equation

Performance included in mitigation option, either consequence or relative probability

$$\text{RSE: } \frac{(\text{Risk of Problem} - \text{Risk after Mitigation})}{\text{EAC of Mitigation}}$$

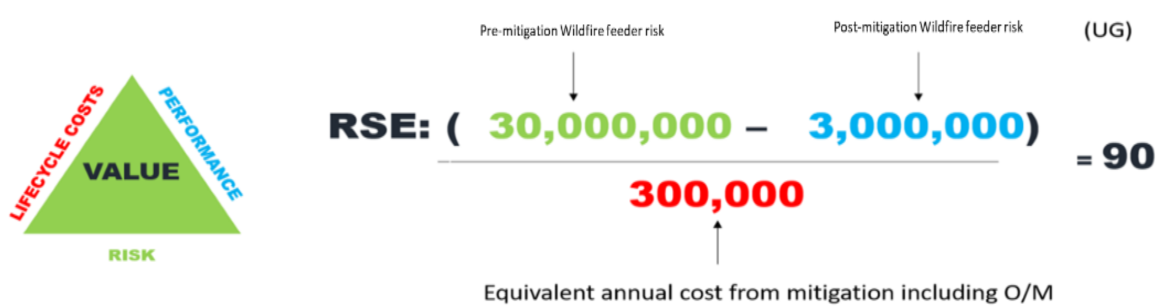
NOTE: RSE = Risk Spend Efficiency, **EAC**= Equivalent Annual Cost

PGE applies RSE concepts in assessing mitigation alternatives across a wide range of PGE programs, including PSPS, vegetation management, system hardening/capital investment, and operations. PGE is continually improving its RSE assessment approach for use in both long-term and real-time planning and analysis. The following example analyses illustrate how PGE uses RSE to inform the direction of its mitigation strategies.

The illustrative examples below show the mitigation alternatives assessment for a hypothetical feeder located within a PGE HFRZ, with specified wildfire risk characteristics (heat intensity, flame height, burn probability, detection probability, response time, egress limitations, etc.) not shown.

The assessments compare the RSE outcomes for one hypothetical mitigation measure (undergrounding) vs. another (reconductoring and installation of fire-safe fuses).

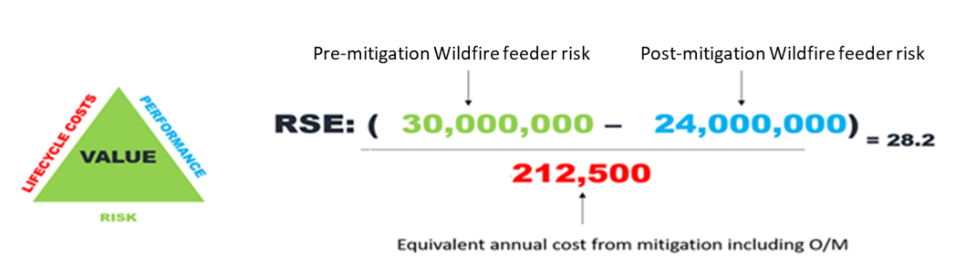
Figure 6: Illustrative Risk Spend Efficiency Assessment: Undergrounding



As this hypothetical example illustrates, in this case, undergrounding the line would yield an RSE coefficient of 90 (a 90:1 risk reduction per dollar of investment).

The following figure shows the RSE assessment for a second potential mitigation measure: reconductoring and installing fire-safe fuses.

Figure 7: Illustrative Risk Spend Efficiency Assessment: Reconductoring and Fire-Safe Fuses



In this hypothetical example, undergrounding the line (Example 1) would yield a higher RSE value—risk reduction per dollar of investment—than Example 2 (reconductoring the line and installing fire-safe fuses): an RSE value of 90:1 vs. 28:1.

RSEs directionally inform selection of wildfire mitigation options for inclusion in the mitigation strategies within the HFRZs. PGE's goal is to achieve the highest estimated risk reduction value per dollar invested. This RSE assessment approach is flexible enough to allow PGE to adjust the analytical variables to account for factors such as climate change, and to incorporate findings from its ODF, USFS, and local fire agency partnerships.

PGE uses data from internal as well as external benchmarking sources. For example, a statistical understanding of how failure modes and ignition drivers for covered conductor affect risk is critical to effectively evaluating the appropriate locations to install covered conductor. Through its participation in the International Wildfire Risk Mitigation Consortium (IWRMC), PGE has leveraged the experiences of industry peers to inform its fire detection probability analysis as well as decision-making around the most effective locations for use of covered wire.

The following sections provide detail about the ways in which PGE uses risk-based decision-making in specific areas of its Program:

6.5.1 Risk-Informed Decision Making for PSPS Events

PGE uses meteorological, outage data and predictive analytics to make risk-informed decisions regarding PSPS events, as well as curtailment decisions. Before and during Fire Season, PGE reviews regional NWS forecasts, fire activity briefings, fire potential forecasts, and data from PGE weather stations[3] strategically located throughout the service territory. PGE makes its weather station data publicly available via MesoWest, for anyone needing data to improve regional forecasting and the analysis of extreme weather events.

In 2023, PGE plans to improve its risk-informed decision-making through improved situational awareness capabilities. PGE plans to install 30 new remote automated weather stations (RAWS) and deploy its four mobile weather stations, as needed, within HFRZs. As RAWS are installed they will be incorporated into PGE situational awareness intake. Site selection for RAWS will take utility, meteorology, and stakeholder requirements into consideration to ensure optimal placement, as discussed in more detail in the Research and Development section of the WMP, in late 2022 PGE operationalized a prototype of a Storm Predictive Tool that will incorporate weather data from across PGE's service territory to better inform PGE's PSPS execution decision analysis. As additional RAWS come online, the data they record is intended to further refine the Predictive Outage model.

Please refer to Section 9.2, below, for addition detail regarding PGE's PSPS decision-making process.

6.5.2 Risk-Informed Decision Making and Mitigation Actions for Vegetation Management

PGE's vegetation management strategy includes both cyclical, routine inspections, and maintenance of the entire PGE distribution system. Additionally, PGE performs Advanced Wildfire Risk Reduction (AWRR) vegetation management activities in the HFRZs within PGE's service territory. Annual AWRR activities are guided by the designated boundaries of PGE's HFRZs, data from PGE's Remote Sensing Project (which uses LiDAR and hyperspectral imagery to monitor vegetation density and proximity to PGE assets), and annual vegetation surveys. AWRR crews follow program trim specifications, which include increased removal rates and enhanced vegetation control techniques, discussed in more detail in Section 11, Vegetation Management.

The evolution of PGE's Vegetation Management program also illustrates the influence of the Wildfire Risk Mitigation Assessment methodologies on PGE's wildfire-related investment decision-making. Originally dedicated to enhancing electrical reliability through compliance with OPUC safety and clearance requirements, PGE Vegetation Management has transitioned to a dual-track program, focused on increasing system reliability and decreasing the chance of infrastructure-caused ignitions.

[3] In 2022, PGE deployed 24 additional permanent weather stations and one temporary station to increase situational and conditional awareness and provide visibility within its HFRZs, bringing the number of permanent weather stations deployed within its service territory to 52.

Use of risk-based decision-making protocols has allowed PGE's Vegetation Management program to prioritize resources.

In much the same way, cross-organizational access to data from PGE's Remote Sensing Project data allows working groups across the company to plan and implement mitigation activities using a consistent set of data and analysis, with benefits shared across PGE workflows, including design and vegetation maintenance. PGE's GIS, Strategic Assessment Management, WM&R and Vegetation Management organizations all use LiDAR data, both independently and cooperatively, to benefit operational efficiency.

6.5.3 Risk-Informed Decision Making and Mitigation Actions for System Hardening

PGE continues to leverage its SAM Structures Model and Fire-Safe Construction Standard to harden the transmission and distribution (T&D) system within its HFRZs. PGE's system hardening activities are designed to accomplish three goals:

- Reduce the risk of potential wildfire ignition caused by PGE facilities through the use of ductile iron poles, fiberglass crossarms, covered wire, transformers, and conductor undergrounding
- Reduce the impacts of a wildfire on PGE's assets by installing system hardening technologies (fire mesh, ductile iron poles, fiberglass crossarms, conductor undergrounding)
- Protect utility infrastructure during potentially disruptive natural and human-caused disasters, strengthening PGE's ability to maintain and quickly restore reliable electrical service to support disaster relief and public safety.

In working towards these goals, PGE will deploy additional reliability and wildfire risk mitigation improvements within the HFRZs. PGE is guided by its annually updated Fire-Safe Construction Standard in executing equipment replacements in HFRZs. As specified in the Fire-Safe Construction Standard, the company will evaluate the following assets for replacement, installation, or implementation, when warranted:

- Avian-safe framing and phase covers
- Replacement of wood structures with nonflammable structures (e.g.: ductile iron poles, fiberglass crossarms)
- Polymer cutouts and cutout covers
- Aging conductors in HFRZs
- Tree wire, an insulated overhead conductor designed to reduce service interruptions, which also reduces the potential for the conductor to become an ignition source
- Overhead to underground conversions on specific feeders with key wildfire response variables including fire response/detection probability and egress
- Fuse replacement with fire-safe fuses and/or ELF (non-expulsion) fuses to eliminate a potential ignition source
- Reclosers and switching devices to increase operational flexibility and minimize customer impacts through the application of wildfire operational settings

6.5.4 Risk-Informed Decision Making and Mitigation Actions for Capital Investments

PGE uses the SAM Structural Model and the RSE methodology discussed in Section 6.5, Wildfire Risk-Based Decision-Making, in assessing project alternatives and prioritization of wildfire risk mitigation investments. Based on the outcomes of this analysis, PGE's multi-year wildfire capital investment strategy ranks system hardening and situational awareness projects as the highest-value risk mitigation per dollar of investment to inform prioritization of PGE's capital budget. Please refer to Section 12, Wildfire Program Costs, for detailed information regarding year-to-year actual and planned WM&R O&M and capital expenditures.

For example, undergrounding and reconductoring feeders and distribution lines is one of the most effective ways to shield PGE equipment from vegetation and animal contacts that could lead to wildfire ignition. Table 3, below, shows the planned undergrounding and reconductoring investments currently included in PGE's 2023 wildfire capital investment strategy.

PGE is revising its 2023–2026 wildfire capital investment strategy, which distributes planned capital spending among multiple asset and mitigation classes in alignment with the Wildfire Risk Mitigation Assessment of wildfire risk change over time. The goal of this effort is to create an optimized multi-year investment framework to implement separate but interrelated mitigation strategies, based on a risk profile that incorporates a broad spectrum of wildfire risk drivers.

PGE is consistently evaluating its long-term investment strategy in response to R&D findings, risk modeling and industry experience, and will continue to optimize its investment strategy for wildfire risk mitigation based on the best available information and analysis. Tables 3 and 4, below, reflect PGE's best estimates of planned investments and timelines at the time this document was submitted; however, PGE recognizes that factors outside of the company's control or to customer advantage may require adjustments to this schedule of activities. Planned line-miles per year are targets or estimates, which may be adjusted based on a wide variety of factors aimed to reduce wildfire risk and increase system resiliency.

PGE's portfolio of planned capital investment projects offers co-benefits in addition to their wildfire mitigation value; for example, many of the PGE feeders with the highest Customers Experiencing Multiple Interruptions (CEMI) values[4] (feeders that experience multiple outages per year) are designated for hardening under this strategy. By aligning its strategy to prioritize both wildfire mitigation and CEMI, PGE is investing in outcomes that offer regional benefit beyond wildfire hardening. System hardening projects on Tribal lands, and within culturally or environmentally sensitive areas, provide the co-benefits of improved cultural resource and environmental protection.

Ultimately, upon successful completion of the measures referenced above, these system hardening investments will reduce PGE's wildfire risk while shrinking the geographic boundaries of three existing PGE HFRZs—as line-miles of PGE infrastructure are hardened over the next several years, PGE will no longer need to de-energize those circuits to prevent potential ignitions during PSPS events. PGE plans

[4] CEMI is an industry-standard metric of system reliability

to estimate these risk reduction values with a combination of volumetric mileage in a mitigated state as well as number of customer meters impacted by PSPS events.

PGE will also estimate non-wildfire-related resiliency benefits from these investments—for example, increased protection from wind/ice storm damage—using traditional asset management expected risk and net economic benefit ratios. The following tables show PGE's planned undergrounding/reconductoring projects and situational awareness/programmatic investments, by region, for 2023:

Table 3: Planned Wildfire Undergrounding/Reconductoring Investments (in Line-Miles), 2023

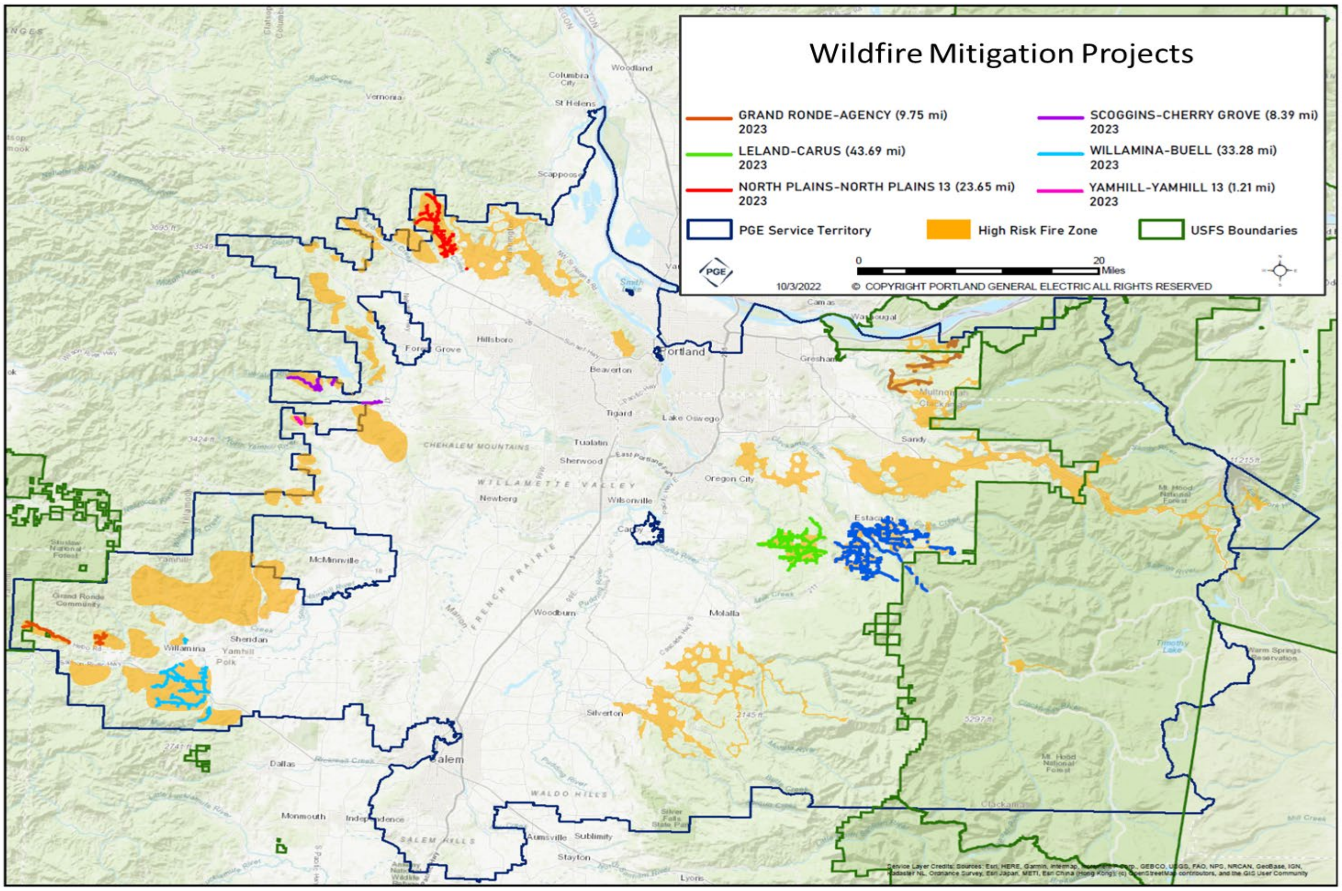
UG/RECON	2023
Grande Ronde-Agency (UG)	9.75
Scoggins-Cherry Grove (UG)	8.39
Yamhill-Yamhill 13 (UG)	0.6
North Plains (RC)	8.0
Leland-Carus (RC)	14.56
Willamina-Buell (UG)	11.09
TOTAL	**44.39**

Table 4: Planned Situational Awareness/Programmatic Investments, 2023

Programmatic	2023
AI-Equipped UHD Cameras	6
Weather Stations	30
Reclosers	50
Fire-Safe Fuses	600
Early Fault Detection (EFD)[5]	1 feeder

[5] Early Fault Detection is a technology that uses sensors to detect anomalies on the feeder in real time, allowing PGE to intervene (replace or repair) the affected component(s) prior to a failure that could cause an ignition.

Figure 8: Planned PGE Wildfire Mitigation Investments 2023



6.5.5 Risk-Informed Decision-Making and Mitigation Actions for Operations

PGE relies on a wide variety of weather and fuel models, as well as human analysis, to obtain the granularity of information required to accurately forecast and model hazardous fire weather conditions. The goal is to use these models to forecast potential hazardous fire weather conditions 7-10 days in advance. These models can provide decision-makers with a detailed understanding of the uncertainties and range of outcomes possible for a given weather pattern. Operational procedures within the HFRZs during the Fire Season are discussed in further detail in Section 8.2, System Operations During Fire Season.

In 2023, PGE will conduct further model testing and validation to assess the Storm Predictive Tool's ability to incorporate more granular and sophisticated inputs to better inform PGE's PSPS execution decision analysis and improve system alarming. For additional details regarding the Storm Predictive Tool, please refer to Section 15.4, below.

This tool should improve PGE's ability to predict potential equipment outages based on forecasted and real-time meteorological data. Once integrated with other PGE capabilities, the Storm Predictive Tool is intended to offer co-benefits to PGE's Utility Asset Management program, including increased spare equipment ordering efficiency, as well as improved spare equipment mobilization and operational standards and practices.

6.5.6 Risk-Informed Decision Making for Prioritized Opportunistic Interventions

Generally, when repairs are needed on an asset and the cost of the repair is higher than the value of the asset, the asset will be evaluated for replacement. Once crews are mobilized, there may also be reliability and economic benefits to proactive asset replacement, particularly within HFRZs. Whenever possible, PGE assesses the cost/benefit of proactive asset replacement during planned improvement/maintenance activities on other nearby assets. This approach helps PGE maintain reliable electric service and increase cost efficiency.

PGE prioritizes capital investments and maintenance activities that provide highest benefits to the system including reduced outage duration, improved asset survival and other impacts to infrastructure beyond wildfire mitigation. This multi-dimensional view allows PGE to achieve the best value risk reduction per dollar of investment.

7. High Fire Risk Zones (HFRZs)

PGE has identified areas of its service territory where vegetation, terrain, meteorology, population density and the wildland-urban interface (WUI) increase the risks associated with utility-caused wildfire ignition. For the purposes of this WMP, PGE refers to these areas as High Fire Risk Zones (HFRZs). PGE may choose to implement a proactive PSPS within a given HFRZ during periods of extreme weather wildfire threat. For 2023, PGE has identified the same 10 HFRZs as in 2022, with minor refinements, modifying the geographic boundaries of some zones and adding a total of 355 distribution poles and 57 transmission structures to the areas potentially impacted by PSPS events (see Figure 10 below for details):

HFRZ 1: Mt. Hood Corridor/Foothills
HFRZ 2: Columbia River Gorge
HFRZ 3: Oregon City
HFRZ 4: Estacada
HFRZ 5: Scott's Mills
HFRZ 6: Portland West Hills
HFRZ 7: Tualatin Mountains
HFRZ 8: North West Hills
HFRZ 9: Central West Hills
HFRZ 10: Southern West Hills

PGE relied on the ISO-31000 wildfire risk analysis framework for the 2023 HFRZ Assessment. For this assessment PGE incorporated new variables and refined boundary conditions to improve its understanding of:

- Wildfire risk
- Location based wildfire intensity and behavior
- Climate change impact projections
- Fire behavior and consequences

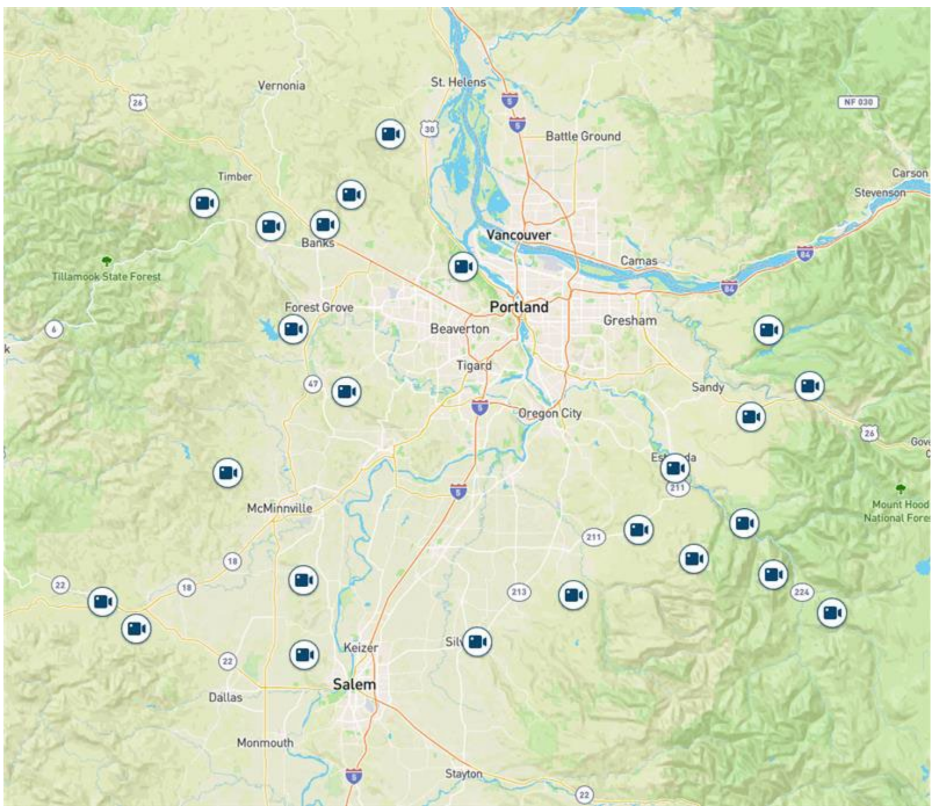
PGE's Wildfire Risk Assessment factors in the likelihood that a given PGE asset could become an ignition source, as well as the likelihood that such an ignition could spread into a large, uncontrolled fire. Additional analytical factors include vegetation density, fuels dryness, the potential for extreme weather conditions, probability of mechanical control, fire response time, detection probability and the presence of structures and other infrastructure.

In conducting the risk assessment, PGE ran thousands of scenarios in a Monte Carlo simulation to identify the areas of the PGE service territory where the risks associated with a utility-caused ignition are highest. The results of this modeling provided the basis for PGE's 2023 HFRZ analysis.

7.1 Enhanced Monitoring and Technology in HFRZs

In a partnership with the Electric Power Research Institute (EPRI), PGE installed a network of connected, intelligent fire detection cameras equipped with artificial intelligence (AI) within its HFRZs. These ultra-high-definition camera systems give PGE a 360-degree fire detection triangulation capability across its service territory, accurate to within +/- 100 yards. The Pano AI platform's machine learning algorithms automate fire detection, awareness, and notifications, helping PGE expand and improve regional fire detection resources. Under its 2023 Wildfire Capital Investment Strategy, PGE is planning to install six additional AI-equipped UHD cameras within the HFRZs (refer to Figure 9 for details regarding camera locations). For additional details on PGE's Wildfire Capital Investment Strategy, please refer to Section 12, Wildfire Program Costs.

Figure 9: 2023 PGE Pano AI Camera Locations



These camera systems are part of a larger situational awareness strategy in which PGE coordinates with federal, state, Tribal, and local fire agencies, fire management officers, and district foresters, as well as private landowners. In 2023, PGE will continue to seek ways to share access to this information with its Public Safety Partners, 30 of which currently have access to the camera network and notifications:

- Canby Fire District
- Forest Grove Fire & Rescue
- Gresham Fire & Emergency Services
- Lake Oswego Fire Department
- City of Portland Fire & Rescue
- City of Portland Water Bureau
- Clackamas Fire District #1
- Clackamas County Fire Defense Board
- The Confederated Tribes of Grande Ronde Emergency Services
- Estacada Rural Fire Protection District
- Gaston Fire District
- Hillsboro Fire & Rescue
- Hoodland Fire District
- Life Flight Network
- Marion County Fire Defense Board
- Marion Area Multi Agency Emergency Telecommunications (METCOM)
- Mt. Angel Fire District
- Multnomah County Fire Defense Board
- Oregon Department of Forestry
- Oregon State Police
- Polk County Fire Defense Board
- Sandy Fire District
- State of Oregon
- T-Mobile
- Tualatin Valley Fire & Rescue
- USFS – Mt. Hood District
- Washington County Fire Defense Board
- Washington County Consolidated Communications Agency (WCCCA)
- Yamhill County Fire Defense Board
- Yamhill Communications Agency (YCOM)

To illustrate the potential value of this technology, at 1525 on July 14, PGE's Bald Peak Pano AI camera notified users that it had detected smoke in a rural area in the western part of PGE's service territory. At 1625, PGE's High Compromise camera issued a second "detected smoke" notification and triangulated the smoke's location 6.8 miles away. The Pano AI system's initial detection and notification was 104 minutes before the regional fire reporting service issued a potential wildland fire alert, and 140 minutes before emergency services personnel were dispatched to the fire. ODF and other federal, Tribal, state, and local fire departments as well as land management agencies have provided feedback that the early detection information and triangulation accuracy obtained through PGE's Pano AI camera network is making a difference in crew deployment optimization and initial attack speed.

The following figures show PGE's 2023 HFRZs, and changes in HFRZ boundaries from 2022 to 2023.

Figure 10: PGE HFRZs 2023 vs. 2022

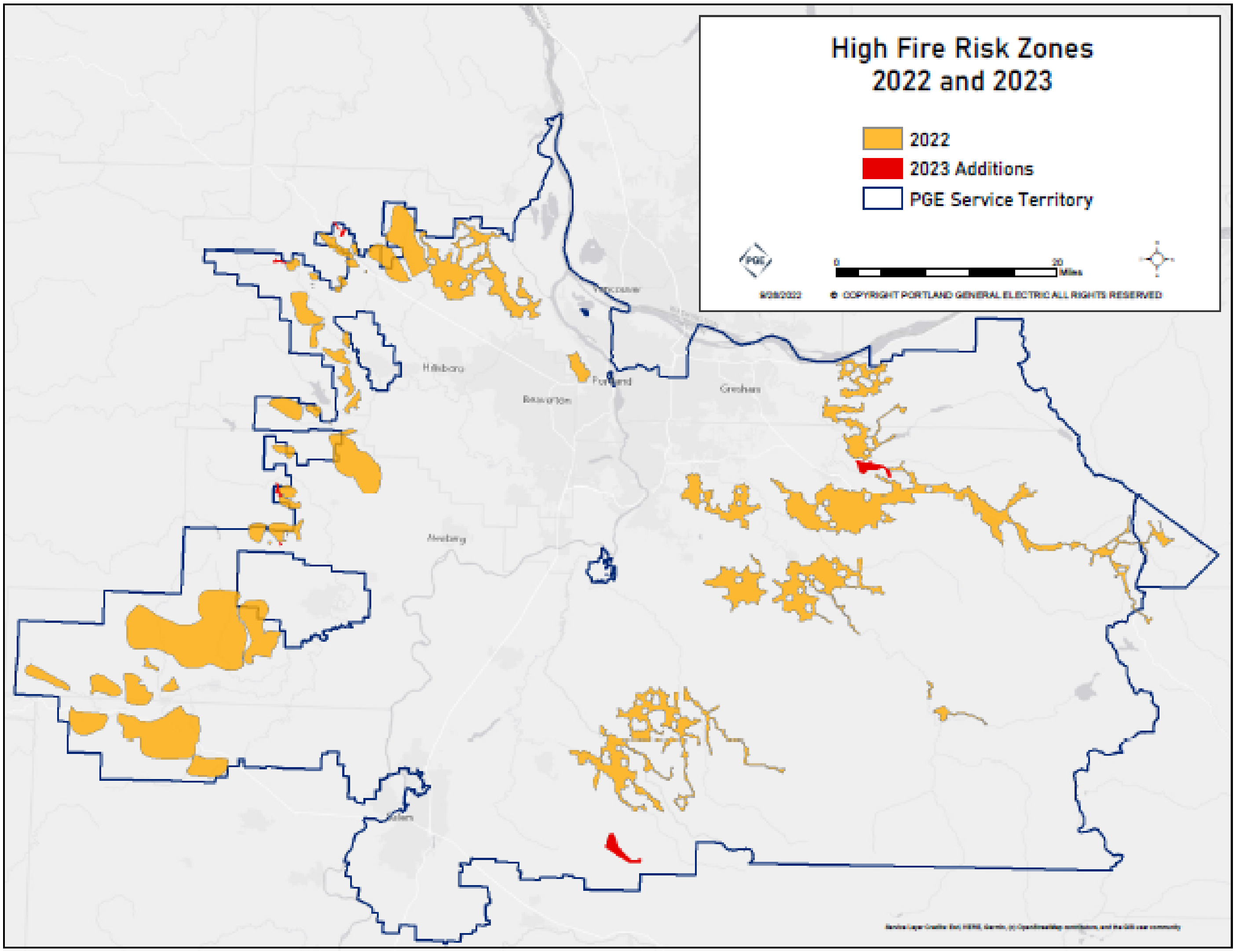


Figure 11: 2023 PGE HFRZs

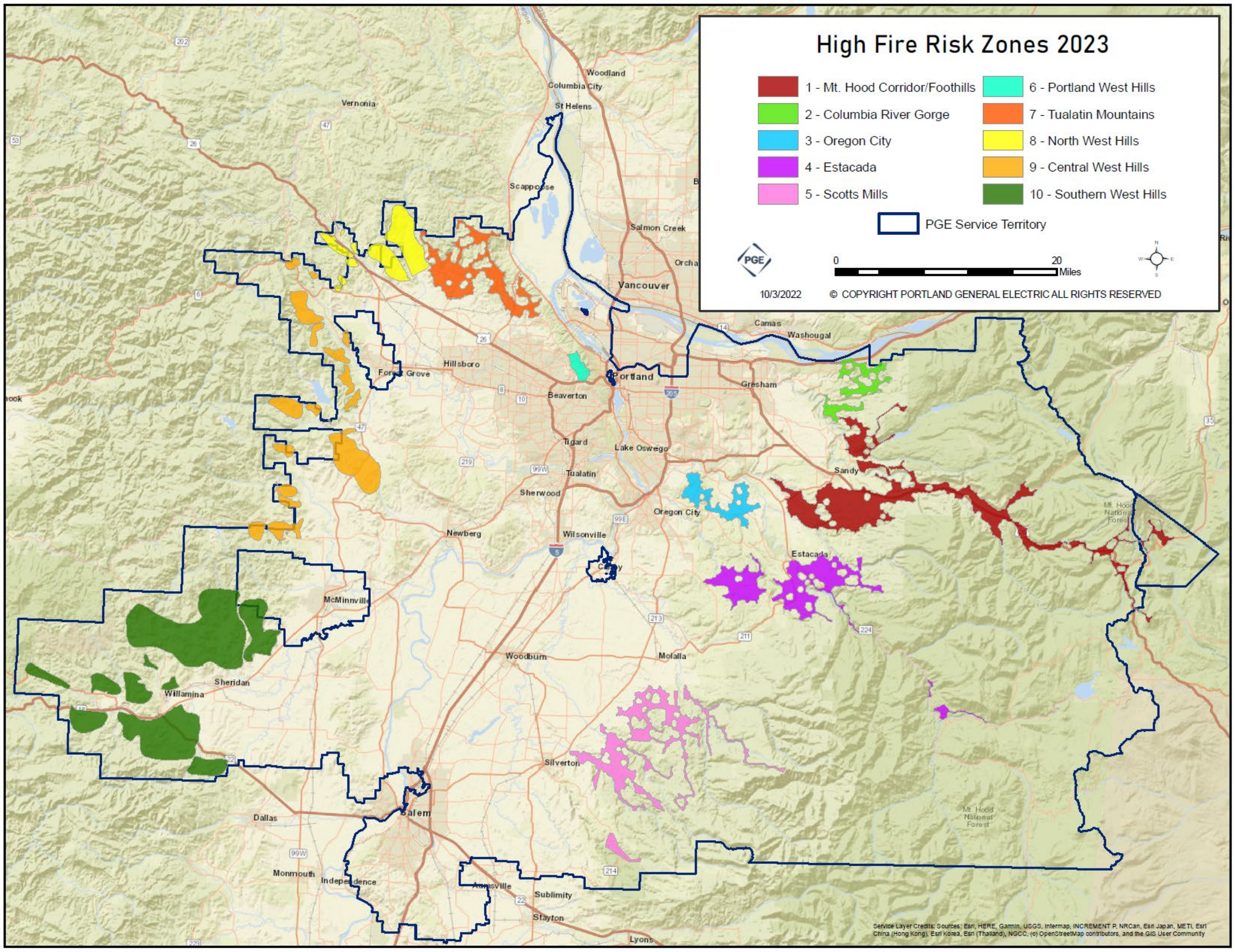


Table 5: Changes in Distribution Line-Miles Within PGE's HFRZs, 2022 vs 2023

	DISTRIBUTION LINE MILES		T&D POLES		CUSTOMERS (METERS)	
HFRZ	2022	2023 (NET CHANGE)	2022	2023 (NET CHANGE)	2022	2023 (NET CHANGE)
Zone 1	244.8	249.7 (+4.9)	7,780	7,930 (+110)	9,464	9.513 (+49)
Zone 2	24.7	24.7 (0.0)	710	710 (0)	456	456 (0)
Zone 3	47.4	47.4 (0.0)	1,268	1,268 (0)	1,743	1,743 (0)
Zone 4	138.5	138.5 (0.0)	3,727	3,726 (-1)	2,655	2,652 (-3)
Zone 5	142.7	150.7 (+8.0)	3,274	3,442 (+168)	1,927	2,000 (+73)
Zone 6	15.0	15.0 (0.0)	702	702 (0)	961	960 (-1)
Zone 7	91.6	91.6 (0.0)	2,182	2,182 (0)	1,525	1,524 (-1)
Zone 8	41.4	43.1 (+1.7)	1,025	1,068 (+43)	731	762 (+31)
Zone 9	75.4	78.4 (+3.0)	1,742	1,820 (+78)	1,005	1,049 (+44)
Zone 10	134.9	133.9 (-1.0)	3,091	3,085 (-6)	1,711	1,710 (-1)

8. Operating Protocols

8.1 Fire Season

PGE declares its own Fire Season based on a variety of factors, such as current and forecasted weather, drought status/timing and intensity, fuel availability and flammability, agency posture, and regional fire activity. PGE bases its decisions on data and information from multiple sources and considers State and Tribal Fire Season declarations within its service territory. The annual Fire Season declaration initiates a series of PGE operational changes.

PGE's Fire Season declaration:

- Changes how the company operates the PGE system, initiating fire-season-specific settings within parts of the grid, including disabling reclosing/testing capabilities, where applicable
- Initiates Fire Season operational work practices in the field
- Activates internal 24x7 Wildfire Threat Alert Notifications (Threat Alerts). Threat Alerts are a GIS-triggered, near-real-time analytical tool that alerts PGE when:
    - Any fire incident has been confirmed by the Integrated Reporting of Wildland-Fire Information (IRWIN) service within one mile of a PGE facility in the last hour (five miles for PGE Parks)
    - A Red Flag Warning has been issued covering an area within one mile of a PGE facility within the last 24 hours (five miles for PGE Parks), and
    - A confirmed fire perimeter is updated by the National Interagency Fire Center (NIFC) within one mile of a PGE facility in the last hour (five miles for PGE Parks) in the event of an expanding wildfire.

8.2 System Operations During Fire Season

Once it declares the start of Fire Season, PGE implements operational changes to reduce the risk that PGE infrastructure and operations could become ignition sources. For non-Supervisory Control and Data Acquisition (SCADA) distribution reclosing devices in PGE's HFRZs, these system changes include manually blocking the automatic test-energization of circuits following temporary faults, such as momentary tree branch contacts and lightning strikes with no damage. SCADA distribution reclosing devices are operated as shown in Table 6. Prior to re-energizing, PGE will patrol the downstream circuit to verify that the cause of the fault has been cleared.

PGE may also change settings outside of Fire Season, when the risk of wildfire danger is elevated, or when a Red Flag Warning is in effect. In these instances, PGE will proactively block automatic reclosing on SCADA-controlled devices within PGE's HFRZs.

PGE annually reviews and updates settings for protection and control devices located within PGE HFRZs. In 2023, PGE will continue to implement circuit breaker and recloser protection to minimize fault energy and reduce the risk of utility-caused ignitions during Fire Season.

Additionally, the distribution feeder breakers servicing PGE's HFRZs (those equipped with relays and SCADA) can be set one of three modes: Normal, Fire Season, or Red Flag. Those 13 kV feeders that do not have relays utilize the electronic reclosers' necessary protection settings: Normal, Wildfire, and Red Flag mode.

The tables below show the distribution system operations inside and outside of Fire Season that provide the necessary protection settings for Normal, Fire Season, and Red Flag modes.

Table 6: Distribution System Operations In and Out of Fire Season

Mode	Description	Reason
Normal	The feeder breaker will have two attempts of reclosing (an automatic test energization of the circuit following a fault event) and instantaneous (relay trips instantly when a fault occurs, with no preprogrammed delay)	Maximize reliability
Fire Season	The feeder breaker or electronic recloser will have one attempt of reclosing and trip on definite time instantaneous (a programmed delay before the relay trips).	Minimize risk of ignition
Red Flag Warning (during Fire Season)	The feeder breaker or electronic recloser trips on definite time instantaneous and reclosing is blocked.	Minimize risk of ignition

NOTE: Transmission lines located east of the Cascades that traverse PGE's HFRZs do not have specialized wildfire protective modes. As a result, they are placed in the most conservative mode of operation during PGE's declared Fire Season. Transmission lines that are not equipped with SCADA-enabled reclosing will be blocked from reclosing throughout Fire Season. Transmission lines that are equipped with SCADA-enabled reclosing will remain in automatic mode when PGE declares Fire Season. If one of these lines relays and recloses, reclosing will be blocked via SCADA and the line will be patrolled.

Table 7: Pelton & Round Butte Transmission System Operations In and Out of Fire Season

Mode	Description	Reason
Normal	Two recloses at Pelton, one reclosure at Round Butte	Maximize reliability
Fire Season & Red Flag Warning	Reclosing is blocked—reclosers open and lock out without testing the circuit by auto-reclosing.	Minimize risk of ignition

8.3 Preparedness and Training

Prior to Fire Season, PGE provides annual wildfire training to keep employees who will be working in the field during Fire Season safe. This includes non-field personnel that may go into the field on an as-needed basis. Participants receive training, either through computer-based training or a hands-on curriculum covering the use of required fire suppression tools and equipment during field deployments. Contractors who perform work in the field on behalf of PGE must also satisfy this training requirement and carry fire suppression tools and equipment. Training topics for 2023 focus on employee and contractor safety and include (but are not limited to):

- How fuels, weather, and topography impact the ignition and spread of wildfires
- What a fire weather zone forecast is, and how to interpret key factors and validate them in the field
- The suppression tools and equipment PGE, and those acting on behalf of PGE, are required to carry
- Basic suppression tactics for low-intensity ground and surface fires, and
- How to identify lookouts, communications, escape routes, and safety zones (LCES), and how this critical life safety acronym applies to all PGE Fire Season operations.

8.4 Event Response & Management

PGE closely monitors active wildfires in or near its distribution service territory and generation asset areas in Oregon and Washington. As an incident expands in size and complexity, PGE will contact the appropriate agency Incident Management Team (IMT) and may offer to embed PGE representatives at the incident command post. PGE representatives are delegated authority to make decisions that align with Corporate Incident Management Team (CIMT) and company leadership direction on PGE's behalf. The goal of this strategy is to enhance interoperability, share information, and promote collaboration with utility peers, Public Safety Partners, and state, Tribal, and local emergency managers to achieve shared objectives to serve the community and affected customers.

During a PSPS event, PGE's CIMT will follow established procedures and protocols to manage the event—see Section 9, Operations During PSPS Events, for more details. Under certain circumstances, the CIMT may execute additional de-energizations known as Preventative Outage Areas (POAs)to protect against risk of ignition or to protect life and safety. POAs are executed as needed based upon critical circumstances such as emerging meteorological events, system topology conditions, and/or interactions with PGE's Public Safety Partners during PSPS events. POAs are outside of PGE-defined PSPS Areas and do not receive pre-fire season communications. CRCs will also not be deployed for POA events.

POAs are executed under PGE's protocols for emergent de-energizations, which can occur during and outside of Fire Season. PGE personnel on-site also have authority to de-energize portions of the distribution system without requesting permission from or notifying PGE management (for example: to de-energize a downed power line). In addition, first responders may request an emergent de-energization from PGE via 911.

PGE personnel on-site have the authority to de-energize that portion of the distribution system without requesting permission from or notifying PGE management (for example: to de-energize a downed power line). In addition, first responders may request an emergent de-energization from PGE via 911.

9. Operations During PSPS Events

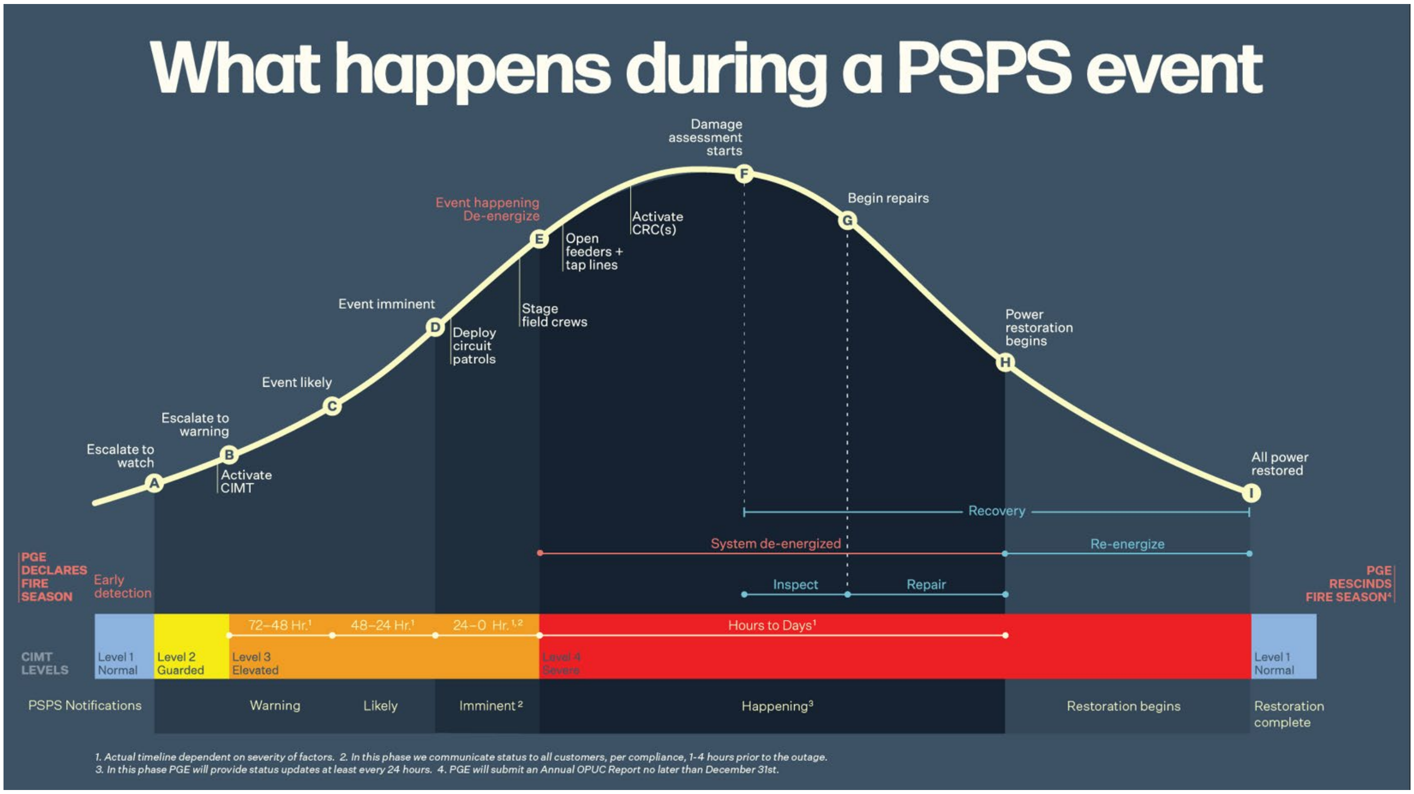
As discussed in Section 6.5.1, Risk-Based Decision-Making for PSPS Events, PGE uses meteorological and outage data and predictive analytics to decide whether to execute a PSPS event. This section provides a high-level overview of the escalating levels of a PSPS event, and the actions taken within each level. PGE maintains detailed, annually updated operational plans and protocols for PSPS events in internal documentation libraries.

The PSPS Process bell curve (Figure 12, below) correlates the various incident levels defined in internal PGE emergency operations plans to illustrate typical operations during the various phases of a PSPS event. It is intended to provide a point of reference only, as PGE may adjust operations during a PSPS event based on real-time conditions.

During an event, information including location, de-energization estimates, and estimated restoration times (ERTs) for each impacted PSPS Area can be found on PGE'S Wildfire Outages and PSPS webpage. PGE's website has the bandwidth capable of handling web traffic surges expected during PSPS events, and all web-based PSPS information will be easily readable and accessible on mobile devices.

During the 2023 Fire Season, PGE will provide multiple options to allow Public Safety Partners to access real-time GIS information pertaining to PSPS outages. These options include a link to PGE's public PSPS web layer service and an ArcGIS Online (AGOL) web map containing PSPS information as required by OAR 860-300-0060. Both the PSPS web layer service and AGOL web maps are updated simultaneously with the PSPS Area map found on PGE'S Wildfire Outages & PSPS page. PGE will continue to evaluate the customer experience with these tools and look for ways to improve that overall experience in the 2023 Fire Season.

Figure 12: PSPS Process Bell Curve

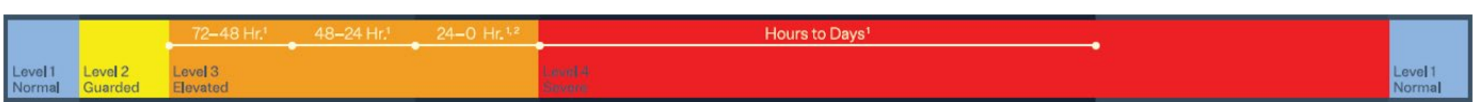


9.1 Protocols for De-Energization of Power Lines and Power System Operations During PSPS Events

As a last-resort safety measure to protect people, property, and public areas, PGE will proactively turn off power within one or more PSPS Areas when conditions threaten the ability to safely operate the grid. When PSPS events are declared, PGE takes steps to keep customers and stakeholders well-informed and strives to mitigate customer impacts by limiting the duration of the outage, as much as conditions allow.

9.2 Levels of a PSPS Event

If PGE makes the decision to execute a PSPS event, the order of operation generally follows the PSPS Process Bell Curve (Figure 12, above). PGE will adapt actual PSPS event operations as required to address evolving, dynamic, and unpredictable circumstances.



Level 1: Normal

Once Fire Season has been declared, under **Level 1: Normal** conditions, PGE closely monitors and communicates regional weather and wildfire situation/status to operational leadership. Through real-time situational awareness monitoring, PGE can tailor operational and system changes during Fire Season, thereby increasing safety and operational efficiency.

Year-round, PGE conducts a Daily (M-F) Operations Call. Should weather or other related events warrant communications outside the normal schedule, PGE may decide to convene the Daily Operations Call on weekends or holidays. During Fire Season, this daily briefing includes, but is not limited to:

- Fire weather forecasts and fire potential specific to PGE's service territory
- Reporting of National Weather Service (NWS)-issued Fire Weather Watches and/or Red Flag Warnings
- Summary of current regional fire activity

Additionally, PGE closely monitors changing or deteriorating conditions, regularly communicating critical updates to affected business units. To assist with this, PGE maintains working relationships with fire agencies, fire management officers, district foresters and dispatch centers at the federal, state, Tribal and local levels, including the Portland office of the NWS. These partnerships provide PGE with specific, granular situational awareness, assistance with forecast modeling validation, fire suppression resource pre-positioning, and activity/growth updates for fires in proximity to PGE assets.

Level 2: Guarded

If PGE determines that current or predicted fire risk conditions warrant an escalation in planning and coordination, PGE shifts from **Level 1: Normal** to **Level 2: Guarded**, which represents a PSPS Watch posture. When this occurs, PGE will activate the PSPS Assessment Team (PAT) to monitor conditions and prepare the company to initiate the next phase of PSPS plans and procedures, if necessary. PGE also issues a preliminary notification to internal stakeholders and ESF-12 OPUC Safety Staff that PGE has moved to **Level 2: Guarded** status. Following the decision to issue a **Level 2: Guarded** notification, PGE will place the company's full CIMT on standby and build out its duty roster.

Level 3: Elevated

PGE's decision to escalate from **Level 2: Guarded** to **Level 3: Elevated** status is predicated on conditions on the ground, pace of onset of weather conditions and risk tolerance at the time. Once the decision is made to proceed to **Level 3: Elevated**, PGE will fully activate the CIMT.

Level 3: Elevated is divided into three sequential, time-boxed phases, each representing an escalated state of readiness. To the extent practicable, PGE will adhere to the following notification timeline in advance of a PSPS event:

- **PSPS Warning**: 72-48 hours prior to de-energization
- **PSPS Likely**: 48-24 hours prior to de-energization
- **PSPS Imminent**: 4-1 hours prior to de-energization

Preparation for De-Energization

During the **Level 3: Elevated** phase of the potential PSPS event, PGE closely monitors fire potential indicators, situation, and status. The CIMT develops Incident Action Plans (IAPs) for each operational period (or as directed by the CIMT's IC), including situation-specific tactics and detailed instructions for field and support personnel—for example, pre-positioning of Pre-PSPS Circuit Patrol personnel and Community Resource Centers (CRCs) in applicable PSPS Areas. Immediately prior to de-energization, PGE resources in the field move into their "Get Set" positions or designated staging areas until execution of de-energization begins.

PGE will continue to monitor fire weather conditions throughout the **Level 3: Elevated** phase. When threshold conditions indicate that a PSPS is imminent and the CIMT's Situational Unit and IC have determined that escalating to **Level 4: Severe** (Event Happening stage) is appropriate, they will request de-energization approval for the appropriate PSPS areas(s) from the Officer-In-Charge (OIC).

Level 4: Severe: (Event Happening)

Transitioning from **Level 3: Elevated** to **Level 4: Severe**, is triggered by the decision to de-energize the PSPS Area(s). Immediately thereafter, field resources are given the "Go" signal to open feeder and tap line breakers and activate CRCs. PGE will communicate the start of the de-energization, as indicated in Table 8, below.

Community Resource Centers (CRCs)

During PSPS events, PGE may establish CRCs in selected areas to provide critical restoration information, including updates and real-time information, to customers impacted by the outage(s). The CRCs also provide customers with electronic and/or medical device charging, internet access, and clean water and ice, to offset some of the impacts associated with PSPS de-energization.

PGE has identified multiple potential locations for CRCs within or near each PSPS Area, to provide the flexibility to select the location that best suits customers' needs based on event specifics. PGE may or may not activate CRCs at all pre-designated locations during a particular PSPS event—depending on the nature of the event, some CRC locations may not be needed, or it may also be possible to serve multiple PSPS-impacted areas from a common CRC location. Pre-identifying multiple CRC locations within each PSPS Area also gives PGE options if mandatory evacuations require the relocation of a CRC. PGE's goal is to locate CRCs as near as possible to the areas impacted by the de-energization, although specific circumstances may make this impractical.

PGE's decision-making process for the potential deployment of CRCs begins during the **Level 3: Elevated** PSPS Likely phase. At this phase, PGE selects the specific CRC location(s) and sets hours of operation. Whenever possible, PGE will work with community partners to make CRC resources available to impacted customers; in some instances (for example, when resources are being provided by a County, Red Cross, or other entity, when multiple PSPS Areas are served by a single CRC, or when safety concerns preclude PGE's ability to site a particular CRC), PGE may not establish a CRC in an impacted PSPS Area. PGE will notify Public Safety Partners and Adjacent Public Safety partners as soon as CRC location and activation schedules have been confirmed. PGE will make efforts to have CRCs operational within 24 hours of de-energization, and to keep these locations operational as long as they are of benefit to customers.

Figure 13: September 2022 PGE CRC Volunteers

9.3 Communications Requirements During PSPS Events

Beginning at the **Level 3: Elevated** phase, to the extent practicable, PGE will initiate a methodical sequence of pre-event PSPS notifications and subsequent updates, delivered in 24-hour intervals, that progress from each of the three **Level 3: Elevated** phases (Warning, Likely, Imminent) through the **Level 4: Severe** Restoration Complete phase. During a PSPS event, PGE will communicate with Public Safety Partners, operators of utility-identified Critical Facilities (including Communications facilities), customers, and other stakeholders at the intervals identified in Table 8. PGE will provide priority notifications to Public Safety Partners, Adjacent Public Safety Partners, and operators of utility-identified critical facilities beginning 72-48 hour prior to de-energization, if possible.

In addition, prior to and during PSPS events, PGE makes current PSPS status information, information including location, de-energization estimates, and estimated restoration times (ERTs) for each impacted PSPS area, available on www.portlandgeneral.com's wildfire and PSPS outage webpage. All PSPS information on portlandgeneral.com will be easily readable and accessible on mobile devices.

Table 8: PSPS Notification Cadence

Notification Cadence	Audience		
	Public Safety Partners, Adjacent Public Safety Partners, Stakeholders	Utility-identified critical facilities[1]	Customers
PSPS Warning 72-48 hours prior to de-energization	✓	✓	
PSPS Likely 48-24 hours prior to de-energization	✓	✓	✓
PSPS Imminent 4-1 hours prior to de-energization	✓	✓	✓
PSPS Happening At de-energization	✓	✓	✓
Restoration Begins	✓	✓	✓
Restoration Complete	✓	✓	✓
At a minimum, status updates at 24-hour intervals until service has been restored[2]	✓	✓	✓

Notes

[1] Including Communications facilities

[2] These notifications may be required any time after initial notifications during **Level 3: Elevated** through restoration, as dictated by the event

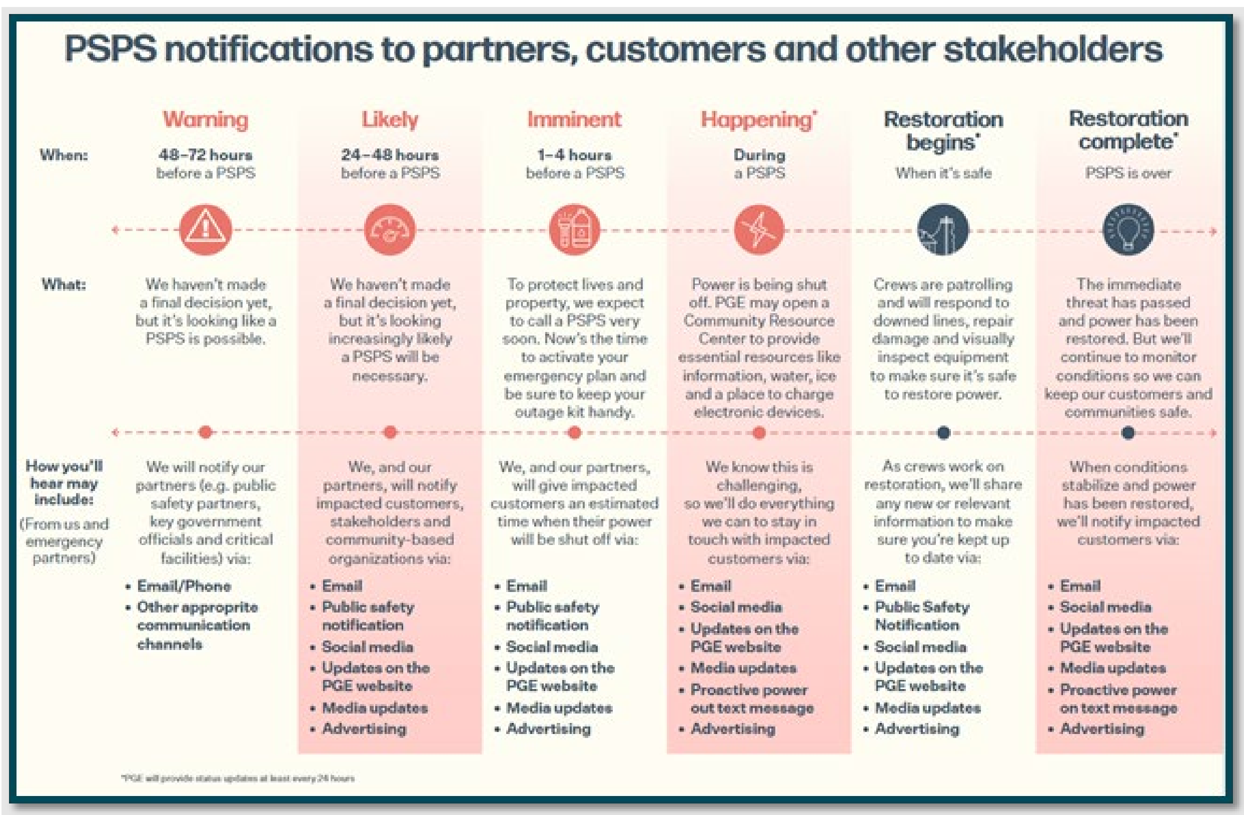
PGE will use multiple media channels, including owned, earned and sponsored channels, to inform impacted customers, communities and stakeholders throughout the PGE service area in accordance with OAR 860-300-0050, with special attention to those within the affected PSPS Area(s). PGE will deliver notifications in multiple formats across multiple channels that may include, but are not limited to, phone calls, text messages, prepared public safety notifications distributed through Public Safety Partners, social media posts, media advisories, emails, and messages to agencies that serve diverse community populations. For PSPS outreach to customers and stakeholders, PGE aims to address the geographic and cultural demographics of the PSPS Area, including languages spoken, access to broadband, and accessibility for those who are visually or hearing impaired, through the following strategies:

- All of PGE's PSPS-related written communications are provided in English and Spanish.
- PGE Customer Service offers a Language Hotline that can answer customer questions in 200 languages.

- PGE works closely with Public Safety Partners and the broadcast and print media to provide regular PSPS-related SMS (text) messages and news reports to help customers who may not have in-home broadband access stay informed throughout the PSPS event.
- All of the PSPS-related content on the portlandgeneral.com website is designed to be ADA-A-compliant[6]; for vision- or hearing-impaired customers, PGE provides both audible and written messaging options, as well as closed-captioning on all videos posted to the website.
- Throughout the event, PGE disseminates its PSPS-related messaging via as many platforms and formats as possible to facilitate the widest possible reach—text messaging, online content, traditional media, paid advertising, written materials and customer service in multiple languages, closed captioning—and works with community-based organizations and Public Safety Partners to reach as many impacted customers as possible.

PGE recognizes the criticality of effective communication to stakeholders before, during, and after a PSPS event; to the extent practicable, the following figure provides a visual summary of PGE's PSPS notifications process.

Figure 14: PSPS Notifications Strategy



Throughout the PSPS event, PGE will provide the elements of notification information required by OAR 860-300-0050 to Public Safety Partners, Adjacent Public Safety Partners, operators of Utility-

[6] Reference to Web Content Accessibility Guidelines: https://www.w3.org/WAI/WCAG21/quickref/

identified Critical Facilities (including communications facilities), and customers as summarized in Table 9.

Table 9: Notification Information

Notification Information	Audience		
	Public Safety Partners, Adjacent Public Safety Partners, Stakeholders	Utility-Identified Critical Facilities	Customers
Date and time PSPS will be executed	√	√	√
Estimated duration of PSPS	√	√	√
Notice of when re-energization efforts will begin and when re-energization is expected to be complete	√	√	
At a minimum, status updates at 24-hour intervals until service has been restored	√	√	√
Number of customers impacted by PSPS	√		
The PSPS zone, which would include Geographic Information System shapefile(s) depicting current boundaries of the area subject to de-energization	√	√	
When feasible, the Public Utility will support Local Emergency Management efforts to send out emergency alerts	√		
A statement of impending PSPS execution, including an explanation of what a PSPS is and the risks that the PSPS would be mitigating			√
A 24-hour means of contact customers may use to ask questions or seek information			√
How to access details about the PSPS via the Public Utility's website, including education and outreach materials disseminated in advance of the annual Wildfire Season			√

Note

[1] Specifically provided to Operators of Communications Facilities located within the area(s) of the anticipated PSPS.

10. Ignition Prevention Inspections

PGE conducts annual Ignition Prevention Inspections within its 10 HFRZs, as well as in areas subject to heightened wildfire risk within PGE's right-of-way for generation and transmission assets located outside of PGE's service territory. PGE inspects each supporting structure (pole or tower) within the HFRZs or area subject to heightened risk each year – approximately 26,000 structures in all, scattered across more than 1,000 line-miles located within PGE's service territory and over 100 line-miles located outside of PGE's service territory. The following table quantifies the number of assets inspected:

Table 10: PGE Structures Surveyed 2022

Location	Structure Count	Line Miles
PGE HFRZs 1-10	25,250	1,100
PGE Generation and Transmission Assets Outside Service Territory	750	100

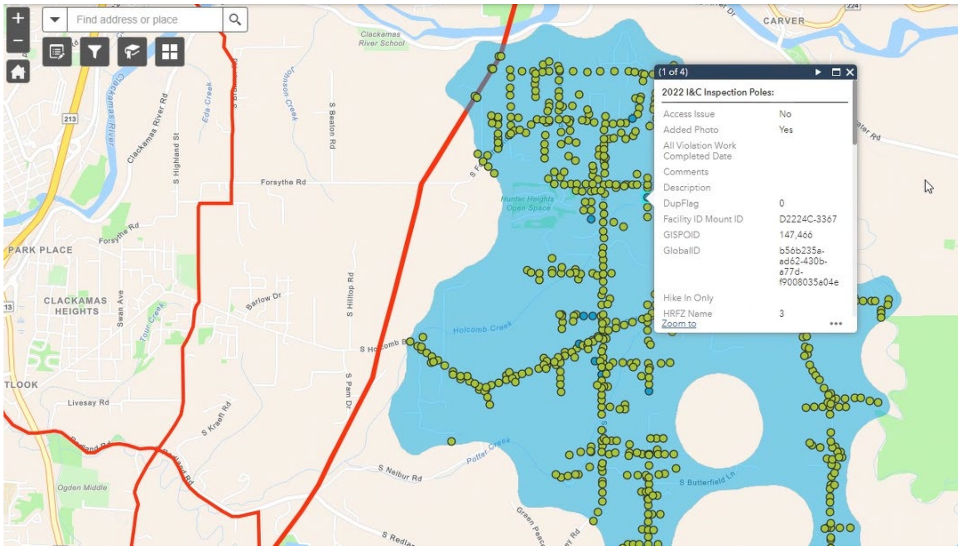
10.1 Ignition Prevention Inspection Procedures

PGE's Ignition Prevention Inspections are performed in-person. Under PGE's Inspect-Correct methodology, crews perform inspection tasks and complete most corrections during the initial visit to the structure, significantly reducing PGE's average correction times, and reducing customer impacts by eliminating the need for multiple site visits.

Within PGE's service territory, crews visually inspect distribution system support structures, lines, and equipment from the ground using binoculars or a spotting scope mounted on a tripod; physically measure vegetation and structural clearances; and sound each wooden supporting structure to detect internal damage or decay. The crew may drill the pole or capture more detailed measurements to assess the extent of damage or decay in more detail. Crews use a standard form (see Appendix 2) to consistently and repeatably record conditions during the field inspections and capture digital photos of each supporting structure using mobile GIS software.

Figure 15 illustrates the data displayed and tracked through PGE's mobile GIS structure tracking application:

Figure 15: PGE ARCGIS Online Structure Tracking Data



PGE also uses the Inspect-Correct methodology to annually inspect over 170 distribution poles located near its generation facilities in areas of heightened risk outside of the PGE service territory.

Ignition Prevention Inspections conducted outside of PGE's service territory primarily address conditions in the right-of-way (ROW) for PGE 230 kV or 500 kV transmission facilities. These inspections are performed by PGE Transmission Patrolmen with detailed knowledge of how these transmission facilities are constructed, operated, and maintained, including specialized knowledge of supporting structure bonding and grounding configurations. The PGE Transmission Patrolmen visually inspect the supporting structures, lines, and equipment from the ground using binoculars, and use drones to assess conditions in the overhead space. PGE Transmission Patrolmen also use a standard form to consistently and repeatably capture conditions during the inspections.

10.2 Ignition Prevention Inspection Standards

PGE's Ignition Prevention Inspection standards build upon several years of PGE experience in administering its Facility Inspection and Treatment to the National Electrical Safety Code (FITNES) Program, which satisfies OAR 860-024-0011 and OAR 860-024-0012. The FITNES Program inspects approximately 28,000 poles annually, or approximately 10 percent of PGE's system, for non-compliance with safety rules governing PGE's and pole occupant facilities.

PGE continues to refine its Ignition Prevention Inspection work practices through active participation in industry discussions and forums. In 2023, based on feedback received from OPUC Safety Staff, PGE will continue to include inspection standards relating to conductor attachments to trees.

PGE's Ignition Prevention Inspection standards direct inspection teams to identify conditions which, left unaddressed, could lead to vegetation or wildlife contact with energized conductors or equipment and, potentially, an ignition event. PGE's Ignition Prevention Inspection standards address the following inspection categories:

- Damaged/broken/missing/loose hardware and equipment

- Damaged conductor
- Conductor clearances
- Bonding
- Damaged/decayed poles
- Broken lashing wire
- Tree attachments
- Other potential sources of ignition

A full list of PGE's Ignition Prevention Inspection standards is found in Appendix 2. PGE will update these standards as required to reflect updated information or OPUC guidance.

PGE 's HFRZ Ignition Prevention Inspections may be combined with other safety or detailed inspections as required by OAR 860-024-0001(6). To avoid multiple inspections of the same pole each year, PGE's ignition prevention inspections may also incorporate the safety patrol standards described in OARs 860-024-0011(2)(c) and 860-024-0018(4). Depending on the facility to be inspected, PGE may also choose to accomplish both the FITNES inspection (OAR 860-024-0011(1)(b)) and ignition prevention inspection during the same site visit.

10.3 Ignition Prevention Inspection Program Oversight

PGE's Ignition Prevention Inspection Program management team oversees project management, administration, fieldwork, technical support, and management oversight and reporting.

Each year, prior to the start of the inspection season, the crews responsible for PGE's ignition prevention inspections undergo in-depth training covering the following major topic areas:

- Scope and locations of the inspections
- Inspect/Correct standards, including printed specifications showing which conditions to inspect for and correct, with diagrams and example photos
- Inspect/Correct procedures, including how to conduct the visual inspection, identify pole occupants, obtain measurements, and capture digital photos
- Inspection software, with hands-on training in use of the GIS software
- Required crew configuration, tools and equipment, and materials
- Communications protocols between PGE and the vendor conducting the inspections
- Protocols for communicating with customers prior to accessing private property
- Quality Assurance requirements
- Other requirements associated with vendor performance
- Wildfire awareness and suppression safety training

During the initial one to two weeks of the HFRZ ignition prevention inspection period, each inspection crew is accompanied by a PGE observer who verifies work performed, provides feedback, and answers questions. During the remainder of the inspection period, PGE performs weekly QA/QC of each crew's work. New crews added during the inspection season are required to complete the same training and initial PGE observer requirements.

Ignition Prevention Inspections conducted outside of PGE's service territory but within the ROW for its 230 kV and 500 kV transmission facilities are accomplished by PGE Transmission Patrolmen and directed through monthly coordination meetings. PGE Lead Working Foremen are responsible for QA/QC of each Transmission Patrolman's work.

The Ignition Prevention Inspections Program is monitored by the assigned PGE project manager, using a GIS dashboard that monitors each supporting structure located in an HFRZ or area of heightened risk. PGE monitors inspection results daily during the inspection season.

10.4 Ignition Prevention Inspection Timing

Annual HFRZ Notifications

Per OAR 860-024-0011(2)(b), PGE will notify all Owners and Operators of Facilities of any geographic changes to the HFRZ in which their facilities are located no later than 60 days before the start of the 2023 Ignition Prevention Inspections. The number and geographical boundaries of PGE HFRZs are reassessed annually and are subject to change as system hardening projects are completed and new information and analysis becomes available.

Timing of Annual Ignition Prevention Inspections

PGE's goal is to begin its annual ignition prevention inspections as early as possible during the calendar year and to complete the inspections no later than July 31, with the majority of inspections completed prior to PGE's declaration of the start of 2023 Fire Season. Accumulated snowfall at higher elevations within the HFRZs and areas of heightened wildfire risk may delay the inspection process in some areas by hindering physical access to supporting structures and obscuring defects on conductors or equipment.

HFRZ Inspect-Correct Timeframes

PGE categorizes HFRZ corrections and specifies their mitigation timeframes as follows:

- A condition that poses an imminent danger to life or property must be repaired, disconnected, or isolated by the operator immediately upon discovery
- A condition that correlates to a heightened risk of utility-caused ignition shall be corrected no later than 180 days after discovery unless an occupant receives notification under OAR 860-028-0120(6) that the violation must be corrected in less than 180 days to alleviate a significant safety risk to any operator's employees or a potential risk to the general public
- All other conditions requiring correction shall be corrected consistent with OAR 860-024-0012.

PGE recognizes that OAR 860-024-0018 sets forth several new duties for operators of electric facilities, including requirements to address conditions not associated with PGE facilities and conditions involving supporting structures to which PGE is attached but does not own. With respect to conditions associated with other pole occupants, PGE will comply with OAR 860-024-0018(8) – 860-024-0018(11) and utilize remediation tools afforded to Operators of electric facilities by the OPUC's High Fire Risk Zone Safety Standards.

10.5 Ignition Probability Values and Historic Ignition Tracking

In 2021, in response to new OPUC requirements, PGE created an ignition management tracking database and process. This allows PGE to evaluate the system hardening investments described in the Targeted Interventions to Reduce Wildfire Risk Section, below, in light of the risk drivers that deliver an optimized risk/spend efficiency calculation. For example, if analysis shows that georisk represents a feeder's only risk, but 99 percent of all the ignitions recorded at that site are caused by animal contact, then installing animal protection devices would likely be the appropriate risk mitigation outcome for that location.

As PGE collects risk assessment data and supplements it with lessons learned and industry best practices, it refines its ignition probability values database to create more accurate risk projections. These risk projections, based on quantifiable drivers, allow PGE to map risk velocity (risk forecasted through time) and link it to the various strategies described in Section 6.5, Wildfire Risk-Based Decision-Making, to drive highest-value risk mitigations.

10.6 Ignition Reporting Requirements

PGE tracks ignitions potentially caused by PGE equipment, as well as fires that impact PGE facilities. Relevant tracking and reporting include documentation of the initial observation and recording of ignition events in the field, as well as the specific geographic and ROW location of any impacted PGE equipment.

PGE conducts a review of any ignition events reported in the field, and documents relevant data for submission to the OPUC. In addition, PGE tracks and reports the progress of ignition event reports submitted to the OPUC and archives its OPUC ignition event reports for future compliance purposes. Historic ignition event data[7] is used to inform strategic asset management decisions, including system hardening measures, with a more granular understanding of risk. PGE plans to continue to build out this ignition tracking/reporting database as a key component of understanding ignition events by drivers.

[7] PGE has been tracking historic ignition event data since May 2021

11. Vegetation Management

PGE's vegetation management strategy has two major components: PGE's Routine Vegetation Management (RVM) program and the Advanced Wildfire Risk Reduction (AWRR) program. PGE will continue to implement a phased approach to implementation of its AWRR work within the HFRZs. One of the primary goals of PGE's Vegetation Management program is to annually inspect and mitigate identified trees within its HFRZs. PGE establishes internal targets for completion of various work scopes in line with the activities listed below.

11.1 Routine Vegetation Management (RVM) Inspection & Maintenance

Under its RVM program, PGE manages approximately 2.2 million trees within its ROW of 12,000 miles of overhead conductor. In recent years, PGE has expanded its vegetation management program to trim with increased clearances and remove more vegetation that is dead, dying, diseased, or displaying growth habits or defects that could impact overhead power lines. PGE performs cyclic patrols and trims vegetation to comply with OAR 860-024-0016 minimum conductor vegetation clearance standards. During routine maintenance inspections, PGE also patrols for and mitigates readily climbable vegetation.[8] PGE documents relevant tree trimming plans and makes them available to the OPUC upon request.

Under its RVM program, PGE inspects about one-third of its overhead distribution assets annually. Routine inspection timing may change as PGE evaluates the effectiveness of its vegetation management cycles to optimize effectiveness and efficiency. Across PGE's overhead system, routine vegetation management activities are ongoing year-round.

PGE inspectors evaluate all vegetation adjacent to PGE facilities, including PGE-owned communications facilities, for proximity, species, growth habits, strength, and overall tree health. When assessing trees along powerlines, PGE considers the following in its vegetation management prescriptions:

- Line voltage
- Location
- Line configuration
- Potential sag under various environmental conditions, and

[8] OAR 860-024-0016(1) "Readily climbable" means vegetation having both of the following characteristics: (a) Low limbs, accessible from the ground and sufficiently close together so that the vegetation can be climbed by a child or average person without using a ladder or other special equipment and (b) A main stem or major branch that would support a child or average person either within arms' reach of an uninsulated energized electric line or within such proximity to the electric line that the climber could be injured by direct or indirect contact with the line.

- Clearance requirements to avoid off-cycle trimming.

PGE inspectors create project-specific work layout for vegetation contractors to complete while moving through the system performing RVM activities. Line clearance trim specifications are designed to maintain vegetation clearances during routine wind and adverse weather conditions. At a minimum, PGE adheres to the voltage-based clearance requirements specified in OAR 860-024-0016. PGE vegetation contractors trim identified trees to PGE specifications during the three-year standardized maintenance cycle to comply with OAR Division 24 Safety Standards (Division 24), ORS 758.282 and 758.284, and ANSI A300 and OSHA Z133 guidelines.

In addition, RVM work is field-validated by PGE forestry personnel who work closely with the crews to confirm completion. PGE subjects its vegetation management activities to a detailed QA/QC process to verify that vegetation management tasks have been completed to specification. To increase RVM program effectiveness, PGE also coordinates vegetation management activities closely with external stakeholders, including USFS, ODF, Oregon Department of Transportation (ODOT), municipalities, and private landowners.

11.2 Advanced Wildfire Risk Reduction (AWRR) Vegetation Management Program for HFRZs

AWRR operations fall outside of PGE's routine maintenance and trimming operations as the AWRR scope, operational practices, inspection schedule, and cadence are all on escalated cycles. AWRR program activities are guided by the results from PGE's Wildfire Risk Assessment modeling program.

For 2023, PGE has continued to refine its vegetation management activities, including the AWRR program, to address current climatic conditions and focus on OPUC requirements. ORS 758.280-758.286 provides PGE's operational framework for AWRR-related activities, as most of this work occurs outside of designated PGE ROW, utility easements, and annual maintenance schedules.

Under the AWRR program, PGE performs annual vegetation inspections on overhead line mileage that falls within HFRZs, mitigates vegetation based upon inspection results, performs QA/QC of vegetation management work completed by crews, documents its vegetation management activities, and coordinates them with county, municipal, and other external agencies, including ODOT, ODF, and USFS.

PGE closely manages AWRR program work to verify that it is completed to PGE specifications, from the establishment of the AWRR work schedule at the beginning of the year through QA/QC of the completed work. AWRR vegetation prescriptions follow program specifications, which include more stringent inspection and maintenance cycles and tree removal guidelines than those required under Division 24.

Tree removal practices associated with AWRR are applicable to any tree within striking distance of PGE electrical infrastructure, regardless of the tree's condition. PGE classifies trees that are an imminent hazard to PGE facilities as "P1" trees. PGE classifies trees that pose a probable hazard to the line or facility as "P2." A P2 designation can refer to any tree condition that could create a hazard to a PGE line or facility–trees that are dead, dying, diseased, or damaged, or that have fungal or insect infestation or stress, sunscald, overall poor health, mechanical damage, multiple tops, poor site conditions, conks on trunk, excavation or aggradation in the root zone, as well as trees that are located too close to PGE facilities.

In 2023, PGE will conduct as much of the AWRR Program's vegetation and P1 inspections and subsequent trimming and P1 mitigation within designated HFRZs as possible during the first six months of the year, although this work is ongoing throughout the year.

Figure 16: SlashBuster Clearing Right-of-Way

Figure 17: 105′ Aerial Lift Removing Dead Tree on Border of AWRR Zone

11.3 Inspection & Maintenance Frequencies for AWRR

Table 11: PGE HFRZ Inspection & Maintenance Strategies

AWRR Mitigation	Inspection or Maintenance	Cadence	Description
Clearance and P1 Inspection	Inspection	Annual	During this inspection, PGE AWRR inspectors identify vegetation that is within 5′ of high-voltage conductors, and newly established vegetation that is not suitable for a given location. Inspectors verify ongoing vegetation clearance compliance and identify any vegetation that has encroached on PGE assets since the previous inspection. AWRR inspections occur annually, outside of the RVM program's 3-year vegetation maintenance cycle. Inspectors also identify any P1 trees.
Clearance and P1 Mitigation	Maintenance	Annual	Trees/vegetation identified by the AWRR inspectors as too close, and/or wrong tree for the location are trimmed back to proper specification by tree crews. PGE mitigates all P1 hazard trees as quickly as possible, frequently within 24 hours of identification.
Enhanced Vegetation Inspection	Inspection	Annual, ongoing	PGE performs a comprehensive inspection along designated HFRZ lines for all potential P2 trees. PGE is currently tracking stems of large diameter trees within minimum approach distance that are mature and not susceptible to movement. PGE will be reviewing these trees for safety every year. In addition, AWRR inspectors identify and target specific sections of line that require more intensive clearance work, including increased side-clearance, overhang removal, selective removal of tree parts, expansion of ROW widths, ROW mowing, and whole tree removal.
Enhanced Vegetation Trimming and Mitigation	Maintenance	Annual, on-going	PGE removes or otherwise mitigates P2 trees on an ongoing basis throughout the year. Once planned, PGE enhanced vegetation trimming and removal projects are executed as seasonal conditions allow. PGE will mitigate any large-diameter trees that show decline from conditions recorded in the AWRR database appropriately. Due to the scale and logistics of P2 mitigation, some projects planned for a given year may carry over for completion in the subsequent year.

12. Expected Wildfire Program Costs

PGE develops an annual budget of implementation and administrative costs, as well as forecasted capital budgets, for the Program. The activities and expenditures generally included in these budgets include:

Wildfire-Related Operations & Maintenance (O&M):

For 2023, Program operation and maintenance (O&M) includes, but is not limited to:

- Wildfire Mitigation Program implementation
  - Wildfire training (described in Section 8)
  - Wildfire-related staff
  - Wildfire Analytics and Planning and tool development (described in Sections 5 and 6)
- Vegetation management, wildfire-related (described in Section 11)
- Support Areas
  - Community Resource Centers and costs (described in Sections 9 and 12)
  - Portable battery pilot (described in Section 15)
  - Wildfire-related outreach and education costs (described in Section 13)
  - Engineering (described in Sections 9 and 15)

Table 12: 2023 PGE Wildfire Mitigation O&M and Capital Costs

HFRZ 1-10 O&M	
Activity	**Cost (2023)**
Wildfire Mitigation Program	$4.7M
Inspections	$3.1M
Vegetation Management	$14.8M
Support Areas (Includes CRCs, Communications, Engineering, Portable Battery Pilot)	$1M
TOTAL	**$23.6M[9]**

[9] This budget is based on the 2022 General Rate Case decision dated 04/25/2022.

HFRZ 1-10 Capital	
Cost Area	**Cost (2023)**
Wildfire Mitigation & Resiliency	$9 M-$20.9 M[10]
Utility Asset Management (Project Management Office)	$5.3 M
Utility Asset Management	$0.8 M
TOTAL	**$15.1 M - $27.0 M**

For reference, as of filing this WMP, PGE's $15 million 2022 capital investments for wildfire mitigation included:

- 23 additional weather stations
- 20 AI cameras in HFRZ
- 11 miles of copper replacement (construction started fall 2022)
- 44 Smart Reclosers/TripSavers
- PGE exceeded its 2022 Fuse Replacement Program goal of 480 by installing 979 non-expulsion (fire-safe) fuses.

PGE will continue to refine its Wildfire Risk Mitigation Assessment program in 2023 and beyond and will continue to forecast its WM&R capital and O&M spending needs based on the results of that analysis. PGE's planned programs may be augmented if PGE is successful as it actively pursues State and Federal grant funding for a variety of wildfire risk reduction and resiliency improvement projects. These programs include FEMA BRIC grants and the DOE Bipartisan Infrastructure Bill (BIL) with grant funding opportunities through the Grid Resilience and Innovation Partnerships (GRIP) section. PGE is also exploring additional opportunities through the State of Oregon's formula grants under the BIL.

[10] Project designs are currently in various stages of completion

13. WMP Engagement, Public Outreach and Awareness, and Public Safety Partner Coordination

13.1 Engagement, Outreach and Coordination Overview

PGE's employs a three-pronged approach to collecting feedback, educating, and coordinating with customers and stakeholders regarding the WMP. It includes:

- WMP Engagement Strategy
- Community Outreach and Awareness Strategy
- Public Safety Partner Coordination Strategy

PGE's WMP Engagement Strategy is focused on building long-term relationship and equitable engagement with a diverse set of community members, using the guiding principle "Nothing about me without me." PGE actively seeks to understand the needs and wishes of the communities it serves.

The Community Outreach and Awareness Strategy focuses on educating customers and communities about PGE's wildfire mitigation efforts and preparing them for the possibility of wildfire or PSPS events. Outreach and awareness are year-round efforts using multiple mediums and communication channels to reach customers and community stakeholders. PGE values close working relationships with its Public Safety Partners and considers them integral to the success of a well-coordinated Wildfire Mitigation Program. PGE's Public Safety Partner Coordination Strategy outlines the format and cadence of coordination for these efforts.

13.2 2022 Public Safety Partner Coordination and Collaboration

PGE collaborated with its Public Safety Partners via multiple channels in 2022 to support development of the 2023 WMP. Those engagement channels included After Action Review (AAR) processes for both the PSPS Tabletop Exercise at PGE's Integrated Operations Center on May 13 and for the September 2022 PSPS event, as well as a PGE-facilitated Pano AI workshop with fire agencies in October.

PSPS Tabletop Exercise AAR

During the exercise, participants commented that Public Safety Partners would benefit from having input into the refinement of PGE's public notification templates, as there is specific information that external partners and stakeholders will request and need access to during a PSPS event.

Public Safety Partners expressed their appreciation that they were included in the exercise. Participants commented that it would be beneficial to conduct a functional exercise to allow all partners to work through a PSPS event collaboratively, in real time.

September 2022 PSPS Event

PGE also solicited feedback from its Public Safety Partners during the AAR process following the September 9–12, 2022 PSPS event. Some of the suggestions that PGE is working to incorporate in its 2023 Program include:

- Host a Public Safety Partner workshop to allow external stakeholders to advise and support clarification of cross-jurisdictional coordination responsibilities for alerts and warnings
- Evaluate alongside Public Safety Partners the use of Wireless Emergency Alerts for PSPS events and define policies and agreements to facilitate its successful deployment and reduce "overspray" confusion for notification recipients.
- Build a county partnership model to support Public Safety Partner-hosted locations with water and ice donations
- Hold a work session with Public Safety Partners, including ESF-12, to share information about CRCs, locations, information sharing, and other incident support services for community members
- Develop centralized dashboards, status hubs, and granular data feeds readily accessible to all stakeholders, with emphasis on dashboards targeted to all PGE employees, Public Safety Partners, and customers
- Evaluate a method to further granulate GIS data to identify the current stage of the PSPS event for each PSPS Area.

A more detailed description of PGE's engagement with Public Safety Partners and lessons learned during the September 2022 PSPS event is available in PGE's ***PSPS Annual Report*** to the OPUC.

Pano AI Partnership

On October 19, 2022, PGE held a workshop with representatives from Pano AI and six Oregon fire agencies to coordinate development opportunities for situational awareness. Participants discussed how the Pano AI wildfire camera technology is improving detection/alerting processes and decision-making, learned more about existing Pano AI capabilities, and discussed potential improvements to the platform's features and tools. For example, workshop participants explored the feasibility of capturing weather data at the camera locations to provide real-time meteorological condition information to responders. The group also discussed the potential for this technology to improve emergency evacuation processes by sharing access and data with law enforcement agencies county to county and even state to state.

13.3 2023 WMP Engagement Strategy

PGE's 2023 WMP Engagement Strategy is influenced by the community feedback captured during the 2022 program year (see Appendix 3 for comments received during PGE's 2022 WMP engagement sessions) and will focus on continuing to proactively engage and collaborate with PSPs, local communities, and customers. The annual Wildfire Mitigation planning process provides PGE with the opportunity to solicit feedback on its WMP and strengthen long-term engagement relationships with Public Safety Partners and local community members.

PGE's engagement methods are shaped by OPUC compliance rules and recommendations, as well as the iterative feedback received from Public Safety Partners, community-based organizations (CBOs), local community stakeholders and customers throughout the year. The metrics and criteria PGE uses to evaluate engagement effectiveness include quantitative metrics such as number of participants/attendees per event and workshop ratings/scores, as well as qualitative feedback received during and after each engagement event. Although the specific schedule for these events has not been established at this time, PGE's 2023 WMP engagement activities may include:

- Anticipate contracting with a qualified communications, outreach, and public involvement consultancy with strong ties to local communities to help PGE host a series of WMP engagement sessions across the PGE service territory.
- Hosting at least one WMP engagement session within each county (or group of adjacent counties within reasonable geographic proximity), with access and functional needs considerations, in its service territory. Participants will be able to attend these public workshops in-person or virtually.
- Holding a pre-planning session with Public Safety Partners to identify any language or functional needs to be accommodated during public engagement sessions.
- Capturing WMP feedback from both in-person and virtual WMP engagement session participants to better understand the needs and concerns of those most impacted by PGE's wildfire mitigation efforts, while meeting OPUC rule requirements.
- Providing additional feedback opportunities through follow-up surveys, to further inform the 2024 WMP.

One of the main goals of PGE's WMP Engagement Strategy is to complete all engagement session planning by the end of the first quarter of 2023, with the aim of delivering these sessions as early as the second quarter of 2023. One of the key takeaways from PGE's 2022 engagement sessions was the importance of the timing of these events. PGE will focus on delivering its 2023 WMP Engagement Strategy events during the peak of Fire Season and/or when wildfire concern and activity is at its highest, rather than too early or late in the year.

PGE's 2023 WPM Engagement Strategy will consider including breakout stations/tables for PGE's Public Safety Partners, engaging American Sign Language and Spanish-speaking interpreters for the virtual or onsite events, and offering a virtual or onsite Spanish-only community engagement event.

13.4 Wildfire Community Outreach and Awareness Strategy

The goal of PGE's 2023 Wildfire Community Outreach and Awareness Strategy is to take a comprehensive and cohesive approach in communicating directly with community stakeholders and partners, customers, and the general public about PGE's wildfire mitigation efforts. The purpose of this strategy is to prepare communities for Wildfire Season by providing information about specific preparedness actions they can take, as well as steps PGE may take, including PSPS events. Outreach methods will reflect an umbrella approach that covers multiple partners, stakeholders, and channels to reach customers and communities throughout the PGE service territory. This approach will also incorporate stakeholder, Public Safety Partner, and customer feedback, as well as insights from available data about how customers are engaging with the information PGE provides. PGE is developing a strategy for expanded collaboration with Public Safety Partners and Local Communities during the 2024 WMP development process.

PGE's efforts to connect with the target audiences for its community outreach and awareness program will begin with outreach to regulators, state and emergency response agencies, PSPs and local municipalities to raise awareness about PGE's HFRZs, beginning with the annual submittal of PGE's WMP and continuing through Fire Season. In 2023, PGE will provide these entities with information about steps PGE is taking to reduce the risk of wildfire, and about opportunities to participate in one of the scheduled informational conference calls and tabletop exercises prior to PGE declaring Fire Season. PGE conducts ongoing outreach to state agencies and government officials to share vital information about PGE's wildfire mitigation efforts and potential PSPS events.

13.4.1 Wildfire Communication & Awareness Channels and Campaigns

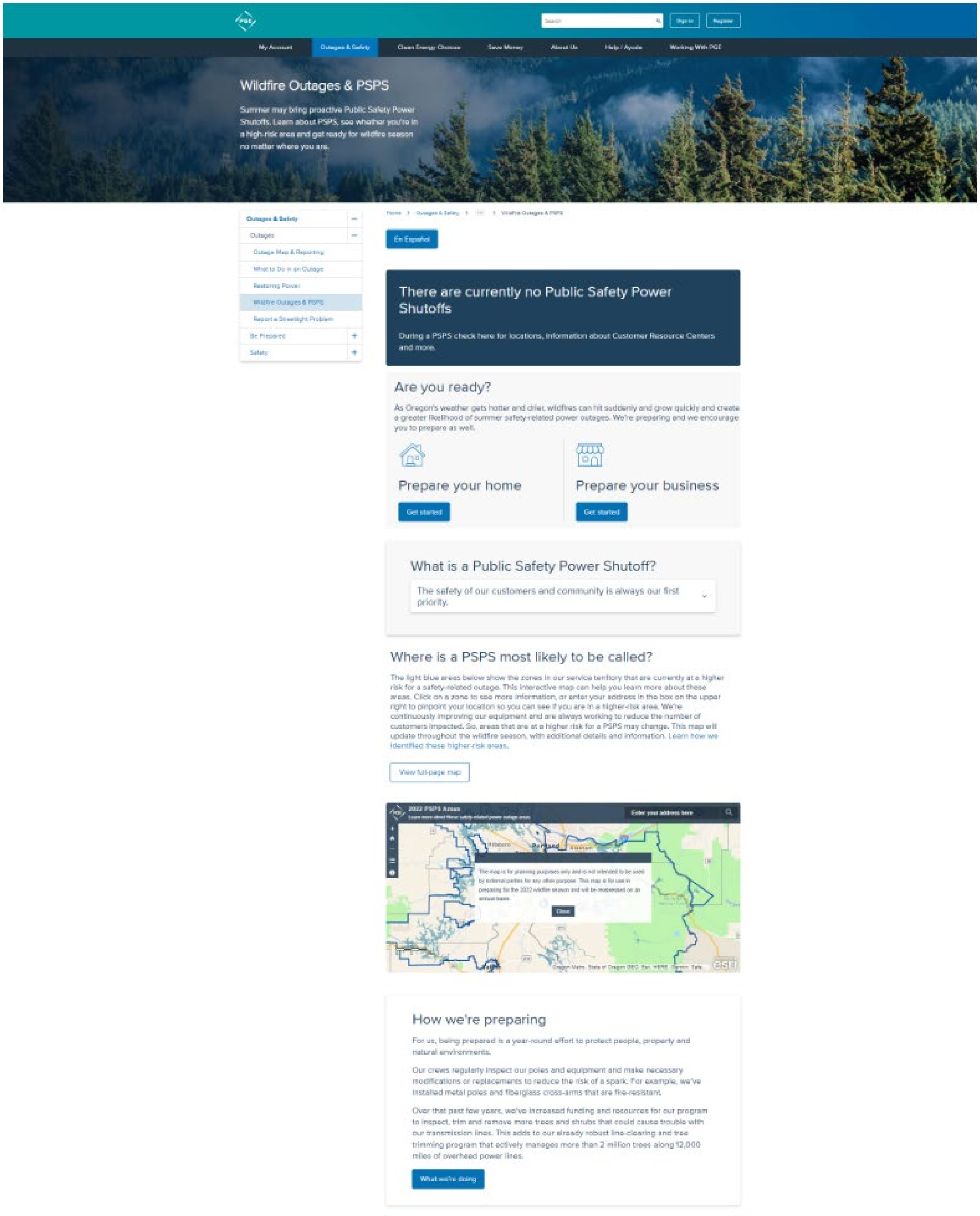
PGE employs a variety of tools and communication channels to broadly disseminate wildfire information and awareness and to ensure equitable information access for all members of the local community. For example, PGE has shared information with over 250 Community-Based Organizations (CBOs), food banks and school districts within PGE's service territory, enlisting their help in communicating with specific communities and customer groups to build awareness about the Wildfire Mitigation Program and potential PSPS events. PGE engages with CBOs by providing a toolkit (Appendix 7) of sample outage preparedness messages for use in social media, email, newsletter, and website messaging, in 15 languages (Arabic, Burmese, Chinese (simplified), Chinese (traditional), English, Farsi, Japanese, Korean, Rohingya, Romanian, Russian, Somali, Spanish, Swahili, and Vietnamese)—the most commonly spoken languages in PGE's service territory according to Oregon Census data. This learning has been validated through PGE's language line, which provides phone interpretation services in over 200 languages.

One of the main communication tools at PGE's disposal is the use of its public-facing website, (portlandgeneral.com) to communicate with all customers regarding wildfire awareness and PSPS preparedness. To provide stakeholders, partners, customers, and the public a central resource for wildfire-related information, PGE annually updates its wildfire outages web content in English and Spanish and provides a more specific set of information in 13 additional languages. The portlandgeneral.com wildfire pages provide information on the following topics:

- What is a Public Safety Power Shutoff?
- An interactive map of PGE's service territory and pre-identified PSPS areas, showing which zone (if any) is currently active. The map allows users to enter a service address to see whether it's located within the active area
- How to prepare a home or business for a PSPS event (which includes information about emergency plans, kits, and checklists)
- A high-level overview of PGE's wildfire preparation/mitigation strategy
- Information regarding how PGE's HFRZs were identified
- Factors considered in evaluating the likelihood of a PSPS event (e.g.: wind speed, temperature, humidity, the dryness of trees and brush, etc.)
- PSPS FAQs

Figures 18 and 19 provide examples of PSPS educational content found on the www.portlandgeneral.com website.

Figure 18: portlandgeneral.com's Wildfire Outages and PSPS Page (English and Spanish Versions)



Apagones por incendios forestales

El verano podría traer consigo Interrupciones del Suministro Eléctrico por Motivos de Seguridad Pública (PSPS) proactivas. Infórmese sobre las PSPS, vea si se encuentra en un área de alto riesgo y prepárese para la temporada de incendios forestales.

En Español
Obtenga ayuda con su factura
Ahorre en su factura y ayude al planeta
Administre su cuenta
Manténgase seguro y prepárese
Prepare su hogar
Apagones por incendios forestales
Equipos médicos que usan energía eléctrica
Seguridad
Alerta de fraude

Home > En Español > ... > Apagones por incendios f...

Actualmente no hay Interrupciones del Suministro Eléctrico por Motivos de Seguridad Pública (o PSPS) activas

Durante una PSPS, consulte aquí para encontrar las ubicaciones de las PSPS, información sobre los Centros de Recursos Comunitarios de PGE y más.

¿Está preparado?

A medida que el clima de Oregón se vuelve más caluroso y seco, los incendios forestales pueden comenzar de repente y crecer rápidamente, lo que aumenta las probabilidades de que se produzcan apagones de verano por motivos de seguridad. Nosotros nos estamos preparando, y le pedimos que se prepare usted también.

Prepare su hogar

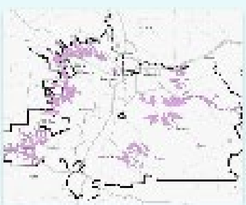
Prepárese

Prepare su empresa (en inglés)

Prepárese

Interrupción del Suministro Eléctrico por Motivos de Seguridad Pública

La seguridad de nuestros clientes y la comunidad son siempre la máxima prioridad.



Áreas con mayor riesgo de PSPS

Por motivos de un apagón de seguridad las áreas en morada clara son áreas en nuestro territorio de servicio de más alto riesgo. Haga clic en un área del mapa o ingresar su dirección en la caja para precisar su ubicación. Este mapa se actualizará durante la temporada de incendios forestales con detalles e información adicionales.
Entérese cómo identificamos estas áreas de mayor riesgo.

Ver mapa en vivo

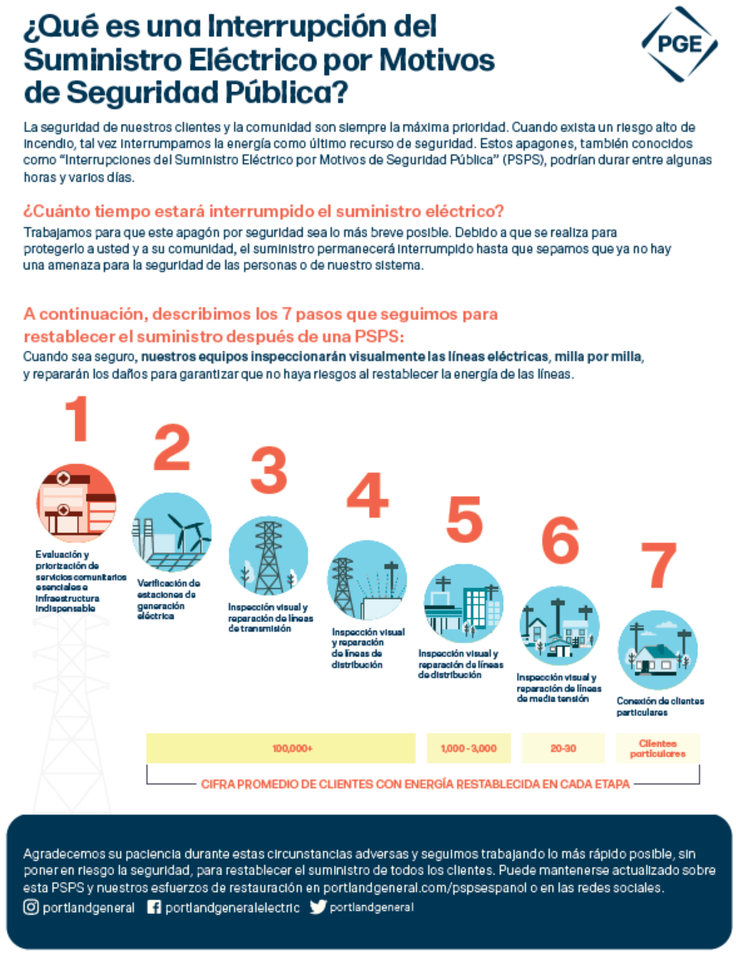
Cómo nos estamos preparando

Nos preparamos durante todo el año para proteger a las personas, las propiedades y los ambientes naturales.

Nuestras cuadrillas revisan periódicamente los postes y los equipos, y realizan las modificaciones o los reemplazos que sean necesarios para reducir el riesgo de chispas. Por ejemplo, hemos instalado postes metálicos y crucetas de fibra de vidrio que son ignífugos.

En los últimos años, hemos aumentado los fondos y los recursos para que nuestro programa revise, pode y quite más árboles y arbustos que puedan causar

Figure 19: "What Is a Public Safety Power Shutoff?" – Spanish Version



Additionally, PGE may attend wildfire preparedness events and town halls hosted by county and fire agencies, for the purpose of sharing information about the potential for wildfire-related power (PSPS) outages. In 2022, PGE attended five such events in Clackamas County and shared information and checklists for making an outage kit and preparing an emergency plan, as well as information about Public Safety Power Shutoffs, including when PGE may call them and why and what factors PGE will consider in making that determination, with reference to resources on portlandgeneral.com.

Figure 20: Flyer for 2022 PGE Community Wildfire Preparedness Events

For 2023, PSPS preparedness information provided on the www.portlandgeneral.com website will be available in 15 languages (see Section 13.4.1, above, for the full list). PGE will also provide PSPS preparedness checklists translated into multiple languages, available via the PGE website during Fire Season, as well as PSPS preparedness one-pagers to CBOs, food banks, and schools throughout the PGE service territory. In addition, throughout Wildfire Season, PGE references the Language Line on its website and customer communications. PGE Customer Resource Centers distribute fliers in multiple languages with the following message: "We speak your language. Our customer service advisors can assist you in 200+ languages. Call us at 503-228-6322."

As Wildfire Season approaches, PGE will activate a campaign to raise awareness of wildfire and the potential for PSPS events, including a Wildfire Safety Month press release in May, distributed to 280 media outlets in Oregon via FlashAlert. Additionally, PGE will send out wildfire awareness and PSPS preparedness emails and direct mail to targeted customer segments in English and Spanish.

Throughout Fire Season, PGE will issue additional press releases and/or generate media stories about wildfire preparedness, what a PSPS is, and when a PSPS may be called, using mass communications to reach broad audiences.

Additionally, PGE will share at least one communications toolkit[11] with messaging for use by Public Information Officers for cities, counties, and emergency response agencies in PGE's service area. In late spring and throughout Fire Season, PGE's Twitter and Facebook will regularly share graphics and information driving viewers to portlandgeneral.com for wildfire awareness and PSPS information. PGE has chosen these social media communications tools for breadth of reach.

In 2023, PGE plans to build on its 2022 communications, education, and preparedness campaigns, using these existing communications and educational channels as a baseline and working collaboratively with community leaders and PSPs to refine and update the direction and content as required to keep customers informed. Please refer to Appendix 4 for an inventory of PGE's 2022 efforts and channels utilized.

13.4.2 Outreach and Awareness Timing

In 2023, PGE will perform outreach and awareness activities prior to and during the 2023 Fire Season to reach customers, Operators of Critical Facilities, federal, state and local governments and elected officials, agencies, Tribes, and Public Safety Partners. Customer communications will begin in May, with cadence and medium tailored to specific target audiences including residential and business customers, key managed accounts, critical and pole customers, and customers inside and outside of PSPS areas. Communications will continue throughout Wildfire Season in the form of paid advertising (daily) and strategic direct customer outreach (every two to four weeks). Activities will follow the same seasonal timeline employed during in 2022. Refer to Appendix 5 for timeline details.

13.4.3 Outcome of 2022 Outreach and Awareness Efforts

Outcomes of 2022 outreach and awareness efforts are provided in Appendix 6, Outcomes of 2022 Outreach & Awareness Efforts.

13.5 Assessing Effectiveness of Wildfire Community Outreach and Awareness Efforts

In 2023, PGE, in partnership with its Public Safety Partners, will seek measurably equitable outcomes and metrics for its wildfire community outreach and awareness activities. Goals for PGE's community outreach and awareness activities include raising awareness for customers and other stakeholders regarding PGE's Wildfire Mitigation Program and building collaborative relationships with these groups. PGE will work to provide communications that are inclusive and meet people where they are by using languages they understand. These equitable outcomes and metrics include:

- **Outcome:** Deliver wildfire mitigation information and awareness in an approachable and accessible manner that benefits all community members

[11] Please see Appendix 7 to view sample 2022 toolkit materials.

- **Outcome:** Empower Public Safety Partners with access to timely and actionable information

PGE will measure the effectiveness of its outreach and awareness efforts through the use of surveys as well as the following metrics:

- **Customer Marketing**:
  - Site visits to our wildfire pages on portlandgeneral.com
  - Wildfire newsletter and email open and click-through rates
  - Click through rates on wildfire digital ads
- **Corporate Communications**:
  - Reach of wildfire press release
  - Breadth of coverage generated
  - Number of social media posts and engagement

Finally, PGE will use 2023 as a baseline year to start measuring customer wildfire awareness with annual surveys.

13.6 Public Safety Partner Coordination Strategy

PGE works closely with Public Safety Partners to facilitate information sharing, community outreach and wildfire preparedness and response. PGE defines Public Safety Partners as the OPUC's Emergency Support Function (ESF)-12, Local Emergency Management, Oregon Department of Emergency Management (OEM) and Oregon Department of Human Services (ODHS). PGE's Public Safety Partner Coordination Strategy is divided into three phases: prior to, during, and after Fire Season. By working in partnership with each Public Safety Partner, PGE can maximize the effectiveness of its outreach efforts and the size of the audience receiving these communications and improve operational coordination and information sharing. Meeting frequency and location will be determined in collaboration with our Public Safety Partners.

13.6.1 Prior To Fire Season

Before Fire Season, PGE will engage in joint planning processes and deliver presentations to Public Safety Partners at existing information sharing and preparedness coordination forums, as needed. PGE will include wildfire preparedness topics in one of the all-hazards quarterly summits with Public Safety Partners. PGE and ESF-12 coordinate on the location, time, and topics for quarterly summits. PGE will also coordinate with Public Safety Partners to implement the WMP Engagement Strategy.

PGE will also host at least one annual pre-Fire Season tabletop exercise with Public Safety Partners that will focus on PSPS notification procedures and processes. This tabletop will occur before the end of the second quarter of 2023 and will follow the Homeland Security Exercise and Evaluation Program (HSEEP) principles and guidelines. All Public Safety Partners will receive an invite to attend the tabletop exercise and participate in the associated AAR process. When possible, PGE will engage in exercises developed by other Public Safety Partners to improve interoperability during an actual event.

13.6.2 During Fire Season

Once PGE declares the start of the Fire Season, the company will inform its various Public Safety Partners regarding in-season operational modifications to the PGE system.

Additionally, during Fire Season, PGE enhances situational awareness monitoring and maintains a state of operational readiness. Should a new fire start or expanding fire threaten PGE infrastructure, a company representative will contact the agency and/or Incident Management Team (IMT)-identified point of contact to coordinate appropriate utility response. For all incidents, PGE acts as a cooperating partner when company infrastructure is at risk or has been impacted by a wildfire.

If an incident requires the activation of the PGE CIMT, PGE will notify impacted stakeholders and initiate in-person and virtual coordination activities. As required, PGE will deploy dedicated utility representatives to jurisdictional Emergency Operations Centers (EOCs), Emergency Coordination Centers (ECCs), or Incident Command Posts (ICPs).

After wildfire incidents, PSPS events or PGE-led tabletop or functional exercises, PGE will conduct an AAR process that is consistent with HSEEP and utility sector best practices, reviewing incident response and identifying continuous improvement action items. A detailed summary of input from our Public Safety Partners and lessons learned captured through exercises and events from 2022 can be found in Appendix 8.

13.6.3 After Fire Season

When the annual Fire Season ends, PGE will solicit feedback from Public Safety Partners about implementation of the Wildfire Mitigation Program and any opportunities for improvement. This feedback is solicited through phone calls and meetings.

14. Participation in National and International Forums

In 2023, as in previous years, PGE will be an active participant in a wide array of national and international industry forums addressing wildfire and outage-related issues.

Emergency managers from PGE, PacifiCorp, NW Natural, and BPA collaborate throughout the year as part of an Energy Emergency Management Team (EEMT). Annually, the EEMT exchanges contact information with the Northwest Coordination Center (NWCC) for emergency communications during Fire Season. Dispatch/Control Center numbers provided by the energy companies are for dispatch-to-dispatch communications. Emergency management contacts are provided for both NWCC and fire dispatch center personnel to assist with strategic decision-making and incident coordination.

In addition, PGE annually participates in a variety of industry forums that may discuss wildfire-related topics, including:

- **International Wildfire Risk Mitigation Consortium (IWRMC):** PGE participates with utilities from across the Western U.S., Canada, South America, and Australia to benchmark and share best practices for wildfire mitigation. The IWRMC is comprised of four working groups: Operations & Protocols, Risk Management, Vegetation Management, and Asset Management.

  PGE has leadership positions on the Operations & Protocols and Risk Management working groups. In 2022, PGE used this forum to benchmark its approach to wildfire risk mitigation assessment to industry best practices and accelerate its learning on capital investments while understanding the difference in the environments other industry participants experience. PGE also participated in the group to understand new technologies and their potential applicability to PGE operations, as well as vegetation management approaches from around the globe.

  Through the IWRMC, PGE is able to leverage lessons learned for specific wildfire mitigation strategies already implemented by other utilities: for example, the use of covered conductor to reduce wildfire risk. Utilities that implemented this strategy failed to account for detection, fire response, and failure modes that could result in wire-down events, increasing wildfire risk as covered conductor failed to de-energize, resulting in ignition events that were sometimes undetected for hours. This was a costly lesson learned for peer utilities, which were forced to remove and underground covered conductor in environments where that failure mode would be common. PGE customers benefit from the company's active participation in this forum as the shared data and review of mitigation strategy outcomes help PGE avoid pitfalls and select more cost-effective and successful risk mitigation measures.
- **Electric Power Research Institute (EPRI):** PGE engages with its research partners at EPRI through multiple programs to address wildfire mitigation research and is leveraging EPRI-led programs such as the Incubatenergy Network to gain knowledge of new technologies and start-ups in wildfire-related disciplines. PGE engages with EPRI at multiple leadership levels. The PGE President and CEO serves on the EPRI Board of Directors; a PGE Senior Vice President serves on the EPRI Research Advisory Council; multiple PGE Senior Managers and Directors

serve as Sector Council advisors, and dozens of PGE SMEs engage with EPRI at the program advisory and technical working group levels.

In partnership with EPRI, PGE sponsored the three-day Utility Wildfire Symposium on November 8–10, 2022, in Portland, attended by OPUC Commissioners and staff, representatives from research institutes and industry, and government officials. Attendees viewed demonstrations of wildfire-related technologies, heard presentations on current wildfire-related research, and discussed opportunities for new research projects and collaboration across participating entities.

EPRI was recently commissioned to conduct a study for the California Investor-Owned Utilities to determine which portable battery products are best-suited to back up medical devices during power outages (such as PSPS events). PGE has engaged with its research partners at EPRI to design a Portable Battery Pilot Project, in which PGE will study the feasibility of offering no-cost portable battery devices to PSPS-impacted residential customers also enrolled in PGE's medical certificate program (for additional details, please see Section 15.6, below).

- **Oregon Joint Use Association (OJUA):** PGE is active in the leadership of the OJUA, a non-profit industry workgroup whose mission involves building trust, cooperation, and organizational cohesion between utility pole owners, users, and government entities to promote the safe, efficient use of the ROW. The OJUA has featured educational presentations on the topic of wildfire mitigation at its past two annual meetings. Additionally, by administrative rule, the OJUA is an advisor to the OPUC on the adoption, amendment, or repeal of administrative rules governing utility pole owners and occupants.
- **Other National and Regional Forums:** PGE is actively engaged with industry research partners at the Western Energy Institute, Edison Energy Institute (EEI), and the U.S. Department of Energy. This is evidenced by PGE participation in the leadership of these organizations, as well as its active engagement in the industry technical sessions and conferences.
- **Regional Disaster Preparedness Organization (RDPO):** PGE actively participates in the RDPO, which encompasses the five Portland metro region counties (Multnomah, Washington, Clackamas, Columbia, and Clark), as a utility/energy sector participant and steering committee member. In this role, PGE provides the RDPO with insights and a utility perspective on issues. In addition, participation in this group has enhanced PGE's regional partnerships and provided insights into regional disaster resilience and preparedness initiatives.
- **Oregon Wildfire Detection Camera Interoperability Committee:** PGE participates in this committee, whose primary goals and objectives include developing and maintaining statewide wildfire camera detection system(s) and fostering coordination and collaboration among its members. The committee membership includes the Governor's Office, public safety agencies, fire agencies, emergency managers, USFS, Bureau of Land Management, Statewide Interoperability Coordinator, ODF (co-chair of the committee), the Oregon Hazards Lab at the University of Oregon (co-chair of the committee), Tribal representatives, and Oregon's investor-owned utilities.

PGE is also working with federal partners to support the Wildfire Working Group's interdisciplinary and interagency efforts, representing the utility sector in the President's 2022 wildfire meetings with cabinet secretaries to emphasize the need for continued leadership at the federal level on wildfires and shared responsibility on the matter, among other issues.

In 2022, PGE participated in site visits with the San Diego Gas & Electric and Southern California Edison wildfire mitigation teams. The purpose of this benchmarking trip was to accelerate PGE's learning toward mitigating wildfire risks from PGE assets, as well as how to communicate with and support our customers. The teams discussed risk analysis, incident management approaches, capital investment strategies, fire suppression tools, community resource models, and communication techniques. Some key takeaways from the visits include:

- Opportunities to leverage greater automated notification capabilities around PSPS communications
- Opportunity to develop stronger relationships with local media to broaden and deepen awareness around wildfire preparedness and PSPS communications
- Significant investments being made in reconductoring in areas where undergrounding is not feasible or cost-effective
- Southern California Edison has a robust electronic Customer Care Plan Dashboard on all impacted customers during a PSPS event, allowing them to drill down to the individual customer/meter
- Both utilities were providing grants to assist with wildfire burn opportunities
- Considerable investments were being made to acquire aviation assets (helicopters and drones) available to provide air support to combat wildfires
- The importance of robust and dedicated meteorology and wildfire communications teams.

One finding from PGE's benchmarking peer reviews is that CPUC Decision 21-06-034[12], which requires California IOUs to consider the needs of Medical Baseline and Access and Functional Needs Communities impacted by PSPS events, could have implementation and customer impacts for Northwest utilities. PGE Interviewed representatives from California IOUs to understand the findings and best practices they observed during the rapid deployment of this regulatory mandate, as well as challenges, uptake rates, and implementation best practices. These interviews led PGE to work with EPRI to create the Portable Battery Pilot Project described in Section 15.6.

[12] https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/safety-and-enforcement-division/documents/decision-phase-3-gl.pdf

15. Research & Development

PGE is undertaking a variety of wildfire-related research projects with public and private research institute and industry partners.

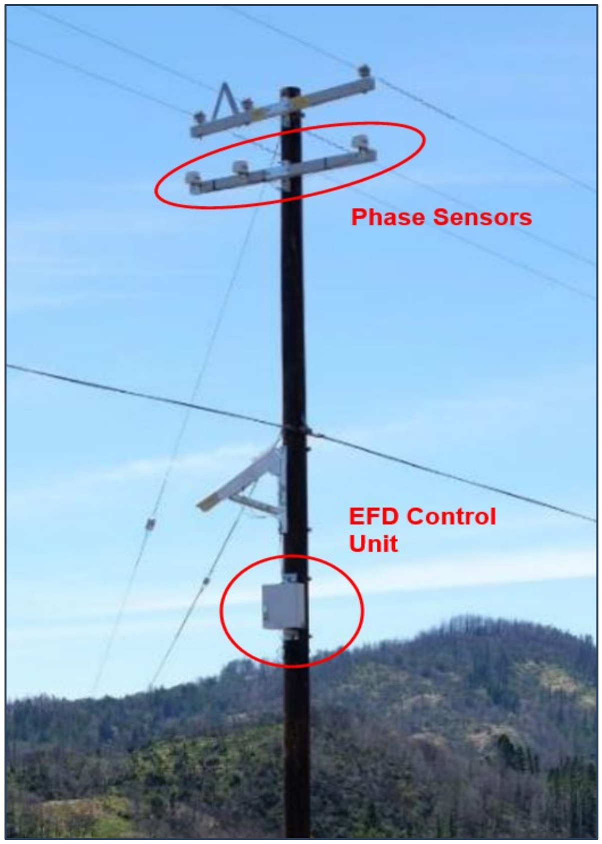
15.1 Early Fault Detection Pilot Project

As a result of its collaboration with EPRI, PGE deployed the Early Fault Detection (EFD) pilot project in 2021.[13] EFD uses sensors to detect anomalies on the feeder in real time, allowing PGE to intervene (replace or repair) the affected component(s) prior to a failure that could cause an ignition. In 2023, PGE will deploy the first of three planned EFD systems on feeders within its HFRZs and, if possible, will add further EDF systems by leveraging potential federal grant funding opportunities. In addition, in 2023 PGE will evaluate detection/response times for covered conductor equipped with an EFD system to assess the viability of this approach as an alternative to undergrounding within its HFRZs.

Figure 21: Damaged Conductor Identified by EFD System in 2022 and corrected by PGE

[13] Incubatenergy Labs 2020 Pilot Project Report: IND Technology – Early Fault Detection for Power Lines

Figure 22: Example of An Installed EFD System

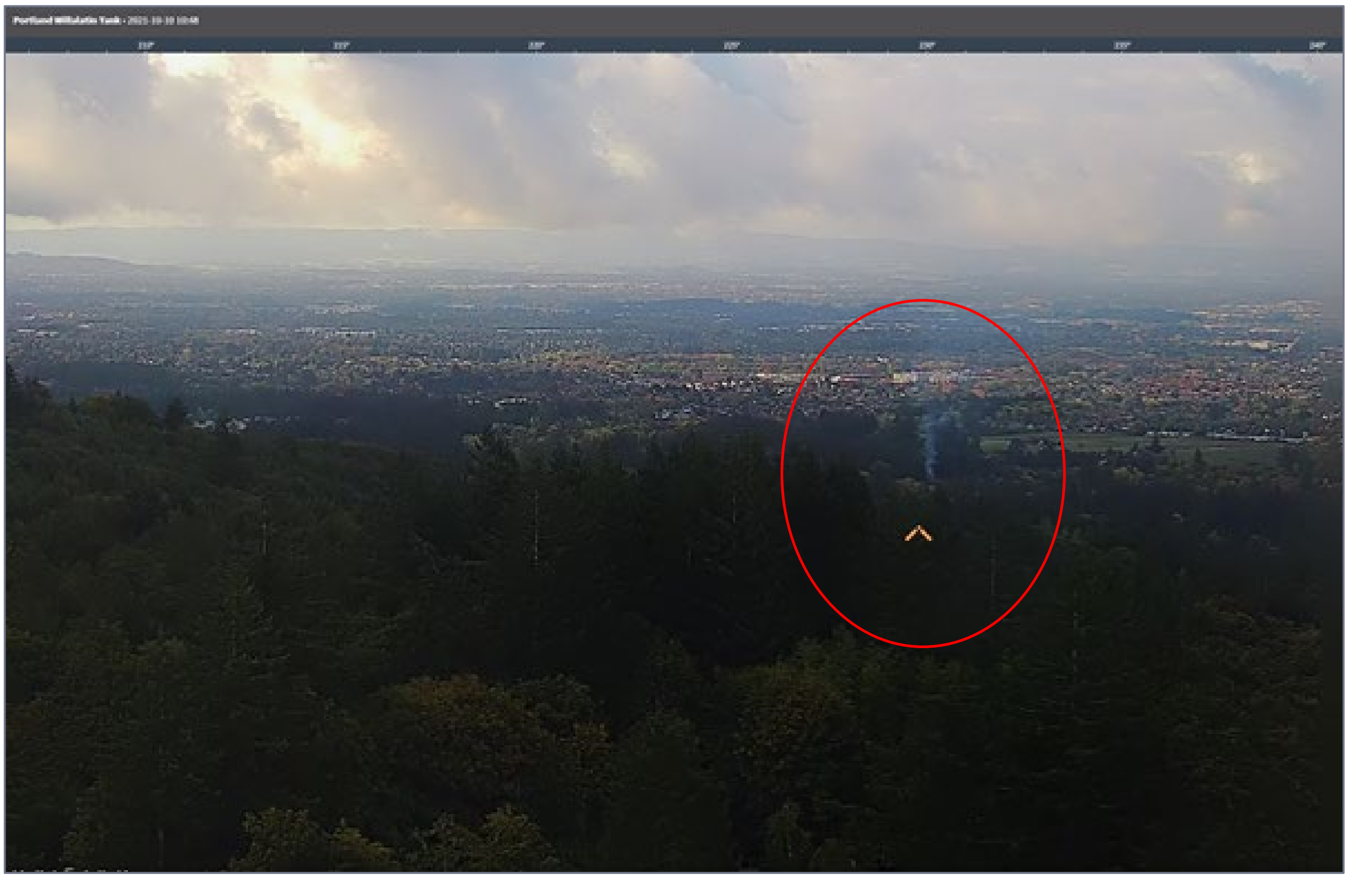


15.2 Pano AI: 360-Degree, AI-Based Imaging

In 2021, in partnership with EPRI and the City of Portland, PGE tested an artificial intelligence-enhanced ultra-high-definition (UHD) camera technology, Pano AI (Incubatenergy Labs 2021 Pilot Project Report – Pano AI – 360-Degree, AI-Based Imaging for Wildfire Situational and Locational Awareness). These cameras can detect and identify smoke through ultra-high-definition video imaging, and notify PGE if it detects a fire, in real time. As the PGE-sponsored pilot project showed, this technology has proven benefits in accelerating fire detection and response times. The cameras are now operational within all PGE HFRZs and detected multiple fires (not wildfires) in 2022.

As of 2022, PGE validated the efficacy of this technology and deployed 22 Pano AI cameras across its 10 HFRZs (see Figure 9 for locations) and plans to deploy an additional 15 cameras in 2023. PGE also provided access to these cameras to multiple Public Safety Partners, including the Columbia Cascade Interagency Communications Center (which provides camera access to USFS, ODF, U.S. Fish & Wildlife Service and other agencies), three ODF Forest Protection Districts, and the Confederated Tribes of Grande Ronde, among others. See Section 7.1, Enhanced Monitoring & Technology In HFRZs, for a full list of agencies with access to PGE's Pano AI network.

Figure 23: Smoke Detected by AI-Equipped UHD Camera



15.3 Remote Sensing Pilot Project

In 2021, PGE conducted a Remote Sensing data acquisition project for its HFRZ feeders, to support wildfire and resiliency preparedness and operational design and engineering work in 2022. The project used various high-tech geospatial imaging technologies (listed below) to provide PGE with a detailed understanding of vegetation risk, clearances to poles and wires, and ROW accessibility within PGE's HFRZs.

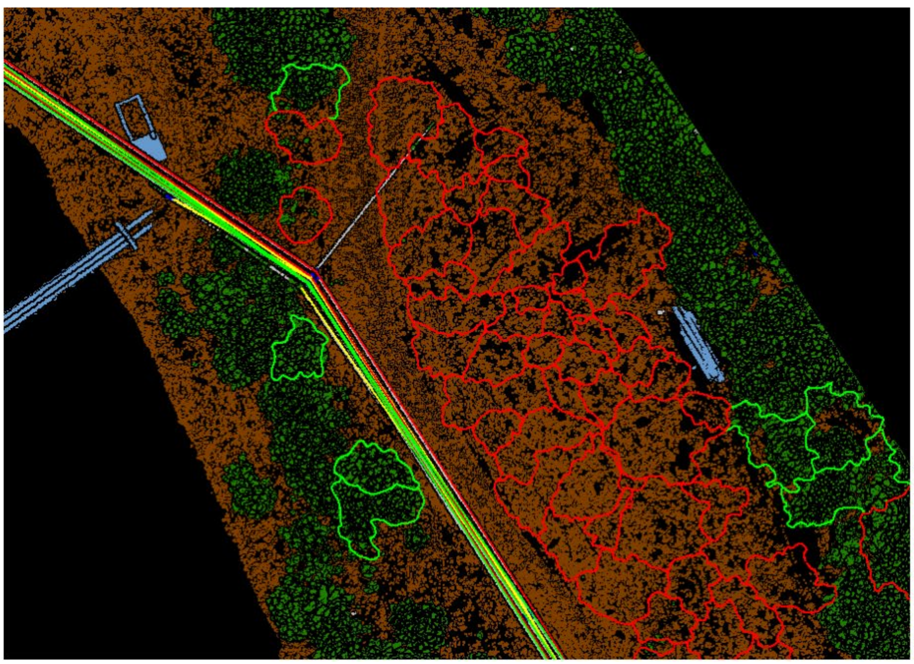
The 2021 HFRZ Remote Sensing Pilot Project produced precise mobile and aerial LiDAR imaging, spherical imagery, and satellite multispectral imagery surveys of 774 circuit-miles of conductor and nearly 15,000 poles within the PGE HFRZs.

This data and analysis have also been taken into consideration in PGE's 2023 capital planning work, which guides its wildfire investment strategy. It will also help PGE understand how much risk has been mitigated through previous years' AWRR (vegetation management) activities and is being used for 2023 vegetation management program planning.

PGE's Remote Sensing Pilot Project also provides:

- GIS-enabled analyses of vegetation clearance and vegetation health
- Consolidated pole/span inventory
- Pole/span change detection analysis (2019-2021)
- Consolidated tree threat inventory (2019 and 2021)
- Tree change detection analysis (2019-2021).

Figure 24: Sample Aerial LiDAR Imagery



Areas outlined in red show trees identified as threats in 2019 that have since been removed.

15.4 Storm Predictive Tool

In late 2022 PGE operationalized a prototype version of a Storm Predictive Tool that will assess wildfire weather risk to PGE equipment using weather data from across the PGE service territory. In 2023, PGE will conduct further model testing and validation to assess the Storm Predictive Tool's ability to incorporate more granular and sophisticated inputs to better inform PGE's PSPS execution decision analysis and improve system alarming.

When initialized in Q4 2023, this tool will significantly improve PGE's ability to predict potential equipment outages based on forecasted and real-time meteorological data. The Storm Predictive

Tool will offer co-benefits to PGE's Utility Asset Management program, including increased spare equipment ordering efficiency, spare equipment mobilization, and operational standards and practices.

15.5 5G PGE Energy Lab

PGE also leads the 5G PGE Energy Lab, focused on the development of innovative wildfire mitigation technologies. The collaboration is evaluating use cases and developing business cases for wildfire-related surveillance, sensing and data collection, and cloud storage technologies, laying the groundwork for the use of artificial intelligence-driven analysis in these disciplines. Through this collaboration group, PGE has been investigating ways to interface the emerging 5G network with Pano AI to explore how greater communications bandwidth can enhance this fire detection technology. Results from the research will guide the deployment of additional Pano AI wildfire cameras across PGE's service territory in 2023.

In September 2022, T-Mobile US announced a partnership with Pano AI and PGE to connect the network of AI-enabled cameras to T-Mobile's powerful and far-reaching 5G system. The partnership will allow PGE and Pano AI to gather high-quality video in at-risk areas and send "vast amounts"[14] of data to Pano AI's command center in real time. This project is especially important in rural and remote areas; the long range of T-Mobile's 5G network will allow the partnership to bring this state-of-the-art fire detection technology to some of the state's most vulnerable locations.

15.6 Proposed Project: Portable Battery Pilot

Based on peer benchmarking learnings from the California utilities, in 2023 PGE proposes to pilot and study a select customer offering of no-cost portable battery devices to provide backup power to PSPS-impacted residential customers also enrolled in PGE's medical certificate program. The purpose of the pilot would be to understand the customers' usage of the battery devices to back up critical medical devices, impacts on feelings of preparedness and resilience, and the customer's experience during an outage prior to and after receiving a device. The budgeted cost to provide a portable battery device to qualified customers and study the impacts for Year 1 is estimated at $100,000. PGE will file a detailed program application for an operational tariff prior to offering this option to customers.

[14] Link to article: T-Mobile US, Pano AI help detect wildfires with 5G, AI (rcrwireless.com)

Contact PGE

For information regarding PGE's wildfire mitigation program and wildfire-related emergency kits, plans, checklists, education, and preparedness information, please visit PGE's website (portlandgeneral.com), or call at 1-800-542-8818. Current situational updates, outage status, and wildfire information are also available via social media platforms (Facebook, Twitter, Instagram, and LinkedIn).

15. Revisions Log

The following table details the nature, date, and primary author of major revisions to this document. All impactful revisions—revisions that make significant changes to PGE Wildfire Mitigation strategies—will be described in the Revision Description column.

Date	Version	Revision Description
12/21/2022	1	Issued for implementation by WM&R

Appendices

Appendix 1: Oregon Wildfire Mitigation Rules and 2022 OPUC Independent Evaluator Recommendations In the WMP

Oregon Administrative Rules - Wildfire Mitigation Plans

Oregon Administrative Rule: Chapter 860, Division 300	
Rule Citation	**Where addressed in PGE Wildfire Mitigation Plan**
860-300-0020: **Public Utility Wildfire Mitigation Plan Filing Requirements**	
1(a)	**Section 6.1** (Risk Assessment Overview)
1(a)(A)	**Section 6.1** (Risk Assessment Overview) **Section 7** (High Fire Risk Zones)
1(a)(B)	**Section 6.1** (Risk Assessment Overview) **Appendix 9** (PGE Wildfire Risk Assessment Overview & Process)
1(b)	**Section 6.5** (Wildfire Risk-Based Making)
1(c)	**Section 6.5** (Wildfire Risk-Based Making)
1(d)	**Section 13.4** (Wildfire Community Outreach and Awareness Strategy)
1(e)	**Section 9** (Operation During PSPS Events and Protocols for De-Energization of Power Lines) **Section 9.1** (Power System Operations During PSPS Events) **Section 9.2** (Levels of a PSPS Event) **Section 9.3** (Communication Requirements During PSPS Events)
1(f)	**Section 13.4.2** (Outreach and Awareness Timing) **Appendix 5** (2022 Wildfire Outreach and Awareness Efforts)
1(g)[15]	**Section 10** (Ignition Prevention Inspections)
1(h)[16]	**Section 11** (Vegetation Management)
1(i)	**Section 12** (Wildfire Program Costs)

[15] Utility infrastructure inspection consistent with OAR 860-024-0018
[16] Vegetation management within HFRZs consistent with OAR 860-024-0016

Oregon Administrative Rule: Chapter 860, Division 300	
Rule Citation	**Where addressed in PGE Wildfire Mitigation Plan**
1(j)	**Section 14** (Participation in National and International Forums)
1(k)[17]	**Section 10** (Ignition Prevention Inspections)
2	**Section 1** (Introduction)
3	**Section 1** (Introduction)
4	Not applicable.
860-300-0030: **Risk Analysis**	
1	**Section 6.1 (Risk Assessment Overview) , 6.2** (Updates to the 2023 Wildfire Risk Mitigation Assessment) Appendix 9 (PGE Wildfire Risk Assessment Overview & Process)
1(a)	**Section 6.3** (Wildfire Risk Categories)
1(a)(A)	**Section 6.3.1** (Baseline Wildfire Risk)
1(a)(B)	**Section 6.3.2** (Seasonal Wildfire Risk)
1(a)(C)	**Section 6.3.3** (Risk to Residential Areas)
1(a)(D)	**Section 6.3.4** (Risk to PGE Equipment)
1(b)	**Section 6.2** (Updates to 2023 Wildfire Risk Mitigation Assessment)
1(c)	**Section 6.3.5** (Georisk) **Appendix 9** (PGE Wildfire Risk Assessment Overview & Process)
1(c)(A)	**Section 6.4** (Risk Assessment Methodologies: Data Quality and Review Frequency)
1(c)(B)	**Section 6.4** (Risk Assessment Methodologies: Data Quality and Review Frequency)
1(d)	**Section 6.5** (Wildfire Risk-Based Decision Making)
1(d)(A)	**Section 6.5.1** (Risk-Based Decision Making for PSPS Events)
1(d)(B)	**Section 6.5.2** (Risk-Based Decision Making and Mitigation Actions for Vegetation Management)
1(d)(c)	**Section 6.5.3** (Risk-Based Decision Making and Mitigation Actions for System Hardening)
1(d)(D)	**Section 6.5.4** (Risk-Based Decision Making and Mitigation Actions for Capital Improvements)

[17] Ignition inspection program per OAR 860-024.

Oregon Administrative Rule: Chapter 860, Division 300	
Rule Citation	**Where addressed in PGE Wildfire Mitigation Plan**
1(d)(E)	**Section 6.5.5** (Risk-Based Decision Making and Mitigation Actions for Operations)
2	**Section 6.2** (Updates to 2023 Wildfire Risk Mitigation Assessment)
860-300-0040: **Wildfire Mitigation Plan Engagement Strategies**	
1	**Section 13.3** (2023 WMP Engagement Strategy)
1(a)	**Section 13.3** (2023 WMP Engagement Strategy)
1(a)(A)	**Section 13.3** (2023 WMP Engagement Strategy)
1(a)(B)	**Section 13.3** (2023 WMP Engagement Strategy)
1(b)	**Section 13.3** (2023 WMP Engagement Strategy)
2	**Section 13,.4** (Wildfire Community Outreach and Awareness Strategy)
2(a)	**Section 13,.4** (Wildfire Community Outreach and Awareness Strategy)
2(a)(A)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(a)(B)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(a)(C)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(a)(D)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(b)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(b)(A)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(b)(B)	**Section 13.4.2** (Outreach and Awareness Timing) **Appendix 4** (Inventor of Community Outreach and Engagement Materials and Channels)
2(b)(C)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(b)(C)(i)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(b)(C)(ii)	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
3	**Section 13.5** (Assessing Effectiveness of Wildfire Community Outreach and Awareness Efforts)
4	**Section 13.6** (Public Safety Partner Coordination Strategy)
4(a)	**Section 13.6.1** (Prior to Fire Season)
4(b)	**Section 13.6.1** (Prior to Fire Season)
4(c)	**Section 13.6.1** (Prior to Fire Season)

Oregon Administrative Rule: Chapter 860, Division 300	
Rule Citation	**Where addressed in PGE Wildfire Mitigation Plan**
860-300-0050: **Communications Requirements Prior, During, and After a Public Safety Power Shutoff**	
1	**Section 9.3** (Communication Requirements During PSPS Events)
1(a)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(A)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(B)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(C)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(D)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(E)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(F)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(G)	**Section 9.3** (Communication Requirements During PSPS Events)
1(b)(H)	**Section 9.3** (Communication Requirements During PSPS Events)
1(c)	**Section 9.3** (Communication Requirements During PSPS Events)
1(c)(A)	**Section 9.3** (Communication Requirements During PSPS Events)
1(c)(B)	**Section 9.3** (Communication Requirements During PSPS Events)
1(c)(C)	**Section 9.3** (Communication Requirements During PSPS Events)
1(c)(D)	**Section 9.3** (Communication Requirements During PSPS Events)
1(c)(E)	**Section 9.3** (Communication Requirements During PSPS Events)
1(d)	Not applicable
2	**Section 9.3** (Communication Requirements During PSPS Events)
2(a)	**Section 9.3** (Communication Requirements During PSPS Events)
2(a)(A)	**Section 9.3** (Communication Requirements During PSPS Events)
2(a)(B)	**Section 9.3** (Communication Requirements During PSPS Events)
2(a)(C)	**Section 9.3** (Communication Requirements During PSPS Events) **Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
2(b))	**Section 9.3** (Communication Requirements During PSPS Events)
2(b)(A)	**Section 9.3** (Communication Requirements During PSPS Events)
2(b)(B)	**Section 9.3** (Communication Requirements During PSPS Events)
2(b)(C)	**Section 9.3** (Communication Requirements During PSPS Events)
2(b)(D)	**Section 9.3** (Communication Requirements During PSPS Events)

Oregon Administrative Rule: Chapter 860, Division 300	
Rule Citation	**Where addressed in PGE Wildfire Mitigation Plan**
2(b)(E)	**Section 9.3** (Communication Requirements During PSPS Events)
2(b)(F)	**Section 9.3** (Communication Requirements During PSPS Events)
2(b)(G)	**Section 9.3** (Communication Requirements During PSPS Events)
3	**Section 9.3** (Communication Requirements During PSPS Events)
3(a)	**Section 9.3** (Communication Requirements During PSPS Events)
3(b)	**Section 9.3** (Communication Requirements During PSPS Events)
3(c)	**Section 9.3** (Communication Requirements During PSPS Events)
4	Not applicable
5	Not applicable
860-300-0060: **Ongoing Informational Requirements for Public Safety Power Shutoffs**	
1	**Section 9** (Operations During PSPS Events)
2	**Section 13.4.1** (Wildfire Communication and Awareness Channels and Campaigns)
3	**Section 9** (Operations During PSPS Events)
4	**Section 9** (Operations During PSPS Events)
860-300-0070: **Reporting Requirements for Public Safety Power Shutoffs**	
1	In the event of a PSPS event, PGE will file with the OPUC, an annual report(s) on de-energization lessons learned, no later than December 31.
2	Non-confidential versions of annual reports filed with the OPUC under this section will be made available on PGE's website.

Appendix 2: PGE Ignition Prevention Inspection Standards

The following checklist is used by PGE's Utility Asset Management organization to ensure a thorough and consistent ignition prevention inspection process for PGE assets.

1	Permanently out of service or abandoned electrical equipment
2	Blocked access roads to supporting structures
3	Abandoned/coiled service wire hanging from pole
4	Broken secondary lashing wire
5	Service/primary neutral touching guy, transformer, or pole
6	Damaged, broken, or frayed power conductor
7	Broken/cut/missing ground
8	Broken communication mainline lashing wire
9	Broken power insulator or tie wire
10	Slack, corroded, or broken power guy
11	Anchor pulled loose/not holding
12	Crossarm brace damaged/broken, missing, or loose
13	Damaged/broken/corroded/loose distribution hardware and connectors
14	Equipment leaking oil—transformer, regulator, etc.
15	Damaged/broken cutout, lightning arrestor, or similar pole-mounted equipment
16	Damper damaged, slipped, or missing
17	Service or conductor attached to tree
18	Midspan horizontal clearance to unattached pole per NESC requirements
19	Missing cotter key, insulator nut, or other line hardware
20	Power hardware, including transmission, not properly grounded/bonded
21	Midspan vertical (pole-to-pole)
22	Midspan horizontal primary (conductor close to building or sign per NESC requirements)
23	Midspan vertical
24	Low transmission or primary conductor close to neutral, secondary or communications or other equipment/conductors per NESC requirements
25	Midspan vertical—power over drivable surface
26	Midspan vertical—power over driveway or pedestrian surface
27	Midspan vertical—communications over drivable surface
28	Overloaded pole
29	Damaged or decayed pole
30	Severely leaning or washed-out pole
31	Vegetation—hazard trees, limbs laying on conductor, impaired clearances to vegetation, tree limbs burning or burned in
32	Crossarm damaged/broken

Appendix 3: Comments Received During PGE's 2022 WMP Engagement Sessions

We Hear You—Customer Feedback

- Customers are both appreciative and frustrated. Some recognize the depth of the plan and appreciate how hard PGE works to get them this information. But others feel ignored and want to know how they can help to improve the outage map.

I did read the entire 65 page report and ***appreciated the depth and detail of the plans documented.*** *Thank you for investing the time and resources to develop it, I look forward to the hard work in the years ahead to put it all into practice.*

My only comment on the PSPS is that ***I wish that communication was more frequent than every 24 hours.*** *It would be preferable to have it at least every 6-12 hours.*

I very much appreciate PGE. I realize your challenges are significant. I am frustrated with my current frequent power outages (almost once a month). However, ***I was encouraged about what I learned at the presentation about mitigation steps you are taking to prevent planned power shutoffs and how this could also improve the current (un)reliability of my power.*** *I appreciate PGE's environmental consciousness.* ***You are heads above other power companies I have dealt with.*** *I appreciate your front line folks. Your operators on the phone are pleasant, informative and helpful (and I can be cranky when my power is off since I have to water, no heat, no phone, no septic). Your linemen are super - I know they are working long hours but I have found them to be helpful, cheerful and informative. Thanks for your service!*

Thank you for the presentation and your work.

I would like to ***know how those of us who live in rural areas could help in reporting*** *obvious power outages and/or line issues we observe before an emergency occurs*

Thank you for doing these events *and having the opportunity to connect with PGE.*

They told me they would call me. Nobody has. Not impressed

As a long time customer, we do not support your strategy to mitigate your liability during infrequent fire weather events that severely hampers rural landowners ability to care for livestock, maintain food safety, personal hygiene, and most importantly protect their homes and outbuildings from fire. ***You are transferring your risk and costs to your customers who have to invest in expensive backup systems to maintain their own safety*** *without your power supply while you reap additional profits by shipping customer power out of state. Your "Public Safety" power redistribution has made me a very unsatisfied customer.*

Communicate more frequently during PSPS. *Every 6-12 hours instead of once every 24 hours.*

Question:
Was there anything you wanted to bring up during the workshop, but you were unable to at the time? Tell us what it was here.

We Hear You—Customer Feedback

- Clarity and preemptive communication are highly important. And the PSPS led to some customer suspicion as to PGE's motives. More communication about the connection between power lines and fires is needed help customers understand the importance of the PSPS.

Just stop doing power outages to limit your liability under the guise of public safety. *If your infrastructure is built and maintained according to PUC standards, there should be no problems, especially when red flag warnings are so broadly forecast with significant variation in actual on the ground weather conditions within the geographic area.* ***Rural customers have no way to protect their property from fire when they lose power to their wells.*** *Communication with customers without power lose internet* ***and cannot do business or receive updates from you via email.***

Being clear about when power would be restored *to those of us who had our power turned off.*

They need to listen to customers. ***They should have listening sessions regarding the psps map.***

I do not want to place all of the blame on PGE as it is clear they made an effort to contact our business. ***I would like to know minimum 1 week prior to the shut off event.*** *This is obviously hard to estimate when dealing with weather.* ***Info on where the resource centers are would be nice.*** *I did not know PGE had created those. Again I will be more attentive now that I know the situation is likely to happen again.*
Perhaps PGE could work in conjunction with The Dept of Land Conservation and Development to establish lower risk areas that include state zoned farm land that did not seem high risk at all.

Our power goes off all the time up here and I am tired of it!!
The power lines should be underground so you don't disrupt so many people!
Is this going to be a constant thing to just turn off our power when the wind blows? ***You're forcing everyone to get a generator, which I would love to have but can't afford!!***

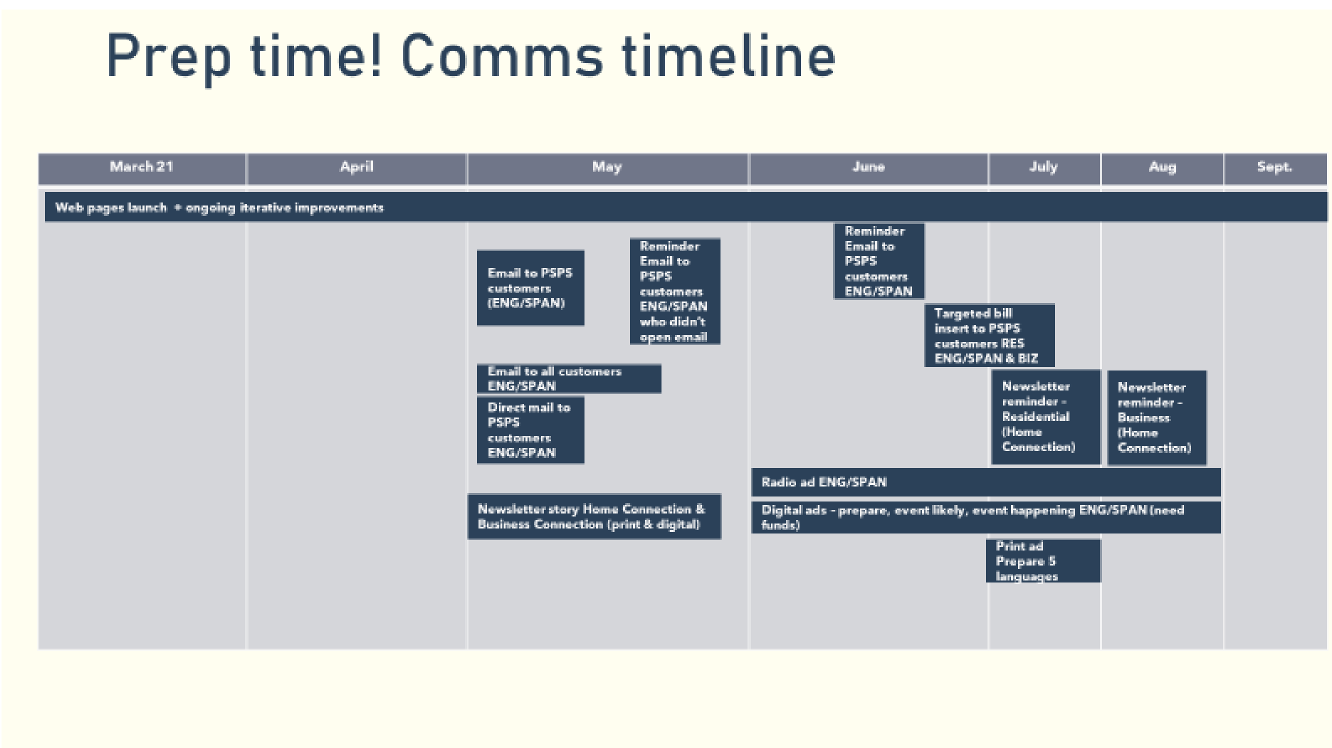
Question:
What would you change or improve about PGE's communications during a PSPS?

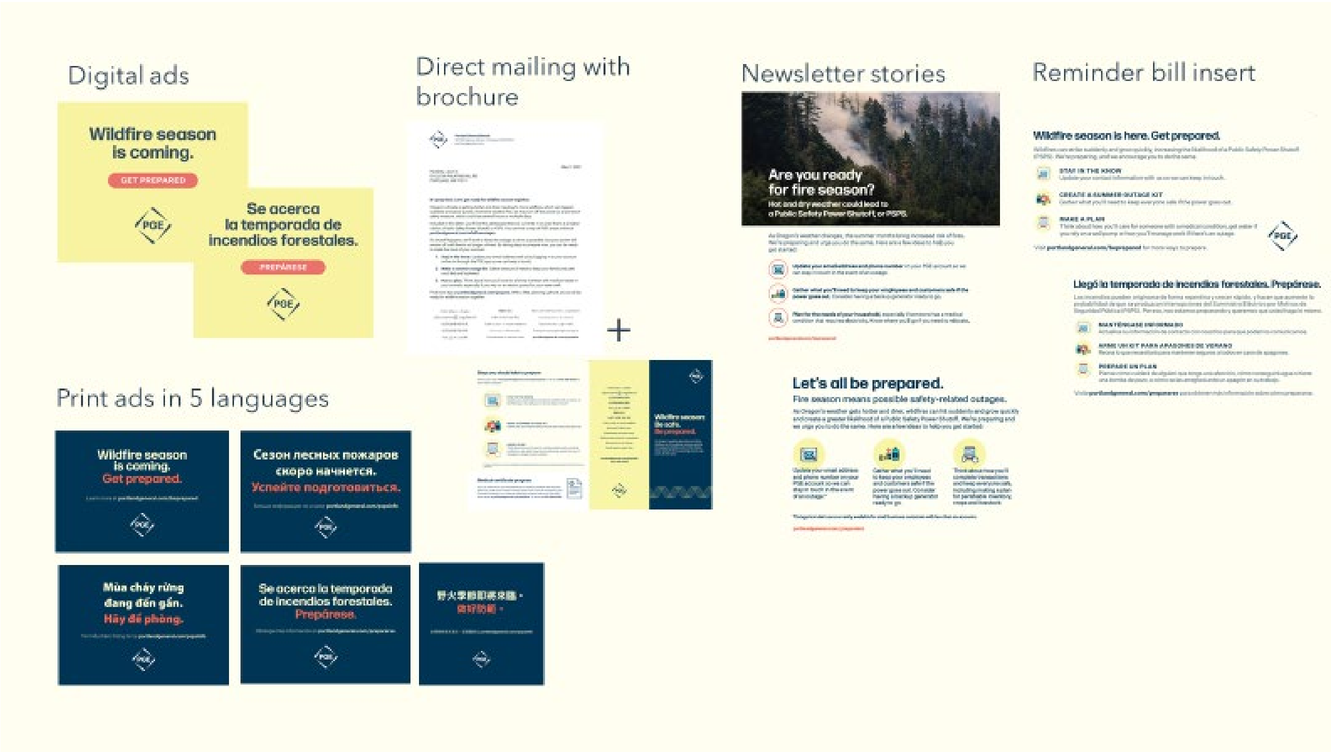
Appendix 4: Inventory of Community Outreach and Engagement Materials and Channels (2022)

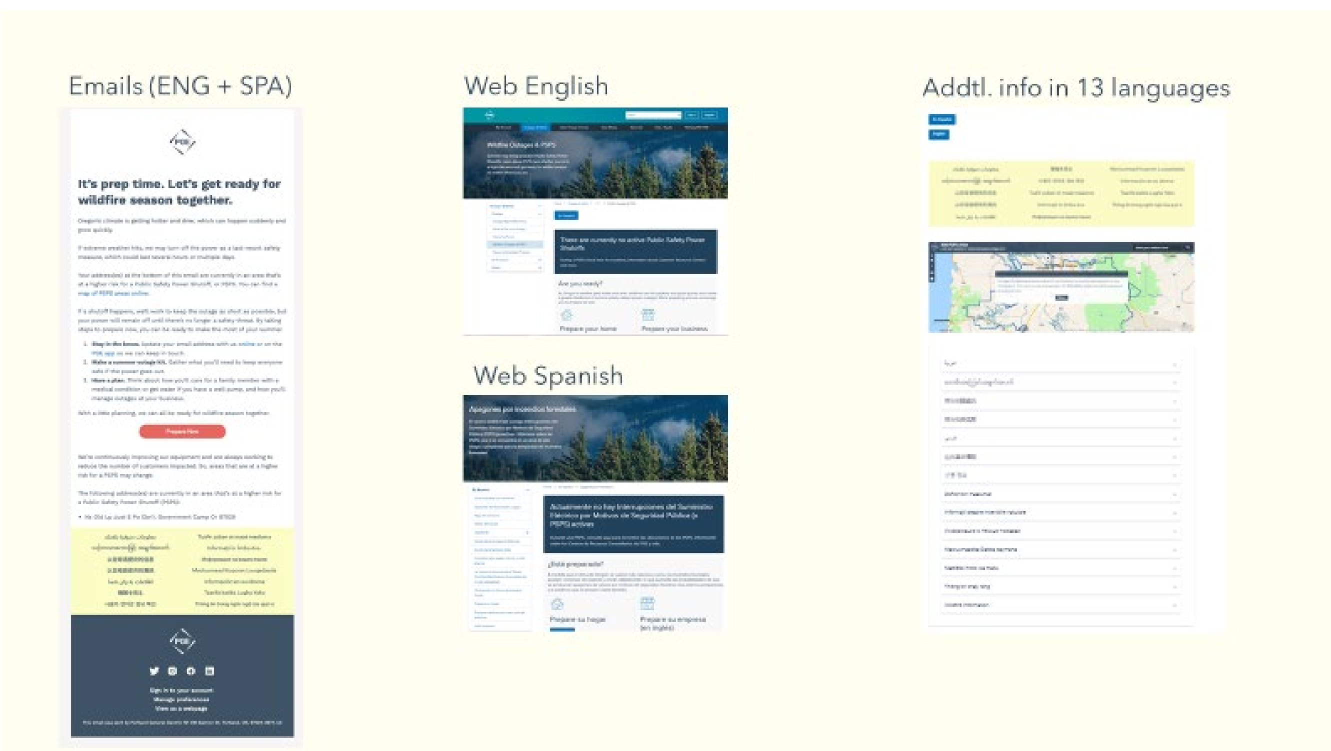
Channel	Effort/Deliverable	Campaign	Audience	Timing
Stakeholder outreach around new HFRZs with one-pager on wildfire mitigation and HFRZ information	Emails, phone calls, meetings	Wildfire Preparation & PSPS Awareness	All Stakeholders	Dec. 2021
PortlandGeneral.com wildfire and PSPS information	https://portlandgeneral.com/outages-safety/wildfire-outages https://portlandgeneral.com/en-esPanol/apagones-por-incendios-forestal https://portlandgeneral.com/outages-safety/safety/wildfire-safety https://portlandgeneral.com/outages-safety/be-prepared https://portlandgeneral.com/outages-safety/be-prepared/prepare-your-home https://portlandgeneral.com/en-esPanol/prepare-su-hogar https://portlandgeneral.com/outages-safety/be-prepared/prepare-your-business	Wildfire Preparation & PSPS Awareness	Broad awareness	March 2022 through Fire Season
Tool kit in 15 languages that provided preparedness tips and info about PSPS areas	Direct email	Wildfire Preparation & PSPS Awareness	Community-Based Organizations	June 24, 2022
Statewide press release for Wildfire Awareness Month	Press release	Wildfire Preparation	Media, public	May 9, 2022
Public Information Officers (regional and in cities/counties that have PSPS areas)	Toolkit	Wildfire Preparation + PSPS Awareness	Broad public	July 13, 2022
Advertising				
Direct customer communications & PGE newsletters				
Media engagement about wildfire preparedness & PSPS awareness	Interviews and information shared with KGW, KATU, KOIN, KPTV, Oregon Capital Chronicle, Oregon Public Broadcasting, KDRV, KTVZ, Bloomberg, Utility Dive, and others.	Wildfire preparation & PSPS Awareness	Broad public	May through Sept. 2022

Channel	Effort/Deliverable	Campaign	Audience	Timing
Community wildfire preparedness meetings to share preparedness and PSPS information	WM&R presentations at six events focused on wildfire preparedness at the request of government officials and public safety partners. Brochures about wildfire awareness and PSPS were available in English and Spanish.	Wildfire Preparation & PSPS Awareness	Public, customers	May and June 2022
Social media posts about wildfire preparedness and PSPS	Posts on @portlandgeneral on Twitter and @portlandgeneralelectric on Facebook	Wildfire preparation & PSPS Awareness	Public, customers	May through Sept. 2022

Appendix 5: 2022 Wildfire Outreach and Awareness Timeline




Digital ads
Wildfire season is coming.
GET PREPARED
Se acerca la temporada de incendios forestales.
PREPÁRESE
Direct mailing with brochure
Newsletter stories
Are you ready for fire season?
Hot and dry weather could lead to a Public Safety Power Shutoff, or PSPS.
Let's all be prepared.
Fire season means possible safety-related outages.
Reminder bill insert
Wildfire season is here. Get prepared.
Llegó la temporada de incendios forestales. Prepárese.
Print ads in 5 languages
Wildfire season is coming. Get prepared.
Сезон лесных пожаров скоро начнется. Успейте подготовиться.
Mùa cháy rừng đang đến gần. Hãy đề phòng.
Se acerca la temporada de incendios forestales. Prepárese.

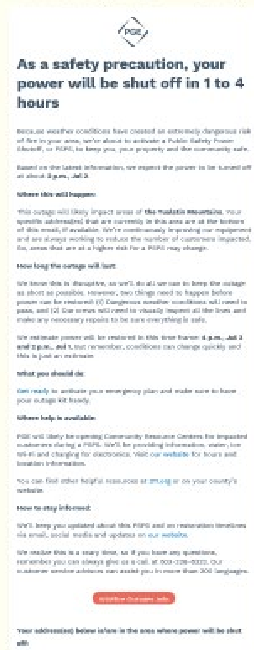

Emails (ENG + SPA)
It's prep time. Let's get ready for wildfire season together.
Web English
Wildfire Outages & PSPS
There are currently no active Public Safety Power Shutoffs
Prepare your home
Prepare your business
Web Spanish
Apagones por incendios forestales
Actualmente no hay Interrupciones del Suministro Eléctrico por Motivos de Seguridad Pública (o PSPS) activos
Prepare su hogar
Prepare su empresa (en inglés)
Addtl. info in 13 languages

Wildfire event customer comms

Digital ads - Event likely (ENG + SPA)

Digital ads - Event happening (ENG + SPA)

Emails (ENG + SPA)



Web banner & PSPS active page

SP to screenshot

Expanded details

March – May

- March/April: Web pages (test pages: landing, /prepare, /preparebiz, /wildfireoutages, /psps, /wildfire) live + constant, iterative improvement
- May 10: PSPS letter/DM sent to customers with 4-panel brochure
- May 9 - 20: Email to ALL residential & biz customers, excluding customers in PSPS zone
- May 2 - 6: Email 1 to PSPS customers (RES & BIZ)
- May 23 - 27: Email 2 to PSPS customers (RES & BIZ) who didn't email open

May - September

May 1: Newsletter story in Home Connection & Business Connection

Web pages (test pages: landing, /prepare, /preparebiz, /wildfireoutages, /psps, /wildfire) live + constant, iterative improvement

- Paid and organic social
  - Run through September
- June 1: Radio ads
  - Run through September
  - Streaming targeted: 80% of spend focused on PSPS areas, 20% territory-wide
  - Terrestrial radio, focused on country and oldie stations
- June 1: Digital ads
  - Run through September
  - Targeted: 80% of spend focused on PSPS areas, 20% territory-wide
- June 27-July 11: Reminder email to PSPS customers (RES & BIZ)
- July: Print ads

Web pages (ENG/SPA/Multi lang)

Launch 3/21 with constant, iterative improvement through September

- Prepare landing – Generic landing for residential or business customers, links to preparedness pages and helpful outage information.
- Prepare your home - Educate residential customers about what they need to do to prepare for summer outages.
- Multilanguage page – Educate customers in 13 languages on how to use interactive map, how to prepare and where to get the latest information.
- Prepare your business – Educate general business and key customers about what they need to do to prepare for summer outages.
- Wildfire outages – Educate customers (and media) about wildfire threat and resulting PSPS possibility. Define a PSPS, show map of zones, answer FAQs.
- Wildfire safety - Educate stakeholders (and customers) about wildfire threat & what we're doing to keep they system safe.

Email/Direct Mail/Newsletter story

Email -

May 2 - 6 - PSPS customers - you are in a high-risk area for wildfires, here's how you prepare

- Residential English
- Business English
- Residential Spanish
- Customers with both residential and commercial accounts

May 9 - 20 - All customers - Get prepared for wildfire season

- Residential English
- Residential Spanish
- Business English

May 23-27: Reminder only to customers who didn't open first email - PSPS customers - reminder to get prepared

- Residential English
- Residential Spanish
- Business English

June 27-July 11: Reminder email to all PSPS customers (BIZ & RES)

Direct Mail

May 9 & 10: PSPS customers - you are in a high-risk area for wildfires, here's how you prepare

- PSPS residential customers English
- PSPS residential customers Spanish
- PSPS business customers English
- Customers with both residential and commercial accounts

Newsletter story in Home Connection & Business Connection

May bill cycles - Get prepared (Home Connection & Business Connection)

- Residential English
- Business English

July bill cycles: Reminder newsletter (Home Connection)

Aug. bill cycles: Reminder newsletter (Business Connection)

Targeted bill insert to PSPS customers (RES & BIZ)

- June 15 - July 15: targeted bill insert

Advertising

Digital

- English and Spanish
- June - September
- 80% of spend targeted to PSPS areas, 20% territory-wide

Radio

- English and Spanish
- June - September
- Streaming radio will target 80% of spend on PSPS areas, 20% territory-wide
- Terrestrial radio English, focused on oldie and adult contemporary or country stations
- Terrestrial radio Spanish will play on all stations in local media network, Bustos.

Print (Oregonian, Gresham Outlook, Beaverton Valley Times, Hillsboro News Times, Statesman Journal, El Latino De Hoy, + Chinese/Vietnamese/Other non-English outlets)

- July
- English will target local community papers in PSPS areas
- Spanish will run in largest local Spanish-language publication

Appendix 6: Outcomes of 2022 Outreach and Awareness Efforts

1. Wildfire Webpage Visits (May-September)

- 4,403 sessions to https://portlandgeneral.com/psps-info
- 186,177 sessions to https://portlandgeneral.com/outages-safety/wildfire-outages
- 10,168 sessions to https://portlandgeneral.com/en-esPanol/apagones-por-incendios-forestales10,168 sessions to https://portlandgeneral.com/en-esPanol/apagones-por-incendios-forestales
- 4,689 sessions to https://portlandgeneral.com/outages-safety/safety/wildfire-safety
- 27,962 sessions to https://portlandgeneral.com/outages-safety/be-prepared
- 48,805 sessions to https://portlandgeneral.com/outages-safety/be-prepared/prepare-your-home
- 3,175 sessions to https://portlandgeneral.com/en-esPanol/prepare-su-hogar3,175 sessions to https://portlandgeneral.com/en-esPanol/prepare-su-hogar
- 1,421 sessions to https://portlandgeneral.com/outages-safety/be-prepared/prepare-your-business

2. Newsletter and Email Results

Newsletter

- **Home Connection – goes to 325k+**
  - May – 40% OR; 3.12 Click-to-open rate
  - July – 50% OR; 3.47 Click-to-open rate
- **Business Connection – goes to 12k+**
  - May – 38% OR; 2.8% Click-to-open rate
  - August – 44% OR; 2.4% Click-to-open rate

Email

- **Round 1**
  - In Zone: Early May – 43% OR: 2.9% Click through rate
  - In Zone: Late May reminder – 17% OR; 1.9% Click through rate
  - Not In Zone – 48% OR; 1.4% Click through rate
- **Round 2**
  - In Zone (biz, res (Eng/Span) and biz+res) – 44% OR; 1.7% Click through rate
  - Not In Zone – 49% OR; 1.4% Click through rate

Digital Banner Ads

- *English:*
  - Impressions: 5,179,558
  - Clicks: 6972
  - Click-through rate: 0.13%
- Spanish
  - Impressions: 2,124,270
  - Clicks: 4033

  - Click-through rate: 0.19%

Pandora Digital Radio

- English
  - Impressions: 1,721,154
  - Clicks: 2038
  - Click-through rate: 0.19%
- Spanish
  - Impressions: 227,042
  - Clicks: 346
  - Click-through rate: 0.27%

Appendix 7: Toolkit for Community-Based Organizations (CBOs)—Sample Outage Preparedness Messages for Social Media, email, Newsletter and Website Messaging

Toolkit – Wildfire Preparedness

May 2022

Social media posts

English	Hot and dry weather conditions increase the risk of wildfires and the likelihood of safety-related power outages. So, PGE wants you to be prepared. Learn how to stay in the know, create an outage kit and make a plan to keep your family safe at **portlandgeneral.com/prepare.**
Arabic	إن حالات الطقس الجاف والحار تزيد من خطر نشوب الحرائق في الغابات واحتمال انقطاع التيار الكهربائي للسلامة العامة. ولهذا، تود شركة PGE إعدادك لمواجهة ذلك. تعرَّف على كيفية البقاء على علم بالمستجدات، وأَنشِئ مجموعة أدوات انقطاع التيار الكهربائي وارسم خطة للحفاظ على سلامة أسرتك عبر موقع **portlandgeneral.com/pspsinfo.**
Chinese (simplified)	炎热干燥的天气条件会增加发生野火的风险，与安全相关的停电的可能性也会增加。所以，PGE 希望您做好准备。在 **portlandgeneral.com/pspsinfo** 上学习如何了解最新情况、如何打造停电工具包以及如何制定家庭安全计划。
Chinese (traditional)	炎熱乾燥的天氣條件會增加發生野火的風險，與安全相關的停電的可能性也會增加。所以，PGE 希望您做好準備。在 **portlandgeneral.com/pspsinfo** 上學習如何瞭解最新情況、如何打造停電工具包以及如何制定家庭安全計畫。
Farsi	شرایط آب‌وهوایی گرم و خشک خطر آتش‌سوزی جنگل‌ها و احتمال قطعی برق مرتبط با ایمنی را افزایش می‌دهد. بنابراین، PGE از شما می‌خواهد آماده باشید. نحوه مطلع ماندن، تهیه کیت لوازم ضروری در زمان قطعی برق و برنامه‌ریزی برای ایمن نگه داشتن خانواده خود را در **portlandgeneral.com/pspsinfo**
Japanese	気候が熱く乾燥していると、山火事のリスクや安全に関わる停電発生の可能性が高まります。そこで、PGEから万が一に備えた準備についてご案内いたします。**portlandgeneral.com/pspsinfo**にアクセスして、ご家族皆様の安全をお守りできるよう、役立つ情報をご確認の上、停電キットを作成してください。
Korean	덥고 건조한 날씨는 산불 위험과 안전 관련 정전 가능성을 높입니다. PGE와 함께 위험에 대비하시기 바랍니다. **portlandgeneral.com/pspsinfo**에서 최신 정보를 파악하고, 정전

	키트를 만들고, 가족을 안전하게 지키기 위한 계획을 세우는 방법을 알아보십시오.
Rohingya	Goróm ar fúwana abaháwar haálot ókkol ólla bouli zoñlor-oin or hótara ar óitfaredé héfazoti-mutalek kaáren bon táka ókkol bari zargoi. Étolla, PGE é oñnorare toiyar rákito saár. Zanifuni keengori tákiba, outage kit (kaáren bon tákar saaman) toiyari ar oñnor fémelire héfazot rákibar plan ókkol zaniloiyó eçe **portlandgeneral.com/pspsinfo.**
Russian	Жаркие и засушливые погодные условия повышают риск возникновения лесных пожаров и вероятность отключения электроэнергии для обеспечения безопасности. Поэтому компания PGE хочет подготовить вас к этому. С советами о том, как оставаться в курсе событий, подготовить набор необходимых вещей на случай летних отключений электроэнергии и составить план по обеспечению безопасности своей семьи можно ознакомиться на странице **portlandgeneral.com/pspsinfo.**
Somali	Xaaladaha cimilada kulul ee qalalan ayaa kordhinaaya khatarta dabka iyo suurtagalnimada koronto jarista la xariirta badqabka. Marka, PGE waxay doonaysaa inaad diyaar garoowdo. Baro sida aad ku helayso xogtii ugu danbaysay, furo kiishada xogta ee ku saabsan koronto go'a kadibna samayso qorshe aad ku dhawrayso badqabka qoyskaaga adoo galaaya **portlandgeneral.com/pspsinfo.**
Spanish	Los climas cálidos y secos aumentan el riesgo de incendios y la probabilidad de apagones por seguridad. Por eso, PGE quiere que esté preparado. Conozca cómo estar informado, crear un kit para apagones y un plan para mantener a su familia segura en **portlandgeneral.com/prepararse.**
Swahili	Hali ya hewa ya joto na kavu huongeza hatari ya moto wa mwituni na uwezekano wa kupotea kwa nguvu za umeme kwa sababu ya usalama. Hivyo basi, PGE ingependa uwe tayari. Pata maelezo kuhusu jinsi ya kupata taarifa, kuunda zana ya kupotea kwa umeme na kuweka mpango wa kudumisha usalama wa familia yako kwenye **portlandgeneral.com/pspsinfo.**
Vietnamese	Điều kiện thời tiết nóng và khô làm tăng nguy cơ cháy rừng và khả năng cắt điện vì lý do an toàn. Do đó, PGE muốn quý vị chuẩn bị sẵn sàng. Tìm hiểu cách luôn cập nhật thông tin, tạo lập một bộ công cụ phòng khi cắt điện và lập kế hoạch giữ an toàn cho gia đình quý vị tại **portlandgeneral.com/pspsinfo.**

Newsletter or web copy

English	If extreme weather conditions threaten PGE's ability to safely operate the electrical grid, they may need to turn off power to help protect

	public safety. These last-resort safety outages are called a Public Safety Power Shutoffs, or PSPS. No one likes an outage but being prepared makes them a little easier to get through. Find tips at **portlandgeneral.com/pspsinfo.**
Arabic	إذا كانت الظروف الجوية القاسية تهدد قدرة PGEعلى تشغيل شبكة الطاقة الكهربائية بأمان، فيتعيّن عليهم فصل التيار الكهربائي للمساعدة في حماية السلامة العامة. تُعرف عمليات انقطاع التيار الكهربائي لدواعي السلامة التي يتم اللجوء إليها كحلٍّ نهائيٍّ باسمPublic Safety Power Shutoffs (انقطاع التيار الكهربائي للسلامة العامة)، أو PSPS. لا أحد يحب قطع التيار الكهربائي ولكن الاستعداد لذلك يُسهِّل عملية تجاوز تلك الفترة. اطلع على النصائح على **portlandgeneral.com/pspsinfo**
Chinese (simplified)	如果极端天气条件威胁到 PGE 安全运行电网的能力，他们可能需要关闭电源，以帮助保护公共安全。这种停电是最后的手段，被称为 Public Safety Power Shutoffs（公共安全电源关闭），或 PSPS。没有人喜欢停电，但做好准备会让停电不那么难熬。在 **portlandgeneral.com/pspsinfo 上查找提示。**
Chinese (traditional)	如果極端天氣條件威脅到 PGE 安全運行電網的能力，他們可能需要關閉電源，以幫助保護公共安全。這種停電是最後的手段，被稱為 Public Safety Power Shutoffs（公共安全電源關閉），或PSPS。沒有人喜歡停電，但做好準備會讓停電不那麼難熬。在 **portlandgeneral.com/pspsinfo 上查找提示。**
Farsi	اگر شرایط آب‌وهوایی غیرعادی توانایی PGE برای اداره ایمن شبکه برق را تهدید کند، ممکن است لازم باشد آنها برای کمک به محافظت از ایمنی عمومی برق را قطع کنند. این قطعی‌های برق با هدف حفظ ایمنی، که آخرین راه‌حل هستند، Public Safety Power Shutoffs (قطعی‌های برق جهت حفظ ایمنی عمومی) یا PSPS نامیده می‌شوند. هیچ‌کس قطعی برق را دوست ندارد، اما آمادگی قبلی پشت سر گذاشتن قطعی برق را کمی آسان‌تر می‌کند. نکات را در **portlandgeneral.com/pspsinfo** پیدا کنید.
Japanese	気候の状況があまりにも過酷でPGEが送電網を安全に操作できない場合は、公衆安全を保護するために電気を停止させていただくことがあります。このような停電は最後の手段となり、Public Safety Power Shutoffs(保護停電公衆安全）またはPSPSとも呼ばれます。停電は誰もが不便を感じるものですが、停電に向けて準備をすることで少しは乗り越えやすくなります。**portlandgeneral.com/pspsinfo**にアクセスして、役立つヒントをご確認ください。
Korean	극한의 기상 조건이 PGE의 안전한 전력망 운영 능력에 위협이 되는 경우, 공공 안전을 보호하기 위해 전력 공급을 중단해야 할 수도 있습니다. 이렇게 안전을 위한 최후의 수단으로서 실시하는 정전을 Public Safety Power Shutoff(PSPS, 공공 안전 전원 차단)라고 합니다. 정전을 좋아하는 사람은 아무도 없지만 미리 준비한다면 좀 더 수월하게 대응할 수 있습니다. 관련 팁은 **portlandgeneral.com/pspsinfo**에서 제공됩니다.
Rohingya	Zodi ódorbaára abaháwar haálot é PGE ír héfazoti kaáren bebosta gorár kaabiliyotire dómkidile, ítara aám maincor héfazot ólla bouli kaáren bon gori fílit fare. Héfazotílla kaáren bon tákede é ahéri mouka íyan ore Public Safety Power Shutoffs (Páblik or Héfazoti Kaáren Bon

	Táka), yáto PSPS bouil hoó. Kiyóu kaáren no tákare fosón no gore kintu toiyar tákile cómoi iín faráite asán ó. Mocuwara ókkol tuwai so eçe **portlandgeneral.com/pspsinfo.**
Russian	Если ввиду экстремальных погодных условий компания PGE не может гарантировать безопасность эксплуатации электрической сети, компания может быть вынуждена отключить электроснабжение для обеспечения общественной безопасности. Такие крайние меры в виде аварийных отключений называются Public Safety Power Shutoffs (отключения электроэнергии для обеспечения общественной безопасности) или PSPS. Никому не нравятся подобные отключения, но их легче пережить, будучи готовым. Больше советов по ссылке **portlandgeneral.com/pspsinfo.**
Somali	Haddii xaaladaha cimilada daran ay khatar gashaan awooda PGE ee ku shaqaynta si amaan ah qalabka korontada, waxay u baahan karaan inay damiyaan korontada si loo dhawro badqabka dadwaynaha. Koronto jaristaan ah talaabada ugu danbaysa ee badqabka ayaa loogu yeeraa Public Safety Power Shutoffs (Koronto Jarista Badqabka Dadwaynaha), ama PSPS. Ma jiro qof jecel koronto goyn laakiin inaad u diyaar garoowdo ayaa yaraysa niyad jabka hadhoow imaan kara. Tilmaamo ka fiiri **portlandgeneral.com/pspsinfo.**
Spanish	Si, debido a condiciones meteorológicas extremas, se ve afectada la capacidad de PGE para operar la red eléctrica de manera segura, cortaremos la energía para contribuir a la protección de la seguridad pública. Estos apagones se realizan como último recurso de seguridad y se denominan Public Safety Power Shutoffs (Interrupciones del Suministro Eléctrico por Motivos de Seguridad Pública) o PSPS. A nadie le gustan los apagones, pero estar preparado hace que sean un poco más fáciles de sobrellevar. Encuentre consejos en **portlandgeneral.com/prepararse.**
Swahili	Ikiwa hali mbaya ya hewa inatishia uwezo wa PGEwa kuendesha gridi ya umeme kwa usalama, wanaweza kuhitaji kuzima nguvu za umeme ili kusaidia kulinda usalama wa umma. Hatua hii ya mwisho ya kupoteza umeme inajulikana kama Public Safety Power Shutoffs (Kuzima Umeme kwa Sababu ya Usalama wa Umma), au PSPS. Hakuna mtu anayependa kupotea kwa umeme lakini kuwa tayari kunarahisisha kidogo kukabili hali hii. Pata vidokezo kupitia **portlandgeneral.com/pspsinfo**.
Vietnamese	Nếu điều kiện thời tiết khắc nghiệt có nguy cơ làm trở ngại khả năng của PGE trong việc vận hành an toàn mạng lưới điện, công ty có thể cần cắt nguồn điện để giúp bảo vệ an toàn công cộng. Các biện pháp an toàn cuối cùng bằng cách cắt điện này được gọi là Public Safety Power Shutoffs (Cắt Điện Vì An Toàn Công Cộng), hay PSPS. Không ai thích rơi vào tình trạng mất điện nhưng việc chuẩn bị sẵn sàng sẽ giúp họ vượt qua điều đó dễ dàng hơn một chút. Hãy xem các lời khuyên tại **portlandgeneral.com/pspsinfo.**

July 2022

PGE Wildfire + PSPS Toolkit

Overview

Portland General Electric (PGE) is preparing for the 2022 Wildfire Season and the possibility of proactive Public Safety Power Shutoffs (PSPS) as a tool to help protect lives and property—like we did in the Mt. Hood corridor during the September 2020 wildfires that swept across Oregon.

This year, parts of 10 areas in communities we serve are at higher risk for Public Safety Power Shutoffs, including:

1. Mt. Hood Corridor/Foothills
2. Columbia River Gorge
3. Oregon City
4. Estacada
5. Scotts Mills
6. Portland West Hills
7. Tualatin Mountains
8. North West Hills
9. Central West Hills
10. Southern West Hills

A map of those PSPS areas is at portlandgeneral.com/wildfireoutages. That page is available in English and Spanish and includes a link to portlandgeneral.com/psps-info for information and brochures about wildfire preparedness and information about PSPS's in Arabic, Burmese, Chinese (simplified and traditional), Farsi, Japanese, Korean, Romanian, Rohingya, Russian, Somali, Swahili, and Vietnamese. Our customer service advisors can also assist customers in 200+ languages.

While we have sectioned off our system to reduce the number of customers who may be impacted by a PSPS, and we are communicating broadly and directly to all who may be impacted, we would appreciate your help encouraging communities to plan and prepare.

You may use the information below on your website, in newsletters and on your social media channels. In the event that we experience extreme weather conditions that may lead to a PSPS, PGE will share information over numerous channels, including via portlandgeneral.com, PGE's social media channels, through FlashAlert and outreach to PIOs, Public Safety Partners and media in affected areas.

If you have any questions about these materials or want to make sure you're on our PIO contact list, please contact PGE via PGECommunications@pgn.com.

Wildfire Brochure

You may print and share the document attached to your email titled *PGE 2022 Wildfire + PSPS One Pager May* or post it on your website. It provides an overview of PGE's year-round focus on wildfire protection and steps customers can take to get prepared. It also includes an explanation of Public Safety Power Shutoffs, when they are called and what to expect.

Web Copy

As Oregon's weather gets hotter and drier, the possibility of wildfires and a Public Safety Power Shutoff is increasing. If you're a PGE customer, learn how to stay in the know, make a summer outage kit and a plan. Check PGE's interactive map to see if your home or business is in an area where PGE may proactively shut off power to protect public safety. Visit portlandgeneral.com/wildfireoutages.

Newsletter Copy

Hot and dry weather could lead to a Public Safety Power Shutoff, or PSPS.

As Oregon's weather changes, the summer months bring increased risk of fires. Everyone has a role to play when it comes to being prepared. If you're a PGE customer:

- ***Stay in the know** by updating your email address and phone number on your PGE account so they can stay in touch in the event of an outage.*
- ***Create an outage kit** by gathering what you'll need to keep employees, customers and your family safe if power goes out. Make sure your employees and family members know where to find it.*
- ***Make a plan** to keep your business or family safe during an outage, especially if a medical condition or water for livestock or crops requires electricity. Know where you'll go if you need to relocate.*

Social Media Copy

PGE is posting wildfire preparedness information on Twitter (@PortlandGeneral), Facebook (@PortlandGeneralElectric) and Instagram (@PortlandGeneral). Posts are available in English and Spanish.

Please use the links below to retweet on Twitter, share on Facebook and/or share to your organization's stories on Instagram. Feel free to tag us!

Also, please note that in the event we call a PSPS, we will share updates on Facebook, Instagram and Twitter and would appreciate your amplification.

Social Posts to Amplify

Please consider liking and sharing these posts on Facebook, retweeting PGE posts and sharing PGE posts as Instagram stories.

- Post on 5/11: Summertime means Prep Time! Fire Season is here – now is the time to start thinking about the proactive steps you can take to best prepare for the potential of wildfire and corresponding power outages. Learn more: bit.ly/3F4nbCm

  Twitter:
  https://twitter.com/portlandgeneral/status/1524426615660453889?s=20&t=1Bbyv8rEtWnO-vdG2_kh4w
  Facebook:
  https://www.facebook.com/PortlandGeneralElectric/posts/5873100286050493
  Instagram: https://www.instagram.com/p/CdbK1tguYks/?utm_source=ig_web_copy_link

- Post on 5/18: As Oregon's weather gets hotter and drier, wildfires can hit suddenly and grow quickly. NOW is the time to confirm your contact information is up to date in our system so that we can alert you ahead of, and throughout, potential wildfire outages.

  Twitter:
  https://twitter.com/portlandgeneral/status/1526963325371826176?s=20&t=1Bbyv8rEtWnO-vdG2_kh4w
  Facebook:
  https://www.facebook.com/PortlandGeneralElectric/posts/5893798357314019

- Post on 5/25: When wildfires hit and electricity outages occur, what's your plan? With a little planning, we can all be ready for Wildfire Season together.

  Twitter: https://twitter.com/portlandgeneral
  Facebook: https://www.facebook.com/PortlandGeneralElectric
  Instagram: https://www.instagram.com/portlandgeneral/

- Post on 6/1: For us, being prepared is a year-round effort to protect people, property, and natural environments. Our crews regularly inspect our poles and equipment and make necessary modifications or replacements to reduce the risk of a spark.

  Twitter: https://twitter.com/portlandgeneral
  Facebook: https://www.facebook.com/PortlandGeneralElectric
  Instagram: https://www.instagram.com/portlandgeneral/

Next Steps

As we move through Wildfire Season, additional toolkit content may be shared. Please reach out to PGECommunications@pgn.com if you have questions or need additional information and resources. We appreciate your help getting information out and raising awareness!

It's fire season. Be prepared.

Oregon's climate is getting hotter and drier, and that means wildfires can hit suddenly and grow quickly. If extreme weather conditions make it unsafe to keep our equipment on, we may need to turn off the power as a last-resort safety measure.

These outages, also known as a **Public Safety Power Shutoff (PSPS)**, could last several hours or multiple days, so it's important to be prepared.

You can find a map of areas that are at higher risk for safety-related outages at **portlandgeneral.com/wildfireoutages**.

Here's how you can prepare:

1 **Stay in the know** by updating your email on your PGE account so we can send you notices in the event of a safety-related outage.

2 **Create a summer outage kit** and make sure everyone in your home knows where to find it.

Some basic items include:

- Emergency phone numbers, including PGE Customer Service: 503-228-6322

  Our customer service advisors can assist you in 200+ languages.
- Flashlights or headlamps
- Battery-powered or hand-crank radio and clock or watch
- Battery-powered or hand-held fans
- Extra batteries
- Car chargers for cell phones, laptops and/or tablet computers
- Bottled water for people and animals (if you rely on electricity to pump water)
- Frozen cold packs or water frozen in bags or plastic bottles (keep ready in your freezer)

3 **Make a plan** to keep your family and your home safe during an outage.

- Plan ahead to relocate with a friend, family member or to a shelter, especially if you have a medical condition that requires electricity or if you'll need to work or learn from home during an outage.
- Plan for medical needs so you can still power medical equipment during an outage and consider enrolling in our Medical Certificate program. This will help us proactively communicate with you about outages. Visit **portlandgeneral.com/medical** or call 503-612-3838 to learn more about the program.
- Consider buying a backup generator and follow manufacturers' guidelines for its safe operation.
- Plan for feeding and watering pets or livestock if you rely on an electric pump for water.
- Get more information from your county's website or the **National Fire Protection Association**, the **Red Cross** and **Ready.gov**.

Find additional tips on how to get prepared at **portlandgeneral.com/prepare**.

Appendix 8: Summary of Input from Public Safety Partners and Lessons Learned Captured During the 2022 Fire Season

The following improvement plan includes a set of recommendations for identified actions that are based on observations presented in PSPS Tabletop AAR, Public Safety Partners communication conference calls, and September 2022 PSPS AAR. As appropriate, these actions have been incorporated throughout the 2023 WMP.

Core Capability	Objective ID	Objective
Public Information and Sharing	A	Identify what sequential and iterative notifications need to be made, the process to be taken, and who will support notifications.
	B	Identify customer communications needs and conduct appropriate stakeholder outreach.
Operational Coordination	C	Determine how the Corporate Incident Management Team (CIMT) is activated and structured.
	D	Identify key points of coordination with jurisdictional Emergency Operations Centers (EOCs).
Intelligence and Information Sharing	E	Identify what data and information are required to support decision making including identification of specific information and data products.
Operational Coordination	F	Identify primary and alternate means of communicating with internal and external partners.
	G	Identify communications/data management failure points with limited or no redundancy that could lead to failures in informing customer information needs.

Recommended actions that have been added are:

Objective ID	Opportunities for Improvement	Recommended Actions
D	Confusion in difference of communications between emergent, PSPS, restoration, etc.	Designate specific communications for Preventative Outage Area initiation, PSPS, and restoration.
D, F	Need for enhanced coordination with external partners to identify required information and updates needed during a PSPS.	Create unique templates for critical Public Safety Partners with partner input.
G	Public Safety Partners asked to expand the socialization of the PSPS plan with external partners.	Develop and socialize external facing PSPS plan elements (e.g., PSPS Bell Curve) that can be aligned with or incorporated into Public Safety Partner operational plans.

Objective ID	Opportunities for Improvement	Recommended Actions
A	Public Safety Partners identified need to coordinate timing of messaging to minimize confusion and the impact of other emergency alerts.	Coordinate with public safety partners to align notification procedures including cadence of notifications and use of mass notification systems.
All	Internal and External observations regarding vocabulary and acronym confusion.	Formalize a shared vocabulary within internal and external partners to ensure consistent messaging.
A, B	Establish and socialize triggers signaling PGE staff to send updates to Public Safety Partners	Document list of triggers to send updates to public partners to include with PSPS Playbook and NEP Tracker.
E	PGE acknowledged it is helpful when customer resource centers publicize hours of service.	Coordinate with public safety partners around messaging provided at facilities providing assistance to impacted populations (e.g., cooling centers) to support consistency and alignment of messaging
D	Align PSPS response, with cadence of communications withing the CIMT structure.	Align PSPS response in PSPS Playbook and with reference to the timing a news cycle.

The following table summarizes Lessons Learned from the September 2022 PSPS event in PGE's service territory:

Strengths	
Crisis Communications	PGE demonstrated a sincere commitment to communicate and coordinate with external partners.
Whole Community	Stakeholder communications were robust and comprehensive
	On-the-fly adjustments to community support strategies were effective
	Working collaboratively with PGE, some counties stood up their own CRCs at public locations, while PGE donated supplies to these locations for distribution to impacted communities
Operations	Additional recloser installations prior to the event enabled PGE to reduce the September 2022 PSPS event's customer impacts
	The expanded (for 2022) network of PGE weather stations provided an accurate view of meteorological conditions closer to PGE infrastructure when compared to other weather stations in the regional network
Community Resource Centers	Customers were grateful that PGE was present—CRCs are invaluable during PSPS events and a positive expression of PGE's care for the community

Opportunities for Improvement	
Crisis Communications	Advise and support Public Safety Partners to host a workshop to clarify cross-jurisdictional coordination responsibilities for alerts and warnings.
	PGE and Public Safety Partners should evaluate the use of WEA for PSPS events and define policies and agreements to facilitate its successful and beneficial deployment and reduce "overspray" confusion for notification recipients
Operations	Define additional internal controls for PSPS Areas to more precisely align appropriate PSPS boundaries and actual outage areas.
	Invest in additional tools and equipment to allow more targeted and automated control of PSPS Areas
	Update PSPS Area data to include all critical facilities with consideration for seasonality such as back-to-school dates.
	Designating additional Preventive Outage Areas, in real-time, created communications, operational, logistical and community support challenges.
	During future PSPS events, Ops will use QEWs for patrol crews; field weather observations, however, could be conducted by classifications other than QEWs.
	Cutsheets should be finalized as far as possible in advance of the PSPS event and should be named by feeder and by HFRZ. During the September 2022 PSPS event, crews had to do a lot of sorting through the cutsheets to identify the feeders that needed to be de-energized for each zone; each cutsheet should include a list of feeders within the HFRZ
Whole Community	Establish and document clear lines of responsibility between PGE and Public Safety Partners for CRCs, locations and information sharing.
	Evaluate the use of Wireless Emergency Alerts for PSPS events, with our Public Safety Partners, to reduce "overspray" confusion for notification recipients.
	Assess options to improve the PSPS map functionality and simplify the customer experience
Community Resource Centers	Review site locations using updated criteria and finalize contracts for all locations.
	Formalize CRC volunteer strategy, templates, and training.
	Supplemental employees signed up and trained in advance of the PSPS event.
	Renew contract with CRC vendor for 2023 wildfire season.
	Incorporate vendor recommendations into contract.

	Plan prior to fire season for worst-case scenario – identify CRC locations and ensure that adequate MRUs and supplies are available even if all 10 HFRZs are impacted by a PSPS event

Appendix 9: PGE Wildfire Risk Assessment Overview & Process

PGE consults with wildfire risk experts to model fire behavior while also benchmarking its risk methodology/modelling and data with local and international wildfire programs. Key terms in this process are identified below.

Ignition Potential Index

The Ignition Potential Index (IPI) is a relative measure of the propensity for weather conditions and fuel characteristics at a given location to result in a utility-related wildfire ignition that escapes initial suppression efforts to become a large and potentially damaging fire. PGE models the potential for a wildfire ignition as a function of wind speed, fuel dryness, and heat per unit area, using a model patterned after the California Public Utilities Commission's electric utility Ignition Index and Utility Threat Index. The model derives its base weather observations from gridMET, a historical 4-km resolution, gridded daily weather dataset; PGE applies downscaling and bias-correction algorithms to increase model precision and weather data accuracy. The following sections provide additional details regarding the weather factors considered in PGE's Ignition Potential Index model.

Wind Speed

PGE explored the use of two gridded historical wind speed datasets (gridMET and National Renewable Energy Laboratory (NREL)) in its Ignition Potential Index model. Neither dataset alone was sufficiently detailed to allow PGE to determine the influence of wind speed on the potential for a utility-caused ignition to result in significant fire damage. The gridMET dataset provides detailed daily wind speed grids but includes bias on annual timescales relative to other national products with finer spatial resolutions. PGE corrected this bias using the NREL annual mean wind speed dataset (Draxl et al. 2015) by deriving a daily calibration factor from the overlapping time periods of the two datasets (2007-2013). This approach allows the model to coordinate wind speed and dryness observed in gridMET using the precision of the NREL dataset. The bias correction factor was derived by dividing the mean annual NREL wind speed by the average annual gridMET wind speed during the overlapping time periods. This factor was then applied to daily gridMET wind speeds.

Schroeder Probability of Ignition

Schroeder Probability of Ignition ([SPI], Schroeder 1969) is a long-established measure of the likelihood that a competent ignition source will result in a fire start. SPI is a function of fuel temperature and moisture content. By making some simplifying assumptions, PGE calculates SPI from air temperature and relative humidity, both of which are standard weather variables included in historical summaries and weather forecasts (such as gridMET), and both can be adjusted adiabatically (occurring without loss or gain of heat) for elevation.

Heat Per Unit Area

Heat per unit area (HPA) is a measure of the heat content of the fuelbed (kJ/m2). For surface fuels, HPA is largely a function of the surface fire behavior fuel model (fuel loading by size class and component). For crown fires, HPA also includes the proportion of canopy fuel expected to be involved in a fire.

For a given fuel complex, HPA varies with wind speed and fuel moisture content. PGE classified each day in the record into one of 27 weather types, then computed Daily HPA using a proprietary version of the FlamMap fire modeling system as a function of each cell's fuel characteristics and weather type.

During wildfire events, higher HPA values manifest in greater flame length and increased resistance to firefighter control. HPA can vary by several orders of magnitude. PGE's IPI model takes the square root of HPA to obtain an estimated flame length (flame length is roughly the square root of fireline intensity).

Conditional IPI

Conditional Ignition Potential Index (cIPI) provides PGE with a modeled representation of expected IPI for each weather type studied. The daily IPI dataset provides an assessment of fire potential based on historical observations; however, not all potential weather conditions were represented for each location in the analysis area. PGE therefore created a set of Ignition Potential indices applicable for future weather observations organized by the weather-type classification used throughout this analysis.

PGE applied this general IPI calculation with the following customizations: To calculate localized wind speed, PGE applied the downscaling factors developed to calibrate predominant winds to local, terrain-influenced wind speeds at the mid-point wind speed of each weather type. PGE calculated a mean SPI for each fuel moisture class using the daily historical record. For moisture classes with fewer than 50 observations in the historical record, PGE incorporated the SPI observations of the nearest moisture class to increase the sample size. This was necessary primarily in the northwest corner of the analysis area, where the driest moisture types rarely, if ever, occur in the historical record. PGE applied the same supplemental data approach to model the mean Large Fire Probability (LFP) for each moisture class as well.

Weather Type Probabilities

Weather type probabilities (WTP) are a set of weighting factors derived from the IPI within each weather type relative to the total IPI for a given raster cell. Rasters are matrices of cells organized into rows and columns or grids, where each cell contains a value representing information, such as temperature. Rasters are often displayed as data layers along with other geographic data on maps or used as the source data for spatial analysis.

WTPs integrate the relative ignition potential for that weather type and its relative frequency within the observed record. A weather type with high wind speed, high SPI, etc. will receive a high weighting according to the larger IPI value, but weather types with lower IPI values may also receive a higher weighting if they occur at high frequency.

Spatial Resolution

PGE used downscaling and smoothing to achieve a final cell resolution of 120 meters x 120 meters (3.56 acres). The fuel layers necessary for HPA are available at a 30-meter resolution. To resolve the spatial resolution issue, PGE resampled (using bilinear interpolation, a statistical method by which related known values are used to estimate an unknown value, using other established values located in sequence with the unknown value) the 30-meter HPA estimates for each of the 27-wind speed and fuel moisture combinations to the coarser resolutions of 120-meter and 4-kilometer (depending on the data set).

Smoothing

Data smoothing uses an algorithm to remove "noise" from a data set, such as one-time outlier data points, to allow important patterns to stand out and help the user predict trends. This relatively standard process allows PGE to resample coarse raster cells to a finer resolution—for the IPI model, from 4-kilometer (gridMET native resolution) to 120-meter. PGE used an additional custom process to remove any visible artifacts of the original 4-kilometer resolution, to maintain the fidelity of the synoptic weather processes seen in the gridMET data while achieving spatial coherence with the other provided data products at the 120-meter resolution.

For WTP, the smoothing process included a re-normalization to verify the results and ensure that the weighting factors were still valid (a fraction of the total IPI and therefore all WTP values still summed to one for a given raster cell).

Downscaling

To assess the local effects of topography on weather, PGE downscaled gridMET weather data using adiabatic[18] relationships of elevation to temperature and humidity and modeled the local topographic effect on prevalent wind direction and speeds. For each 120-meter x 120-meter cell and day in the record, PGE adjusted the observed gridMET temperature by the relative difference in elevation between the gridMET 4-kilometer cell and the finer 120-meter cell. This also changed the relative humidity at the 120-meter cell under the assumption that the same absolute water content in an area persisted under variable elevation and temperature.

To assess localized wind speeds, PGE used the WindNinja modeling system (a fluid dynamics physics model that accounts for the effects of topography on wind speed and direction) to run simulations with the prevalent wind at the eight cardinal (indicating the numerical value) and ordinal (indicating the position of the value in a series) directions. This produced eight factors that modified the 4-kilometer wind speed to show the local effects of terrain at the 120-meter resolution. For each day in the record, PGE classified the wind direction to the nearest corresponding factor and adjusted the wind speed to produce a terrain-adjusted wind speed estimate at 120-meter resolution. After

[18] "Adiabatic" refers to a process in which no heat transfer takes place.

downscaling the temperature, humidity, and wind speed, PGE then calculated daily IPI at a 120-meter resolution.

Conditional Impact

Conditional Impact (CI) is a measure of the relative impact of a wildfire (i.e., loss), given that a fire has occurred. CI is a function of fire growth potential and the vulnerability of assets and resources in the area around potential source locations. Fire growth potential is a function of fuel, weather, and topography. Vulnerability is a function of the exposure and susceptibility of homes, resources, and assets across the landscape where the fire occurred.

Unlike IPI, CI does not lend itself to a deterministic (models that produce the same exact results for a particular set of inputs) mathematical solution. To generate CI, PGE applies fire growth modeling to specific ignition locations, then ties the spatial data within the final simulated perimeters back to the ignition location. After generating the final fire-perimeter event set, PGE's model overlays each simulated wildfire with spatial data representing the impacts of wildfire—conditional losses associated with high-value resources and assets.

PGE generalized the event-set results to produce a CI raster at 120 m that represents the tendency for fires originating in that area to impact resources and assets. Thus, PGE was able to model the potential for a wildfire to result in an urban conflagration (such as the 2020 Almeda Fire in Ashland) by including burnable urban fuel models within the appropriate weather types.

Wildfire Simulation

PGE conducted wildfire simulation modeling using the Minimum Travel Time (MTT) algorithm, called Randig. Randig models short duration burn periods under constant weather conditions, assuming no suppression effects. This assumption is appropriate for modeling extreme wildfire spread events, where fire weather and fire behavior can overwhelm suppression resources. PGE applied the Randig algorithm in iterative runs using the 216 unique weather types and other parameters shown in Table 2 (weather types were derived from gridMET weather data as described above).

The following table shows example inputs for the 216 weather types included in PGE's IPI model. Each set of parameters is repeated for each of the eight cardinal direction wind bins (0, 45, 90, 135, 180, 225, 270, 315), yielding a total of 216 unique weather types. These wind speeds are banded in 9 groups of 5 mph increments.

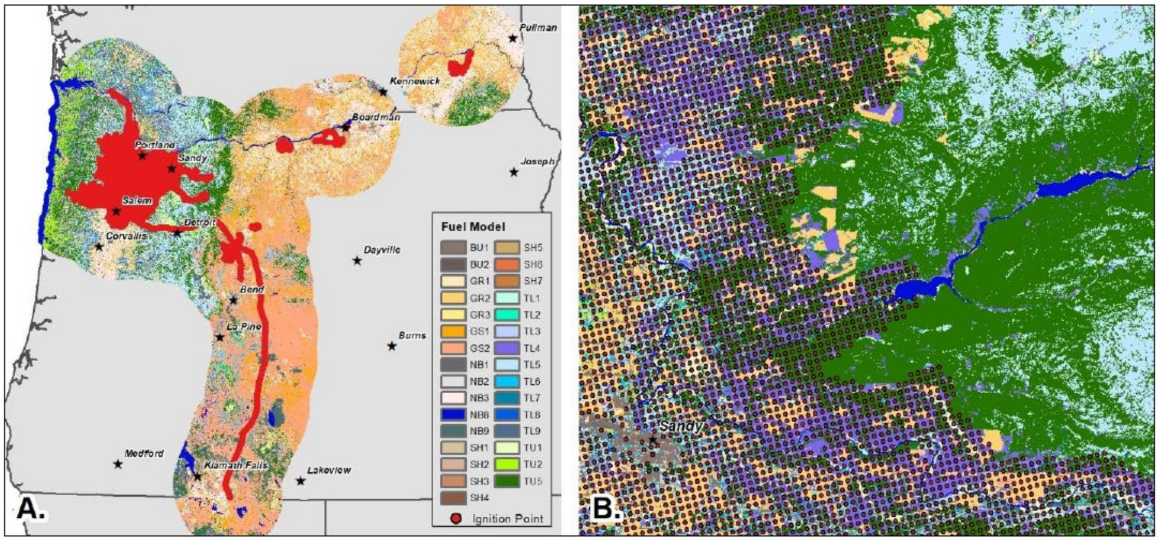
Example PGE Weather Types IPI Model Inputs

20-ft Wind Speed (mi/hr)	MC Class	1-hr MC	Live Herb MC	Live Woody MC	Duration (min)	Spot prob	Burnable Urban?
1	very dry	3%	45	80	60	10%	N
1	dry	5%	60	90	60	0%	N
1	moderate	8%	90	100	60	0%	N
5	very dry	3%	45	80	120	30%	N
5	dry	5%	60	90	120	15%	N
5	moderate	8%	90	100	120	0%	N
10	very dry	3%	45	80	180	50%	N
10	dry	5%	60	90	180	35%	N
10	moderate	8%	90	100	180	20%	N
15	very dry	3%	45	80	240	70%	Y
15	dry	5%	60	90	240	55%	N
15	moderate	8%	90	100	240	40%	N
20	very dry	3%	45	80	300	80%	Y
20	dry	5%	60	90	300	65%	Y
20	moderate	8%	90	100	300	50%	Y
25	very dry	3%	45	80	375	85%	Y
25	dry	5%	60	90	375	70%	Y
25	moderate	8%	90	100	375	55%	Y
30	very dry	3%	45	80	450	90%	Y
30	dry	5%	60	90	450	75%	Y
30	moderate	8%	90	100	450	60%	Y
35	very dry	3%	45	80	525	95%	Y
35	dry	5%	60	90	525	80%	Y
35	moderate	8%	90	100	525	65%	Y
40	very dry	3%	45	80	600	100%	Y
40	dry	5%	60	90	600	85%	Y
40	moderate	8%	90	100	600	70%	Y

The modeled weather types were further downscaled within each wildfire simulation by running Randig with both WindNinja and fuel moisture conditioning functionality. PGE used pre-calculated WindNinja grids representing terrain-adapted wind speed and direction, generated at 120 m resolution, and then up-sampled to 30 m resolution as inputs to Randig. The model applied 10 adjusted moisture contents to individual cells based on canopy cover and topography (slope and aspect).

PGE then applied the Randig algorithm to a lattice grid of ignition points across the analysis area, generating a 270 m grid of ignition points based on a one-kilometer buffer of PGE features within the analysis area. PGE removed certain points based on burnability characteristics; the resulting analysis yielded a total of 84,749 wildfire ignition points for simulation. Figure 4, below, depicts the overall extent of the wildfire simulation ignition points (Panel A) and a detailed view of the ignition lattice (Panel B) near the community of Sandy, Oregon. The red areas in the left-hand panel (left) show the general location of where ignition points are concentrated.

Figure 4: PGE Wildfire Simulation Modeling Results – Potential Ignition Points



PGE simulated each ignition point using each of the 216 weather types described above, at a 90m resolution, resulting in a total of 18,305,784 simulated fires. Modeling wildfire ignition potential at such a fine-scale resolution across such a large area is a computationally intensive exercise, occupying a series of Windows 10 machines with 48-thread CPUs for nearly 3,600 machine-hours.

Highly Valued Resources and Assets (HVRA) Impact Raster

PGE updated the Conditional Net Value Change (cNVC) or "Impact" raster using data produced originally for the Pacific Northwest Quantitative Wildfire Risk Assessment (PNRA)1. PGE adjusted response functions used in the PNRA assessment to remove the beneficial effects of fire, replacing positive values with zero. The final list of Highly Valued Resources and Assets (HVRA) includes (but is not limited to) People and Property, Timber, Wildlife, Infrastructure, and Surface Drinking Water.

All data inputs, including response to fire and relative importance weights, were leveraged from PNRA1, with one exception: the dataset and methodology used to represent housing-unit density was updated in the People and Property HVRA to use the Housing-Unit Density (HUDen) data built for the Wildfire Risk to Communities Project (Scott et al. 2020). This dataset uses population data at the census block level and Microsoft Building footprints to allocate people and homes spatially within a census block.

Additionally, to account for the potential for wildfire spread into urban areas (mapped by LANDFIRE[19] as non-burnable), PGE used an iterative smoothing process to spread distributions of flame-length

[19] LANDFIRE (Landscape Fire and Resource Management Planning Tools), is a shared, government-developed program used by the wildland fire management programs of the U.S. Forest Service and U.S. Department of the Interior, that uses landscape-scale geospatial products to support cross-boundary planning, management, and operations.

probabilities into non-burnable land cover (other than open water or ice) within 1.5 km of contiguous, burnable land cover at least 500 ha in size. These areas would otherwise have a zero probability of burning in the fire model (FSim). This allowed PGE to recalculate cNVC using response functions and relative importance values assigned by the PNRA1 project, while accounting for wildfire spread into urban areas.

Finally, PGE applied a fractional exposure value based on the distance from the burnable fuel (the source of exposure) to account for the decreased exposure of housing units within the 1.5 km distance from burnable fuel. PGE adjusted housing-unit density exposure by multiplying HUDen by the exposure mask value in each pixel. The final People and Property HVRA included housing units directly exposed to wildfire (located in burnable pixels) as well as those indirectly exposed to wildfire (within a 1.5 km distance of burnable fuel).

PGE applied these modified response functions to all other HVRA cNVC layers; the layers were otherwise unaltered from the PNRA1 project. The final cNVC map (summed for all HVRA) serves as the impact raster necessary for the spatial intersection with the simulated fire perimeters—it provides the key to unlocking and understanding the HVRA impact simulations.

Impact Raster Overlays

PGE ran an overlay script to sum the total cNVC within each simulated wildfire perimeter. The total cNVC reported within each perimeter (including spot fires) was attributed back to the original ignition location. This allowed PGE to apply cNVC values (representing the estimated HVRA impacts for each of the 216 modeled weather conditions) to each of the original 84,749 modeled (simulated) ignition points.

Rasterization

Once it had attributed impacts by fire simulation to the corresponding ignition locations, PGE applied a smoothing process to convert the vector datatype to rasters, while also gap-filling the vector data. PGE first converted each set of vector ignitions for a given weather type to a 120 m raster, using an inverse distance weighting (IDW) algorithm using the four nearest ignition points, an exponential distance weighting of 1.5, and a maximum search distance of 1,500 m. The maximum search distance was intentionally large to fill in data gaps created by the original ignition lattice falling on areas of non-burnable fuel cells, accounting for fires that do not spread beyond the ignition cell.

Wildfire Threat Index (WTI)

PGE calculates the Wildfire Threat Index (WTI) as the product of conditional IPI, CI, and the weighting of the WTP, which were calculated at the original gridMET resolution and smoothed to the coincident 120 m resolution.

The resulting WTI raster and vector data provide an estimate of relative wildfire threat across the analysis area for the range of weather conditions specified. As the product of IPI and CI, WTI allows PGE to identify locations with the greatest combination of utility-related ignition and resulting wildfire damage potentials.

Conditional Wildfire Threat Index

The overall WTI integrates the results from all 216 weather types, while a conditional WTI (cWTI) for each individual weather type provides an estimate of wildfire threat for specific weather conditions. The cWTI is simply the product of the individual weather type IPI and CI.

PGE Wildfire Risk Assessment Results by HFRZ

Zone #		1	2	3	4	5	6	7	8	9	10
Asset Density	Relative Commercial and Res Meter Count	6	2	5	3	4	8	5	4	3	3
Asset density (per SqMi)		252	147	260	194	161	497	165	88	77	51
	Share of all HFRZ assets	32	3	6	214	12	3	9	4	7	12
Land area SqMi		61	10	11	34	34	3	25	22	42	111
Weather Threat/ Pyrologix Calculations	Probability of Exceeding Manual Control	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Extreme Burn Probability		.2-.4	.2-.4	.2-.4	.2-.4	.2-.4	.2-.4	.2-.4	.2-.4	.2-.4	.2-.4
	Heat Intensity per unit area - Scenario 18	10523	13221	7778	7537	7069	8798	8570	12520	12979	12774
WTI MEAN - Scenario 118		2793110	14649487	19637320	20570382	11673496	7232637	4728634	4627615	17186568	35309464
	CI MEAN - Scenario 118	315	106	582	496	305	119	162	114	263	163
IPI MEAN - Scenario 118		80	87	82	78	97	134	141	184	218	221
Accessibility / Terrain	Fire station within 5 min	4	1	3	2	1	5	1	1	1	2
Road condition vulnerability		4	0	0	1	1	0	1	1	1	3
	Slope – Mean	477	308	129	351	319	256	231	183	176	195
Aspect – Mean		260	263	324	283	298	92	199	168	104	112
Social Indicators	% households 200% below fed poverty line	25	26	18	23	16	8	17	16	22	37
Household Disability Composition		18	13	12	15	14	8	13	11	15	20
	Hispanic or Latino	7	8	2	3	3	4	5	9	5	7
Age 65+		25	17	20	18	22	16	20	13	18	16
	Housing/transportation vulnerability	30	30	20	46	35	12	56	30	32	78
Overall social vulnerability		30	35	22	37	34	5	11	16	30	65
Ecological & Cultural Vulnerability	Critical Habitats	2	3	1	2	3	1	3	2	2	2
Cultural/historical/protected areas		3	3	3	3	2	2	1	1	2	3

Wildland / Urban Interface	% in WUI	90	75	100	90	20	85	70	70	50	50
USDF WF Risk to Communities		1778	657	146	7	69	75	28	6.3	6	7
Outage History	June-Sept outages 2017-2021 on UG	101	28	41	20	9	15	13	7	16	18
June-Sept outages 2017-2021 on UG - avg duration		2960.405	575.72	430.8725	336.616	1165.777	453.5525	257.5067	184.19	1118.426	342.285
	June-Sept outages 2017-2021 on OH	246	44	77	130	105	55	90	55	203	83
June-Sept outages 2017-2021 on OH - avg duration		1940.033	921.71	292.6325	722.6057	1259.567	659.32	547.1725	317.1633	391.9871	277.6914

PGE Corporate Headquarters
121 SW Salmon Street
Portland, Oregon 97204
portlandgeneral.com

PGE/317

PGE's 2024 Wildfire Mitigation Plan

December 29, 2023

Via Electronic Filing

Public Utility Commission of Oregon
Attention: Filing Center
P.O. Box 1088
Salem, OR 97308-1088

RE: UM 2208 – PGE's Wildfire Protection Plan

Dear Filing Center:

Please find attached the Portland General Electric Company ("PGE") 2024 Wildfire Mitigation Plan (WMP), which is being submitted as required per Oregon Administrative Rule 860-300-0020(2).

PGE continues to adapt its approach to mitigating the risk of wildfires in response to a changing climate in Oregon. For example, we modified several of our existing High Fire Risk Zones and introduced one new zone based on continued refinements made during our 2023 risk analysis. In 2024, PGE plans on expanding its situational awareness capabilities through new Pano AI camera installations, early fault detection systems, and weather stations. These efforts are in addition to capital investments in 2024 to harden our system, operational changes that occur during PGE's declared fire season, and our inspection and vegetation management programs. PGE anticipates that our WMP will continue to evolve along with our risk assessment and wildfire mitigation capabilities.

PGE appreciates Staff's efforts to review and recommend approval of PGE's 2024 WMP; we look forward to the sharing and learning expected during the review cycle. Please direct all formal correspondence and requests to the following email address: pge.opuc.filings@pgn.com.

Respectfully Submitted,

/s/ K. D. Cloud

Kellie Cloud
Senior Director, Wildfire & Operational Compliance

Portland General Electric

2024 Wildfire Mitigation Plan

Publication Date: 12/29/2023

Scope

PGE's Wildfire Mitigation Plan (WMP) contains statements that relate to future plans, objectives, expectations, performance, and events. These forward-looking statements represent Portland General Electric's (PGE) estimates and assumptions as of December 1, 2023. Because PGE is continually updating its wildfire data, the information included in the WMP reflects the data available at publication. Furthermore, the estimated costs and schedules contained herein are subject to uncertainties, including delays in supply chain and increased supply costs, nonperformance of counterparties, and other work factors. PGE is unable to update or revise any forward-looking statement resulting from new information, future events, or other factors.

These forward-looking statements are not a guarantee of future performance, and any such statements are subject to risks and uncertainties that may be difficult to predict or are beyond PGE's control. As a result, actual results may differ materially from those projected.

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1 Executive Summary

PGE's Wildfire Mitigation team plans and implements the Wildfire Mitigation Program (Program), developing and coordinating wildfire mitigation activities across the company. PGE's approach to wildfire mitigation continues to evolve in response to global climate change, learnings from worldwide landscape-altering wildfire events, and governance from the Oregon Public Utility Commission (OPUC). In compliance with Oregon Administrative Rules (OAR) governing wildfire mitigation plans, the WMP outlines PGE's approach to wildfire risk mitigation and guides PGE's Program. PGE's goal is to improve regional safety by:

- Increasing the resilience of PGE assets to wildfire damage
- Limiting customer impact during Public Safety Power Shutoff (PSPS) events
- Reducing the risk of wildfires
- Engaging in additional mitigation activities involving customers

The WMP presents PGE's approach to risk modeling, which informs PGE's Wildfire Program's. PGE's multiple risk assessment tools and models are collectively referred to as the Wildfire Risk Mitigation Assessment (WRMA) and include Value Spend Efficiency (VSE) calculations to develop and guide activities. The WRMA provides wildfire guidance to PGE through operating protocols, PSPS events, asset management and inspections, vegetation management, Public Safety Partner and community engagement, public awareness and outreach, and research and development. PGE restoration activities also have a risk-informed process that is not unique to wildfire. Restoration relies on outage management by optimizing grid performance and resources.

High Fire Risk Zones (HFRZ) are areas within PGE's service area where vegetation, terrain, meteorological patterns, access and response timing, and wildland-urban interface considerations increase the risks associated with wildfire. PGE implements specific inspection and maintenance, vegetation management, community and customer awareness, and operational actions within these HFRZ during and in preparation for PGE's declared fire season for improved ignition prevention and safety. The 2024 WRMA adds one (1) HFRZ for a total of 11.

In addition, PGE continues to expand its situational awareness capabilities, including installing new remote automated weather stations (RAWS) and artificial-intelligence (AI)-enhanced, ultrahigh-definition Pano AI cameras to automatically notify PGE and its Public Safety Partners in 'real time' when a fire is detected. PGE will continue to invest in mitigation efforts to reduce wildfire risk throughout its system.

At PGE, wildfire-related planning, mitigation, and 'lessons learned' are year-round endeavors. PGE may update this WMP and the Program throughout the year to address new findings, data, and analysis. In addition to its regulatory responsibilities to the OPUC, PGE will continue to work collaboratively with Public Safety Partners, Tribes, local communities, and other key stakeholders to prioritize the safety of people, property, and public spaces.

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Acronyms and Glossary

AI: Artificial Intelligence

AWRR: Advanced Wildfire Risk Reduction

BIL: Bipartisan Infrastructure Bill

BPA: Bonneville Power Administration

C1: Vegetation that is an imminent hazard to PGE facilities.

C2: Vegetation that is dead, dying, diseased, or damaged, has fungal or insect infestation, stress, sun scald or overall poor health. This includes mechanical damage, multiple tops, poor site conditions, conks on the trunks, or aggradation in the root zone, or trees too close to PGE facilities.

CIMT: Corporate Incident Management Team

CRC: Community Resource Center

cWTI: Conditional Weather Threat Index

Dead Fuel: Naturally occurring fuels with moisture content that responds solely to ambient environmental conditions and is critical in determining fire potential. When the fuel moisture content is less than 30%, that fuel is considered to be dead.

DOE: Department of Energy

Earned Media: Publicity or articles written without a payment or solicitation from a business.

EEI: Edison Energy Institute

EEMT: Energy Emergency Management Team

EFD: Early Fault Detection

EPRI: Electric Power Research Institute

ERT: Estimated Restoration Times

ESF-12: Refers to Emergency Support Function-12 and indicates the Public Utility Commission of Oregon's role in supporting the State Office of Emergency Management for energy utilities' issues during an emergency, per OAR 860-300-0010 (2).

FAQ: Frequently Asked Question

Fire Season: Period(s) of the year during which wildland fires are most likely to occur, spread, and affect resources sufficient to warrant organized fire management activities.

Fire Weather: Weather conditions that influence fire ignition, behavior, and suppression.

FITNES: Facilities Inspection & Treatment to National Electrical Safety Code

FPI: Fire Potential Index

GIS: Geographic Information System

High Fire Risk Zone(s) (HFRZ): Geographic areas at elevated risk of wildfire ignition that are identified by PGE in its risk based WMP.

HPA: Heat per Unit Area

HSEEP: Homeland Security Exercise & Evaluation Program

IAM: Institute of Asset Management

IC: Incident Commander

ICS: Incident Command System

International Wildfire Risk Mitigation Consortium (IWRMC): An industry-sponsored collaborative designed to facilitate the sharing of wildfire risk mitigation insights and discovery of innovative and unique wildfire practices from across the globe.

Investor-Owned Utility (IOU): Regulated utilities that generate and distribute power to a customer. These utilities also issue stock owned by shareholders.

IPI: Ignition Potential Index

ISO: International Organization for Standardization

LiDAR: Light Detection & Ranging

Local Community: Any community of people living, or having rights or interests, in a distinct geographical area, per OAR 860-300-0010

Local Emergency Management: Refers to city, county, and Tribal emergency management entities, per OAR 860-300-0010 (4)

Momentary Average Interruption Frequency Index MAIFI: A reliability index commonly used by electric utilities. MAIFI is the average number of momentary (less than five minutes) interruptions that a customer would experience during a given period. It is usually measured over the course of a year.

NEM: Notification Execution Manager

No-Test Policy: PGE will disable auto-reclosing on protective devices and not manually close-in a faulted circuit.

NWCC: Northwest Coordination Center

NWS: National Weather Service

O&M: Operations and Maintenance

OAR: Oregon Administrative Rule

ODF: Oregon Department of Forestry

ODHS: Oregon Department of Human Services

ODOT: Oregon Department of Transportation

OH: Overhead

OJUA: Oregon Joint Use Association

OPUC: Public Utility Commission of Oregon

PAT: PSPS Assessment Team

PIO: Public Information Officer

PSPS: Public Safety Power Shutoff

Public Safety Partners: Includes the Emergency Support Function-12, Local Emergency Management, and Oregon Department of Human Services (ODHS), per OAR 860-300-0010 (7)

QA/QC: Quality Assurance/Quality Control

RAWS: Remote Automated Weather Station

RDPO: Regional Disaster Preparedness Organization

Red Flag Warning (RFW): Issued by the National Weather Service (NWS) to alert forecast users of an ongoing or imminent critical fire weather pattern that would allow for rapid fire starts and/or spread, as well as extreme fire behavior. This pattern must coincide with fuels that are critically dry and fire danger that is moderate to high. Evaluations of fuel conditions will be made in accordance with current National Fire Danger Rating System (NFDRS) Energy Release Component values and in consultation with fire managers.

The weather criteria for RFWs vary depending on location and climate. The products will be issued for specific zones, which are formed based on area with similar vegetation and topography. Our transmission, distribution and generation are covered by the NWS offices in Portland and Pendleton, Oregon.

Representative Concentration Pathway (RCP 4.5): A scenario of long-term, global emission of greenhouse gases, short-lived species, and land-use-land cover which stabilized radiative forcing at 4.5 watts per meter squared. *[For further definition, see Oregon Climate Change assessment, referenced in section 3 of the WMP.]*

Risk Spend Efficiency (RSE): A calculation of the cost effectiveness of mitigation; similar to a cost/benefit analysis using risk points.

ROW: Right-of-way

RVM: Routine Vegetation Management

SME: Subject Matter Expert

SPI: Schroeder Probability of Ignition

Staff: Regulatory employees of the Public Utility Commission of Oregon, excluding commissioners and Administrative Law Judges. Staff serves as an advocate for the public interest and participates in proceedings.

Striking Distance: A term used to describe a tree that has the potential to impact PGE powerlines and other equipment.

Supervisory Control and Data Acquisition (SCADA): The control system architecture comprising computers, networked data communications and graphical user interfaces (GUI) for high-level process supervisory management, while also comprising other peripheral devices like programmable logic controllers (PLC) and discrete proportional-integral-derivative (PID) controllers to interface with process plant or machinery.

System Average Interruption Duration Index (SAIDI): Indicates the total sustained interruption duration for the average customer during a predefined period of time. It is commonly measured in minutes or hours of interruption.

System Average Interruption Frequency Index (SAIFI): A reliability index commonly used by electric utilities. SAIFI is the average number of interruptions per customer. It is usually measured over the course of a year.

T&D: Transmission and Distribution

Tree Attachment: Secondary wires attached to trees. OAR 860-024-0018(2) prohibits utilities from attaching utility supply conductors to live trees in HFRZs.

Tribes: This term is used collectively to describe federally recognized Tribes within the Pacific Northwest.

USFS: United States Forest Service

Utility-Identified Critical Facilities: The facilities identified by PGE within its service area that have the potential to threaten life safety or disrupt essential socioeconomic activities if their services are interrupted. Communications facilities and infrastructure are considered critical facilities.

UTRA: Utility Tree Risk Assessment

Wildfire Mitigation Program: The activities and actions conducted by PGE's Wildfire Mitigation team in support of the 2024 Wildfire Mitigation Plan.

Wildfire Risk Mitigation Assessment (WRMA): PGE program that models and assesses a wide range of potential wildfire-related risk factors to inform PGE's operational and financial decision-making.

WMP: Wildfire Mitigation Plan

WTI: Wildfire Threat Index

2 Introduction

PGE designed the WMP to provide strategic direction for the programs and activities that seek to mitigate the potential for PGE equipment, facilities, or activities to become wildfire ignition sources and to guide PGE's compliance with all applicable laws and regulations, including the OPUC's wildfire rules and recommendations. Appendix 1 and Appendix 2 provide an outline of Chapter 860 OAR applicable to the WMP and PGE's response. Appendix 3 addresses Staff's recommendations outlined in Order 23-221 and specifies workshop dates when the recommendations were discussed. Please note that references to specific recommendation numbers within the remainder of this document refer directly to staff's recommendations outlined in Order 23-221. The WMP incorporates 'lessons learned' from the 2023 fire season and describes PGE's wildfire preparedness and response activities for 2024.

The success of the Program relies on the active participation of a broad spectrum of internal and external stakeholders with the coordination of PGE's Wildfire Mitigation organization. The Program is informed by PGE's WRMA and Value Spend Efficiency (VSE) calculations. PGE uses these calculations to develop and guide Program activities and wildfire mitigation investments. Industry benchmarks and WRMA's findings inform our activities aimed at reducing the frequency of utility-caused ignition events, including:

- Use of PSPS to prevent utility-caused ignitions during high or extreme fire danger periods
- Vegetation management
- Engineering of reliable systems that experience fewer events that result in spark failure modes
- Inspection and maintenance of poles and equipment
- Operational readiness during fire season, including using system protection devices such as electronic reclosers
- Situational awareness
- System hardening

PGE reviews its fire season operations and wildfire mitigation preparedness and response actions annually and updates the WMP as needed. PGE will also update the WMP as required to comply with applicable regulatory requirements or changes in law. If PGE substantively updates the plan outside of the annual submission cycle, the WMP in Docket UM 2208 will be refiled with the OPUC and the most current version of the WMP will be posted on PGE's website.

The issues PGE seeks to address with the WMP are dynamic, and the increasing risks of wildfire have been and will continue to be hard to predict. Oregon has been subject to unprecedentedly fierce heat and ice storms, increases in dead fuels, population growth (with accompanied extension of electric service) into the wildland urban interface, and hard to predict local weather conditions that can accelerate the speed and spread of fire, and amplify the destruction of property and critical services. At the recommendation of OPUC staff, PGE is planning to adopt a maturity model that will inform our wildfire management planning and help us to continually improve by developing new tools and incorporating leading practices appropriate to our geography and risk.

Some of the most significant changes made to the 2024 WMP include the ongoing evolution of PGE's WRMA in partnership with PGE's Public Safety Partners. Section 3.2, "Updates to 2024 Wildfire Risk Mitigation Assessment", provides updated methodologies and feedback loops. PGE also expanded its situational awareness capabilities with Pano AI fire detection cameras covering all 11 of PGE's 2024 HFRZ. Dozens of fire agencies have direct access to this technology, potentially improving response time to fires in their areas. In addition, PGE's network now consists of 80 weather stations providing weather data at a more granular level, allowing for more precisely informed PSPS decision-making as well as informing operational all hazards situational awareness. PGE continues progressing with non-expulsion fuse installation and other ignition prevention investments, such as tree wire and undergrounding projects. One additional capital improvement included the expanded use of intelligent reclosers to reduce the number of customers impacted by PSPS events.

2.1 Operating Environment

Global climate change continues to alter the Pacific Northwest's climate in ways that are difficult to model and predict. This reality will drive continuous evaluation and modification of PGE's WMP for the foreseeable future. As the effects of climate change continue to impact the West Coast of North America, there will be competition for available fire suppression, inspection, and vegetation management resources in the Pacific Northwest. Additional details are provided in Section 3.5, "Climate Change".

However, factors beyond PGE's control, including supply chain issues, climate-driven changes to weather patterns, and competition for limited contract resources may impact the delivery of PGE's 2024 Program. Investor-owned utilities (IOUs), the OPUC, and other stakeholders must strive to balance impact on customer rates and meaningful risk reduction.

2.2 PGE Service Area Overview

PGE's service area is distributed over 4,000 square miles of forested, mountainous, urban, and suburban environments. See Figure 1. Much of the eastern and western portions of PGE's service area are forested, particularly in the Mt. Hood corridor along Highway 26, in the foothills of the Coast Range, and south toward Estacada. While most of PGE's service area is located within the most densely populated area of the State, PGE's managed right-of-way (ROW) contains more than 2.2 million trees, with millions more off-ROW trees. In managing off-ROW conditions, PGE must coordinate with multiple neighboring utilities that interconnect to our system, including the Bonneville Power Administration (BPA), Consumers Power, Inc., Forest Grove Light & Power, McMinnville Water and Light, PacifiCorp, Wasco Electric Cooperative, and West Oregon Electric Cooperative.

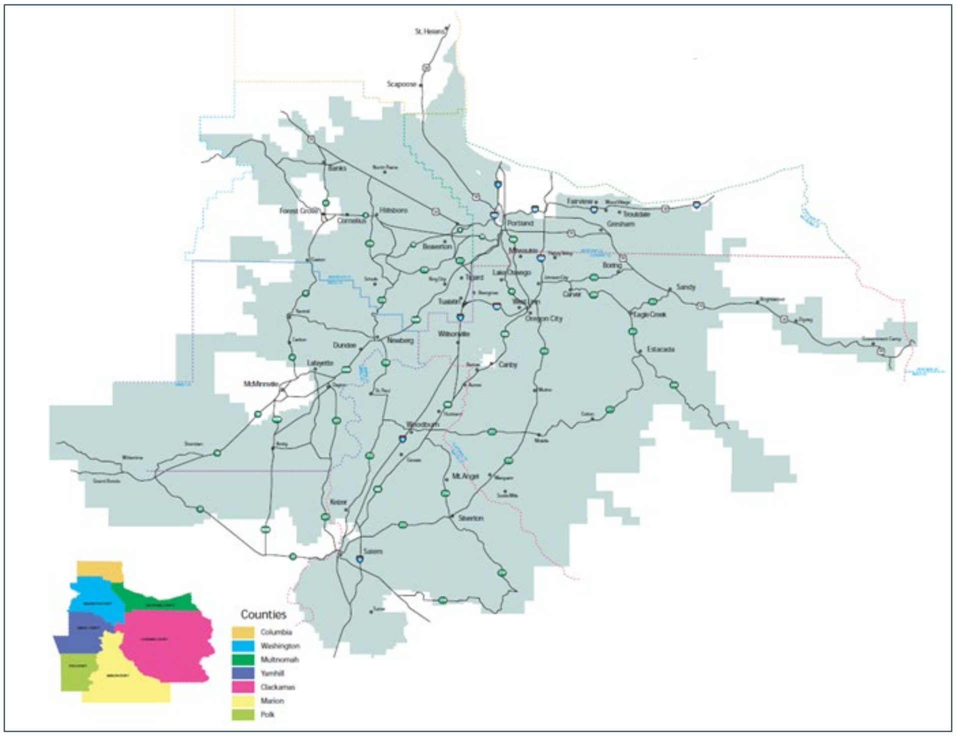


Figure 1. PGE Service Area

3 Wildfire Risk Mitigation Program Overview

PGE's primary wildfire risk mitigation objective is to reduce the risk of ignition from PGE assets while limiting the impacts of specific mitigation activities, such as PSPS events, to customers. The Program can be broken down into four risk mitigation approaches and associated objectives which are represented visually in Figure 2.

- **PSPS:** Temporarily turn off power during extreme weather conditions to reduce wildfire risk.
- **Operational Practices:** Implement operational system settings, including protection systems (e.g., reclosers), line and vegetation maintenance, and use a risk-informed protection strategy to reduce the risk of ignitions.
- **Situational Awareness:** Improve PGE's wildfire-related risk management and situational awareness capabilities.
- **System Hardening:** Implement a systematic, risk-informed approach to identify and prioritize system hardening and resiliency measures to reduce the likelihood of ignitions caused by utility assets and protect PGE assets from damage.

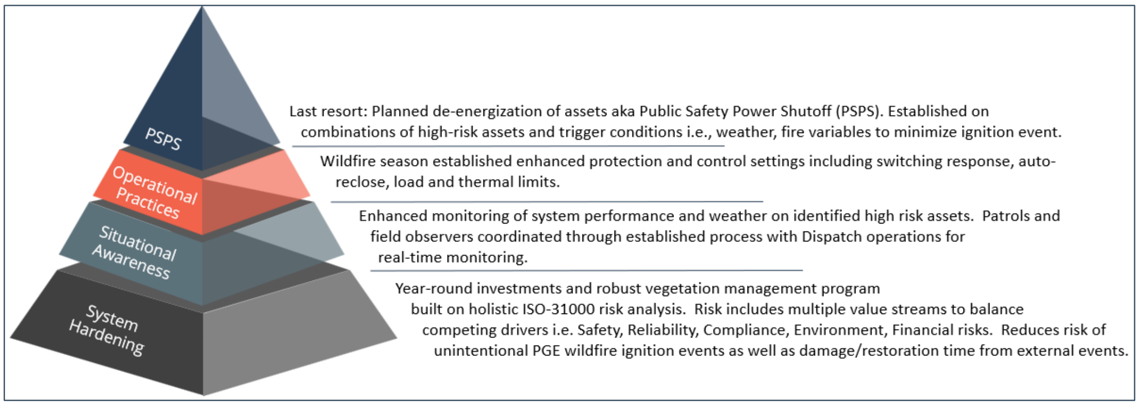


Figure 2. PGE's Wildfire Risk Mitigation Hierarchy

PGE has delivered and continues to find cost-effective ways to maximize wildfire risk reduction by applying risk assessment modeling to guide mitigation strategies. This work aims to deliver the highest risk reduction per dollar spent on mitigation. The company's WRMA methodologies and mitigation measures are discussed in more detail throughout this document.

3.1 Annual Wildfire Risk Assessment

PGE WRMA methodologies include multiple statistical models that use a variety of data sources to identify the areas of highest wildfire risk within PGE's service area to:

- Identify and refine the boundaries of the HFRZ within the PGE service area.
- Quantify the likelihood that individual PGE assets could contribute to the ignition of large wildfires (>100 hectares for fires in timber; >400 hectares for grass or rangeland), and map their location.
- Apply a consequences model to determine where a potential wildfire ignition would be most significant.

These methods enable PGE to identify the highest-risk areas within its service area and prioritize wildfire mitigation actions. The assessment results were a key input to developing PGE's 2024 WMP. In addition, PGE evaluates wildfire risk across PGE transmission and generation assets outside our service area.

Assessment results allow PGE to evaluate susceptibility to the natural and human factors that could contribute to electric asset-caused wildfire ignitions and provide data-driven guidance for PGE's Program. A technical overview of PGE's fire behavior modeling, a component of the wildfire risk assessment, is provided in Appendix 6.

3.2 Updates to PGE's 2024 Wildfire Risk Mitigation Assessment

PGE improves its WRMA methodologies through engagement with external experts, internal controls, and feedback loops across the organization.

In 2023, this engagement included workshops and field site visits with the Oregon Department of Forestry (ODF), US Forest Service (USFS), and local fire agencies to examine response times to ignition events and assess how vegetation and access conditions influence fire growth potential. In addition, PGE hosted virtual technical working sessions with local fire districts, including Clackamas Fire District, Tualatin Valley Fire District, Multnomah County Fire District, and ODF to learn about anticipated fire response times, watershed boundaries, and detection probabilities. These engagements and variables directly informed PGE's 2024 reassessment of the HFRZ geographical boundaries as described in Section 4, "High Fire Risk Zones".

Through an internal post-fire season 'lessons learned' process, PGE refined its WRMA methodologies by introducing new variables layered onto the assessment framework. These additional variables include:

- Access and egress road density
- Detection probability
- Fire response time/proximity to emergency response (modeled at 5, 10, and 15 minutes)
- Social vulnerability, including income level, vehicle access, and English-as-a-second-language considerations

These risk assessment improvements refined in 2023 were validated with fire agencies, as well as across the industry, through the International Wildfire Risk Mitigation Consortium (IWRMC).

PGE continues investigating improvements to data sets and analytical techniques to evolve its WRMA methodologies and integrate fire risk into PGE's overall asset and risk management portfolios. Over the past two years, PGE has made the following changes to its baseline WRMA:

- Begun to develop a four-year wildfire risk mitigation roadmap, laying out planned mitigation activities through fiscal year 2027.
- Increased the number of individual weather scenarios used to model baseline and seasonal wildfire risk to 216 scenarios, increasing model confidence. Appendix 6 provides additional model details.
- Introduced new spatial variables to PGE's Geographic Information System (GIS)-based wildfire risk mapping through virtual, technical work sessions with local fire districts and the OPUC, including fire detection probability and estimated response time.

3.2.1 UPDATES TO WILDFIRE RISK ASSESSMENT WITH FIRE AGENCIES

In response to recommendation one (1), Table 1 outlines the coordination between PGE and fire agencies, specific to the review of PGE's HFRZ.

Table 1. PGE and Fire Agency Coordination

Zone	Participants	Date	Area of Change	Rationale	Change	Data Validation
9	Chief, Yamhill Fire Protection District	8/24/23	Join Cherry Grove zones from Stimson Mainline Rd. to Patton Ave, between SW Larson Rd and SW Lee Rd	Yamhill FD does mutual aid with Gaston FD, has access concerns	Increase HFRZ boundary area	Access & Response Timing
9	Chief, Yamhill Fire Protection District Chief, McMinnville Fire Dept.	8/24/23	Extend the zone surrounding Menefee Park to the southeast to include NW Turner Creek Rd until 45.389283,-123.270884	This area includes roads in poor condition with limited access, as well as frequent calls to the FD	Increase HFRZ boundary area	Access & Response Timing
11	Chief, Mt. Angel Fire Chief, Marion County Fire	9/20/23	New zone 11	Wind behavior, past fire behavior, response time	Net new zone	Access & Response Timing & Weather Behavior
3	Chief, Clackamas Fire District Battalion Chief, Clackamas Fire District Division Chief, Operations, Clackamas Fire District	9/25/23	Add a new area on S Ridge Rd. to S. Mosier Rd	Narrow, poorly maintained gravel forest service roads. Dense vegetation and East-West drainage conditions.	Increase HFRZ boundary area	Access and Response Timing and Weather Behavior
11	ODF–North Cascade District	10/13/23	New Zone 11	Wind behavior, past fire behavior, response time and critical infrastructure for suppression.	Net new zone	Access and Response Timing and Weather Behavior and Critical Infrastructure

3.2.2 HIGH FIRE RISK ZONE REVIEW WITH FIRE AGENCIES

In response to recommendation one (1), Table 2 lists the dates on which PGE and Fire Agencies coordinated regarding PGE's HFRZ and risk behavior data sets and constraints.

Table 2. PGE and Fire Agency Review of HFRZ

Agency	Representative	Date
United States Forest Service	Fire Planner	1/20/2023
United States Forest Service	Fire Planner	2/03/2023
United States Forest Service	Fire Planner	2/10/2023
Yamhill Fire Protection District	District Chief	8/24/2023
McMinnville Fire Department	District Chief	8/24/2023
Mt. Angel Fire District	District Chief	9/20/2023
Marion County Fire District	District Chief	9/20/2023
Clackamas County Fire District	District Chief, Battalion Chief, Division Chief	9/25/2023
ODF–North Cascade District	Wildland Fire Supervisors, Foresters	10/13/2023

3.2.3 COORDINATION WITH PEER UTILITIES

PGE collaborates with other utilities including BPA, Eugene Water and Electric Board, PacifiCorp, and Idaho Power Company, sharing its HFRZ philosophy and methodology. There are some areas in which different electric utility facilities overlap, such as in the shared ROWs for large transmission corridors. In general, each utility's systems and how they are operated and maintained are different. HFRZ overlap comparison is an area PGE is working to improve and is actively participating in monthly joint IOU meetings to understand fire science, effectiveness, fire, weather, meteorology models and risk drivers.

In response to recommendations three (3) and eight (8), PGE has initiated coordination with other utilities in areas where boundaries overlap to understand where similarities and learnings can be leveraged for HFRZ determination. PGE recognizes this as an ongoing effort, and utilities will continue refining the process to develop best practices and shared datasets. PGE will prioritize any actionable or universal datasets that can be leveraged on this shared journey.

Figure 3 outlines the intended road map of collaboration on HFRZ among PGE and the IOUs. PGE recognizes IOUs will have opportunities to collaborate when wildfire risk boundaries overlap in modeling, asset geographic boundaries, or datasets. PGE will continue to work with other utilities, including PacifiCorp and Idaho Power Company, to coordinate overlapping determinations.

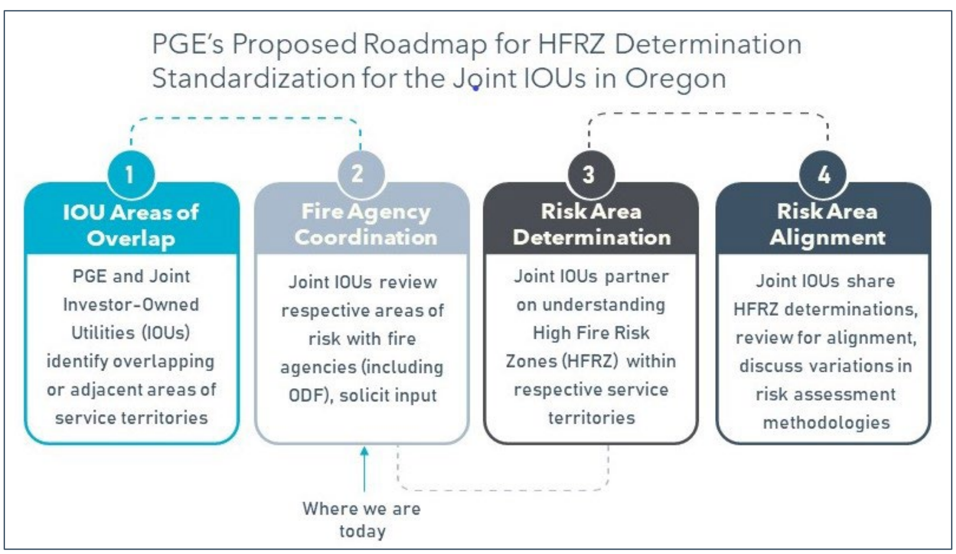


Figure 3. Proposed Roadmap for HFRZ Determination Standardization

3.2.4 PGE Wildfire Planning and Analytics

PGE's Wildfire Planning and Analytics teams determine HFRZ based on where the potential consequences of an ignition caused by PGE equipment would be the highest. Factors such as detection time, road accessibility, fire station proximity, weather patterns, topography, vegetation density, and critical infrastructure locations are considerations. PGE collaborates with fire agencies to review these zones on an annual basis. Figure 4 is a zone graphic outlining changes to HFRZ.

3.2.4.1 What's Changing

- Establishing Zone 11, Salem Hills, south of Salem.
- Adding one square mile to Zone 3, Oregon City, along Mosier Creek.
- Reshaping Zone 9, Central West Hills.
- Removing sections in Zones 1, 5, and 9 where lines are underground.
- Changes of <1% of total overhead (OH) distribution line miles, poles, and meters in HFRZ from 2023 to 2024.

3.2.4.2 What Stayed the Same

- No changes to Zones, 2, 4, 6, 7, 8 or 10.

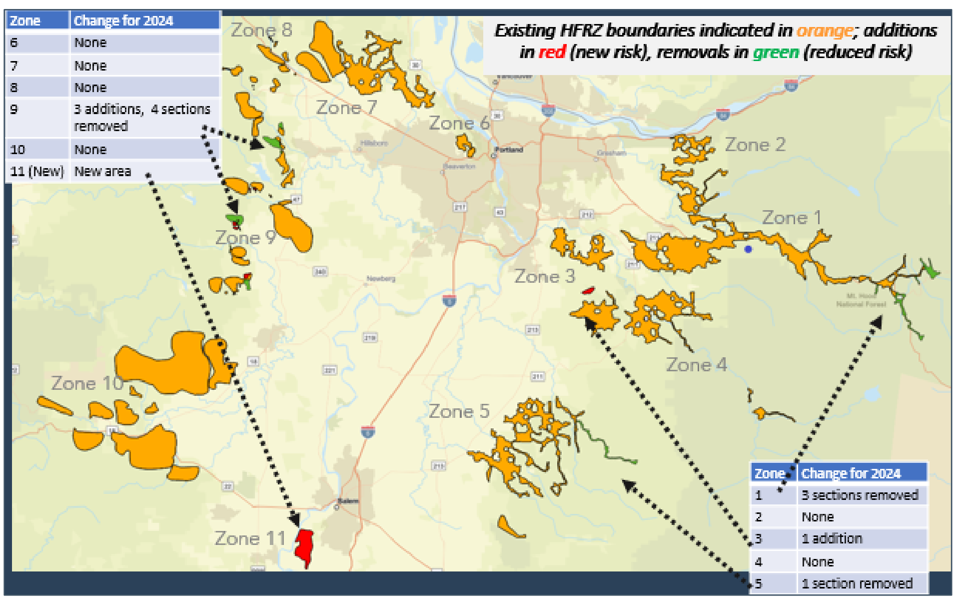


Figure 4. 2024 HFRZ Updates

3.3 Wildfire Risk Categories

PGE's WRMA methodologies consider baseline and seasonal wildfire risk, risk to areas served by PGE, and risks to PGE-owned generation facilities, substations, and powerlines. PGE uses these methodologies and corresponding outputs to inform wildfire mitigation strategies that provide location-specific reliability and resiliency benefits. This holistic risk assessment approach helps PGE align specific mitigations to risk reduction areas and benefit a broad spectrum of regional stakeholders.

PGE seeks to align mitigation measures to risk across PGE's Program, from design and operational standards to construction practices, vegetation management, training, utility asset management, and capital investment.

3.3.1 Baseline Wildfire Risk Seasonal Wildfire Risk

PGE calculates baseline asset risk as ignition probability (the annual likelihood that a given piece of equipment could cause a wildfire ignition given its type, age, condition, and location) and the consequences of ignition. These consequences evaluate how a wildfire ignited at a specific location may burn and the potential magnitude of the damage it may cause. In most cases, probability values vary with the age and condition of the asset, increasing as the equipment ages.

In addition to modeling baseline risk per OAR 860-300-0030(1)(A), PGE has analyzed fire data back to 1962 to better understand the effect of historical fires in PGE service area. A summary of the statistics is found in Table 3.

Table 3. Historic Wildland Fire Occurrence

Historical Records of Fires Suppressed by Oregon Department of Forestry, 1962–2022		
	Count of Fires	Total Acres Burned
All Fires	67,590	7,235,646
Fires within five miles of PGE transmission and distribution (T&D) circuits	5,852	535,167
Source: Oregon Department of Forestry		

The ODF has suppressed more than 67,500 wildland fires, which have burned over 7 million acres since 1962. Approximately 8% of those fires burned within five (5) miles of PGE T&D circuits.

PGE also models geographic wildfire risk (georisk). For the Program, georisk represents wildfire risk due to vegetation encroachment on the conductor or animal contact impacting the components of the PGE structure (equipment). Georisk is distinct from asset risk; asset risk is defined as risk due to failed equipment. PGE integrates this information into the Strategic Asset Management Structures Model (Structures Model), a WRMA methodology component that allows PGE to evaluate wildfire risk more precisely.

PGE inputs asset and georisk data into the Pyrologix[1] fire physics engine to create simulated probabilistic models that assess fire risk by location for long-term planning and real-time decision support. As discussed in Section 3.2, "Updates to PGE's 2024 Wildfire Risk Mitigation Assessment", PGE continues to refine variables in coordination with external agencies. This collaboration has led PGE to add new variables for consideration in its ongoing risk analysis processes. These new variables include remote sensing data, light detection and ranging (LiDAR) and high-definition imagery, wildfire spread distributions, and situational awareness variables.

Table 4 details the data sources for the various inputs PGE uses to assess georisk, as well as the proposed cadence of updates to these data sources.

[1] Pyrologix is a Missoula, MT based wildfire threat assessment research firm that provides utility wildfire risk assessment, hazard and risk assessment, stochastic wildfire simulation, fuel treatment prioritization, fuel inventory and management, and exposure analysis modeling and analysis services.

Table 4. Georisk Modeling Data Sources and Update Cadence

Data Sources	Inputs	Proposed Cadence of Updates
Wildfire Modeling	Fire Propagation and Fire Behavior	**Annual Review** Affirm/update Subject Matter Expert (SME) assumptions/updated failure data. Landfire (geospatial layering program) calibration through Pyrologix proprietary adjustments Flame Height Energy Release Component (real-time through 72 hours out) Fuel Moisture (measured at 1hr/10hr/100hr) (real time through 72 hours out) Live Fuel Moisture Hourly/real time Fire Response Time Flame Intensity Detection Probability
	Elevation Data	**Annual/Semi-Annual Review** Affirm/update SME assumptions/updated failure data. National Survey Data USGS LiDAR
	Meteorological Data	**Annual/Semi-Annual Review** National weather data PGE weather stations (real time)
	Burn Probability	**Annual Review** Affirm/Update SME assumptions/updated failure data. Landfire calibration through Pyrologix proprietary adjustments

3.3.2 SEASONAL WILDFIRE RISK

Seasonal risk is integral to PGE's WRMA. PGE's assessment of seasonal wildfire risk leverages the consequences modeled from 216 fire weather scenarios. PGE also accounts for climate change variability in seasons by leveraging fuel ecology and wildfire studies for the Willamette Valley and Oregon[2]. Appendix 6 provides additional details regarding seasonal risk.

3.3.3 RISK TO RESIDENTIAL AREAS

PGE recognizes that ignition potential is not limited by HFRZ boundaries, and it models ignition points as a grid across the entire PGE service area. PGE assesses risk to residential areas in the fire behavior models as described in Appendix 6. PGE's modeling includes high-density locations as well as adjusted burn probabilities. Risk-informed decision-making considers that detection probability and fire response time vary with access and population density.

[2] Studies included in PGE's Wildfire Risk Mitigation Assessment include Climate Change Increases Risk of Extreme Rainfall Following Wildfire in the Western United States (Touma, Stevenson et al 2022); Changing Wildfire, Changing Forests: The Effects of Climate Change on Fire Regimes and Vegetation in the Pacific Northwest, USA (Halofsky, Peterson and Harvey, 2020); Impacts of Climate Change on Fire Regimes and Carbon Stocks of the U.S. Pacific Northwest (Rogers et al 2011).

3.3.4 Risk to PGE Equipment

PGE protects equipment and facilities within its HFRZ with established wildfire design and construction standards (e.g., replacement of wood poles that are damaged with ductile iron poles located in HFRZ, replaced as part of non-wildfire projects, or reached end-of-life). System hardening is further discussed in Section 10, "System Hardening". PGE is developing the capability to assess which equipment items are most likely to be impacted – if a fire occurs in each area – by overlaying asset information geospatially with the weather-specific fire behavior models discussed in Section 3.2, "Updates to PGE's 2024 Wildfire Risk Mitigation Assessment". For real-time determinations of fire risk to equipment, PGE added a new feature to the Pano AI wildfire camera alert viewer that shows the location of PGE assets on a map alongside fires detected by the cameras.

3.4 Risk Assessment Methodologies: Data Quality and Review Frequency

PGE WRMA methodologies include multiple statistical models that use a variety of data sources to identify the areas of highest wildfire risk within PGE's service area. PGE's methodology is consistent with the International Organization for Standardization (ISO) 31000 Monitoring and Review structure, which provides internal controls to enhance confidence while considering the dynamic nature of risk.

PGE's quality assurance and quality control (QA/QC) process for finalized Wildfire Risk Assessment models identifies the cadence of updates and required review tasks. Required QA/QC tasks include:

- Review and affirmation of existing or updated data.
- SME assumptions.
- Review of mathematical formulas.
- Variance testing of updates to confirm that updates are reasonable.

Table 5 defines the cadence of updates for the inputs used in PGE's annual wildfire risk assessment process.

Table 5. Cadence of Updates

Sources Data	Inputs	Cadence of Updates
Annual Probability of Asset Failure	Weibull failure curve parameters	**Annual Review** Affirm/update SME assumptions/updated failure data
	Health indexing	**Annual Review** Incorporate condition data as available
	Demographics from database	**Periodic Updates** As data becomes available GIS/Maximo
	GIS data for components on structure	**Annual Update** Address reconfiguration/replacement
Annual Probability of Asset Caused Ignition	Probability of equipment related outage is source of ignition	**Annual Review** Affirm/update SME assumptions
	Probability of equipment in violation of PGE patrol/ guidelines	**Annual Review** Incorporate available inspection data Incorporate updated SME assumptions
	Equipment multipliers	**Annual Review** Affirm/update SME assumptions
Ignition Data	Tracking PGE caused ignitions by failure mode/driver	**Twice-Monthly Review** Propagates into all wildfire risk processes
Intervention Costs	Capital cost estimates for wildfire mitigation	**Annual Review** Affirm/update SME assumptions
Consequence of Wildfire	The wildfire consequence model developed by Pyrologix identifies structures in burnable locations and estimates the expected consequence of a large fire, e.g., min 400 hectare started at each location	**Periodic Updates** As required
Predictive Outage Model	Weather data & outage to understand outage correlation with storms/wind	**Annual Review** Machine learning model will be continuously learning

3.5 Climate Change

In response to recommendation four (4), PGE recognizes that global climate change has far-reaching consequences that impact how PGE approaches risk management and infrastructure planning, as illustrated in Figure 5. The increasing frequency and intensity of extreme weather events, driven by climate change, are not just abstract global statistics; they have tangible impacts on local communities and the electrical grid. Extreme conditions increase the likelihood and the consequences of certain events, such as prolonged outages due to ice storms that make the roads impassable.

The changing climate also places compounding stress on vegetation. Drought conditions and record temperatures have made vegetation more susceptible to wildfires. Dry vegetation serves as fuel, making wildfires more intense and more complex to control. The 2021 Oregon drought, characterized by its early onset and severity, is a testament to this escalating challenge. Such conditions, when combined with the increased likelihood of extreme weather events, create a feedback loop of vegetation stress and dead fuels that further elevate wildfire risk.

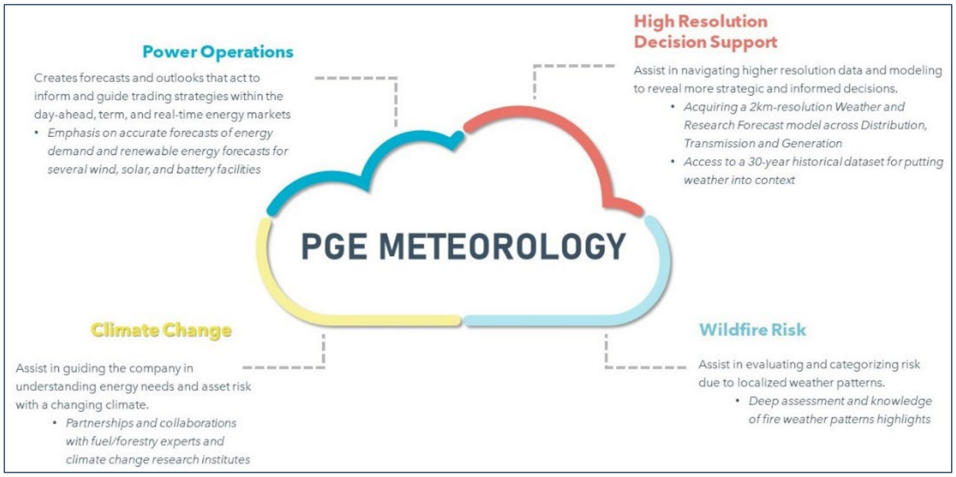


Figure 5. Meteorology Purpose and Accomplishments

3.5.1 IMPACTS ON PGE'S SERVICE AREA

Figure 6 illustrates the annual mean temperature in Oregon as observed (blue and red bars: relative to the 1970-1999 average, from NOAA Climate at a Glance) and as simulated by the Coupled Model Intercomparison Project Phase 6 (CMIP6) models for the past (heavy black curve and grey shading). The colored bands and solid curves indicate the average of the two CMIP6 scenarios for 2015-2100, and the dashed curve shows the corresponding results for CMIP5 (2006-2100). Shaded regions denote the range between the smoothed minimum and maximum annual mean temperature for the eight models. The modeled time series were smoothed with a LOWESS (Locally Weighted Scatterplot Smoothing) filter. Mean values for the eight models are to the right of the curves and represent the warming relative to the period 1970–1999.

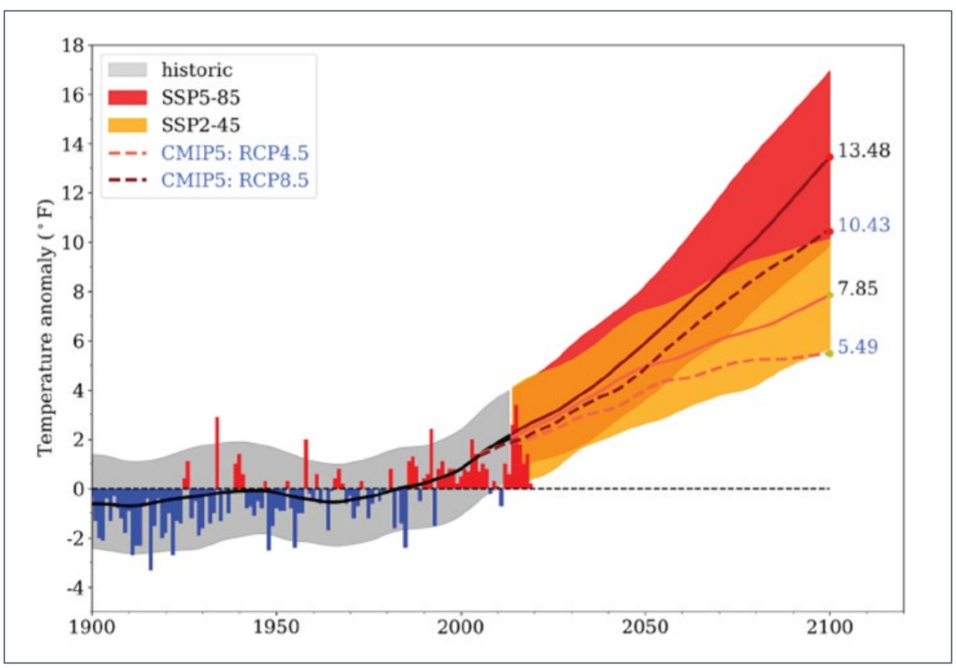


Figure 6. Annual Mean Temperature in Oregon

Key forecasts suggest that fuel in PGE's service area, and the land area that may be burned, is projected to increase by 500–900% over the next 10–20 years. In addition, the burn probability for any ignition source due to the cumulative damage resulting from sustained drought and prolonged increased temperatures means that PGE fire severity, as predicted in Oregon's 5th and 6th climate change assessment, is in the highest severity rating across the state. Figure 6 illustrates that in low-end temperature forecasts for low boundary conditions (Representative Concentration Pathway 4.5), the relationship of land area burned percentage and average annual temperature increase is still significantly more than current conditions as depicted above for 2022 temperatures. The relationship of land area burned is a direct function of temperature increase. For references to land area burned as a function of temperature increase, see sources listed in Table 6. In addition, the fire severity for fuel surrounding and encompassed in PGE's service area is the highest fire regime group, reflecting the fuel conditions are most susceptible to periods of drought and heat for large mega-fires.

3.6 PGE's Inclusion of Climate Change Variables in Risk Assessments

Historically, utilities, including PGE, have looked to past weather and fire behavior to inform the understanding of future weather and fire conditions. However, the past is no longer a reliable predictor of the future, especially in a changing climate. Recognizing this, and in response to recommendation four (4), PGE collaborated with the Oregon Climate Change Research Institute and Oregon State University (OSU) to conduct a comprehensive study. This study aimed to project the impacts of extreme heat, wind, freezing rain, and ice accumulation within PGE's service area through and beyond 2070. Projections were based on two different RCP emissions scenarios, providing insights into potential climate futures. If extreme weather events become more frequent and intense, as suggested by the OSU study, the utilities' risk profile changes dramatically. For instance, a once-in-a-century storm might become a once-in-a-decade event. This shift has profound implications for infrastructure planning, maintenance schedules, and emergency response protocols.

PGE teams assess the impact that climate change projections have on risk profiles. Using projections from Changing Wildfire, Changing Forests: The Effect of Climate Change on Fire Regimes and Vegetation in the Pacific Northwest, USA, published in the Association for Fire Ecology, PGE assumes that the effects of climate change will be increasingly apparent year over year, with a marked uptick beginning around 2030 and plateauing in 2040 at levels far exceeding what we see today.[3]

Climate change risk is reflected in PGE's Structures Model Methodology as a combination of risk factors, including wildfires, floods, extreme heat, and ice storms. Unitless and dollar-value multipliers reflecting climate change risk by year are applied in models as appropriate.

As referenced in Section 12, "Participation in Regional, National, and International Forums", PGE is deeply involved with the IWRMC and continuously learns from presentations and scholarly publications shared by the consortium. Of particular resonance, as PGE looks toward 2024, are the findings of John T. Abatzoglou, Projected Increases in Western US Forest Fire Despite Growing Fuel Constraints,[4] which demonstrate increasing ecological risk beyond what was projected in prior years, as well as

[3] Halofsky, Jessica E., David L. Peterson, and Brian J. Harvey. "Changing Wildfire, Changing Forests: The Effects of Climate Change on Fire Regimes and Vegetation in the Pacific Northwest, USA." Fire Ecology 16, no. 1 (2020). https://doi.org/10.1186/s42408-019-0062-8

[4] Abatzoglou, John T., David S. Battisti, A. Park Williams, Winslow D. Hansen, Brian J. Harvey, and Crystal A. Kolden. "Projected Increases in Western US Forest Fire Despite Growing Fuel Constraints." Communications Earth & Environment 2, no. 1 (2021). https://doi.org/10.1038/s43247-021-00299-0

Tubbesing's Rethinking Fire-Adapted Species in an Altered Fire Regime, which projects the changing vegetation dynamics in areas with similar forest composition.[5]

In addition, the findings from studying Western US forests suggest a clear upward trend in forest aridity over the last two decades, with increased extremes in the burned land area. Results from the Impact of Anthropogenic Climate Change on Wildfire Across Western US Forests are shown in Figure 7.[6] The study suggests the impacts of anthropogenic climate change approximately doubled the western US forest fire area. This finding is beyond expected natural climate variability alone, from 1984–2015. Coupled with data, leading climate experts' judgment that temperature records reflect a higher likelihood that temperature trends are on the RCP 8.5 trajectory suggests that the speed of change in weather patterns, fire behavior, and land area burned will see exponential increases.

PGE recognizes that climate change and wildfire impacts are a global phenomenon. These observations are illustrated in Figure 7 and Figure 8, which depict North American forest fuel aridity and the response of fire activity across forests worldwide, which are realizing drastic increases from wildfires. An important climate change consideration for PGE is the impact of wildfire on carbon capture. As described in "Forest Fire Threatens Global Carbon Sinks and Population Centers Under Rising Atmospheric Water Demand", a key finding is that climate change projections are expected to lead to widespread increases in risk, with at least 30 additional days above critical thresholds for fire activity in forest biomes on every continent by 2100 under rising emissions scenarios.[7] This cyclical activity of wildfire carbon release has a feedback loop with net new carbon emissions that further impacts temperatures and aridity across the world.

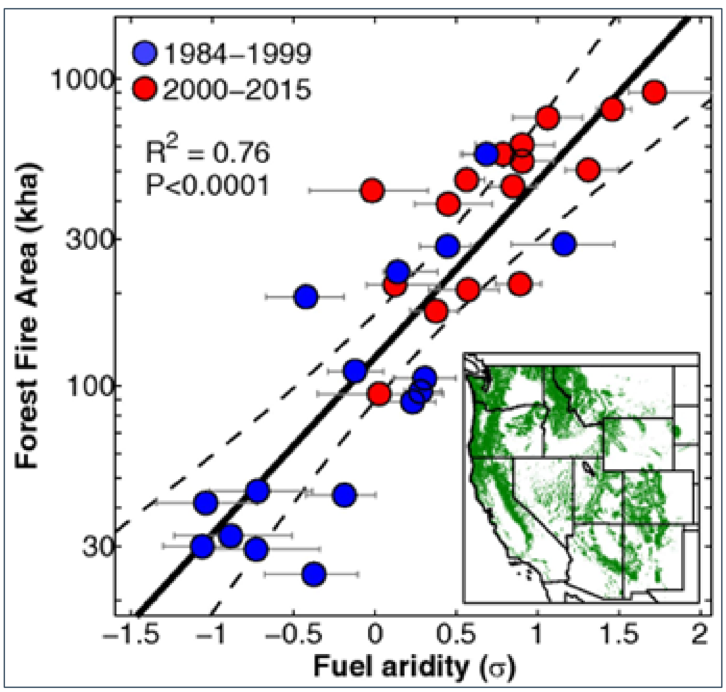


Figure 7. Annual Western Continental US Forest Fire Area vs. Fuel Aridity

[5] Tubbesing, C. L., R. A. York, S. L. Stephens, and J. J. Battles. 2020. Rethinking fire-adapted species in an altered fire regime. Ecosphere 00(00):e03091. 10.1002/ecs2.3091

[6] Abatzoglou, John T., and A. Park Williams. 2016. "Impact of Anthropogenic Climate Change on Wildfire across Western US Forests." Proceedings of the National Academy of Sciences 113 (42): 11770–75. https://doi.org/10.1073/pnas.1607171113.

[7] Clarke, Hamish, Rachael H. Nolan, Victor Resco De Dios, Ross Bradstock, Anne Griebel, Shiva Khanal, and Matthias M. Boer. "Forest Fire Threatens Global Carbon Sinks and Population Centres under Rising Atmospheric Water Demand." Nature Communications 13, no. 1 (2022)

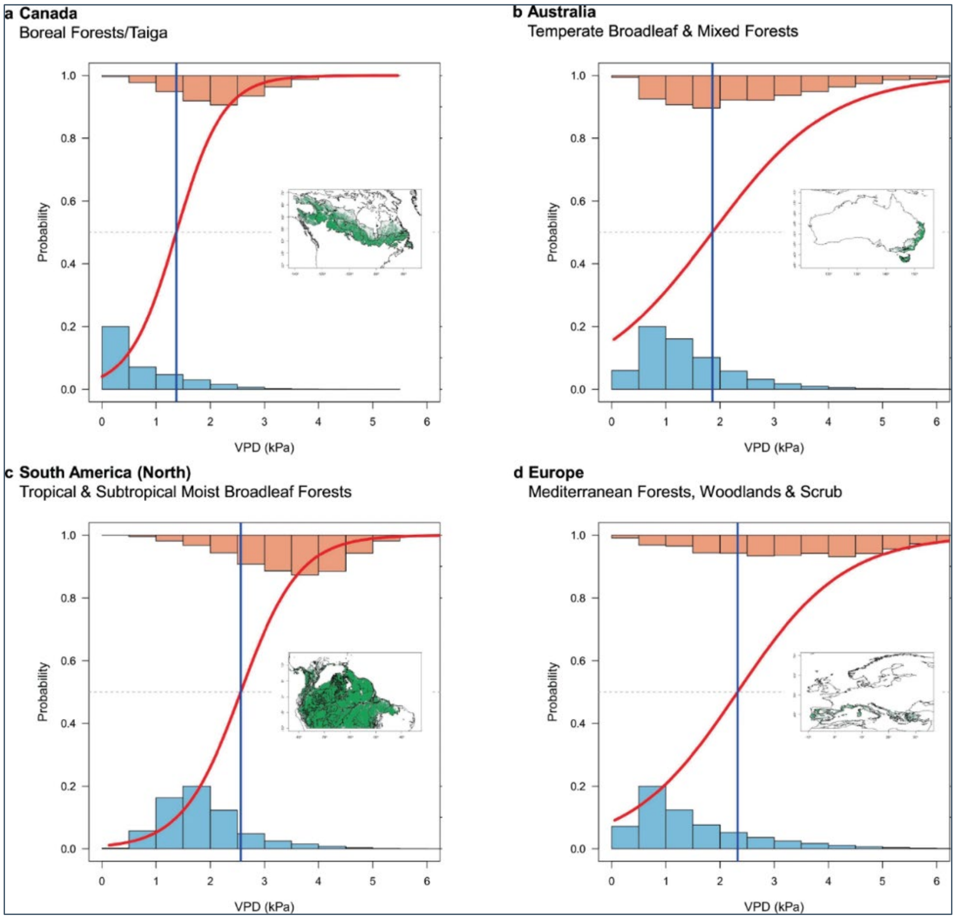


Figure 8. Response of Forest Fire Activity to VPD in Four Continental Forest Biomes[8]

PGE incorporates fire regime and fire history into its understanding of climate and geographical risk using the following definition:[9]

> In general a fire regime characterizes the spatial and temporal patterns and ecosystem impacts of fire on the landscape (Bradstock, Williams, and Gill 2002; Morgan et al. 2001; Brown and Smith 2000; Keeley et al. 2009). The two most important factors for determining fire regimes are vegetation type (or ecosystem) and weather and climate patterns. Fire history provides evidence of past relationships between fire and climate. That evidence makes it clear that changing climate will profoundly affect the frequency and severity of fires in many regions and ecosystems in response to factors such as earlier snowmelt and more severe or prolonged droughts (Westerling et al. 2006; Bowman et al. 2009; Flannigan et al. 2009; Littell et al. 2009; Morgan, Heyerdahl, and Gibson 2008; Kitzberger et al. 2007).

As demonstrated in Figure 9, PGE's service area falls into Fire Regime Groups I, III, and V, reflecting the conifer forests of the area, with the dominant overlay being fire severity V in the areas identified as HFRZ.

Dense conifer forests typically have a higher fuel load due to accumulated needles and branches, leading to less frequent but more intense fires when they occur. In dense conifer forests, especially in cooler or wetter regions, fires might be infrequent but most of the trees are killed when they occur. In contrast,

[8] Forest Fire Threatens Global Carbon Sinks and Population Centres under Rising Atmospheric Water Demand

[9] Joint Fire Science Program

conifer forests dominated by pines, especially those adapted to regular fires, may experience more frequent, low-intensity fires due to the flammability of pine needles and reduced fuel accumulation.[10]

PGE's commitment to participation with industry experts and partners, is reflected in Table 6. Climate change, wildfire risk, and industry learning are reflected throughout this plan. The information in this section addresses recommendation 27.

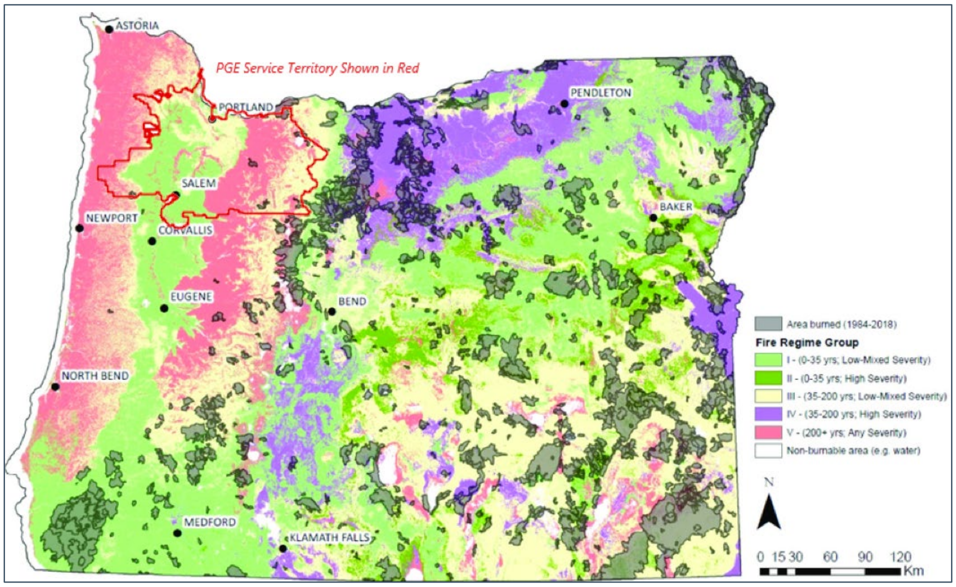


Figure 9. PGE Service Area Overlaid with Fire Regime Group Data[11]

Table 6. Bibliography of Risk Valuation Research, Reports, and Studies

Article	Summary	Implications for Wildfire Mitigation Approaches
Halofsky, Jessica E., David L. Peterson, and Brian J. Harvey. "Changing Wildfire, Changing Forests: The Effects of Climate Change on Fire Regimes and Vegetation in the Pacific Northwest, USA." Fire Ecology 16, no. 1 (2020).	Analyzes the impact of climate change on wildfires and forest ecosystems in the Pacific Northwest.	Climate change intensifies wildfires in the Pacific Northwest, necessitating adaptive management strategies and fuel treatments to enhance forest resilience.
Stephens, Scott L., and Jason J. Moghaddas. "Experimental Fuel Treatment Impacts on Forest Structure, Potential Fire Behavior, and Predicted Tree Mortality in a California Mixed Conifer Forest." Forest Ecology and Management 215, no. 1–3 (2005): 21-36.	Examines the effects of forest thinning on fire severity and tree mortality.	Forest thinning can reduce fire severity and tree mortality, making it a viable strategy for wildfire mitigation.
Agee, James K., and Carl N. Skinner. "Basic Principles of Forest Fuel Reduction Treatments." Forest Ecology and Management 211, no. 1–2 (2005): 83–96.	Discusses the principles and effects of forest fuel reduction treatments.	Fuel reduction treatments can effectively reduce wildfire hazards and promote ecological values.

[10] Eidenshink, J., B. Schwind, K. Brewer, Z. Zhu, B. Quayle, and S. Howard. 2007. A project for monitoring trends in burn severity. Fire Ecology 3(1): 3-21

[11] Fire Regime and Condition Class

Article	Summary	Implications for Wildfire Mitigation Approaches
Kramer, Anu, Gavin M. Jones, Sheila A. Whitmore, John J. Keane, Fidelis A. Atuo, Brian P. Dotters, Sarah C. Sawyer, Sarah L. Stock, R.J. Gutiérrez, and M. Zachariah Peery. "California Spotted Owl Habitat Selection in a Fire-Managed Landscape Suggests Conservation Benefit of Restoring Historical Fire Regimes." Forest Ecology and Management 479 (2021): 118576.	Investigates the impact of past wildfires on the current and future fire regimes.	Past wildfires can influence the characteristics and outcomes of future fires, emphasizing the importance of understanding fire history.
Levine, Jacob I, Brandon M Collins, Zachary L Steel, Perry de Valpine, and Scott L Stephens. "Higher Incidence of High-severity Fire in and near Industrially Managed Forests." Frontiers in Ecology and the Environment 20, no. 7 (2022): 397–404.	Highlights the increased incidence of high-severity wildfires and their ecological and social impacts.	Addressing the causes and consequences of high-severity wildfires is crucial for both ecological preservation and human safety.
Foster, Daniel, John Battles, Brandon Collins, Robert York, and Scott Stephens. "Potential Wildfire and Carbon Stability in Frequent-fire Forests in the Sierra Nevada: Trade-offs from a Long-term Study." Ecosphere 11, no. 8 (2020).	Analyzes the trade-offs between wildfire and carbon stability in frequent-fire forests.	Understanding the balance between wildfire and carbon stability can inform forest management practices and carbon sequestration efforts.
Jones, Gavin M, RJ Gutiérrez, Douglas J Tempel, Sheila A Whitmore, William J Berigan, and M Zachariah Peery. "Megafires: An Emerging Threat to Old-forest Species." Frontiers in Ecology and the Environment 14, no. 6 (2016): 300–306.	Evaluates the effects of the King Fire on spotted owls and the implications for old-forest species.	Large, high-severity fires pose threats to old-forest species, but forest restoration may be more compatible with their conservation than previously believed.
Touma, Danielle, Samantha Stevenson, Daniel L. Swain, Deepti Singh, Dmitri A. Kalashnikov, and Xingying Huang. "Climate Change Increases Risk of Extreme Rainfall Following Wildfire in the Western United States." *Science Advances* 8, no. 13 (April 1, 2022). https://doi.org/10.1126/sciadv.abm0320.	The study predicts a significant increase in the occurrence of extreme fire weather events followed by extreme rainfall events in the western United States, particularly in California and the Pacific Northwest, by the mid-21st century under a high warming scenario.	The projected increase in compound events of extreme fire weather followed by extreme rainfall underscores the need for comprehensive wildfire mitigation strategies that also account for subsequent hydrologic risks, such as flash floods and landslides, in post-fire management and community preparedness.
Fleishman, E., editor. 2023. Sixth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University	Outlines the current and projected impacts of climate change on Oregon, highlighting increased heatwaves, drought conditions, severe wildfires, and alterations in precipitation patterns, with substantial effects on the environment, economy, and public health.	Oregon should act with urgency to developing and implementing robust wildfire mitigation and adaptation strategies, considering not only environmental but also economic and health-related consequences, with a focus on safeguarding vulnerable communities and ecosystems.

3.7 Wildfire Risk Informed Decision-Making

Climate change will continue to increase wildfire threats, requiring continual adaptation of asset management and other routine business practices. This challenging reality and PGE's responsibility to maintain reliable electric service require a careful balance between often-competing interests and system requirements. As the complexity of this analysis increases with each passing year, the industry's best practice of risk-informed decision-making (selecting mitigation projects based on estimated risk reduction value) continues to guide PGE. The Institute of Asset Management (IAM) criteria in the ISO 55000 standards define value as a function of lifecycle costs, performance, and risk. Figure 10 illustrates this relationship.

In advancing the risk-informed decision-making process, PGE has developed and is evaluating a new method to measure risk. Value Spend Efficiency (VSE), builds off the Risk Spend Efficiency (RSE) concept shared in the 2023 WMP, in which pre-and post-mitigation risk is measured in a quantifiable way and adjusted for qualitative impacts not easily measured in dollars. An example of this is the impact of wildfires on watersheds/drinking water—a critical consequence to understand and factor into decision-making, but not accounted for in the classical RSE equation.

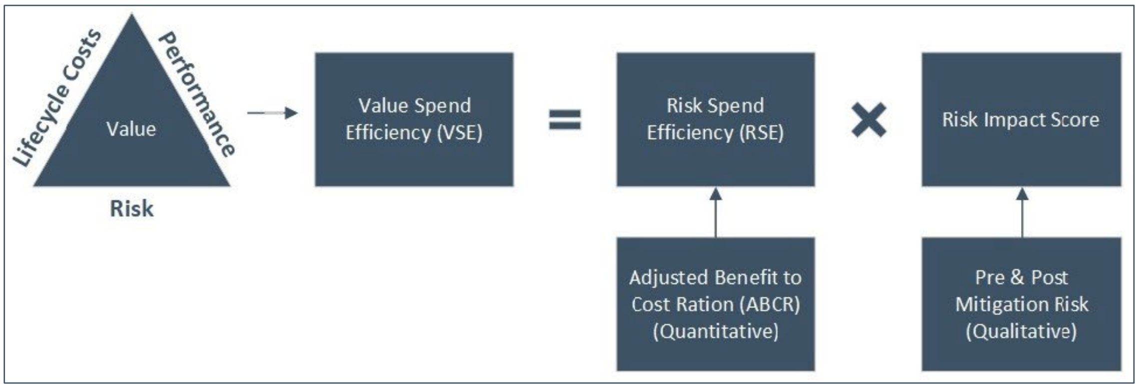


Figure 10. The Value Spend Efficiency Equation

PGE factors in changing environmental conditions, impacts on the public and the environment, QA/QC on data quality, and new data sources to iterate and develop its wildfire risk mitigation strategy. PGE follows the ISO 31000 risk framework in evolving its WRMA methodologies and leverages both IAM and ISO concepts in value quantification to calculate RSE across PGE's Program. This concept allows PGE to factor risk, lifecycle costs, and performance into a single process to guide understanding and estimate the effectiveness of mitigation measures.

PGE works to continuously apply RSE/VSE concepts in assessing mitigation alternatives across various PGE programs, including PSPS, vegetation management, system hardening, capital investment, and operations. PGE continually improves its RSE/VSE assessment approach for long-term and real-time planning and analysis.

PGE recognizes that RSE and VSE only directionally inform the selection of wildfire mitigation options for inclusion in the mitigation strategies within the HFRZ. PGE aims to achieve the highest estimated risk reduction value per dollar invested. This VSE assessment approach is flexible enough to allow PGE to adjust the analytical variables to account for factors such as climate change and to incorporate findings from its ODF, USFS, and local fire agency partnerships, as well as other critical concepts in mitigation, including the speed of execution.

PGE uses data from internal and external benchmarking sources. For example, a statistical understanding of how failure modes and ignition drivers for covered conductors affect risk is critical to effectively evaluating the appropriate locations to install covered conductors. Through its participation in the IWRMC, PGE has leveraged the experiences of industry peers to inform its fire detection probability analysis and decision-making around the most effective locations for the use of covered wire.

Additional PGE risk-informed decision-making details are discussed in subsequent sections of this Plan.

The ability to understand and forecast the weather on a more granular scale in Oregon's complex terrain is important to utilities, as extreme weather events become more frequent with climate change. This desire propelled the acquisition of a high-resolution (2 km) weather and vegetation moisture forecast model already established and in use across the Pacific Northwest by PacifiCorp. Combining this forecast model with its 30-year historical database allows weather events to be put into context and to create analogs to previous weather events that have resulted in impact to utility infrastructure, which resultingly informs decision-making – including operational strategies and response – as well as understanding and conveying risk. Data science will also utilize this data to understand better reliability impacts in the past and future.

Figure 11 shows PGE's current Weather Research and Forecasting (WRF) roadmap and implementation plan.

Figure 11. Weather Model: Timeline of Acquisition, Utilization, and Development

4 High Fire Risk Zones

PGE has identified areas where vegetation, terrain, meteorology, population density, and the WUI increase the risks associated with utility-caused wildfire ignition. For this WMP, PGE refers to these areas as HFRZ. PGE may choose to implement a proactive PSPS within a given HFRZ during periods of extreme weather wildfire threat.

- HFRZ 1: Mt. Hood Corridor/Foothills
- HFRZ 2: Columbia River Gorge
- HFRZ 3: Oregon City
- HFRZ 4: Estacada
- HFRZ 5: Scotts Mills
- HFRZ 6: Portland West Hills
- HFRZ 7: Tualatin Mountains
- HFRZ 8: Northwest Hills
- HFRZ 9: Central West Hills
- HFRZ 10: Southern West Hills
- HFRZ 11: Salem Hills

PGE relies on the ISO-31000 wildfire risk analysis framework for annual HFRZ assessment. For 2024, PGE incorporated new variables and refined boundary conditions to improve its understanding of:

- Climate change impact projections
- Fire behavior and consequences
- Location-based wildfire intensity and behavior
- Wildfire risk
- Critical state fire protection infrastructure

PGE's wildfire risk assessment factors in the likelihood that a given PGE asset could become an ignition source and that such an ignition could spread into a large, uncontrolled fire. Additional analytical factors include:

- Detection probability
- Fire response time
- Fuel dryness
- Potential for extreme weather conditions
- Presence of structures and other infrastructure
- Probability of mechanical control
- Vegetation density

In conducting the risk assessment, PGE ran thousands of scenarios in a Monte Carlo simulation to identify the service areas where the risks associated with a utility-caused ignition are highest. The results of this modeling provide the basis for PGE's HFRZ analysis.

4.1 Changes in HFRZ from 2023 to 2024

PGE performs an annual review of HFRZ, which may result in adding new areas to existing zones, adding new zones, or removing areas previously identified as HFRZ. New areas within existing HFRZ and new zones are evaluated based on conditions, including input from fire authorities, forestry authorities, egress models, observed fire behavior, and location of critical infrastructure and resources. For 2024, PGE added new areas in Zone 3 (Oregon City) and Zone 9 (Central West Hills), as well as a net new zone: Zone 11 (Salem Hills).

PGE may reduce HFRZ size if SMEs determine that system hardening efforts, such as undergrounding, have reduced risk of a utility-related wildfire in the area. After evaluating underground network performance within the PGE network, extensive benchmarking among other utilities, and knowledge-sharing in the industry forums in which PGE participates, PGE determined undergrounding reduces the risk of wildfire from utility infrastructure enough to merit removing such areas from HFRZ, barring other potential risk factors specific to an area. For 2024, PGE removed several areas from its 2023 HFRZ in which distribution mainlines and taplines are underground. Those HFRZ are Zone 1 (Mt. Hood Corridor/Foothills), Zone 5 (Scotts Mills), and Zone 9 (Central West Hills). Figure 12 identifies changes to HFRZ from 2023 to 2024.

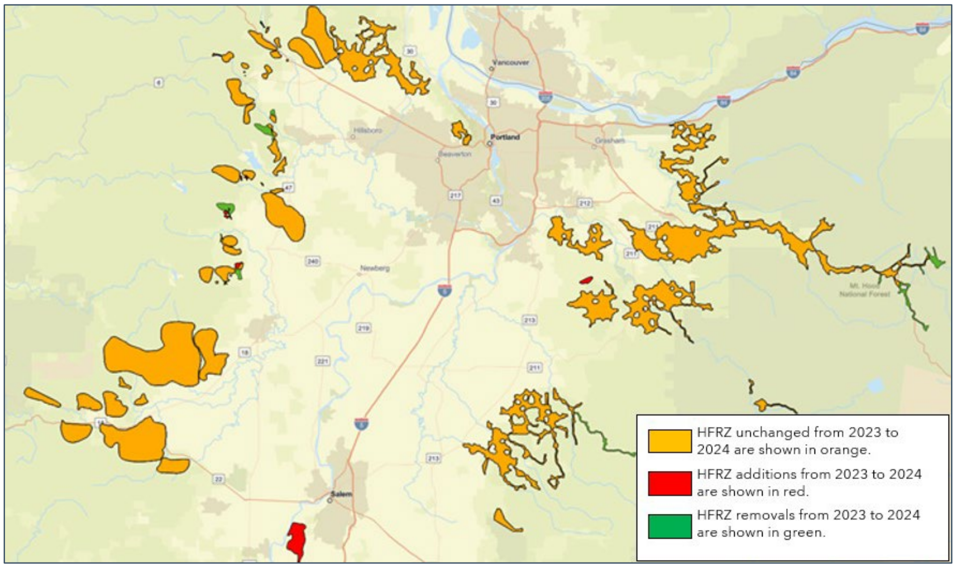


Figure 12. HFRZ Changes 2023 to 2024

Figure 13 and Table 7 indicate mapped relative locations of 2024 HFRZ within PGE's distribution service area and comparisons of key statistics by HFRZ, respectively.

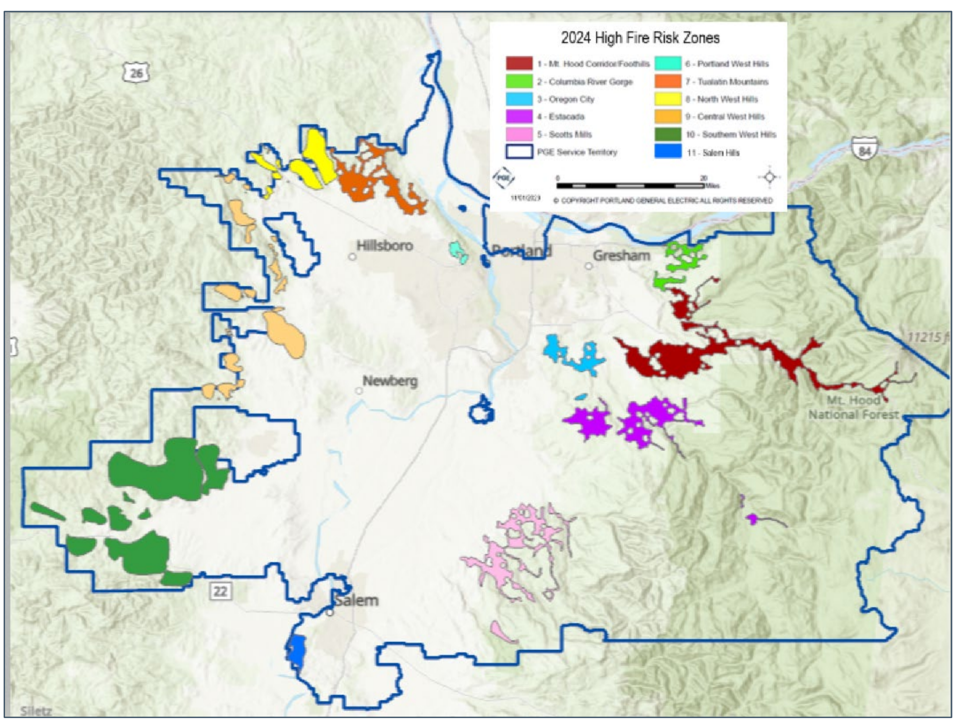


Figure 13: PGE 2024 HFRZ

Table 7. Changes in Distribution Line Miles in PGE's HFRZ 2023 vs. 2024

	Distribution Line Miles (Primary OH Miles)			Distribution Line Miles (Primary UG)			T&D Poles (Distribution structures + Transmission poles)			Customers (meters)		
HFRZ	'23	'24	Net Change	'23	'24	Net Change	'23	'24	Net Change	'23	'24	Net Change
Zone 1	250	249	0%	184	166	-11%	7,930	7,851	-1%	9,513	9,535	0%
Zone 2	25	25	0%	38	38	0%	710	704	-1%	456	458	0%
Zone 3	47	50	6%	34	36	6%	1,268	1,349	6%	1,743	1,800	3%
Zone 4	139	138	0%	68	68	0%	3,726	3,693	-1%	2,652	2,654	0%
Zone 5	151	150	0%	63	50	-26%	3,442	3,426	0%	2,000	2,005	0%
Zone 6	15	16	6%	13	13	0%	702	743	6%	960	1121	14%
Zone 7	92	91	0%	52	52	0%	2,182	2171	-1%	1,524	1,527	0%
Zone 8	43	43	0%	28	28	0%	1,068	1,061	-1%	762	768	1%
Zone 9	78	82	5%	51	43	-19%	1,820	1,916	5%	1049	1043	-1%
Zone 10	134	133	0%	83	84	1%	3,085	3,084	0%	1,710	1,724	1%
Zone 11	N/A	18	N/A	N/A	17	N/A	N/A	466	N/A	N/A	425	N/A

4.2 Enhanced Monitoring and Technology in HFRZ

PGE has invested in enhanced monitoring and technology tools to reduce wildfire risk in HFRZs. See Section 10, "System Hardening", for additional details.

In a partnership with the Electric Power Research Institute (EPRI), PGE installed a network of connected, intelligent fire detection cameras equipped with AI within its HFRZ, beginning in 2021. These ultra-high-definition camera systems give PGE a 360-degree fire detection triangulation capability across its service area, accurate to within 100 yards. The Pano AI platform's machine learning algorithms automate fire detection, awareness, and notifications, helping expand and improve regional fire detection resources. These real-time data feeds and predictive capabilities allow PGE to proactively manage risks, enable a faster emergency response by fire suppression agencies, and minimize the spread of wildfires.

In 2023, PGE installed six (6) more AI-equipped UHD cameras. See Figure 14. For additional details on PGE's Wildfire Capital Investment Strategy, please refer to Section 11, "Expected Wildfire Mitigation Program Costs".

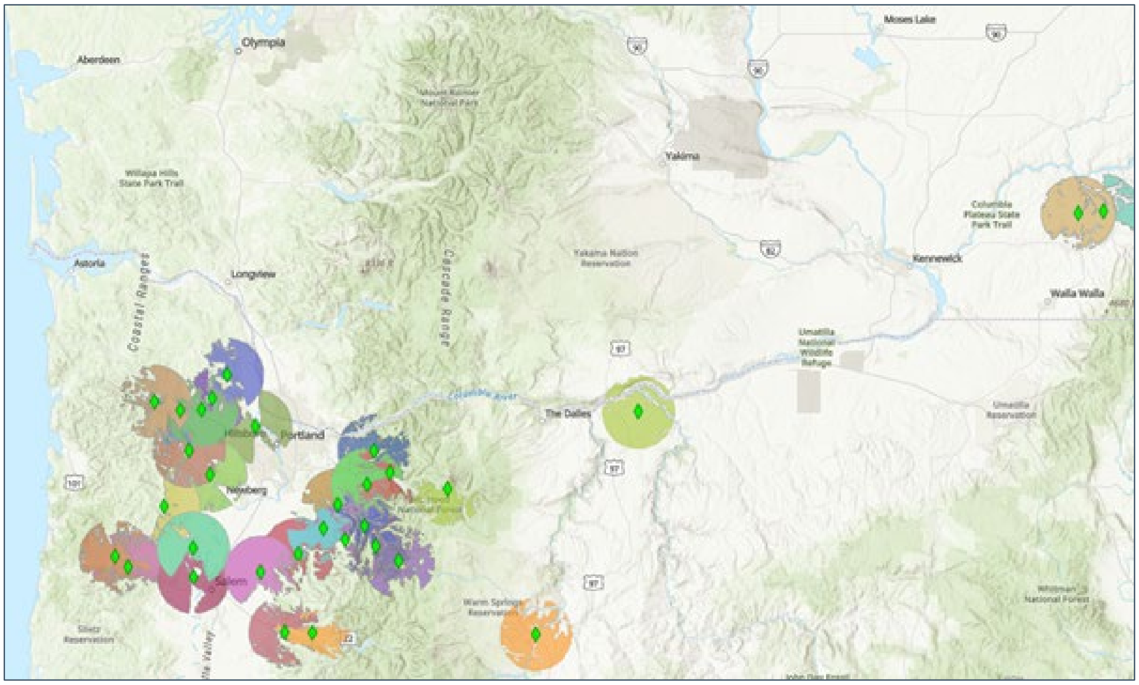


Figure 14. 2023 PGE Pano AI Camera Locations & Minimum Viewsheds

These camera systems are part of a larger situational awareness strategy in which PGE coordinates with federal, state, Tribal, and local fire agencies, fire management officers, district foresters, and private landowners. As of October 2023, 46 fire/emergency/communications agencies are actively using PGE's network of cameras, with more than 140 users and alert subscribers. The agencies using the network are listed in Table 8. Information in this table is in response to recommendation 27.

These cameras have proved to be an essential asset for PGE, as well as the many fire agencies and emergency service leaders to whom PGE has granted access and real-time alerts. Feedback from these users, often fire department chiefs themselves, has been consistently positive. There are now numerous detections on named fires, sometimes up to two hours before traditional detection methods like satellite and 911 calls. Early detection of wildfires from this technology has garnered more than ten instances of media coverage by outlets in PGE's service area in the first eight months of 2023. Figure 15 shows smoke detected by an AI-equipped camera.

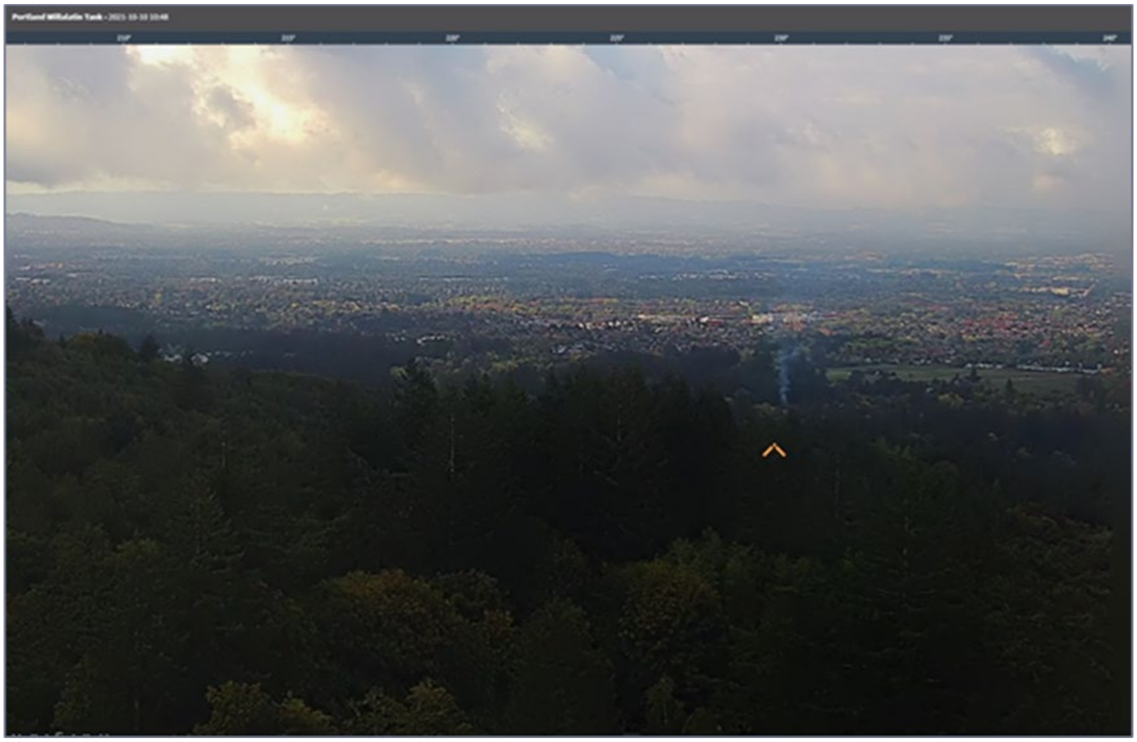


Figure 15. Smoke Detected by an AI Equipped Camera

The camera feeds and alerts system are utilized by a large contingent of PGE's Public Safety Partners, including the Columbia Cascade Interagency Communications Center (which provides camera access to USFS, ODF, US Fish & Wildlife Service, and other agencies), three ODF Forest Protection Districts, and the Confederated Tribes of Grande Ronde, among others. See Table 8 for a complete list of agencies with access to PGE's Pano AI network.

Table 8. Agencies Using PGE Pano AI Cameras

Agencies Using PGE Camera Network	
Canby Fire	NWCG
CCOM Dispatch	NWS Portland
City of Portland	ODF Forest Grove
Clackamas County	ODF North Cascades
Clackamas Fire	ODF Western Region
Clackamas Sheriff	Oregon State Fire Marshal
Colton Fire	Portland BOEC
Columbia 911 Dispatch	Portland Fire and Rescue
Columbia Cascade Dispatch	Portland Water Bureau
Columbia County Fire District 3	Scappoose Fire
Confederated Tribes of Grand Ronde	Sheridan Fire
Confederated Tribes of Warm Springs	State of Oregon
Corbett Fire	TVFR
Estacada Fire	USFS Mt Hood East
Forest Grove Fire	USFS Mt Hood West
Gaston Fire	USFS Northwest
Gresham Fire	Walla Walla Fire District #2
Hillsboro Fire	Washington County
Hoodland Fire	WCCCA
Lafayette Fire	Yamhill County
Lake Oswego Fire	Yamhill Fire
McMinnville Fire	YCOM Dispatch
Mt Angel Fire	

To illustrate the value of this technology, at 3:25 pm on July 14, 2022, PGE's Bald Peak Pano AI camera notified users that smoke in a rural area in the western part of PGE's service area was detected. At 4:25 pm, PGE's High Compromise camera issued a second smoke detected notification and triangulated the smoke's location 6.8 miles away. The Pano AI system's initial detection and notification was 104 minutes before the regional fire reporting service issued a potential wildland fire alert and 140 minutes before emergency services personnel were dispatched to the fire. ODF and other federal, Tribal, state, and local fire departments and land management agencies have provided feedback that the early detection information and triangulation accuracy obtained through PGE's Pano AI camera network is increasing crew deployment optimization and initial attack speed.

As per recommendation two (2), PGE has provided detailed quantities of assets within PGE's HFRZ in Table 9.

Table 9. PGE Assets Grouped by HFRZ

HFRZ	Ductile Iron Poles	Substations	Transformers	Reclosers	Trip Savers	Fuses
Zone 1	412	4	4206	29	21	1802
Zone 2	30	0	340	1	2	144
Zone 3	23	0	939	3	1	428
Zone 4	162	3	1698	22	4	839
Zone 5	56	0	1399	9	6	768
Zone 6	2	0	373	4	5	168
Zone 7	44	0	1080	6	0	530
Zone 8	20	0	549	0	0	304
Zone 9	105	0	848	0	3	424
Zone 10	89	0	1408	4	1	673
Zone 11	0	18	310	0	0	155

5 Operating Protocols

PGE relies on various weather and fuel models, as well as human analysis, to obtain the granularity of information required to forecast and model hazardous fire weather conditions accurately. The goal is to use these models to forecast potential hazardous fire weather conditions 7–10 days in advance. These models provide decision-makers with a detailed understanding of the uncertainties and range of outcomes possible for a given weather pattern.

The Wildfire Mitigation organization is developing a methodology to gauge the Fire Potential Index (FPI) in the PGE service area. PGE is developing a framework for determining FPI using information shared by IOUs across the West Coast. While many of the elements of the underlying calculation for FPI are readily accessible, some have proven to be more difficult to procure and/or evaluate, such as vegetation greenness scores. Many utilities leverage Landsat Normalized Difference Vegetation (LNDV) satellite imagery to determine the density of green in an area of land.

PGE declares the beginning and end of its fire season based on current and forecasted weather, drought status/timing and intensity, fuel availability and flammability, agency posture, and regional fire activity. PGE bases its decisions on data and information from multiple sources and considers State and Tribal fire season declarations within its service area. The annual fire season declaration initiates a series of PGE operational changes.

PGE's fire season declaration:

- Changes how PGE operates the system, initiating fire-season-specific settings within parts of the grid, including reducing or disabling reclosing/testing capabilities, where applicable.
- Initiates fire season operational work practices in the field.
- Activates internal 24×7 Wildfire Threat Alert Notifications (Threat Alerts). Threat Alerts are a GIS-triggered, near-real-time analytical tool that alerts PGE when:
  - Any fire incident has been confirmed by the Integrated Reporting of Wildland-Fire Information service within one (1) mile of a PGE facility in the last hour (five (5) miles for PGE Parks).
  - A Red Flag Warning (RFW) has been issued covering an area within one (1) mile of a PGE facility within the last 24 hours (five (5) miles for PGE Parks).
  - A confirmed fire perimeter is updated by the National Interagency Fire Center within one (1) mile of a PGE facility in the last hour (five (5) miles for PGE Parks) in the event of an expanding wildfire.

5.1 System Operations During Fire Season

At the start of fire season, PGE implements operational changes to reduce the risk that PGE infrastructure and operations could become ignition sources. For non-Supervisory Control and Data Acquisition (SCADA) distribution reclosing devices in PGE's HFRZ, these system changes include manually blocking the automatic test-energization of circuits following temporary faults, such as momentary tree branch contacts and lightning strikes with no damage. SCADA distribution reclosing devices are operated as shown in Table 10. When a fault occurs within a HFRZ during fire season, PGE patrols the downstream circuit before re-energizing to verify that the cause of the fault has been cleared.

PGE may also change settings outside of fire season, when fire danger is elevated, or when a RFW is in effect. In these instances, PGE proactively blocks automatic reclosing on SCADA-controlled devices within PGE's HFRZ.

PGE annually reviews and updates settings for protection and control devices located within PGE HFRZ. In 2024, PGE will continue implementing circuit breaker and recloser protection to minimize fault energy and reduce the risk of utility-caused ignitions during fire season.

The distribution feeder breakers servicing PGE's HFRZ (those equipped with relays and SCADA) are set to one of three modes: normal, fire season, or red flag. The 13 kV feeders that do not have relays utilize the electronic reclosers' necessary protection settings: normal, wildfire, and red flag mode.

Table 10 and Table 11 detail the distribution system operations inside and outside of fire season that provide the necessary protection settings for normal, fire season, and red flag modes.

Table 10. Distribution System Operations In and Out of Fire Season SCADA Devices

Mode	Description	Reason
Normal	The feeder breaker or electronic recloser will have 2-3 attempts at reclosing and trip on time delay or instantaneous if it is normally enabled.	Maximize reliability
Fire Season	The feeder breaker or electronic recloser will have one attempt at reclosing and trip on definite time instantaneous (a programmed delay before the relay trips).	Minimize risk of ignition
RFW during fire season	The feeder breaker or electronic recloser trips on definite time instantaneous and reclosing is blocked.	Minimize risk of ignition

Table 11. Pelton and Round Butte Transmission System Operations

Mode	Description	Reason
Normal	Two attempts at reclosing at Pelton, one reclosure at Round Butte	Maximize reliability
Fire Season and RFW	Reclosing is blocked—reclosers open and lock out without testing the circuit by auto-reclosing.	Minimize risk of ignition

Transmission lines located east of the Cascades, which route outside PGE's HFRZ, do not have specialized wildfire protective modes. As a result, they are placed in the most conservative mode of operation during PGE's declared fire season. Transmission lines not equipped with SCADA-enabled reclosing will be blocked from reclosing throughout fire season. Transmission lines equipped with SCADA-enabled reclosing will remain in normal operation with one attempt at reclosing when PGE declares fire season. If a SCADA-enabled line trips and recloses, reclosing will be blocked, and the lines will be patrolled before returning to normal operation.

PGE began implementing safety-adjusted protection settings on protection devices to mitigate ignition risk for a full fire season in HFRZ starting in 2021. These settings are coupled with operational protocols that require PGE personnel to physically patrol the area following protective device operations in HFRZ during fire season before re-energization, likely resulting in additional sustained interruptions and longer interruption durations.

Using 2019 and 2020 as reference years, PGE performed calculations to capture the system-wide reliability impacts of implementing safety-adjusted protection settings, using the System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI), and Momentary Average Interruption Frequency Index (MAIFI) reliability metrics (excluding Major Event Days).

Table 12, which addresses recommendation 13, compares system-wide metrics of SAIDI, SAIFI, and MAIFI metrics from June 1–October 31 before and after safety-adjusted settings were implemented by PGE (again, beginning in 2021).

Table 12. System Wide Daily Reliability Performance June 1-October 31

Timeframe	SAIDI		SAIFI		MAIFI	
	Non RFW	RFW Day	Non RFW	RFW Day	Non RFW	RFW Day
2019-2020	0.29897	0.32451	0.00182	0.00250	0.00545	0.00345
2021-2023	0.29167	0.33027	0.00176	0.00211	0.00505	0.00601
% Difference	Negligible	2%	Negligible	Negligible	Negligible	74%

Due to PGE's implemented safety-adjusted protection settings for wildfire in 2021, the average annual impact to SAIDI has been 1.05 minutes; SAIFI and MAIFI impacts have been negligible.

Given uncertainties and challenges in predicting future weather conditions (e.g., RFWs) and interruption frequencies and impacts, PGE will continue monitoring reliability performance impacts for safety-adjusted protection settings on protection devices to mitigate ignition risk in HFRZ.

Based on the limited sample size, PGE's safety-adjusted protection settings have a negligible overall impact on reliability during most fire seasons. Still, they are causing longer-duration outages on days when weather conditions are more extreme. Although affected, there is no overall appreciable impact on reliability because HFRZ are a fraction of the PGE's service area. Red flag days account for a small fraction of the total days during fire season.

5.2 Preparedness and Training

PGE provides annual wildfire operations and safety training to keep employees and contractors who will be working in the field during Fire Season safe. This includes non-field personnel that may perform work in the field on an as-needed basis. Participants receive training that has historically covered topics such as fire suppression tools and equipment required during Fire Season, basic suppression tactics, operational practices, ignition reporting requirements, and more. This training curriculum, along with its delivery method(s), is evaluated and adjusted annually.

5.3 Event Response Management

PGE closely monitors active wildfires in or near its distribution service area and generation asset areas in Oregon and Washington. As an incident expands in size and complexity, PGE contacts the appropriate agency-incident management team to offer PGE resource assistance at the incident command post. This strategy aims to enhance interoperability, share information, and promote collaboration with Public Safety Partners, utility peers, and state, Tribal, and local emergency managers to achieve shared objectives to serve the community and affected customers.

During a PSPS event, PGE's CIMT will follow established procedures and protocols to manage the event. Section 6, "Operations During PSPS Events", provides additional details.

PGE uses the Incident Command System (ICS) as its framework for managing incidents and events that exceed the scope of routine management. ICS allows PGE to scale up a response that requires additional internal and external resources and clear lines of command and control. It also enables interoperability with other utilities and public safety partners. For PSPS, PGE's ICS Command and general staff organizational chart is shown in Figure 16.

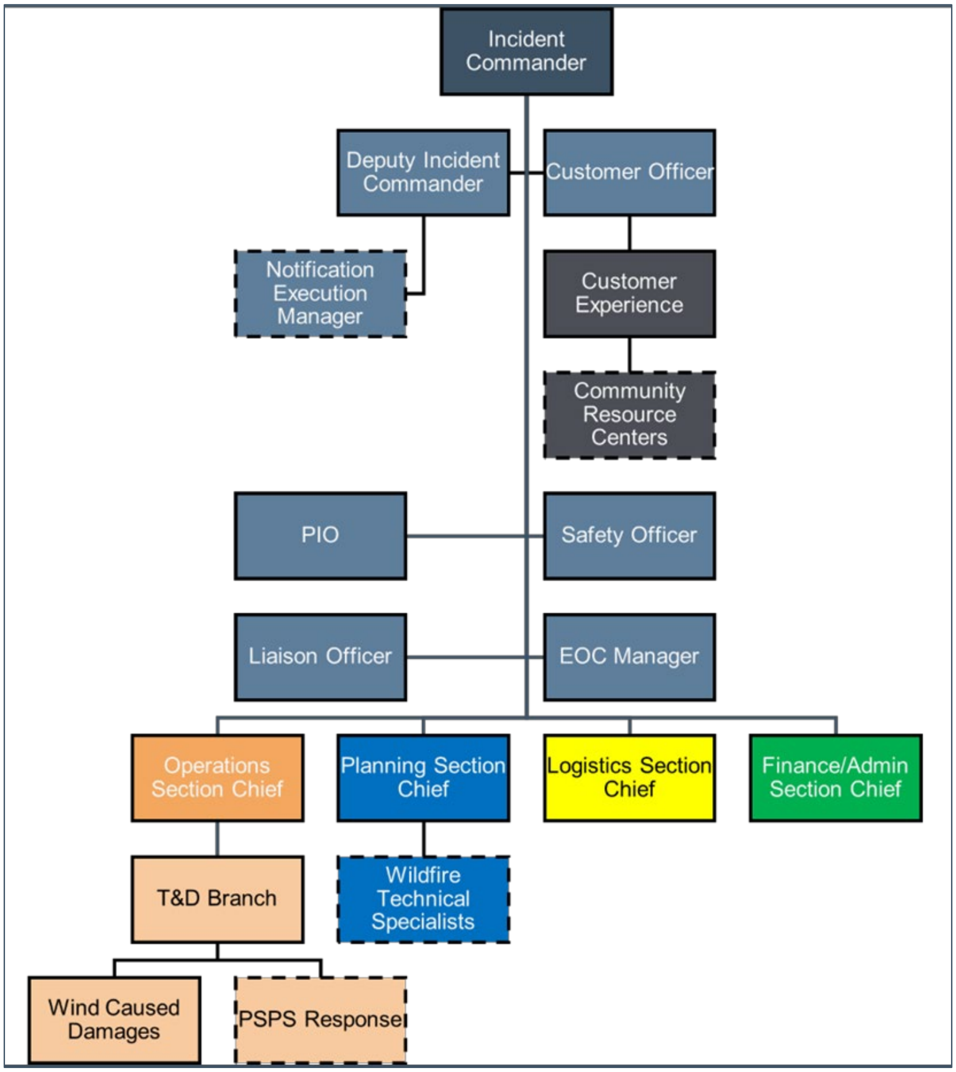


Figure 16. PGE's ICS Command and General Staff

PGE evaluates the PSPS Command and general staff organizational chart and may make changes based on feedback from exercises or events. Based on internal feedback from PGE's September 2022 PSPS, in 2023 the Notification Execution Manager (NEM) reporting was moved from the Public Information Officer (PIO) to the Deputy Incident Commander (IC) to raise visibility and allow the PIO to focus on more strategic outreach during a PSPS. See Section 6, "Operations During PSPS Event", for decision-making throughout a PSPS activation. The information in this section partially addresses recommendation 14.

Real-time de-energizations, which are for reasons other than extreme weather conditions, can occur during and outside of fire season. PGE personnel on-site also have the authority to de-energize portions of the distribution system without requesting permission from or notifying PGE management – for example, to de-energize a downed power line. In addition, first responders may request a real-time de-energization from PGE via 911.

6 Operations During PSPS Event

This section provides a high-level overview of the escalating levels of a PSPS event, and the actions taken within each level. In internal documentation libraries, PGE maintains detailed, annually-updated operational plans and protocols for PSPS events. Details describing PSPS decision-making are found in Section 6.2, "Levels of a PSPS Event", through Section 6.9, "Community Resource Centers". These sections, along with Figure 16, address recommendation 14.

PGE uses meteorological, outage data, and predictive analytics to make risk-informed decisions regarding PSPS events and curtailment decisions. PGE closely monitors Fire Weather Forecasts before and during fire season from several NWS offices around the region, including Seattle, Pendleton, and Medford, fire activity briefings, fire potential forecasts, and data from PGE weather stations strategically located throughout the service area. PGE makes its weather station data publicly available via MesoWest to improve regional forecasting and the analysis of extreme weather events.

In 2024, PGE plans to improve its risk-informed decision-making through improved situational awareness capabilities. PGE plans to install five new RAWS and deploy its four mobile weather stations, as needed, within HFRZ. As RAWS are installed, they will be incorporated into PGE situational awareness intake. Site selection for RAWS will consider utility, meteorology, and stakeholder requirements for optimal placement, as discussed in Section 13, "Research and Development". In late 2022, PGE operationalized a prototype of a Storm Predictive Tool that will incorporate weather data from across PGE's service area to inform PGE's PSPS execution decision analysis. As additional RAWS come online, the data they record is intended to refine the Predictive Outage model further.

The PSPS Process bell curve in Figure 17 correlates the various incident levels defined in internal PGE emergency operations plans to illustrate typical operations during the multiple phases of a PSPS event. It only provides a point of reference, as PGE may adjust operations during a PSPS event based on real-time conditions.

During an event, information including location, de-energization estimates, and estimated restoration times (ERTs) for each area impacted by a PSPS can be found on PGE'S Wildfire Outages and PSPS webpages. PGE's website has the bandwidth capable of handling web traffic surges expected during PSPS events, and all web-based PSPS information is easily readable and accessible on mobile devices.

Prior to the 2024 fire season, PGE will provide multiple options for Public Safety Partners to access real-time GIS information pertaining to PSPS outages. These options will include a link to PGE's public PSPS web layer service and an ArcGIS Online web map containing PSPS information, as required by OAR 860-300-0060, both of which are currently available. The PSPS web layer service and AGOL web maps are updated simultaneously with the PSPS Area map found on PGE'S Wildfire Outages & PSPS page. PGE will continue to evaluate the customer experience with these tools and look for ways to improve that overall experience in the 2024 fire season.

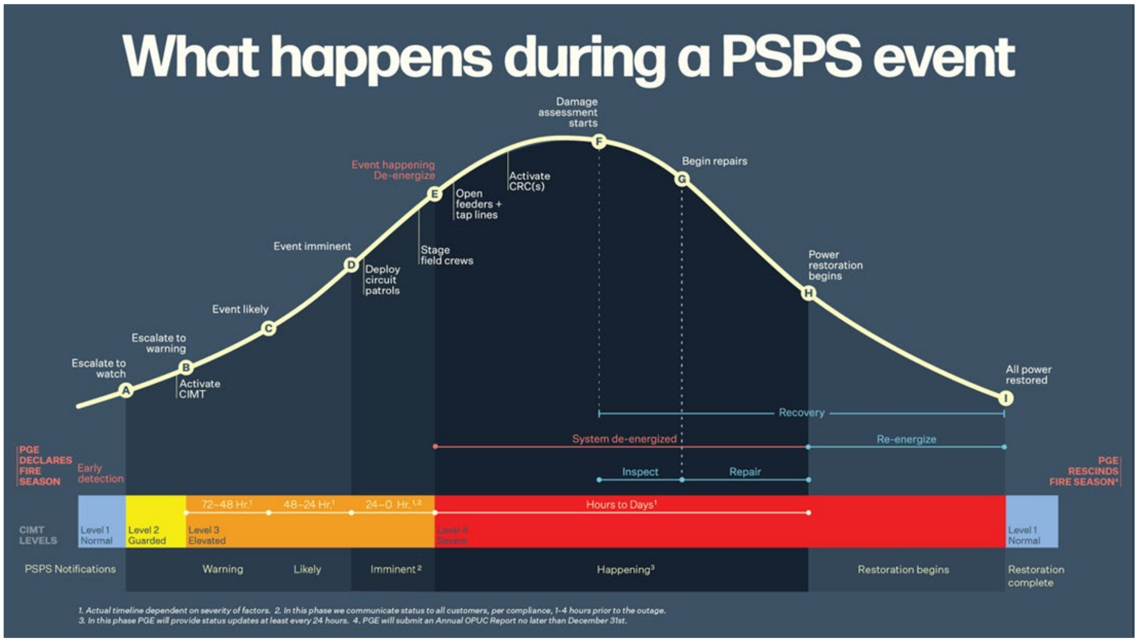


Figure 17. PSPS Process Bell Curve

6.1 De-Energizing Power Lines and Power System Operations During PSPS Events

As a last-resort safety measure to protect people, property, and public areas, PGE will proactively turn off power when conditions threaten the ability to operate the grid safely. PGE's declaration of a PSPS is not limited to an HFRZ and may occur anywhere in the service area, based on the same criteria used to declare a PSPS within an HFRZ. When PSPS events are declared, PGE keeps customers and stakeholders well-informed and strives to mitigate customer impacts by limiting the outage duration, as much as conditions allow.

6.2 Levels of a PSPS Event

When PGE makes the decision to execute a PSPS event, the order of operation generally follows the PSPS Process Bell Curve. PGE will adapt actual PSPS event operations as required to address evolving, dynamic, and unpredictable circumstances. Event posture decision-making authority is assigned to the PSPS Assessment Team (PAT) IC when PGE moves from Level 1: Normal to Level 2: Guarded. The PAT IC makes the decision to escalate or de-escalate the PSPS event based on data and input from Wildfire Mitigation SMEs. If the event posture is escalated to Level 3: Elevated, the event posture decision-making authority is transferred to the CIMT ICs and remains with the CIMT until the end of the PSPS event.

6.3 Level 1: Normal

Once fire season has been declared, under Level 1: Normal conditions, PGE closely monitors and communicates regional weather and wildfire situation/status to operational leadership. Through real-time situational awareness monitoring, PGE can tailor operational and system changes during fire season, thereby increasing safety and operational efficiency.

Year-round, PGE conducts a weekday operations call. Should weather or other related events warrant communications outside the normal schedule, PGE may convene the daily operations call on weekends or holidays. During fire season, this daily briefing includes:

- Fire weather forecasts and fire potential specific to PGE's service area
- Reporting of NWS-issued watches and warnings
- Summary of current regional fire activity

Additionally, PGE closely monitors changing or deteriorating conditions, regularly communicating critical updates to affected business units. To assist with this, PGE maintains working relationships with fire agencies, fire management officers, district foresters and dispatch centers at the federal, state, Tribal, and local levels, including the Portland office of the NWS. These partnerships provide PGE with specific, granular-level situational awareness, assistance with forecast modeling validation, fire suppression resource pre-positioning, and activity/growth updates for fires in near PGE assets.

6.4 Level 2: Guarded

If PGE determines that current or predicted fire risk conditions warrant an escalation in planning and coordination, PGE shifts from Level 1: Normal to Level 2: Guarded, which represents a PSPS Watch posture. When this occurs, PGE's Senior Director of Wildfire & Operational Compliance or their designee, will activate the PAT to monitor conditions, evaluate conditions, and prepare to initiate the next phase of PSPS plans and procedures, if necessary. PGE also issues a preliminary notification to internal stakeholders, Emergency Support Function (ESF) 12, and OPUC Safety Staff that PGE has moved to Level 2: Guarded status. Following the decision to issue a Level 2: Guarded notification, PGE will place the full CIMT on standby and build its duty roster.

6.5 Level 3: Elevated

PGE's decision to escalate from Level 2: Guarded to Level 3: Elevated status is predicated on conditions on the ground, and the pace of the onset of weather conditions at the time. Once the PAT IC has made the decision to proceed to Level 3: Elevated, PGE will fully activate the CIMT.

Level 3: Elevated is divided into three sequential, time-boxed phases, each representing an escalated state of readiness. To the extent practicable, PGE will adhere to the following notification timeline in advance of a PSPS event:

- PSPS Warning: 72–48 hours prior to de-energization.
- PSPS Likely: 48–24 hours prior to de-energization.
- PSPS Imminent: 4 hours–1 hour prior to de-energization.

6.6 Preparation for De-Energization

During the Level 3: Elevated phase of the potential PSPS event, PGE closely monitors fire potential indicators, situation, and status. The CIMT develops Incident Action Plans for each operational period (or as directed by the CIMT's IC), including situation-specific tactics and detailed instructions for field and support personnel – for example, the strategic pre-positioning of Field Observers personnel and Community Resource Centers (CRCs). Immediately prior to de-energization, PGE resources in the field move into their "Get Set" positions or designated staging areas until execution of de-energization begins.

PGE will continue to monitor fire weather conditions throughout the Level 3: Elevated phase. When threshold conditions indicate that a PSPS is imminent and the CIMT's Situational Unit and IC has determined that escalating to Level 4: Severe (Event Happening stage) is appropriate, they will request de-energization approval for the appropriate PSPS areas(s) from the IC.

6.7 Level 4: Severe Event Happening

Transitioning from Level 3: Elevated to Level 4: Severe is triggered by the IC decision to de-energize the area impacted by PSPS. Immediately after, operational resources are given the "Go" signal to open feeder and line devices and strategically isolate the circuit to support a safe, efficient re-energization when weather conditions allow. Also, at this step, the Customer Officer will order the mobilization of CRCs to support customers, as described in Section 6.9, "Community Resource Centers".

6.8 Level 4: Severe Restoration

Once weather conditions necessitating a PSPS de-energization subside, PGE crews conduct patrols to assess damages and begin necessary repairs. Once given authorization by the IC, based on input and data provided by the Situation Unit, line crews execute cutsheets to restore power. PGE sends an "End of PSPS" notification when all power is restored.

6.9 Community Resource Centers

During PSPS events, PGE may establish CRCs in selected areas to provide critical restoration information to customers impacted by the outage(s), including updates and real-time information. The CRCs also provide customers with electronic and medical device charging, internet access, and clean water and ice to offset some of the impacts associated with a PSPS.

PGE has identified multiple potential locations for CRCs within or near each HFRZ to provide the flexibility to select the location that best suits customers' needs based on event specifics. PGE may not activate CRCs at all pre-designated locations during a particular PSPS event. Depending on the nature of the event, PGE may determine some CRC locations are not needed, or it is possible to serve areas that have been impacted by a PSPS event from a common CRC location. Pre-identifying multiple CRC locations within each HFRZ also gives PGE options if mandatory evacuations require the relocation of a CRC. PGE's goal is to locate CRCs as near as possible to the areas impacted by the de-energization. However, specific circumstances may make this impractical. Decisions need to be made quickly regarding where and how many CRCs are required. In 2023, PGE developed a CRC staffing model that includes an Activation Lead who coordinates directly with Fire DAWG and the CIMT to stand up and operate the CRCs. In addition, PGE trains employees in advance to act as either Customer Experience Leads or general support staff that report to any active CRC location to assist visitors as needed and report vital real-time information impacting the CRC to the acting CRC Activation Lead. PGE trained enough employees to staff up to 10 CRCs in rotation for as long as necessary. PGE will implement the same recruiting and training strategy for the 2024 fire season. This content addresses recommendation 15.

PGE's decision-making process for potentially deploying CRCs begins during the Level 3: Elevated PSPS Likely. At this phase, PGE selects the specific CRC location(s) and sets hours of operation. Whenever possible, PGE will work with community partners to make CRC resources available to impacted customers regardless of whether a pre-determined location is available for the specific PSPS event. For example, if a location is outside the known HFRZ areas, PGE will work quickly to identify an appropriate location. PGE uses the community's customer demographic data to inform location placement to select sites that are fully accessible (on or near main roads) and known locations within the community. PGE will notify Public

Safety Partners and adjacent Public Safety Partners as soon as CRC locations and activation schedules are confirmed. PGE will try to have CRCs operational within 24 hours of de-energization and keep these locations operational for as long as they benefit customers. Sometimes, PGE may not establish a CRC in an impacted PSPS Area; this may be due to resources being provided by a county, Red Cross, or other entity, when a single CRC is serving multiple PSPS areas, or when safety concerns preclude PGE's ability to site a particular CRC. Figure 18 is a photo of PGE Volunteers.

Figure 18. September 2022 PGE CRC Volunteers

6.10 Communications During a PSPS Event

Beginning at the Level 3: Elevated phase, to the extent practicable, PGE will initiate a methodical sequence of pre-event PSPS notifications and subsequent updates, delivered in 24-hour intervals, that progress from each of the three Level 3: Elevated phases (Warning, Likely, Imminent) through the Level 4: Severe Restoration Complete phase. During a PSPS event, PGE will communicate with Public Safety Partners, operators of utility-identified critical facilities (including Communications facilities), customers, and other stakeholders at the time periods identified in Table 13. If possible, PGE will provide priority notifications to Public Safety Partners, Adjacent Public Safety Partners, and utility-identified critical facility operators 72–48 hours before de-energization.

In addition, before and during PSPS events, PGE makes current PSPS status information, including location, de-energization estimates, and ERTs for each impacted PSPS Area, available on www.portlandgeneral.com's wildfire and PSPS outage webpage. All PSPS information on portlandgeneral.com is easily readable and accessible on mobile devices.

Table 13. Notification Cadence

Notification Cadence	Audience		
	Public Safety Partners, Adjacent Public Safety Partners, Stakeholders	Utility-identified critical facilities[12]	Customers
PSPS Warning 72-48 hours prior to de-energization	√	√	
PSPS Likely 48-24 hours prior to de-energization	√	√	√
PSPS Imminent 4-1 hours prior to de-energization	√	√	√
PSPS Happening At de-energization	√	√	√
Restoration Begins	√	√	√
Restoration Complete	√	√	√
At a minimum, status updates at 24-hour intervals until service has been restored[13]	√	√	√

PGE uses multiple media channels to inform impacted customers, communities, and stakeholders throughout the PGE service area per OAR 860-300-0050. Special attention is given to those within areas affected by a PSPS event. PGE will deliver notifications in multiple formats across multiple channels, including phone calls, text messages, prepared public safety notifications distributed through Public Safety Partners, social media posts, media advisories, emails, and messages to agencies that serve diverse community populations. For PSPS outreach to customers and stakeholders, PGE aims to address the geographic and cultural demographics of the PSPS Area, including language, access to broadband, and accessibility for those who are visually impaired or hard of hearing, through the following strategies:

- All of PGE's PSPS-related written communications are in English and Spanish.
- PGE Customer Service offers a language hotline to answer customer questions in 200 languages.
- PGE works closely with Public Safety Partners, broadcast, and print media to provide regular PSPS -related text messages and news reports to help customers who may not have in-home broadband access.
- All PSPS-related content on the portlandgeneral.com website is designed to be ADA-compliant for vision-impaired, deaf, and hard-of-hearing customers.[14] PGE provides both audible and written messaging options and closed captioning on all videos posted to the website.

[12] Including Communications facilities

[13] These notifications may be required any time after initial notifications during Level 3 Elevated through restoration, as dictated by the event.

[14] Reference to Web Content Accessibility Guidelines

- Throughout the event, PGE distributes PSPS-related information through various platforms and formats such as text messaging, online content, traditional media, paid advertising, written materials, and information sharing with community-based organizations and Public Safety Partners to achieve the broadest reach possible.

PGE recognizes the importance of effective communication with stakeholders before, during, and after a PSPS event. Figure 19 provides a visual summary of PGE's PSPS notifications process.

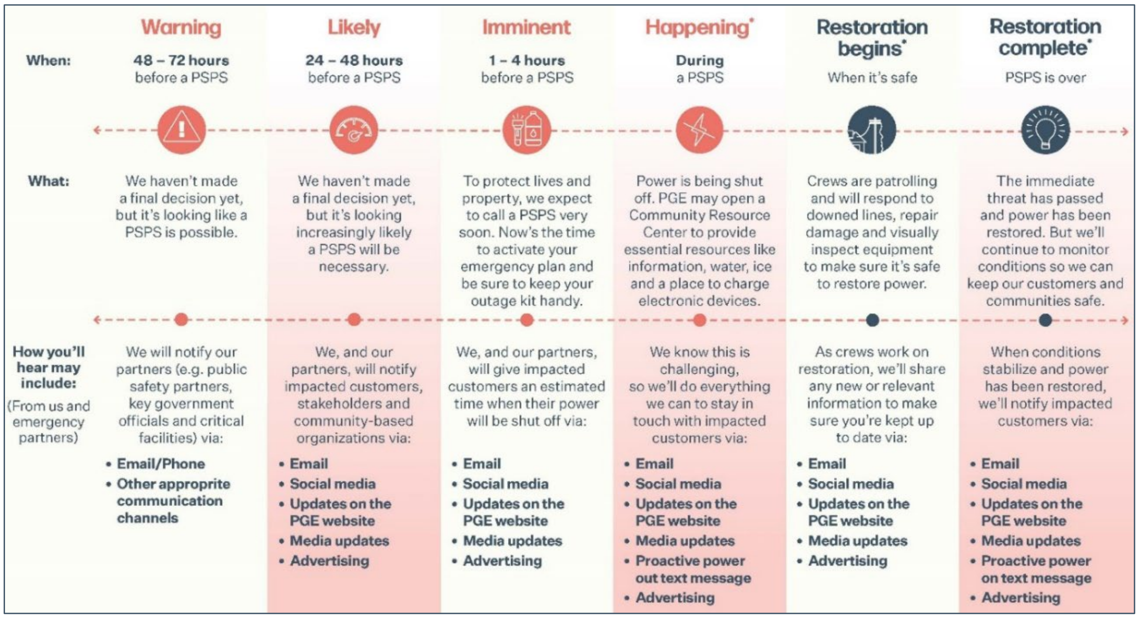


Figure 19. PSPS Notification Strategy

Throughout the PSPS event, PGE provides the elements of notification information required by OAR 860-300-0050 to Public Safety Partners, Adjacent Public Safety Partners, operators of utility-identified critical facilities (including communications facilities), and customers as summarized in Table 14. PGE developed the CIMT role of NEM for PSPS events. The NEM sends required notifications to the required audience at the prescribed times and intervals.

Table 14. Notification Information

Notification Information	Audience		
	Public Safety Partners, Stakeholders	Utility-Identified Critical Facilities	Customers
Date and time PSPS will be executed	√	√	√
Estimated duration of PSPS	√	√	√
Notice of when re-energization efforts will begin and when re-energization is expected to be complete	√	√	
At a minimum, status updates at 24-hour intervals until service has been restored	√	√	√
Number of customers impacted by PSPS	√		
The PSPS Area, which would include GIS shapefile(s) depicting current boundaries of the area subject to de-energization	√	√	
When feasible, the Public Utility will support Local Emergency Management efforts to send out emergency alerts	√		
A statement of impending PSPS execution, including an explanation of what a PSPS is and the risks that the PSPS would be mitigating			√
A 24-hour means of contact customers may use to ask questions or seek information			√
How to access details about the PSPS via the Public Utility's website, including education and outreach materials disseminated in advance of the annual fire season			√

7 Wildfire Safety, Prevention, Communication and Engagement Strategies

PGE employs a three-pronged strategy to educate, engage, and solicit feedback regarding wildfire safety and prevention with customers and stakeholders.

- **Wildfire Awareness and Education Communications Campaign:** This strategy focuses on educating customers and communities about PGE's wildfire mitigation efforts and preparing them for the possibility of wildfire or PSPS events. Outreach and awareness are comprehensive efforts using multiple mediums and communication channels to reach customers and community stakeholders.
- **WMP Engagement:** This strategy focuses on partnering with Public Safety Partners and local communities to host public forums where customers can learn about PGE's WMP, associated programs, and to solicit feedback during or after each event. PGE hosts these events throughout the service area before or during fire season each year.
- **Public Safety Partner Engagement:** PGE works closely with our Public Safety Partners to facilitate information sharing, community outreach, and wildfire preparedness and response. PGE divides its Public Safety Partner coordination approach into three phases: before, during, and after fire season. By working in partnership with each Public Safety Partner, PGE can maximize the effectiveness of its outreach efforts and the size of the audience receiving these communications and improve operational coordination and information sharing.

The overriding purpose of these strategies is to prepare communities for fire season by providing information about specific preparedness actions they can take, as well as steps PGE may take, including PSPS events. Communications utilizes multiple partners, stakeholders, and channels to reach customers and communities throughout the PGE service area.

This approach incorporates stakeholders, Public Safety Partners, customer feedback, and insights from survey data about how customers engage with the information PGE provides.

As fire season approaches, PGE activates a communications campaign to raise awareness of its wildfire mitigation efforts and the potential for PSPS events. In May of 2022 and 2023, PGE teamed up with PacifiCorp, Idaho Power, and the OPUC to issue a joint press release in support of National Wildfire Awareness Month. PGE plans to continue this approach to present a unified front and promote the need to be prepared.

Similar to previous years, PGE will conduct awareness and education activities before and during the 2024 fire season to reach customers, critical facility operators, federal, state, and local governments and elected officials, agencies, Tribes, and Public Safety Partners. Communication activities are carried out during fire season through media outreach, website information, social media, paid advertising, and strategic direct customer outreach. Based on learnings from 2022 and 2023, direct customer communications will begin in July when the information is more relevant, with cadence and medium tailored to specific target audiences, including residential and business customers, key managed accounts, and customers inside and outside of HFRZ.

7.1 Education Approach

PGE's efforts to connect with the target audiences for its community outreach and awareness program will begin with outreach to regulators, state and emergency response agencies, Public Safety Partners, and local municipalities to raise awareness about PGE's wildfire mitigation efforts, beginning with the annual submittal of PGE's WMP and continuing through fire season.

In 2024, PGE will provide these entities with information about steps PGE is taking to reduce the risk of wildfire and about opportunities to participate in one of the scheduled informational conference calls and tabletop exercises before PGE declares fire season. PGE conducts ongoing outreach to state agencies and government officials to share vital information about PGE's wildfire mitigation efforts and potential PSPS events.

Additionally, PGE continues coordinating with utilities throughout the state to align on similar PSPS and safety settings language for Public Safety Partners and communities. This coordination is to help Public Safety Partners and communities clearly understand measures and modifications made to protect communities during fire season. This collaborative work is ongoing with the approach for safety setting language planned for completion before the 2024 fire season. This coordination addresses recommendation 16.

In 2024, PGE plans to build on its 2023 communications, education, and preparedness campaigns, revising and expanding, where applicable, existing communication materials and by working collaboratively with community leaders and Public Safety Partners and learning from customer survey results to refine and update the direction and content to keep customers informed.

7.2 Education Campaign: Channels and Outcomes

PGE employs a multichannel communication strategy to reach local communities effectively and equitably with wildfire safety and prevention information. The goal is to equip customers and the broader public with actionable, timely information throughout fire season.

The Wildfire Outages & PSPS page on the PGE website serves as a primary information hub for customers to learn about ways the company is reducing wildfire risks, tips to prepare for a PSPS event, and general information on wildfire safety. This resource for wildfire-related information is annually updated in English and Spanish and provides information in 13 additional languages.

The Wildfire Outages & PSPS hub provides information on the following:

- A high-level overview of measures and investments PGE is making to mitigate wildfire.
- An interactive map of PGE's service area with zones most likely to experience a PSPS, showing which areas are currently experiencing a safety outage. The map allows users to enter a service address and check if the location is within an active PSPS Area.
- How to prepare a home or business for a PSPS event, including information about emergency plans, kits, and checklists.
- Link to the PGE WMPs.
- PSPS Frequently Asked Questions (FAQs).
- Safety tips to prepare for and prevent wildfires.

In 2024, PGE plans to split the current wildfire safety and preparedness information web page into two (2) separate web pages. The purpose is to improve the customer experience by bifurcating the information into separate sections so customers can access the information they need depending on the time of year or situation.

- Wildfire Safety and Prevention: A page with information relevant to preparedness activities, the WMP and FAQs relative to:

  - How to prepare for wildfire-related outages.
  - Programs and initiatives PGE is implementing to mitigate wildfire risk.
  - Wildfire safety system settings and the potential impact of forecasted weather on company readiness posture.
- PSPS: A page dedicated to PSPS-specific information, how they work, what to expect, and why PGE would need to call one:
  - Central location for up-to-date information/resources if PGE is activating PSPS.
  - Status of PSPS in PGE's service area.
  - Interactive PSPS map.
  - PSPS-specific FAQs to include information on CRCs.
  - PSPS information in multiple languages.

PGE will continue to improve the web-based interface used during the September 2022 PSPS. Real-time, dynamic location information is provided via a map. De-energization and re-energization estimates are provided by the area impacted and PSPS. More information on how the web-interface worked during the 2022 PSPS can be found in PGE's Public Safety Power Shutoff 2022 Annual Report.

Another key channel PGE uses to generate awareness is engagement with broadcast, print, and radio news outlets. In 2023, PGE strategically engaged with national, trade, and Portland Metro media outlets to promote the strategies and investments PGE is making to mitigate wildfire risk, sharing wildfire safety information and general information on PSPS.

Before the 2023 season, PGE hosted a wildfire preparedness media day at the Sherwood Training Center in May to launch its awareness and education efforts. The event was a focused opportunity to share PGE's wildfire mitigation efforts, educate about PSPS, and encourage customers to take preparedness steps. All four broadcast affiliates, OPB, The Oregonian, Pamplin Media, and KXL sent reporters to cover the event, which generated significant educational news coverage.

Throughout the fire season, an array of national and local media outlets published nearly 30 different stories highlighting the company's innovative use of technology, strong public safety partner coordination, and strategic investments that help to protect life, property, and public spaces. Safety and preparedness messages from PGE were included as the headline or at the beginning of articles/reports. For national stories, PGE was cited as an industry leader in planning and delivering an effective WMP.

Advertising is essential in our integrated communication approach to educate customers about how PGE prepares for wildfire and how they can prepare for a PSPS event. We garnered over 16 million combined impressions during the summer months across digital banners, radio, print ads, and a sponsorship with KPTV.

PGE promoted safety and preparedness messages in multiple languages across various channels. Print ads ran in five languages (English, Spanish, Chinese (Mandarin), Vietnamese, and Russian) in publications including *Afisha*, *Asian Reporter*, *Latino De Hoy*, *Oregonian*, *Pamplin Media Group*, *Phuong Dong News*, *Portland Chinese Times*, and the *Statesman Journal*. Pandora and digital ads were in English and Spanish.

PGE worked with KPTV on a paid sponsorship that synchronized storytelling across paid media and earned media outreach and customer emails. Throughout the summer, we share important safety-themed information, including weather and safety, year-round preparedness, and fire season and outage preparedness.

We bolster our customer reach via earned media and digital communication when we pair those efforts with in-person engagement at community events. In August 2023, PGE attended community information meetings in response to the Camp Creek Fire burning near the Bull Run Watershed. PGE representatives attended meetings in three different cities, Sandy, Welches, and Corbett-to share PSPS related information. PGE will continue to attend wildfire preparedness events and town halls hosted by county and fire agencies to share information about the potential for wildfire-related power outages.

PGE provides PSPS preparedness checklists translated into multiple languages, available through the PGE website and PSPS preparedness one-pagers available for Community-Based Organizations, food banks, and schools serving customers in the PGE service area. PSPS preparedness information provided on the PGE website is available in 15 languages. In addition, throughout fire season, PGE references the Language Line on its website and customer communications. PGE Customer Resource Centers distribute fliers in multiple languages with the following message: "We speak your language. Our customer service advisors can assist you in 200+ languages. Call us at 503-228-6322."

Another key pillar of the communication campaign is educating PGE employees about the company's wildfire mitigation efforts and fire season's operational and logistical impacts, including providing employees with visibility into company investments and work to mitigate wildfire risks and the plans needed to perform an effective PSPS or safety-related power outage.

PGE shares employee communications across all internal channels, including the intranet, all-employee weekly emails, digital boards, and direct employee communications specifically for those living in HFRZ. The focus was to help our employees better understand PGE's wildfire mitigation efforts to aid them in understanding the impacts fire season has on our operations and what that means for our customers. Information also included a detailed look at our WMP, support from the company if employees are affected by mandatory wildfire evacuations, profiles on new wildfire mitigation technologies and resources, and a full breakdown of what it means for PGE and our customers if the company calls a PSPS.

In 2024, PGE will continue employee communication by building on 2023 efforts, as we equip employees with up-to-date and timely wildfire safety information.

7.3 Education Campaign and Customer Survey Results

In 2023, PGE launched the first ongoing semi-annual Safety Message Awareness and Knowledge Tracking survey to understand its communication effectiveness better. The survey was emailed to a representative sample of PGE's customers, both within and outside of HFRZ, to gauge general awareness of message recall and awareness. Survey topics included wildfire mitigation efforts, whether customers acted to prepare for wildfire and wildfire-related outages and measured general understanding of PSPS. The survey aims to collect and analyze feedback to improve communication plans and meet customers where they are. Access to the survey will be expanded in the spring to gather additional input through non-English versions.

Survey Methodology

- Successfully delivered 9,516 survey invitations.
- Received 420 completed surveys across two customer groups of interest for a 4.4% response rate.
- 200 customers in HFRZ.
- 220 customers outside the HFRZ, within the service area.

Survey Instrument

- Based on their response, customers were asked up to 18 total questions.
  - 1 PGE brand-level satisfaction question
  - 6 PSPS awareness/understanding questions
  - 5 Outage experience/preparedness questions
  - 5 demographic questions
  - 1 survey sweepstakes question

Key Findings

- Customers are aware of PSPS events and why PGE has or would use them.
  - Customers within PGE's HFRZ, awareness of PSPS is at 84%
  - Customers outside of PGE's HFRZ, awareness of PSPS is 47%
- Seventy-three percent of HFRZ customers say they can explain a PSPS to someone, and when asked, it was very common for them to include wildfires, severe weather, and downed power lines in their explanations.
  - While less confident they could explain a PSPS to others, non-HFRZ customers still often mentioned wildfires, severe weather, and downed power lines in their explanations.
- PGE is a more common source of PSPS information (45% across all channels included in survey) than new stories (36%) for HFRZ customers.
  - Non-HFRZ customers are 29% more likely to have heard of PSPS from the news than from PGE (11% across all channels included in the survey).
- Customers residing in an HFRZ are more likely to have experienced an outage in the past six (6) months. They are also likely to have taken steps to prepare for a future severe weather event/outage.
- Customers in HFRZ are more likely to be homeowners, this gives them more of an opportunity to make severe weather/outage preparations, like purchasing a generator or clearing yard debris from the property.

Survey results show that customers who live within a HFRZ are generally more aware of PGE's wildfire mitigation efforts compared to those who live outside a HFRZ. These results are consistent with our previous focus on communicating specifically with customers who live in HFRZ about PSPS preparedness, given they are more likely to experience one. As we evolve our operational PSPS efforts to include the entire service area, we can increase awareness with customers who do not live within HFRZ. Though there is a disparity in awareness level between HFRZ and non-HFRZ customers, most are aware of PSPS events, and generally know why PGE has or would use it. Expanded survey results can be found in Appendix 6.

PGE and the Joint IOU's will continue to mature the effectiveness measures discussed during the 2023 WMP Recommendations Workshop held on August 22, 2023. The list of effective measures that will be tracked, as applicable, are included in Appendix 7. Appendix 8, and the information in Section 7.3, "Education Campaign and Customer Survey Results", addresses recommendation 18.

7.4 2023 Engagement Activities and 2024 Engagement Strategy

PGE uses OPUC regulations and event feedback to shape the WMP Engagement Strategy. PGE remains committed to evaluating and implementing, when possible, the recommendations received from customers, local communities, and Public Safety Partners at annual WMP Engagement Strategy public events.

In planning for 2023, PGE identified several areas of focus based on lessons learned in 2022. Emphasis was placed on holding the 2023 events by the end of Q2, furthering collaboration with Public Safety Partners by inviting them to participate and improving inclusivity and accessibility for access by functional needs populations. Figure 20 is a photo from PGE's 2023 Wildfire Ready event in Mt. Angel.

PGE achieved each of these goals. All six events, including four in-person and two virtual, were hosted between June 5th–June 16th, 2023. Invitations to participate were extended to various relevant partners including:

- Clackamas Co. Disaster Management
- ESF-12
- FireWise, USA Community P2B
- Grand Ronde Emergency Services
- Mt. Angel Fire District
- ODHS Office of Resilience & Emergency Management
- ODF
- Oregon Office of State Fire Marshall
- OSU's Extension Fire Program
- Sandy Fire District
- Sheridan Fire District
- Yamhill Co. Emergency Management
- Washington Co. Emergency Management

American Sign Language and Spanish interpreters were present at in-person and virtual events. PGE verified Americans with Disabilities Act accessibility before selecting each location.

Overall, 2023 showed an increased interest in PGE hosting events like these from both the public and partners. The feedback received from attending partners was overwhelmingly positive as they appreciated the opportunity these events afforded them to speak directly to their communities and asked to be invited to future PGE-hosted events. Customer attendance tripled from the previous year. Survey results indicate that, on average, 80% of public attendees felt their one-on-one conversations with PGE's SMEs increased their knowledge of topics like PSPS, wildfire-related investments, and overall wildfire preparedness.

A complete 2023 WMP engagement event registry is provided in Appendix 9. Along with this information, Appendix 5 and Appendix 10 respond to recommendation 12.

Figure 20. 2023 Wildfire Ready Event in Mt. Angel

As 2024 planning commences, PGE remains committed to continuously improving the WMP Engagement Strategy and compliance with OAR 860-300-0040. Although PGE will remain flexible throughout the planning process, feedback and internal evaluation point towards the following being the significant areas of focus for 2024:

- Growing the breadth of topics and variety of partners participating in the events to provide customers with a more holistic and well-rounded experience. This will build upon the steps taken by PGE in 2023 and fulfill recommendation 17 for 2024.
- Expanding the reach and methods of event promotion to enhance awareness and drive attendance.
- Continuing to improve the inclusivity and accessibility of the events and promotion for access and functional needs populations by partnering with PGE's internal diversity, equity, and inclusion experts and local Public Safety Partners.
- Coordinating with PacifiCorp and Idaho Power Corporation in the planning process to determine if any coordination opportunities exist with Public Safety Partners.

7.5 Public Safety Partner Coordination Strategy

In 2023, PGE collaborated with its Public Safety Partners, utilizing various channels to support the development of the 2024 WMP. PGE provides a full listing of all supported events coordinated with Public Safety Partners in Appendix 9. This additional coordination will partially address recommendation 18.

7.5.1 Coordination Approach

PGE works closely with our Public Safety Partners to facilitate information sharing, community outreach, and wildfire preparedness and response. PGE divides its Public Safety Partner coordination approach into three phases: before, during, and after fire season. By working in partnership with each Public Safety Partner, PGE can maximize the effectiveness of its outreach efforts and the size of the audience receiving these communications and improve operational coordination and information sharing. PGE will collaborate with our Public Safety Partners to determine meeting frequency and location.

7.5.1.1 Before Fire Season

Before fire season, PGE will engage as requested in joint planning processes and deliver presentations to Public Safety Partners at existing information sharing and preparedness coordination forums. PGE will also include wildfire preparedness topics in one of the all-hazards bi-annual summits with Public Safety Partners. PGE and ESF-12 coordinate the location, time, and topics for summits.

PGE will also host at least one annual pre-fire season tabletop exercise with Public Safety Partners focusing on PSPS notification procedures and processes. This tabletop will occur before the end of the second quarter and will follow the Homeland Security Exercise and Evaluation Program (HSEEP) principles and guidelines. As part of each exercise, PGE will provide the relevant details of the CIMT structure. All Public Safety Partners will receive an invitation to attend the tabletop exercise and participate in the After-Action Review. When possible, PGE will engage in exercises developed by other Public Safety Partners to improve interoperability during an actual event. Section 7.5.1, "Coordination Approach", addresses recommendation 14.

7.5.1.2 During Fire Season

Once PGE declares the start of the fire season, the company will inform Public Safety Partners regarding in-season operational modifications to the PGE system.

During fire season, PGE enhances situational awareness monitoring and maintains a state of operational readiness. Should a new fire start, or an expanding fire threaten PGE infrastructure, a company representative will contact either the specific agency managing the fire or the dispatch center dispatching for the fire to coordinate an appropriate utility response.

For all incidents, PGE acts as a cooperating partner supporting public and first responder life safety, incident priorities, and objectives, or when company infrastructure is at risk and is impacted by a wildfire. Additionally, PGE prioritizes sharing information and intelligence with fire agency partners and dispatch centers in an effort to provide enhanced situational awareness for new or existing fires.

In August 2023, PGE's Pano AI fire detection camera network was leveraged and proved invaluable technology for first responding, initial attack resources responding to a lightning-caused wildfire burning in the Bull Run Watershed, a critical water source for over 1 million people in the greater Portland metro area. Even though it was nighttime, the cameras could detect, triangulate, and provide the exact location of the (then unnamed) Camp Creek Fire. Armed with coordinates and high-definition, live-streaming, 30× optical zoomed video of the fire-depicting the fire area's fuel type, behavior, and rate-of-spread, PGE staff were able to exercise existing agency relationships to share this critical, time-sensitive intelligence quickly and efficiently.

The technology did exactly what it was deployed to do: rapidly detect, validate, and communicate fire starts. Agency representatives involved in the initial attack confirmed that response time is a critical element in fire suppression, particularly in remote areas and/or overnight periods. The technology and actions taken by PGE provided the Camp Creek IC with more than four (4) hours of advanced planning time than if the fire had been reported at daybreak by traditional, human detection methods. The advanced notification resulted in getting the correct type and quantity of both air and ground resources ordered and routed early, setting the tempo going into the first full operational period.

If an incident requires the activation of PGE's CIMT, PGE will notify impacted stakeholders and initiate in-person and virtual coordination activities. PGE will deploy dedicated utility representatives to jurisdictional Emergency Operations Centers, Emergency Coordination Centers, or Incident Command Posts as needed.

After wildfire incidents, PSPS events, or PGE-led tabletop or functional exercises, PGE will conduct an after action-review consistent with HSEEP and utility sector best practices, reviewing incident response and identifying continuous improvement action items. A summary of input from our Public Safety Partners and lessons learned captured through exercises and events from 2023 is in Appendix 4.

7.5.1.3 After Fire Season

When PGE declares an end to fire season, the company will inform the Public Safety Partners that safety-adjusted device settings and other operating protocols have returned to normal operations. PGE will hold meetings and make phone calls to solicit feedback from Public Safety Partners about the Wildfire Mitigation Program and any opportunities for improvement.

8 Ignition Prevention Inspections

PGE conducts annual Ignition Prevention Inspections within its HFRZ and in areas subject to heightened wildfire risk within PGE's ROW for generation and transmission assets located outside of PGE's service area in accordance with OAR 860-024-0018(3)(4). PGE inspects each supporting structure (pole or tower) within the HFRZ or area subject to heightened risk. Each year approximately 27,214 structures are inspected, scattered across more than 995 line-miles located within PGE's service area and over 63 line-miles located outside of PGE's service area. Table 15 quantifies the number of structures to be inspected in 2024.

Table 15. Number of Inspected Structures and Line Miles

Location	Structure Count	Line Miles
PGE HFRZ 1–11 (2024)	26,464	995
PGE Generation and Transmission Outside the Service Area	750	63

Using a competitive bidding process, PGE selects the vendor to perform the Ignition Prevention Inspections within the HFRZ. The pricing structure of the competitive bidding process is based on unit rates associated with specific inspection and correction tasks. The vendor's crews who perform the inspection and correction tasks are signatories to the International Brotherhood of Electrical Workers (IBEW), Local 125. This information addresses recommendation 19.

8.1 Inspection Procedures

Two (2) person crews perform PGE's Ignition Prevention Inspections. Under PGE's inspect-correct methodology, crews perform inspection tasks and complete many corrections during the initial visit to the structure. This is important because it significantly reduces PGE's average correction times and completes most corrections before each year's fire season. Additionally, the inspect-correct methodology reduces customer impact by eliminating the need for multiple site visits. This description addresses recommendation 19.

Within PGE's service area, crews visually inspect distribution system support structures, lines, and equipment from the ground using binoculars or a spotting scope mounted on a tripod. During this process, the crews also physically measure vegetation, conductor clearances, and sound each wooden supporting structure to detect internal damage or decay. The crews may drill the pole or capture more detailed measurements to assess the extent of damage or decay in more detail. Crews use a standardized form to record conditions consistently and repeatably during the field inspections and capture digital photos of each supporting structure using mobile GIS software.

Figure 21 illustrates the data displayed and tracked through PGE's mobile GIS structure tracking application.

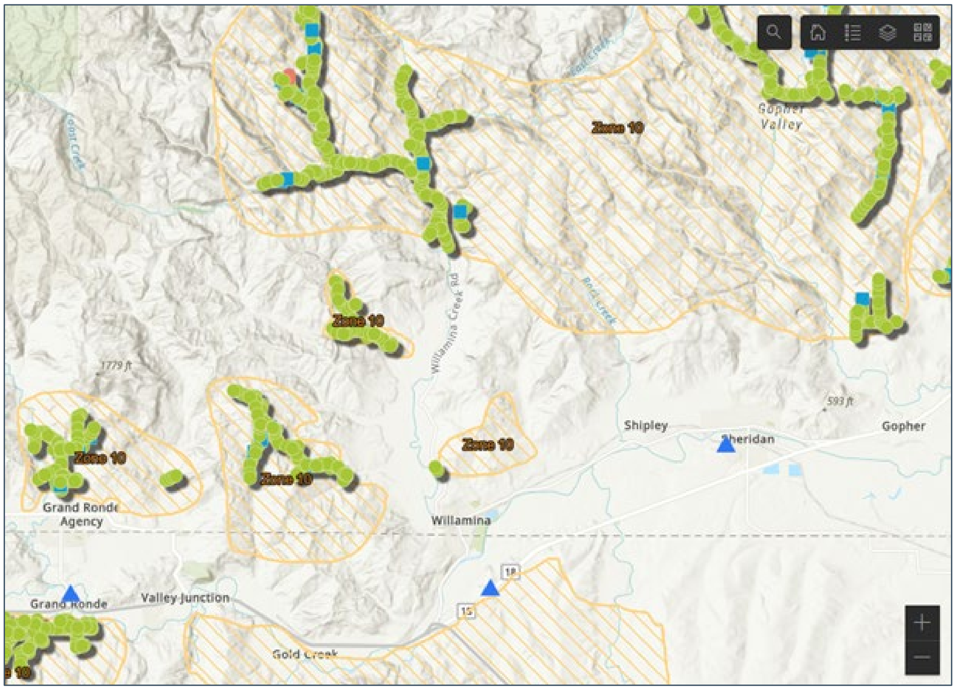


Figure 21. PGE ARCGIS Online Structure Tracking Data

Ignition Prevention Inspections conducted outside PGE's service area primarily address conditions in the ROW for PGE 230 kV or 500 kV transmission facilities. PGE Transmission Patrolmen conduct these inspections with specialized knowledge of how these transmission facilities are constructed, operated, and maintained, and supporting structure bonding and grounding configurations. The PGE Transmission Patrolmen visually inspect the supporting structures, lines, and equipment from the ground using binoculars and drones to assess conditions in the overhead space. PGE Transmission Patrolmen also use a standard form to capture conditions consistently and repeatably during the inspections.

8.2 Ignition Prevention Inspection Standards

PGE's Ignition Prevention Inspection standards build upon several years of PGE experience in administering its Facility Inspection and Treatment to the National Electrical Safety Code (FITNES) Program, in compliance with OAR 860-024-0011 and OAR 860-024-0012. The FITNES Program inspects approximately 28,000 poles annually, or approximately 10% of PGE's system, for non-compliance with safety rules governing PGE's and pole occupant facilities. Two (2) person crews perform the FITNES inspections. The vendor performing the work is a signatory to IBEW, Local 125. This addresses recommendation 19.

PGE continues to refine its Ignition Prevention Inspection work practices through active participation in industry discussions and forums.

PGE's Ignition Prevention Inspection standards direct inspection teams to identify conditions that, left unaddressed, could lead to vegetation or wildlife contact with energized conductors or equipment and, potentially, an ignition event. PGE's Ignition Prevention Inspection standards address the following inspection categories:

- Bonding
- Broken lashing wire
- Conductor clearances

- Damaged conductor
- Damaged, broken, missing, or loose hardware and equipment
- Damaged or decayed poles
- Tree attachments
- Other potential sources of ignition

A full list of PGE's Ignition Prevention Inspection standards is found in Appendix 11. PGE will update these standards as required to reflect updated information or OPUC guidance.

PGE 's HFRZ Ignition Prevention Inspections may be combined with other safety or detailed inspections as required by OAR 860-024-0001(6). To avoid multiple inspections of the same pole each year, PGE's ignition prevention inspections may also incorporate the safety patrol standards described in OAR 860-024-0011(2)(c). Depending on the facility to be inspected, PGE may also choose to accomplish both the FITNES inspection (OAR 860-024-0011(1)(b)) and the ignition prevention inspection during the same site visit.

8.3 Ignition Prevention Inspection Program Oversight

PGE's Ignition Prevention Inspection program management team oversees project management, administration, fieldwork, technical support, and management oversight and reporting.

Each year, before the start of the inspection season, the crews responsible for PGE's Ignition Prevention Inspections undergo in-depth training covering the following major topic areas:

- Communication protocols between PGE and the vendor conducting the inspections.
- Inspect/Correct procedures, including conducting the visual inspection, identifying pole occupants, obtaining measurements, and capturing digital photos.
- Inspect/Correct standards, including printed specifications showing which conditions to inspect for and correct, with diagrams and example photos.
- Inspection software, with hands-on training on the use of the GIS software.
- Other requirements associated with vendor performance.
- Protocols for communicating with customers before accessing private property.
- Quality Assurance requirements.
- Required crew configuration, tools and equipment, and materials.
- Scope and locations of the inspections.
- Wildfire awareness and fire suppression safety training.

During the initial one (1) to two (2) weeks of the HFRZ Ignition Prevention Inspection period, a PGE Quality Control Inspector accompanies each inspection crew to verify the work performed, provide feedback, and answer questions. During the remainder of the inspection period, PGE performs weekly QA/QC of each crew's work. New crews added during the inspection season must complete the same training and initial PGE observer requirements. During each year's inspection season, PGE's Quality Control Inspector performs several QA tasks, in addition to the QC of Ignition Prevention Inspection results and corrections. For example, the PGE Quality Control Inspector reviews inspection results and conducts periodic refresher training with the crew. They meet onsite with crews to answer questions, perform fieldwork to assess access constraints, and verify mapping information. Section 8.3, "Ignition Prevention Inspection Program Oversight", addresses recommendation 21.

Ignition Prevention Inspections conducted outside PGE's service area but within the ROW for its 230 kV and 500 kV transmission facilities are accomplished by PGE Transmission Patrolmen and directed through monthly coordination meetings. PGE's Lead Working Foremen are responsible for QA/QC of each Transmission Patrolman's work.

The Ignition Prevention Inspections Program is monitored by the assigned PGE project manager, using a GIS dashboard that monitors each supporting structure located in an HFRZ or area of heightened risk. PGE monitors inspection results daily during the inspection season.

8.4 Timing of Annual Ignition Prevention Inspections

PGE's goal is to begin its annual Ignition Prevention Inspections as early as possible during the first quarter of each year and to complete the inspections no later than July 31, with most inspections completed before PGE declares the start of fire season. PGE continues to study the timing of its inspections to identify any conditions associated with PGE's facilities caused by seasonal winter weather events. Additionally, accumulated snowfall at higher elevations within the HFRZ and areas of heightened wildfire risk may delay the inspection process in some areas by hindering physical access to supporting structures and obscuring defects on conductors or equipment.

8.5 HFRZ Correction Timeframes

PGE categorizes HFRZ corrections and specifies their mitigation timeframes as follows:

- A condition that poses an imminent danger to life or property must be repaired, disconnected, or isolated by the operator immediately upon discovery.
- A condition correlating to a heightened risk of utility-caused ignition shall be corrected no later than 180 days after discovery unless notification is received under OAR 860-028-0120(6). This OAR specifies the violation must be corrected in less than 180 days to alleviate a significant safety risk to any operator's employees or a potential risk to the public.
- All other conditions requiring correction shall be corrected consistent with OAR 860-024-0012.

8.6 Ignition Prevention Inspection Learnings

- **Joint Use:** In 2022, the OPUC adopted OAR 860-024-0018, which sets forth several new duties for operators of electric facilities, including requirements to address conditions not associated with utility facilities and conditions involving supporting structures to which PGE is attached but does not own. In response, PGE performed new tasks in connection with its year 2023 Ignition Prevention Inspections. In accordance with OAR 860-024-0011(2)(b), PGE provided inspection notice concerning its 2023 HFRZ to every entity in which PGE maintains a joint use relationship, including pole owners and occupants. Additionally, PGE has adhered to the notice of violation requirements outlined in OAR 860-024-0018(6). In terms of actions that the electric operator must take if a condition is not remedied timely by a different pole or equipment owner, OAR 860-024-0018 also sets forth specific requirements. In 2023, PGE actively utilized the mechanism afforded by OAR 860-024-0018(7). When the equipment owners failed to complete the corrections timely, PGE performed the repair and charged the equipment owner for the cost of the work plus a 25% fee. In the future, PGE will continue to administer and refine its process for addressing conditions associated with other pole and equipment owners and may utilize the complaint process provided by OAR 860-024-0016.

- **Tree Attachments:** PGE remains active in identifying and correcting conditions associated with PGE conductors attached to trees. OAR 860-024-0018(2) provides: "Utility supply conductors shall not be attached to trees and should only be attached to poles and structures designed to meet strength and loading requirements of the National Electrical Safety Code." This section does not apply to customer-supplied equipment at the point of delivery. Compliance with this section must be achieved prior to December 31, 2027. Most tree attachments PGE identified are in PGE's HFRZ 1: Mt. Hood Corridor/Foothills. In 2023, PGE maintained discussions with the USFS Zig Zag Ranger District concerning coordination, as several tree attachments are located on federal lands.
  - Additionally, PGE is actively working with many individual property owners. Information sharing has been essential in PGE's program to remedy tree attachments. PGE maintains a tree attachment informational website with contact information to improve communication.
  - PGE is in active partnership with USFS in seeking funding opportunities as it relates to wildfire risk reduction and tree attachment removal.

8.7 Ignition Tracking Database

In 2024, PGE will leverage its ignition tracking database to identify possible changes or additions to its 2025 Ignition Prevention Inspections standards. Ignition probability values and historic ignition tracking address recommendations 20 and 30, as both the database tracking (recommendation 20) and root cause analysis (recommendation 30) are described in detail below.

In 2021, as our response to new OAR requirements, PGE created an ignition management tracking process and database.[15] PGE uses this information to evaluate the system hardening investments described in Section 10, "System Hardening". For example, if analysis shows that georisk represents a circuit's only risk, but 99% of all the ignitions recorded at that site are caused by animal contact, installing animal protection devices would likely be the appropriate risk mitigation outcome for that location.

Since developing the ignition management tracking database in 2021, PGE has made several updates to the accompanying processes to capture a complete data picture. After a series of meetings with users, PGE revised the ignition reporting form to include additional failure modes and ignition details and removed the requirement to enter observational weather data. Weather data is now supplemented by data pulled directly from the nearest PGE weather station to the ignition point, which is more accurate and reduces the time and effort required to fill out the form. Features currently in development will allow for easier entry of ignition reports by repair workers when responding to an outage and increased data integrity between outage reports and ignition reports.

Ignition events identified from a regular review of outage data, including comments from dispatchers and responders, supplement the data submitted via the ignition form. PGE collects data points from the outage management system, reliability database, weather stations, follow-up conversations with crews, and reports submitted in the field to paint a complete picture of each ignition. In line with recommendations five (5) and six (6), this data is regularly compiled and evaluated in geospatial programs

[15] PGE tracked historic ignition event data since May 2021

to determine ignition density and intersection in HFRZ. Dashboards and visuals relating to ignition counts and details are prepared in Tableau; a data visualization tool that integrates data for advanced analytics.

As PGE collects risk assessment data and supplements it with lessons learned and industry best practices, it refines its ignition probability values database to create more accurate risk projections. Based on quantifiable drivers, these risk projections allow PGE to map risk velocity (risk forecasted through time) and link it to the strategies described in Section 3.7, "Wildfire-Risk Informed Decision-Making", to drive the highest-value risk mitigations.

8.8 Ignition Reporting

To address recommendations five (5), six (6), and 20, ignition reporting, database tracking, and root cause investigation processes are described below in detail.

PGE tracks ignitions potentially caused by PGE equipment and fires that impact PGE facilities as required by OAR 860-024-0050. Tracking and reporting include documentation of the initial observation and recording of ignition events in the field and the specific geographic and ROW location of any impacted PGE equipment.

PGE reviews all ignition events reported in the field. PGE submits reportable ignition event information to the OPUC Safety Department. In addition, PGE archives ignition event reports for future compliance purposes. PGE uses historic ignition event data to inform strategic asset management decisions, including system hardening measures, with a more granular understanding of risk. PGE continues to scale and improve its ignition tracking and reporting database as a key component of understanding ignition event drivers.

8.9 Ignition Management and Root Cause Analysis

PGE considers an ignition event to be a fire caused by PGE's infrastructure, when fire impacts PGE infrastructure, or when excessive heat results in the burning or charring of PGE equipment or the surrounding area. Table 16 details how WM is informed of ignition events and the data points available.

Table 16. WM Information Distribution

	Data Points Available					
Current ways WM is informed of ignition events	Photos	Observational weather	Impacted device	Voltage (as a form field)	What burned	Fire suppression type/agency
Field reports in IQGeo[16] (feed to Quickbase, email)	Yes	Yes	Yes	Yes	Yes	Maybe
Media	Maybe	No	Yes	No	Yes	Yes
Legal Affairs	Maybe	No	Yes	No	Yes	Maybe
Conversational (ex: discussion of ignition event during a meeting)	No	No	Yes	No	Maybe	Maybe
Outages caused by vegetation during PGE WF Season	No	No	Yes	No	Maybe	Maybe
Outages with OMS operator notes indicating ignition and fire department response	No	No	Yes	No	Maybe	Maybe
Other searching in OMS as related to WM initiatives	No	No	Yes	No	Maybe	Maybe

As PGE collects risk assessment data and supplements it with 'lessons learned' and industry best practices, it refines its ignition probability values database to create more accurate risk projections. Based on quantifiable drivers, these risk projections allow PGE to map risk velocity (risk forecasted through time) and link it to the strategies described in Section 3.7, "Wildfire Risk-Informed Decision-Making", to drive the highest-value risk mitigations. Refer to Table 17 for details on the ignition tracking database. This table addresses recommendation 20.

[16] Ignitions recorded in IQGeo can be traced back to an OMS event. Data only captured by an IQGeo form is only available for ignitions reported in the field.

Table 17: Ignition Tracking Database Fields

Associated Asset	Facility Notified	Outage (OMS) Number
Contributing Factor	Facility Type	Outage Occurred
Created Date	Failed Equipment	Precipitation
Created User	Fire Size	Property Type
Database Updated Date	Fire Suppressed By	OPUC Reportable
Device Operated Line Fuse	Fire Suppression Agency	Source
Device Operated Other Device	Foreign Object Contact	Status
Device Operated Poletop Recloser	Initiating Event	Temperature
Device Operated Substation Breaker	IQGeo ID	Updated Date
Device Operated Transformer	IQGeo Link	Updated User
Device Operated Tripsaver	Item Burned	Visibility
Event Cause	Latitude	Visibility Other
Event Start Date	Longitude	Voltage
Event Start Time	Notes	Wind

8.9.1 OPUC Reportable Ignitions Process

PGE reviews ignition events reported in the field to determine if they meet the criteria for being reported to OPUC and prepares the necessary forms. In addition, PGE tracks and reports the progress of ignition event reports submitted to the OPUC and archives its OPUC ignition event reports for future compliance purposes. Historic ignition event data informs strategic asset management decisions, including system hardening measures, with a more granular understanding of risk. PGE continues to scale and improve upon its ignition tracking/reporting database as a key component of understanding ignition events by drivers.

8.9.2 Ignition Engineering Review Task Force

At the end of 2022, PGE chartered a task force to meet monthly to reduce wildfire risk and equipment failure through an ongoing collaborative review of engineering standards and strategy in areas of reported ignition events. This task force formalized the strategic integration of key SMEs between separate organizations to affirm best practices for engineering and standards are utilized in areas where ignition events have occurred and reflect a commitment to continuous learning and data-informed strategic decision-making. The deeper insights into engineering, asset management, standards, fire science, and wildfire risk variables gleaned from this group's efforts help determine priorities and projects for the WM organization. This team establishes corrective actions post-ignition to minimize ignition events and informs root cause analysis for systemic trends. Figure 22, depicting PGE's ignition review process, integration into business processes, and risk decision-making addresses recommendations six (6) and 30.

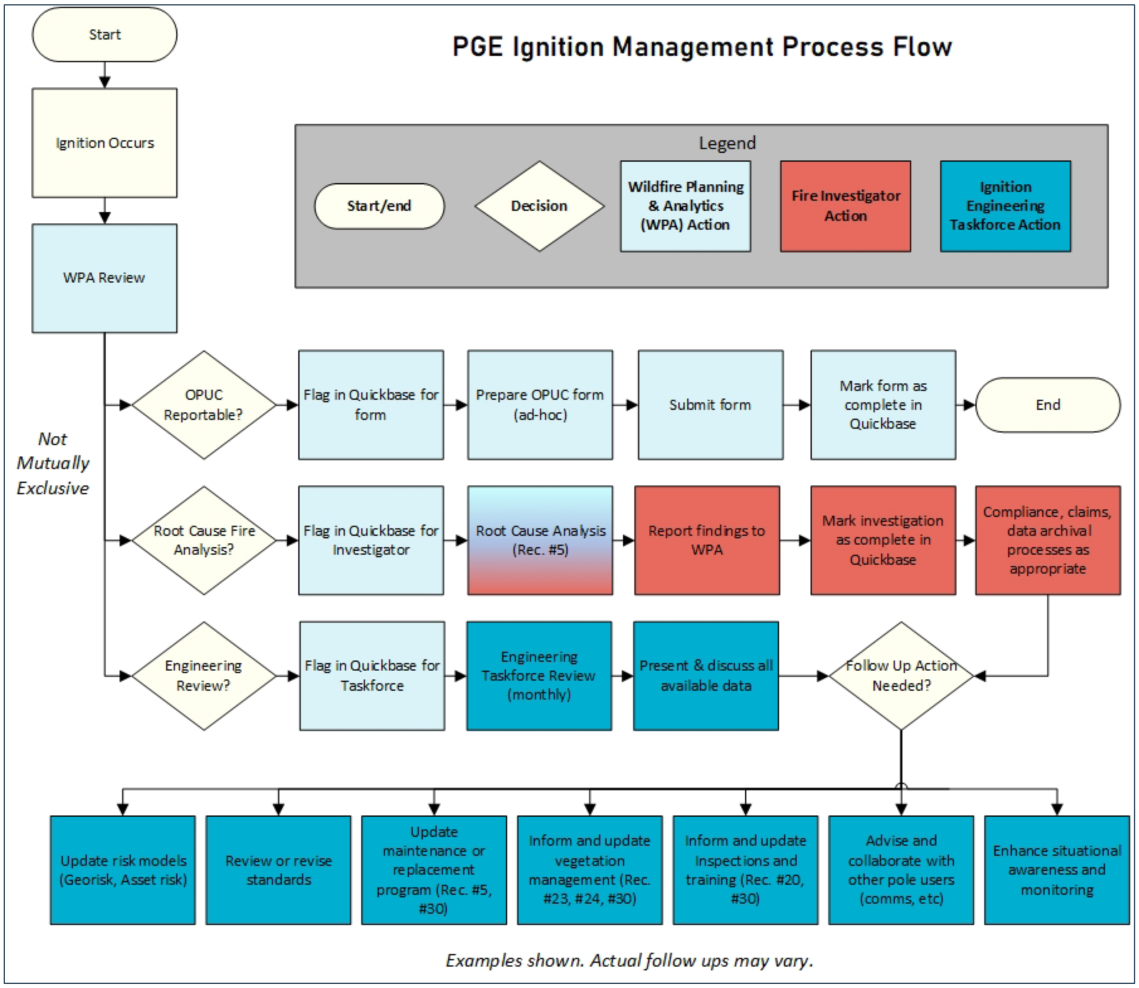


Figure 22. PGE Management Process Flow

In addition to the engineering review task force, PGE also has in-house fire investigation capabilities. This allows PGE to have dedicated SMEs to perform root cause investigations for focused ignition events. PGE has completed an estimated total of 52 root-cause fire investigations since 2022. PGE recognizes this information has a variety of potential learnings to understand and explore integration across the wildfire programs; however, where PGE can take on specific and intentional learnings, that information is prioritized.

To address recommendation 20, PGE has taken ‘lessons learned’ from ignitions to inform patrols and inspections to look for specific conditions that may pose ignition risks. The examples below provide real-world programmatic changes to ignition inspections due to these industry learnings.

An example is a root cause analysis of tree wire high impedance faults where an ignition undetected by protective devices can result in long thermal events with high burning potential. These root cause findings have been critical in testing PGE’s detection and response time modeling to inform fall-in risk where tree wire or insulated cable is not the best value alternative.

PGE has also leveraged root cause investigations from other utilities where ignitions have resulted from specific equipment to inform PGE programs. For example, when open wire secondary or copper conductor has caused fires, PGE has aligned its inspection criteria to identify these locations to inform corrective or capital/maintenance actions that reduce wildfire risk. Section 8.8.2, “Ignition Engineering Review Task Force”, addresses recommendation 30.

8.9.3 Role of Vegetation in Ignitions

Vegetation plays an unpredictable role in PGE's identified ignitions. Approximately 90% of ignitions identified by PGE resulted from contact with a foreign object, with trees and tree limbs comprising the majority. As discussed in Section 3.5, "Climate Change", extreme weather strains vegetation and increases the likelihood of fall-in, both from wind and spontaneously. Given that PGE's ROWs are densely vegetated, vegetation contact with equipment happens year-round across the service area despite scheduled and *ad hoc* trimming.

PGE recognizes that risk-based decision-making to the vegetation management program is critical for reducing wildfire risk and maximizing customer value. Ignitions resulting from vegetation contact are captured in PGE's ignition management database and help inform the vegetation management program where applicable. An example that addresses recommendation 24 has been ignitions in areas designated as HFRZ, which PGE can escalate for corrective action prioritization.

To address recommendation 23, cause code delineation of the ignition's root cause of vegetation contact is captured. It is critical that this data helps complement the vegetation management program but is only one of the sources of designing an advanced wildfire risk reduction (AWRR) program.

PGE anticipates that learnings from our EPRI participation in 2024 and continued industry discussions with fellow utilities and OPUC learnings will result in continued feedback loops and learning opportunities for exploration and adoption.

9 Vegetation Management

PGE's vegetation management strategy has two major components: PGE's routine vegetation management (RVM) program which addresses non-HFRZ, and the AWRR program which is executed entirely in HFRZ. Including both RVM and AWRR, PGE manages approximately 2.2 million trees within its ROW of 12,000 miles of overhead conductor. PGE's vegetation management strategy includes cyclical and routine inspections and maintenance of the entire PGE distribution system. One of the primary goals of PGE's AWRR program is to inspect and mitigate identified trees within its HFRZ annually. PGE will continue to implement a phased approach to the implementation of its AWRR work within the HFRZ. PGE establishes internal targets for completing various work scopes in line with the activities listed below.

Annual AWRR activities are guided by the designated boundaries of PGE's HFRZ, data from PGE's remote sensing project (which uses LiDAR and hyper-spectral imagery to monitor vegetation density and proximity to PGE assets), and annual vegetation surveys. AWRR crews follow program trim specifications, which include increased removal rates and enhanced vegetation control techniques, discussed in more detail below.

The evolution of PGE's Vegetation Management program also illustrates the influence of the WRMA methodologies on PGE's wildfire-related investment decision-making. Dedicated initially to enhancing electrical reliability through compliance with OPUC safety and clearance requirements, PGE Vegetation Management has transitioned to a dual-track program focused on increasing system reliability and decreasing the chance of infrastructure-related ignitions. Risk-based decision-making protocols have allowed PGE's Vegetation Management program to prioritize how resources are allocated.

In much the same way, cross-organizational access to data from PGE's Remote Sensing Project data allows working groups across the company to plan and implement mitigation activities using a consistent set of data and analysis, with co-benefits shared across PGE workflows, including design and vegetation maintenance. PGE's GIS, Strategic Assessment Management, Wildfire Mitigation, and Vegetation Management organizations all use LiDAR data independently and cooperatively to benefit operational efficiency.

9.1 Routine Vegetation Management Inspection and Maintenance

In recent years, PGE has expanded its vegetation management program to include increased clearances and remove more dead, dying, diseased vegetation or displaying growth habits or defects that could impact overhead power lines. PGE performs cyclic patrols and trims vegetation to comply with OAR 860-024-0016 minimum conductor vegetation clearance standards. During routine maintenance inspections, PGE also patrols for and mitigates readily climbable vegetation.[17] PGE documents relevant tree -trimming and provides the documentation to the OPUC upon request.

Under its RVM program, PGE inspects about one-third of its overhead distribution assets annually. Routine inspection timing may change as PGE evaluates the effectiveness of its vegetation management cycles to optimize effectiveness and efficiency. Across PGE's overhead system, RVM activities are ongoing year-round.

[17] OAR 860-024-0016(1) "Readily climbable" means vegetation having both of the following characteristics: (a) Low limbs, accessible from the ground and sufficiently close together so that the vegetation can be climbed by a child or average person without using a ladder or other special equipment and (b) A main stem or major branch that would support a child or average person either within arms' reach of an uninsulated energized electric line or within such proximity to the electric line that the climber could be injured by direct or indirect contact with the line.

PGE inspectors evaluate all vegetation adjacent to PGE facilities, including PGE-owned communications facilities, for proximity, species, growth habits, strength, and overall tree health. When assessing trees along powerlines, PGE considers the following in its vegetation management prescriptions:

- Clearance requirements to avoid off-cycle pruning.
- Line configuration.
- Line voltage.
- Location.
- Potential sag under various environmental conditions.

PGE inspectors create project-specific work layouts for vegetation contractors to complete while moving through the system and performing RVM activities. Line clearance pruning specifications are designed to maintain vegetation clearances during routine wind and adverse weather conditions. At a minimum, PGE adheres to the voltage-based clearance requirements specified in OAR 860-024-0016. During the three-year standardized maintenance cycle, PGE vegetation contractors trim identified trees to PGE specifications to comply with OAR Division 24 Safety Standard, and American National Standards Institute A300 and OSHA Z133 guidelines.

In addition, RVM work is field validated by PGE forestry personnel who work closely with the crews to confirm completion. PGE subjects its vegetation management activities to a detailed RAW process to verify that vegetation management tasks have been completed to specification. To increase the RVM program's effectiveness, PGE coordinates vegetation management activities closely with external stakeholders, including USFS, ODF, Oregon Department of Transportation (ODOT), municipalities, and private landowners.

9.2 Advanced Wildfire Risk Reduction Vegetation Management Program

AWRR operations fall outside PGE's RVM and trimming operations, as the AWRR scope, operational practices, inspection schedule, and cadence are all on escalated cycles. AWRR program activities are guided by PGE's Wildfire Risk Assessment modeling program results.

For 2024, PGE will continue to refine its vegetation management activities, including the AWRR program, to address current climate conditions and focus on OPUC requirements. OAR 860-024-0016 provides PGE’s Vegetation Management regulatory framework, therefore influencing PGE’s operational practices for AWRR-related activities. Most of this work occurs outside designated PGE ROW, utility easements, and annual maintenance schedules.

Under the AWRR program, PGE performs annual vegetation inspections on overhead line mileage that falls within HFRZ and mitigates vegetation to PGE specifications, which may include mowing (Figure 23) and whole tree removal (Figure 24). Following OAR 860-024-0016 PGE performs QA/QC of vegetation management work completed by crews, documents vegetation management activities, and coordinates with county, municipal, and other external agencies, including ODOT, ODF, and USFS.

PGE closely manages AWRR program work to verify that it is completed to PGE specifications, from establishing the AWRR work schedule at the beginning of the year through QA/QC of the completed work. AWRR vegetation prescriptions follow program specifications, which include more stringent inspection and maintenance cycles and tree removal guidelines than those required under Division 24.

Regardless of a tree's condition, removal practices associated with AWRR apply to any tree within striking distance of PGE electrical infrastructure. PGE classifies trees that are an imminent hazard to PGE facilities as C1 trees. PGE classifies trees that pose a probable hazard to PGE lines or facilities as C2. A C2 designation refers to any trees that are dead, dying, diseased, or damaged, or that have fungal or insect infestation or stress, sun scald, overall poor health, mechanical damage, multiple tops, poor site conditions, conks on trunk, excavation, or aggradation in the root zone, as well as trees too close to PGE facilities.

In 2024, PGE will conduct as much of the AWRR Program's vegetation and C1 inspections and subsequent pruning and C2 mitigation within designated HFRZ as possible during the year's first six months. However, this work will be ongoing throughout the year.

Figure 23. SlashBuster Clearing Right of Way

Figure 24. Aerial Lift Removing Dead Tree on Border of AWRR Zone

9.3 Inspection and Maintenance Frequencies for AWRR

Table 18 outlines the cadence of PGE's inspections and describes the AWRR inspection cycles. Corrective actions and preventative maintenance actions are described in Section 8.2, "Ignition Prevention Inspection Standards".

Table 18. PGE HFRZ Inspection and Maintenance Strategies

AWRR Mitigation	Inspection or Maintenance	Cadence	Description
Patrol & Mitigation 1 (PM1)	Inspection	Annual	During this inspection, occurring in the first six months of the year, PGE AWRR inspectors identify C1 trees and vegetation inside of HFRZ that is within five feet of high-voltage conductors (V5) (in compliance with OAR Division 24 safety standards), and newly established vegetation that is not suitable for a given location. Inspectors verify ongoing vegetation clearance compliance and identify any vegetation encroaching PGE assets since the previous inspection.
Patrol & Mitigation 2 (PM2)	Maintenance	Annual	Contract tree crews mitigate vegetation identified by AWRR inspectors during PM1 by pruning trees and brush to PGE specifications in compliance with OAR Division 24 safety standards. Tree crews will target mitigation of C1 trees as quickly as possible, frequently within 24 hours of identification. C2 trees are targeted for mitigation within one year of identification.
Full-scope Patrol (FSP)	Inspection	2-year Cycle	AWRR inspectors perform a comprehensive inspection along designated HFRZ lines. Inspectors identify C1, C2, and V5 (per OAR Division 24 safety standards) and target specific sections of line that require more intensive clearance work, including increased side-clearance, overhang removal, selective removal of tree parts, expansion of ROW widths, ROW mowing, and whole tree removal.
Full-scope Mitigation (FSM)	Maintenance	2-year Cycle	PGE contracted tree crews mitigate, as directed by AWRR inspectors, any C1, C2, and V5 trees. Crews also address the areas identified by AWRR inspectors that may include sections of line that require more intensive clearance work (per OAR Division 24 safety standards), including increased side-clearance, overhang removal, selective removal of tree parts, expansion of ROW widths, ROW mowing, and whole tree removal. Due to the scale and logistics of C2 mitigation, some projects planned for a given year may carry over for completion in the subsequent year.

9.4 Risk Informed Vegetation Management

PGE recognizes the critical role of vegetation management in reducing wildfire risks and ignition potential. As part of recommendation 22, PGE will participate in a national EPRI study in 2024 to understand if a methodology can be internally developed or adopted from an external source to help inform a vegetation management program. Without this methodology, PGE embraces risk-based vegetation management, including how PGE looks at vegetation and assesses the likelihood of failure and corrective measures for those failures. The following overview on determining assessment levels, and their definitions showcase how PGE risk-informed decision-making is used to manage the vegetation program.

9.4.1 Levels of Assessment

In response to recommendation 23, PGE has addressed how vegetation risk assessments are conducted in support of AWRR work. All assessments are done according to Level 1 and Level 2 as defined by the ISA Utility Tree Risk Assessment (UTRA):

Level 1: Limited Visual Assessment from a specified perspective, such as foot, vehicle, or aerial patrol of an individual tree or a population of trees near set targets to identify specified conditions or obvious defects (ISA UTRA 2020).

Level 2: Basic Assessment is a detailed visual assessment of a tree and surrounding site that may include using simple tools. The forester must walk entirely around the tree trunk, looking at the site, above-ground roots, trunk, and branches (ISA UTRA 2020)

Level 3: Beyond the scope of AWRR routine program objectives, vegetation management activities will only be conducted on an as-needed basis with SME contribution. Examples of these activities include, utilizing a sonograph, extracting core-samples, or sounding. This is a more intrusive inspection methodology that would be used for removal activities when the burden of proof is elevated (ex. sensitive customers).

The AWRR forester is only required to perform a Level 3 assessment if requested by the forestry manager.

9.5 Determining Likelihood of Impact on Target

The likelihood of impact is combined with the likelihood of tree failure to predict the likelihood of failure from a tree impacting the target, as shown in Table 19. This information guides the forester in determining the likelihood of failure.

Table 19. Likelihood of Impacting the Target

Likelihood of Failure	Likelihood of Impacting the Target			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat Likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat Likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat Likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Appendix 11 provides definitions for Likelihood of Failure and Likelihood of Impacting the Target probabilities.

10 System Hardening

PGE continues to leverage its SAM Structures Model and Fire-Safe Construction Standard to harden the T&D system within its HFRZ. PGE's system hardening activities are designed to accomplish three goals:

- Reduce the risk of potential wildfire ignition caused by PGE facilities through the use of ductile iron poles, fiberglass crossarms, covered wire, fire-safe fusing, and conductor undergrounding.
- Reduce the impacts of a wildfire on PGE's assets by installing system hardening technologies (fire mesh, ductile iron poles, fiberglass crossarms, conductor undergrounding).
- Protect utility infrastructure during potentially disruptive natural and human-caused disasters, strengthening PGE's ability to maintain and quickly restore reliable electrical service to support disaster relief and public safety.

PGE will deploy additional reliability and wildfire risk mitigation improvements within the HFRZ to achieve these goals. Its annually updated Fire-Safe Construction Standard guides PGE in executing equipment replacements in HFRZ. As specified in the Fire-Safe Construction Standard, the company will evaluate the following assets for replacement, installation, or implementation when warranted:

- Aging conductors in HFRZ.
- Avian-safe framing and phase covers.
- Fuse replacement with fire-safe fuses and/or ELF (non-expulsion) fuses to eliminate a potential ignition source.
- Overhead to underground conversions on specific feeders with key wildfire response variables, including fire response/detection probability and egress.
- Polymer cutouts and covers.
- Reclosers and switching devices to increase operational flexibility and minimize customer impacts through the application of wildfire operational settings.
- Replacement of wood structures with nonflammable structures (i.e., ductile iron poles, fiberglass crossarms).
- Tree wire, an insulated overhead conductor designed to reduce service interruptions and reduce the potential for the conductor to become an ignition source.

In assessing project alternatives and prioritization of capital investments for wildfire risk mitigation, PGE uses risk-informed decision-making, the VSE methodology discussed in Section 3.7, "Wildfire Risk Informed -Decision-Making". Based on the outcomes of this analysis, PGE's multi-year wildfire capital investment strategy ranks system hardening and situational awareness projects as the highest-value risk mitigation per dollar of investment to inform the prioritization of PGE's capital budget. It is important to note these values are a critical input to the planning process but are not the sole indicators of value. They are complemented by other risk analysis variables, including executing mitigation speed to complete the VSE methodology.

Section 11, "Expected Wildfire Mitigation Program Costs", details the information involving year-to-year actual and planned Wildfire Mitigation Operations and Maintenance (O&M) and capital expenditures.

For example, undergrounding and reconductoring distribution lines are two of the most effective ways to shield PGE equipment from vegetation and animal contact that could ignite wildfire. Table 20 shows the planned undergrounding and reconductoring investments in PGE's 2024 wildfire capital investment strategy.

Table 20. Planned Underground Reconductoring Investments in Line Miles 2024-2027

UG/RECON	Line Miles	VSE
Grande Ronde-Agency (UG)	9.8	322
Scoggins-Cherry Grove (UG)	10.8	234
Leland-Carus (RC)	45.0	132
Willamina-Buell (UG)	33.3	482
Orient–Oxbow (UG & RC)	20.0	In Planning Phase N/A
Summit–Summit 13 (UG)	7.0	In Planning Phase N/A
North Plains–Mason Hill (RC)	16.0	In Planning Phase N/A
TOTAL	**141.9**	

PGE is revising its 2024–2027 wildfire capital investment strategy, which distributes planned capital spending among multiple asset and mitigation programs in alignment with the WRMA of wildfire risk change over time. This effort aims to create an optimized multi-year investment framework to implement separate but interrelated mitigation strategies based on a risk profile that incorporates a broad spectrum of wildfire risk drivers.

PGE consistently evaluates its long-term investment strategy in response to R&D findings, risk modeling, and industry experience. The company will continue to optimize its investment strategy for wildfire risk mitigation based on the best available information and analysis. Table 21 reflects PGE's planned investment estimates and timelines, current at publication of the 2024 WMP. However, PGE recognizes factors outside of the company's control (e.g., resource scarcity or cost increases from unforeseen disruption) or to customer advantage may require adjustments to this schedule of activities. Planned line-miles per year are targets that may be adjusted based on several factors to reduce wildfire risk and increase system resiliency.

Table 21. Planned Situational Awareness Programmatic Investments, 2024

Programmatic	Quantities/Scope
AI-Equipped UHD Cameras	2
Weather Stations	5
Reclosers	37 (VSE of 1332)
Fire-Safe Fuses	2 Feeders (VSE of 59)
Fire Mesh Pole Wrap	1,200 poles
Early Fault Detection (EFD)[18]	1 distribution and 1 transmission circuit

PGE's portfolio of planned capital investment projects offers co-benefits in addition to their wildfire mitigation value. For example, PGE feeders with the highest CEMI values (feeders that experience multiple outages per year) are designated for hardening under this strategy [19]. By aligning its strategy to prioritize both wildfire mitigation and CEMI, PGE is investing in outcomes that offer customer benefits beyond wildfire hardening. With appropriate planning and permitting to mitigate any short-term construction impacts, system hardening may also reduce the risk of negative wildfire impacts to environmentally sensitive areas, species, and habitats.

[18] Early Fault Detection is a technology that uses sensors to detect anomalies on the feeder in real time, allowing PGE to intervene (replace or repair) the affected component(s) prior to a failure that could cause an ignition.

[19] CEMI is an industry standard metric of system reliability.

When an asset needs repair, and the repair cost is higher than the asset's value, PGE will mobilize crews to evaluate the asset for replacement. There may be reliability and economic benefits to proactive asset replacement, particularly within HFRZ. PGE assesses the cost/benefit of proactive asset replacement during planned improvement/maintenance activities on other nearby assets whenever possible. This approach helps PGE maintain reliable electric service and increase cost efficiency.

PGE prioritizes capital investments and maintenance activities that provide the highest benefits to the system, including outage prevention, reduced outage duration, improved asset survival, and other impacts to infrastructure beyond wildfire mitigation. This multi-dimensional view allows PGE to achieve the best value risk reduction per dollar of investment.

To address recommendations seven (7) and 25, PGE showcases its wildfire prioritization process for investments, which combines VSE, climate science, and execution speed as strategic variables. This process is performed and updated throughout the year to reduce wildfire risk through a holistic and data-informed approach. PGEs process is represented in Figure 25.

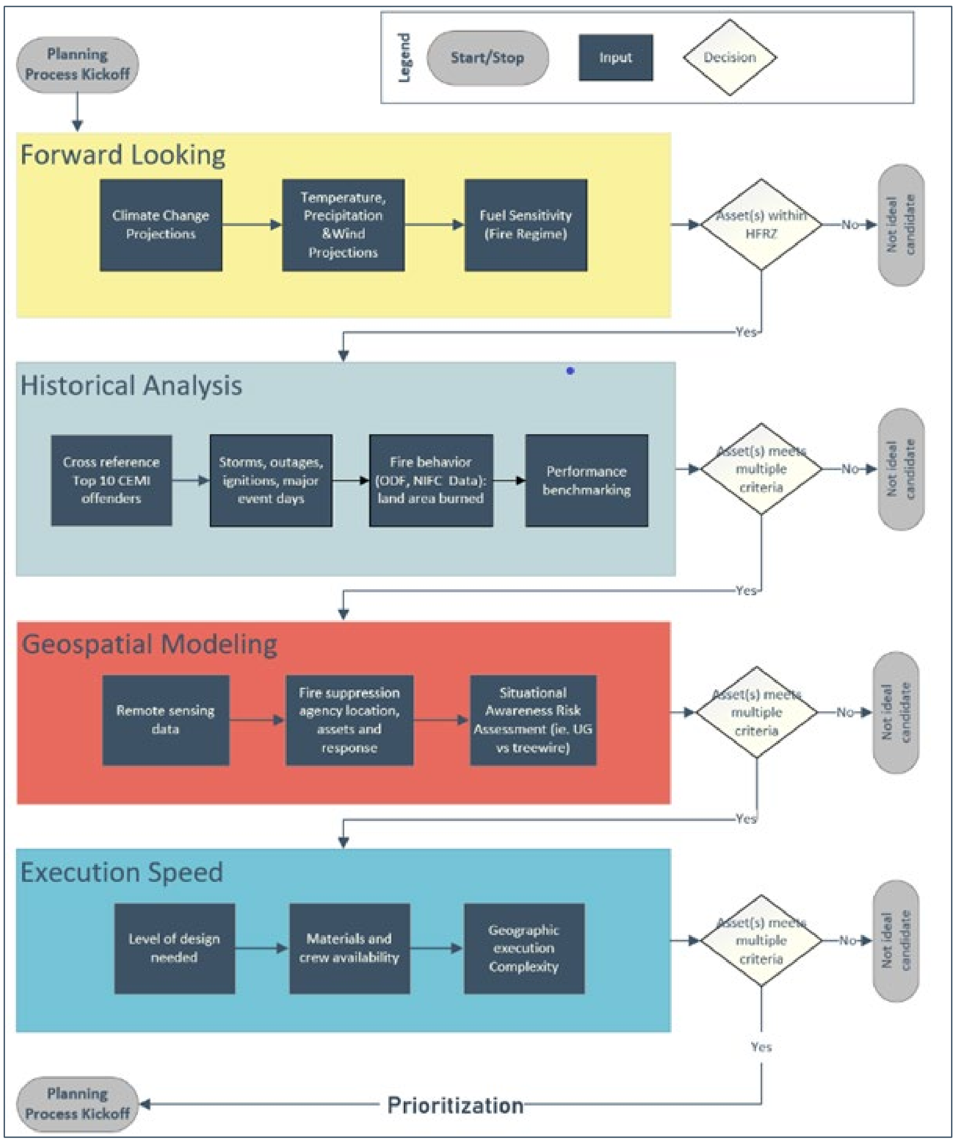


Figure 25. Inputs Considered for Wildfire Investment Prioritization

Upon completion of the measures referenced above, these system-hardening investments will reduce PGE's wildfire risk while shrinking the geographic boundaries of existing HFRZ. As line-miles of PGE infrastructure are hardened over the next several years, PGE anticipates no longer needing to de-energize those circuits to prevent potential ignitions during PSPS events. PGE estimates these risk reduction values with a combination of volumetric mileage in a mitigated state and the number of customer meters impacted by PSPS events.

PGE will also estimate non-wildfire-related resiliency benefits from these investments for example, increased protection from wind/ice storm damage, using traditional asset management expected risk and net economic cost/benefit ratios. Table 20 and Table 21 show PGEs planned undergrounding reconductoring projects and situational awareness/programmatic investments, by region, for 2024.

Some of these planned investments include the early scoping and planning phases and are not intended to reflect a final construction energization schedule.

To address recommendation seven (7), PGE has included the VSE for the investments in the execution phases. Not all investments have a VSE score. PGE is working towards focusing its efforts on value spending efficiency on the hardening projects and continues to make strides in the other areas (e.g., programmatic investments). A map of PGEs 2023 planned wildfire investments is shown in Figure 26.

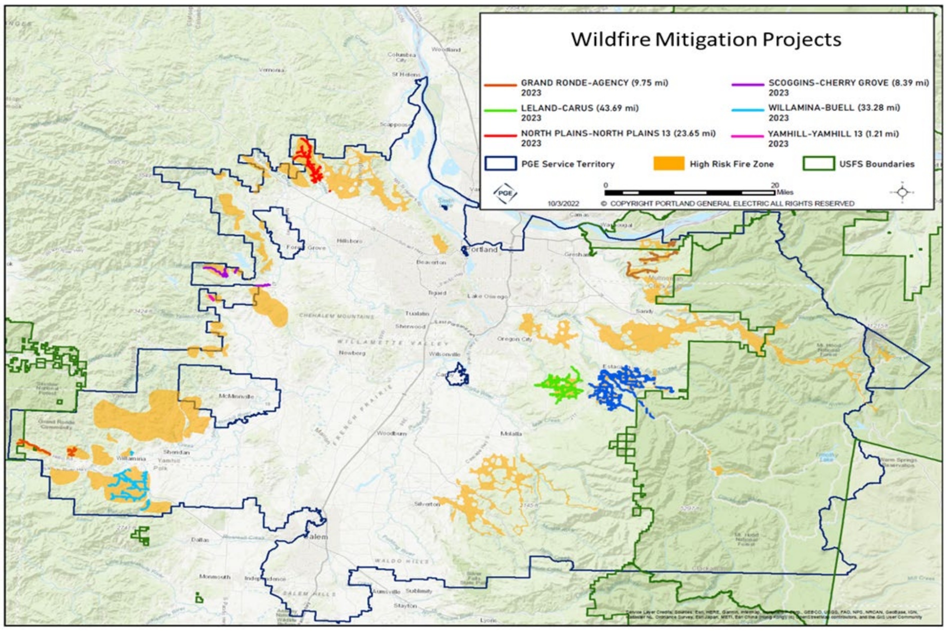


Figure 26. PGE Planned Wildfire Mitigation Investments, 2023

11 Expected Wildfire Mitigation Program Costs

PGE develops an annual implementation and administrative cost budget and an administrative costs and forecasted capital budgets for the Program. This section is added to address recommendation 11. The activities and expenditures are outlined in the following sections.

11.1 Wildfire-Related Operations, Maintenance, and Construction

For the 2024 WMP, PGE has updated O&M and Capital Cost Areas to be more descriptive of the activities and associated budget forecasts compared to the 2023 WMP.

- O&M forecasted cost areas of Wildfire Mitigation and Support Services were split into new, more program-focused cost areas as detailed in Table 22.

Table 22. PGE 2024-2027 Wildfire Mitigation Forecasted O&M Costs

HFRZ 1–11 O&M Forecast (millions, including direct loadings) [20]				
Cost Area	2024	2025	2026	2027
Wildfire Mitigation Program & Compliance	$2.1	$2.7	$2.8	$2.9
Risk Mapping & Simulations	$0.8	$1.1	$1.1	$1.2
Grid Operations & Protocols	$0.5	$0.7	$0.7	$0.7
PSPS Program	$0.9	$1.1	$1.1	$1.2
WMP Engagement, Public Awareness & Education, and Public Safety Partner Coordination	$0.7	$0.8	$0.9	$0.9
Asset Management & Inspections	$3.6	$3.7	$3.5	$3.7
Vegetation Management & Inspections (AWRR)	$36.2	$39.3	$38.3	$39.7
Investment O&M	$0.5	$0.5	$0.5	$0.5
WMP Total	$45.3	$48-$50	$47-$49	$49-$51

Capital cost areas of Utility Asset Management (Project Management Office) and Utility Asset Management have been combined into Utility Asset Management for clarity and detailed in Table 23.

Table 23. PGE 2024–2027 Wildfire Mitigation Forecasted Capital Costs

HFRZ 1–11 Capital (millions, including direct loadings)				
Cost Area	2024	2025	2026	2027
Wildfire Mitigation	$39.5–$44.4	$52.6–$73.7	$57.9–$73.7	$61.1–$78.9
Wildfire-Related Utility Asset Management	$3.5–$4.8	$4.0–$4.6	$4.2–$4.7	$4.4–$5.7
WMP Total Range	$43–$49.2	$56.6–$78.3	$62.1–$78.4	$65.5–$84.6

For reference, as of the filing of PGE's 2024 WMP, $14.9 million, excluding all loadings, has been executed in 2023 capital investments. Figure 27 compares the 2023 WMP Plan vs Actuals for Planned Wildfire Undergrounding/Reconductoring Investments and illustrates the multiyear projects at various stages of execution. The percentage completed is compared to the goal of 2023 progress, not the overall project schedule.

[20] See OPUC Order 23-370, Appendix A Page 10

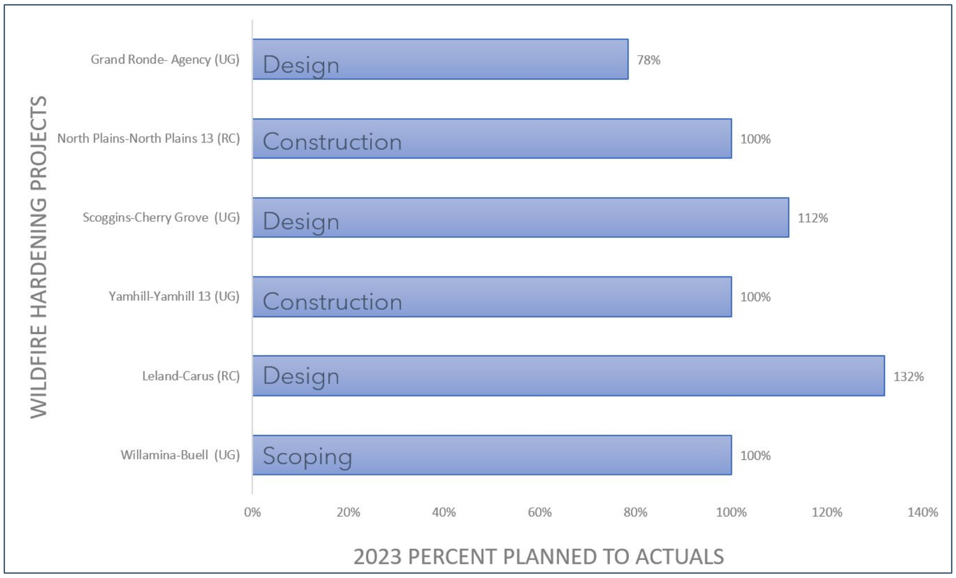


Figure 27. 2023 WMP Undergrounding/Reconductoring Investment: Planned vs. Actuals

Figure 28 reflects the programmatic planned to actuals for 2023 activities. As programmatic efforts are at various stages throughout the year, progress is measured to construction only. It is important to note that work that includes scoping, design, and permitting for targets can be a much higher percentage than that of the physical installation.

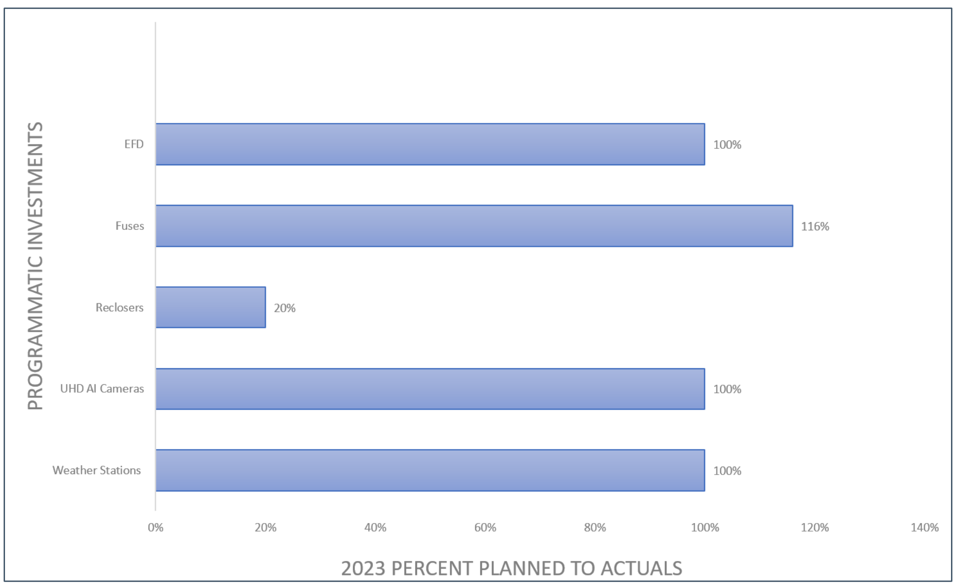


Figure 28. 2023 WMP Situational Awareness/Programmatic Investment Planned vs. Actuals

Discussion of 2023 planned versus actual investments are in PGE's Retrospective Reports. PGE files these reports biannually with the OPUC in Docket UE-412. Table 24 provides 2024 WMP activities and descriptions for O&M and Capital.

Table 24. 2024 WMP Activity and Descriptions

Activity	Description
Operations and Maintenance	
Wildfire Mitigation Program and Compliance	Develop, monitor, and track compliance to PGE's WMP. Includes Industry Engagement and Research & Development.
Risk Mapping & Simulation	Activities included in PGE's WRMA, HFRZ development, and valuation of capital projects and O&M programs.
Grid Operations and Protocols	Develop, implement, and monitor changes to PGE's Operations during fire season. Includes fire season training to select employees.
PSPS Program	Continue maturing PGE's de-energization protocols for public safety. Includes CRC and Customer Programs associated with supporting customers during a PSPS.
WMP Engagement, Public Awareness & Education, and Public Safety Partner Coordination	Engage customers, communities, and public safety partners to educate and gather feedback on PGE's WMP.
Asset Management & Inspections	Ignition Prevention Inspections and corrections performed under PGE's Inspect-Correct methodology in HFRZ.
Vegetation Management & Inspections (AWRR)	AWRR annual inspections, trimming, and tree removals within HFRZ.
Investment O&M	O&M associated with prior investments in system hardening and situational awareness to reduce wildfire risk in HFRZ.
Capital	
Wildfire Mitigation	System hardening and situational awareness investments that are focused on risk reduction in HFRZ
HFRZ Utility Asset Management	Capital additions and/or replacements in HFRZ based on inspection results or specific programs.

PGE will continue to refine its WRMA program in 2024 and beyond and will continue to forecast its wildfire mitigation capital and O&M spending needs based on the results of that analysis. State or Federal grant funds may augment PGE's planned programs if PGE receives an award. PGE is pursuing further grant funding for wildfire risk reduction and resiliency improvement. These programs include Federal Emergency Management Agency's Building Resilient Infrastructure and Communities grants and the Department of Energy's (DOE) Bipartisan Infrastructure Bill (BIL) with grant funding opportunities through the Grid Resilience and Innovation Partnerships section. PGE also explores additional opportunities through the State of Oregon's formula grants under the BIL.

11.2 Co-Benefits

To address recommendation 26, PGE demonstrates how both hardening and O&M bring benefits to customers and the region beyond wildfire mitigation. PGE has also partnered with peer IOUs to align on realizing co-benefits from investments, operations & maintenance. Table 25 illustrates how these activities overlap in co-benefits.

Table 25. Co-Benefits from Investments and O&M

Projects	Utility Definition	DSP	Safety	Reliability	Resilience
Utility Definition					
Vegetation Management	Includes Base & AWRR		X	X	
Asset Inspections and Corrections	Safety & Wildfire Inspections/ Corrections		X	X	
Grid Hardening	i.e., Undergrounding/ Reconductor	X	X	X	X
Situational Awareness	i.e., AI Cameras/Weather Stations	X	X	X	X
R&D					
Remote Sensing	i.e., Imagery/LiDar	X	X	X	X
Advanced Weather Forecasting	Predictive Forecasting		X	X	X
Updated Study Cost Power Interruptions	Value of Service Modeling	X		X	
POET Projects	Value of Resiliency Modeling	X			X

12 Participation in Regional, National, and International Forums

In 2024, as in previous years, PGE will actively participate in various regional, national, and international industry forums addressing wildfire and outage-related issues.

Emergency managers from PGE, PacifiCorp, NW Natural, and BPA collaborate throughout the year as part of an Energy Emergency Management Team (EEMT). Annually, the EEMT exchanges contact information with the Northwest Coordination Center (NWCC) for emergency communications during fire season. Dispatch/Control Center numbers provided by the energy companies are for dispatch-to-dispatch communications. Emergency management contacts are provided for NWCC and fire dispatch center personnel to assist with strategic decision-making and incident coordination.

In addition, PGE participates in industry forums that discuss wildfire-related topics, as discussed in the following sections.

12.1 International Wildfire Risk Mitigation Consortium

PGE participates with utilities from across the Western U.S., Canada, South America, and Australia to benchmark and share best practices for wildfire mitigation. The IWRMC is comprised of four working groups: Operations & Protocols, Risk Management, Vegetation Management, and Asset Management.

PGE holds leadership positions on the Risk Management and Asset Management working groups and chaired the 2023 Risk Management committee. PGE uses this forum to test PGE climate change assumptions and how climate change plays a role in both strategic risk management as well as understanding the value proposition of investments. PGE also participated in the group to understand new technologies and their potential applicability to PGE operations, as well as vegetation management approaches from around the globe. For example, through IWRMC, PGE will participate in The Hazard / Strike Tree Benchmarking and Best Practices Study to formulate a process and approach for identifying, assessing, and mitigating Hazard/Strike Trees with industry peers. This effort is scheduled to conclude in 2024.

PGE attended the IWRMC Annual Meeting on February 12–February 16, 2023. Key learnings PGE will consider in 2024 and future WMPs:

- Wildfire modeling results are increasingly diverging from observed fires. Temperature, as well as fire and fuel behavior are off by orders of magnitude from a predicted-to-actuals standpoint. Due to the combination of fuels in WUI being unique, climate change stresses on vegetation and wind patterns.
- Vegetation stress from cumulative drought suggests higher probability of down trees and limbs during any time of year. Failure of root system and poor moisture penetration driven by drought can result in down trees even in the absence of wind.
- Utilities are implementing a new standard for breakaway disconnects to mitigate the impact of limbs or trees falling into overhead secondary circuits. This design reduces PSPS impacts driven by overhead secondary risk and minimizes outage restoration time with easy reconnecting.
- Community engagement is recognized as a vital part of any WMP effort. A number of utilities have dedicated teams to support this work.

Through the IWRMC, PGE can leverage 'lessons learned' for specific wildfire mitigation strategies already implemented by other utilities, such as using covered conductors to reduce wildfire risk. Utilities that implemented this strategy failed to account for detection, fire response, and failure modes that could result in wire-down events, increasing wildfire risk as the covered conductor failed to de-energize, resulting in ignition events that were sometimes undetected for hours. This was a costly lesson learned for peer utilities, which were forced to remove an underground covered conductor in environments where that failure mode would be common. PGE customers benefit from the company's active participation in this forum as the shared data and review of mitigation strategy outcomes helped PGE avoid pitfalls and select more cost-effective and successful risk mitigation measures.

12.2 Electric Power Research Institute

PGE engages with its research partners at EPRI through multiple programs to address wildfire mitigation research. It is leveraging EPRI-led programs such as the Incubatenergy Network to gain knowledge of new technologies and start-ups in wildfire-related disciplines. PGE Senior Leadership actively engages in EPRI roles, and some are specific to wildfire, details of which are shared below in Section 12.7, "Summary of PGE Participation in Industry Forums.

In 2023, PGE participated in multiple EPRI climate advisory workshops and asset management peer reviews. Different learnings and applications were shared across industry, (e.g., benefits vs. risks of tree wire). In 2024, PGE plans to participate in a dedicated vegetation management EPRI study to understand if and how an RSE metric or calculation might be possible for its vegetation management program.

12.3 Oregon Joint Use Association

PGE is active in the leadership of the Oregon Joint Use Association (OJUA), a non-profit industry workgroup. The OJUA's mission involves building trust, cooperation, and organizational cohesion between utility pole owners, users, and government entities to promote the safe, efficient use of the ROW. The OJUA has featured educational presentations on wildfire mitigation at its past two annual meetings. Additionally, by administrative rule, the OJUA is an advisor to the OPUC on the adoption, amendment, or repeal of administrative rules governing utility pole owners and occupants.

12.4 Other National and Regional Forums

PGE engages with industry research partners at the Western Energy Institute, Edison Energy Institute (EEI), and the US DOE. This is evidenced by PGE's participation in the leadership of these organizations, as well as its active engagement in the industry technical sessions and conferences. PGE attended the EEI Wildfire Technologies Conference February 15–16, 2023. Key learnings were how utilization of the FPI could give Operations more advanced notice of Operational changes due to weather and some use cases that can augment safety-adjusted settings to reduce wildfire risk.

12.5 Regional Disaster Preparedness Organization

PGE is an active participant in the Regional Disaster Preparedness Organization (RDPO), which encompasses the five Portland metro region counties (Multnomah, Washington, Clackamas, Columbia, and Clark), as a utility/energy sector participant and steering committee member. In this role, PGE provides the RDPO with insights and a utility perspective on issues. In addition, participation in this group has enhanced PGE's regional partnerships and provided insights into regional disaster resilience and preparedness initiatives.

12.6 Oregon Wildfire Detection Camera Interoperability Committee

PGE participates in the Oregon Wildfire Detection Camera Interoperability Committee. This committee's primary goals and objectives include developing and maintaining statewide wildfire camera detection system(s) and fostering coordination and collaboration among its members. Membership includes the Governor's Office, public safety agencies, fire agencies, emergency managers, USFS, Bureau of Land Management, Statewide Interoperability Coordinator, ODF (co-chair of the committee), the Oregon Hazards Lab at the University of Oregon (co-chair of the committee), Tribal representatives, and Oregon's investor-owned utilities.

12.7 Summary of PGE Participation in Industry Forums

Below is a summary of engagement by PGE personnel in industry forums. This list is not exhaustive and does not capture the engagements in numerous forums within broader organizations, for example, EEI and WEI. Table 26 partially fulfills recommendation 28 for 2024. Recommendation 28 is supported by specific examples of those learnings included throughout the 2024 WMP.

Table 26. PGE Industry Forum Participation

Industry Forum	PGE Participant	Role
IWRMC Risk Management	Manager, Wildfire Planning & Analytics	Chair
IWRMC Asset Management	Senior Manager, Wildfire Operations Program Management	Vice-chair
IWRMC Vegetation Management	Manager Forestry	Participant
IWRMC Operations & Protocols	Director, Wildfire Mitigation & Resiliency	Participant
EPRI	Manager, Wildfire Planning & Analytics	Senior Advisory Board
Oregon Joint Use Association	Senior Manager, Strategic Asset Management	Chair
Regional Disaster Preparedness Organization	Manager, Business Continuity & Emergency Management	Steering Committee Member
Oregon Wildfire Detection Camera Interoperability Committee	Senior Manager, Wildfire Operations Program Management	Participant

13 Research and Development

PGE is participating in a variety of wildfire related research projects with public and private research institutes and industry partners.

13.1 Early Fault Detection Pilot Program

As a result of its collaboration with EPRI, PGE deployed the EFD pilot project in 2021.[21] EFD uses sensors to detect anomalies on the circuit in real-time, allowing PGE to replace or repair the affected component(s) before a failure that could result in ignition. Figure 29 is a damaged conductor identified by the EFD system and corrected by PGE in 2022.

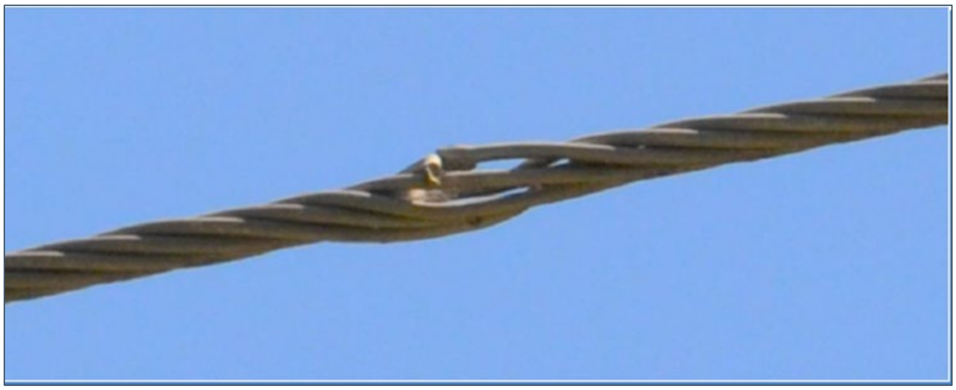


Figure 29. Damaged Conductor Identified by EFD System

In 2023, PGE expanded the EFD system from the original pilot program on Mt. Hood by adding sensors covering the Sandy-Sandy 13 overhead circuit. In preparation for the expansion, business processes were identified and refined to have a clear chain of responsibility for responding to alerts. As a result, PGE's work order management and dispatching tools have been updated to include response to EFD alerts as a standard procedure. Additional process refinement around proactive pattern identification, signal monitoring, and response prioritization will come with the program's expansion. PGE plans to expand EFD to additional circuits, both distribution and transmission lines in 2024. Figure 30 is an example of an installed EFD system.

[21] Incubatenergy Labs 2020 Pilot Project Report: IND Technology – Early Fault Detection for Power Lines

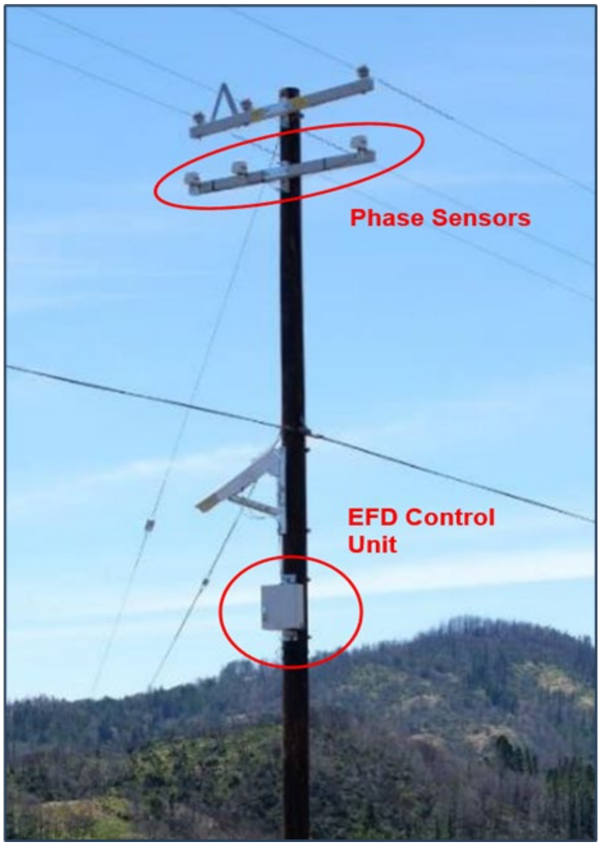


Figure 30. Installed EFD System

13.2 Remote Sensing Pilot Project

In 2021, PGE conducted a remote sensing data acquisition project for its HFRZ circuits to support wildfire and resiliency preparedness and operational design and engineering work in 2022. The project used various high-tech geospatial imaging technologies (listed below) to provide PGE with a detailed understanding of vegetation risk, clearances to poles and wires, and ROW accessibility within PGE's HFRZ.

The 2021 HFRZ Remote Sensing Pilot Project produced precise mobile and aerial LiDAR imaging, spherical imagery, and satellite multispectral imagery surveys of 774 circuit miles of conductor and nearly 15,000 poles within the PGE HFRZ. Figure 31 is a sample aerial LiDAR image.

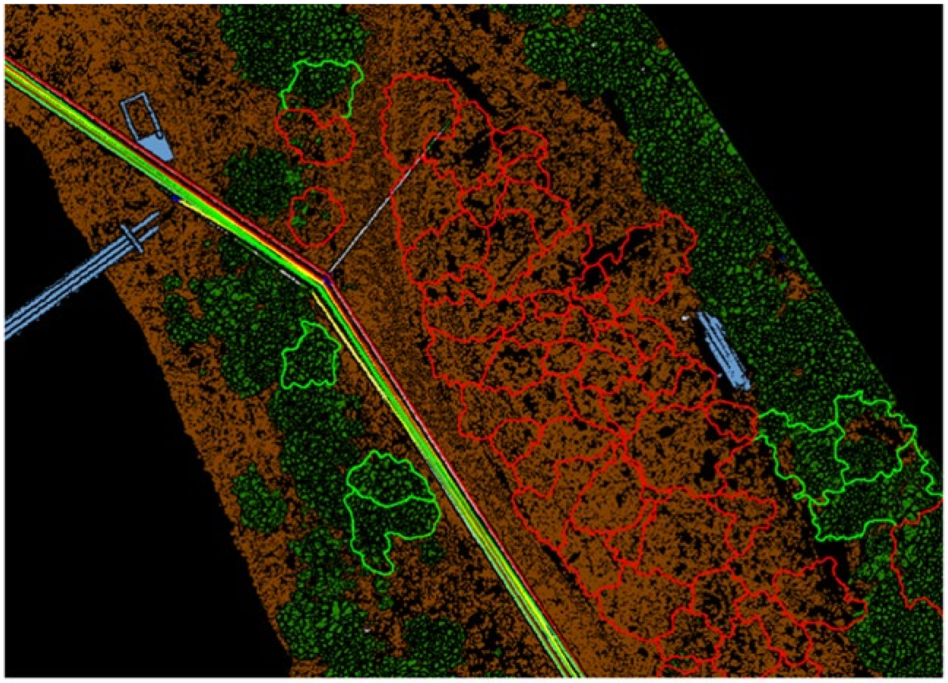


Figure 31. Sample Aerial LiDAR Imagery

Areas outlined in red are trees identified as threats in 2019 which have been removed.

PGE considered this data and analysis in the 2023 capital planning work, which guides its wildfire investment strategy. The data will also help PGE understand how much risk has been mitigated through previous years' AWRR (vegetation management) activities. PGE is using this information to plan our 2023 vegetation management program.

PGE's Remote Sensing Pilot Project also provided the following:

- GIS-enabled analyses of vegetation clearance and vegetation health
- Consolidated pole/span inventory
- Pole/span change detection analysis (2019–2021)
- Consolidated tree threat inventory (2019 and 2021)
- Tree changes detection analysis (2019–2021)

Additionally, PGE acquired satellite imagery for all HFRZ, 1,100 miles of conductor, to administer pilots using machine learning models to assess vegetation clearance, visualize line of sight, and identify hazard trees along T&D lines. PGE plans to expand its remote sensing capabilities and refresh data, including LiDAR, Orthoimaging, and satellite in all HFRZ. PGE will also invest in standardizing an imagery and inspection program to deliver organized and structured inspection data on a centralized data platform.

13.3 Storm Predictive Tool

PGE has operationalized version 1.0 of a Storm Predictive Tool that assesses high wind conditions that can be leveraged for winter storm and wildfire weather scenarios. Throughout 2023, PGE has conducted further model testing and validation to assess the Storm Predictive Tool's ability to incorporate more granular and sophisticated inputs to inform PGE's PSPS execution decision analysis, crew positioning, sparing strategy and improve system alarming. As the machine learning tool matures and learns, it will significantly improve PGE's ability to predict potential equipment outages based on forecasted and real-time meteorological data. The Storm Predictive Tool will offer co-benefits to PGE including equipment demand planning, spare equipment mobilization, and operational standards and practices, such as positioning crews geographically to respond to outages faster. Figure 32 is a sample of the predictive outage model output.

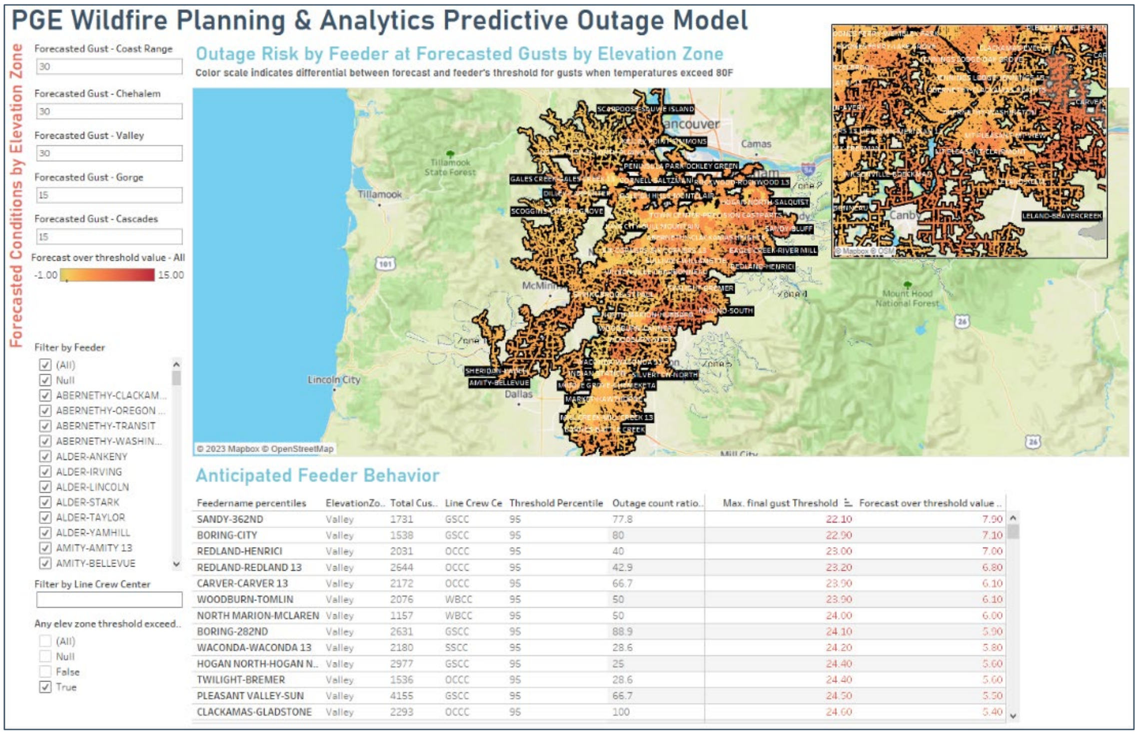


Figure 32. Sample Predictive Outage Model Output

13.4 PGE 5G Energy Lab

PGE leads the 5G PGE Energy Lab which is focused on developing innovative wildfire mitigation technologies. The collaboration evaluates use cases and develops business cases for wildfire-related surveillance, sensing and data collection, and cloud storage technologies, laying the groundwork for using AI-driven analysis in these disciplines. Through this collaboration group, PGE has investigated ways to interface the emerging 5G network with fire detection technology, EFD, and weather stations.

13.5 Customer Medical Battery Support

In the 2023 plan, PGE proposed to provide no-cost portable batteries to select qualified customers based on peer benchmarking learnings from the California utilities. The budget request to give these portable batteries and study the impacts for Year 1 was $100,000. The key objective of the offering was to understand the customers' usage of the battery devices to back up critical medical devices, customers perception of preparedness and resilience, and the customers experience during an outage before and after receiving a device.

PGE filed a promotional concession notifying the OPUC of the intent to offer portable batteries to PSPS-impacted residential customers enrolled in PGE's medical certificate program and the Income-Qualified Bill Discount Program on May 19, 2023, pre-identified 46 qualified customers in July of 2023, and began the initial outreach to deliver portable batteries to the identified customers in August. PGE contacted customers via email, mail, and phone calls to make them aware of the offering, and as customers signed up and returned liability waivers, the devices were shipped directly to them from PGE's supplier, Goal Zero.

As of the close of the 2023 fire season, 37 pre-identified customers who had been contacted received their battery, a Goal Zero Yeti 1500x. This model has enough energy for 1,516 watt hours and can power a CPAP for 24 hours or a refrigerator for 21 hours.[22] This model was chosen after a competitive RFP selection process. PGE secured favorable battery purchase pricing, allowing the Company to purchase enough devices to continue the offering into 2024.

PGE will conduct surveys and interviews with customers who have received these devices to understand their experiences and feelings of preparedness, tentatively planning for Spring of 2024 after the customer has been through a winter season and prior to fire season.

13.6 Future Offerings & Research

PGE has budgeted for $200,000 per year through this plan to continue evaluating and piloting new innovative customer solutions to support customer needs not otherwise addressed within this plan. The CRCs are an important element of PGE's customer support during PSPS events, but PGE recognizes that not all customers have equal access or benefit from the CRCs. The medical battery offering was the first step in providing additional support to customers who may be disproportionately harmed by a power outage or unable to access a CRC readily. However, PGE knows this is not the end of the need. PGE is exploring expanded support for medical needs, such as solutions to keep insulin cold and more options to get resilience solutions to those who could benefit from them.

PGE would like to explore solutions for ensuring customers have continued access to water, especially in the rural areas affected by PSPS, where many customers rely on wells that fail to work during an outage. Besides the apparent comfort, health, and hygiene impacts of losing access to water, water loss removes the primary mechanism for preventing wildfire spread in times of extreme wildfire risk. PGE seeks to explore solutions supporting water supply continuity for personal and community wells.

13.7 Advanced Meter & Data Analytics

In addition to fulfilling recommendation 27, PGE's participation in Association of Edison Illuminating Companies and the EEI has led to the adoption of an advanced meter analytics initiative. The goal is to leverage advanced meter infrastructure data to identify opportunities on the network to increase reliability for customers with reduced customer minutes of interruption and truck rolls. PGE, leveraging these industry forums and learnings, has been able to pilot evaluating voltage drops to predict hot wires on the ground and reduce public safety hazards. PGE anticipates this effort to continue to grow over time.

Contact PGE

For information regarding PGE's wildfire mitigation program and wildfire-related emergency kits, plans, checklists, education, and preparedness information, visit PGE's website, or call at 1-800-542-8818. Current situational updates, outage status, and wildfire information are also available via social media platforms Facebook, Twitter, Instagram, and LinkedIn.

[22] GoalZero Yeti 1500 Portable Power Station

14 Appendix and Compliance Index

14.1 Appendix 1: Chapter 860, Division 024 Applicable Rules

Rule Citation	Document Sections
860-024-0018	
1	Appendix 10: PGE Ignition Prevention Standards
2	8.6 Ignition Prevention Inspection Learnings
3	8.1 Inspection Procedures
3(a)	4.2 Enhanced Monitoring and Technology in HFRZ
	5.1 System Operations During Fire Season
	Table 10: Distribution System Operations In and Out of Fire Season SCADA Devices
	8 Ignition Prevention Inspections
	Table 15: Number of Inspected Structures and Line Miles
	4.2 Enhanced Monitoring and Technology in HFRZ
3(b)	5.1 System Operations During Fire Season
	Table 11: Pelton and Round Butte System Operations
	8 Ignition Prevention Inspections
	Table 15: Number of Inspected Structures and Line Miles
	8.5 HFRZ Correction Timeframes
	8.5 HFRZ Correction Timeframes
4	8.5 HFRZ Correction Timeframes
5	8.5 HFRZ Correction Timeframes
5(a)	8.5 HFRZ Correction Timeframes
5(b)	8.5 HFRZ Correction Timeframes
5(c)	8.6 Ignition Prevention Inspection Learnings
6	8.6 Ignition Prevention Inspection Learnings
7	8.6 Ignition Prevention Inspection Learnings
8	8.6 Ignition Prevention Inspection Learnings
9	Note to utility about rule intentions.
10	Appendix 10: PGE Ignition Prevention Standards

14.2 Appendix 2: Chapter 860, Division 300 Applicable Rules

Rule Citation	Document Sections
860-300-0030	3 Wildfire Risk Mitigation Program Overview
860-300-0040	7 Wildfire Safety, Prevention, Communication and Engagement Strategies
	7.4 2023 Engagement Activities and 2024 Engagement Strategy
1	7.4 2023 Engagement Activities and 2024 Engagement Strategy
1(a)	7.4 2023 Engagement Activities and 2024 Engagement Strategy
1(a)(A)	7.5 Public Safety Partner Coordination Strategy
	7.5.1.1 Before fire season
	7.5.1.3 After fire season
1(a)(B)	7 Wildfire Safety, Prevention, Communication and Engagement Strategies
	Appendix 4: Summary of Input from Public Safety Partners
1(b)	7.2 Education Campaign: Channels and Outcomes
2	7.1 Education Approach
2(a)	7.2 Education Campaign: Channels and Outcomes
	6.10 Communications During a PSPS Event
2(a)(A)	7.2 Education Campaign: Channels and Outcomes
2(a)(B)	7.2 Education Campaign: Channels and Outcomes
2(a)(C)	7.2 Education Campaign: Channels and Outcomes
2(a)(D)	7.2 Education Campaign: Channels and Outcomes
2(b)(A)	7.2 Education Campaign: Channels and Outcomes
2(b)(B)	7.5.1 Coordination Approach
	7.5.1.1 Before Fire Season
2(b)(C)	7.4 2023 Engagement Activities and 2024 Engagement Strategy
2(b)(C)(i)	7.2 Education Campaign: Channels and Outcomes
2(b)(C)(ii)	7.2 Education Campaign: Channels and Outcomes
3	Appendix 7: Community and Stakeholder Engagement Metrics
4	8.5.1.1 Before Fire Season
4(a)	7.5.1.1 Before Fire Season
4(b)	7.5.1.1 Before Fire Season
	7.5.1.2 During Fire Season
	7.5.1.3 After Fire Season
4(c)	Appendix 4: Summary of Input from Public Safety Partners
860-300-0050	6 Operations During PSPS Event
1	6 Operations During PSPS Event
1(a)	6.10 Communications During a PSPS Event
1(b)	6.10 Communications During a PSPS Event
1(b)(A)	6 Operations During PSPS Event
1(b)(B)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy

1(b)(C)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
1(b)(D)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
1(b)(E)	6.3 Level 1: Normal
1(b)(F)	Table 14: Notification Information
1(b)(G)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
1(b)(H)	Note to Utility that this rule does not preclude additional communication.
1(c)	6 Operations During PSPS Event
1(c)(A)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
1(c)(B)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
1(c)(C)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
1(c)(D)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
1(c)(E)	6 Operations During PSPS Event
1(d)	6.4 Level 2: Guarded
2	6 Operations During PSPS Event
2(a)	6 Operations During PSPS Event
2(a)(A)	6.10 Communications During a PSPS Event
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(a)(B)	6.10 Communications During a PSPS Event
2(a)(C)	2 Introduction
	6 Operations During PSPS Event
2(b)	6.10 Communications During a PSPS Event

	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(b)(A)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(b)(B)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(b)(C)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(b)(D)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(b)(E)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(b)(F)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
2(b)(G)	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information
	Figure 19: PSPS Notification Strategy
3	6.4 Level 2: Guarded
3(a)	6.5 Level 3: Elevated
3(b)	6.5 Level 3: Elevated
3(c)	6.5 Level 3: Elevated
4	Note to Utility that this rule does not replace emergency alerts.
5	Note to Utility that this rule allows for additional communication beyond stated rule.
860-300-0060	6 Operations During PSPS Event
1	6 Operations During PSPS Event
	Appendix 4: Summary of Input from Public Safety Partners
2	6.10 Communications During a PSPS Event
	Table 13: Notification Cadence
	Table 14: Notification Information

	Figure 19: PSPS Notification Strategy
3	6 Operations During PSPS Event
4	6 Operations During PSPS Event
860-300-0070	
1	In the event of a PSPS event, PGE will file with OPUC an annual report(s) on de-energization lessons learned, no later than December 31.
2	The non-confidential versions of PGE's annual report filed with the OPUC will be made available on PGE's website.
860-300-0080	Not Applicable

14.3 Appendix 3: 2023 WMP Recommendations and Workshop Dates

Recommendation	Document Sections	Workshop Date
1. Detail recommendations from local partners in establishing HFRZ.	3.2.1 Updates to Wildfire Risk Assessment with Fire Agencies 3.2.2 High Fire Risk Zone Review with Fire Agencies	October 17, 2023
2 Provide explicit details of assets within and outside the HFRZ. Staff further recommends that PGE provide explicit details of assets within and outside the HFRZ. Staff believes this should be constructed using a common reporting structure across the IOUs.	4.2 Enhanced Monitoring and Technology in HFRZ Figure 14: 2023 PGE Pano AI Camera Locations Table 8: Agencies Using PGE Pano AI Cameras Figure 13: PGE 2024 HFRZ Table 9: PGE Assets Grouped by HFRZ	August 2, 2023
3 Joint IOUs explore calibration of wildfire risk modeling methods to coordinate that when and where overlaps occur, they are consistent, or explicably inconsistent, in their risk designation. Such designation and coordination across utilities may lend greater clarity for stakeholders and Staff to understand relative risks.	3.2.2 High Fire Risk Zone Review with Fire Agencies 3.2.3 Coordination with Peer Utilities Figure 3: Proposed Roadmap for HFRZ Determination Standardization	August 22, 2023
4 Provide details for incorporation of climate change modeling in establishing the HFRZ.	4.5 Climate Change 4.5.1 Impacts on PGE's Service Area 4.6 PGE's Inclusion of Climate Change Variables in Risk Assessments	August 2, 2023
5 Provide historic root cause analysis supporting equipment ignition risk determinations.	8.9 Ignition Management and Root Cause Analysis Table 17: Ignition Tracking Database Fields Figure 22: PGE management Process Flow	October 5, 2023
6 Demonstrate the Company's ignition management tracking database and processes.	8.6 Ignition Prevention Inspection Learnings 8.9 Ignition Management and Root cause Analysis Table 17 Ignition Tracking Database Fields 8.9.2 Ignition Engineering Review Task Force	October 5, 2023
7 Provide valuation for undergrounding and reconductoring projects identified in the Company's 2023 WMP, in addition to any subsequently identified hardening projects.	10 System Hardening Table 20:Planned Underground Reconductoring Investments in Line Miles 2024-2027 Figure 26: PGE Planned Wildfire Mitigation Investments, 2023 11 Expected Wildfire Mitigation Program Costs 11.1 Wildfire-Related Operations, Maintenance, and Construction Table 22: PGE 2024-2027 Wildfire Mitigation Forecasted O&M Costs Table 23: PGE 2024-2027 Wildfire Mitigation Forecasted Capital Costs Figure 27: 2023 WMP Undergrounding/Reconductoring Investment: Planned vs. Actuals	August 2, 2023 August 22, 2023

Recommendation	Document Sections	Workshop Date
	Figure 28: 2023 WMP Situational Awareness/Programmatic Investment Planned vs. Actuals Table 24: 2024 WMP Activity and Descriptions	
8 Detail progress made towards a uniform risk-spend valuation methodology.	1 Executive summary 3.4 Risk Assessment Methodologies: Data Quality and Review Frequency Table 5: Cadence of Updates 3.6 PGE's Inclusion of Climate Change Variables in Risk Assessments Table 6: Risk Valuation Research, Reports, and Studies References 3.7 Wildfire Risk Informed Decision Making Figure 10: The Value Spend Efficiency Equation	August 22, 2023
9 Provide planned and actual work by program for the prior and future years, as well as associated estimations of risk reduction for the work completed.	3 Wildfire Risk Mitigation Program Overview 3.3 Wildfire Risk Categories 3.7 Wildfire Risk Informed Decision Making 8.9.3 Role of Vegetation in Ignitions 9 Vegetation Management 9.2 Advanced Wildfire Risk Reduction Vegetation Management Program 10 System Hardening Table 20Planned Underground Reconductoring Investments in Line Miles 2024-2027 Figure 26: PGE Planned Wildfire Mitigation Investments, 2023 11 Expected Wildfire Mitigation Program Costs 11.1 Wildfire-Related Operations, Maintenance, and Construction Table 22: PGE 2024-2027 Wildfire Mitigation Forecasted O&M Costs Table 23: PGE 2024-2027 Wildfire Mitigation Forecasted Capital Costs Figure 27: 2023 WMP Undergrounding/Reconductoring Investment: Planned vs. Actuals Figure 28: 2023 WMP Situational Awareness/Programmatic Investment Planned vs. Actuals Table 24: 2024 WMP Activity and Descriptions	August 2, 2023
10 Provide planned and actual work by program for the prior and future years, as well as associated estimations of risk reduction for the work completed.	Duplicate of recommendation 9	
11 Provide a multiyear plan (at least four years out) with project-level details for any capital investments and the estimated risk reduction for the selected mitigation method.	10 System Hardening Table 20Planned Underground Reconductoring Investments in Line Miles 2024-2027 Figure 26 PGE Planned Wildfire Mitigation Investments, 2023 11 Expected Wildfire Mitigation Program Costs	August 2, 2023

Recommendation	Document Sections	Workshop Date
	11.1 Wildfire-Related Operations, Maintenance, and Construction Table 22: PGE 2024-2027 Wildfire Mitigation Forecasted O&M Costs Table 23: PGE 2024-2027 Wildfire Mitigation Forecasted Capital Costs Figure 27: 2023 WMP Undergrounding/Reconductoring Investment: Planned vs. Actuals Figure 28: 2023 WMP Situational Awareness/Programmatic Investment Planned vs. Actuals Table 24: 2024 WMP Activity and Descriptions	
12 Include as an appendix to its WMP a registry of Public Safety Partner events, with feedback and actions taken as a result of the feedback.	7.4 2023 Engagement Activities and 2024 Engagement Strategy 7.5 Public Safety Partner Coordination Strategy Appendix 4: Summary of Input from Public Safety Partners	October 17, 2023
13 Provide findings of analyses on operational modifications based upon Fire Season or other relevant elevated wildfire periods.	5.1 System Operations During Fire Season Table 12: System Wide Daily Reliability Performance June 1-October 31	August 2, 2023
14 Staff recommends that PGE outline roles and responsibilities that are in place during PSPS activations; PGE should communicate this structure to Public Safety Partners, at a minimum during tabletops or exercises.	5.3 Event Response Management 6 Operations During PSPS Event 6.1 De-Energizing Power Lines and Power System Operations During PSPS Event 6.2 Levels of a PSPS Event 6.3 Level 1: Normal 6.4 Level 2: Guarded 6.5 Level 3: Elevated 6.6 Preparation for De-Energization 6.7 Level 4: Severe Event Happening 6.8 Level 4: Severe Restoration 6.9 Community Resource Centers 7.5.1.1 Before Fire Season	October 17, 2023
15 Staff recommends that PGE continue to develop its experience in placing and operating CRCs when activated.	6.9 Community Resource Centers Figure 17 PSPS Process Bell Curve	October 17, 2023
16 Joint IOUs establish language for Public Safety Partners and communities regarding modified operational practices, including "sensitive settings", PSPS and other utility operational modes to mitigate wildfire risk.	7.1 Education Approach	August 2, 2023
17 Coordinate community outreach with partners, including ESF-12, and consider broadening the workshop to include relevant community safety topics, inviting Public Safety Partners regarding	6.4 Level 2: Guarded 7.4 2023 Engagement Activities and 2024 Engagement Strategy 7.5.1.1 Before Fire Season	October 17, 2023

Recommendation	Document Sections	Workshop Date
other topics appropriate to the community.		
18 Detail methods for determining the effectiveness of customer outreach and describe any modifications made to outreach strategies as a result. Further Staff recommends that the IOUs consider coordinating community outreach (where overlap of Public Safety Partners may exist) and developing consistent methods for evaluating the effectiveness of their public outreach and their Public Safety Partner outreach and establish methods.	Appendix 7: Community and Stakeholder Engagement Metrics Table 30: Customer Campaign Metrics Appendix 9: 2023 Public Safety Partner Event Registry	August 22, 2023
19 Portland General Electric provide cost analysis supporting its inspection correction process for Ignition Prevention Inspections, including demonstrable details that substantiate this selection.	8 Ignition Prevention Inspections 8.1 Inspection Procedures 8.2 Ignition Prevention Inspections Standards	August 22, 2023
20 Portland General Electric demonstrate the use of its ignition management tracking database to support its approach to ignition prevention inspections.	8.6 Ignition Prevention Inspection Learnings 8.9 Ignition Management and Root cause Analysis Table 17: Ignition Tracking Database Fields 8.9.2 Ignition Engineering Review Task Force Figure 22: PGE Management Process Flow	October 5, 2023
21 Portland General Electric explore the results of its QA/QC program for ignition prevention inspections and determine a reasonable quality assurance level and associated costs for administering the program.	8.3 Ignition Prevention Inspection Program Oversight	October 17, 2023
22 Staff recommends PGE utilize the previously recommended RSE methodology to determine the risk reduction that AWRR delivers to customers.	9.4 Risk Informed Vegetation Management	August 22, 2023
23 Staff recommends that root cause analysis for vegetation-related risks be conducted to support the determination of how AWRR is employed.	8.9.2 Ignition Engineering Review Task Force Figure 22: PGE Management Process Flow 8.9.3 Role of Vegetation in Ignitions 9.4.1 Levels of Assessment	October 5, 2023
24 Staff recommends that PGE demonstrate its use of its ignition management tracking database to evaluate the logic of its programmatic decisions for vegetation management in HFRZ.	8.9 Ignition Management and Root cause Analysis Table 17: Ignition Tracking Database Fields 8.9.2 Ignition Engineering Review Task Force Figure 22: PGE Management Process Flow 8.9.3 Role of Vegetation in Ignitions	October 5, 2023

Recommendation	Document Sections	Workshop Date
25 PGE include a summary of the quantitative analysis used in the choice and prioritization of specific solutions and investments.	10 System Hardening Table 24: 2024 WMP Activity and Descriptions 11.1 Wildfire-Related Operations, Maintenance, and Construction 13 Research and Development	August 2, 2023 August 22, 2023
26 PGE include how solutions providing co-benefits have been considered in its investment strategies.	11.2 Co-Benefits Table 25: Co-Benefits from Investments and O&M	August 2, 2023 August 22, 2023
27 PGE discuss the impact of participation in expert forums on identification of solutions most likely to provide the benefits anticipated. This should include: a. Cited research, reports, and studies used in any analysis, unless the source is confidential. b. How the factors unique to the Company's facilities and service territory were used when considering the applicability of specific options to its systems.	4.2 Enhanced Monitoring and Technology in HFRZ Table 6: Risk Valuation Research, Reports, and Studies References 13.7 Advanced Meter Analytics	October 17, 2023
28 In Recommendation 27, Staff recognized certain of the industry learnings were likely related to risk valuation, however directly responsive to the broader research and development and industry participation, Staff recommends PGE provide specifics on program changes made in response to learnings from industry forums, as well as greater detail of who from the company participates and in what roles they function in various industry forums.	12.7 Summary of PGE Participation in Industry Forums Table 26: PGE Industry Forum Participation 13 Research and Development	October 17, 2023
29 Staff recommends PGE and joint utilities evaluate the CPUC WSD maturity model and develop an Oregon IOU rubric as part of their 2024 WMPs; Staff would welcome the opportunity to participate in such a collaborative work effort.	Appendix 12: Joint IOU Evaluate CPUC Maturity Model & Develop an Oregon IOU Rubric Figure 36: Oregon Maturity Model Timeline	August 22, 2023
30 Staff recommends PGE demonstrate the use of its ignition management database to perform root cause analyses which led to any ignition inspection program changes.	8.6 Ignition Prevention Inspection Learnings 8.9 Ignition Management and Root cause Analysis Table 17: Ignition Tracking Database Fields 8.9.2 Ignition Engineering Review Task Force Figure 22: PGE Management Process Flow	October 5, 2023

14.4 Appendix 4: Summary of Input from Public Safety Partners

The following improvement plan includes recommendations for actions from the PSPS Tabletop after action review from the Public Safety Partners Spring Summit. As appropriate, these actions have been incorporated throughout the 2024 WMP. Please see Appendix nine (9) and Appendix 10 for complementary information on a registry of events PGE facilitated.

Table 27. PSPS Strengths and Opportunities

Strengths	
Public Information	Regional Joint Information System: PGE's (PIO) and support staff are a part of the regional network of PIOs that would activate the Regional Joint Information System (RJIS) during Events
Public Information	Public/Private collaboration of PSPS Messaging: Local electric utilities in Oregon have partnered to develop PSPS related terms and messaging that can be used by public agencies in their jurisdiction's alert and warning messaging platforms.
Whole Community	PGE has programs and initiatives that can assist in preparedness or be activated during a response to mitigate impacts to critical facilities and customers. Examples include processes to escalate disaster assistance facilities, convey customer public safety issues to human services agencies, and offer limited back up battery systems to qualified vulnerable customers. Public Safety Partners suggested that PGE should add information about batteries for residential use on PGE's website, like information provided about backup generators.
Operational Coordination	Daily Coordination Call: PGE's response procedures include a daily coordination call with Public Safety Partners during a PSPS event. Public Safety Partners agree this is a helpful way to convey key information critical to public safety partners.
Opportunities for Improvement	
Public Information	Maps & Incident visualization: PGE's GIS team to evaluate the feasibility of making enhancements to PGE public facing website for PSPS information. Enhancements could include visually depicting the different PSPS stages, streamlined updates to Raptor for just-in-time PSPS areas, and standardized symbols and conventions with electric utilities.
Whole Community	Customer and community care responsibilities: • PGE Business Continuity & Emergency Management (BCEM) leadership to meet with county emergency management agency leadership and OREM to explore Community Resource Centers alternatives that are complimentary and scalable. • During PSPS events, the PGE Customer Officer to share the CRC implementation strategy and criteria used for allocating available customer care resources during daily coordination calls with public safety partners. • Public safety partners develop a scalable regional mass care strategy for PSPS events and engage PGE to supplement the strategy with PGE resources, information, and capabilities.
Operational Coordination	Meeting Schedule Conflicts: • PGE BCEM will follow its standard meeting cadence and will consider adjusting the schedule for Public Safety Partner coordination calls based on regional or state coordination calls involving the same stakeholders. • BCEM will evaluate the potential of uploading a standard PSP situation report into OpsCenter for jurisdictions to access when a daily coordination meeting is not possible.

14.5 Appendix 5: PGE Wildfire Risk Assessment Overview and Process

PGE consults with wildfire risk experts to model fire behavior while benchmarking its risk methodology, modeling, and data with local and international wildfire programs. Key terms in this process are identified below.

Ignition Potential Index: The Ignition Potential Index (IPI) measures the propensity for weather conditions and fuel characteristics at a given location to result in a utility-related wildfire ignition that escapes initial suppression efforts to become a significant and potentially damaging fire. Using a model patterned after the California Public Utilities Commission's Ignition Index and Utility Threat Index, PGE models the potential for wildfire ignition as a function of wind speed, fuel dryness, and heat per unit area (HPA). The model derives its base weather observations from gridMET, a historical 4-km resolution, gridded daily weather dataset; PGE applies downscaling and bias-correction algorithms to increase model precision and weather data accuracy. The following sections provide additional details regarding the weather factors in PGE's IPI model.

Wind Speed: In its IPI model, PGE explored using two gridded historical wind speed datasets (gridMET and National Renewable Energy Laboratory (NREL)). Neither dataset alone was sufficiently detailed to allow PGE to determine the influence of wind speed on the potential for a utility-caused ignition to result in significant fire damage. The gridMET dataset provides detailed daily wind speed grids but includes bias on annual timescales relative to other national products with finer spatial resolutions. PGE corrected this bias using the NREL annual mean wind speed dataset (Draxl et al. 2015) by deriving a daily calibration factor from the overlapping periods of the two datasets (2007-2013). This approach allows the model to coordinate wind speed and dryness observed in gridMET using the precision of the NREL dataset. The bias correction factor was derived by dividing the mean annual NREL wind speed by the average yearly gridMET wind speed during overlapping periods. PGE applied this factor to daily gridMET wind speeds.

Schroeder Probability of Ignition: Schroeder Probability of Ignition ([SPI], Schroeder 1969) is a long-established measure of the likelihood that a competent ignition source will result in a fire start. SPI is a function of fuel temperature and moisture content. By making some simplifying assumptions, PGE calculates SPI from air temperature and relative humidity, both of which are standard weather variables included in historical summaries and weather forecasts (such as gridMET), and both can be adjusted adiabatically (occurring without loss or gain of heat) for elevation.

Heat Per Unit Area: HPA measures the heat content of the fuel bed (kJ/m2). HPA is primarily a function of the fuel loading by size class and component for surface fuels. For crown fires, HPA also includes the proportion of canopy fuel expected to be involved in a fire.

HPA varies with wind speed and fuel moisture content for a given fuel complex. PGE classified each day in the record into one (1) of 27 weather types, then computed Daily HPA using a proprietary version of the FlamMap fire modeling system as a function of each cell's fuel characteristics and weather type.

During wildfire events, higher HPA values manifest in greater flame length and increased resistance to firefighter control. HPA can vary by several orders of magnitude. PGE's IPI model takes the square root of HPA to obtain an estimated flame length (flame length is roughly the square root of fire line intensity).

Conditional IPI: Conditional Ignition Potential Index provides PGE with a modeled representation of expected IPI for each weather type studied. The daily IPI dataset assesses fire potential based on historical observations; however, not all potential weather conditions were represented for each location in the analysis area. PGE created a set of IPIs applicable for future weather observations organized by the weather-type classification used throughout this analysis.

PGE applied this general IPI calculation with the following customizations: to calculate localized wind speed, PGE applied the downscaling factors developed to calibrate predominant winds to local, terrain-influenced wind speeds at the mid-point wind speed of each weather type. Using the daily historical record, PGE calculated a mean SPI for each fuel moisture class. For moisture classes with fewer than 50 observations in the historical record, PGE incorporated the SPI observations of the nearest moisture class to increase the sample size. This was necessary primarily in the northwest corner of the analysis area, where the driest moisture types rarely, if ever, occur in the historical record. PGE also applied the same supplemental data approach to model the mean Large Fire Probability for each moisture class.

Weather Type Probabilities: Weather type probabilities are weighting factors derived from the IPI within each weather type relative to the total IPI for a given raster cell. Rasters are matrices of cells organized into rows and columns or grids, where each cell contains a value representing information, such as temperature. Rasters are often displayed as data layers along with other geographic data on maps or used as the source data for spatial analysis.

WTPs integrate the relative ignition potential for that weather type and its relative frequency within the observed record. A weather type with high wind speed, high SPI, etc., will receive a high weighting according to the larger IPI value, but weather types with lower IPI values may also receive a higher weighting if they occur at high frequency.

Spatial Resolution: PGE used downscaling and smoothing to achieve a final cell resolution of 120 meters × 120 meters (3.56 acres). The fuel layers necessary for HPA are available at a 30-meter resolution. To resolve the spatial resolution issue, PGE resampled (using bilinear interpolation, a statistical method by which related known values are used to estimate an unknown value, using other established values located in sequence with the unknown value) the 30-meter HPA estimates for each of the 27-wind speed and fuel moisture combinations to the coarser resolutions of 120-meter and 4-kilometer (depending on the data set).

Smoothing: PGE used downscaling and smoothing to achieve a final cell resolution of 120 meters × 120 meters (3.56 acres). The fuel layers necessary for HPA are available at a 30-meter resolution. To resolve the spatial resolution issue, PGE resampled the 30-meter HPA estimates for each 27-wind speed and fuel moisture combination to the coarser resolutions of 120-meter and 4-kilometer (depending on the data set). Bilinear interpolation, a statistical method by which related known values are used to estimate an unknown value using other established values located in sequence with the unknown value, was used.

For WTP, the smoothing process included a re-normalization to verify the results and confirm the weighting factors were still valid (a fraction of the total IPI and, therefore all WTP values still summed to one for a given raster cell).

Downscaling: To assess the local effects of topography on weather, PGE downscaled gridMET weather data using adiabatic relationships of elevation to temperature and humidity and modeled the local topographic effect on prevalent wind direction and speeds. For each 120-meter × 120-meter cell and day in the record, PGE adjusted the observed gridMET temperature by the relative difference in elevation between the gridMET 4-kilometer cell and the finer 120-meter cell. This also changed the relative humidity at the 120-meter cell under the assumption that the same absolute water content in an area persisted under variable elevation and temperature.

To assess localized wind speeds, PGE used the WindNinja modeling system (a fluid dynamics physics model that accounts for the effects of topography on wind speed and direction) to run simulations with the prevalent wind at the eight cardinal (indicating the numerical value) and ordinal (indicating the position of the value in a series) directions. This produced eight factors that modified the 4-kilometer wind speed to show the local effects of terrain at a 120-meter resolution. For each day in the record, PGE classified the wind direction to the nearest corresponding factor and adjusted the wind speed to produce a terrain-adjusted wind speed estimate at a 120-meter resolution. After downscaling the temperature, humidity, and wind speed, PGE then calculated daily IPI at a 120-meter resolution.

Conditional Impact: Conditional Impact (CI) measures the relative impact of a wildfire (i.e., loss), given that a fire has occurred. CI is a function of fire growth potential and the vulnerability of assets and resources around potential source locations. Fire growth potential is a function of fuel, weather, and topography. Vulnerability is a function of the exposure and susceptibility of homes, resources, and assets across the landscape where the fire occurred.

Unlike IPI, CI does not lend itself to a deterministic (models that produce the same results for a particular set of inputs) mathematical solution. To generate CI, PGE applies fire growth modeling to specific ignition locations and then ties the spatial data within the final simulated perimeters back to the ignition location. After generating the final fire-perimeter event set, PGE's model overlays each simulated wildfire with spatial data representing the impacts of wildfire—conditional losses associated with high-value resources and assets.

PGE generalized the event-set results to produce a CI raster at 120 meter representing the tendency for fires originating in that area to impact resources and assets. Thus, PGE was able to model the potential for a wildfire to result in an urban conflagration (such as the 2020 Almeda Fire in Ashland) by including burnable urban fuel models within the appropriate weather types.

Wildfire Simulation: PGE conducted wildfire simulation modeling using the Minimum Travel Time algorithm called Randig. Randig models short duration burn periods under constant weather conditions, assuming no suppression effects. This assumption is appropriate for modeling extreme wildfire spread events, where fire weather and fire behavior can overwhelm suppression resources. PGE applied the Randig algorithm in iterative runs using the 216 unique weather types and other parameters. Weather types were derived from gridMET weather data as described above.

Table 28 shows example inputs for the 216 weather types included in PGE's IPI model. Each set of parameters is repeated for each of the eight cardinal direction wind bins (0, 45, 90, 135, 180, 225, 270, 315), yielding 216 weather types. These wind speeds are banded in nine (9) groups of five (5) mph increments.

Table 28. Example Inputs for the 216 Weather Types

20-ft Wind Speed mi/hr	MC Class	1-hr MC	Live Herb MC	Live Woody MC	Duration min	Spot prob	Burnable Urban?
1	very dry	3%	45	80	60	10%	N
1	dry	5%	60	90	60	0%	N
1	moderate	8%	90	100	60	0%	N
5	very dry	3%	45	80	120	30%	N
5	dry	5%	60	90	120	15%	N
5	moderate	8%	90	100	120	0%	N
10	very dry	3%	45	80	180	50%	N
10	dry	5%	60	90	180	35%	N
10	moderate	8%	90	100	180	20%	N
15	very dry	3%	45	80	240	70%	Y
15	dry	5%	60	90	240	55%	N
15	moderate	8%	90	100	240	40%	N
20	very dry	3%	45	80	300	80%	Y
20	dry	5%	60	90	300	65%	Y
20	moderate	8%	90	100	300	50%	Y
25	very dry	3%	45	80	375	85%	Y
25	dry	5%	60	90	375	70%	Y
25	moderate	8%	90	100	375	55%	Y
30	very dry	3%	45	80	450	90%	Y
30	dry	5%	60	90	450	75%	Y
30	moderate	8%	90	100	450	60%	Y
35	very dry	3%	45	80	525	95%	Y
35	dry	5%	60	90	525	80%	Y
35	moderate	8%	90	100	525	65%	Y
40	very dry	3%	45	80	600	100%	Y
40	dry	5%	60	90	600	85%	Y
40	moderate	8%	90	100	600	70%	Y

Randig and WindNinja downscaled the modeled weather types within each wildfire simulation by running and fuel moisture conditioning functionality. PGE used pre-calculated WindNinja grids representing terrain-adapted wind speed and direction, generated at 120 m resolution, and then up-sampled to 30 m resolution as inputs to Randig. The model applied 10 adjusted moisture contents to individual cells based on canopy cover and topography (slope and aspect).

PGE then applied the Randig algorithm to a lattice grid of ignition points across the analysis area, generating a 270 m grid of ignition points based on a one-kilometer buffer of PGE features within the analysis area. PGE removed specific points based on burnability characteristics; the resulting analysis yielded 84,749 wildfire ignition points for simulation. Figure 33, below, depicts the overall extent of the wildfire simulation ignition points (panel A) and a detailed view of the ignition lattice (panel B) near the community of Sandy, Oregon. The red areas in panel A show the location of concentrated ignition points.

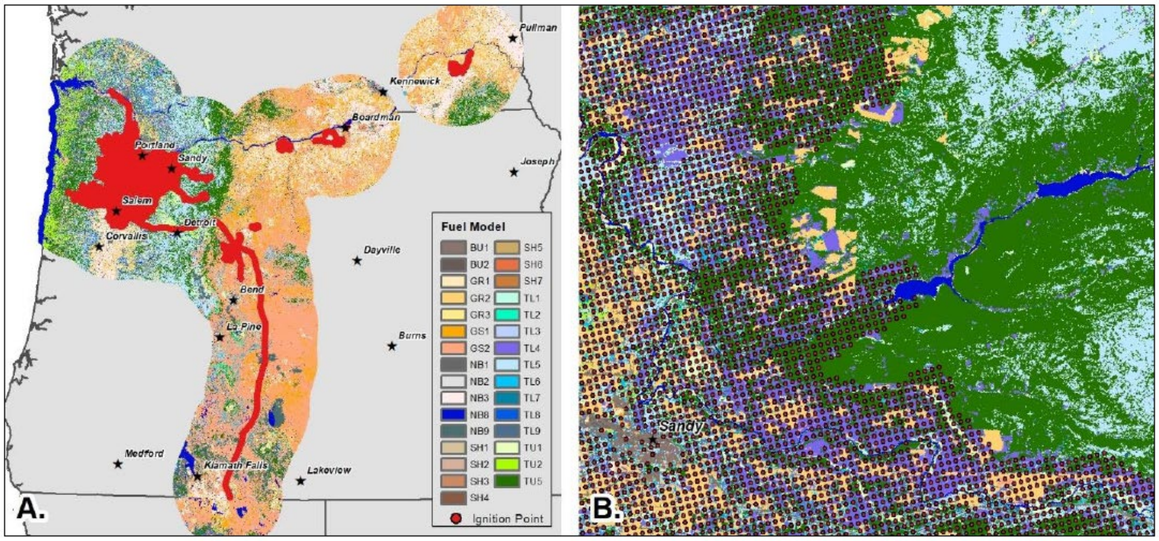


Figure 33. Extent of the Wildfire Simulation Ignition Points

Additionally, to account for the potential for wildfire spread into urban areas (mapped by LANDFIRE[23] as non-burnable), PGE used an iterative smoothing process to spread distributions of flame-length probabilities into non-burnable land cover (other than open water or ice) within 1.5 km of contiguous, burnable land cover at least 500 ha in size. These areas would otherwise have a zero probability of burning in the fire model. This allowed PGE to recalculate cNVC using response functions and relative importance values assigned by the PNRA1 project while accounting for wildfire spread into urban areas.

Finally, PGE applied a fractional exposure value based on the distance from the burnable fuel (the source of exposure) to account for the decreased exposure of housing units within the 1.5 km distance from burnable fuel. PGE adjusted housing-unit density exposure by multiplying the housing unit density by the exposure mask value in each pixel. The final People and Property HVRA included housing units directly exposed to wildfire (located in burnable pixels) and those indirectly exposed to wildfire (within a 1.5 km distance of burnable fuel).

PGE applied these modified response functions to all other HVRA cNVC layers; the layers were otherwise unaltered from the PNRA1 project. The final cNVC map (summed for all HVRA) serves as the impact raster necessary for the spatial intersection with the simulated fire perimeters—it provides the key to unlocking and understanding the HVRA impact simulations.

Impact Raster Overlays

PGE ran an overlay script to sum the total cNVC within each simulated wildfire perimeter. The total cNVC reported within each perimeter (including spot fires) is attributed back to the original ignition location. This allowed PGE to apply cNVC values, representing the estimated HVRA impacts for each of the 216 modeled weather conditions, to each of the original 84,749 simulated ignition points.

Rasterization

Once it had attributed impacts by fire simulation to the corresponding ignition locations, PGE applied a smoothing process to convert the vector datatype to rasters while also gap-filling the vector data. PGE first converted each set of vector ignitions for a given weather type to a 120 m raster, using an inverse distance weighting (IDW) algorithm using the four nearest ignition points, an exponential distance weighting of

[23] LANDFIRE (Landscape Fire and Resource Management Planning Tools), is a shared, government-developed program used by the wildland fire management programs of the U.S. Forest Service and U.S. Department of the Interior that uses landscape-scale geospatial products to support cross-boundary planning, management, and operations.

1.5, and a maximum search distance of 1,500 m. The maximum search distance was intentionally large to fill in data gaps created by the original ignition lattice falling on areas of non-burnable fuel cells, accounting for fires that do not spread beyond the ignition cell.

Wildfire Threat Index (WTI): PGE calculates the WTI as the product of conditional IPI, CI, and the weighting of the WTP, which are calculated at the original gridMET resolution and smoothed to the coincident 120 m resolution.

Conditional Wildfire Threat Index (cWTI): The overall WTI integrates the results from all 216 weather types, while a cWTI for each weather type provides an estimate of wildfire threat for specific weather conditions. The cWTI is the product of the weather type IPI and CI.

Table 29. Wildfire Benchmarking and Risk Methodology

	Zone	1	2	3	4	5	6	7	8	9	10	11
Asset Density	Total Meter Count	162	46	150	78	57	374	61	33	27	16	71
	T&D pole density per mi²	127	70	111	108	97	123	82	44	48	27	68
	Share of HFRZ T&D poles	0	0	0	0	0	0	0	0	0	0	0
	Land area mi²	59	10	12	34	35	3	25	23	39	111	6
Pyrologix Probability	Probability exceeding manual control	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%
	Probability exceeding mechanical control	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%
	Probability extreme fire behavior	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%	2%-4%
Pyrologix Weather Scenario	Heat Intensity per unit area	10096	12775	10199	13221	7882	7541	6854	7333	8565	12451	12617
	WTI MEAN Scenario 158	1141609	472579	1575943	2030959	1312534	611661	767440	798307	1557185	1436931	6580233
	CI MEAN Scenario 158	424	209	906	135	476	624	333	152	148	138	228
	IPI MEAN Scenario 158	2789	6213	6729	3549	3047	3313	3892	3897	4684	5227	6441
Accessibility	Average drive time from a fire station	5-10 min.	10+min.	5-10 min.	10+min.	10+min.	5-10 min.	10+min.	10+min.	10+min.	10+min.	10+min.
	Slope-mean	6	8	5	6	6	9	7	9	9	9	7
	Aspect-mean	262	272	337	296	306	124	201	164	92	97	316
Social Indicators	Households below 200% Federal Poverty Line	25%	22%	16%	22%	15%	7%	16%	16%	22%	36%	17%
	Household Disability Composition	18	13	12	15	14	8	13	11	15	20	10
	Hispanic or Latino	7	8	2	3	3	4	5	9	5	7	9
	Age 65+	25	17	20	18	22	16	20	13	18	16	20
	Housing / transportation vulnerability	30	30	20	46	35	12	56	30	32	78	40

	Social vulnerability index	30	35	22	37	34	5	11	16	30	65	35
Ecological & Cultural Vulnerability	Critical Habitat 1-5 (1 is least relative presence of attribute)	2	3	1	2	3	1	3	2	2	2	1
	Cultural / historical protected areas (relative rank 1-5)	3	3	3	3	2	2	1	1	2	3	1
Rural / Urban Divide	Percent in WUI	77	57	100	77	64	82	71	72	53	52	99
Outage History	June–Sept 2018–2022 on UG	79	12	19	14	7	9	12	0	17	5	4
	June–Sept 2018–2022 on UG average duration	2705	647	419	367	1412	655	253	0	695	420	442
	June–Sept 2018–2022 on OH	265	31	72	98	106	54	103	50	203	76	126
	June–Sept 2018–2022 on UG average duration	1758	2344	327	805	1418	527	538	325	381	299	168

14.6 Appendix 6: Message Awareness & Knowledge Tracking Survey

PGE

Safety Message Awareness & Knowledge Tracking Survey

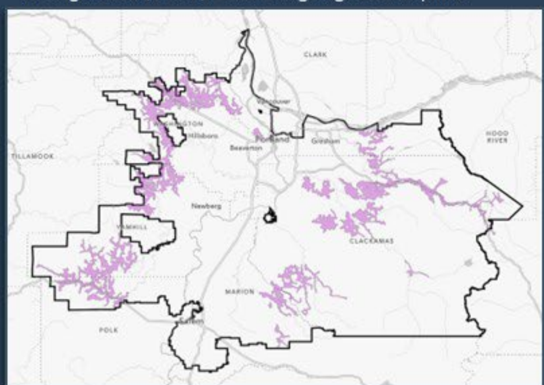
Brock Vriesman, Market Insights Analyst

October 2023

Overview

PGE Service Territory Map

w/ High-Risk (PSPS) Zones Highlighted in pink



SURVEY PURPOSE

- This survey was commissioned by John Farmer and Brett Phillips and the Wildfire Ops group at PGE.
- It was designed to be the first of an on-going, bi-annual survey to capture the knowledge level of our customers around PGE communications related to severe weather and wildfires.

SURVEY METHODOLOGY

- On September 26, 2023, we successfully delivered 9,516 survey invites
- We received 420 total completed surveys across two customer groups of interest, for a 4.4% response rate:
  - 200 customers in High Fire Risk Zones (HFRZ)
  - 220 customers outside the HFRZ, within the service territory

SURVEY INSTRUMENT

- Customers were asked 15-18 questions based on their responses.
  - 1 PGE brand-level satisfaction question (standard across MiT surveys)
  - 6 PSPS awareness/understanding questions
  - 5 Outage experience/preparedness questions
  - 5 demographic questions
  - 1 survey sweepstakes question

Key Findings

- Customers are not only aware of Public Safety Power Shutoffs (PSPS), but generally know why PGE has or would use them.
  - Within PGE's HFRZ, customer awareness of PSPS is at 84%.
  - Outside the HFRZ (the rest of the service territory), awareness is 47%.
- A majority of HFRZ customers say they can explain a PSPS to someone (73%) and when asked, it was very common for them to include wildfires, severe weather, and downed power lines in their explanations.
  - While less confident they could explain a PSPS to others, Non-HFRZ customers still often mentioned wildfires, severe weather, and downed power lines in their explanations.
- PGE is a more common source of PSPS information (45% across all channels included in survey) as stories in the news (36%) for HFRZ customers.
  - Non-HFRZ customers are much more likely to have heard of PSPS from the news (29%) than from PGE (11% across all channels included in survey).
- If you reside in an HFRZ, it is much more likely you've experienced an outage in the past six months. You're also extremely likely to have taken steps to prepare for a severe weather event/outage in the future.
- Customers in HFRZ are more likely to be living in a single-family home they own. This gives them more of an opportunity to make severe weather/outage preparations like purchasing a generator or clearing yard debris from the property.

PGE

PSPS Awareness & Knowledge

How Aware are Customers of Public Safety Power Shutoffs?

- An encouraging sign is 84% of customers in our HFRZ said they have heard of the term Public Safety Power Shutoff.
- By comparison, customers in Non-HFRZ's reported less than 50% awareness of the term.

Before today, have you ever heard of the term Public Safety Power Shutoff or PSPS?
**Percentages represent sample population*

Question text: Before today, have you ever heard of the term Public Safety Power Shutoff or PSPS?
Base: Total HFRZ Customers - 200; Total Non-HFRZ Customers - 220

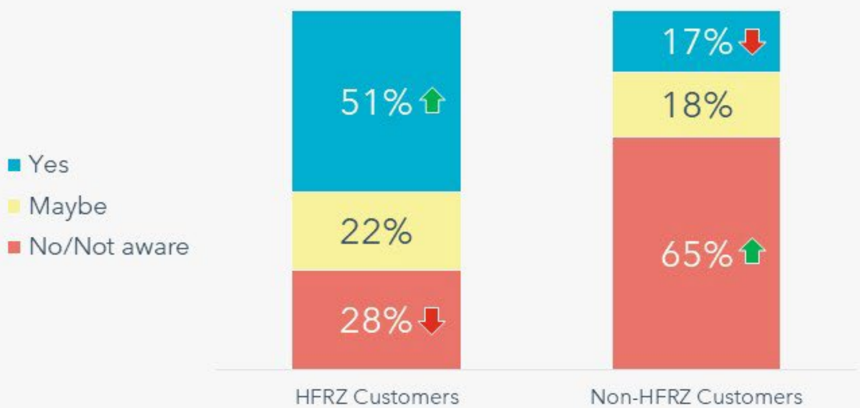
Significance testing at 90% Confidence Level

Awareness is High, but do Customers Feel They Know About PSPS?

- We asked customers if they thought they could explain the term to others and over 50% of HFRZ customers said they could confidently explain a PSPS. Another 22% thought they might be able to.
- Non-HFRZ customers were significantly less confident. Most were not aware of PSPS at all.

Would you say you know enough about the term to explain it to others?

**Percentages represent sample population*



Question text: Would you say you know enough about the term Public Safety Power Shutoff to explain it to others?
Base: Total HFRZ Customers - 200; Total Non-HFRZ Customers - 220

Significance testing at 90% Confidence Level

How do Customers Describe a PSPS?

- Customers that have heard of a PSPS tended to know what they were talking about when describing it.
  - Most included "fire" or "wildfire" in their explanations as well as the need for shutting power off to prevent them. It's important to note though that "Power Shutoff" was included in the question text. This may have hinted at its purpose, but customers were descriptive.

Word Frequency Ranking (Approx.)

	HFRZ Customers	Non-HFRZ Customers
1	Power	Power
2	Fire/Fires/Wildfire	Fire/Fires/Wildfire
3	Shut	Shut
4	High	Weather
5	Lines	High
6	Weather	Prevent
7	Wind/Winds	Risk
8	Conditions	Lines
9	Danger	Conditions
10	PGE	Wind/Winds

Word Cloud Key

Size = Frequency; Color = Group

Highest

Second

Third

Lowest

Question text: Could you give a brief example of the explanation you'd give about Public Safety Power Shutoffs? One or two sentences would be fine.
Base: HFRZ Customers Answering "Yes" or "Maybe" able to explain a PSPS - 145;
Total Non-HFRZ Customers Answering "Yes" or "Maybe" able to explain a PSPS - 76

Key:

HFRZ Customers | Non-HFRZ Customers

More PSPS explanations from customers…

Public Safety Power Shutoffs are done to keep people, wildlife & property safe during extreme weather conditions. Summer is a more dangerous time with the climate change that is happening. **Drier conditions, drought, high winds, thunder & lightening storms put us all at risk so when PGE feels the conditions are dangerous enough, they need to employ PSPS procedures**. Do I like it when it happens? Not particularly, but I understand the reasons why it is necessary & I prefer a little inconvenience if it will keep us all safer.

When the **temperature rises and there is a higher-than-normal wind predicted**, shutting off the power helps to prevent the increased risk of wildfires… **when in fact, the only risk you're worried about is the risk of litigation happening again**.

Public Safety Power Shutoff is when a power company cuts power to help **protect communities in high fire-risk zones by proactively shutting off electricity during extreme and dangerous weather conditions**.

I live less than a mile from where a downed line started a fire in Sept 2020. PSPS are used to help **prevent downed lines from starting fires during extreme weather events**.

PGE will **shut off power during extreme dry conditions/very low humidity along with wind** to protect against wildfires

The power is **shut off to the lines in a danger zone such as wildfires**. I believe it would keep the live lines from sparking new fires.

In **high wind or storms, sometimes the power needs to be shut off to prevent fires** from downed wires or arcing

Due to **natural or unnatural disasters** the utility company can **shut down service to avoid a most catastrophic situation**.

Sometimes the electric company might need to turn off power to an area to **reduce the risk of wildfires**.

If **conditions are dry and strong winds**, power could be turned off in case of fires starting with downed lines…?

It's a **proactive shut down** of the grid to prevent damage to the system or **wildfire ignition**

PSPS is when PGE has to **turn off power on parts of the grid to prevent harm**, for example turning off power **during high winds to avoid a wildfire**.

Question text: Could you give a brief example of the explanation you'd give about Public Safety Power Shutoffs? One or two sentences would be fine.
Base: HRZ Customers Answering "Yes" or "Maybe" able to explain a PSPS - 145;
Total Non-HRZ Customers Answering "Yes" or "Maybe" able to explain a PSPS - 76

When do Customers Think a PSPS Might be Called?

- HFRZ customers focused on the high winds as conditions for a PSPS while Non-HFRZ customers mentioned dry conditions more often.
- Regardless of the customer group, there was a high level of knowledge of conditions for a PSPS.

HFRZ Customers

Non-HFRZ Customers

Word Cloud Key
Size = Frequency; Color = Group
Highest
Second
Third
Lowest

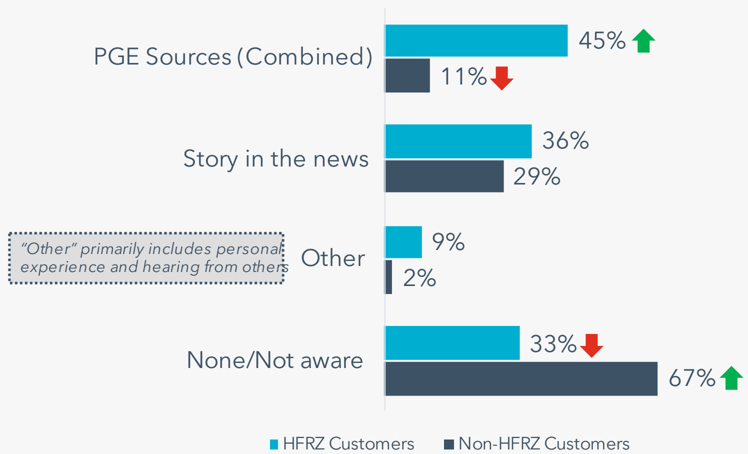
Question text: Based on this definition (PGE definition provided for a PSPS), what are some examples of conditions you would expect PGE to call a Public Safety Power Shutoff?
Base: Total HFRZ Customers - 200; Total Non-HFRZ Customers - 220

How Far is PGE's Reach with PSPS Information?

- For HFRZ customers, PGE has contributed the highest level of PSPS information. Email leads the way while the website and Wildfire Ready Events contribute, but to a smaller degree.
- Outside of not knowing, Non-HFRZ customers said the news was their primary source of information.

Do you recall where you've heard about Public Safety Power Shutoffs most recently ?

**Percentages represent sample population*



PGE Sources

**Percentages based to total respondents*

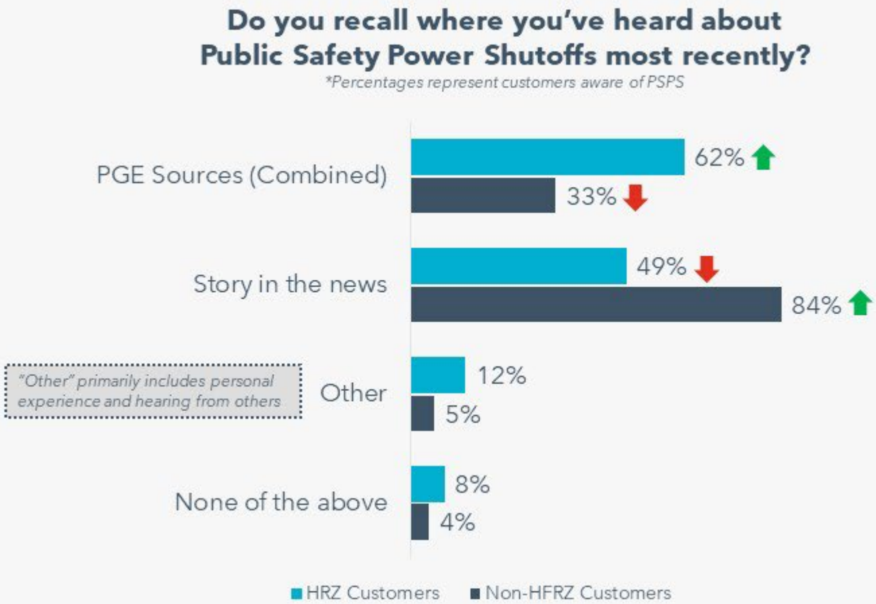
	HRZ Customers	Non-HRZ Customers
PGE Email	**35%** ↑	8% ↓
PGE Wildfire Ready Event	14% ↑	3% ↓
PortlandGeneral.com	13% ↑	4% ↓

Question text: Do you recall where you've heard about Public Safety Power Shutoffs most recently?
Base: Total HRZ Customers – 200; Total Non -HRZ Customers - 220

↑/↓ Significance testing at 90% Confidence Level

Focusing on Those Aware of PSPS, Where Does PGE Land?

- A very high proportion of Non-HFRZ Customers said that the news was a source of PSPS information. Only a third said PGE was a source.
- Even among Non-HFRZ Customers aware of PSPS, there is significant room to grow PGE's presence.



PGE Sources

Percentages represent customers aware of PSPS

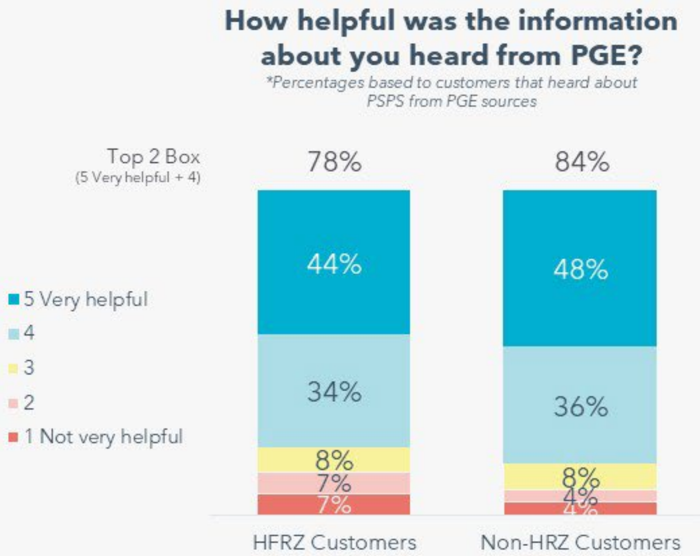
	HFRZ Customers	Non-HFRZ Customers
PGE Email	48% ⬆	22% ⬇
PGE Wildfire Ready Event	19% ⬆	9% ⬇
PortlandGeneral.com	18% ⬆	11% ⬇

Question text: Do you recall where you've heard about Public Safety Power Shutoffs most recently?
Base: HFRZ Customers Answering "Yes" or "Maybe" able to explain a PSPS - 145;
Total Non-HFRZ Customers Answering "Yes" or "Maybe" able to explain a PSPS - 76

⬆⬇ Significance testing at 90% Confidence Level

How Helpful is Information from PGE?

- When customers have gotten PSPS information from PGE, they have generally found it to be helpful. Over 75% gave a score of 4 or 5.
- A small proportion said PGE info was not helpful, but that may be tied to their dissatisfaction with PGE rather than the content being shared.



Explanations of PSPS

Information Helpfulness Scores of 1-3

This is an opportunity for PGE to shut power off in SW Portland and send it to California in collaboration with BPA as a façade for safety.

There's a fire/wind danger in your area, so we're going to shut your power down, sucker!!

PGE is more concerned about their liability than the impact on the public that they shut power down. The Loss of food in freezer and refrigerator are not their concern vs their image of protecting the public. But as with everything… follow the money.

A PSPS is PGEs way of not taking responsibility for their overhead lines. So rather than fix the problem they are just bailing on their customers, shutting off their power, and forcing customers to buy generators and install expensive transfer switches, all because PGE refuses to do what should have been done to begin with and PUT THE LINES UNDERGROUND

Public Safety Power shutoff is what PGE does to control the amount electricity used and will not reimburse you for damages caused at their expense. Example: freezers thawed and full of meat. Also, PGE will give you little to no notice before shutting off power, unapologetically.

Diplomatic B.S.

The power is shut off to prevent fires during wind events and dry conditions. Even though last time we barely had any wind, and it was off for days with very poor communication. It was complete ridiculous and poorly executed. If I had a choice, I would choose a different power company. We have way too many power outages as it is.

Question text: How helpful was the information about Public Safety Power Shutoffs you heard from PGE?
Base: HFRZ Customers Heard of PSPS from PGE Source - 145;
Total Non-HFRZ Customers Heard of PSPS from PGE Source - 76

Significance testing at 90% Confidence Level

PGE

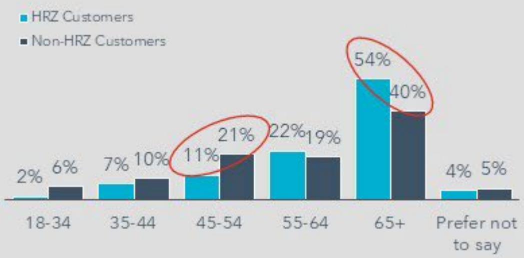
Demographics

Demographic Differences

PGE

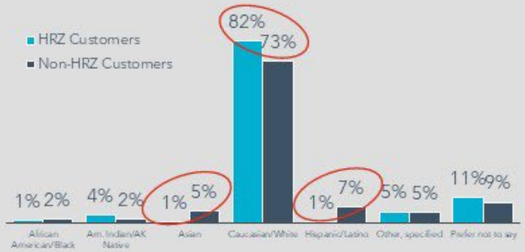
- Between the two sample groups, there were a few significant demographic differences. Demographics were less descriptive of differences in survey metrics than whether you lived in a High Fire-Risk Zone or not OR your recent outage experience.

Age



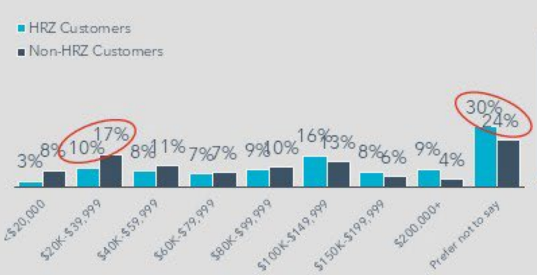
Age Highlights
- HFRZ customers are older than Non-HFRZ
- Significantly more likely to be 65+

Race/Ethnicity



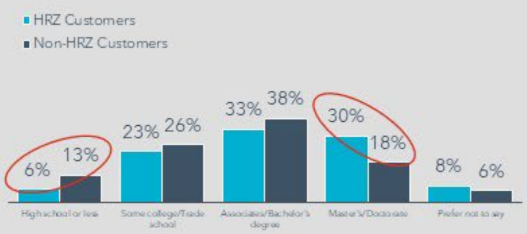
Race/Ethnicity Highlights
- HFRZ customers are more likely to be Caucasian/White
- Non-HRZ has higher representation of Asian and Hispanic/ Latino

Household Income



HHI Highlights
- Non-HFRZ customers are significantly more likely to have an HHI under $100K

Education



Education Highlights
- HFRZ customers are more likely to have a Master's/Doctorate
- Non-HFRZ more likely to have HS education or less

Base: Total HFRZ Customers - 200; Total Non-HFRZ Customers - 220

Significance testing at 90% Confidence Level

14.7 Appendix 7: Community and Stakeholder Engagement Metrics

PGE and the joint IOUs will continue to measure the effectiveness measures discussed during the 2023 WMP Recommendations workshop held August 22, 2023. These metrics address recommendation 18.

These metrics are indicators for the effectiveness of customer engagement campaigns, but they are not definitive and may be influenced by other factors. For example, customers who have been directly impacted by PSPS may have better recall of PSPS messaging and more likely to complete a PSPS video.

Table 30. Customer Campaign Metrics

Metric	Definition	Success Criteria	Justification for Inclusion
Social Media Engagement	Clicks/Impressions	Baseline average click through rate (CTR) for utility campaigns	Metric can identify how well customers are engaging with key messaging.
Video Completion Rate (VCR)	Video completion / clicks (a type of CTR)	Prior year's VCR for a category of video messaging.	Metric can identify how well customers are engaging with a particular campaign
Email Campaign	Count of emails successfully sent to customers.	Positive customer feedback from biannual engagement surveys.	Informs preferred direct customer communication medium.
Customer Bill Inserts	Count of bill inserts mailed to customers.	Positive customer feedback from biannual engagement surveys.	Informs preferred direct customer communication medium.
Phone Engagement	Count of inbound / outbound calls.	Call rate.	Used to identify customer concerns and overall call volume related to wildfire.
Face-to-face Engagement	In-person conversation.	Attendance at events and number of conversations.	Community outreach directly informs customers, and validates they are being heard.

14.8 Appendix 8: 2024 Wildfire Mitigation Plan Event Registry

Date	Event Name	Location
March 16, 2023	Northeast Multnomah County Community Association Board Meeting	Corbett, OR
April 10, 2023	Grand Ronde + PGE WMP	Virtual
May 10, 2023	Mount Hood Corridor Wildfire Partnership (MHCWP) Monthly Meeting	Welches, OR
May 10, 2023	Oregon Small Woodlands Association Meeting	Virtual
May 13, 2023	Mt. Hood 26 Corridor Wildfire Mitigation Fair	Government Camp, OR
May 18, 2023	PGE UAM Customer Meeting	Virtual
May 20, 2023	Wildfire Preparedness Weekend	Portland, OR
May 21, 2023	Wildfire Preparedness Weekend	Portland, OR
May 31, 2023	Estacada Community Wildfire Preparedness	Estacada, OR
June 5, 2023	Wildfire Ready	Virtual
June 6, 2023	Wildfire Ready	North Plains, OR
June 9, 2023	Wildfire Ready	Sandy, OR
June 12, 2023	Wildfire Ready	Sheridan, OR
June 14, 2023	Wildfire Ready	Virtual
June 15, 2023	Wildfire Ready	Mt. Angel, OR
July 20, 2023	Northeast Multnomah County Community Association Board Meeting	Corbett, OR
August 17, 2023	Portland Public Schools/PGE Heat/Smoke Events and Potential Power Outages	Virtual
September 26, 2023	Tonquin Project Community Meeting	Tualatin, OR
September 30, 2023	Tonquin Project Community Meeting	Wilsonville, OR
October 7, 2023	Woodburn Fire Department Open House and Safety Fair	Woodburn, OR
October 14, 2023	Gaston Fire Open House	Gaston, OR
October 15, 2023	Fire on the Mountain Film Festival	Government Camp, OR

14.9 Appendix 9: 2023 Public Safety Partner Event Registry

Date	Event Name	Location
February 6, 2023	RDPO Steering Committee	Virtual
February 15, 2023	What's Up, Estacada	Estacada, OR
March 6, 2023	RDPO Steering Committee	Virtual
March 16, 2023	OR Fire Resilience Learning Network	Salem, OR
March 21, 2023	RDPO PSPS Communications AAR	Virtual
March 22, 2023	2022 PSPS PSP Kickoff-1st Offering	Virtual
March 24, 2023	Pre-season Meeting at the NWCC	Portland, OR
March 29, 2023	2023 PSPS PSP Kickoff-2nd Offering	Virtual
April 3, 2023	East County Wildfire Workshop AAR	Virtual
April 6, 2023	PGE/Pano AI Summit	Wilsonville, OR
April 11, 2023	Pre-Season Meeting at the Portland NWS	Portland, OR
April 18, 2023	Bull Run CPO Meeting	Welches, OR
May 1, 2023	RDPO Steering Committee	Virtual
May 10, 2023	Mt Hood Corridor Wildfire Partnership	Zigzag, OR
May 26, 2023	PGE PSP PSPS Exercise Planning Meeting 1	Virtual
June 9, 2023	PGE PSP PSPS Exercise Planning Meeting 2	Virtual
June 21, 2023	PGE PSP PSPS Exercise/Prep Summit	Virtual
June 21, 2021	OR Fire Resilience Learning Network	Virtual
June 30, 2023	PGE PSP PSPS Exercise After Action Meeting	Virtual
July 12, 2023	Marion County Emergency Management Collaboration	Salem, OR
July 19, 2023	RDPO Regional Wildland Fire Project Presentation	Virtual
September 14, 2023	Lake Oswego Emergency Preparedness Fair	Lake Oswego, OR

14.10 Appendix 10: PGE Ignition Prevention Standards

The following is used by PGE's Utility Asset Management organization to assure a thorough and consistent ignition prevention inspection process for PGE assets.

1	Permanently out of service or abandoned electrical equipment
2	Blocked access roads to supporting structures
3	Abandoned/Coiled Service Wire Hanging from Pole
4	Broken Secondary Lashing Wire
5	Service/Primary Neutral Touching Guy, Transformer or Pole
6	Damaged, Broken or Frayed Power Conductor
7	Broken/Cut/Missing Ground
8	Broken Communication Mainline Lashing Wire
9	Broken Power Insulator or Tie Wire
10	Slack, Corroded, or Broken Power Guy
11	Anchor Pulled Loose / Not Holding
12	Crossarm Brace Damaged / Broken, Missing, or Loose
13	Damaged/Broken/Corroded/Loose Distribution Hardware and Connectors
14	Equipment Leaking Oil–Transformer, Regulator, etc.
15	Damaged/Broken Cutout, Lighting Arrestor, or Similar Pole-mounted Equipment
16	Damper Damaged, Slipped, or Missing
17	Service or conductor attached to tree
18	Midspan Horizontal Clearance to Unattached Pole per NESC requirements
19	Missing Cotter Key, Insulator Nut, or Other Line Hardware
20	Power hardware, including transmission, not properly grounded/bonded
21	Midspan Vertical (pole-to-pole)
22	Midspan Horizontal Primary (Conductor Close to Building or Sign per NESC Requirements)
23	Midspan Vertical
24	Low Transmission or Primary Conductor Close to Neutral, Secondary or Communications or Other Equipment/Conductors per NESC Requirements
25	Midspan Vertical–Power Over Drivable Surface
26	Midspan Vertical–Power over Driveway or Pedestrian Surface
27	Midspan Vertical–Communications over Drivable Surface
28	Overloaded Pole
29	Damaged or decayed pole
30	Severely leaning or washed out pole
31	Vegetation: hazard trees, limbs laying on conductor, impaired clearances to vegetation, tree limbs burning or burned in
32	Crossarm Damaged/Broken

14.11 Appendix 11: Definitions of Failure and Impact Probability

Likelihood of Failure Definitions	
Improbable	The tree or branch is not likely to fail during normal weather conditions and may not fail in many severe weather conditions within the specified period.
Possible	Failure could occur, but it is unlikely during normal weather conditions within the specified period.
Probable	Failure may be expected under normal weather conditions within the specified period.
Imminent	Vegetation has come in contact with or caused damage to electric facilities; or pruning or removing the vegetation is necessary to protect life or property or restore electric service.
Likelihood of Impact Definitions	
Very Low	The chance of the failed tree or branch impacting the specified target is remote.
Low	Not likely that the failed tree or branch will impact the target. This is the case in a constant target that is well protected from the assessed tree.
Medium	The failed tree or branch may or may not impact the target, with nearly equal likelihood. This is the case in a constantly occupied area that is partially protected from the assessed tree.
High	The failed tree or branch will most likely impact the target. This is the case when a fixed target is fully exposed to the assessed tree or near a high-use road or walkway with an adjacent street tree.

14.12 Appendix 12: Joint IOU Rubric Evaluation and Development

On August 22, 2023, PGE, Idaho Power Company, and PacifiCorp met with OPUC Safety Staff to discuss recommendation 29 from OPUC Order 23-221. Staff recommended PGE and joint utilities evaluate the CPUC WSD maturity model and develop an Oregon IOU rubric as part of their 2024 WMPs. Staff welcomed the opportunity to participate in such a collaborative work effort.

The Joint IOUs with Staff approval, invited leadership from IWRMC to discuss their experiences with CPUC Wildfire Safety Division (WSD) Utility Wildfire Mitigation Maturity Model and how the IWRMC maturity model compares and contrasts. The outcome of the meeting was acknowledgement that PGE and joint utilities had evaluated CPUC Utility Wildfire Mitigation Maturity Model and secured agreement with Staff to incorporate the IWRMC Maturity Model as the basis of an Oregon IOU rubric.

The IWRMC Maturity Model is comprised of 50 Key Capabilities organized into 10 broad categories as shown in Figure 35, Overview of Key Capabilities. Each Key Capability has been defined in a detailed manner, with examples provided for each scoring level.

Maturity Category	Key Capabilities					
A. Risk assessment and mapping	1. Estimation of ignition probability	2. Estimation of wildfire consequences	3. Estimation of wildfire and pre-emptive power shutoff risk-reduction impact	4. Climate/Weather scenario modeling and sensitivities	5. Risk maps and simulation algorithms	
B. Situational awareness and forecasting	6. Weather variables utilized	7. Weather data resolution	8. Weather forecasting	9. Weather vulnerability and damage prediction	10. Wildfire detection	
C. Grid design and system hardening	11. Prioritization and justification of wildfire risk mitigation grid design/ system hardening initiatives	12. Grid design for minimizing ignition risk	13. Grid design for resiliency and minimizing pre-emptive power shutoffs (if applicable)	14. Risk-based grid hardening and cost efficiency	15. Evaluation and Deployment of Technology & Innovations	
D. Asset management and inspections	16. Asset inventory and condition assessments	17. Asset inspection cycle	18. Asset inspections & diagnostic effectiveness	19. Asset maintenance and repair efficiency, effectiveness, and compliance	20. QA / QC for asset management	
E. Vegetation management and inspections	21. Vegetation inventory and condition assessment data	22. Vegetation analytics & diagnostic effectiveness	23. Vegetation grow-in inspection and trimming / treatment process & cycle times	24. Vegetation fall-in / hazard inspection and mitigation process & cycle times	25. Fuel Load Management	26. QA / QC for vegetation management
F. Grid operations and protocols	27. Protective equipment and device settings	28. Incorporating ignition risk factors in grid control	29. Pre-emptive power shutoff operating model and consequence mitigation (if applicable)	30. Pre-emptive power shutoff initiation protocols (if applicable)	31. Pre-emptive power shutoff re-energization protocols (if applicable)	32. Ignition prevention and suppression
G. Data governance	33. Data quality and comprehensiveness	34. Data management	35. Data democratization & literacy	36. Data & cyber security	37. Analytic solutions	
H. Resource allocation methodology	38. Benefit-cost assessment and scenario analysis	39. Portfolio-wide initiative allocation methodology	40. Portfolio-wide innovation in new wildfire initiatives	41. Wildfire Organization design, resourcing, and skills		
I. Emergency planning and preparedness	42. Wildfire plan consistency with overall disaster / emergency plan	43. Plan to restore service after wildfire related outage	44. Emergency community engagement during and after wildfire	45. Protocols in place to learn from wildfire events	46. Processes for continuous improvement after wildfire and pre-emptive power shutoffs (if applicable)	
J. Stakeholder cooperation and community engagement	47. Data and practices sharing, and cooperation with external stakeholders	48. Engagement with communities and stakeholders on wildfire mitigation planning and mitigation initiatives	49. Engagement and communication with disadvantaged populations	50. Collaboration with emergency response agencies		

Figure 34. Overview of Key Capabilities

A significant difference between the IWRMC Maturity Model and that of the CPUC relates to the incorporation of a Risk Exposure element. The IWRMC approach considers the objective level of wildfire risk the utility faces and adjusts the scoring scale in accordance with this level. Without this adjustment, utilities may invest in technologies and approaches that may deliver marginal risk reduction at a disproportionate cost. Figure 35, is a graphical representation of how Wildfire Risk Exposure can be compared to Wildfire Risk Mitigation Capability to provide alignment on where to focus efforts due to risk and maturity.

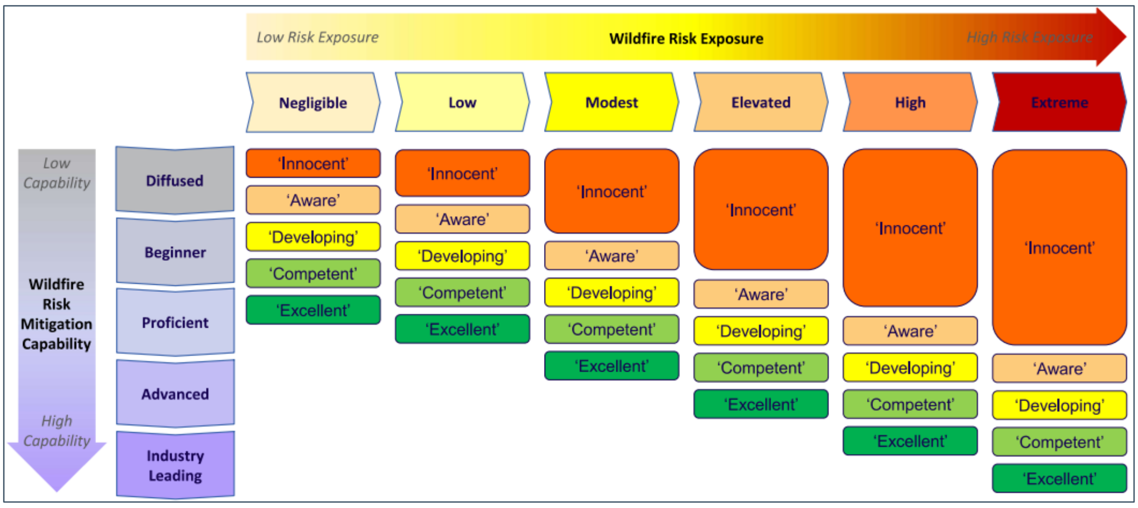


Figure 35. Wildfire Risk Exposure vs. Wildfire Risk Mitigation

Recognizing that accurately evaluating the more than 250 elements of the IWRMC Maturity Model as well as jointly developing the framework, governance, and structure to fully implement a sustainable, value-add maturity model will take time, PGE and the joint utilities propose the following.

The proposed Oregon Maturity Model timeline, Figure 36, is broken into four elements in 2024 to align on results-oriented outcomes while utilizing a pilot to test the value prior to fully incorporating the process in 2025.

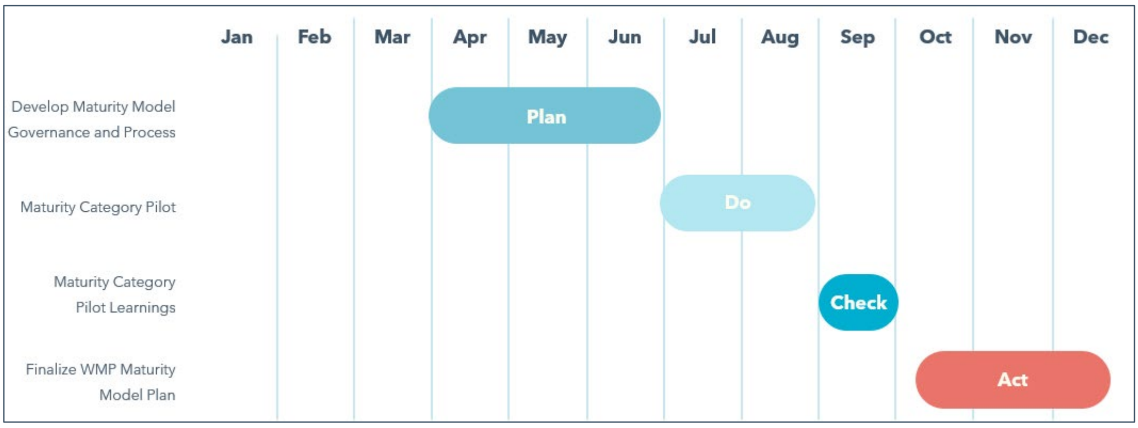


Figure 36. Oregon Maturity Model Timeline

Table 31. Schedule Elements

Schedule Element	Description
Develop Maturity Model Governance and Process	Overall structure of the Maturity Model program. How the maturity model will be used. Development of annual maturity model schedule. Engagement on reviewing results and sharing learnings.
Maturity Category Pilot	PGE chooses a Maturity Category to pilot. Completes Risk Assessment. Completes Maturity Category Survey.
Maturity Category Pilot Learnings	PGE and OPUC Safety Staff discuss Maturity Category Pilot results and learnings. PGE and OPUC Safety Staff adjust as necessary to the Governance and Process model.
Finalize WMP Maturity Model Plan	PGE incorporates Maturity Model Governance and Process into 2025 WMP. PGE includes 2025 plan to evaluate all Maturity Categories.

PGE/318

Daisy Caballero, KGW8, PGE to Add More AI Cameras, Including One in Timberline Lodge on Mount Hood, to Detect Wildfires

(July 20, 2023)

PCN 6 / PGE / 318
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WILDFIRE

PGE to add more AI cameras, including one in Timberline Lodge on Mount Hood, to detect wildfires

Portland General Electric already has 27 of these high-def AI cameras throughout the Portland area.

Author: **Daisy Caballero**
Published: **7:55 PM PDT July 18, 2023**
Updated: **10:16 AM PDT July 20, 2023**

PORTLAND, Ore. — Portland General Electric (PGE) has partnered with Pano AI for the last two years. A company that deploys mountaintop cameras that use artificial intelligence (AI) to detect active smoke and wildfires in a minimum 10-mile radius.

The utility company just announced they will add six more AI cameras east of the Cascades.

“We take ultra high definition security cameras and we rotate them 360 degrees every minute,” said Sonia Kastner, CEO of Pano AI. “And then we transmit the data to the cloud using modern communication technology like 5G cellular technology. We then take that data and analyze it, our AI algorithms look for the first wisps of smoke. Then smoke detections are reviewed by a human to make sure there are no false positives.”

PGE currently has 27 of these cameras. They’re typically atop communication towers throughout the greater Portland metro area. Their first new camera will be installed at the Timberline Lodge on Mount Hood.

“It has brought together the fire agencies, the utilities and the private space together in a way to try and tackle this issue as a ‘we’ problem,” said Dan Nunez, manager of wildfire planning and analytics at PGE. “It has been an incredible journey at this point with [Pano AI]. We have been able to get more people on board. From a partnership perspective, it has gone excellent.”

The overall goal here is to give PGE and fire districts a better way to minimize fire threats and track down a blaze. As the AI camera pinpoints the exact fire location and sends a push notification to your cell phone or email — with a clip of the wildfire detection and its location. It also knows the difference between steam, fog and smoke.

The Clackamas Fire District is beyond thankful for this as they’ve already used the new technology first hand.

“I really do truly believe that it’s a game changer for the fire service,” said Phil Schneider, division chief for Clackamas Fire Dist. 1. “We’re getting early detection, we only run off of time and if we can lessen the time to get to that scene it’s going to be a good outcome.”

Each location has two cameras that have a 180-degree view. But they work together to create a panoramic perspective. Giving fire districts and PGE a better insight of what actively going on.

"As crews are able to be dispatched in real time I think we'll see over and over again that it will be saving homes and lives," said Nunez.

Oregon, California, Colorado, Washington, Idaho and Montana are the six states already using this camera technology. Alongside two Australian states — New South Wales and Queensland.

Related Articles

Washington to combat wildfire threats with artificial intelligence technology

Tech company partners with T-Mobile to detect Oregon wildfires

Here's how Oregon power companies are adapting to the reality of wildfire weather

T-Mobile teams up with a tech company to detect wildfires using its 5G technol...

PGE/319

2022 PSPS Annual Report

December 30, 2022

Via Electronic Filing

Public Utility Commission of Oregon
Attention: Filing Center
P.O. Box 1088
Salem, OR 97308-1088

RE: UM 2268 - 2022 Public Safety Power Shutoff (PSPS) Annual Report

Dear Filing Center:

Please find attached the Portland General Electric Company ("PGE") 2022 Public Safety Power Shutoff (PSPS) Annual Report which is being submitted as required per Oregon Administrative Rule 860-300-0070(1).

Due to extreme fire weather conditions across the service territory, PGE performed one PSPS in 2022, which began on September 9, 2022 at 0247 with the first de-energization, and concluded on September 11, 2022 at 2212 with the last customer restoration. This report includes a narrative description of this PSPS event, information, and data to support the narrative, and lessons learned over the entirety of the event. Additionally, this report will be made available on PGE's website in its entirety as it does not contain confidential information.

PGE looks forward to Staff's review of the PSPS Annual Report. Please direct all formal correspondence and requests to the following email address pge.opuc.filings@pgn.com.

Respectfully Submitted,
/s/ W. M. Messner

William M. Messner
Director Wildfire Mitigation & Resiliency

Public Safety Power Shutoff (PSPS) 2022 Annual Report

Portland General Electric Company (PGE)

Summary

PGE submits its 2022 Annual PSPS Report in compliance with Oregon Administrative Rule (OAR) 860-300-0070(1), Reporting Requirements for Public Safety Power Shutoffs (PSPS), as stated below. In addition, per OAR 860-300-0070(2) the report has been posted to PGE's website.

(1) The Public Utility is required to file annual reports on de-energization lessons learned, providing a narrative description of all PSPS events which occurred during the fire season. Reports must be filed no later than December 31st of each year.

(2) Non-confidential versions of the reports required under this section must also be made available on the Public Utility's website.

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Acronyms

BCEM: PGE's Business Continuity & Emergency Management organization
CET: PGE's Customer Experience Team
CIMT: PGE's Corporate Incident Management Team
CRC: Community Resource Center
EOC: Emergency Operations Center
ERC: Energy Release Component
ERT: Estimated Restoration Time
ESF-12: The Public Utility Commission of Oregon's Emergency Support Function-12
GIS: Geographic Information System
HFRZ: High Fire Risk Zone
IC: Incident Commander
LWF: Lead Working Foreman
MRU: Mobile Response Unit (trailers used during CRC deployment)
NWS: National Weather Service
ODF: Oregon Dept. of Forestry
ODHS: Oregon Dept. of Human Services
ODOE: Oregon Dept. of Energy
ODOT: Oregon Dept. of Transportation
OIC: Officer-In-Charge
OPUC: Public Utility Commission of Oregon
PAT: The CIMT's PSPS Assessment Team
PGE: Portland General Electric
PIO: Public Information Officer
POA: Preventative Outage Area.
PSPS: Public Safety Power Shutoff
QEW: Qualified Electrical Worker
RFW: Red Flag Warning (issued by the NWS)
WEA: Wireless Emergency Alert

Glossary

Cutsheet: Written instruction sheets provided to field operations personnel charged with executing a PSPS event, describing the actions required to operate devices that control the flow of power through the PGE transmission and distribution systems. The cutsheet (also called a switching sheet) authorizes field personnel to take the actions required to de-energize the PSPS Area, affecting the operation, protection, and/or reliability and connectivity of electrical equipment.

Earned Media: Any material written about a person or business that they haven't paid for or created themselves.

High Fire Risk Zone (HFRZ): Identified areas of the PGE service territory that are subject to a heightened risk of wildfires.

NOTE: "HFRZ" and "PSPS Area" are not equivalent terms – there are geographic differences between the HFRZs and the PSPS Areas that overlap them.

Preventative Outage Area: Like PSPS Areas, POAs are areas of PGE's service territory that are de-energized to protect against potential utility-caused ignitions during a period of extreme wildfire risk. Unlike PSPS Areas, POAs are identified during (rather than prior to) potential PSPS events, based on changing meteorological conditions and system topology.

PSPS Areas: Map the PGE infrastructure impacted by the shutdown -- the total area, both inside and outside a given HFRZ, where customers and facilities will lose power during a PSPS event. The activities described in this Report are focused primarily on the PSPS Areas.

Public Safety Power Shutoff: A temporary, pre-planned de-energization of a portion of a utility's infrastructure during periods of extreme fire danger to prevent the electrical system from becoming the source of an ignition which could endanger communities, residents and the power grid.

Utility-Identified Critical Facilities: Facilities PGE identifies that, because of their function or importance, have the potential to threaten life safety or disrupt essential socioeconomic activities if their services are interrupted. Communications facilities and infrastructure are considered Critical Facilities.

Executive Summary

PGE's top priority is the safety of the customers and communities in our service territory. PGE executes a Public Safety Power Shutoff (PSPS) as a last resort when severe fire potential and meteorological conditions increase the risk of utility-caused ignitions and wildfire. PGE understands that turning off power causes significant challenges and hardships for customers and communities and takes this decision seriously.

PGE executed only one Public Safety Power Shutoff (PSPS) event during the 2022 Wildfire Season. Beginning on September 6 through September 12, 2022, PGE executed a PSPS event in response to the National Weather Service (NWS) Red Flag Warnings and hazardous fire potential conditions across its service territory. The September 2022 PSPS event impacted all 10 of PGE's identified High Fire Risk Zones (HFRZs), as well as an additional seven Preventative Outage Areas (POAs) that were de-energized in response to observed meteorological and topological conditions.

In response to fire potential and meteorological conditions including wind, temperature, humidity and fuel moisture content measurements, PGE de-energized the first PSPS Area at 0247[1] on Sept. 9, and de-energized the final segment of its grid (POA 7, in the Sandy area) at 0406 on Sept. 10. Wind and other hazardous conditions began to subside later in the morning of Sept 10, and restoration crews were dispatched to inspect the de-energized feeders and repair any damage prior to restoring power. The event impacted a total of 34,994 customer meters, including 599 Utility-Identified Critical Facilities. PGE delivered PSPS notifications before, during and after the event via multiple communication channels and platforms, established six Community Resource Centers (CRCs) and provided support to affected counties to operate eight additional CRCs. By 2212 on Sept. 11, PGE crews had fully restored power to all 10 PSPS Areas and all seven POAs.

This report summarizes the execution and outcome of the September 2022 PSPS event. It provides an incident overview and describes PGE's processes for PSPS decision-making; PSPS notifications; PGE's engagement before, during, and after the PSPS event with Public Safety Partners, Tribal, State and local governmental entities, and operators of Utility-Identified Critical Facilities; operations during the restoration phase of the event; and lessons learned – both strengths of PGE's response and opportunities for improvement. The report also summarizes metrics of successful execution for all of the above.

[1] During the PSPS event, PGE recorded data and event activity using 24-hour time notation: e.g.: 0247= 2:47 am; 2212= 10:12 pm. 24-hour time notation is used throughout this report.

1 Incident Overview

During the period of Sept. 9-11, 2022, critical fire weather conditions led to a PGE PSPS that de-energized all 10 of PGE's identified HFRZs and seven additional POAs identified during the event, as shown in Figure 1. Please Refer to Appendix 1 for a description of the 10 PGE HFRZs.

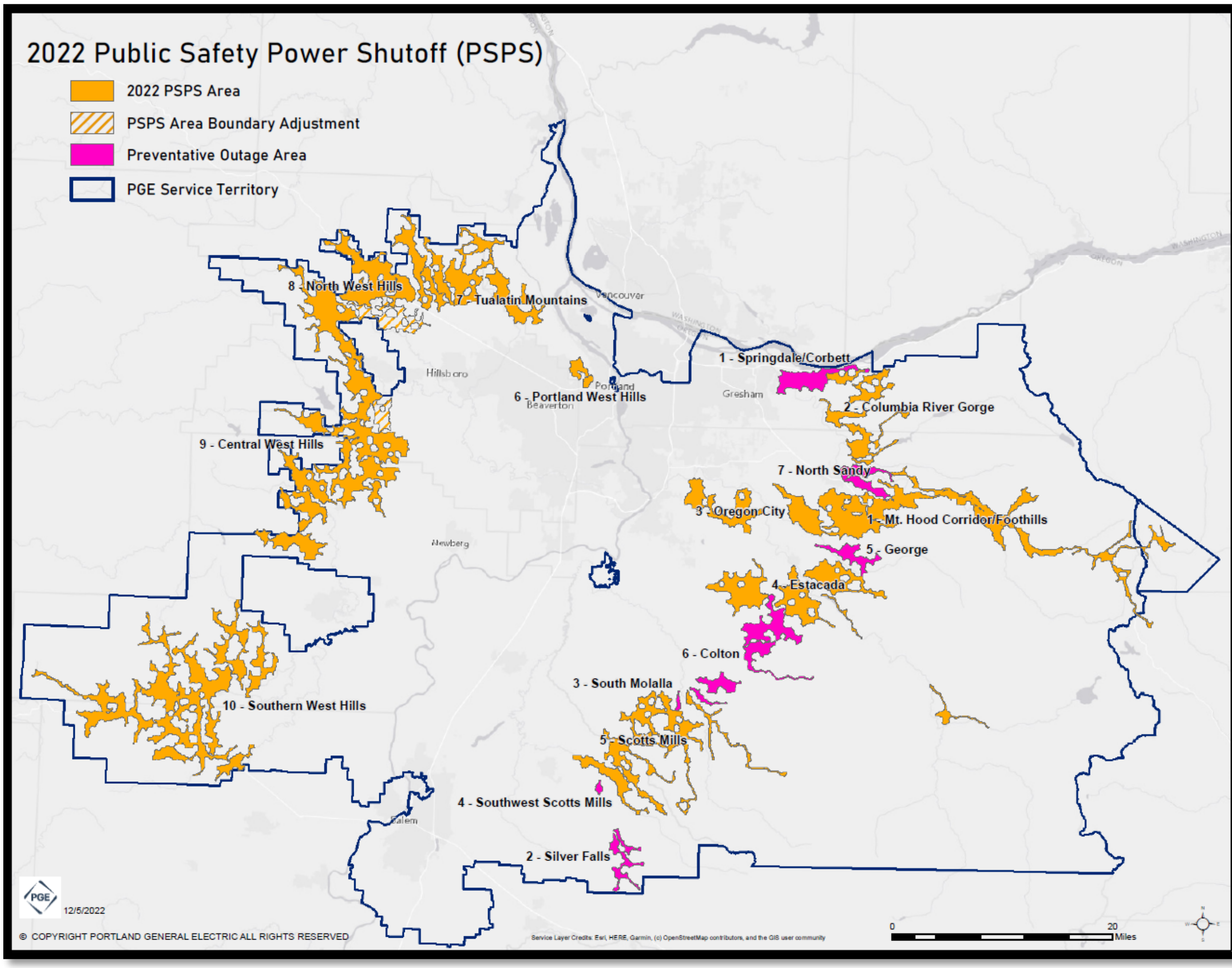


Figure 1: Map of Public Safety Power Shutoff Area & Preventive Outage Areas

As shown in the PSPS Event Timeline (Figure 2), the event began with the de-energization of PSPS Area 1 and POA 3 at 0247 on Sept. 9. It ended with the restoration of power to PSPS Areas 1 and 4 at 2212 on Sept. 11. The longest outage duration was 68 hours in PSPS Area 1 and the shortest was 33 hours in PSPS Area 6:

Figure 2: PSPS Event Timeline

PSPS Area	*Dur Hrs.	12/9/2022 0001-1200	12/9/2022 1201-2400	12/10/2022 0001-1200	12/10/2022 1201-2400	12/11/2022 0001-1200	12/11/2022 1201-2400
POA 3 (South Molalla)	65						
PSPS Area 1 (Mt. Hood	68						
POA 2 (Silver Falls)	59						
POA 1 (Springdale/Corbett)	63						
PSPS Area 2 (Columbia River Gorge)	62						
PSPS Area 4 (Estacada-Faraday)	62						
PSPS Area 5 (Scotts Mills)	55						
POA 4 (Southwest Scotts Mills)	54						
PSPS Area 3 (Oregon City-S. Redland)	54						
PSPS Area 6 (Portland West Hills)	33						
PSPS Area 7 (Tualatin Mountains)	55						
PSPS Area 8 (North West Hills)	52						
PSPS Area 9 (Central West Hills)	53						
PSPS Area 10 (Southern West Hills)	51						
POA 5 (George)	41						
POA 6 (Colton Area)	33						
POA 7 (Sandy Area)	40						

*Duration of Outage in Hours: (+/-) 1-hour

As shown in Figure 3, below, the September 2022 PSPS event impacted 34,994 customer meters (including 599 meters at PGE-Identified Critical Facilities) at the peak of the event.

Figure 3: Customer and Critical Facility Meters Impacted

PSPS Number	PSPS Name	Total Customer Meters	Critical Facility Meters
1	Mt. Hood Corridor/Foothills	9296	174
2	Columbia River Gorge	524	10
3	Oregon City-S. Redland	1677	39
4	Estacada-Faraday	2442	51
5	Scotts Mills	1752	22
6	Portland West Hills	845	43
7	Tualatin Mountains	1510	21
8	North West Hills	3157	37
9	Central West Hills	4684	61
10	Southern West Hills	5911	103
PSPS Totals		31798	561
POA Number	**POA Name**		
1	Springdale/Corbett	886	14
2	Silver Falls	200	2
3	South Molalla	124	0
4	Southwest Scotts Mills	28	1
5	George	243	1
6	Colton Area	1060	14
7	Sandy Area	655	6
POA Totals		**3196**	**38**
PSPS/POA Totals		34994	599

The monitoring, planning and notifications phases of the September 2022 PSPS event began on Tuesday, Sept. 6, when the National Weather Service (NWS), and PGE meteorologists began forecasting critical fire weather conditions (heat, low relative humidity and fuel moisture content, with strong offshore winds) throughout PGE's service territory. The extreme weather conditions were expected to begin Friday, Sept. 10.

At 0800 on Sept. 6, PGE placed its Corporate Incident Management Team (CIMT) on standby. PGE activated its PSPS Assessment Team (PAT) and convened the group's initial briefing at 1100 that day. At 1500, PGE fully activated its CIMT, with the first full CIMT shift beginning at 0600 on Sept. 7. PGE's Business Continuity & Emergency Management (BCEM) team established the Emergency Operations Center (EOC) for the event at PGE's Integrated Operations Center. At 1300 on Sept. 7, PGE's Incident Commander (IC) escalated PGE's posture to Level 3 – Elevated (PSPS Likely).

By Thursday, Sept. 8, weather models throughout the region confirmed the forecast of steady east-northeast winds of 10-25 mph with gusts up to 55 mph on exposed ridges from the Cascades to the Coast Range, beginning at midnight on Sept. 9. The NWS issued Red Flag Warnings (RFW) impacting all 10 of the HFRZs identified in PGE's 2022 Wildfire Mitigation Plan.

During the course of the September PSPS event, in partnership with PGE's Public Safety Partners, the CIMT identified seven additional POAs (listed below) -- preventive power outages to help reduce the risk of wildfire. These areas were at high risk of fire given unique and extreme weather conditions, including strong wind gusts of up to 35-40 MPH.

Preventative Outages Areas (POAs) -- September 2022 PSPS Event

1. Springdale/Corbett
2. Silver Falls
3. South Molalla
4. Southwest Scotts Mills
5. George
6. Colton
7. Sandy

Meteorological conditions manifested as forecasted in the early morning hours of Sept. 9, triggering PSPS execution and causing wind damage to PGE infrastructure. High winds began to subside by the morning of Sept. 10, and field crews were able to begin patrolling, inspecting lines, making necessary repairs, and restoring power to the impacted areas.

Based on the best available data at the time, PGE reported that the peak number of customer meters out due to PSPS was approximately 37,000. During an active event PGE's outage management systems are being updated through multiple channels. Because of this challenge, we have standard outage classification clean-up and correction processes that provide a more accurate number after the event. As PGE continued to correct outage classification data following the PSPS event, the more accurate number proved to be approximately 35,000 customer meters de-energized. The original 37,000 peak count included customer meters located outside the PSPS Areas which were out due to other factors (e.g., weather, equipment failure, and vegetation causes).

During the peak of the power restoration on Sunday, Sept. 11, PGE deployed nearly 500 operational personnel, including 112 PGE contractors and mutual assistance crew members. Severe meteorological conditions generated 96 wire-down repairs, 21 transformer replacements, and 11 pole replacements across PGE's service territory. Power was fully restored to all impacted PSPS Areas and POAs by 2212 on Sept. 11. Figure 4 summarizes PSPS operational statistics from the event:

Figure 4: PSPS Operational Statistics

Customer Call Stats	Statistic
Calls Offered to Advisors	22,558
Calls Answered by Advisors	21,707
Abandoned Calls	851
Escalated calls	770
Call Center Staff – Peak Calls	147
Community Resource Centers	
Customers Assisted	2,500 (approximation)
Cases of Water Distributed	800 (approximation)
Bags of Ice Distributed	3,200 (approximation)
Employees who worked at center	50
Mutual Assistance Crews	
BC Hydro – Distribution Crews	2
Snohomish PUD – Distribution Crews	2
Avista – Distribution Crews	2
PG&E Contract Crews – Distribution Crews	10
Contract Crews	
Contract Dock Crews	19
Number of Crews Worked Event	
Circuit Captains	11
Line Crews	104
Vegetation Management Crews	96
Safety	
Minor Injuries/First aid needed	0
Minor Vehicle Incident	1
Equipment Repaired or Replaced	
Poles Replaced	11 ea.
Wire Cable Replaced	3955 ft.
Transformers Replaced	21 ea.

2 Decision-Making Process

2.1 PGE's PSPS Decision-Making Process

During its declared Fire Season, PGE closely monitors and communicates regional weather and wildfire situation/status to operational leadership. Through real-time situational awareness monitoring, PGE can tailor operational and system changes during fire season, thereby increasing safety and operational efficiency.

Year-round, PGE conducts a Daily (Monday-Friday) Operations Call, expanded to include weekend briefings during periods of extreme fire hazard conditions. During PGE-declared fire season, this daily briefing includes, but is not limited to:

- Fire weather forecasts and fire potential specific to PGE's service territory
- Reporting of National Weather Service (NWS)-issued Fire Weather Watches and/or Red Flag Warnings
- Summary of current regional fire activity
- Discussion of PGE's current PSPS Decision Level (if applicable).

The figure below provides a visual overview of PGE's typical operations during the various phases of a PSPS event.

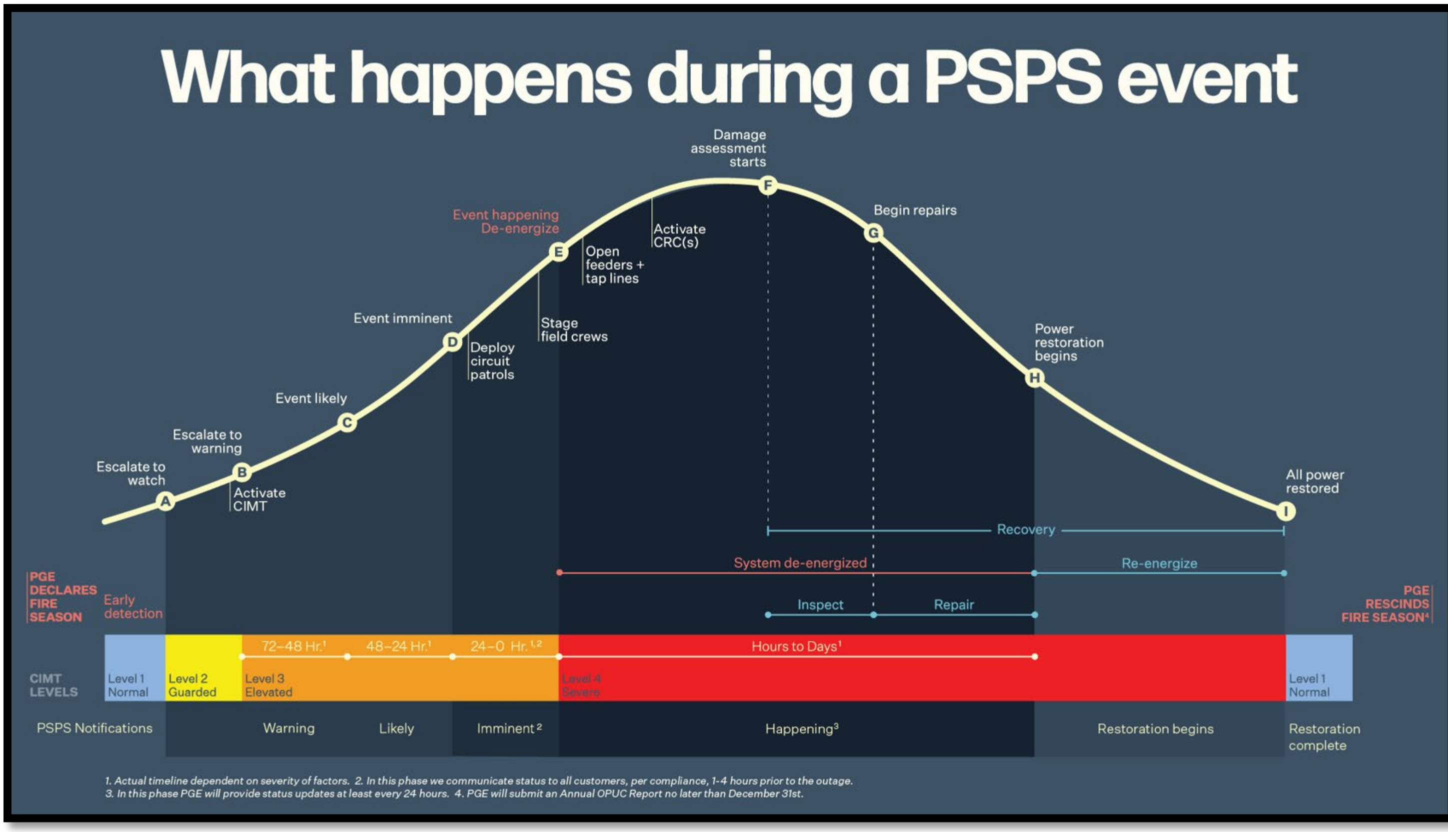


Figure 5: PSPS Event Levels

PGE closely monitors changing or deteriorating weather conditions, regularly communicating critical updates to affected business units and exchanging information and updates with external Public Safety Partners such as fire agencies, district foresters, and dispatch centers. These partnerships provide PGE with specific, granular situational awareness, assistance with forecast modeling validation, fire suppression resource pre-positioning, and activity/growth updates for fires in proximity to PGE assets.

2.2 PSPS Incident Flow/Cadence

As illustrated in Figure 2, the PSPS decision-making and operational process initiates when PGE escalates from Level 1 – Normal to Level 2 – Guarded (PSPS Watch). At each phase in the PSPS process, PGE initiates required communications with Public Safety Partners, the ESF-12, customers, and stakeholders.

No single factor dictates PGE's decision to initiate a PSPS – the de-energization decision is based on a consideration of multiple environmental conditions. PGE's Director of Wildfire Mitigation & Resiliency (WM&R) makes the decision to escalate to Level 2 – Guarded (PSPS Watch), taking into consideration information provided in the Daily Operations Call, among other factors[2]. At this time, the Corporate Incident Management Team (CIMT) activates its PSPS Assessment Team (PAT).

Once the escalation to Level 2 -- Guarded has taken place, the CIMT Incident Commander (IC) is responsible for the decision to escalate to Level 3 – Elevated (PSPS Warning). This occurs when meteorological and fire potential assessments indicating a high potential for increased wildfire risk remain constant or escalate. Escalation to Level 3 -- Elevated means that a PSPS event is possible within the next 72 hours. PGE's Public Information Officer (PIO) function is activated (and initiates communications processes) at the Level 3 -- Elevated stage, as is the full CIMT.

The Elevated level is divided into three sequential, time-boxed phases, each representing an escalated state of readiness. At each of these phases, PGE issues notifications guided by the recipient lists, content specifications and timelines required under OAR 860-300-0050.

- **PSPS Warning**: 72-48 hours prior to de-energization
- **PSPS Likely**: 48-24 hours prior to de-energization
- **PSPS Imminent**: 4-1 hours prior to de-energization

[2] Meteorological conditions, fire potential indices, fuel and fire behavior advisories, Haines Index values, and the ODF's Significant Fire Potential ratings all play a role in the escalation/de-escalation decision.

If environmental conditions stay the same or continue to deteriorate, the IC, in consultation with the CIMT, PGE Operations, Director of WM&R and others, will recommend escalation to Level 4 – Severe (PSPS Event) and propose a de-energization time. The IC will ask the PGE Officer-In-Charge (OIC) for final approval for de-energization.

2.3 Decision-Making During the September 2022 PSPS Event

PGE assessed data (wind, temperature, fuel moisture, and relative humidity) from 59 PGE and regional weather stations across its service territory during the decision-making process leading up to the September 2022 PSPS event. By Sept. 6, conditions on the ground, combined with meteorological forecasts from multiple sources, indicated that all PGE HFRZs were on track to reach the pre-established factors triggering an escalation to Level 2 -- Guarded (PSPS Watch) status.

By Thursday, Sept. 8, models throughout the region confirmed the forecast of steady east-northeast winds of 10-25 mph with gusts up to 55 mph on exposed ridges from the Cascades to the Coast Range, beginning at midnight on Sept. 9. The NWS issued Red Flag Warnings (RFW) impacting all 10 PGE HFRZs. Forecasted meteorological conditions materialized in the early morning hours of Sept. 9, and PGE began PSPS execution.

By 1800 on Sept. 9, wind gust measurements in nine of the 10 HFRZs averaged 22.9 mph. Average fuel moisture content was at the lowest point observed in more than 12 months, six times lower than average for this point in the season. Daytime relative humidity showed an average value of 17 percent across the 10 HFRZs. Wind gusts eventually reached 52 mph in some areas of PGE's service territory.

In addition to the observed and forecasted fire weather conditions, PGE's situation/status (internal) briefings and Public Safety Partner (external) coordination calls confirmed that other conditions would continue to escalate over the next 24 hours, including fuel modeling, Critical Burn Environment, and Oregon Department of Forestry (ODF) fire potential risk levels. During the period of the PSPS event, ODF's Energy Release Component (ERC) index, one of the most significant PSPS data points, neared historic highs for the Northwest Oregon and North Cascades regions, exceeding ODF's "Extreme Risk" criteria.

Figure 6: Local News - Red Flag Warning

3 De-Energization Time, Place, and Duration

Early in the first week of September 2022, PGE's operational departments began preparing for a potential PSPS event later in the week.

PGE's Line Operations organization collaborated with personnel at PGE's System Control Center to begin pre-positioning crews and equipment in anticipation of PSPS execution. On Thursday, Sept. 8, crews were provided with cutsheets for the circuits they were assigned to de-energize, and Lead Working Foremen (LWF) began ordering crews to report to their assigned points of isolation to await de-energization orders. PGE dispatched pre-PSPS circuit patrols to report on actual conditions within their assigned PSPS Areas. PGE Engineers updated cutsheets as required and sent them to the LWF. Field crews were informed that the PSPS event would likely impact all 10 of PGE's pre-designated PSPS Areas. Late in the evening of Sept. 8, PGE made the decision to proceed with the PSPS event. At 0247 on Sept. 9, the first PSPS Area (Mt. Hood Corridor) was de-energized. By 1430 on Sept. 9, all 10 PSPS Areas had been de-energized.

In addition to the 10 PSPS Areas, PGE also de-energized seven POAs as an extra precaution to prevent potential utility-caused ignitions. The POAs were identified by the CIMT in response to updated meteorological and system topology data during the event. Because the POAs had not been identified prior to the event, PGE worked closely with Public Safety Partners and other external stakeholders to notify and minimize impacts to customers.

The following figure shows the timeline under which de-energization was executed during the September 2022 PSPS event:

Summary of PSPS Area/POA De-energization			
PSPS Area/POA	Date of De-energization	Time De-energization Initiated	*Dur Hrs
PSPS Area 1 (Mt. Hood Corridor/Foothills)	09/09/22	0247	68
PSPS Area 2 (Columbia River Gorge)	09/09/22	0502	62
PSPS Area 3 (Oregon City-S. Redland)	09/09/22	1206	54
PSPS Area 4 (Estacada-Faraday)	09/09/22	0816	62
PSPS Area 5 (Scotts Mills)	09/09/22	1109	55
PSPS Area 6 (Portland West Hills)	09/09/22	1215	33
PSPS Area 7 (Tualatin Mountains)	09/09/22	1232	55
PSPS Area 8 (North West Hills)	09/09/22	1315	52
PSPS Area 9 (Central West Hills)	09/09/22	1429	53
PSPS Area 10 (Southern West Hills)	09/09/22	1430	51
POA 1 (Springdale/Corbett)	09/09/22	0500	63
POA 2 (Silver Falls)	09/09/22	0308	59
POA 3 (South Molalla)	09/09/22	0245	65
POA 4 (Southwest Scotts Mills)	09/09/22	1154	54
POA 5 (George)	09/09/22	1442	41
POA 6 (Colton Area)	09/10/22	0432	33
POA 7 (Sandy Area)	09/10/22	0406	40
*Duration of Outage in Hours: (+/-) 1-hour			

Figure 7: De-energization Timetable by PSPS Area/POA, Sept 2022

4 PSPS Notifications

4.1 Notifications Guidance From 2022 PSPS Plan

Please refer to Sections 11.2 (Wildfire Information & Awareness Strategy) and 11.5 (PSPS Notification Strategies) of PGE's 2022 Wildfire Mitigation Plan for details regarding PGE's notifications strategy.

PGE's strategy called for engaging with media representatives at strategic times and providing updates timed to news cycles, to invite coverage that was timely, on-point and provided key information to customers in advance of the major phases of the PSPS event.

4.2 Notifications During the September 2022 PSPS Event

During the September 2022 PSPS event, staff from PGE's Communications, Business Continuity & Emergency Management, Government Affairs/Local Government Affairs, Diversity, Equity & Inclusion, and other organizations worked around the clock to keep customers and other stakeholders informed, provide situational awareness, and meet the notifications requirements defined under OAR 860-300-0050.

As PGE moved through the notification phases (Event Likely, Imminent, Happening, Restoration Begins and Restoration Complete), PGE issued press releases via the FlashAlert service, reaching 280 media outlets and public safety organizations. Additionally, PGE shared social media updates via Twitter and Facebook, again timed to PSPS phase. The PGE website was also updated regularly to reflect the current phase of the event.

Figures 8, 9, 10 and 11 summarize email notifications that PGE sent to customers in the PSPS Areas and the POAs identified once the September 2022 PSPS event was underway.

As shown in Figure 8, PGE issued multiple "Imminent" notifications to customers in PSPS Areas 1 and 4. This was due to the fact that, under OPUC rules, PGE is required to notify customers 1-4 hours prior to the start of the PSPS event; however, actual meteorological conditions did not meet the forecasted levels, and PGE repeatedly delayed de-energization in those PSPS Areas. That is why they received multiple notifications.

Notifications to the POAs are not specifically addressed in the OPUC's PSPS notifications rules. However, PGE made efforts to abide by the spirit of the OPUC's notifications requirements, opting to the extent possible to err on the side of more notifications rather than less.

Event Order	Message	Audience	Approximate Notification Timeline (+/- 15 minutes)				
			PSPS Area 1	PSPS Area 2	PSPS Area 3	PSPS Area 4	PSPS Area 5
Likely 48-72 hrs.	IMPORTANT: Power outage likely in your area	Critical Facilities, Poles	9/7/22 12:49	9/7/22 12:49	9/7/22 12:49	9/7/22 12:49	9/7/22 12:49
Likely 24-48 hrs.	IMPORTANT: Power outage likely in your area	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/7/22 22:13	9/7/22 22:13	9/7/22 22:13	9/7/22 22:13	9/7/22 22:13
Pre-Imminent 12-24 hrs.	URGENT: A power outage will happen soon	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/8/22 23:30	9/8/22 23:30	9/8/22 23:30	9/8/22 23:30	9/8/22 23:30
Imminent 1-4 hrs.	URGENT: A power outage is about to happen	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 1:55	9/9/22 4:36	9/9/22 8:09	9/9/22 1:55	
	URGENT: A power outage is about to happen	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 2:29		9/9/22 11:44	9/9/22 2:29	9/9/22 2:29
	Correction - URGENT: A power outage is about to happen	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 2:50			9/9/22 2:50	9/9/22 7:09
	URGENT: A power outage is about to happen	Critical Facilities, Poles, Non-managed Customers, Residential, Business				9/9/22 7:09	9/9/22 10:09
Happening	SAFETY UPDATE: Your power has been shut off	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 3:17	9/9/22 6:15	9/9/22 13:09	9/9/22 8:14	9/9/22 11:18
24-hour Updates	PSPS Update from PGE	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 22:30	9/9/22 22:30	9/9/22 22:30	9/9/22 22:30	9/9/22 22:30
Restoration Begins	We are in the process of restoring your	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/10/22 21:10	9/10/22 21:10	9/10/22 21:10	9/10/22 21:10	9/10/22 18:02
Restoration Complete	Your power has been restored	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28	9/12/22 0:31	9/12/22 0:28

Figure 8: PSPS Email Notifications (Area 1-5)

NOTE: "Poles" denotes entities that may not be PGE customers, but have infrastructure poles that rely on PGE power: for example, telecommunications or cable/internet providers.

Figure 9: PSPS Email Notifications (Area 6-10)

Event Order	Message	Audience	Approximate Notification Timeline (+/- 15 minutes)				
			PSPS Area 6	PSPS Area 7	PSPS Area 8	PSPS Area 9	PSPS Area 10
Likely 48-72 hrs.	IMPORTANT: Power outage likely in your area	Critical Facilities, Poles	9/7/22 12:49	9/7/22 12:49	9/7/22 12:49	9/7/22 12:49	9/7/22 12:49
Likely 24-48 hrs.	IMPORTANT: Power outage likely in your area	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/7/22 22:13	9/7/22 22:13	9/7/22 22:13	9/7/22 22:13	9/7/22 22:13
Pre-Imminent 12-24 hrs.	URGENT: A power outage will happen soon	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/8/22 23:30	9/8/22 23:30	9/8/22 23:30	9/8/22 23:30	9/8/22 23:30
Imminent 1-4 hrs.	URGENT: A power outage is about to happen	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 11:15	9/9/22 11:15	9/9/22 11:15	9/9/22 11:15	9/9/22 11:15
Happening	SAFETY UPDATE: Your power has been shut off	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 13:27	9/9/22 13:44	9/9/22 13:44	9/9/22 13:44	9/9/22 13:38
24-hour Updates	PSPS Update from PGE	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/9/22 22:30	9/9/22 22:30	9/9/22 22:30	9/9/22 22:30	9/9/22 22:30
Restoration Begins	We are in the process of restoring your	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/10/22 21:10	9/10/22 18:02	9/10/22 18:02	9/10/22 18:02	9/10/22 18:02
Restoration Complete	Your power has been restored	Critical Facilities, Poles, Non-managed Customers, Residential, Business	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28

The email scripts for POA customer notifications during the September 2022 PSPS event were the same as those found in Appendix 6. The following table summarizes emails sent and delivered metrics for the event:

Figure 10: Preventive Outage Areas (POA)

Event Order	Message	Approximate Notification Timeline (+/- 15 minutes)						
		Springdale Corbett	Silver Falls	Southwest Scotts Mills	South Molalla	George	North Sandy	Colton
Likely 24-48 hrs.	IMPORTANT: Power outage likely in your area	9/8/22 19:44	9/8/22 19:44					
24-hour Updates	PSPS Update from PGE	9/9/22 22:56	9/9/22 22:56					
24-hour Updates	PSPS Update from PGE	9/10/22 0:04		9/10/22 0:04	9/10/22 0:04	9/10/22 0:04		
24-hour Updates	PSPS Update from PGE	9/10/22 8:39					9/10/22 8:39	9/10/22 8:39
Restoration Begins	We are in the process of restoring your power	9/10/22 21:43	9/10/22 20:33	9/10/22 21:43	9/10/22 21:43	9/10/22 21:43	9/10/22 21:43	9/10/22 21:43
Restoration Complete	Your power has been restored	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28	9/12/22 0:28

Figure 11: Email Notification Statistics

Audience	Email Sends	Email Deliveries	Email Delivery Rate	Email Open Rate
Residentional, Business	112,523	112,183	99.70 %	63.10 %
Critical Facilities	3,408	3,372	99.10 %	31.89 %
Poles	774	765	98.84 %	41.96 %
POA	5,682	5,654	99.51 %	60.52 %

4.3 Utility-Identified Critical Facilities

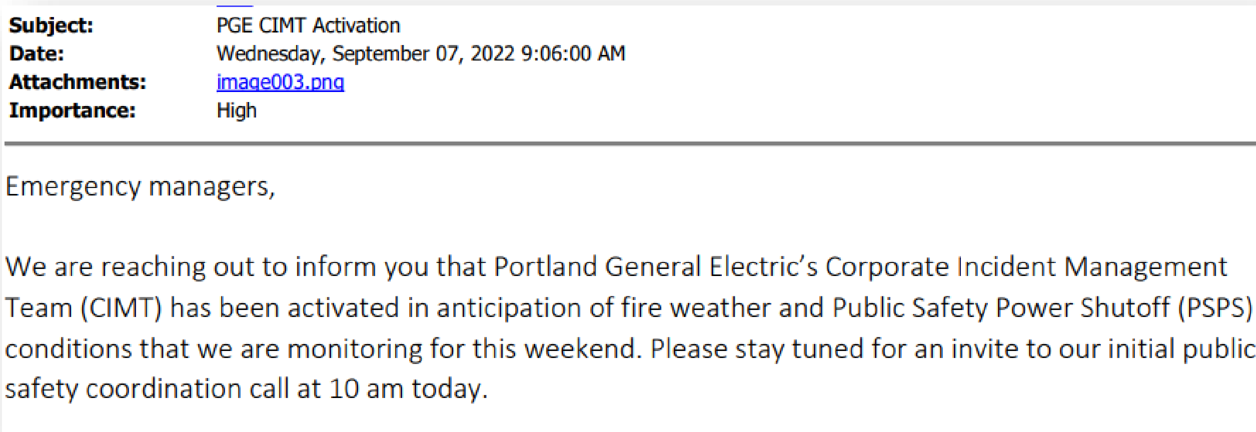
PGE provided notifications to 442 owners of Utility-Identified Critical Facilities (including 27 Owners of Communications Facilities) during the September 2022 PSPS event. Please refer to Figures 8 and 9, above, for information about the timing and cadence of these notifications.

4.4 Public Safety Partners

Public safety notifications delivered by Public Safety Partners provided notice to impacted communities, augmenting the previously discussed customer-facing communications platforms. During the September 2022 PSPS, PGE coordinated the delivery of PSPS-related notifications with county and state emergency management staff responsible for administering public alerting programs. County emergency managers can deploy public alerts using the Everbridge public warning platform, which delivers targeted, address-based text messaging to individuals located within zones impacted by natural disasters and other events.

Most residents in PSPS Areas 1-10 received an Everbridge "Event Likely" alert at 0950 on Sept. 8, followed by an "Event Imminent" alert at 2030 the same day. Due to the staggered timing of restoration across the various PSPS Areas, the introduction of POAs and the saturation of other alerts and media coverage surrounding the PSPS event, PGE and its Public Safety Partners elected not to use the Everbridge system for the "Restoration Begins" alert.

PGE also provided direct email updates to Public Safety Partners at various phases of the PSPS event (see Figures 12 and 13, below, for examples):

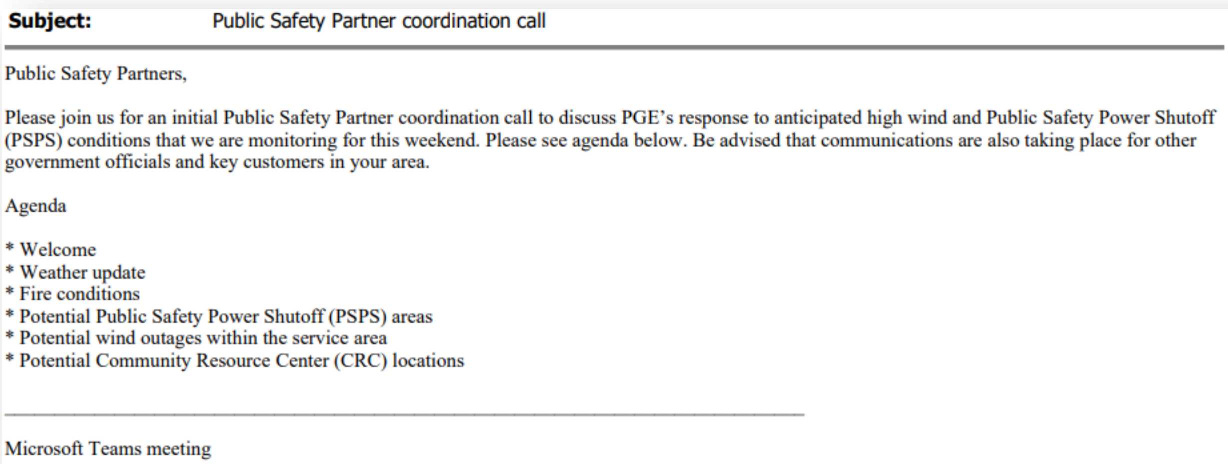


Subject: PGE CIMT Activation
Date: Wednesday, September 07, 2022 9:06:00 AM
Attachments: image003.png
Importance: High

Emergency managers,

We are reaching out to inform you that Portland General Electric's Corporate Incident Management Team (CIMT) has been activated in anticipation of fire weather and Public Safety Power Shutoff (PSPS) conditions that we are monitoring for this weekend. Please stay tuned for an invite to our initial public safety coordination call at 10 am today.

Figure 12: Public Safety Partner Email Content



Subject: Public Safety Partner coordination call

Public Safety Partners,

Please join us for an initial Public Safety Partner coordination call to discuss PGE's response to anticipated high wind and Public Safety Power Shutoff (PSPS) conditions that we are monitoring for this weekend. Please see agenda below. Be advised that communications are also taking place for other government officials and key customers in your area.

Agenda

* Welcome
* Weather update
* Fire conditions
* Potential Public Safety Power Shutoff (PSPS) areas
* Potential wind outages within the service area
* Potential Community Resource Center (CRC) locations

____

Microsoft Teams meeting

Figure 13: Public Safety Partner Coordination Call Invitation

4.5 Paid Advertisements

During the September 2022 PSPS event, PGE purchased digital banner advertisements that appeared on various websites targeted to the profile of the desired viewer (in this case, a broad audience reaching everyone 18+ in the PGE service territory). The ads were targeted to reach users within all 10 of the PSPS areas. The ads went live on the following schedule:

- Event Likely (all zones): Sept. 8 (0815)
- Event Happening

- Sept. 9 (1201) – PSPS Areas 1-5
- Sept. 9 (1249) – All PSPS Areas
- Sept. 10 (0816) – PSPS Areas 1-4, 6

PGE began scaling back its Event Happening advertisements as restoration proceeded on Sept. 10; by 2023 on Sept. 10 PGE paused all Event Happening advertisements.

4.6 Web Updates

PGE updated the PSPS and outage-related content on its www.portlandgeneral.com website at each phase of the September 2022 PSPS event (Watch, Warning, Likely, Imminent, Happening, Restoration, Restoration Complete). In addition, PGE regularly updated web content to display current weather conditions and CRC information (locations, hours of operation). See Appendix 5 for a table of all updates made to PGE's website before and during the event.

The following list summarizes unique site visits to www.portlandgeneneral.com and its wildfire and PSPS-related sub-pages during the period of the PSPS event:

September 7-12, 2022

- 2,893 sessions to https://portlandgeneral.com/psps-info
- 161,707 sessions to https://portlandgeneral.com/outages-safety/wildfire-outages
- 5,337 sessions to https://portlandgeneral.com/en-espanol/apagones-por-incendios-forestales
- 2,283 sessions to https://portlandgeneral.com/outages-safety/safety/wildfire-safety
- 18,394 sessions to https://portlandgeneral.com/outages-safety/be-prepared
- 12,456 sessions to https://portlandgeneral.com/outages-safety/be-prepared/prepare-your-home
- 1,121 sessions to https://portlandgeneral.com/en-espanol/prepare-su-hogar
- 706 sessions to https://portlandgeneral.com/outages-safety/be-prepared/prepare-your-business

4.7 Earned Media

PGE issued press releases at the Likely, Imminent, Happening, Restoration Begins and Restoration Complete phases of the September 2022 PSPS. PGE engaged directly with local, regional, and national media throughout, generating a total of 529 stories in top-tier business, regional and local news and broadcast outlets. Most referenced information available on PGE's website. For details and links, please refer to Appendix 2.

PGE's strategy of engaging at strategic times and providing updates timed to news cycles helped effectively generate timely, informative coverage. PGE press releases were distributed via FlashAlert, which reaches 280 newsrooms in Oregon (See Table 8), including non-English-speaking media outlets. The table below shows the date and time each of PGE's PSPS-related press releases were distributed via FlashAlert.

Appendix 3 contains the media releases PGE provided at each phase of the PSPS event.

Figure 14: List of PGE Press Releases During September 2022 PSPS Event

Date/Time	Phase	Press Release Title
9/7/2022 19:45	Likely	PGE Announces Likelihood of Public Safety Power Shutoffs in 10 Areas and Potential for Weather-Related Power Outages
9/8/2022 22:21	Imminent	PGE Solidifies Plans for Public Safety Power Shutoff in 10 PSPS Areas
9/9/2022 16:10	Happening	PGE Shuts Power Off to Help Keep Customers, Communities Safe
9/10/2022 9:29	Non-PSPS	PGE Shuts Off Power in Five New Areas Overnight
9/10/2022 14:56	Restoration Begins	Work Begins to Restore Power for PGE Customers
9/10/2022 19:58	Restoration Begins - Update	Work Continues to Restore Power for PGE Customers
9/11/2022 23:42	Restoration Complete	PGE Restores Power to All Customers Impacted by Public Safety Power Shutoff

4.8 Social Media

The following table summarizes PGE's social media posts on Twitter and Facebook at the Likely, Imminent, Happening, Restoration Beginning and Restoration Complete phases of the PSPS. and click/view/share/like metrics during the September PSPS event:

Figure 15: PGE Social Media Statistics, English & Spanish, September 2022 PSPS Event

PSPS Event Social Media Posts (Eng & Span)						
Site	**Posts**	**Reach**	**Clicks**	**Comments**	**Shares**	**Likes**
Twitter	14	223,216	25,440	732	1,307	608
Facebook	8	304,502	19,819	204	536	594
Total	**22**	**527,718**	**45,259**	**936**	**1,843**	**1,202**

5 Public Safety Partner, Local & State Government, Tribal, Critical Facilities, & Communications Facilities

5.1 2022 Wildfire Mitigation Plan Guidance on Public Engagement

Please refer to Sections 11.4 (Public Safety Partner Coordination Strategy) and 11.5 (PSPS Notification Strategies) of PGE's 2022 Wildfire Mitigation Plan for details regarding PGE's Public Safety Partner engagement strategy. Throughout the event, CIMT participants from PGE's Business Continuity & Emergency Management (BCEM), Rates & Regulatory Affairs (RaRA), and Government Affairs (GA) organizations conducted direct coordination calls and provided email notifications to the Public Safety Partners, including ESF-12, Local Emergency Management and Oregon Department of Human Services (ODHS).

5.2 Public Safety Partner Engagement

5.2.1 Coordination Call

PGE began its Public Safety Partner engagement process with a coordination call on the afternoon of Sept. 6. PGE started with a list of approximately 70 individual Public Safety Partner contacts; as the event progressed, PGE's contact list grew to approximately 120 individuals. For example, when a state duty officer wasn't part of the original list, they were added. A list of the Public Safety Partners that PGE contacted during the September 2022 PSPS event can be found in Appendix 7.

PGE contacted the Public Safety Partners directly, via email, at various points during the September 2022 PSPS event (please refer to Section 4.2 for examples). In addition, Public Safety Partners were invited to participate in a daily PGE-facilitated Public Safety Partner Coordination Call. Meetings were held every day at 10 AM from Sept. 7-14, and followed a standing agenda (with time for discussion of other issues/circumstances as required):

Public Safety Partner Coordination Call Standing Agenda

- Welcome
- Weather update
- Fire conditions
- Potential Public Safety Power Shutoff (PSPS) areas
- Potential wind outages within the service area
- Potential Community Resource Center (CRC) locations

5.2.2 Wireless Emergency Alerts (WEA)

Prior to the 2022 wildfire season, PGE developed and exercised a Public Safety Notification Procedure with Public Safety Partners responsible for sending public alerts. Participants weighed the pros and cons of using WEA; both PGE staff and Public Safety Partners agreed to include this method of notification in their portfolio of PSPS notification platforms.

During the September 2022 PSPS event, some jurisdictions supported the planned use of WEA notifications, while others did not due to concerns that it could create confusion. PGE staff, Public Safety Partners, and managers of 911 centers raised concerns about the timing of alerts for some PSPS Areas de-energized during early morning hours – it is problematic for public safety notifications to go out after 9 pm, with the exception of imminent life safety notifications. This concern required adjustments to messaging scripts, often at the last minute.

As expected, the WEA notifications spread beyond their target audience; this led to confusion as some customers located outside the impacted PSPS area received notifications and visited the PGE website or contacted PGE directly to find out whether their power was going to be shut off.

The fact that the September 2022 PSPS event impacted such a wide geographic area led to other utilities (in addition to PGE) notifying customers and other stakeholders of PSPS activities, creating a challenge for counties with multiple electric service providers to manage notifications. This exposed gaps in WEA system functionality. For example, prior to delivering the "PSPS may occur within 24 hours" notification, state emergency management partners convened a coordination call with multiple utilities (including PGE), impacted counties and the ESF 12 to discuss the potential of delivering region-wide WEA alerts rather than a county-by-county approach. Ultimately, the group decided to continue with the county-by-county approach.

5.3 Federal, Local and State Government Engagement

During the September PSPS event, PGE sent notifications to Federal, Tribal, State, County and City representatives, as well as to community-based organizations, food banks and school districts. A record of emails sent to those entities, along with a listing of the organizations contacted, can be found in Appendix 4.

Before, during, and after the September 2022 PSPS event, PGE's Government Affairs/Local Government Affairs organization had 224 separate outgoing email contacts with Local, State and Federal Government and community-based organizations (CBOs), using PGE contact lists for entities including the Oregon Department of Human Services (ODHS), Oregon Department of Transportation (ODOT), Oregon Department of Energy (ODOE), and Oregon Department of Emergency Management (OEM), among others. These contacts occurred at the Level 3 – Elevated (PSPS Warning) phase 72-48 hours prior to the event, Level 3 – Elevated (PSPS Likely) phase 48-24 hours prior, Level 3 – Elevated (PSPS Imminent) phase 4-1 hours prior to the start of the event, at the Event In Progress phase (every 24 hours during the event), and at the Re-Energization (multiple daily emails), and Event Complete phases (sent September 11 at 2310). For a complete list of these government and CBO email contacts and a list of the CBOs and school districts PGE contacted during the event, please refer to Appendices 4 and 10, respectively.

5.4 Tribal Engagement

As part of PGE's PSPS notifications strategy, the Confederated Tribes of Grande Ronde Community was notified as part of the Public Safety Partner notifications process. These notifications included direct emails, CRC coordination, and participation in the Public Safety Partner daily information briefing.

5.5 Engagement with Operators of PGE-Identified Critical Facilities

In the leadup to the PSPS event, PGE sent automated notifications to 442 utility-identified Critical Facilities operators to help them analyze and plan for potential de-energization impacts. Notifications were also sent at the Level 3 – Elevated (PSPS Warning) phase 72-48 hours prior to the event, Level 3 – Elevated (PSPS Likely) phase 48-24 hours prior, Level 3 – Elevated (PSPS Imminent) phase 4-1 hours prior to the start of the event, at the Event In Progress phase (every 24 hours during the event), and at the Re-Energization (multiple daily emails), and Event Complete phases (sent September 11 at 2310). A sample notification can be found in Appendix 9. The cadence of these notifications is described in Section 4.2.

5.6 Engagement with Operators of Communications Facilities

In June 2022, PGE sent emails containing a link to geographical information system files regarding areas of anticipated PSPS to Operators of Communications facilities located within the PGE service territory to help them analyze and plan for potential de-energization impacts. The email also included a link to related wildfire information found on the www.portlandgeneral.com website. Please refer to Appendix 8 for a list of recipients. A copy of PGE's June PSPS GIS-Based Platform email is available upon request.

6 Power Restoration

6.1 Power Restoration During September 2022 PSPS Event

By Saturday, Sept. 10, high winds had abated to the point that PGE could begin dispatching inspection crews to begin the Restoration phase of the PSPS event. Crews visually inspected all impacted PGE circuits to identify and repair any damage and verify that re-energization could proceed safely. Fortunately, winds were not severe enough to cause extensive damage – most of the damage PGE crews found was due to downed limbs and trees rendered brittle by the extended drought.

Inspection times varied from 2-6 hours per circuit. Across PGE's service territory, crews found and quickly repaired a total of 3,955 feet of damaged wire cable, 21 damaged transformers and 11 damaged poles. Figures 16 and 17 show examples of storm damage.

Figure 16: Damage to Distribution Pole, September 2022 PSPS Event

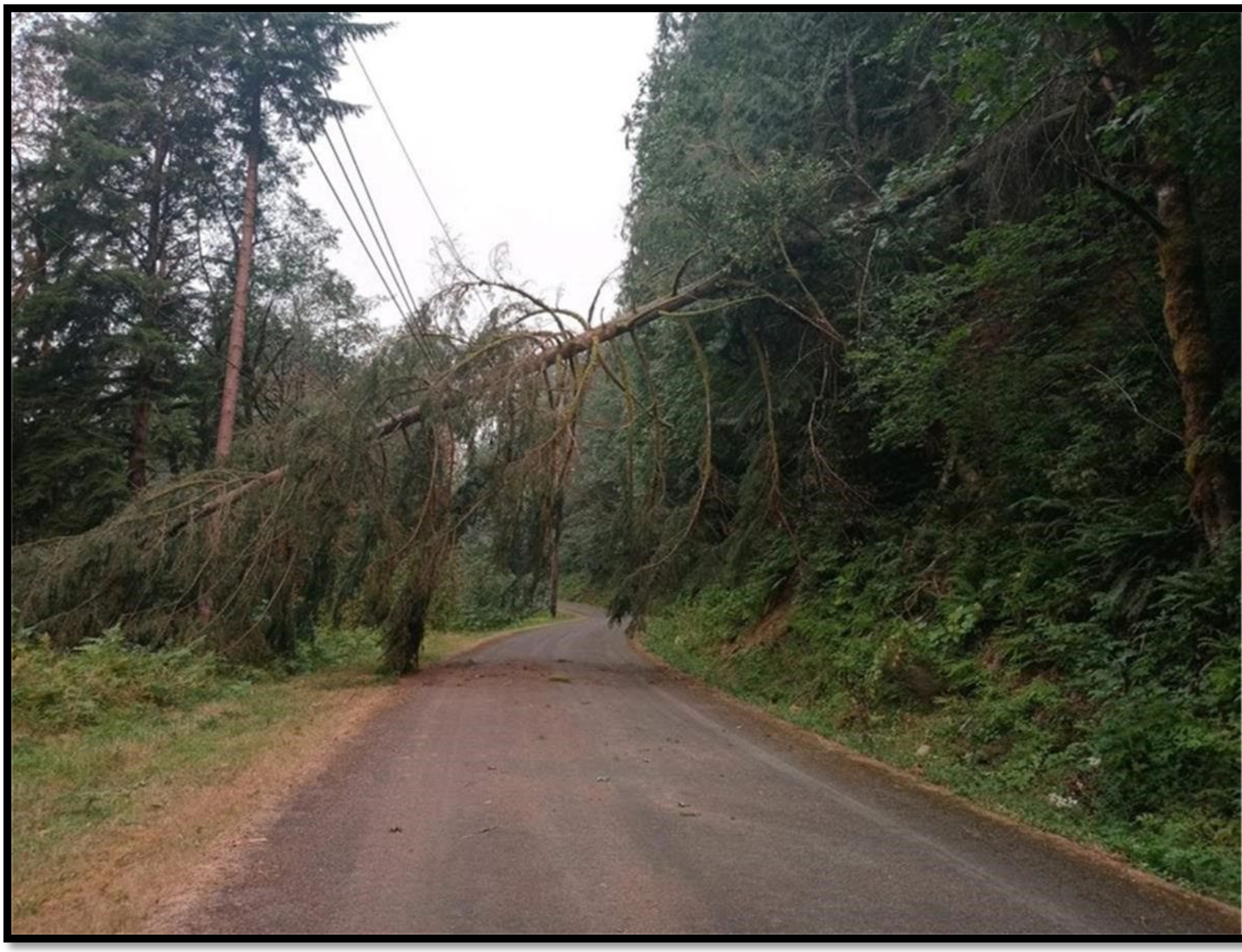


Figure 17: Fallen Tree Across Power Line

By 2212 on Sept. 11, crews had restored power to all PSPS Areas and POAs impacted by the event.

Figure 18: Power Restoration Timetable, September 2022 PSPS Event

Summary of PSPS Area/POA Restoration		
PSPS Area/POA	Date of Power Restoration	Time of Complete Power Restoration
PSPS Area 1 (Mt. Hood Corridor/Foothills)	09/11/22	2212
PSPS Area 2 (Columbia River Gorge)	09/11/22	1944
PSPS Area 3 (Oregon City-S. Redland)	09/11/22	1725
PSPS Area 4 (Estacada-Faraday)	09/11/22	2212
PSPS Area 5 (Scotts Mills)	09/11/22	1840
PSPS Area 6 (Portland West Hills)	09/10/22	2043
PSPS Area 7 (Tualatin Mountains)	09/11/22	1915
PSPS Area 8 (North West Hills)	09/11/22	1645
PSPS Area 9 (Central West Hills)	09/11/22	1915
PSPS Area 10 (Southern West Hills)	09/11/22	1645
POA 1 (Springdale/Corbett)	09/11/22	1921
POA 2 (Silver Falls)	09/11/22	1400
POA 3 (South Molalla)	09/11/22	1840
POA 4 (Southwest Scotts Mills)	09/11/22	1840
POA 5 (George)	09/11/22	0756
POA 6 (Colton Area)	09/11/22	1149
POA 7 (Sandy Area)	09/11/22	1855

7 Community Resource Centers

7.1 2022 Wildfire Mitigation Plan Guidance on Community Resource Centers (CRCs)

During PSPS events, PGE decides whether to establish CRCs in selected communities to provide critical restoration information, including updates and real-time information, to customers impacted by the outage(s). The CRCs provide other crucial services as well: electronic and/or portable medical device charging, internet access, and clean water and ice, offsetting some of the impacts associated with the PSPS de-energization. Although CRCs are not required under the OPUC rules, PGE believes they are an important factor in minimizing the impacts of PSPS events on the communities we serve.

PGE began the planning process for CRC deployment with the development of its 2022 Mobile Resource Unit Strategy Plan prior to fire season.

PGE pre-identifies multiple potential locations for CRCs within or near each PSPS Area, to provide the flexibility to select the location that best suits customers' needs based on the specifics of the event. Depending on the nature of the event, it may also be possible to serve multiple PSPS-impacted areas from a common CRC location. Pre-identifying multiple CRC locations within each PSPS area gives PGE options if a government agency dictates mandatory evacuations which require the relocation of a CRC. PGE's goal is to locate CRCs as near as possible to the areas impacted by the de-energization, although specific circumstances may make this impractical. Customers located within impacted PSPS Areas receive notifications detailing available CRC locations, hours of operation and services available.

PGE's decision-making process for the potential deployment of CRCs begins during the PSPS Event Likely phase (see Figure 5 for details). PGE notifies Public Safety Partners and Adjacent Public Safety partners as soon as CRC location and activation schedules have been confirmed. PGE strives to have CRCs operational within 24 hours of de-energization and will keep these locations operational as long as there is benefit to the community. This typically means they will be closed the day service is restored.

Please see Figure 19 for a map of the September 2022 PSPS event CRC locations. Figure 20 lists the CRC locations operated by PGE. Additionally, Multnomah, Washington, Clackamas and Yamhill Counties operated resources centers during this event, supported by PGE contributions of bottled water, ice and branded and written materials for distribution to customers.

7.2 CRC Operations During September 2022 PSPS Event

Beginning September 6, when it became apparent that the potential PSPS event would impact multiple HFRZs, PGE's Customer Experience team and its CRC vendor, Fire DAWG, engaged in strategic discussions regarding CRC resource availability and location optimization – how and where to deploy CRC resources to best meet the needs of customers across PGE's service territory.

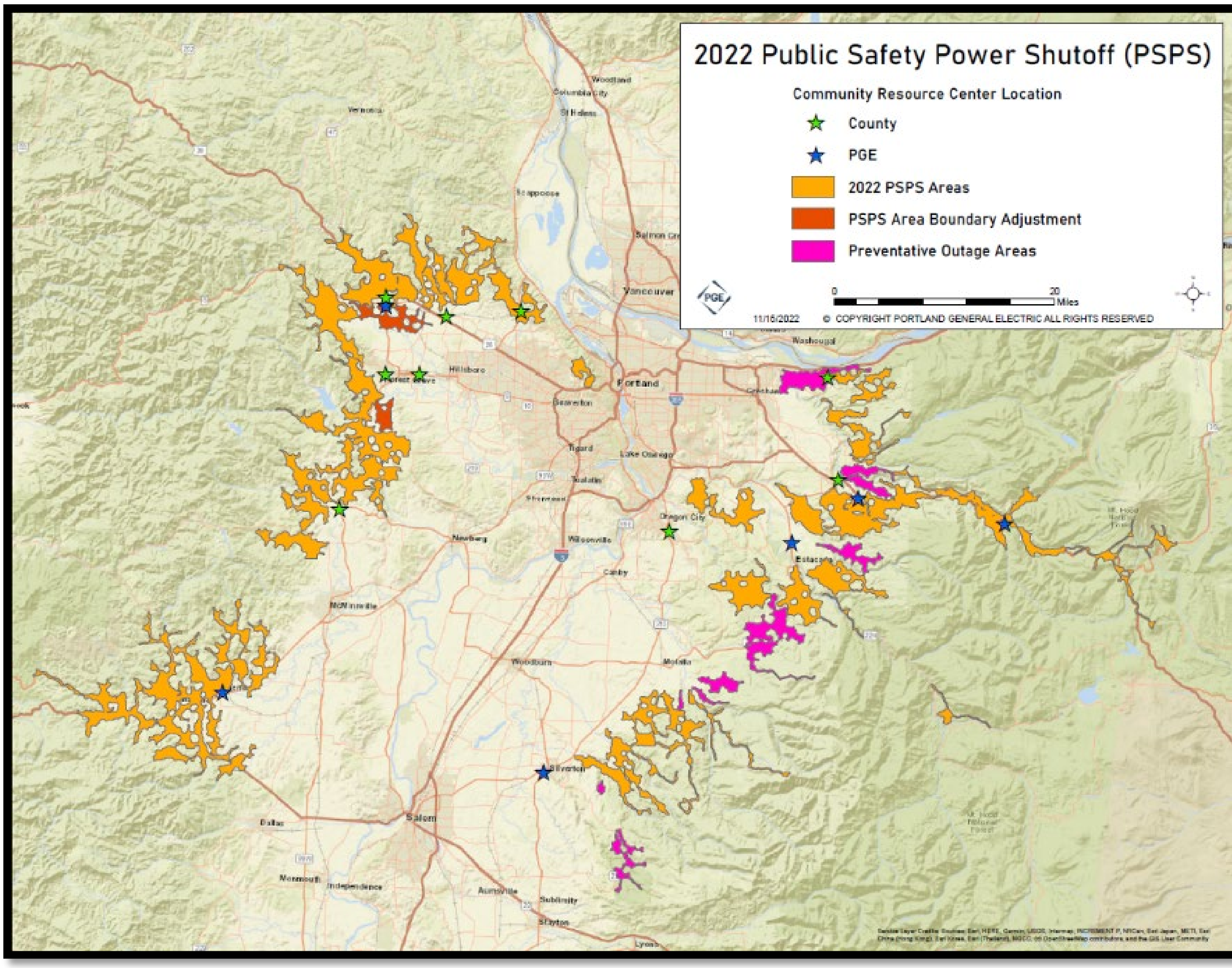


Figure 19: CRC Locations Map, September 2022 PSPS Event

Ultimately, with a total of five Mobile Resource Units (MRUs, or trailers) available from the vendor, PGE identified centralized CRC locations that could, in some instances, provide services to customers from multiple HFRZs. PGE established five CRC locations, supplemented with nine county-run resource centers, for a total of 14 CRC locations (some without trailers) during the event. On September 7, when PGE escalated to PSPS Warning (Level 3), PGE requested Fire DAWG to begin pre-positioning CRC resources.

Figure 20: PGE Community Resource Centers (CRC)

PGE Community Resource Centers (CRC)					
County	Site Name	Address	Operating Days/Hour	Site Type	Amenities Provided
Marion	Silverton Safeway	301 Westfield St, Silverton	7am -7pm	PGE MRU/CRC	Bottled water, 5lb ice bags, device charging, Wi-Fi, PSPS information
Washington	Banks Jims Thriftway	12350 NW Main St, Banks			
Yamhill	Sheridan High School	433 S Bridge St, Sheridan			
Clackamas	Welches Elementary School	24901 E Salmon River Rd, Welches			
Clackamas	Firwood ElementarySchool	42900 SE Trubel Rd, Sandy*			

*PGE's Estacada CRC location (First Baptist Church) was relocated to Sandy after Day 1 due to a fire.

Figure 20: County-Run Resource Centers

County Community Resource Centers (CRC)					
County	Site Name	Address	Operating Days/Hour	Site Type	Amenities Provided
Multnomah	Corbett Fire Station	36930 E Historic Columbia River Highway, Corbett	N/A	County Run Site	N/A
Multnomah	TVFR West Hills Fire Station	11646 NW Skyline Blvd, Portland			
Washington	North Plans Library	31334 SW Commercial St, North Plains			
Washington	Forest Grove Library	2114 Pacific Ave, Forest Grove			
Washington	Banks Public Library	42461 NW Market St, Banks			
Washington	Cornelius Public Library	1340 N Adair St, Cornelius			
Clackamas	Clackamas Community College	19600 S Molalla Ave, Oregon City			
Clackamas	AntFarm Café and Bakery	39140 Proctor Blvd, Sandy			
Yamhill	Yamhill City Hall	205 S Maple St, Yamhill			

Beginning the morning of Sept. 9 and continuing until the impacted PSPS Area was re-energized, PGE's CRCs staffed by PGE volunteers, operated from 7 am to 7 pm. They provided customers with bottled water, ice, portable device charging, and PSPS event update information. PGE made numerous adjustments to its CRC strategy in response to changing circumstances:

- Moved the Estacada CRC location (Estacada First Baptist Church) to the alternate location in Sandy (Firwood Elementary School) in response to a fire
- Added staff to accommodate unexpectedly high demand in some locations
- Worked with affected counties to provide water, ice, and branded and written materials (signage, t-shirts, brochures etc.) to the government-run sites established to serve the communities located within the seven ad hoc POAs.

In all, PGE's CRC locations served more than 2,500 customers during the PSPS event.

Figure 21: CRC Volunteers, September 2022 PSPS Event

A representative sample of the customer feedback PGE CRC volunteers received during the event included:

- Customers were grateful for the services provided at CRCs
- Customers wanted more frequent and accurate updates about when their power would be restored
- Customers were frustrated by the fact that their power had been turned off, given the less-severe-than-forecasted meteorological conditions at their location
- Customers were grateful that PGE was present – that CRCs are invaluable and a positive expression of PGE’s care for their community.
- Customers were frustrated that a CRC was not established at a specific site location.

8 Lessons Learned from this Event

8.1 Strengths

8.1.1 Crisis Communications

- PGE, in coordination with external partners, communicated timely and effectively with customers.

8.1.2 Whole Community

- Stakeholder communications were robust and comprehensive
- On-the-fly adjustments to community support strategies were effective
- Working collaboratively with PGE, some counties operated their own resource centers at public locations, while PGE donated supplies to these locations for distribution to impacted communities.

8.1.3 Operations

- Additional recloser installations prior to the event enabled PGE to reduce the September 2022 PSPS event's customer impacts
- The expanded (for 2022) network of PGE weather stations provided an accurate view of meteorological conditions closer to PGE infrastructure when compared to other weather stations in the regional network.

8.2 Opportunities for Improvement

8.2.1 Rule-Required Notifications

- Advise and support Public Safety Partners to host a workshop to clarify cross-jurisdictional coordination responsibilities for alerts and warnings as this event impacted electric utilities beyond PGE.
- PGE and Public Safety Partners should evaluate the use of Wireless Emergency Alerts for PSPS events and define policies and agreements to facilitate its successful and beneficial deployment and reduce "overspray" confusion for notification recipients.

Prior to the 2023 Wildfire Season, PGE will continuously improve our notification and documentation processes.

8.2.2 Operations

- Define additional internal controls for PSPS areas to more precisely align appropriate PSPS boundaries and actual outage areas.

- Review mitigation tools for PSPS Areas based on experiences from the 2022 PSPS event -- Invest in additional tools and equipment to allow more targeted and automated control of PSPS areas
- Update PSPS area data to include Critical Facilities with consideration for seasonality such as back-to-school dates.
- Create processes to assist with the community support and notifications challenges associated with the dynamic nature of designating POAs, in real-time, during a PSPS event.
- During future PSPS events, PGE will evaluate how to best leverage resources to perform circuit patrols and field weather observations.
- Continue to refine cutsheet development process to enhance PSPS execution.

8.2.3 Whole Community

- Establish and document clear lines of responsibility between PGE and Public Safety Partners for CRCs, locations, and information sharing.
- Evaluate the use of Wireless Emergency Alerts for PSPS events, with our Public Safety Partners, to reduce "overspray" (and, in some cases, "underspray") confusion for notification recipients.
- Assess options to improve the PSPS map functionality and simplify the customer experience.

8.2.4 Community Resource Centers

- Review site locations using updated criteria and finalize contracts for all locations.
- Formalize CRC volunteer strategy, templates, and training.
    - Supplemental employees signed up and trained in advance of the PSPS event.
- Renew contract with CRC vendor for 2023 wildfire season; incorporate vendor recommendations into contract.
- Plan prior to fire season for expanded scenarios – identify CRC locations and ensure that adequate MRUs and supplies are available even if all 10 HFRZs are impacted by a PSPS event.

9 Appendices

Appendix 1. Geographic Description of PGE's 2022 PSPS Areas

PSPS Area 1: Mt. Hood Corridor/Foothills

Following the Mt. Hood Highway, this area includes Douglass Ridge, Marmot and Brightwood, Welches, Zigzag, Rhododendron, Government Camp, and other surrounding areas. The Bull Run area north of Sandy is also included in this area.

PSPS Area 2: Columbia River Gorge

Beginning east of the Sandy River near Troutdale, this area includes Springdale, Corbett, Latourell and follows the Sandy River south to include Aims and Bull Run. The northeast corner terminates at Shepperd's Dell State Natural Area.

PSPS Area 3: Oregon City

Covering areas south of the Clackamas River, this area is bordered by Holcomb Creek to the west, Foster Creek to the east and includes Logan, Cedarhurst Park, and portions of Redland.

PSPS Area 4: Estacada

This area includes parts of South Upper Highland Road, including Highland and Upper Highland, and an area along the Woodburn-Estacada Highway and the Clackamas Highway, including Garfield and Dodge, and the recreation area Promontory Park. The southwestern corner of this area follows Clackamas Highway 224 and includes Three Lynx, terminating at Lake Harriet.

PSPS Area 5: Scotts Mills

This area includes Scotts Mills, Wilhoite, Glen Avon, and portions of Butte Creek Road, Abiqua Road Northeast, South Dickey Prairie Road and others. The southwestern corner terminates at the western edge of Santiam State Forest and the furthest east corner follows Pine Creek, terminating south of Emerald Lake.

PSPS Area 6: Portland West Hills

The southern edge of this area is bordered by Sunset Highway 26. The eastern edge borders Macleay Park and the west border closely follows NW Miller Road from Highway 26, terminating south of Bonny Slope. This area includes Sylvan, Green Hills and part of West Slope.

PSPS Area 7: Tualatin Mountains

From NW Pumpkin Ridge Road to the east to NW Newberry Road to the west, this area includes portions of NW Skyline Boulevard, NW Shadybrook Road, NW Collins Road, and others.

PSPS Area 8: Northwest Hills

This area goes along NW Dersham Road (North of Highway 26) following Dairy Creek past NW Meacham Road, Plentywater Creek, Bump Reservoir and NW Shermans Mill Road. This area also includes Mountaindale along Highway 6 and Sunset Highway 26, incorporating Manning and Staley's Junction, and terminates on the northwest corners of NW Strassel Road and Nehalem Highway 47. The northwest corner terminates before Buxton on Highway 47.

PSPS Area 9: Central West Hills

This area follows Highway 6, incorporating Glenwood, Kansas City, Gales Creek, Watts. It then continues south along Highway 47, incorporating Stimson Mill, Seghers, Cherry Grove, Gaston, Dellwood, Wapato, Laurelwood, Cove Orchard, Lunnville. This area does not include city of Yamhill but does include Pike and follows northwest along NW Turner Creek Road, terminating at Menafee Park. The southern corner is split across NW Moores Valley Road and NW Puddy Gulch Road, and forks north at NW Rockyford Road and NW Oak Ridge Road. Does not include Fairdale or Carlton.

PSPS Area 10: Southern West Hills

This area follows Highway 18 from Erratic Rock State Natural Site and includes Bellevue, Gopher, Sheridan, Shipley, Willamina, Gold Creek, Valley Junction, Fort Hill, and Grand Ronde. It includes a northwest section from Valley Junction along Hebo Road (Highway 22) and Grand Ronde Agency and Midway. The western corner extends along Hebo Road and terminates before NF-2234 and Conklin Creek. From Gold Creek moving southeast along Willamina-Salem Highway 22, it incorporates Buell and Salt Creek (where the furthest southern edge of the area terminates).

Appendix 2. Earned Media Coverage During September 2022 PSPS Event

Print/Online

- ABC News: Oregon facing extreme fire danger this weekend as several blazes burn [abcnews.go.com], Sep. 10, 2022
  - Notable reprints: MSN [msn.com], NewsBreak [newsbreak.com], WBAL [wbal.com], KZEL [kxel.com], Yahoo! Canada [ca.sports.yahoo.com] & more
- The Associated Press: Wind, storms could spread wildfires in Oregon this week [nam02.safelinks.protection.outlook.com], Sept. 6, 2022
  - Notable reprints: KPTV [nam02.safelinks.protection.outlook.com], OPB [nam02.safelinks.protection.outlook.com], The Telegraph [nam02.safelinks.protection.outlook.com], The Oregonian [nam02.safelinks.protection.outlook.com], Seattle Times [nam02.safelinks.protection.outlook.com], Eastern Oregonian [nam02.safelinks.protection.outlook.com], San Francisco Chronicle [nam02.safelinks.protection.outlook.com] & more
- The Associated Press: High winds to pose severe wildfire risk in Pacific Northwest [nam02.safelinks.protection.outlook.com], Sept. 8, 2022
  - Notable reprints: OPB [nam02.safelinks.protection.outlook.com], East Oregonian [nam02.safelinks.protection.outlook.com], The Darien Times [nam02.safelinks.protection.outlook.com], Daily Record [nam02.safelinks.protection.outlook.com], The Blue Mountain Eagle [nam02.safelinks.protection.outlook.com] & more
- The Associated Press: Storm's fierce winds complicate California wildfire fight [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
  - Notable Reprints: MSN.com [nam02.safelinks.protection.outlook.com], WJMF (NBC), [nam02.safelinks.protection.outlook.com] DC News Now [nam02.safelinks.protection.outlook.com] and more
- The Associated Press: Oregon adopts Calif fire tactic, shuts power amid high winds [apnews.com], Sept. 10, 2022
  - Notable Reposts: The Seattle Times [nam02.safelinks.protection.outlook.com], ABC News [nam02.safelinks.protection.outlook.com], US News and World Report [nam02.safelinks.protection.outlook.com], HuffPost Impact [huffpost.com], NBC Bay Area [nbcbayarea.com] and more
- The Associated Press: 18 wildfires burning across Oregon, Washington force evacuations; thousands without power [apnews.com], Sept. 10, 2022
  - Notable Reposts: MSN [msn.com], OPB [opb.org], SFgate.com, [sfgate.com] US News and World Report [usnews.com], CBS News [cbsnews.com] and more
- The Associated Press: California weather helps firefighters but unleashes floods [apnews.com], Sept. 12, 2022

    - Notable reprints: ABC News [abcnews.go.com], Bloomberg News [bloomberg.com], US News and Report [usnews.com], Fox News [foxnews.com] and more
- Arizona Daily Sun: California and the West broil in record heat wave [nam02.safelinks.protection.outlook.com], Sept. 6, 202
    - Note: This is a partial reprint from an AP piece, but the original did not mention PGE.
- The Banks Post: PGE: 'increasingly likely' chance of power shutoffs in western Washington County starting Friday over wildfire risk [nam02.safelinks.protection.outlook.com], Sept. 8, 2022
    - Notable reprints: Gales Creek Journal [nam02.safelinks.protection.outlook.com]
- Banks Post: Power out in Banks, small brush fire knocked down behind Banks Veterinary Clinic [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- Baker City Herald: Power shut off to thousands in Oregon [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- Breitbart: VIDEO: Oregon Utility Companies Begin Power Cuts amid Wildfire Threat, 40K Possibly Affected [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- Canby First: Rural Residents May Experience Weather-Related Power Shutoffs, Outages [nam02.safelinks.protection.outlook.com], Sept. 7, 2022
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- The Columbian: Clark County under Red Flag Warning for wildfire danger, says NWS Portland [nam02.safelinks.protection.outlook.com], Sept. 8, 2022
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    - Notable reprints: KVIA [nam02.safelinks.protection.outlook.com], KYMA, archyde.com [archyde.com]

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- Curry Coastal Pilot: Be Prepared: State prepares for heightened wildfire danger [nam02.safelinks.protection.outlook.com], Sept. 8, 2022
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- Fox 12: Power returns to Portland's West Hills after safety shutoffs [kptv.com], Sept. 12, 2022
- Gales Creek Journal: PGE opens community resource center at Jim's Market in Banks for charging, ice, info [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
    - Notable reprint: Banks Post [nam02.safelinks.protection.outlook.com]
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- The Hill: Storm's fierce winds complicate California wildfire fight [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- Jefferson Public Radio: Worrisome weekend weather for fire conditions in Oregon and Washington [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- KATU: Power shutoffs begin Friday as Western Oregon, SW Wash. face critical fire danger [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- KATU: Oregon utility companies may shut off power for some due to wildfire danger [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- KATU: Utility companies warn of potential power shutoffs due to fire danger [nam02.safelinks.protection.outlook.com], Sept. 7, 2022
    - Notable reprints: KTVL [nam02.safelinks.protection.outlook.com]
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- KOIN: Fire danger, red flag warning in effect across Oregon and Washington [nam02.safelinks.protection.outlook.com], Sept. 9, 2022
- KOIN: PGE shutting off power at 30,000 homes and businesses [nam02.safelinks.protection.outlook.com], Sept. 8, 2022
- KOIN: Schools announce closures ahead of power shutoffs, fire danger [nam02.safelinks.protection.outlook.com], Sept. 8, 2022
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Broadcast Citations

- Full report & clippings are available HERE [app.criticalmention.com]
    - 378 clips as of 9/11 at 4:30 p.m. PT

Appendix 3. PGE Media Releases from September 2022 PSPS Event

1. PSPS Likely Phase

PGE ANNOUNCES LIKELIHOOD OF PUBLIC SAFETY POWER SHUTOFFS IN 10 AREAS AND POTENTIAL FOR WEATHER-RELATED POWER OUTAGES

Customer safety will drive a decision in the next 24-48 hours

PORTLAND, Ore., Sept. 7th, 2022 —Portland General Electric announced that it is monitoring dangerous, high-risk fire conditions and is increasingly likely to call public safety power shutoffs (PSPSs) in 10 areas that are at a higher fire risk, affecting approximately 30,000 customer meters. A PSPS is when PGE turns off power in a limited, high-risk area to help reduce the risk of wildfire and to help protect people, property, and the environment.

PGE is actively monitoring conditions and will make the decision based on factors including wind speed, temperature, humidity and the dryness of trees and brush, field observations and information from local fire departments and agencies. PGE will continue to monitor conditions for the next 24-48 hours and will provide an update. If conditions persist, PGE aims to provide up to four hours of notice before turning off power.

Weather forecasts indicate strong, gusty winds are predicted across PGE's service area, starting as early as Friday morning. "PGE works year-round to help keep our system safe and resilient from wildfire, including managing over 2.2 million trees along 12,000 miles of power lines," said Larry Bekkedahl, senior vice president of Advanced Energy Delivery, PGE. "However, we are expecting extreme winds that could cause outages. We are preparing to have crews at the ready to begin repairing damage following the high winds, as soon as conditions are safe."

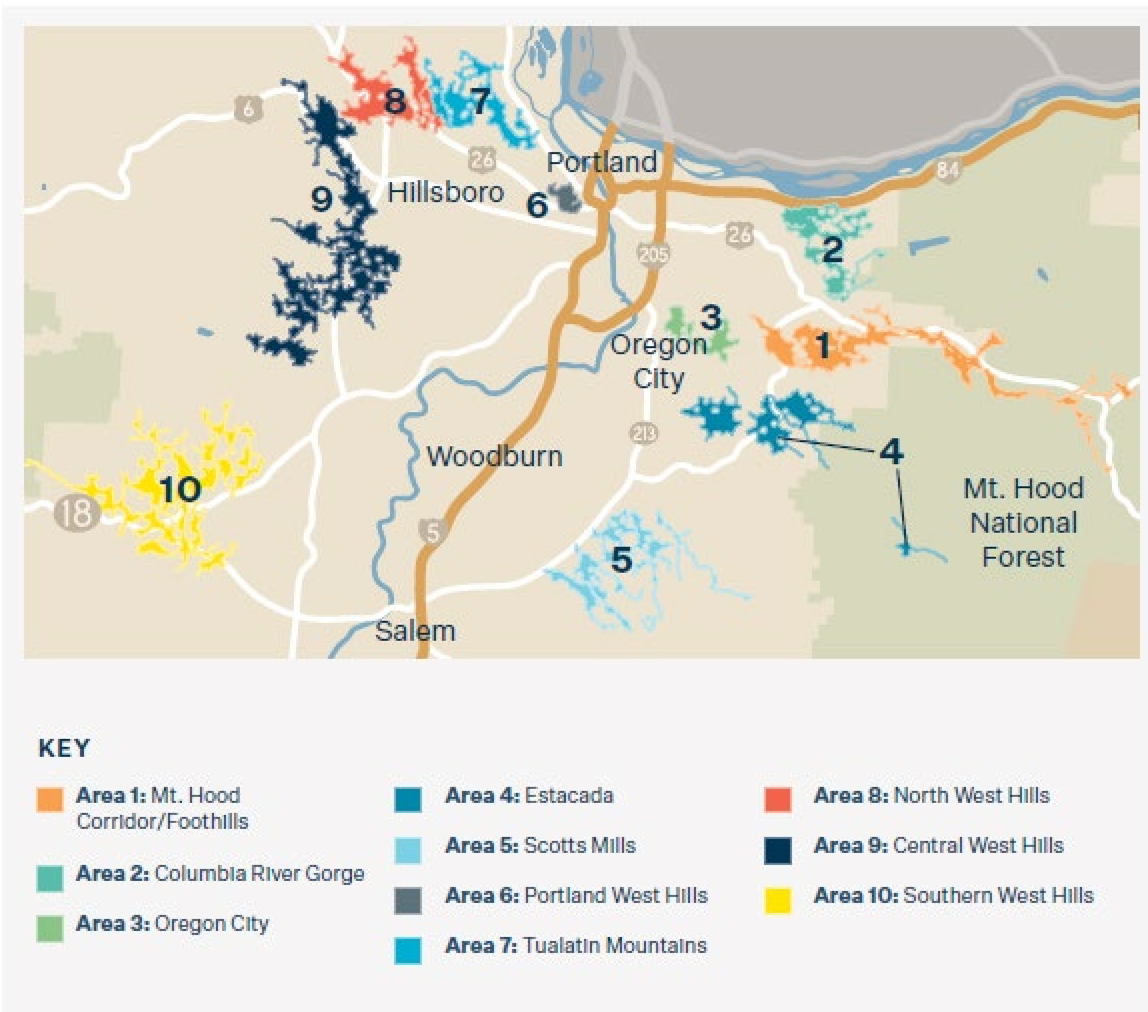
The 10 PSPS areas are shown in the map below. Customers in these areas should check portlandgeneral.com/psps to confirm if their power may be impacted. PGE encourages everyone who may be impacted by a PSPS or a weather-related outage to make an emergency plan and prepare an outage kit using the preparedness information that PGE sent to customers and that is also available on PGE's website.

If PGE calls a PSPS in these areas, PGE will shut off power as long as necessary to protect against the risk of fire. A PSPS can last for multiple days. After weather conditions return to normal, PGE will begin to visually inspect its equipment and make any repairs necessary to safely re-energize lines. Based on current information, PGE estimates a PSPS could be called on Friday morning, and power could be out through Saturday night. Assuming this event duration and no damage to our system, power restoration would begin Sunday morning and power to customers could be restored by Monday night.

If PGE calls a PSPS in these areas, Community Resource Centers will likely be opened to provide information, water, ice, Wi-Fi and access to charging for personal electronics. More information will be provided in future updates.

PGE is communicating directly with customers in the impacted areas and will also communicate through the news media, on portlandgeneral.com/psps and on social media, @PortlandGeneral on Twitter and @PortlandGeneralElectric on Facebook, among other channels.

Customer service is available at 503-228-6322 and service advisors can assist customers in more than 200 languages.



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Contact Info:
PGE Communications, PGECommunications@pgn.com; 503-464-2067

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2. PSPS Imminent Phase

PGE SOLIDIFIES PLANS FOR PUBLIC SAFETY POWER SHUTOFF IN 10 PSPS AREAS

Given expected weather conditions PGE also asks all customers to prepare for outages

PORTLAND, Ore., Sept. 8, 2022 – Due to the imminent high, gusty winds during extreme fire conditions, Portland General Electric announced today that it will initiate a public safety power shutoff (PSPS) for approximately 30,000 customer homes and businesses located in 10 designated PSPS areas and two additional areas with high fire risk. The 10 designated PSPS areas are as follows: Mt. Hood Corridor and Foothills (Area 1); Columbia River Gorge (Area 2); Oregon City (Area 3); Estacada (Area 4); Scotts Mills (Area 5); Portland West Hills (Area 6); Tualatin Mountains (Area 7); Northwest Hills (Area 8); Central West Hills (Area 9); and Southern West Hills (Area 10). In partnership with local officials, we are also planning preventive outages in two additional areas: Silverdale/Corbett and Silver Falls. These actions are a proactive measure to reduce the risk of wildfire during these extreme fire conditions and to help protect people, property and the communities we serve.

Winds are expected to increase overnight at higher elevations and move across our service territory through Friday morning into the afternoon. The most critical weather conditions are anticipated for late Friday evening into Saturday morning. Based on current information, PGE estimates public safety power shutoffs in PSPS areas will start Friday morning between 12:00 a.m. and noon. If the event duration is as anticipated and assuming there is no damage to our system, power restoration could begin as early as Saturday evening. Damage to our equipment and/or system could create delays in restoration timing.

Estimated power shut off start times by area for Friday, Sept. 9 are as follows:

- Area 1: 3:00 a.m.-6:00 a.m.
- Area 2: 5:00 a.m.-8:00 a.m.
- Area 3: 8:00 a.m.-11:00 a.m.
- Area 4: 3:00 a.m.-6:00 a.m.
- Area 5: 5:00 a.m.-8:00 a.m.
- Areas 6, 7, 8 and 9: 10:00 a.m.-1:00 p.m.
- Area 10: 11:00 a.m.-2:00 p.m.

In addition, while the following areas are not in the designated high fire risk zones or in the PSPS areas, because of the imminent high winds, the extreme fire conditions currently found in Oregon and in partnership with local officials, the areas of Silverdale/Corbett and Silver Falls will also experience preventive outages. We expect the outages for these two areas to start Friday, Sept. 9 between 5:00 a.m. and 8:00 a.m.

Crews will be standing by, and as weather conditions allow PGE, will begin to physically inspect power lines and equipment and make any repairs necessary to safely restore power. PGE will provide updates at least every 24 hours until all customers regain power through email, text, social media, press releases, and at portlandgeneral.com.

At this time, PGE customers, and particularly those located in the 10 designated PSPS areas should go to portlandgeneral.com/psps and confirm if power to their address is scheduled to be turned off. After shutoff customers will receive an email and/or text notification confirming we are aware their power is out.

Weather conditions, particularly the high wind, create the potential for outages both within and outside of the high fire risk zones, so we encourage all customers to prepare to activate their emergency plan, gather their outage kit and if they rely on electricity for medical needs, implement their backup plan. Additionally, given the extreme weather conditions, PGE encourages all customers to be aware of their surroundings, pay extra attention to signage and to avoid downed power lines.

To help affected customers and communities during the event, PGE currently plans to open at least 5 Community Resource Centers from 7:00 a.m. to 7:00 p.m. every day, until power is fully restored to the areas. Information, bottled water, ice, access to charging for personal devices and Wi-Fi will be available. More information can be found on portlandgeneral.com/psps; current planned locations include:

- Area 1: Welches Elementary School, 24901 E Salmon River Rd, Welches
- Area 1, 2, 3, 4: Estacada Baptist Church, 29101 SE Eagle Creek Rd, Estacada
- Area 5: Silverton Safeway, 301 Westfield St, Silverton
- Area 7,8, 9: Banks Jim's Thriftway, 12350 NW Main St, Banks
- Area 9,10: Sheridan High School, 433 S Bridge St., Sheridan

PGE is communicating directly with customers in the impacted areas and is raising awareness through news media, social media and other channels. Customers can find the latest information on portlandgeneral.com and on social media -- @PortlandGeneral on Twitter and @PortlandGeneralElectric on Facebook. Customers can speak with customer service advisors by calling 503-228-6322. Our advisors can provide assistance in more than 200 languages.

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3. PSPS Happening Phase

PGE SHUTS POWER OFF TO HELP KEEP CUSTOMERS, COMMUNITIES SAFE

Dangerous conditions, extreme fire danger expected to prolong outage

PORTLAND, Ore., Sept. 9, 2022 – As of 1 p.m. today, PGE turned off power to approximately 30,000 customer homes and businesses located in 10 designated PSPS areas and two additional areas with high fire risk as a safety measure to help protect people, property and the environment.

The 10 designated PSPS areas are as follows: Mt. Hood Corridor and Foothills (Area 1); Columbia River Gorge (Area 2); Oregon City (Area 3); Estacada (Area 4); Scotts Mills (Area 5); Portland West Hills (Area 6); Tualatin Mountains (Area 7); Northwest Hills (Area 8); Central West Hills (Area 9); and Southern West Hills (Area 10).

In partnership with local officials, PGE also implemented preventive outages in two additional areas: Silverdale/Corbett and Silver Falls. PGE turned off power in these limited areas with higher risk of fire in response to unique and extreme weather conditions. If there is need identified by PGE and emergency responders to proactively shut off power in other areas to protect people and property, we will do so.

If the event duration is as anticipated and assuming there is no damage to our system, power restoration could begin as early as Saturday evening. Damage to our equipment and/or system could create delays in restoration timing. To help reduce the impact on affected customers and communities, PGE will provide updates at least every 24 hours until power is fully restored.

PGE Community Resource Centers are open from 7:00 a.m. to 7:00 p.m. every day, until power is fully restored to the areas. Information, bottled water, ice, access to charging for personal devices and Wi-Fi will be available. More information can be found on portlandgeneral.com/psps; locations include:

- Area 1: Welches Elementary School, 24901 E Salmon River Rd, Welches
- Area 1, 2, 3, 4: Estacada Baptist Church, 29101 SE Eagle Creek Rd, Estacada
- Area 5: Silverton Safeway, 301 Westfield St, Silverton
- Area 7,8, 9: Banks Jim's Thriftway, 12350 NW Main St, Banks
- Area 9,10: Sheridan High School, 433 S Bridge St., Sheridan

The State of Oregon and several counties are also providing resources. Call 2-1-1 or 1-866-698-6155 for a complete list of resources in your area.

PGE will monitor conditions and as soon as weather conditions return to normal, will begin inspecting all power lines and equipment to make necessary repairs so lines and equipment can be safely re-energized. PGE, contract and mutual assistance crews are preparing the system for restoration and responding to unplanned outages caused by high gusty winds, and when weather normalizes, will work as quickly as safety allows to restore power.

PGE will continue communicating directly with customers in the impacted areas and will share information with news media, social media and other channels. Customers can find the latest information on portlandgeneral.com/psps, by following PGE on social media -- @PortlandGeneral on Twitter and @PortlandGeneralElectric on Facebook or by calling customer service at 503-228-6322. Our advisors can provide assistance in more than 200 languages.

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4. Preventative Outage Area De-Energization Announcement

PGE SHUTS OFF POWER IN FIVE NEW AREAS OVERNIGHT

High winds and emergency response necessitate unplanned outages

PORTLAND, Ore., Sept. 10, 2022 – As of 5:00 a.m. today, PGE has turned off power in limited portions of five new areas, increasing the total number of preventive power outages to help reduce the risk of wildfire to seven since early Friday morning. We currently have a total of approximately 37,000 customer homes and businesses currently without power.

The five new preventive power outages occurred in limited portions of Southwest Scotts Mills, South Molalla, George, Colton and Sandy, affecting approximately 1,675 customers. These areas were at higher risk of fire given unique and extreme weather conditions including strong wind gusts of up to 40 MPH, which also necessitated a location change for one of PGE's Community Resource Center locations. De-energization decisions are made in partnership with local government partners and fire agencies to help protect people and property by mitigating fire potential as strong dry winds, low relative humidity and an unstable atmosphere exacerbate fire conditions statewide.

Current forecasts predict extreme weather conditions to subside this afternoon. Unless conditions change and assuming no damage to PGE's system, power restoration could begin as early as this evening. Damage to our equipment and/or system could delay efforts to restore power to customers. PGE will continue providing updates at least every 24 hours until power is fully restored.

To help reduce the impact on affected customers and communities, PGE Community Resource Centers will remain open from 7:00 a.m. to 7:00 p.m. every day, until power is fully restored to the areas. Information, bottled water, ice, access to charging for personal devices and Wi-Fi will be available. More information is available on portlandgeneral.com/psps; locations include:

Welches Elementary School, 24901 E Salmon River Rd, Welches

Firwood Elementary School, 42900 SE Trubel Rd, Sandy

Silverton Safeway, 301 Westfield St, Silverton

Banks Jim's Thriftway, 12350 NW Main St, Banks

Sheridan High School, 433 S Bridge St., Sheridan

The State of Oregon and several counties are also providing resources. Call 2-1-1 or 1-866-698-6155 for a complete list of resources in impacted areas. As soon as weather conditions safely allow, PGE will begin inspecting all power lines and equipment to make any necessary repairs to lines and equipment so power can be safely turned on. PGE, contract and mutual assistance crews are preparing for restoration and responding to unplanned outages caused by high gusty winds. PGE will continue communicating with customers in the impacted areas and will share information with news media, social media and other channels. Customers can find the latest information on portlandgeneral.com/psps, by following PGE on social media -- @PortlandGeneral on Twitter and @PortlandGeneralElectric on Facebook or by calling customer service at 503-228-6322. Our advisors can provide assistance in more than 200 languages.

5. Restoration Begins Phase

WORK BEGINS TO RESTORE POWER FOR PGE CUSTOMERS

Crews at work re-energizing and restoring part of PGE's system following safety-related shutoffs

PORTLAND, Ore., Sept. 10, 2022 – Service is starting to come back on for 5,365 Portland General Electric customers in the Southern West Hills and restoration efforts are underway for another 9,385 customers in the Scotts Mills, Central West Hills, North West Hills and Tualatin Mountain areas among 10 Public Safety Power Shutoff (PSPS) areas. Restoration efforts are also underway in Silver Falls, an area where PGE proactively turned power off in response to strong wind gusts and extreme fire conditions to help protect people and communities. Estimated restoration times for these areas will be available on portlandgeneral.com/outages.

Conditions in these areas began returning to normal earlier today, allowing PGE crews, contractors, and mutual assistance crews from Avista, BC Hydro, PG&E and the Snohomish Public Utility District to begin patrolling and visually inspecting all PGE lines and equipment. Repairs were not needed on the main backbone in the Southern West Hills area, allowing power to be turned on for some customers. Restoration is expected to start in PSPS areas including Scotts Mills, Central West Hills, North West Hills and Tualatin Mountain, and in Silver Falls, which was shut off as a preventive measure. Restoration will begin in these areas if patrols and inspections indicate conditions are safe.

Strong winds continue gusting in the remaining five PSPS areas and in six additional areas where PGE implemented preventive power shutoffs in partnership with local government officials and fire agencies. Current weather conditions are stabilizing in our southwest service area, however gusty winds near Mt. Hood are anticipated to bring extreme conditions later this evening. When weather conditions allow, crews will begin patrolling, inspecting and repairing any damaged lines and equipment so that power may safely be restored.

Safety is our top concern. PGE appreciates the patience of customers who have been without power and those waiting for their service to be restored and will continue providing updates at least every 24 hours on portlandgeneral.com/psps. Crews will work as soon as weather allows and then as quickly as safely possible to restore the remaining approximately 17,000 customers affected by PGE's proactive outages.

To help affected customers and communities during the event, PGE currently will continue operating 5 Community Resource Centers from 7:00 a.m. to 7:00 p.m. every day, until power is fully restored in all areas. Information, bottled water, ice, access to charging for personal devices and Wi-Fi will be available.

- Welches Elementary School, 24901 E Salmon River Rd, Welches

- Firwood Elementary School, 42900 SE Trubel Rd, Sandy
- Silverton Safeway, 301 Westfield St, Silverton
- Banks Jim's Thriftway, 12350 NW Main St, Banks
- Sheridan High School, 433 S Bridge St., Sheridan

The latest information and updates are available on portlandgeneral.com/psps and through customer service at 503-228-6322, where representatives can assist in more than 200 languages. PGE is also providing updates on Facebook and Twitter, in addition to direct communications with customers.

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About Portland General Electric Company: Portland General Electric (NYSE: POR) is a fully integrated energy company based in Portland, Oregon. The company serves approximately 900,000 customers with a service area population of 2 million Oregonians in 51 cities. PGE owns 16 generation plants across Oregon and other Northwestern states and maintains and operates 14 public parks and recreation areas. For more than 130 years, PGE has powered the advancement of society, delivering safe, affordable, and reliable energy to Oregonians. PGE and its approximately 3,000 employees are working with customers to build a clean energy future. Together with its customers, PGE has the No. 1 voluntary renewable energy program in the U.S. PGE is committed to achieving at least an 80% reduction in greenhouse gas emissions from power served to customers by 2030 and 100% reduction by 2040. In 2021, PGE became the first U.S. utility to join The Climate Pledge. For the eighth year in a row PGE achieved a perfect score on the 2021 Human Rights Campaign Foundation's Corporate Equality Index, a national benchmarking survey and report on corporate policies and practices related to LGBTQ workplace equality. In 2021, PGE, employees, retirees, and the PGE Foundation donated $4.8 million and volunteered 15,760 hours with more than 300 nonprofits across Oregon. For more information visit www.PortlandGeneral.com/news.

Contact Info:
PGE Communications, PGECommunications@pgn.com; 503-464-2067

6. Restoration Complete Phase

PGE RESTORES POWER TO ALL CUSTOMERS IMPACTED BY PUBLIC SAFETY POWER SHUTOFF

PGE, contractors and mutual assistance crews complete safety-related inspections, repairs.

PORTLAND, Ore., Sept. 11, 2022 — Today, Portland General Electric finalized restoration to customers impacted by the company's proactive public safety power shut-off (PSPS) and preventive power shutoffs implemented on Sept. 9 and 10. These safety measures affecting

17 areas and approximately 37,000 customers were taken in response to extreme fire conditions and hot, strong wind gusts.

"PGE appreciates our customers' patience as we prioritized the safety of people and communities where we work, live and serve," said Larry Bekkedahl, senior vice president of Advanced Energy Delivery, PGE. "This critical work was completed through close collaboration with community leaders and emergency responders."

Nearly 500 operational personnel including 112 PGE, contractor and mutual assistance crews worked around-the-clock shifts patrolling, inspecting and making necessary repairs to safely restore power from PSPS and preventive outages.

PGE's Community Resource Centers served approximately 2475 people during the course of the event, providing access to charging for personal electronics, Wi-Fi and distributing ice and water.

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Contact Info:

PGE Communications, PGECommunications@pgn.com; 503-464-2067

Appendix 4. PGE Local, State, Federal Government and Community-Based Organization Email Contacts During September 2022 PSPS Event, by Event Phase

Date	Time	Type of Log Item	Activity Information	Organization
9/7/2022	9:53 a.m.	email	likely; 48-72 hours	Governor's office
9/7/2022	9:56 a.m.	email	likely; 48-72 hours	OEM
9/7/2022	10:01 a.m.	email	likely; 48-72 hours	ODOE
9/7/2022	10:26 a.m.	email	likely; 48-72 hours	Congress
9/7/2022	7:22 p.m.	email	imminent; 24-48 hours	Governor's office
9/7/2022	7:27 p.m.	email	imminent; 24-48 hours	OEM
9/7/2022	7:32 p.m.	email	imminent; 24-48 hours	ODOE
9/7/2022	7:30 p.m.	email	imminent; 24-48 hours	Congress
9/8/2022	8:37 p.m.	email	happening; 1-4 hours	Governor's office
9/8/2022	8:38 p.m.	email	happening; 1-4 hours	OEM
9/8/2022	8:39 p.m.	email	happening; 1-4 hours	ODOE
9/8/2022	8:41 p.m.	email	happening; 1-4 hours	Congress
9/8/2022	10:39 p.m.	email	in progress	Governor's office
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	1:01 p.m.	email	in progress	Governor's office
9/9/2022	1:06 p.m.	email	in progress	OEM
9/9/2022	1:08 p.m.	email	in progress	ODOE
9/9/2022	1:12 p.m.	email	in progress	Congress
9/10/2022	12:28 p.m.	email	in progress	Governor's office
9/10/2022	12:31 p.m.	email	in progress	OEM
9/10/2022	12:33 p.m.	email	in progress	ODOE
9/10/2022	12:37 p.m.	email	in progress	Congress

Date	Time	Type of Log Item	Activity Information	Organization
9/10/2022	3:26 p.m.	email	re-energization	Governor's office
9/10/2022	3:32 p.m.	email	re-energization	OEM
9/10/2022	3:35 p.m.	email	re-energization	ODOE
9/10/2022	3:36 p.m.	email	re-energization	Congress
9/10/2022	3:46 p.m.	email	re-energization	Congress
9/10/2022	5:24 p.m.	email	re-energization	Governor's office
9/10/2022	5:25 p.m.	email	re-energization	OEM
9/10/2022	5:26 p.m.	email	re-energization	ODOE
9/10/2022	5:27 p.m.	email	re-energization	Congress
9/10/2022	5:28 p.m.	email	re-energization	Congress
9/11/2022	9:14 a.m.	email	re-energization	Governor's office
9/11/2022	9:15 a.m.	email	re-energization	OEM
9/11/2022	9:16 a.m.	email	re-energization	ODOE
9/11/2022	9:17 a.m.	email	re-energization	Congress
9/11/2022	9:18 a.m.	email	re-energization	Congress
9/11/2022	2:34 p.m.	email	re-energization	Governor's office
9/11/2022	2:34 p.m.	email	re-energization	OEM
9/11/2022	2:35 p.m.	email	re-energization	ODOE
9/11/2022	2:36 p.m.	email	re-energization	Congress
9/11/2022	2:36 p.m.	email	re-energization	Congress
9/11/2022	4:05 p.m.	email	re-energization	Governor's office
9/11/2022	4:06 p.m.	email	re-energization	OEM
9/11/2022	4:06 p.m.	email	re-energization	ODOE
9/11/2022	4:06 p.m.	email	re-energization	Congress
9/11/2022	4:06 p.m.	email	re-energization	Congress
9/11/2022	5:05 p.m.	email	re-energization	Governor's office
9/11/2022	5:05 p.m.	email	re-energization	OEM
9/11/2022	5:06 p.m.	email	re-energization	ODOE
9/11/2022	5:06 p.m.	email	re-energization	Congress
9/11/2022	5:07 p.m.	email	re-energization	Congress
9/11/2022	6:27 p.m.	email	re-energization	Governor's office
9/11/2022	6:28 p.m.	email	re-energization	OEM

Date	Time	Type of Log Item	Activity Information	Organization
9/11/2022	6:28 p.m.	email	re-energization	ODOE
9/11/2022	6:28 p.m.	email	re-energization	Congress
9/11/2022	6:28 p.m.	email	re-energization	Congress
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	9:48 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	9:53 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	9:56 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	9:59 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	10:00 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	10:02 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	10:04 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	10:05 a.m.	email	likely; 48-72 hours	Legislators
9/7/2022	7:38 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:40 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:41 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:43 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:44 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:47 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:48 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:49 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:49 p.m.	email	imminent; 24-48 hours	Legislators
9/7/2022	7:51 p.m.	email	imminent; 24-48 hours	Legislators
9/8/2022	8:50 p.m.	email	happening; 1-4 hours	Legislators

Date	Time	Type of Log Item	Activity Information	Organization
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	10:24 a.m.	email	in progress	Legislators
9/9/2022	12:20 p.m.	email	in progress	Legislators
9/9/2022	12:38 p.m.	email	in progress	Legislators
9/9/2022	1:19 p.m.	email	in progress	Legislators
9/9/2022	1:31 p.m.	email	in progress	Legislators
9/9/2022	1:39 p.m.	email	in progress	Legislators
9/9/2022	1:40 p.m.	email	in progress	Legislators
9/10/2022	3:41 p.m.	email	re-energization	Legislators
9/10/2022	4:50 p.m.	email	re-energization	Legislators
9/10/2022	5:40 p.m.	email	re-energization	Legislators
9/10/2022	5:55 p.m.	email	re-energization	Legislators
9/10/2022	5:58 p.m.	email	re-energization	Legislators
9/10/2022	6:05 p.m.	email	re-energization	Legislators
9/10/2022	6:06 p.m.	email	re-energization	Legislators
9/10/2022	6:09 p.m.	email	re-energization	Legislators
9/10/2022	6:40 p.m.	email	re-energization	Legislators
9/11/2022	9:22 a.m.	email	complete	Legislators
9/11/2022	1:21 p.m.	email	complete	Legislators
9/11/2022	1:27 p.m.	email	complete	Legislators
9/11/2022	4:33 p.m.	email	complete	Legislators
9/11/2022	5:25 p.m.	email	complete	Legislators
9/11/2022	5:43 p.m.	email	complete	Legislators
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	9:47 a.m.	text	likely; 48-72 hours	ODOT
9/7/2022	9:50 a.m.	email	likely; 48-72 hours	ODOT
9/7/2022	9:07 p.m.	email	imminent; 24-48 hours	ODOT
9/8/2022	8:41 p.m.	email	happening; 1-4 hours	ODOT
9/8/2022	8:48 p.m.	text	happening; 1-4	ODOT

Date	Time	Type of Log Item	Activity Information	Organization
			hours	
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	11:11 a.m.	email	in progress	ODOT
9/10/2022	1:43 p.m.	email	in progress	ODOT
9/10/2022	4:00 p.m.	email	re-energization	ODOT
9/10/2022	8:12 p.m.	email	re-energization	ODOT
9/11/2022	7:17 p.m.	email	re-energization	ODOT
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/12/2022	8 a.m.	email	complete	ODOT
9/7/2022	9:54 a.m.	email	likely; 48-72 hours	Clackamas county and cities
9/8/2022	8:34 p.m.	email	happening; 1-4 hours	Clackamas county and cities
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	7:58 a.m.	email	in progress	Clackamas county and cities
9/11/2022	5:41 p.m.	email	complete	Clackamas county and cities
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	10:10 a.m.	email	likely; 48-72 hours	ODHS
9/8/2022	7:10 a.m.	email	imminent; 24-48 hours	ODHS
9/8/2022	8:55 a.m.	email	imminent; 24-48 hours	CBO's, schools, food banks
9/8/2022	9:07 p.m.	email	happening; 1-4 hours	ODHS
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/10/2022	3:29 p.m.	email	re-energization	ODHS
9/10/2022	8:51 p.m.	email	re-energization	CBO's, schools, food banks

Date	Time	Type of Log Item	Activity Information	Organization
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/13/2022	8:32 a.m.	email	complete; data provided	ODHS
9/14/2022	11:22 a.m.	email	complete; data provided	ODHS
9/7/2022	9:49 a.m.	email	likely; 48-72 hours	Governor's office
9/7/2022	11:09 a.m.	email	likely; 48-72 hours	Governor's office
9/7/2022	9:27 p.m.	email	imminent; 24-48 hours	Governor's office
9/8/2022	8:33 p.m.	email	happening; 1-4 hours	Governor's office
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	10:22 a.m.	email	in progess	Governor's office
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	10:25 a.m.	email	likely; 48-72 hours	Washington/Columbia counties and cities
9/7/2022	4:59 p.m.	email	imminent; 24-48 hours	Washington/Columbia counties and cities
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	10:03 a.m.	email	likely; 48-72 hours	Marion county and cities
9/7/2022	10:06 a.m.	email	likely; 48-72 hours	Marion county and cities
9/7/2022	10:08 a.m.	email	likely; 48-72 hours	Marion county and cities
9/7/2022	8:14 p.m.	email	imminent; 24-48 hours	Marion county and cities
9/7/2022	8:15 p.m.	email	imminent; 24-48 hours	Marion county and cities

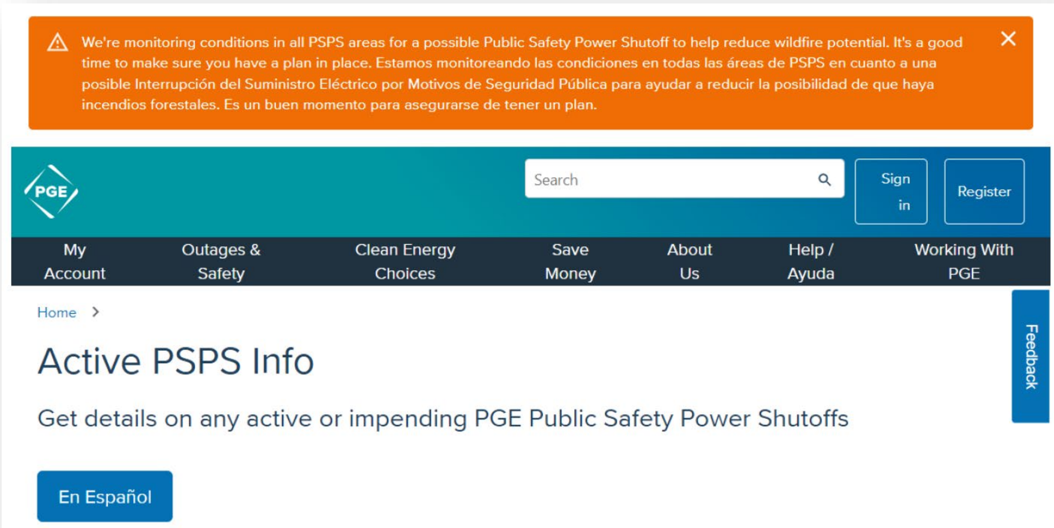
Date	Time	Type of Log Item	Activity Information	Organization
9/7/2022	8:15 p.m.	email	imminent; 24-48 hours	Marion county and cities
9/8/2022	8:28 p.m.	email	happening; 1-4 hours	Marion county and cities
9/8/2022	8:36 p.m.	email	happening; 1-4 hours	Marion county and cities
9/8/2022	8:37 p.m.	email	happening; 1-4 hours	Marion county and cities
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	10:23 a.m.	email	in progress	Marion county and cities
9/10/2022	3:47 p.m.	email	re-energization	Marion county and cities
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	9:50 a.m.	email	likely; 48-72 hours	Yamhill county and cities
9/7/2022	9:53 a.m.	email	likely; 48-72 hours	Yamhill county and cities
9/7/2022	9:58 a.m.	email	likely; 48-72 hours	Yamhill county and cities
9/7/2022	10:12 a.m.	email	likely; 48-72 hours	Yamhill county and cities
9/7/2022	10:18 a.m.	email	likely; 48-72 hours	Yamhill county and cities
9/7/2022	10:33 a.m.	email	likely; 48-72 hours	Yamhill county and cities
9/7/2022	8:11 p.m.	email	imminent; 24-48 hours	Yamhill county and cities
9/7/2022	8:13 p.m.	email	imminent; 24-48 hours	Yamhill county and cities
9/7/2022	8:14 p.m.	email	imminent; 24-48 hours	Yamhill county and cities
9/7/2022	8:16 p.m.	email	imminent; 24-48 hours	Yamhill county and cities
9/7/2022	8:16 p.m.	email	imminent; 24-48	Yamhill county and

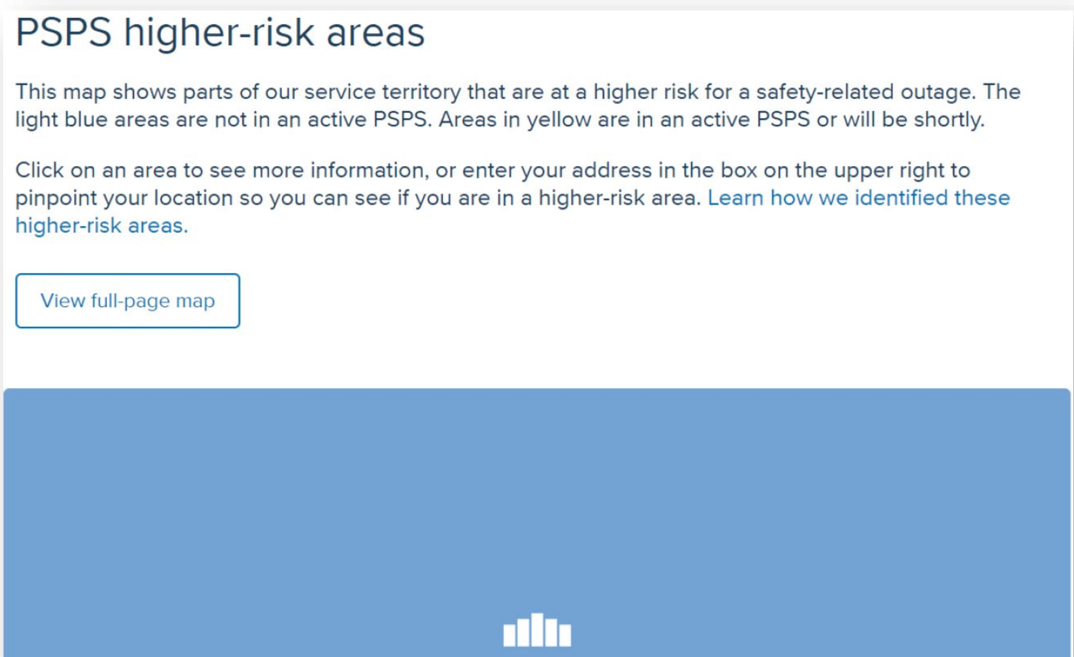
Date	Time	Type of Log Item	Activity Information	Organization
			hours	cities
9/8/2022	8:28 a.m.	email	happening; 1-4 hours	Yamhill county and cities
9/8/2022	8:32 p.m.	email	happening; 1-4 hours	Yamhill county and cities
9/8/2022	8:43 p.m.	email	happening; 1-4 hours	Yamhill county and cities
9/8/2022	8:46 p.m.	email	happening; 1-4 hours	Yamhill county and cities
9/8/2022	8:53 p.m.	email	happening; 1-4 hours	Yamhill county and cities
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/10/2022	3:21 p.m.	email	re-energization	Yamhill county and cities
9/10/2022	3:46 p.m.	email	re-energization	Yamhill county and cities
9/10/2022	3:46 p.m.	email	re-energization	Yamhill county and cities
9/10/2022	3:47 p.m.	email	re-energization	Yamhill county and cities
9/10/2022	3:48 p.m.	email	re-energization	Yamhill county and cities
9/10/2022	3:48 p.m.	email	re-energization	Yamhill county and cities
9/10/2022	3:49 p.m.	email	re-energization	Yamhill county and cities
9/10/2022	3:51 p.m.	email	re-energization	Yamhill county and cities
9/11/2022	5:19 p.m.	email	complete	Yamhill county and cities
9/11/2022	5:22 p.m.	email	complete	Yamhill county and cities
9/11/2022	5:25 p.m.	email	complete	Yamhill county and cities
9/11/2022	5:27 p.m.	email	complete	Yamhill county and cities
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts

Date	Time	Type of Log Item	Activity Information	Organization
9/7/2022	10:30 a.m.	email	likely; 48-72 hours	Wasco county
9/8/2022	8:50 p.m.	email	happening; 1-4 hours	Wasco county
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/10/2022	3:50 p.m.	email	re-energization	Wasco county
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	10:27 a.m.	email	likely; 48-72 hours	Hood River county
9/8/2022	8:49 p.m.	email	happening; 1-4 hours	Hood River county
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/10/2022	3:50 p.m.	email	re-energization	Hood River county
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	10:24 a.m.	email	likely; 48-72 hours	Polk county
9/7/2022	8:17 p.m.	email	imminent; 24-48 hours	Polk county
9/8/2022	8:48 p.m.	email	happening; 1-4 hours	Polk county
9/9/2022	2:17 a.m.	email	in progress	All GA, LGA contacts
9/9/2022	6:01 a.m.	email	in progress	All GA, LGA contacts
9/10/2022	3:49 p.m.	email	re-energization	Polk county
9/11/2022	11:10 p.m.	email	complete	All GA, LGA contacts
9/7/2022	9:53 a.m.	email	likely; 48-72 hours	Governor's office

Appendix 5. PGE Website Updates During September 2022 PSPS Event

PSPS Likely Phase





We’re here to help

We hope we don’t have to call a Public Safety Power Shutoff this fire season, but if we do, we’ll likely set up a mobile Community Resource Center to provide some relief. Learn more in this video.

portlandgeneral.com/pspsinfo >>

معلومات متوفرة بلغتك	情報を見る	Macluumaad Kuqoran Luuqadaada
သင့်ဘာသာစကားဖြင့် အချက်အလက်	사용자 언어로 정보 확인	Información en su idioma
以您母语提供的信息	Tuáñr zuban ot mazé maaluma	Taarifa katika Lugha Yako
以您母語提供的資訊	Informații în limba dvs.	Thông tin trong ngôn ngữ của quý vị
اطلاعات به زبان شما	Информация на вашем языке	

Active PSPS FAQs

Find answers to common questions about any active Public Safety Power Shutoffs here. You can also find general FAQs about what a PSPS is or why we would call one on our Wildfire Outages page.

How long could power be out in a PSPS?

Why was my area designated as a PSPS area?

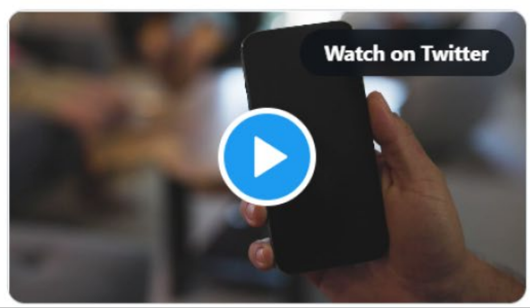
Will a Community Resource Center be available in every PSPS zone?

Media gallery

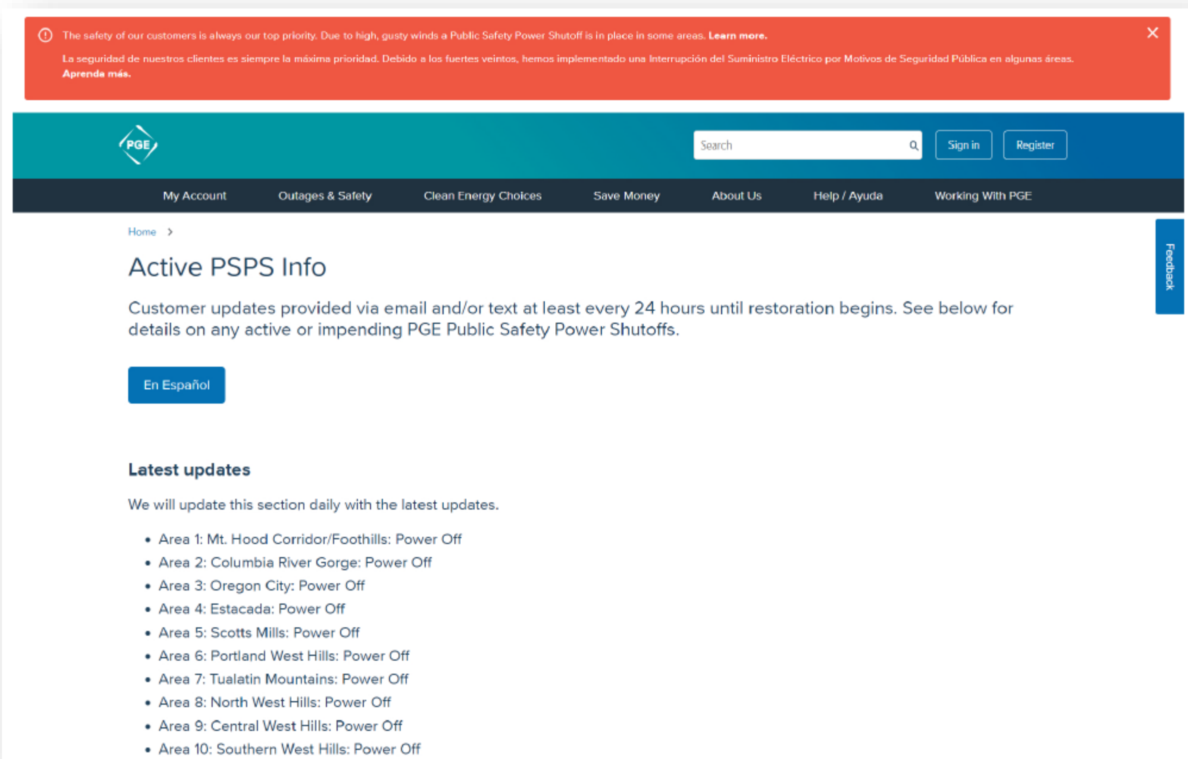
Looking for visuals? Find photos, b-roll and other resources on our Media Gallery.

Portland General
@portlandgeneral · **Follow**

We all want energy that's reliable, affordable and sustainable. When you shift your energy use during times of high demand, you help use more sustainable energy resources that help build a clean energy future for everyone. **bit.ly/3AwzKEJ**

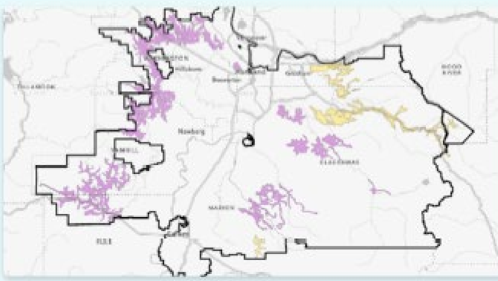


Event Happening Phase



In addition, while the following areas are not in the designated high fire risk zones or in the PSPS areas, because of the imminent high winds, the extreme fire conditions currently found in Oregon and in partnership with local officials, the areas below will also experience preventive outages.

- Preventive Outage Area - Silver Falls: Power Off
- Preventive Outage Area - Silverdale/Corbett: Power Off
- Preventive Outage Area - Southwest Scotts Mills: Power Off
- Preventive Outage Area - South Molalla: Power Off
- Preventive Outage Area - George: Power Off
- Preventive Outage Area - Colton: Power Off
- Preventive Outage Area - North Sandy: Power Off



PSPS higher-risk areas

The interactive map allows you to click on an area to see more information. Enter your address in the search box to pinpoint your location so you can see if you are in a higher-risk area. Learn how we identified these higher-risk areas. Areas in yellow are in an active PSPS or will be shortly. The light purple areas are in a high-risk area but not currently in an active PSPS.

View Live Map

Change(s) Requested	Date	Time	Time Completed
PSPS Warning (72-48 Hours Prior)			
Mobile Banner Update 48 - 72 hours (English)	9/7/2022	10:38 AM	11:04 AM
Mobile Banner Update 48 - 72 hours (Spanish)	9/7/2022	10:38 AM	11:04 AM
Website Banner Update 48 - 72 hours (English)	9/7/2022	10:38 AM	11:04 AM
Website Banner Update 48 - 72 hours (Spanish)	9/7/2022	10:38 AM	11:04 AM
Mobile Banner Update 48 - 72 hours (Spanish)	9/7/2022	11:58 AM	12:53 PM
Website Banner Update 48 - 72 hours (Spanish)	9/7/2022	11:58 AM	12:53 PM
Mobile Banner Update 24 - 48 (English)	9/7/2022	5:30 p.m.	6 p.m.
Mobile Banner Update 24 - 48 (Spanish)	9/7/2022	5:30 p.m.	6 p.m.
Website Banner Update 24- 48 hours (English)	9/7/2022	5:30 p.m.	6 p.m.
Website Banner Update 24 - 48 hours (Spanish)	9/7/2022	5:30 p.m.	6 p.m.
Published Active PSPS page	9/7/2022	5:30 p.m.	6 p.m.
Wildfire Outage Page - CTA for Active PSPS	9/7/2022	6:30 p.m.	8:00 p.m.
Can we make the home page alert banner clickable in the meantime to go straight to Wildfire Outages & PSPS?	9/8/2022	11:00 AM	1:10 PM
Updated /psps vanity URL to direct to Wildfire Outages page	9/8/2022	9:50 AM	9:50 AM
Update active PSPS web page info in English & Spanish	9/8/2022	9:50 AM	
Update PSPS CTA block on wildfire outages page in English and Spanish	9/8/2022	9:50 AM	
Update CRC location information on PSPS web page in English & Spanish	9/8/2022	9:50 AM	
Add the /active-psps-info link to the left nav to be published when we move to imminent.	9/8/2022	10:00 AM	4:00 PM
Please add a line: Learn more about how to prepare and what to expect. and make the sentence a link to */outages-safety/wildfire-outages*	9/8/2022	11:00 AM	1:10 PM
Copy updates to Active PSPS page	9/8/2022	1:15 PM	
Posted new GIS map	9/8/2022	8:30 AM	3:00 PM
portlandgeneral.com/psps." (including the period) be made to correct a linking issue from this website	9/8/2022	11:55 AM	12:20 PM
Event Likely (48-24 Hours Prior)			
Can we make the home page alert banner clickable in the meantime to go straight to Wildfire Outages & PSPS?	9/8/2022	11:00 AM	1:10 PM
Update active PSPS web page info in English & Spanish	9/8/2022	9:50 AM	

Change(s) Requested	Date	Time	Time Completed
Update PSPS CTA block on wildfire outages page in English and Spanish	9/8/2022	9:50 AM	
Update CRC location information on PSPS web page in English & Spanish	9/8/2022	9:50 AM	
Add the /active-psps-info link to the left nav to be published when we move to imminent.	9/8/2022	10:00 AM	
Please add a line: Learn more about how to prepare and what to expect. and make the sentence a link to */outages-safety/wildfire-outages*	9/8/2022	11:00 AM	4:00 PM
Copy updates to Active PSPS page	9/8/2022	1:15 PM	1:10 PM
Posted new GIS map	9/8/2022	8:30 AM	
portlandgeneral.com/psps." (including the period) be made to correct an linking issue from this website	9/8/2022	11:55 AM	3:00 PM
Update En Espanol button to go to Active PSPS in Spanish page	9/8/2022	3:30 PM	12:20 PM
Update active PSPS web page info in English & Spanish	9/8/2022	9:50 AM	3:35 PM
PSPS Imminent (4-1 Hours Prior)			
Mobile Banner Update 1-4 hours (English)	9/8/2022	10:00 PM	
Mobile Banner Update 1-4 (Spanish)	9/8/2022	10:00 PM	
Website Banner Update 1-4 (English)	9/8/2022	10:00 PM	
Website Banner Update 1-4 (Spanish)	9/8/2022	10:00 PM	
Made updates to active PSPS page	9/8/2022	10:00 PM	
Updated all English and Spanish redirects for Event Imminent	9/8/2022	10:00 PM	
Newsroom page updated with newest press release	9/8/2022	10:35 PM	
Updated home page hero to link to active PSPS page	9/8/2022	10:00 PM	
Updated latest info section on active PSPS for Spanish	9/8/2022	11:45 p.m.	12:10 a.m.
Up[dated CRC info on Spanish page with English Accordion	9/9/2022	12:05 a.m.	12:30 a.m.
Event Happening			
Broadcast message - PSPS happening	9/9/2022	1:20 a.m.	
Mobile App - PSPS happening	9/9/2022	2:25 a.m.	
Broadcast message - PSPS happening - consolidation to make it more general	9/9/2022	4:15 a.m.	
Mobile App - PSPS happening - consolidation to make it more general	9/9/2022	4:15 a.m.	
Homepage hero text update	9/9/2022	1:20 a.m.	

Change(s) Requested	Date	Time	Time Completed
Time updates on Active PSPS page - English	9/9/2022	1:20 a.m.	
Time updates on Active PSPS page - Spanish	9/9/2022	2:05 a.m.	
Time updates on Active PSPS page - ENG/SPN	9/9/2022	2:20 a.m.	
Time updates on Active PSPS page - ENG/SPN	9/9/2022	4:15 a.m.	
Added CRC info in Spanish	9/9/2022	4:15 a.m.	
Updated copy on CRC video page - English/Spanish	9/9/2022	4:40 a.m.	
Change Area 2 to power off status	9/9/2022	4:50 a.m.	
Add Power Off Status to Silverdale and Silver Falls preventative areas	9/9/2022	5 a.m.	
Updated translated names of areas on Spanish Active PSPS page	9/9/2022	5:10 a.m.	
Adjusted placement of Preventive Outage Areas and updated "Preventative" to "Preventive" on Active PSPS page - ENG/SPN	9/9/2022	6:06 a.m.	6:56 a.m.
Time updates on Active PSPS page - ENG/SPN	9/9/2022	6:58 a.m.	7:26 a.m.
Add Power Off Status to Estacada - ENG/SPN	9/9/2022	7:08 a.m.	7:52 a.m.
Time updates on Active PSPS page - ENG/SPN	9/9/2022	8:14 a.m.	9:21 a.m.
Time updates on Active PSPS page - ENG/SPN	9/9/2022	8:37 a.m.	9:21 a.m.
Header update on Active PSPS page - ENG	9/9/2022	9:27 a.m.	10:21 a.m.
Time updates on Active PSPS page - ENG/SPN	9/9/2022	9:39 a.m.	10:21 a.m.
Add Power Off Status to Scott Mills - ENG/SPN	9/9/2022	10:07 a.m.	10:56 a.m.
Time updates on Active PSPS page - ENG/SPN	9/9/2022	10:31 a.m.	10:56 a.m.
Time updates on Active PSPS page - ENG/SPN	9/9/2022	11:10 a.m.	11:51 a.m.
Add Power Off Status to Oregon City - ENG/SPN	9/9/2022	11:39 a.m.	12:21 p.m.
Add Power Off Status to all areas	9/9/2022	12:29 p.m.	12:45 p.m.
Added new hero image and button, created new messaging block to Wildfire Outages page - ENG	9/9/2022	7:00 a.m.	2:30 p.m.
Added new messaging block and FAQ to Active PSPS page - ENG	9/9/2022	7:00 a.m.	2:30 p.m.
Add GIS map translation component to Spanish active PSPS page	9/9/2022	3:00pm	5:22pm
Add GIS map translation component to Spanish active Wildfire & Outages page	9/9/2022	3:00pm	5:22pm
Make latest updates section 2 columns on the English Active PSPS page and Spanish PSPS page	9/9/2022	3:03pm	5:22pm
Add GIS map component to PSPS Info Multilanguage page	9/9/2022	3:45pm	5:22pm
Change YT CRC Spanish video background to white	9/9/2022	4:18pm	5:22pm
Add FAQ question to Active PSPS info Spanish page	9/9/2022	4:22pm	6:20pm

Change(s) Requested	Date	Time	Time Completed
Update Active PSPS info English page to say "All locations will be open 7 am to 7 pm each day during the event"	9/9/2022	5:06pm	5:22pm
Update Active PSPS info Spanish page to say "All locations will be open 7 am to 7 pm each day during the event"	9/9/2022	5:06pm	6:20pm
Revert updates section to single column on the English Active PSPS page and Spanish Active PSPS page (2 column showed funky on mobile)	9/9/2022	8:14pm	8:14pm
Update copy underneath "Active PSPS info" page title on Active PSPS English page	9/9/2022	8:51pm	9:07pm
Update copy underneath "Active PSPS info" page title on Active PSPS Spanish page	9/9/2022	8:51pm	9:30pm
Add three locations to preventive outage area list on English Active PSPS page	9/9/2022	9:59pm	10:43pm
Add three locations to preventive outage area list on Spanish Active PSPS page	9/9/2022	9:59pm	10:43pm
Update text in preventive outage to refer to areas "below" vs Silverdale/Corbett/Silver Falls - active PSPS English page	9/9/2022	10:14pm	10:43pm
Update text in preventive outage to refer to areas "below" vs Silverdale/Corbett/Silver Falls - active PSPS Spanish page	9/9/2022	10:14pm	10:43pm
Update CRC location to show Estacada Closed (ENG)	9/10/2022	6:05 a.m.	6:10 a.m.
Update new Preventive Outage Locations - Colton and North Sandy (ENG/SPN)	9/10/2022	6:15 a.m.	6:20 a.m.
Update CRC location to show Estacada closed (SPN)	9/10/2022	6:30 a.m.	6:47 a.m.
Add Sandy CRC information (ENG/SPN)	9/10/2022	7:07 a.m.	7:30 a.m.
Change North to Norte on Spanish updates	9/10/2022	7:26 a.m.	7:30 a.m.
Change order of preventive outage list	9/10/2022	9:30 a.m.	9:45 a.m.
Add new TPQA - the weather doesn't seem extreme English/Spanish	9/10/2022	2:15 PM	4:30 PM
Restoration Begins			
Broadcast message updates for restoration	9/10/2022	1:30 PM	4:30 PM
Broadcast message update - simplify restoration language + Spanish	9/10/2022	5:00 PM	8:30 PM
Mobile app restoration begins language	9/10/2022	8:00 PM	8:30 PM
Banner restoration begins	9/10/2022	8:00 PM	8:30 PM
Update active PSPS page with current info for restoration English/Spanish	9/10/2022	1:30 PM	4:30 PM
Update message block image featuring map	9/10/2022	5:20 PM	8:30 PM

Change(s) Requested	Date	Time	Time Completed
Restoration begins	9/10/2022	8:00 PM	8:30 PM
Homepage restoration begins update	9/10/2022	8:00 PM	8:30 PM
Spanish language edits	9/10/2022	8:00 PM	8:30 PM
Active PSPS page update sub head language English / Spanish	9/10/2022	9:00 PM	9:30 PM
Update PSPS map image on Active PSPS page	9/11/2022	7:30 AM	8:20 AM
Update broadcast message to remove second sentence English/Spanish	9/11/2022	8:34 AM	9:00 AM
Updated mobile app banner to remove second sentence English/Spanish	9/11/2022	8:34 AM	9:00 AM
Update Active PSPS page with "have also experienced" English	9/11/2022	8:34 AM	9:00 AM
Update active PSPS page with new CRC hours and other minor language English/Spanish	9/11/2022	9:26 AM	10:10 AM
Fixed Spanish copy showing up in English Active PSPS page	9/11/2022	10:13 AM	10:24 AM
Update Active PSPS page with power restored for Colton and George	9/11/2022	1:18 PM	1:50 PM
Update Active PSPS page with power restored for Silver falls (English)	9/11/2022	3:43pm	3:53pm
Update Active PSPS page with power restored for Silver falls (Spanish)	9/11/2022	3:43pm	3:53pm
Update Active PSPS page with power restored for area 10 (English)	9/11/2022	4:56pm	5:09pm
Update Active PSPS page with power restored for area 10 (Spanish)	9/11/2022	4:56pm	5:09pm
Update Active PSPS page with power restored for area 3 (English)	9/11/2022	5:32 PM	5:52pm
Update Active PSPS page with power restored for area 3 (Spanish)	9/11/2022	5:32 PM	5:52pm
Remove Silverton CRC center from Active PSPS page (English)	9/11/2022	6:16pm	6:53pm
Remove Sheridan CRC center from Active PSPS page (English)	9/11/2022	6:16pm	6:53pm
Remove banks CRC center from Active PSPS page (English)	9/11/2022	6:16pm	6:53pm
Remove Silverton CRC center from Active PSPS page (Spanish)	9/11/2022	6:16pm	6:53pm
Remove Sheridan CRC center from Active PSPS page (Spanish)	9/11/2022	6:16pm	6:53pm
Remove banks CRC center from Active PSPS page (Spanish)	9/11/2022	6:16pm	6:53pm
Update Active PSPS page with power restored for area 5 (English)	9/11/2022	7:14pm	7:59pm
Update Active PSPS page with power restored for area em3 (English)	9/11/2022	7:14pm	7:59pm
Update Active PSPS page with power restored for area em4 (English)	9/11/2022	7:14pm	7:59pm
Update Active PSPS page with power restored for area 5 (Spanish)	9/11/2022	7:14pm	7:59pm
Update Active PSPS page with power restored for area em3 (Spanish)	9/11/2022	7:14pm	7:59pm
Update Active PSPS page with power restored for area em4 (Spanish)	9/11/2022	7:14pm	7:59pm

Change(s) Requested	Date	Time	Time Completed
Update Active PSPS page with power restored for area 7 (English)	9/11/2022	7:42pm	7:59pm
Update Active PSPS page with power restored for area 9 (English)	9/11/2022	7:42pm	7:59pm
Update Active PSPS page with power restored for area em7 (English)	9/11/2022	7:42pm	7:59pm
Update Active PSPS page with power restored for area 7 (Spanish)	9/11/2022	7:42pm	7:59pm
Update Active PSPS page with power restored for area 9 (Spanish)	9/11/2022	7:42pm	7:59pm
Update Active PSPS page with power restored for area em7 (Spanish)	9/11/2022	7:42pm	7:59pm
Update Active PSPS page with power restored for area 8 (Spanish)	9/11/2022	7:42pm	7:59pm
Update Active PSPS page with power restored for area 8 (English)	9/11/2022	7:42pm	7:59pm
Remove closed-Estacada CRC (English)	9/11/2022	7:42pm	8:48pm
Remove closed-Estacada CRC (Spanish)	9/11/2022	7:42pm	8:48pm
Revise CRC location to reference "all locations below" (English)	9/11/2022	7:50pm	8:48pm
Revise CRC location to reference "all locations below" (Spanish)	9/11/2022	7:50pm	8:48pm
Update Active PSPS page with power restored for area 2 (Spanish)	9/11/2022	7:49pm	7:59pm
Update Active PSPS page with power restored for area 2 (English)	9/11/2022	7:49pm	7:59pm
Update Active PSPS page with power restored for area em1 (Spanish)	9/11/2022	7:49pm	7:59pm
Update Active PSPS page with power restored for area em1 (English)	9/11/2022	7:49pm	7:59pm
Update Active PSPS page with power restored for area 1 (Spanish)	9/11/2022	10:35pm	10:43pm
Update Active PSPS page with power restored for area 1 (English)	9/11/2022	10:35pm	10:43pm
Update Active PSPS page with power restored for area 4 (Spanish)	9/11/2022	10:35pm	10:43pm
Update Active PSPS page with power restored for area 4 (English)	9/11/2022	10:35pm	10:43pm
Update active PSPS page with current info for restoration English/Spanish	9/10/2022	1:30 PM	4:30 PM
Update message block image featuring map	9/10/2022	5:20 PM	8:30 PM
Restoration begins	9/10/2022	8:00 PM	8:30 PM
Homepage restoration begins update	9/10/2022	8:00 PM	8:30 PM
Spanish language edits	9/10/2022	8:00 PM	8:30 PM
Active PSPS page update sub head language English / Spanish	9/10/2022	9:00 PM	9:30 PM
Update PSPS map image on Active PSPS page	9/11/2022	7:30 AM	8:20 AM
Update broadcast message to remove second sentence English/Spanish	9/11/2022	8:34 AM	9:00 AM
Updated mobile app banner to remove second sentence English/Spanish	9/11/2022	8:34 AM	9:00 AM

Change(s) Requested	Date	Time	Time Completed
Update Active PSPS page with "have also experienced" English	9/11/2022	8:34 AM	9:00 AM
Update active PSPS page with new CRC hours and other minor language English/Spanish	9/11/2022	9:26 AM	10:10 AM
Fixed Spanish copy showing up in English Active PSPS page	9/11/2022	10:13 AM	10:24 AM
Update Active PSPS page with power restored for Colton and George	9/11/2022	1:18 PM	1:50 PM
Update Active PSPS page with power restored for Silver Falls (English)	9/11/2022	3:43pm	3:53pm
Update Active PSPS page with power restored for Silver Falls (Spanish)	9/11/2022	3:43pm	3:53pm
Update Active PSPS page with power restored for area 10 (English)	9/11/2022	4:56pm	5:09pm
Update Active PSPS page with power restored for area 10 (Spanish)	9/11/2022	4:56pm	5:09pm
Update Active PSPS page with power restored for area 3 (English)	9/11/2022	5:32 PM	5:52pm
Update Active PSPS page with power restored for area 3 (Spanish)	9/11/2022	5:32 PM	5:52pm
Restoration Complete			
Add restoration complete web banner	9/11/2022	10:35pm	10:43pm
Add restoration complete mobile banner	9/11/2022	10:35pm	10:43pm
Removed banner on mobile app and website	9/12/2022	6:15 AM	8:00 AM
Update Active PSPS page with power restored for all areas header (Spanish)	9/11/2022	10:35pm	10:43pm
Update Active PSPS page with power restored for all areas header (English)	9/11/2022	10:35pm	10:43pm
Homepage header update all areas restored	9/11/2022	11:21pm	11:34pm

Appendix 6. Sample PGE Customer Email Content by Event Phase

PSPS Likely Email Content

PGE

If conditions persist, an outage in your area is likely in the next 24 hours

Based on a range of considerations like wind speed, temperature, humidity and the dryness of trees and brush, fire danger will become extreme in your area over the next couple of days.

It's looking very likely that we'll need to turn off power in the next 24 hours to reduce the risk of wildfires. This emergent de-energization is a last-resort safety measure to keep you, your property and the community safe.

Where this may happen:

This outage will likely impact areas of Silver Falls and Corbett. These communities are not in our 2022 PSPS Areas that you will see on our website. However, out of extreme caution, we have identified the need to shut off power in these additional areas. We're continuously improving our equipment and are always working to reduce the number of customers impacted.

We know outages are disruptive, so if a shutoff happens, we'll work to keep it as short as possible. However, an emergent de-energization can last multiple days – and can go on even after weather conditions return to normal. That's because our crews need to visually inspect all equipment and make any necessary repairs before restoring power.

If you haven't already, now's the time to make sure you're prepared by having an emergency plan.

If you have medical needs that require electricity, please make sure to have your backup plan ready. If you're enrolled in our Medical Certificate program, our customer service advisors will stay in touch with you via phone before and during this event.

What will happen next:

If dangerous conditions persist, we'll provide another update about 1 to 4 hours prior to power being shut off. We believe it's important to overcommunicate during this critical time and you'll probably hear from us in multiple ways.

We appreciate your patience and your preparedness as we all work together to keep our communities safe. If you have any questions, give us a call at 503-228-6322. Our customer service advisors can assist you in more than 200 languages.

Wildfire Outages Info

PGE

Sign in to your account
Manage preferences
View as a webpage

PSPS Event Happening Email Content

PGE

To keep you and our community safe, your power has been shut off.

As we recently shared with you, dangerously hot, dry conditions have been increasing the risk of fire in areas of **the Mt. Hood Corridor/Foothills**. Because your safety and that of our community is our top concern, those risks have reached the point where it's become necessary to activate a Public Safety Power Shutoff, or PSPS.

How long this PSPS will last:

We'll do everything we can to restore your power as soon as possible. However, because of **imminent high, gusty winds during extreme fire** conditions and the associated risk levels, it's hard to say exactly when that may be. Two things have to happen: (1) Dangerous weather conditions will need to pass, and (2) Our crews will need to visually inspect all the lines and make any necessary repairs to be sure everything is safe.

We estimate power will be restored in this time frame: **When weather conditions allow, PGE will physically inspect powerlines and equipment and make any repairs necessary.** But remember, conditions can change quickly and this is just an estimate.

We have resources to support you:

PGE will likely be opening Community Resource Centers for impacted customers during a PSPS. We'll be providing information, water, ice, Wi-Fi and charging for electronics. Visit our website for hours and location information. You can find other helpful resources at 211.org or on your county's website.

Keeping you updated:

We'll be as transparent as possible by keeping you updated about this PSPS and when your power will be back on. Please visit our website for the most up-to-date information.

Thank you for partnering with us to keep everyone safe. We realize this is a scary time, so if you have any questions, remember you can always give us a call at 503-228-6322. Our customer service advisors can assist you in more than 200 languages.

Wildfire Outages Info

Your address(es) below is/are in the area where power will be shut off:

- Ns Old Lp Just E Po Cbn1 , Government Camp Or 97028

PGE

Sign in to your account
Manage preferences
View as a webpage

PSPS 24-Hour Update Email Content

PGE

An update about your power shut off

Because weather conditions have created a dangerous risk of fire in your area, we have activated a Public Safety Power Shutoff, or PSPS, to keep you, your property and the community safe.

As of 1:00pm this afternoon, 10 PSPS areas have been shut off as a wildfire precaution. In partnership with local officials, PGE also implemented preventive outages in your additional area. PGE turned off power in these limited areas with higher risk of fire due to unique and extreme weather conditions.

For maps of PSPS areas and current outages, visit portlandgeneral.com.

How long the outage will last:

We know this is disruptive, so we are doing all we can to keep the outage as short as possible. However, two things need to happen before power can be restored: (1) Dangerous weather conditions will need to pass, and (2) Our crews will need to visually inspect all the lines and make any necessary repairs to be sure everything is safe.

PGE is monitoring conditions and as soon as weather conditions return to normal, will begin inspecting all power lines and equipment to make necessary repairs so lines and equipment can be safely re-energized. If the event duration is as anticipated and assuming there is no damage to our system, power restoration could begin as early as Saturday evening. Damage to our equipment and/or system could create delays in restoration timing.

PGE will provide updates at least every 24 hours until power is fully restored.

Where help is available:

PGE has opened Community Resource Centers for impacted customers during the PSPS. We are providing information, water, ice, Wi-Fi and charging for electronics. Visit our website for hours and location information.

You can find other helpful resources at 211info.org or on your county's website.

How to stay informed:

We'll keep you updated about restoration timelines via email, social media and updates on our website. We realize this is a challenging time, so if you have any questions, remember you can always give us a call at 503-228-6322. Our customer service advisors can assist you in more than 200 languages.

Wildfire Outages Info

PGE

Sign in to your account
Manage preferences
View as a webpage

PSPS Restoration Begins Email Content

The Preventive Outage is ending and we're working to restore your power

We know it's very disruptive to have your power turned off, but we appreciate your patience during this Preventive Outage in areas of **Springdale/Corbett**.

Crews are currently responding to any downed lines, repairing damage and visually inspecting equipment to make sure it's safe to restore your power.

As work continues, we'll share any new or relevant information as soon as we have it. Please know we won't stop until everyone's power is back on.

We have started restoration for your area. For information about your individual restoration time, visit our website. And, if you have any questions, remember you can always call us at 503-228-6322 where our customer service advisors can assist you in more than 200 languages.

Wildfire Outages Info

Sign in to your account
Manage preferences
View as a webpage

This email was sent by Portland General Electric 121 SW Salmon St. Portland, OR, 97204-2977, US

PSPS Restoration Complete Email Content

PGE

The Preventive Outage is over and your power has been restored

Thank you for your patience during the recent Preventive Outage in areas of **Springdale/Corbett**. We realize it was a difficult and disruptive time. The immediate threat has passed, our crews have completed their work and, according to our records, your power has been restored.

If for some reason your power is still out, please call us right away at 503-228-6322.

Wildfires in Oregon are an ongoing threat, so please know we'll continue to monitor conditions so we can help keep our customers and communities safe. Thank you for your partnership in this effort.

Wildfire Outages Info

PGE

Sign in to your account
Manage preferences
View as a webpage

This email was sent by Portland General Electric 121 SW Salmon St. Portland, OR, 97204-2977, US

Appendix 7. Representation of PGE Public Safety Partner Contact List, September 2022 PSPS Event

Jurisdiction/Organization	Role/Position Name
Canby Fire District	Fire Chief
City of Banks	City Manager
City of Banks	Public Works
City of Corbett	Fire Chief
City of Cornelius	Fire Chief
City of Estacada	City Manager
City of Gresham	Fire Chief
City of Oregon City	Administration
City of Oregon City	Public Works
City of Portland/Portland Bureau of Emergency Mgmt	24/7 Duty Officer
City of Portland/Portland Bureau of Emergency Mgmt	24/7 Back Up Duty Officer
City of Portland/Portland Bureau of Emergency Mgmt	ECC
City of Portland/Portland Bureau of Emergency Mgmt	Director
City of Portland/Portland Bureau of Emergency Mgmt	Operations Manager
City of Portland/Portland Bureau of Emergency Mgmt	Operations Coordinator
City of Portland/Portland Bureau of Emergency Mgmt	Business Continuity Planner
City of Sandy	Police
City of Scotts Mills	City Manager
Clackamas Co. Disaster Mgmt	Duty Officer
Clackamas Co. Disaster Mgmt	Interim Director
Clackamas Co. Disaster Mgmt	Interim Deputy Disaster Manager
Clackamas Co. Disaster Mgmt	Operations Coordinator
Clackamas County - Disaster Management	Public Affairs
Clackamas County - Disaster Management	Community Planning Coordinator
Clackamas County Communications PSAP	PSAP Operations Supervisor
Clackamas County Communications PSAP	Director, Dept of Communications
Columbia County 911 PSAP	Executive Director
Columbia County 911 PSAP	Operations Manager
Columbia County Emergency Management	Emergency Management Director
Confederated Tribes of Grand Ronde	Emergency Management Director
Confederated Tribes of Grand Ronde	Emergency Management Coordinator
Dallas FD	Fire Chief
DAS	Statewide Interoperability Coordinator (SWIC)
Everbridge	Technical Account Manager, Professional Services
Gaston FD	Fire Chief
Hood River County 911 PSAP	9-1-1 Supervisor
Hood River County 911 PSAP	9-1-1 Commander
Hood River County 911 PSAP	9-1-1 Supervisor
Hood River County Emergency Management	Emergency Management Director

Jurisdiction/Organization	Role/Position Name
Marion Co. Emergency Mgmt	Emergency Manager
Marion Co. Emergency Mgmt	Emergency Preparedness Coordinator
Marion Co. Emergency Mgmt	Emergency Director
Marion County 911 PSAP	Operations Supervisor
Marion County 911 PSAP	Operations Supervisor
Marion County 911 PSAP	Director of Communications
Marion County Emergency Management	EM Program Coordinator
Marion County Emergency Management	EM Program Coordinator
Mt. Angel Fire District	Fire Chief
Multnomah Co. Emergency Mgmt	Operations Division Chief
Multnomah Co. Emergency Mgmt	Director
Multnomah Co. Emergency Mgmt	Senior Emergency Management Planner
Multnomah County 911 PSAP	Director
Multnomah County 911 PSAP	Operations Manager
Multnomah County 911 PSAP	Assistant Operations Manager
Multnomah County Emergency Management	PIO
New Carlton Fire District	Fire Chief
North Plains Police Department	Police Chief
OEM	Executive Duty Officer OEM EDO
OEM	Communications Officer
OPUC/ESF 12	Emergency Preparedness Manager (ESF 12,2 and SRF 6)
Oregon Department of Human Services	Emergency Preparedness Coordinator
Oregon Department of Human Services	Emergency Preparedness Coordinator
Polk County Emergency Mgmt	Emergency Mgr
Polk County Emergency Mgmt	EM Coordinator
Portland Bureau of Emergency Management	Public Information Officer
Portland Bureau of Emergency Management	Emergency preparedness coordinator
Tualatin Valley Fire & Rescue	Deputy Chief of Operations
Wasco County Emergency Mgmt	Emergency Manager
Washington Co. Emergency Mgmt	Emergency Mgr
Washington Co. Emergency Mgmt	Emergency Mgmt Supervisor
Washington Co. Emergency Mgmt	Emergency Mgmt Coordinator
Washington Co. Emergency Mgmt	Emergency Mgmt Coordinator
Washington County 911 PSAP	Assistant Director
Washington County 911 PSAP	Director
Washington County 911 PSAP	Operations Supervisor
Washington County 911 PSAP	Operations Manager
Washington County Emergency Management	Emergency Management Coordinator
Yahmill County 911 PSAP	Executive Director
Yamhill County Emergency Mgmt	Emergency Mgr

Appendix 8. List of Operators of Communication Facilities

PSPS PGE GIS-Based Platform – Below is a list of Operators of Communication Facilities that were sent links to GIS files

1. T-Mobile
2. T-Mobile West
3. Ziply
4. Sprint
5. Centurylink
6. Electric Lightwave
7. Comcast
8. Frontier
9. Qwest Wireless
10. CBS Oregon
11. Verizon Wireless
12. AT&T
13. Northwest Fiber
14. Molalla Telephone
15. Comcast
16. William T Hayes
17. Twisted Pair Incorporated
18. Tata Communications
19. Barklen LLC
20. AAT Communications Corp
21. Verizon Wireless
22. Sylvan Towers
23. Spring / Nextel
24. Cascade Utilities
25. Wave Broadband
26. Astound Broadband
27. Newpath Networks / Crown Castle

Appendix 9. Sample Critical Facility Email Content

PGE

If conditions persist, an outage in your area is likely in 48 to 72 hours

As you know, it's been very hot and dry around Oregon this summer. Because of that, and based on a range of considerations like wind speed, temperature, humidity and the dryness of trees and brush, fire danger will become extremely dangerous in your area over the next couple of days.

It is looking very likely that we'll need to temporarily turn off power in the next 48 to 72 hours to reduce the risk of wildfires. This Public Safety Power Shutoff, or PSPS, is a last-resort safety measure to keep you, your property and the community safe, and will only happen if absolutely necessary.

Where this may happen:
This outage will likely impact the area of **Estacada**. Specific address information, if available, can be found at the bottom of this email.

For more details about which areas could be impacted, and how long the outage could last, see our online map. And keep in mind that because power lines can serve communities miles away, even those outside a higher risk area may experience an outage.

We know outages are disruptive, so if a shutoff happens, we'll work to keep it as short as possible. However, a PSPS can last multiple days – and can go on even after weather conditions return to normal. That's because our crews need to visually inspect all equipment and make any necessary repairs before restoring power.

What you can do to prepare:
If you haven't already, now's the time to make sure you're prepared by having an emergency plan for a safety-related outage.

If you have medical needs that require electricity, please make sure to have your backup plan ready. If you're enrolled in our Medical Certificate program, our customer service advisors will stay in touch with you via phone before and during a PSPS.

What will happen next:
If dangerous conditions persist, we'll provide another update 24 to 48 hours prior to power being shut off. In fact, because we believe it's important to overcommunicate during this critical time, you'll probably hear from us in multiple ways.

We'll also set up a Community Resource Center for affected customers where we'll provide information, water, ice and charging for electronics.

We appreciate your patience and your preparedness as we all work together to keep our communities safe. If you have any questions, give us a call at 503-228-6322. Our customer service advisors can assist you in more than 200 languages.

WILDFIRE OUTAGES INFO

PGE

- 23723 S Fellows Rd, Beavercreek

PGE

Sign in to your account
Manage preferences
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Appendix 10. List of Community-Based Organizations and School Districts Contacted by PGE During September 2022 PSPS Event

Organization
211
Adelante Mujeres
Affiliated Tribes of the Northwest Indians
African American Alliance for Home Ownership
Albertina Kerr Centers
Beaverton Education Foundation
Bienestar
Birch Community Services
Black United Fund of Oregon, Inc.
Boys & Girls Club of Salem
Boys & Girls Club of Salem
Boys & Girls Clubs of Portland Metro
Bradley Angle
Camp Fire Columbia
CARES Northwest
Cascade Behavorial Health
Causa
Central City Concern
Centro Cultural de Washington County
Chehalem Youth & Family Services
Clackamas County
Clackamas Women's Services
Community Action (Washington County)
Community Action Partnership of Oregon (CAPO)
Community Services Network
Confederated Tribes of Grand Ronde
David Douglas Educational Foundation
Dayton Education Foundation
DePaul Treatment Centers
Estacada Area Food Bank
Farmworker Housing Development Corporation
Garten
Gresham-Barlow Education Foundation
Hillsboro Schools Foundation
Hispanic Metropolitan Chamber of Commerce
Home Forward
Human Solutions
Impact NW
Incight
JOIN
Kinship House
Liberty House
LifeWorks NW
Marion-Polk Food Share Inc.
Metropolitan Family Services

Mid-Willamette Valley Community Action
Multnomah County
NAMI
Neighborhood House
New Avenues for Youth
Newberg FISH Emergency Services
Northwest Housing Alternatives
Northwest Pilot Project, Inc.
Oregon Building Congress
Oregon Energy Fund
Oregon Native American Chamber
Our House of Portland
Outside In
Partners for a Hunger Free Oregon
Portland African American Leadership Forum
Portland Homeless Family Solutions
Portland Housing Center
Proud Ground
Raphael House of Portland
Ride Connection, Inc.
Rose Haven
Rose Initiative
SAGE
Salem Harvest
Salem Multicultural Institute
Salem Schools Foundation
Self Enhancement, Inc.
Sisters Of The Road
SnowCap
St. Vincent dePaul
The Salvation Army
Transition Projects
Trillium Family Services
TriMet
United Way of the Columbia-Willamette
Urban League
Virginia Garcia Memorial Foundation
Wallace Medical Concern
William Temple House
Yamhill Community Action Partnership
YWCA of Greater Portland
Food Banks
Organization
Oregon Food Bank
Allen Temple Food Pantry
Aloha Church of God

Banks Community Food Bank
Beavercreek United Church of Christ
Beaverton SDA
Bethel Congregational Church
C3 Church Food Pantry
CAO Shelter Home EFB
Cascade Vineyard Church King's Kindness Ministries
Catholic Charities Food Pantry
CCC Recuperative Care Program
Clackamas Co. H3S (CWS)
Clackamas Service Center Day and Night Markets
Clay St Table - First Unitarian (Pop Up)
Clay St Table - Pantry
Colton Helping Hands
Community Hands Up
Cornelius United Methodist Church
Crossroads Food Bank
EMO NE Emergency Food Program
Estacada Area Food Bank
Esther's Pantry
Evergreen Christian Center Food Pantry
First Baptist Church EFB
Food for Families
Food Resource at Turning Point Church
Foothills Community Church EFB
Forest Grove Foursquare Church
Forest Grove Spanish SDA
Francis Center
Genesis Community Fellowship Food Pantry
Gladstone SDA
Good Roots Community Church
Hand Up Project - People's Pantry
Helping Hands (Sherwood)
Hereford House Food Pantry
Highland Christian Center
Hillsboro Seventh Day Adventist
Hillsboro Spanish SDA
Holy Trinity Food Closet
HOPE First Baptist
HOPE First Presbyterian
HOPE United Methodist Church
King's Cupboard
Lift Urban Portland
Linnton Community Center EFB
Mainspring Portland (formerly FISH Emergency Services)
Milwaukie Spanish Seventh Day Adventist
Molalla Christian Church

Molalla Service Center
Murray Hills Christian Church
Neighborhood House Community Services
Neighborhood Missions
New Day Family Church (Tree of Life)
North Plains Senior Center EFB
Open Door Counseling EFB
Outside In - Milwaukie High School Based Health Ctr
Parkrose United Methodist Church
Portland Adventist Community Services
Portland Open Bible Community Pantry
Rock Creek Church EFB
Salvation Army Gresham
Salvation Army Moore St Center
Salvation Army Portland Tabernacle Family Services
Salvation Army TV Citadel
Sandy Community Action EFB
Sharon Community Services SDA
Sherwood Essential Needs Hub
SnowCap
St Andre Bessette Catholic Church
St Francis CAC
St Luke Lutheran Church EFB
St Mark's Lutheran Church
St Matthew Lutheran Pantry
Sunset Presbyterian Church - Helping Hands
SVDP All Saints
SVDP Ascension
SVDP Blessed Frederic at Holy Cross
SVDP Christ the King
SVDP Holy Family
SVDP Holy Redeemer
SVDP Immaculate Heart
SVDP Our Lady of Sorrows
SVDP Sacred Heart
SVDP St Agatha
SVDP St Aloysius
SVDP St Andrew
SVDP St Anne
SVDP St Anthony (Portland)
SVDP St Anthony (Tigard)
SVDP St Cecilia (Beaverton)
SVDP St Charles
SVDP St Elizabeth Ann Seton (Aloha)
SVDP St Henry
SVDP St Ignatius
SVDP St James

SVDP St John Fisher
SVDP St John the Apostle
SVDP St John the Baptist
SVDP St Joseph the Worker
SVDP St Juan Diego
SVDP St Louise
SVDP St Matthew (Hillsboro)
SVDP St Michael
SVDP St Patricks Canby
SVDP St Peter
SVDP St Pius X (Cedar Mill)
SVDP St Rita
SVDP St Rose
SVDP St Therese
Tigard Covenant Church - Barb's Pantry
Tigard UMC- Bethlehem House of Bread
Trinity Community Church
True Life Fellowship
Tualatin School House Pantry
U.Me.Us Food Pantry
Union Gospel Mission Food Pantry
Unity of Beaverton
University Park ACS
Wapato Valley Church
Westside Food Brigade
William Temple House
Willowbrook Food Pantry
Wilsonville Community Sharing
Zarephath Pantry
School Districts
Organization
Amity School District
Banks School District
Beaverton School District
Cascade School District
Corbett School District
Dayton School District
Estacada School District
Forest Grove School District
Gaston School District
Gervais School District
Gladstone School District
Gresham Barlow School District
Hillsboro School District
Lake Oswego School District
Molalla River School District

Mt. Angel School District
Newberg School District
North Clackamas School District
North Marion School District
Oregon City School District
Oregon Trail School District
Portland Public Schools
Reynolds School District
Salem-Keizer School District
Scappoose School District
Sherwood School District
Silver Falls School District
St. Helens School District
Tigard Tualatin School District
West Linn-Wilsonville School District
Willamina School District
Woodburn School District
Yamhill Carlton School District

PGE/320 – PGE/322

contain protected information

and are subject to

General Protective Order 23-132

PGE/323

ODOT's Oregon Temporary Traffic Control Handbook (2016)

OREGON

Temporary Traffic Control Handbook

For Operations of Three Days or Less

September 2016

2011

Errata Included
(as of Sept. 2016)

Prepared by the Oregon Department of Transportation

These standards were adopted by the Oregon Transportation Commission on December 21, 2011 as the standards for all temporary traffic control in place for three days or less on Oregon public roads per ORS 810.200.

The development of this handbook has been a cooperative effort of the Oregon Department of Transportation, the Oregon Traffic Control Devices Committee and its subcommittee including representatives from the following agencies and businesses:

Association of Oregon Counties
City of Lake Oswego Public Works
City of Portland Public Works
City of Springfield Public Works
Clackamas County Public Works
DKS Associates
Federal Highway Administration Oregon Division
Jackson County Public Works
Oregon Department of Transportation
- Highway Regions
- Maintenance Districts
- Maintenance Leadership Team
- Technology Transfer (T2) Center
- Traffic-Roadway Section
- Transportation Safety Division

Tri-County Metropolitan Transportation District of Oregon (TriMet)

Oregon
John A. Kitzhaber, M.D., Governor

Department of Transportation
Traffic-Roadway Section MS#5
4040 Fairview Industrial Drive SE
Salem, Oregon 97302-1142
(503) 986-3568
Fax: (503) 986-3749

DATE: December 21, 2011

TO: Handbook Users

We are pleased to bring you this revision to the Oregon Temporary Traffic Control Handbook. The many changes and added information in this edition have been thoughtfully reviewed by representatives of those who work on and along Oregon roads and highways. We gratefully acknowledge their time, expertise, and energy in bringing this handbook revision together.

Within these pages you can find the guidance to apply the 2009 Manual on Uniform Traffic Control Devices to your work needs. This handbook can be accessed via the internet under "Publications" on the Oregon Department of Transportation website at http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/.

By cooperative agreement with ODOT, the Center for Business & Industry of Chemeketa Community College in Salem provides handbooks, training classes, and flagger certification cards through the ODOT Work Zone Traffic Control and Flagging Program. They also can supply additional printed copies of this handbook. They can be reached at (503) 399-5181.

(original signed by)

Bob Pappe, P.E., P.L.S.
State Traffic-Roadway Engineer

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CHAPTER 3 – FLAGGING & OTHER TCM

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CHAPTER 5 – TYPICAL APPLICATIONS

CHAPTER 6 – INCIDENT TRAFFIC CONTROL

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Work space with lane closure(s), non-intersection (continued)

Work space near intersections

Work space near freeway ramps

OREGON

Temporary Traffic Control Handbook

For Operations of Three Days or Less

September 2016

2011

Errata Included
(as of Sept. 2016)

Prepared by the Oregon Department of Transportation

CHAPTER 1– GENERAL STANDARDS AND PRACTICES

1.1 Scope

This handbook provides a reference for the standards and practices for temporary traffic control work zones in place continuously for three days or less on public roads in Oregon. It is based on the principles set forth in Part 6 of the *Manual on Uniform Traffic Control Devices* (MUTCD) and the Oregon MUTCD Supplements.

For work requiring devices in place longer than three days, a more comprehensive Traffic Control Plan (TCP) is required.

These standards were adopted by the Oregon Transportation Commission on December 21, 2011 as the standards for all temporary traffic control in place for three days or less on Oregon public roads per ORS 810.200.

Each road jurisdiction (City, County, State, or Transit Authority) may have additional or more restrictive requirements, and will generally require permits to work within the public right-of-way. The appropriate road jurisdiction should be contacted prior to planning or beginning any work within their jurisdiction.

The primary function of temporary traffic control is to provide safe and efficient movement of road users through or around work zones while protecting workers, and emergency response personnel and equipment.

There are safety concerns for workers while setting up and taking down work zones. As a result, this document is based on the premise, as per the MUTCD, that simplified traffic control procedures are warranted for short term activities.

1.2 Planned, Emergency, and Special Event Traffic Control

Planned Traffic Control includes traffic control for routine activities including construction, maintenance and utility work, repair or new installation of road or roadside hardware, whether road-related or not. Traffic impacts from planned work can be anticipated and the proper equipment that complies with the current MUTCD and this handbook should be stocked and available as the crew heads out to work.

Emergency Traffic Control is used during unanticipated events that require an immediate response to control traffic and to aide emergency responders and protects road user safety. Emergency activities take precedence over planned activities.

All traffic control devices or equipment used for temporary traffic control **shall** be in compliance with the MUTCD and this handbook. However, in emergency situations, the responder may use any available devices or equipment to control and guide traffic through or around the incident response area. As soon as practical, devices and equipment that comply with the MUTCD and this handbook should be placed to control traffic.

Special Event Traffic Control is designed for planned events that impact the flow of traffic. Traffic analysis should be conducted for special events. Analysis includes expected traffic volumes, entry and exit locations, available alternate routes, and normal traffic characteristics. A special event traffic control plan (TCP) is likely to include significant numbers of devices, personnel and alternate routes.

Each road jurisdiction may have permit or other requirements for special events with traffic impacts on their roads. The appropriate road jurisdiction should be contacted as part of the event planning for their assistance and approval of the temporary traffic control.

1.3 Lane Closures, Diversions, and Detours

Lane use changes should be well marked and the alternate path made clear to the traveling public. Extended traffic queues may result from the loss of road capacity, increasing the chance of collisions. Know the likely traffic volumes and conditions as well as possible and be prepared to install additional signing when needed.

Onsite conditions may vary requiring modification to the distances shown in the Typical Applications if the work is on a curving or hilly section of road. Look for a balance between giving warning in time, keeping the work signs free from other roadside clutter, and having too much distance between the advance warning and the work so that road users are otherwise distracted or have forgotten the warning.

1.4 Worker Safety Apparel

All workers within the right of way who are exposed either to traffic or to work vehicles or construction equipment within the work zone **shall** wear high-visibility safety apparel upon adoption of the 2009 MUTCD by ODOT. Safety apparel **shall** meet the requirements of the ANSI/ISEA *High Visibility Safety Apparel Guidelines*, or equivalent revisions, and labeled as ANSI 107-2004 or later for standard performance for Class 2 or 3 risk exposure.

~~1.5 Surveying and Similar Work~~

~~Surveying work, field inventory, utility location, manhole inspection and activities similar in nature, are worthy of special attention. This type of work involves multiple, short-duration activities using lightweight, portable equipment and often a single support vehicle. Therefore, quick deployment and portability are important in minimizing worker exposure and risk of injury.~~

~~The Oregon Department of Transportation (ODOT) publishes a manual specific to surveying work - the *Survey Safety Manual* - which may be referenced for surveying work. The *Survey Safety Manual* is based on the guiding standards and practices within this handbook.~~

1.6 Bicycle and Pedestrian Considerations

Efforts should be made to accommodate the needs of all road users (motorists, bicyclists, and pedestrians, including those with disabilities or visual impairments) within all work zones. If accommodation is not possible or practical, effective alternate routes must be provided and comply with the current *Americans with Disabilities Act* (ADA) and Part 6 of the MUTCD.

The placement of additional temporary signing and Traffic Control Devices (TCD) for the control of non-motorized vehicles and pedestrians should be considered where a reasonable volume of users is expected and where work is expected to last longer than one hour.

Make every practical effort to satisfy the following:

1. Match the level of accommodation to the existing facilities available prior to the work.
2. Use appropriate TCD to keep bicycles and pedestrians outside active work spaces and away from work equipment.
3. Avoid placing bicycles and pedestrians in conflict with traffic, work site vehicles, materials or operations.
4. If using an alternate route, provide sufficient and appropriate advance warning and detour signing for bicycles and pedestrians.
5. If a bicycle facility exists, maintain a 4-foot minimum width for bicycles, unless an alternate route is provided.
6. If the work will impact the sidewalk or pedestrian path, the pedestrian **shall** be provided a safe and accessible path that replicates, as nearly practical, the characteristics of existing facilities.
7. If work closes a sidewalk or sidewalk ramp, close sidewalks at a point where there is an alternate way to proceed or provide an alternate route for pedestrians.

Refer to Chapter 6D of the MUTCD for additional pedestrian safety information.

For additional bicycle and pedestrian accommodation information, see Chapter 5 of this handbook.

1.7 Night Operations

Working at night when there is less traffic on the road can be the only practical way to accomplish some work tasks. Any time drivers must use their headlights for visibility should be considered “night conditions.” Use the following basic principles for adjusting your traffic control for night operations:

- Use enough lighting to provide a safe work environment. Avoid creating glare for oncoming traffic.
- All temporary traffic control devices (TCD) **shall** be retro reflective, including signs, channelization devices, and flagger STOP/SLOW paddles.
- All temporary traffic control devices (TCD) and worker safety apparel should be kept in “Acceptable” condition, according to the current ATSSA *Quality Guidelines for Temporary Traffic Control Devices and Features*.
- If temporary pedestrian facilities are implemented, or obstructions or surface hazards are introduced, check that the path provided for them is lit adequately.
- In residential areas, avoid aiming work space floodlights into homes or yards.
- For information on flagging at night, see the Flagging Section, Chapter 3.

1.8 Roundabouts

Roundabouts pose unique challenges when work or incident management must be done in or around these facilities. It is recommended that work be conducted during off-peak hours.

A roundabout is not designed to hold stopped or waiting traffic during road work. Flagging or a detour may be required if it is likely that work may block traffic from using the circular roadway of a roundabout. Notify emergency services prior to conducting work in a roundabout that will affect response times or if using a detour.

1.9 Pavement Markings

Where permanent pavement markings conflict with the temporary travel paths, use clean, temporary devices (e.g. cones, tubular markers, barricades) to delineate the appropriate path. Temporary pavement markings and delineation **shall** match existing markings at both ends of the work zone.

For the application of temporary pavement markers used to simulate pavement markings, see Part 6 of the MUTCD, ODOT Traffic Control Standard Drawings, and the ODOT "Unique" Special Provisions for pavement preservation projects. Additional temporary pavement marker details are given in Chapter 5, Diagram 5-10.

For the application of permanent pavement markings on state highways, see the ODOT *Traffic Line Manual*.

For city or county roadways, refer to the local road jurisdiction's policy for the proper layout of temporary pavement markings.

The intended vehicle path should be clearly delineated at all times, day and night, and under both wet and dry pavement conditions.

All devices and markings used at night **shall** be retro reflective.

Temporary, removable, non-reflective preformed tape may be used to cover conflicting existing pavement markings.

If raised pavement markers are used to substitute for pavement markings in work zones, their application **shall** meet the requirements of the MUTCD for the line type they are replacing.

Pavement markings **shall** be in place before the road is re-opened to traffic if:

- Work covers or removes the pavement markings for a distance longer than two skip markings or 80 feet measured along the centerline, or
- Markings are covered or removed for any distance in critical areas such as problem horizontal curves, vertical curves, or weaving areas.

Temporary pavement markings may be used until the earliest date it is practical and possible to install permanent pavement markings. Temporary markings should not remain in place for more than two weeks unless it is impractical to place permanent markings.

If road work obscures or obliterates existing pavement markings within No Passing zones, one of the following should be done prior to reopening roadway to traffic:

- Install “DO NOT PASS” (R4-1) and “PASS WITH CARE” (R4-2) signs at each no-passing zone, or
- Use temporary pavement markers to simulate required pavement markings.

For three days or less, no-passing zones for a two or three-lane road may be identified by using “DO NOT PASS” (R4-1) and “PASS WITH CARE” (R4-2) signs rather than pavement markings.

DO NOT PASS and PASS WITH CARE signs may also be used instead of pavement markings on low volume roads (400 ADT) for longer periods in accordance with the road jurisdiction’s policy.

1.10 Portable Traffic Signals

This section covers the use of Portable traffic signals that can be used to control traffic through a one lane, two-way work zone.

Portable Traffic Signal Requirements:

1. Portable traffic signals **shall** be set up for line of sight from one end of the one-lane section to the other and always requires hard-wire interconnect to ensure communication between signals to be maintained.
2. Any intersecting roads or driveways between the portable traffic signals **shall** be closed.
3. An all-red interval is required that is long enough for road users to clear the one lane section.
4. The portable signal control equipment **shall** have safeguards that eliminate the possibility of conflicting signal indications at each end of the work zone.
5. Portable traffic signals **shall** have vertically arranged 12 inch diameter signal lenses.
6. Each portable traffic signal unit **shall** have at least two signal heads. One signal head **shall** be mounted on a pole with the bottom of the signal head at least a minimum of eight feet above the sidewalk or, if there is no sidewalk, above the centerline of the road. At least one vehicle signal head **shall** be located over the travel lane(s) with a minimum vertical clearance of 17 feet to 19 feet above the centerline pavement surface.

7. All signals added to the state highway system, including portable signals, **shall** be by permit, and approval from the State Traffic Engineer is required before a permit can be issued. Check with local road authorities for signal approvals on local, non-State roads.
8. Use of portable traffic signal equipment **shall** be listed on the ODOT Qualified Products List (QPL). On local roads, check with local jurisdictions for signal approval.
9. The timing parameters are supplied by the road jurisdiction to the user in order to properly time the signal and **shall** not be changed without prior approval.
10. Portable traffic signals are for stationary work only.

1.11 Unattended Work Sites

If a work site must be left unattended before the work is completed, all appropriate warning signs and channelization devices **shall** be in place. Turn, cover or remove all inappropriate signs and traffic control devices. Equipment left at the work site should be off the shoulder, if possible. If equipment must be left on the shoulder less than 15 feet from the edge of travel way, exposed to traffic, or in a closed lane, the equipment should be delineated.

Changes in road surface such as rough pavement, excavations or raised plates in the road **shall** have the appropriate advance warning signs in place. Advance warning signs **shall** also be in place for such obstructions. The obstruction **shall** be delineated and protected by cones, drums or barricades.

All unattended work sites with traffic control left in place should be routinely inspected by a knowledgeable person for adequate compliance, visibility and condition of the traffic control devices. Immediately replace all damaged or missing TCDs. Devices left in place must be appropriate for all expected or anticipated conditions, at all times.

1.12 Spotter Performance and Training Guidelines

Purpose: To provide a positive, clear set of expectations for the spotter and employee(s) being protected.

Definition: A spotter is an employee whose sole duty is to provide immediate warning of approaching vehicles, equipment, or other hazards to co-workers. **NOTE: A spotter is *not* a flagger.**

The following are key components in developing and implementing an effective Spotter training and performance program:

1. **Action Plan** – A site or task specific plan along with a hazard assessment for using a spotter must be completed before a spotter can be used. All affected parties must understand the action plan before starting work.
2. **When to Use**- The need for spotters can be dictated by one or more factors for a given operation or task. Common factors that influence the use of spotters include:
    a. Location of task
    b. Type of highway
    c. Vertical or horizontal alignment
    d. Traffic volume or speed
    e. Construction or maintenance activity
    f. Traffic controls used
    g. Added safety control
    h. Vegetation, trees, roadway geometrics or other conditions that might restrict sight distance or safety of an employee.
3. **Location of Spotter** – A spotter **shall** be within visual and verbal contact of employee(s) that are being protected. If visual contact cannot be made with workers, use an air-horn, two-way radio, or other warning device to alert workers of an eminent unsafe condition.
4. **“Alert Call” and Escape Route** – The “Alert Call” (made by voice or mechanical means) needs to be clearly heard above all surrounding noise levels when it appears an unplanned safety problem, errant motorist, equipment or other hazard is intruding into the zone of protection.

   The “Alert Call” **shall** be understood and agreed upon by all work party members prior to beginning work.

   A predetermined escape route for both the spotter and the protected employee(s) **shall** be established prior to beginning work and agreed upon by all affected parties.
5. **Commencement of Work** – The spotter **shall** be in place and prepared to issue alerts before work begins.
6. **Training** – All affected employees **shall** understand the roles and responsibilities of a spotter.

7. **Spotter Roles and Responsibilities** include:
    a. When performing the spotter role, this is your ***only*** duty (a spotter is *not* a flagger).
    b. Be within sight or sound of the employee(s) being protected.
    c. Choose a location that provides optimum sight distance and safety.
    d. Know the "Alert Call" or communication plan.
    e. Be on alert to sound the alarm.
    f. Be in place before the operation begins.
    g. Confirm that all affected parties understand the action plan.

The primary function of a spotter is to provide immediate warning of approaching vehicles, equipment, or other hazards. A spotter may be used to enhance the safety and efficiency of the work space for both workers and road users. Spotters may be used for activities such as debris removal, tagging of survey markers, marking utility lines, material delivery and heavy equipment operations within the work space. For examples, see Chapter 5, Diagrams 360, 400 or 500.

Do not control traffic with a spotter. A spotter is not a Flagger.

Do a hazard assessment to determine if using a spotter is appropriate for a given activity.

Consider using a spotter when:

- Workers must have their backs to traffic or other hazards.
- Workers and heavy equipment are working in the same area concurrently.
- Performing work where adequate gaps in traffic allow work to be done in a live travel lane.
- Work encroaches into the roadway, but maintains a minimum 10 ft travel lane (for example, see Diagram 300).
- Sight distances are limited by vegetation or other conditions.
- Posted speeds are 45 mph or higher.

Other common factors that could influence the usage of a spotter:

- Type of highway
- Vertical or horizontal alignment
- Traffic control used
- Added safety control

Location of Spotter: A spotter must be within visual and/or verbal contact of employee(s) that are being protected. If a spotter is not within visual or verbal contact of an employee, an air-horn, two-way radio, or other warning device **shall** be used.

Alerting Call or Device: The 'Alert Call' **shall** be agreed upon by all affected parties prior to the use of a spotter and **shall** be clearly heard above all surrounding noise levels.

Escape Route: A predetermined escape route for each spotter and the protected employee(s) **shall** be established prior to beginning work.

Commencement of work: The spotter **shall** be in place and prepared to issue alerts before the work operation begins.

Training: All affected employees **shall** be trained in the duties and use of a spotter(s) and retrained every three years or when non-retention of a plan is observed. Documentation of training **shall** be kept in the employees training file up to 1 year.

1.13 Unpaved Roads

Short term traffic control on unpaved public roads presents unique challenges where the full application of the standards and requirements within this Handbook may not be applicable. Local road authorities, with guidance from Part 5 and Part 6 of the 2009 MUTCD, may develop standards and practices specific to traffic control devices and measures appropriate for unpaved public roads within their infrastructure. Developed standards should mimic the requirements of this Handbook where applicable.

CHAPTER 2 – SETTING UP THE WORK ZONE

This section provides guidelines and procedures for setting up work zone, special event, or incidence response.

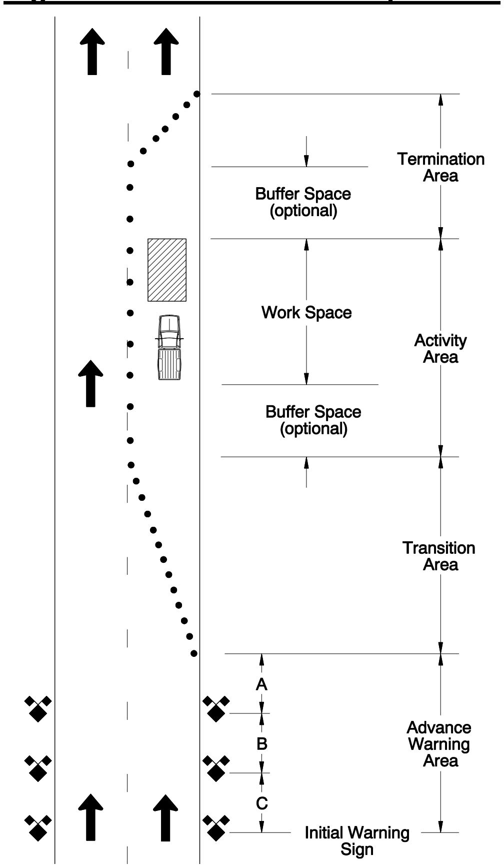
The use of additional devices, such as PCMS, arrow boards, and TMAs during set up and taking down of the work zone may be used to enhance worker safety.

In developing and implementing the TCP, existing devices **shall** be maintained at an equivalent or better level than existed prior to project implementation.

2.1 Work Zone Components

The work zone, as shown in Figure 2-1 below, consists of four parts and extends from the initial advance warning signs to the last temporary traffic control device or the END ROAD WORK sign (optional).

Figure 2-1: Work Zone Components



1. **Advance Warning Area:** An advance warning area is necessary for all work zones. It may vary from a series of signs starting a mile or more in advance of the work space to a single sign or flashing lights on a work vehicle.

   The Advance Warning Area should give road users enough time to react to any downstream changes occurring within the Transition area. The length of the Advance Warning Area will vary based on the number of advance warning signs and the posted speed. Use Table 2-4 to determine appropriate sign spacing and specific advance warning area lengths.

2. **Transition Area:** In a transition area, traffic is moved out of normal traffic paths and into a temporary path around the work space. The transition area commonly contains channelization tapers used to shift or close the travel lane(s) or to close a shoulder.

3. **Activity Area:** The area within a work zone is comprised of the following two sections.

   a. **Buffer Space:** A section of closed road in advance of and following the work space which provides an extra margin of safety for both traffic and workers. Keep buffer spaces clear of vehicles, equipment, materials and personnel to provide a clear recovery area for errant vehicles. Buffer spaces should be provided when space is available, but are optional.

   b. **Work Space:** The portion of the roadway containing the work activity and includes workers, materials and equipment. It should be sufficiently delineated and protected.

4. **Termination Area:** The termination area provides a short distance for traffic to clear the work space and return to normal operation. The downstream cone taper is optional. An END ROAD WORK sign is also optional.

2.2 Tapers

Taper lengths, calculated from the following tables or shown in Figure 2-2, are minimum taper lengths. Longer tapers may be necessary for drivability or to enhance driver performance (e.g. around vertical or horizontal curves or steep grades). To determine if a taper length is adequate or needs to be adjusted, monitor traffic as it maneuvers through the work zone.

TAPER TYPES:

Merging Taper: Merges two traffic lanes in the same direction into one lane.

Shifting Taper: Moves traffic from one path to another.

Shoulder Taper: Used to close a shoulder to traffic.

Flagger (One-Lane, Two-way) Taper: Used as part of a flagging operation. The taper is placed across the lane beyond the Flagger Station to guide queued vehicles into the open lane and around the Flagger Station during two-way, one-lane operations. Taper length is 50 – 100 ft. See Diagrams 320, 325, 340 and 370 for examples.

Downstream Taper: Used to guide the motorist back into their normal travel paths after passing the work space. Taper lengths are 50 – 100 ft.

Figure 2-2: Taper Types

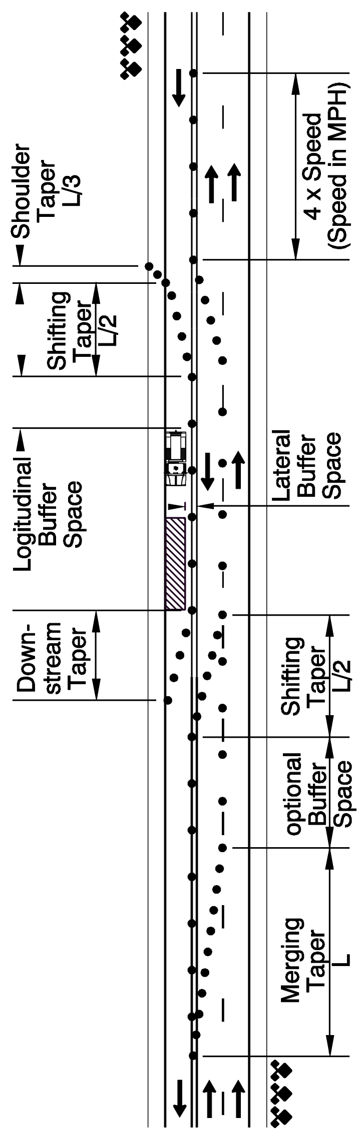


Table 2-1: Taper Length Formulas

POSTED or STATUTORY SPEED	TAPER LENGTH, L (in feet)
40 MPH or Lower	$L = \frac{WS^2}{60}$
45 MPH or Higher	$L = W \times S$

Where: L = Taper length in feet
W = Width of offset in feet
S = Posted Speed in mph

Table 2-2: Taper Types and Lengths

Taper Type	Length (in feet)
Merging Taper (minimum)	L
Shifting Taper (minimum)	(1/2)L or L/2
Shoulder Taper (minimum)	(1/3)L or L/3
Flagger (one-lane, two-way) Taper	50 – 100 feet
Downstream Taper	50 – 100 feet

Table 2-3: Taper Lengths and Device Quantities

Lane Width	10 Feet				11 Feet				12 Feet				Shoulder Tapers	
	MERGING		SHIFTING		MERGING		SHIFTING		MERGING		SHIFTING		SHOULDER	
MPH	L	Cones	L/2	Cones	L	Cones	L/2	Cones	L	Cones	L/2	Cones	L/3	Cones
20	70	5	35	3	75	5	40	3	80	5	40	3	25	3
25	105	6	55	3	115	6	60	4	125	6	65	4	35	3
30	150	6	75	4	165	7	85	4	180	7	90	4	50	3
35	205	7	105	4	225	8	115	5	245	8	125	5	70	4
40	270	8	135	5	295	9	150	5	320	9	160	5	90	4
45	450	11	225	6	495	12	250	7	540	13	270	7	150	6
50	500	11	250	6	550	12	275	7	600	13	300	7	170	6
55	550	11	275	6	605	12	305	7	660	13	330	7	185	6
60	600	11	300	6	660	12	330	7	720	13	360	7	200	6
65	650	11	325	6	715	12	370	7	780	13	390	7	220	7
70	700	11	350	6	770	12	385	7	840	13	420	7	235	7

"L" for shoulder taper equals Shoulder Width x Speed.
Figures shown are for 10' shoulders.

2.3 Device Spacing

- **Taper Spacing:** The distance between cones in the taper should equal the posted speed in feet, e.g. 55 mph = 55 feet.
- **Offset:** At speeds of 45 mph and above, cones in merging tapers should be offset one foot. At speeds of 40 mph and below, the offset will vary with the lane width.
- **Flagger (one-lane, two-way) and Downstream Tapers:** Cones in flagger and downstream tapers should be spaced at 20 foot intervals. The offset is determined by the width of the lane.
- **Four to six cones** are used in flagger and downstream tapers.
- **Buffer & Work Space (Tangent) Cones:** The tangent cone spacing along the buffer and work space should equal twice the posted speed in feet, e.g. 55 mph = 110 feet.

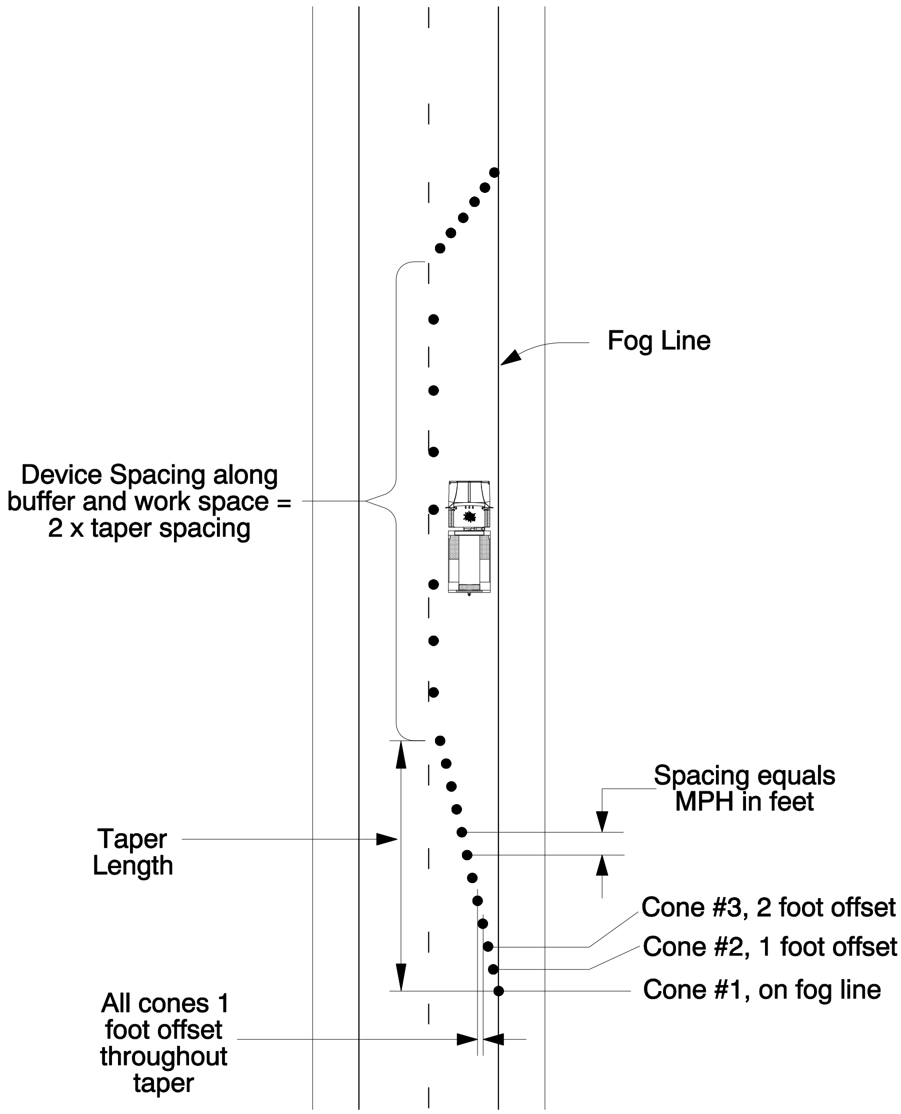
Optional Tighter taper and tangent device spacing may be used in areas where traffic may intrude into the work zone:

- **Taper Cone Spacing** of 20 feet for speeds of 40 mph and below.
- **Taper Cone Spacing** of 40 feet for speeds of 45 mph and above.
- **Tangent Cone Spacing** of 40 feet for speeds of 40 mph and below.
- **Tangent Cone Spacing** of 80 feet for speeds of 45 mph and above.

2.4 Device Placement

1. **Determine the taper length and cone spacing** using the Table 2-3 and Section 2.3, Device Spacing.
2. **Placing the first cone.** Starting at the work space or buffer, measure off the taper length along the edge of travel way or fog line. Place the first cone at the edge of travel way or fog line for merging and shifting taper, at the edge of travel way for shoulder work.
3. **Placing the second cone in the taper.** Start back towards the work space, moving along the edge of travel way a distance equal to the posted speed. Then move over one foot into the roadway and place the second cone (see Figure 2-3).
4. **Placing the third cone.** Again, move towards the work area a distance equal to the posted speed, move over two feet from the edge of travel way and place the third cone.
5. **Placing the remaining cones in the taper.** Continue moving back towards the work area, moving a foot more each time and placing a cone until reaching the end of the taper.
6. **Ensure effective set-up of the work zone** by driving or walking through it and adjust as necessary.

Figure 2-3: Cone Spacing Example



2.5 Signs

All signs mentioned in this section can be found in the MUTCD, the FHWA *Standard Highway Signs* (SHS) or ODOT *Sign Policy and Guidelines*. Use the sign reference numbers to aide in locating signs within the manuals listed.

Choosing Signs: Effective work zone signing tells the road user what to expect, what action to take, what direction to go, or hazard to avoid. Unless otherwise warranted by the activity, avoid exclusively using general warning signs that do not provide any specific information or instruction. For instance, follow a SHOULDER WORK sign with a SHOULDER CLOSED sign, rather than with a CAUTION sign.

The initial advanced warning sign should indicate the type of work or activity the driver can expect. Example initial advanced warning signs include:

ROAD WORK AHEAD (W20-1)	SHOULDER WORK (W21-5)
BRIDGE WORK AHEAD (CW21-10)	WORKERS (W21-1)
UTILITY WORK (W21-7)	DETOUR AHEAD (W20-2)
SURVEY CREW (W21-6)	WRECK AHEAD (CW15-10)
SIGNAL WORK AHEAD (CW21-11)	

A distance (e.g. 1/2 MILE, 1000 FT) may be substituted for AHEAD on a warning sign or added as a rider.

Additional advance or interim signing may be necessary, in some cases, in order to extend advance signing. Signs should be appropriate to what the motorist might encounter. Typical signs include but are not limited to:

BE PREPARED TO STOP (W3-4)	Flagger Ahead (CW23-2)
Reverse Curve (W1-4)	LOOSE GRAVEL (W8-7)
Bicycle (symbol) ON ROADWAY (CW11-1)	
RIGHT LANE CLOSED AHEAD (W20-5)	

Where a symbol sign is available in place of a text sign, the use of a symbol sign is encouraged.

In situations where roadway conditions make it necessary to provide road users with additional regulatory, warning or guidance information, the MUTCD, Section 2A.06, allows state and local highway agencies to develop special word message signs.

Work zone signs **shall**:

- Be clean, fully legible and in good condition.
- Be mounted so that the bottom of the sign is not less than one foot above the traveled way.
- Allow pedestrians and bicyclists an unobstructed travel path.
- When used on the shadow and work vehicle, they **shall** be facing the rear so that the entire sign face is visible at all times.
- Be appropriate to the conditions drivers will encounter downstream.
- Be turned, covered, or removed when inappropriate, when the work zone is not active, or when a flagger is not present.
  - ✷ ***IF*** "FLAGGER" ***SIGNS ARE IN PLACE, A FLAGGER MUST BE ACTIVE*** and at their station, even if only being used to warn drivers of approaching work zone activity.

The following signing enhancements may be used:

- Signs that are larger than the minimum standard may be used any time. Larger signs can be more effective when the visual landscape is crowded or traffic volumes are high.
- Brighter sheeting.
- A flashing warning light may be added to advance signing, if the sign-light-support combination has passed crash testing.
- Fluorescent sign borders or other sign enhancements from Section 2A.15 in the MUTCD.

Sign Placement: Sign spacing and placement in this handbook are for open, unobstructed road conditions. Placement should adequately control traffic and protect the work space. The layout may be modified as necessary to provide visibility, allow safe passage of pedestrians and cyclists and avoid interference with physical features such as curves, hills, intersections, driveways or other traffic control devices.

- Sign spacing may be adjusted to fit field conditions, allow for proper visibility, and to avoid conflicts with existing signing.
- Signs placed on non-freeways may be installed using spacing dimensions up to 2 times those shown on the Sign Spacing & Buffer Lengths Table 2-4, below.
- Small adjustments to freeway sign spacing may be made to fit field conditions, but spacing should not exceed 1.5 times the dimensions shown on Table 2-4.

Consider the following when determining sign layout:

1. Place the initial work advance signs, such as ROAD WORK AHEAD, before entering a horizontal curve or before the crest of a hill if needed to provide adequate sight distance.
2. Space the remaining signs leading up to the work space close enough together to maintain road user awareness and still maintain the sign spacing for the posted speed.
3. If sign spacing needs to be adjusted, keep all the sign spacing distances similar to maintain driver expectancy.
4. If a driveway comes in between the last work zone sign and the work, but the work zone is not apparent from the driveway approach, use a sign or cones at the driveway to alert users.
5. Alter the sign placement, when necessary, to provide a level area. If no level placement is available, make sure the sign is stable and the message is fully visible to approaching drivers.

Table 2-4: Sign Spacing and Buffer Lengths (feet)

<table>
<tr><th rowspan="2">Posted Speed</th><th colspan="3">Spacing Between Signs</th><th rowspan="2">"Buffer" Space</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>20</td><td rowspan="3">100</td><td rowspan="3">100</td><td rowspan="3">100</td><td>50</td></tr>
<tr><td>25</td><td>75</td></tr>
<tr><td>30</td><td>100</td></tr>
<tr><td>35</td><td rowspan="2">350</td><td rowspan="2">350</td><td rowspan="2">350</td><td>125</td></tr>
<tr><td>40</td><td>150</td></tr>
<tr><td>45</td><td rowspan="3">500</td><td rowspan="3">500</td><td rowspan="3">500</td><td>180</td></tr>
<tr><td>50</td><td>210</td></tr>
<tr><td>55</td><td>250</td></tr>
<tr><td>60</td><td rowspan="3">700</td><td rowspan="3">700</td><td rowspan="3">700</td><td>285</td></tr>
<tr><td>65</td><td>325</td></tr>
<tr><td>70</td><td>365</td></tr>
<tr><th colspan="5">Freeways:</th></tr>
<tr><td>55</td><td rowspan="4">1000</td><td rowspan="4">1500</td><td rowspan="4">2640</td><td>250</td></tr>
<tr><td>60</td><td>285</td></tr>
<tr><td>65</td><td>325</td></tr>
<tr><td>70</td><td>365</td></tr>
</table>

- All spacing shown in feet.
- Posted Speed: Equivalent to the existing, posted or statutory speed.
- Spacing “A” may be used as suggested trailing distance for shadow vehicles.
- Adjust spacing as field conditions require.
- Non-Freeway sign spacing **shall** not exceed 2 times the dimensions shown.
- Small adjustments to freeway sign spacing may be made to fit field conditions, but spacing should not exceed 1.5 times the dimensions shown.

Sign Spacing Examples: The following examples may be used to aid in the proper placement of temporary signing when sign sequences have fewer or more than three signs.

Figure 2-4: Four or More Sign Sequence

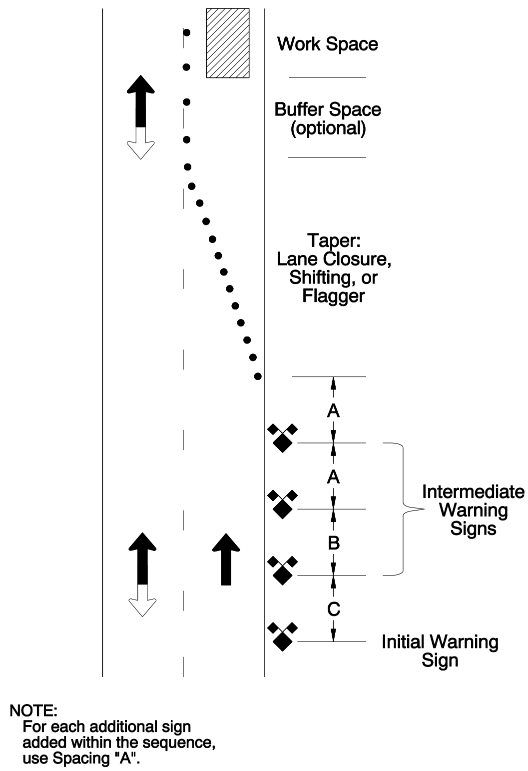
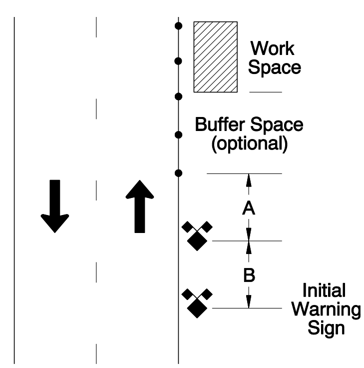


Figure 2-5: Two Sign Sequence



CHAPTER 3 – FLAGGING & OTHER TCM

3.1 Flagging and Other Traffic Control Measures

A variety of Traffic Control Measures (TCM) may be used to control traffic through one-lane, two-way work zones. Flagging, pilot cars, portable signals and Automated Flagger Assistance Devices (AFAD) are effective devices.

Flagging operations are typically used when one direction of a roadway is closed and traffic must alternately share the remaining lane. Flagging operations must accommodate all road users, including non-motorized users.

Pilot cars are used to escort traffic through longer work zones, often where flaggers cannot see from one flagger station to the next. A pilot car operation uses a flagger at each end of the one-lane, two-way section.

Portable traffic signals may be used to control traffic through one-lane, two-way sections when it is more practical than using flaggers. Portable traffic signals must be approved by the ODOT State Traffic Engineer for state highways, or the appropriate official for the local road authority.

AFADs may be used in lieu of flaggers to control one-lane, two-way traffic under certain circumstances. See Section 3.11, below, for additional AFAD details.

Additionally, special care must be taken whenever a work zone may cause traffic to backup up to and/or across a rail crossing.

3.2 Flagging Qualifications

Flaggers who have completed formal training and have certification in Oregon, Washington, Idaho, and Montana, may practice as a Certified Flagger in Oregon. Flaggers should be able to satisfactorily demonstrate the following abilities, as outlined in the MUTCD, Chapter 6E:

1. Ability to receive and communicate specific instructions clearly, firmly, and courteously;
2. Ability to move and maneuver quickly in order to avoid danger from errant vehicles;
3. Ability to control signaling devices (such as STOP/SLOW paddles) in order to provide clear and positive guidance to drivers approaching a work zone in frequently changing situations;
4. Ability to understand and apply safe traffic control practices, sometimes in stressful or emergency situations; and
5. Ability to recognize dangerous traffic situations and warn workers in sufficient time to avoid injury.
6. Flaggers **shall** be 18 years of age or older.

3.3 Flagger Training Requirements

Flagger training requires a course of instruction covering the following topics, as a minimum:

Example Flagger Training Course Outline:

- Fundamental Principles from Part 6 of the MUTCD
- The Four Parts of Work Zones
- Main Traffic Control Devices
  - Signs
  - Cones
  - Barricades
  - Arrow Boards
  - Portable Changeable Message Signs (PCMS)
- Proper Use and Placement of Devices
- Flagging Principles
  - Qualifications
  - Clothing
  - Tools
  - Positions
  - Use of Hand-Signaling Devices
  - Pilot Car Operations

Training **shall** be repeated every three years. Certified training courses and sources for this training will depend on the individual road jurisdiction. Contact the appropriate road jurisdiction for information on their flagger training courses and specific requirements.

3.4 Flagging Principles

1. Flaggers **shall** be used only when other traffic control methods are inadequate to safely guide traffic through a work space or assure the safety of workers.

2. ***DO NOT* CONTROL TRAFFIC BY FLAGGING IN CONFLICT WITH NORMAL INTERSECTION TRAFFIC CONTROL.** Traffic cannot be flagged to proceed through a traffic signal when facing a red traffic signal light or STOP sign, nor flagged to stop when the traffic signal is green, unless it is an emergency.

   Contact the appropriate road jurisdiction for permission to turn off a traffic signal. Coordinate with city, county or state electrical crew personnel or local police. For work under ODOT permit, this should be included in the permit.

Flagging **shall** continue until the signal is back in operation or until alternative traffic control, approved by the road jurisdiction, is in place.

Cover conflicting existing regulatory signs (e.g. STOP, YIELD or RIGHT TURN ONLY, etc.).

Only uniformed police officers may control traffic by flagging in conflict with traffic control devices under Oregon law (ORS 811.265).

3. Under normal conditions, vehicles should not be delayed longer than 20 minutes at the flagger station. In emergency situations or for clearing the road in operations such as blasting, longer delays may be allowed with advance signing. Every effort should be made through media communications to alert the public of long delays.

4. Flaggers should describe the last vehicle in the queue to the flagger at the other end of the work space.

5. For some activities, a flagger may be used to slow traffic. Roadways with high ADTs and high speeds (e.g. freeways) may not benefit from the placement of a flagger slowing traffic due to potentially significant speed differentials and driver interpretation of the “SLOW” message, or to the sudden presence of a flagger where one is not normally expected.

6. To slow traffic on high-speed, high ADT facilities, consider using PCMS messages, tighter channelization device spacing, additional static signing, or other mechanical measures. Use of a TMA may provide additional protection for workers.

   Example PCMS Messages:

WORKERS	WORKERS	SLOWED	WORKERS	TRAFFIC
IN ROAD	IN	TRAFFIC	IN LANE	SLOWED
1 MILE	ROADWAY	1 MILE	SLOW	AHEAD

3.5 Flagger Station Practices

Under normal operating conditions:

1. Flagger stations **shall** be located such that approaching road users will have sufficient sight distance to be able to stop at the intended stopping point.
2. Flagger stations should be kept clear of all equipment and vehicles.
3. Flaggers should identify an unobstructed escape route to avoid errant vehicles.
4. Flagger stations should include one to three cones on the shoulder at an angle in front of the flagger station to enhance the visibility of the flagger station.
5. Flaggers should stand within closed lanes or on the shoulder.
6. After stopping the first few vehicles, flaggers may move from the shoulder to near centerline to be more visible to approaching traffic.
7. Flaggers should stand alone, never permitting a group of workers to congregate around the flagger station.

3.6 Flagging Signs & Equipment

The Flagger Ahead (W20-7) sign (symbol or text) **shall** always precede flaggers.

The FHWA *Standard Highway Signs* (SHS) Flagger symbol sign (W20-7a), showing a flagger holding a flag, not a stop/slow paddle, should not be used.

The Flagger Ahead (W20-7) sign (symbol or text) and the "BE PREPARED TO STOP" (W3-4) sign **shall** be removed, covered or turned away from traffic when flagging is not being done. Flags on portable signs **shall** also be removed or turned down.

1. Flaggers **shall** use a minimum 18" x 18" octagon-shaped retro reflective STOP/SLOW paddle. The paddle **shall** be made of a rigid material and the full face of the STOP and the SLOW sides **shall** be visible and legible at all times when the paddle is in use.

   A 24" x 24" paddle is recommended on high-speed roadways or in other situations where increased visibility is needed.

   Roll-up STOP/SLOW paddles are only for emergency use.

2. Do not use a flag to control traffic, unless in an emergency.

3. Flaggers **shall** use only those hand signals approved as shown in the MUTCD, Figure 6E-3.

   Extended traffic queues can form when a line of vehicles stopped at the beginning of a work zone extend beyond the initial "ROAD WORK AHEAD" (W20-1) sign. When extended queues repeatedly develop, additional signing is needed. An Advance Flagger can be used to assist in warning approaching traffic before they reach the end of the stopped traffic queue.

   a. If queue lengths change frequently and significantly, particularly on roadways posted at 45 mph or higher, consider installing a PCMS approximately ½ mile in advance of the initial ROAD WORK AHEAD sign. Example PCMS messages:

PREPARE	TRAFFIC
TO STOP	STOPPED
1/2 MILE	AHEAD

   b. Advance Flaggers use 18" x 18" minimum octagonal paddles with the SLOW message facing traffic and with the STOP side covered.

      As an option, Advance Flaggers may use a "SLOW/SLOW" paddle for this activity.

4. If using a staff or extended handle for the STOP/SLOW paddle, the bottom of the sign should be above the flagger's eye level. Equipment or other objects attached to the staff **shall** be secured and not allowed to hang freely or loosely. Do not tie clothing to the staff.

5. Flagger Apparel:

   a. While on duty, flaggers **shall** be fully clothed. Do not wear abbreviated clothing such as swimsuits, shorts, tank tops or halter tops.

   b. Flaggers **shall** wear safety apparel meeting ANSI 107-2004 Class II risk exposure. Consider using Class III apparel for night work to enhance flagger visibility.

<u>**Figure 3-1: Extended Traffic Queues with Advance Flagger**</u>

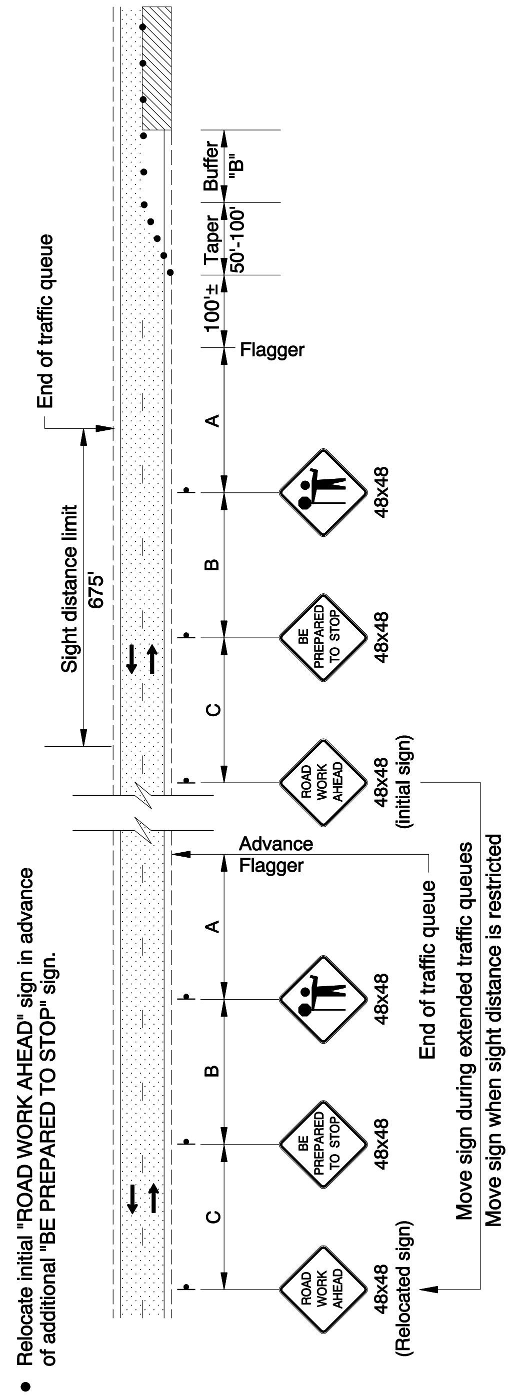


Figure 3-2: Use of Hand-Signaling Devices by Flaggers

Flagging Procedures as described in the MUTCD, Section 6E.07 and shown in MUTCD Figure 6E-3:

TO STOP TRAFFIC

- To stop road users, the flagger **shall** face road users and aim the STOP paddle face toward road users in a stationary position with the arm extended horizontally away from the body.

  The free arm **shall** be held with the palm of the hand above shoulder level toward approaching traffic.

TO LET TRAFFIC PROCEED

- To direct stopped road users to proceed, the flagger **shall** face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body. The flagger **shall** motion with the free hand for road users to proceed.

  Flags **shall** not be used to signal road users to proceed.

TO ALERT AND SLOW TRAFFIC

- To alert or slow traffic, the flagger **shall** face road users with the SLOW paddle face aimed toward road users in a stationary position with the arm extended horizontally away from the body.

  To further alert or slow traffic, the flagger may motion up and down with the free hand, palm down.

3.7 Flagging Through Intersections

Flagging through intersections is especially hazardous for both road users and workers. Other traffic control measures (e.g. full closures with detours) that minimize impacts to the normal operation of the intersection should be considered to accommodate the work.

Concepts applicable to all intersections:

1. Contact the road jurisdiction traffic office ahead of time for help in determining what closures or detours can be set up. All closures **shall** be approved by the road jurisdiction.
2. Avoid flagging, if possible, during peak traffic times, especially on major commuter routes.
3. There should be one flagger for each approach (See Diagram 620). One flagger may be used to control the entire intersection if the intersection has an approach ADT of 400 vehicles per day or less.
4. With multiple flaggers, designate one as the lead flagger. Effective means of communication, such as radio devices, should be used.
5. Approach lanes should be reduced to a single through lane. Consider closing lanes that are not a major movement, such as right turn lanes with only occasional use. Consider prohibiting left turns if there is work or obstruction within the intersection.
6. Dedicated lanes may be provided for major turning movements with appropriate regulatory signing such as “RIGHT TURN ONLY” (R3-5) or “RIGHT LANE MUST TURN RIGHT” (R3-7) signs. Non-conflicting turning movements may be combined with other movements.
7. Conflicting regulatory signs, such as STOP, YIELD or RIGHT TURN ONLY, **shall** be covered.

3.8 Night Flagging

When flaggers and/or pilot cars are necessary during night operations, flagger stations **shall** be illuminated, and **shall** be illuminated separately from the work space. Consider using ANSI Class III high visibility safety apparel during night operations.

Nighttime Flagger illumination strategies should include the following:

1. Locate lighting on the same side of the roadway as the flagger.
2. Flagger station lighting should meet the following criteria:
    a. Locate lighting on the shoulder approximately 5-10 feet from the edge of the traveled way at a 15 degree angle away from the travel lane in advance of the flagger, without impacting the flagger’s escape route.

   b. Illuminate the flagger station with lighting 15-21 feet above the roadway.
   c. Light output of less than 2,500 watts.
   d. Provides a lighted area of at least 40 feet diameter at ground level.
   e. Illuminate the roadway surface throughout the designated flagging area, with at least 5 foot-candles.
   f. Illuminate the flagger so that the flagger is visible, and is discernable as a flagger, from a distance of 1,000 feet.
   g. Spot lights should not be used.

3. For low volume roads and emergencies, where there is no room for the light equipment on the shoulder, the flagger illumination may be stationed on the roadway. Consider using the following to increase visibility during night flagging:
   a. LED lights on the STOP/SLOW paddle, as allowed by the MUTCD. LED STOP/SLOW paddles are available on the ODOT QPL.
   b. Using a 24” x 24” STOP/SLOW paddle.
   c. Adding 2”-wide diagonal bands of alternating white and red retro reflective sheeting on the staff of the STOP/SLOW paddle.
   d. Lighted safety apparel.

3.9 Flagging on Bridges and Other Structures

Avoid locating flagger stations on a bridge, viaduct or other roadway section where there is no feasible escape route. When possible, move flagger stations to the ends of bridges to provide an escape route.

On very long bridges with high traffic volumes where flagger stations cannot be moved to the ends, include a “Buffer” space between the Flagger and the work space (see Table 2-4).

3.10 Pilot Car Operation

Pilot cars may be used to guide traffic through long sections of one-lane, two-way work spaces. Consider using pilot cars if a clear line of sight cannot be made between flagger stations, or to control speeds through the work area.

Cones or tubular markers may be used to separate the work spaces from the open travel lane.

Pilot Car Operational Requirements:

1. Operation of the pilot car **shall** be coordinated with flagging operations.
2. The "PILOT CAR FOLLOW ME" (G20-4-18) sign **shall** be mounted in a conspicuous location on the rear of the vehicle. A vehicle-mounted PCMS may be used for the pilot car sign.
3. The pilot car guides traffic through the work zone by driving in front of the traffic queue, maintaining a safe speed.
4. Radios or other communications should be available between the pilot car driver, the flaggers and the work superintendent or designated worker at all times.
5. No vehicles should be allowed to pass the pilot car.
6. Flaggers should describe the last vehicle in the queue to the flagger at the other end of the work space.

   OPTION: The last vehicle following a pilot car in a queue may be identified by handing off a flag between driver and flaggers. Alternately, the last vehicle can be identified by communications between flaggers.
7. The pilot car should display the name of the road jurisdiction or the contractor prominently on the vehicle.
8. Instead of flaggers, the "WAIT FOR PILOT CAR" (CR4-20) sign may be posted on side roads or accesses intersecting state highways when pilot cars are being used to control traffic on the mainline through the work zone, provided:
   a. Accesses or side road traffic is being stopped for no more than 20 minutes (per Section 00220 of the Oregon Standard Specifications for Construction, and Chapter 3 of the Oregon Temporary Traffic Control Handbook)
   b. Access or side road is a dead-end facility or has no immediate alternate access, has an ADT of 100 vehicles per day or less, and does not access public service facilities (e.g. parks, rest stops, waysides, ranger stations, landfills, utility hubs, treatment plants, etc.).

   For private residential driveways, see sign CR4-20a.

   Intersection or accesses using the WAIT FOR PILOT CAR sign should be checked regularly to ensure safe and effective traffic operations.

   For a facility with an ADT greater than 100 vpd, but not exceeding 400 vpd, the sign may be used only if closed monitored and frequently checked for traffic compliance, operation and safety. If operation issues are observed at these or any other location using the WAIT FOR PILOT CAR sign, the sign should be replaced by Flagging or other traffic control measures as quickly as practical.

3.11 Automated Flagger Assistance Devices Operations

AFADs may be used to control traffic through a work zone. This will enable a flagger(s) to be positioned out of the lane of traffic. These devices are designed to be remotely operated either by a single flagger at one end of the work zone or at a central location, or by separate flaggers near each device's location.

AFADs **shall** ONLY be used in situations where there is a single lane of approaching traffic in the direction to be controlled. If an AFAD is to be used on a multi-lane facility, you must merge all lanes of one direction of traffic into one in advance of the work zone.

AFAD's approved for use in Oregon are operated by a remotely controlled red and yellow lenses and a gate arm to alternately control traffic.

There are two types of Automated Flagger Assistance Devices (AFADs), one that uses a STOP/SLOW sign on a trailer or cart (not approved for use in Oregon) and one that uses remotely controlled red and yellow lenses and a gate arm to alternately control traffic.

AFADs might be appropriate for work activities such as, but not limited to:

- Bridge maintenance
- Culvert replacement
- Haul road crossings
- Pavement patching

When used at night, the AFAD location **shall** be illuminated, similar to flagger stations, such that approaching traffic has sufficient distance to stop in advance of the gate arm.

AFADs **shall** be set up according to Figure 3-3. All of the signs and other traffic control devices are readily visible to the driver of the initial approaching vehicle with advance warning signs alerting other approaching traffic to be prepared to stop.

AFADs **shall** be operated only by a flagger who has been trained on the operation of the AFAD. The flagger(s) operating the AFAD(s) **shall** not leave the AFAD(s) unattended at any time while the AFAD(s) is being used.

AFADs **shall** conform to one of the following methods:

1. An AFAD at each end of the work zone (Method 1), or
2. An AFAD at one end of the work zone and a flagger at the opposite end (Method 2).

A single flagger may simultaneously operate two AFADs (Method 1) ***ONLY*** if all of the following conditions are present:

1. The flagger has an unobstructed view of the AFAD(s);
2. The flagger has an unobstructed view of approaching traffic in both directions; and
3. AFADs are less than 800 ft apart.

The following signs should be used with an AFAD:

- ROAD WORK AHEAD (W20-1)
- BE PREPARED TO STOP (W3-4)
- ONE LANE ROAD AHEAD (W20-4)
- STOP HERE ON RED (R10-6 or R10-6a)

When the AFAD is not in use, the signs associated with the AFAD **shall** be removed or covered.

An AFAD **shall** alternate between a steadily illuminated CIRCULAR RED lens and a flashing CIRCULAR YELLOW lens to control traffic. If post-mounted, the bottom of the lens housing (including brackets) **shall** be at least 7 feet above the pavement. If located over any portion of the highway that can be used by motor vehicles, the bottom of the lens housing (including brackets) **shall** be at least 15 feet above the pavement.

An AFAD **shall** include a gate arm that descends to a down, horizontal position across the approach lane of traffic when the steady CIRCULAR RED lens is illuminated. Then, when the flashing CIRCULAR YELLOW lens is illuminated, the gate arm **shall** ascend into an upright position.

The gate arm **shall** be fully retroreflectorized on both sides, and **shall** have vertical alternating red and white stripes at 16-inch intervals measured. When the arm is in the down position blocking the approach lane:

1. The minimum vertical aspect of the arm and sheeting **shall** be 2 inches; and
2. The end of the arm **shall** reach at least to the center of the lane being controlled.

To inform road users to stop, the AFAD **shall** display a steadily illuminated CIRCULAR RED lens and the gate arm **shall** be in the down position. To inform road users to proceed, the AFAD **shall** display a flashing CIRCULAR YELLOW lens and the gate arm **shall** be in the upright position.

If AFADs are used to control traffic in a one-lane, two-way work zone, mechanical safeguards **shall** be incorporated to prevent the flagger(s) from actuating a simultaneous display of a flashing CIRCULAR YELLOW lens at each end of the work zone.

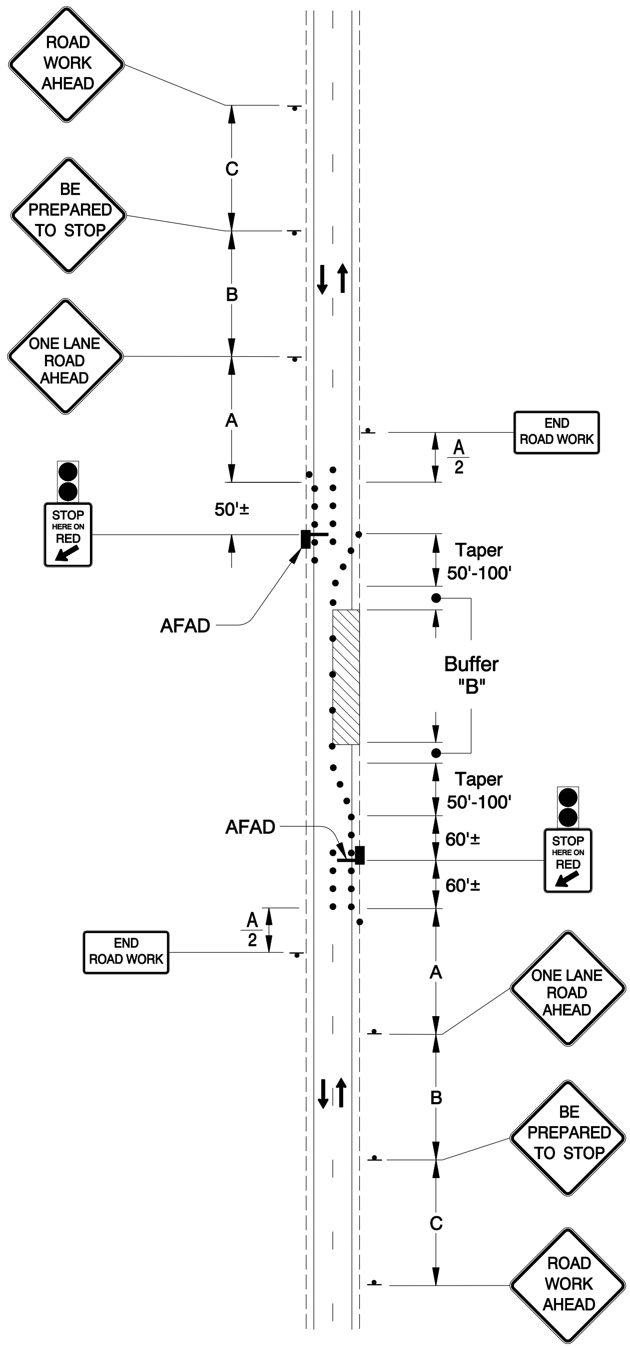
Additionally, the flagger **shall** not actuate the AFAD's display of the flashing CIRCULAR YELLOW lens until all oncoming vehicles have cleared the one-lane portion of the work zone.

The transition between the flashing CIRCULAR YELLOW and the steady CIRCULAR RED should be at least 5 seconds. During the change interval, the CIRCULAR YELLOW lens **shall** be steadily illuminated. The gate arm **shall** remain in the upright position during the display of the steadily illuminated CIRCULAR YELLOW change interval.

Figure 3-3, below, shows the use of two RED/YELLOW LENS AFAD units to control two-way, one-lane traffic.

Figure 3-3: Red/Yellow Lens AFAD

Two-Lane, Two-Way Roadway



CHAPTER 4 – EQUIPMENT SPECIFICATIONS

All temporary traffic control devices (TCD) and worker safety apparel should be kept in ”Acceptable” condition, according to the current ATSSA *Quality Guidelines for Temporary Traffic Control Devices and Features*.

All TCD, including sign and sign support combinations, **shall** be crashworthy per National Cooperative Highway Research Program (NCHRP) 350 or the *Manual for Assessing Safety Hardware* (MASH) requirements.

All traffic control devices used on state highways **shall** be listed on the ODOT Qualified Products List (QPL).

4.1 Signs

Unless otherwise noted, all warning signs used for temporary traffic control **shall** have standard black legends and borders on an orange background except signs for emergency response which may be black legends and borders on fluorescent pink. A fluorescent yellow border may be added to truck-mounted signs to enhance their visibility.

Temporary signs may have the same shapes and colors as the corresponding permanent signs.

All warning and regulatory signs used for temporary traffic control **shall** be retro reflective.

Flexible (“roll up”) signs may be installed on portable sign supports or delineator posts. Rigid signs (sign sheeting installed on a rigid substrate – e.g. plywood, sheet aluminum) may be used on barricades or other supports when appropriately crash tested or when mounted on a vehicle.

Existing rigid signs may only be used in emergency situations and may be used through their life cycle. When these signs are replaced, the replacement signs **shall** meet current standards. Rigid signs may not be used for regularly occurring flooding, slides, or similar situations that can be expected in a particular location.

Standard sign sizes for the diamond shape warning signs can be found in Table 4-1.

Table 4-1: Diamond Warning Sign Sizes

Roadway Type	Diamond Warning Sign Size
Non-Freeways	36” x 36”
Freeways	48” x 48”
Non-State Highways with ADT <400	30” x 30” (minimum)

- For standard and minimum sizes of other sign shapes (e.g. rectangular), see Chapter 6, Table 6F-1 of the MUTCD, the FHWA *Standard Highway Signs*, and Chapter 6 of the ODOT *Sign Policy and Guidelines*.
- Contact local road jurisdiction for permission before using 30”x30” signs.

Signs on portable supports **may** have two fluorescent orange or orange-red flags at least 16 inches square mounted at the top of the sign. When used, flags **shall** be mounted so that the entire sign legend is visible.

All signs **shall** have been crash tested as a combination with the sign support and/or any warning light attached and met the federal crash worthiness requirements. This can be researched on the Federal Highway Administration (FHWA) web site or through the ODOT Qualified Products List.

Sign Supports: Signs may be mounted on portable sign supports. For frequently moving work, signs may be placed on a vehicle. Place ballast on portable sign supports or barricades only on the bottom feet or frame. Sign supports or barricades **shall** only be ballasted with maximum 25 pound sandbags.

4.2 Barricades, Cones, Drums, and Tubular Markers

Barricades: Barricades are classed as Type I, Type II, or Type III. They have from one to three rails with alternating orange and white stripes sloping downward at an angle of 45 degrees in the direction road users are to pass. The minimum length for Type I and Type II barricades **shall** be 24 inches and the minimum length for Type III barricades **shall** be 48 inches. The sides of barricades facing traffic **shall** have retro reflective rail faces.

Barricades **shall** be crashworthy per NCHRP 350 or MASH requirements. Ballast may be placed on the lower parts of the frame or stays. Do not place ballast on top of any striped rail. Do not use non-deformable objects such as rocks or chunks of concrete as ballast.

Signs and flashers may be installed on barricades. The combination of sign, and/or flasher, and barricade **shall** meet NCHRP 350 or MASH requirements.

<u>Cones</u>: Standard cone height is 28 inches. Cones used only during daylight and on low speed roads may have a minimum height of 18 inches. Twenty-eight (28) inch cones **shall** be used on roads with speeds of 45 mph or greater or at night. All cones **shall** have a weighted base and be capable of remaining upright and in place during normal traffic flow and wind conditions common to the area.

Cones used at night **shall** be retroreflectorized. Twenty-eight (28) inch cones **shall** have a minimum 6-inch wide retroreflectorized band three to four inches below the top and a 4-inch wide band a minimum of two inches below the 6-inch band. Cones may be equipped with lighting devices for maximum visibility. The combination of cone and light **shall** meet NCHRP 350 or MASH requirements.

<u>Plastic Drums (Barrels)</u>: Drums used for traffic control **shall** be constructed of lightweight, flexible, and deformable materials, be a minimum of 36 inches in height, and have at least an 18-inch minimum width, regardless of orientation. The markings on drums **shall** be horizontal, full circumference, alternating orange and white retro reflective stripes four to six inches wide. Each drum **shall** have a minimum of two orange and two white stripes. Any non-retro reflective spaces between horizontal orange and white stripes **shall** not exceed two inches wide. Drums **shall** have closed tops that will not allow collection of roadwork or other debris.

Drums should not be used to mark pedestrian paths unless they are continuous between individual devices and detectable to users of long canes. Metal drums **shall** not be used.

<u>Tubular Markers:</u> Tubular markers are cylindrical in shape with a weighted base. The tube **shall** be a minimum of two inches wide facing traffic. Standard tubular marker height is 28 inches. Tubular markers used only during daylight and on low speed roads may have a minimum height of 18 inches. Speeds of 45 mph or greater or night work require 28 inch tubular markers.

Tubular markers used at night **shall** be retroreflectorized. Twenty-eight (28) inch tubular markers **shall** have two 3-inch wide bands no more than two inches below the top with no more than six inches between bands.

Non-cylindrical tubular markers may be used only if they are secured in a way which ensures that the width facing traffic meets the minimum requirements.

4.3 Lights and Lighted Signs

Warning Lights (Flashers & Steady-Burn): Flashing warning lights are vehicle-mounted, high-intensity, rotating, flashing, oscillating or strobe warning lights with 360-degree visibility.

Flashing warning lights are optional on vehicles:

- Behind a rigid barrier system;
- Behind retroreflective channelization devices (cones, tubes, or drums); or,
- More than 15 feet from the travel lane.

Flashing warning lights may be added to temporary signs or barricades as a means to increase device visibility in poorly lit areas, during inclement weather or at night.

The combination of sign and light or barricade and light must have been crash-tested and be approved as a crashworthy device under NCHRP 350 or MASH requirements. Obtain proof of crashworthiness from vendors or manufacturers of the devices being used.

Flashing warning lights **shall** not be used for delineation. Maximum spacing for warning lights should match device spacing requirements. All lights **shall** be mounted a minimum of 30 inches from the ground to the bottom of the lens.

Type A, B, C and D flashing warning lights **shall** be portable, enclosed, self-powered, lens-directed, amber-colored lights. All types **shall** be in accordance with the current Institute of Transportation Engineers (ITE) *Purchase Specification for Flashing and Steady-Burn Warning Lights*. All lights **shall** be visible on a clear night from 3000 feet.

Type A: Low-intensity flashing warning light used during night hours.

Type B: High-intensity flashing warning light. **Shall** be visible on a sunny day from 1000 feet. Used during day, night hours, or 24-hour use.

Type C: Flat lens, steady-burn warning light. Used at night to delineate edge of traveled way. If used in curved section, place only on outside of curve.

Type D: Steady-burn, 360-degree warning light. Used at night to delineate edge of traveled way. If used in curved section, place only on outside of curve.

<u>Arrow Boards (Sequential Arrows)</u>: Sign panels conforming to the requirements of the MUTCD with a matrix of lights capable of either flashing or sequential display of directional mode arrows or chevrons or non-directional (caution) mode. Caution mode may consist of three different patterns, as follows:

- A four-corner display with all four lights flashing simultaneously.
- A mid-position, full horizontal bar flashing steadily or on and off.
- Two, full-height, diamonds flashing simultaneously.

When arrow board is flashing in caution mode, it **shall** not show any sequential movement. See Chapter 5 for graphical examples of allowable caution modes.

- Arrow boards in directional mode **shall** be used for freeway lane closures.
- Arrow boards may be used on multi-lane roads to help warn of lane closures requiring merging of travel lanes.
- For shoulder closure, use arrow boards only in caution mode. The use of arrow boards in caution mode is recommended for shoulder closures on freeways.
- On two-lane, two-way roads, arrow boards **shall** be used in caution mode only except for centerline operations.
- When arrow boards are used to close multiple lanes, a separate arrow board **shall** be used for each closed lane.

For lane closures, the arrow board should be located on the shoulder at the beginning of the cone taper. Where the shoulder is too narrow, they may be placed in the lane being closed. For closure of more than one lane, an arrow board should be used per each additional closed lane.

Table 4-2: Minimum Arrow Board Sign Sizes

Panel Type		Minimum Size	Minimum Legible Distance	Minimum # Elements
A	Urban, Low-Speed	48” x 24”	½ mile	12
B	Standard	60” x 30”	¾ mile	13
C	Freeway	96” x 48”	1 mile	15

Type B arrow boards may be used for maintenance or mobile operations on freeways.

Arrow boards used for night operations **shall** be capable of 50% dimming from their full rated lamp voltage.

Floodlights: Floodlights should be used to illuminate the work space, flagger stations, equipment crossings and other areas such as nearby intersections during nighttime operations. Flagger stations **shall** be illuminated separately from the work space. Ensure that each setup does not aim excessive light into the eyes of oncoming drivers nor produce excessive glare making it difficult to see beyond the main illuminated area. The best way to determine if floodlighting is well placed is to drive through the set up after dark from each approach direction.

Research indicates that 50 lux (five foot candles) is a desirable nighttime illumination level where workers are active. If everything in the light is clearly visible, the lighting level is satisfactory. Sidewalks or pedestrian detours should be included in the lighted perimeter.

Portable Changeable Message Signs (PCMS): Also described as Portable Variable Message Signs (PVMS), PCMS include a message sign panel, control system, power source and mounting and transporting equipment. They **shall** conform to all requirements in the MUTCD and **shall** be listed on the ODOT Qualified Products List for use on state highways. PCMS are used mainly as a supplement to and not as a substitute for conventional signs, pavement markings and lighting. Standard messages and abbreviations should be used whenever possible. See *Guidelines for Operation of Variable Message Signs on State Highways* for information on standard messages (see the ODOT Traffic Section website under "Publications").

PCMS may be used in lieu of required warning signs for frequently changing situations. PCMS **shall** not be used for STOP or YIELD signs.

The display of a PCMS should be visible from ½ mile away under both day and night conditions. Try to select a location such that the entire message can be read at least twice by approaching drivers.

For mobile work zones, a series of truck-mounted PCMS displaying the advance warning messages and moving with the work is recommended for all roads.

A message may contain up to three lines per panel, although less is best. Display may be one or two panels. The display rate **shall** be set so that the entire message can be read at least twice when approached at the posted speed. It is appropriate to consider the operating speed if it is much higher than the posted speed when setting the display rate.

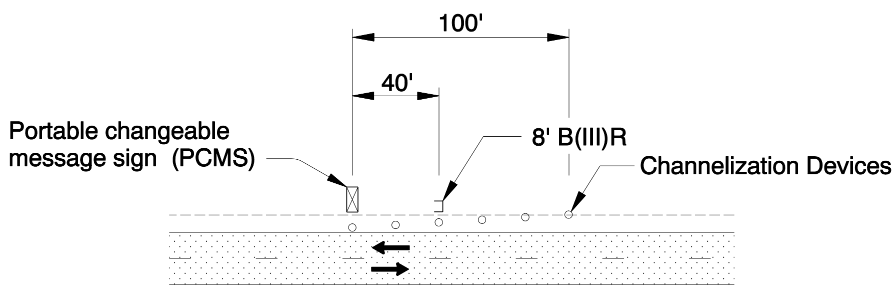
Only two panels **shall** be used; however, if three panels are required for the entire message, a second PCMS unit must be used and set up at the appropriate sign spacing so that drivers have the opportunity to see the entire message twice.

PCMS (trailer or truck-mounted) **shall** be mounted a minimum of seven feet above the road when in operating mode. PCMS should be placed on the shoulder of the road or, if practical, further from the travel lane. The installation should not block pedestrian facilities. The face of the sign should be located and angled to be legible to approaching traffic for the needed distance.

For greater visibility, trailer-mounted PCMS **shall** be delineated by a shoulder taper of six cones or drums. If space allows, drums may be used in place of cones for greater visibility. Maximum spacing is 20 feet.

For work lasting more than eight hours, one or more Type III barricade(s) should be placed facing traffic, in front of the equipment and behind the cones or drums, and 40 feet in front of the sign (See Figure 4-1, below).

Figure 4-1: PCMS Installation



4.4 Shadow and Protection Vehicles

Shadow and Protection Vehicles are strategically placed to protect the workers and work activity and to warn traffic of the operation ahead. A Truck-Mounted Attenuator (TMA) may be used on either vehicle (see Truck-Mounted Attenuators).

If using shadow or protection vehicles, flashing warning lights should be installed on or attached to all vehicles, where practical. Arrow boards in use on shadow or protection vehicles may be used in place of flashing warning lights.

Vehicle-mounted arrow boards may be used to display directional mode arrows or chevrons, or may be used in caution mode (See Section 4.3 Arrow Boards for details). Vehicle hazard lights may be used only as a supplement to the flashing warning lights. Vehicle hazard lights **shall** not be used as a replacement for flashing warning lights.

Signs should be mounted in a manner such that they are not obscured by equipment or supplies. Signs should be covered or turned and flashing warning lights turned off when traveling to and from the work space and work is not in progress.

A **Shadow Vehicle** is used as a warning and traffic control vehicle in a **mobile** work zone (See Diagram 120). Shadow vehicles provide both the advance warning and lane or shoulder closures for a mobile work zone. See Table 2-4 for suggested trailing distances. Additional vehicles may be used to warn oncoming or opposing traffic.

A **Protection Vehicle** may be used in **stationary or mobile** operations to protect the workers and work activity (See Diagram 310). The protection vehicle is placed after the buffer space and sufficiently in advance of the work space protected to allow for run-out if struck, but not so far that road users can drive between it and the work space. When the posted speed is 45 mph or greater, protection vehicles should be considered.

4.5 Truck Mounted Attenuators (TMAs)

Truck-mounted attenuators (TMAs) are crash cushion systems that lower the severity of a rear-end collision with an errant vehicle. TMAs are located to protect the work vehicle(s) and workers ahead of the vehicle with the TMA.

TMAs are designed for use on different classes of vehicles and for specific speed ranges. The manufacturer's rating **shall** be considered in choosing equipment for any particular job site. TMAs used on freeways should be rated for high speeds. Use of a TMA/vehicle combination rated for less than the posted speed where you will be working should only be considered when more appropriate equipment is not available.

When traveling to or from the work site, the TMA **shall** be in an upright position. When used, the attenuator should be in the full down and locked position.

For stationary operations, the TMA-equipped vehicle's parking brake should be set, and when possible, the front wheels turned to direct the vehicle away from the work site if hit and into a safe area. Placement of the run-out distance of the TMA should be based on manufacturer's recommendations.

For mobile operations, the protection vehicle with a TMA **shall** be positioned far enough in advance of the workers or work equipment being protected so that there is sufficient distance for run-out from impact but not so far that errant vehicles can travel around the protecting vehicle, re-enter the work vehicle array and strike the protected workers or equipment.

If only one TMA is used in a mobile work train, the shadow vehicle with the TMA should be the first vehicle exposed to traffic in the travel lane. In this case, a hazard assessment conducted by the supervisor will determine which vehicle should be equipped with the TMA.

For freeways, a TMA is required on the first vehicle exposed to approaching traffic in, or partially in, the travel lane.

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CHAPTER 5 – TYPICAL APPLICATIONS

Temporary Traffic Control

Mobile Operations: Operations where work activities and equipment move continuously along the roadway at speed (averaging 3 mph, but depends on the activity). The advance warning area (See Diagrams 110 and 130 for examples) moves with the work space. Mobile work does not include stopping in the travel lane to perform the work. Example work activities include side cast brooming and striping.

Mobile operations provide for safe traffic control by displaying signs on the work vehicles. This typically requires at least one shadow vehicle (with the exception of some lower speed roads). See applicable notes on the Diagrams in this chapter. On freeways, at least two shadow vehicles are required.

The mobile work zone can be bordered using static advance signing to alert road users of the presence of the slow moving work train ahead. Signing can cover a distance that includes the location of the work space for a significant period of time.

Care **shall** be taken that the road user is still alert to the hazard by the time they reach the active work space. This can be achieved with a NEXT X MILES rider on the static advance warning sign and the placement of occasional cones along the shoulder of the road with interim signing.

Stationary Work: Work that can take just a few minutes in one place, or can take an entire day. The activity can be off the traveled portion of the road or occupy one or more travel lanes and directions. Work may proceed without any disruption of normal traffic flow, or may require traffic to stop and alternate direction of flow through the work space. Stationary Work activities include:

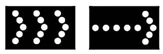
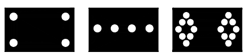
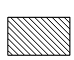
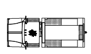
- Signal work
- Paving operations or crack sealing
- Bridge joint or deck drain work
- Sign installation and maintenance

Accordingly, the Diagrams in this chapter for stationary operations are arranged by the location of the work on the road, the extent of traffic control needed and the time required by the work activity or emergency response.

The Diagrams in this handbook do not cover every possible situation. Please refer to the principles described in this handbook as well as Part 6 of the MUTCD when applying these Diagrams to your situation.

5.0 Detail Drawings

Symbol Definitions — Diagram 5-1

	Sequential Arrow Board (shown in Arrow or Chevron mode)
	Sequential Arrow Board (shown in Caution mode) NOTE: Last option shown is "Double Flashing Diamonds" as both diamonds flash simultaneously (*NOT* "Dancing Diamonds").
	Sequential Arrow (shown facing down)
	Channelizing device (cone, tubular marker, or drum)
	Direction of traffic
	Flagger
	Post-mounted sign
	Roll-up warning sign
	Roll-up warning or regulatory sign
	Traffic signal
	Truck-mounted Impact Attenuator (TMA)
	Type II or III barricade
	Work space (Includes workers, materials, equipment)
	Work vehicle

The following tables and detail drawings should be used in developing and implementing your traffic control plan for any short term work.

Sign Spacing and Buffer Lengths Diagram 5-2

Use the following table to determine proper spacing between temporary signs and the proper length for buffer spaces used in work zones. Use the posted speed or statutory speed for the section of road where the work is being conducted in determining sign spacing and buffer space lengths.

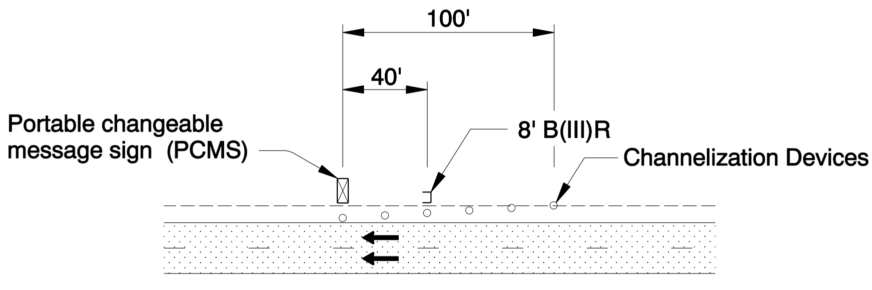
Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365
Freeways:				
55	1000	1500	2640	250
60				285
65				325
70				365

- All spacing shown in feet.
- Posted Speed: Equivalent to the existing, posted or statutory speed.
- Spacing “A” may be used as suggested trailing distance for shadow vehicles.
- Adjust spacing as field conditions require.
- Non-Freeway sign spacing **shall** not exceed 2x the dimensions shown.
- Small adjustments to freeway sign spacing may be made to fit field conditions, but spacing should not exceed 1.5 times the dimensions shown.

PCMS Installation — Diagram 5-3

Portable Changeable Message Sign (PCMS) Installation: A trailer-mounted PCMS requires a shoulder taper using six cones, tubular markers or drums; and, a single Type III barricade placed 40 feet in front of the PCMS, as shown.



NOTES:

- Install PCMS beyond the outside shoulder, when possible.
- Use the appropriate type of barricade panels for PCMS location.
  Right shoulder, use Type B(III)R
  Left shoulder, use Type B(III)L
- Use six channelization devices (cones, tubes, drums) in taper on 20' spacing.
- Detail as shown may also be used for Portable Traffic Signal installation.

Extended Traffic Queues — Diagram 5-4

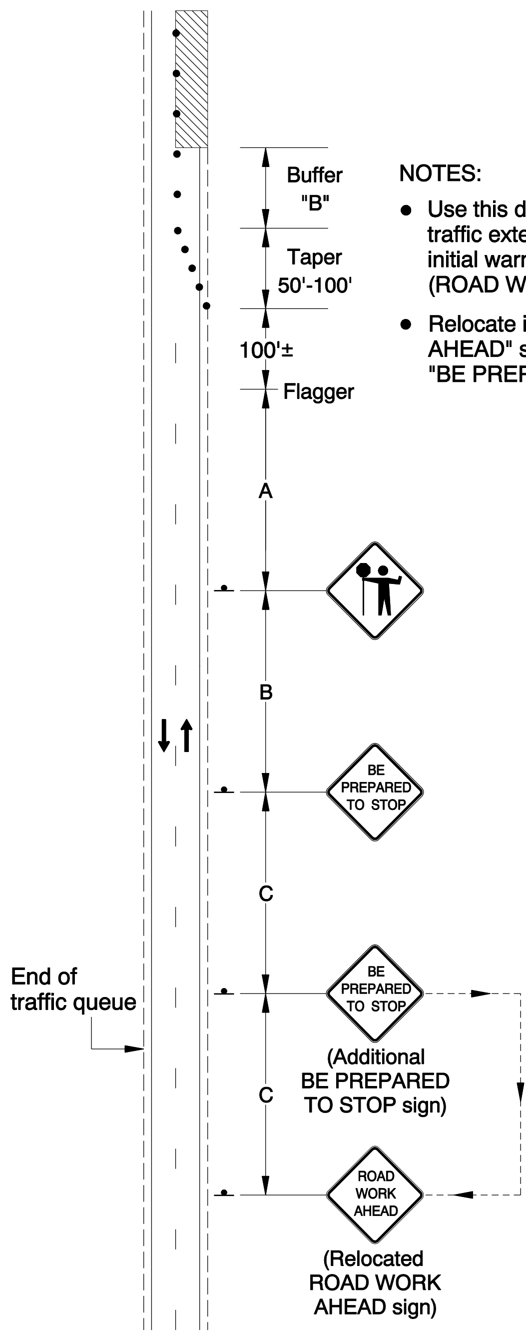
Use the Extended Traffic Queue w/ Single Flagger detail when flagging operations generate traffic queues that extend beyond the initial advance warning sign (e.g. ROAD WORK AHEAD).

- Consider using on high speed, high-volume roadways, or where traffic may be stopped for up to 20 minutes.
- Move the initial advance warning sign (e.g. ROAD WORK AHEAD), as shown, to the beginning of the sign sequence prior to installing any additional signing.
- The ROAD WORK AHEAD (or BRIDGE, or SHOULDER) sign is always the first sign the road user sees and is seen only once per approach to the work zone.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Extended Traffic Queues — Diagram 5-4



NOTES:

- Use this detail when traffic extends beyond initial warning sign (ROAD WORK AHEAD).
- Relocate initial "ROAD WORK AHEAD" sign in advance of additional "BE PREPARED TO STOP" sign.

Advance Flagger for Extended Queues — Diagram 5-5

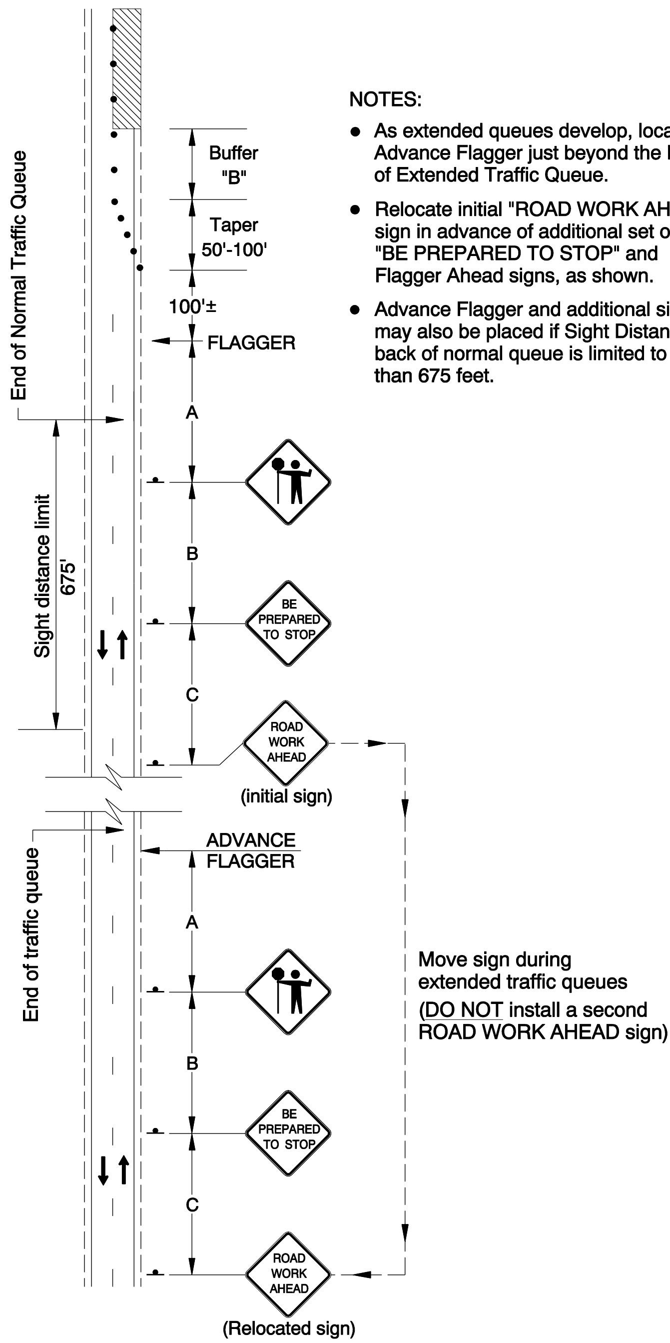
Use the Advance Flagger for Extended Queues detail to further enhance the control of approaching traffic during peak volume periods.

- Consider using this detail if traffic queues extend beyond the initial advance warning sign (e.g. ROAD WORK AHEAD), as shown.
- Move the initial advance warning sign (e.g. ROAD WORK AHEAD) to the beginning of the sign sequence prior to installing any additional signing.
- The ROAD WORK AHEAD (or BRIDGE, or SHOULDER) sign is always the first sign the sign sequence. Road users should only see this initial warning sign once through the work zone.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Advance Flagger for Extended Queues Diagram 5-5



NOTES:

- As extended queues develop, locate Advance Flagger just beyond the End of Extended Traffic Queue.
- Relocate initial "ROAD WORK AHEAD" sign in advance of additional set of "BE PREPARED TO STOP" and Flagger Ahead signs, as shown.
- Advance Flagger and additional signage may also be placed if Sight Distance to back of normal queue is limited to less than 675 feet.

Bicycle and Pedestrian Accommodation Diagrams

The following practices and details address the accommodation of bicycles and pedestrians within work zones. The following detail drawings should be incorporated, where appropriate, into the traffic control plan for any short term work.

1. See Section 1.6 – Bicycle and Pedestrian Considerations for additional guidance.
2. Stay alert for pedestrians and bicycle traffic and accommodate safe passage for them, as needed.
3. The work space should be protected from bicycle and pedestrian intrusion by using barricades or closely-spaced channelizing devices.
4. Maintain access to transit stops or clearly close a transit stop using barricades or channelizing devices.

Bicycle Accommodation — Diagram 5-6

Bicycle Accommodation Principles:

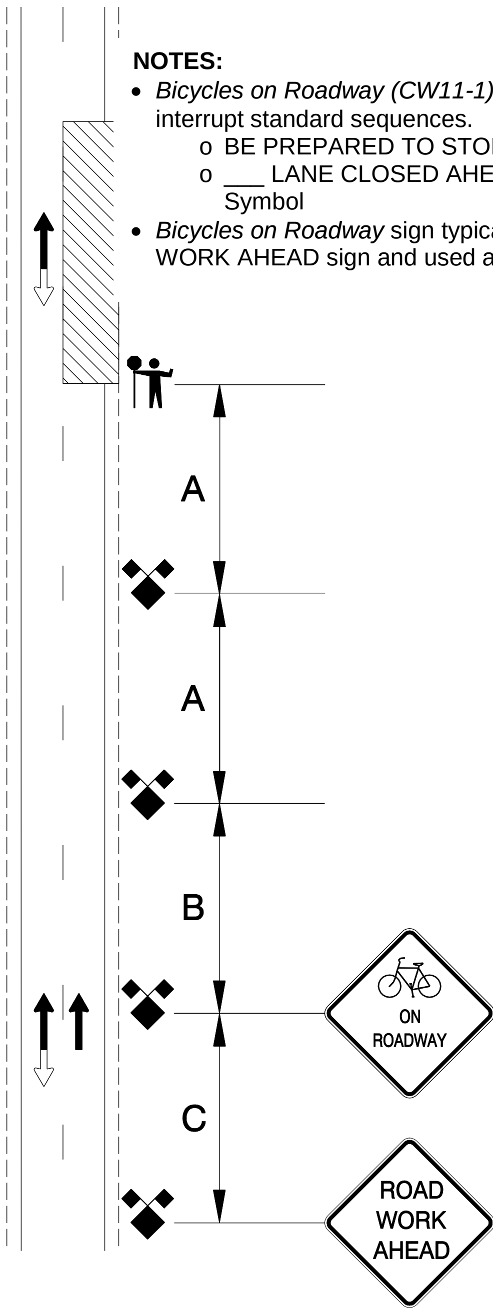
1. If a significant volume of bicycles can be expected and work closes a marked bicycle facility, or requires bicycles to share a travel lane, install a “(Bicycle) ON ROADWAY” sign (CW11-1) or the Bicycle symbol (W11-1) sign with an “ON ROADWAY” (OBW1-5) rider, in advance of the work area.
2. Install temporary signing off the paved shoulder, within the planter (buffer) strip, or share the width needed between the shoulder and the sidewalk, as available.
3. Signs are to remain in place until the surface is restored and the width made available for bicycle use. See Diagram 5-6 for typical bicycle signing placement.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Bicycle Accommodation Diagram 5-6

NOTES:
- *Bicycles on Roadway (CW11-1)* sign should not interrupt standard sequences. For example:
  - o BE PREPARED TO STOP/Flagger Symbol
  - o ___ LANE CLOSED AHEAD/Lane Ends Symbol
- *Bicycles on Roadway* sign typically follows ROAD WORK AHEAD sign and used as general warning.



Pedestrian Accommodation Diagrams

See Diagrams 5-7 and 5-8, below, for pedestrian accommodations in work zones.

Pedestrian Accommodation Principles:

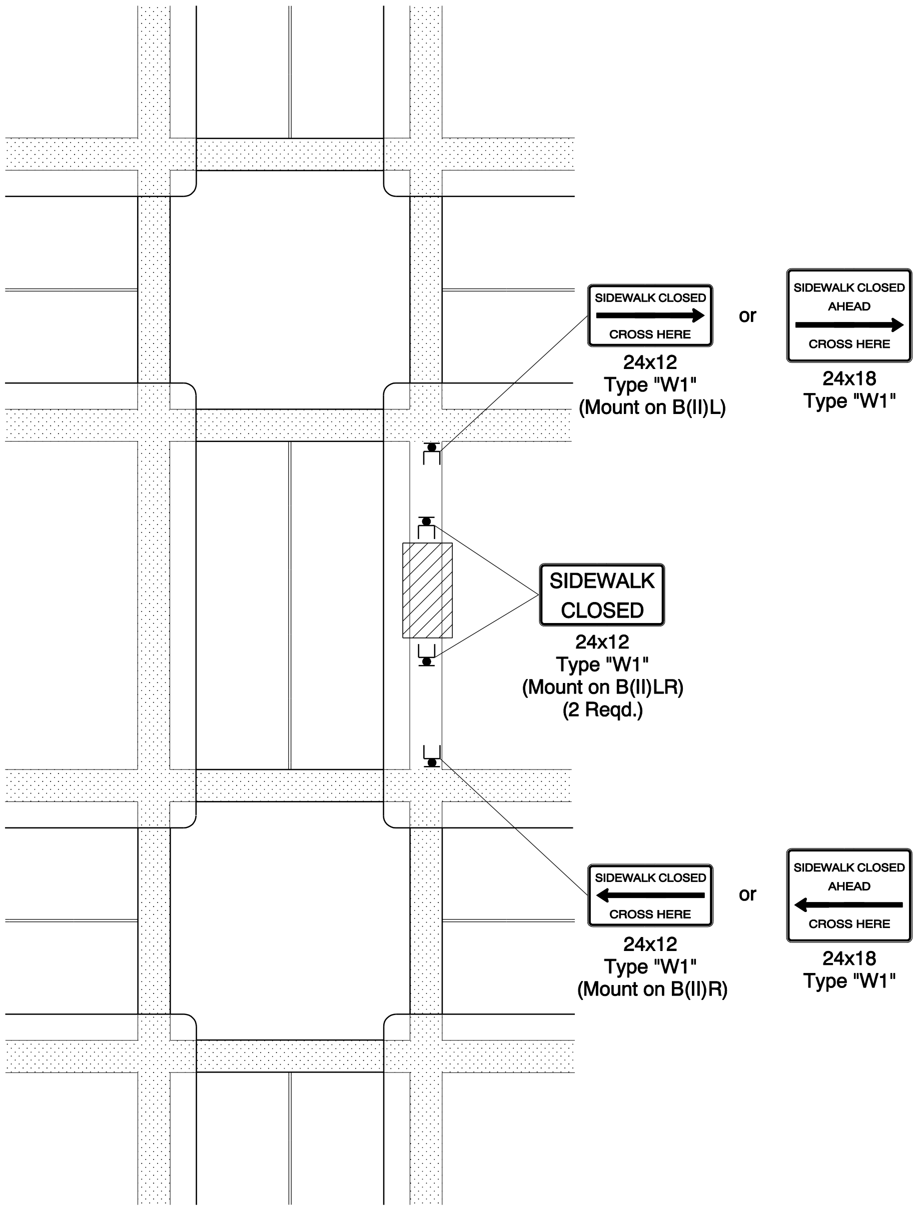
1. If the work impacts the sidewalk or pedestrian facility, provide a safe, accessible path, where practical, in accordance with the requirements of the ADA.
2. If not practical to match the width of the existing pedestrian facilities, maintain a 4-ft minimum width.
3. Unless a reasonably safe route can be provided through the work space, pedestrians should be appropriately directed with advance signing to cross the road. Do not divert pedestrians into travel lanes.
4. Install pedestrian closure or detour signing on Type II barricades.

Make every practical effort to satisfy the following:

- If work closes a sidewalk or sidewalk ramp, close sidewalks at a point where an alternate crossing point or route can be provided. Minimize the amount of out-of-direction travel for pedestrians.
- Use a combination of “SIDEWALK CLOSED” (R9-9), “SIDEWALK CLOSED USE OTHER SIDE” (R9-10), “SIDEWALK CLOSED AHEAD CROSS HERE” (R9-11), and “SIDEWALK CLOSED CROSS HERE” (R9-11a) signing to direct pedestrians to an alternate facility.
- Where there are business destinations between the nearest crosswalk and the work area, close the sidewalk at the business access nearest the work area, where practical using the SIDEWALK CLOSED sign. Include the SIDEWALK CLOSED AHEAD CROSS HERE sign at the nearest crosswalk prior to the closure.

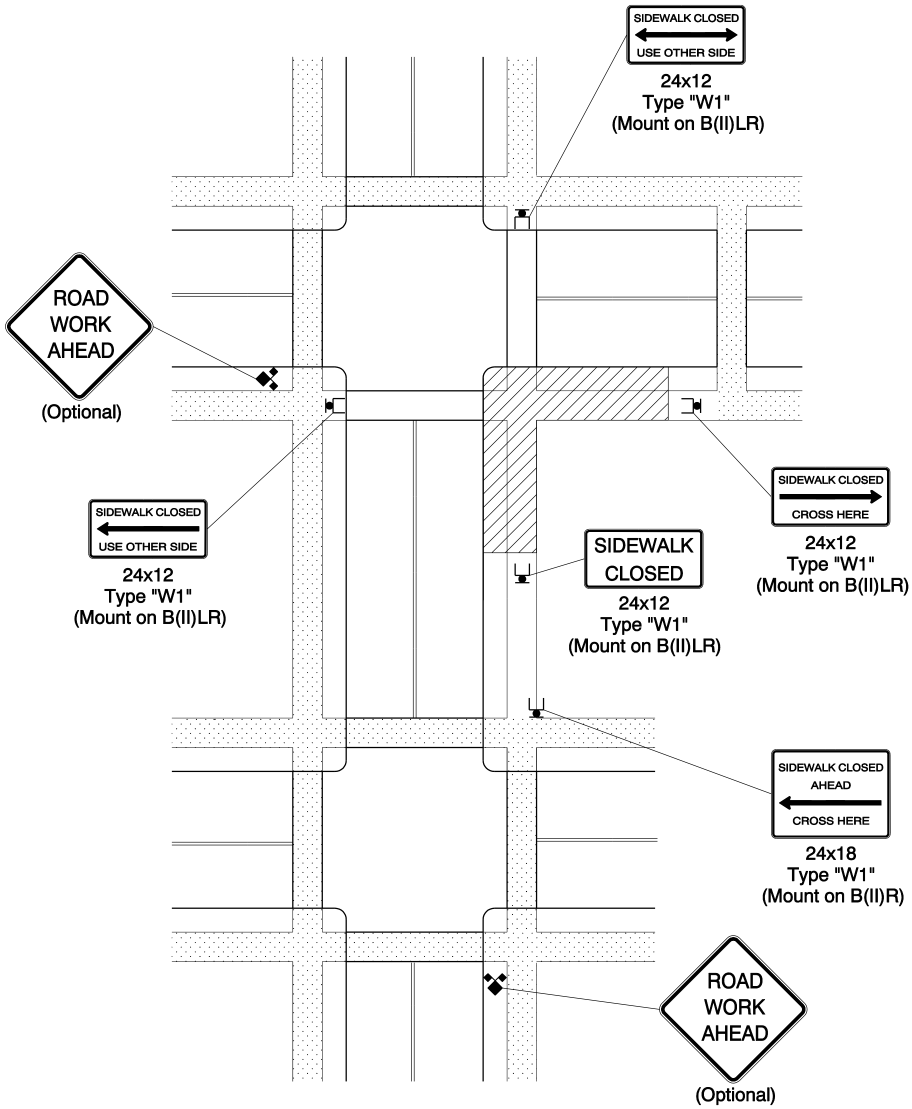
Pedestrian Accommodation, Mid-Block Diagram 5-7

The sidewalk should be closed at the nearest intersection on each side of the work area when a safe, ADA-compliant path through the work area is not available.



Pedestrian Accommodation, Intersection — Diagram 5-8

For work near an intersection, close crosswalks and/or sidewalks as necessary when safe passage cannot be maintained.



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Rail Grade Crossing — Diagram 5-9

Diagram 5-9 covers work in the travel lanes near an at-grade rail crossing. This drawing should be consulted whenever traffic control may cause traffic queues to form up to and/or across the rails.

1. When work will be done within the railroad right-of-way, the railroad or transit authority **shall** be notified. Contact the ODOT Rail Division (503-986-4321) or visit the ODOT Rail Division website for the Railroad Contact list to locate the contact information for the appropriate agency.

2. Minimize the possibility that vehicles may be stopped within the rail crossing, defined as being 15 feet either side of the closest and farthest rail. Position the work or shadow vehicle to keep traffic from stopping near the rails.

3. If any permanent “DO NOT STOP ON TRACKS” (R8-8) signs are obscured or if none are posted, a regulatory DO NOT STOP ON TRACKS sign **shall** be placed on the approach to the tracks.

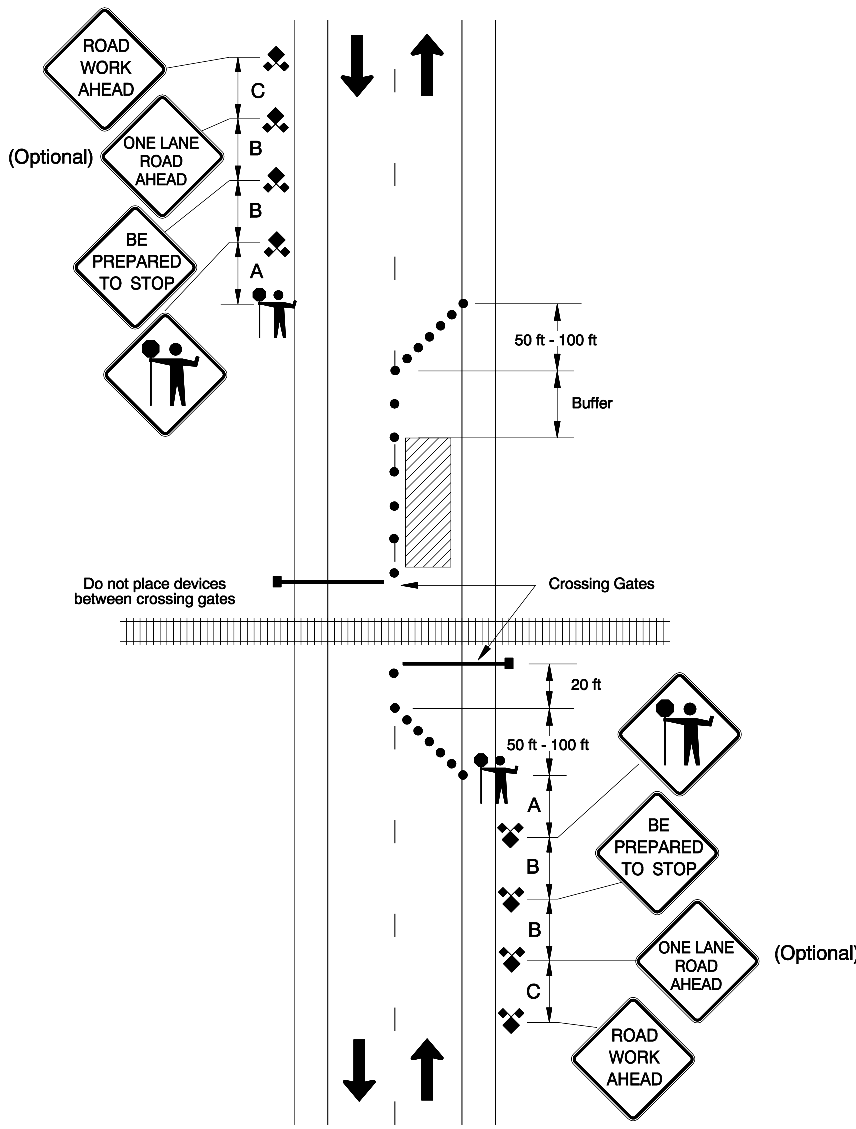
4. Place the DO NOT STOP ON TRACKS sign on the right and near the stop bar, if there is one. If there is no stop bar, place the sign at least eight feet from the tracks. On multi-lane roads, a left side sign may be needed especially if there are three or more lanes in any one direction.

5. If the queuing of vehicles across the tracks cannot be avoided, a law enforcement officer or flagger **shall** be provided at the crossing to prevent vehicles from stopping within the rail crossing, even if automatic warning devices are in place. Flaggers **shall** be certified by the appropriate rail or transit authority.

6. Maintain pedestrian access across the tracks or close the pathway. Use cones or Type II barricades and a “SIDEWALK CLOSED” (R9-9) sign if work impacts the pedestrian crossing. Place the closure where pedestrians are directed to an alternate safe passage.

7. The “ONE LANE ROAD AHEAD” (W20-4) sign is optional and should be considered on high volume or high speed roads, or when extended queues may be expected.

Rail Grade Crossing Diagram 5-9



Temporary Pavement Markers — Diagram 5-10

When work activity obliterates existing pavement markings (i.e. paving or other preservation projects) and placing permanent markings cannot be done following completion of the work, temporary markings must be placed to provide guidance for drivers. However, permanent markings should be placed within two weeks of completing the work.

When the existing centerline striping is obliterated, do the following:

- For roadways where:
  - ADT < 5000, with a posted speed ≥ 45 mph, or
  - ADT < 10,000, with a posted speed < 45 mph

  Install temporary flexible pavement markers for temporary centerline marking as follows:
  - Place and maintain one temporary flexible overlay pavement marker on 40 foot spacing in tangent and curve sections except as below.
  - Place and maintain one temporary flexible overlay pavement marker on 20 foot spacing in channelization areas, and in curves identified by a speed rider displaying less than the posted speed.

- For roadways where:
  - ADT > 5000, with a posted speed ≥ 45 mph, or
  - ADT > 10,000, with a posted speed < 45 mph

  Install temporary flexible pavement markers for temporary centerline marking as follows:
  - To simulate a skip stripe, a group of three markers spaced five feet apart **shall** be used. Leave a gap of 30 feet between each group of three markers.
  - To simulate a solid line, equally space one marker every 10 feet.

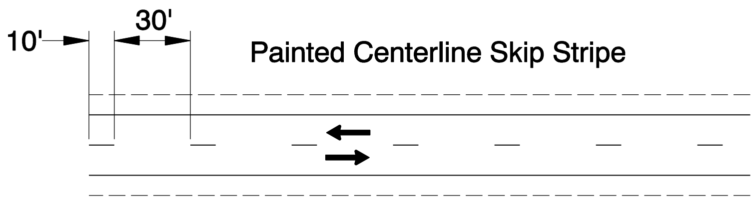
Raised pavement markers should not substitute for right-hand edge line markings, unless engineering judgment indicates the benefits of the markers outweigh:

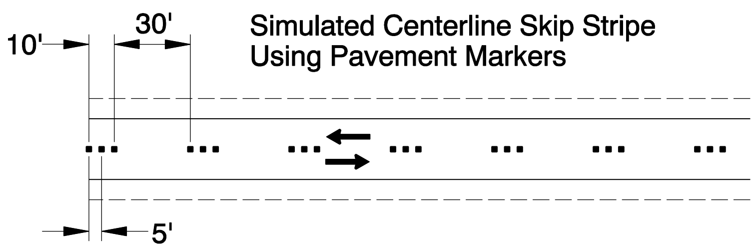
- Possible impacts to bicycles using the shoulder.
- Spacing of the markers on the right-hand edge line is close enough to avoid drivers misinterpreting the line as a broken line during wet, night conditions.

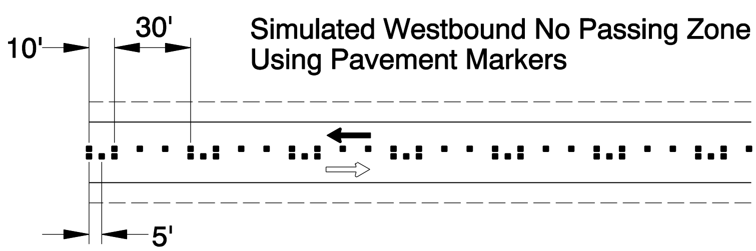
If pavement markers are used as a right-hand edge line, equally space one marker every 10 feet.

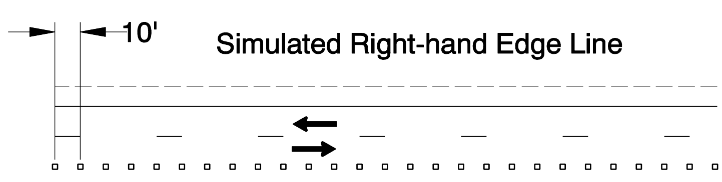
Marker colors **shall** match the color of the line they are simulating.

Temporary Pavement Markers **Diagram 5-10**









5.1 Mobile Operations

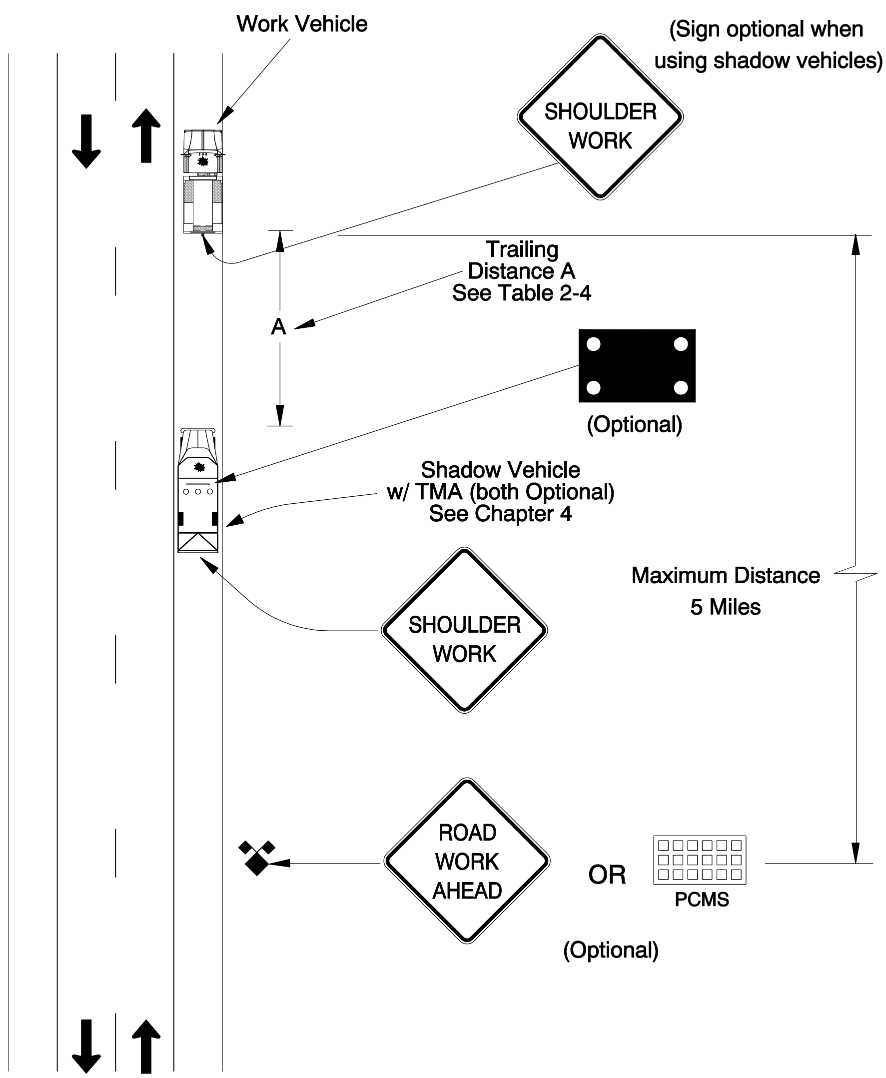
Mobile Operation on Shoulder — Diagram 100

Diagram 100 covers a typical continuous moving operation on the shoulder, not on a freeway (see Section 5.7 – Freeway Work).

1. Use truck-mounted flashing warning lights on work and shadow vehicles.
2. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.
3. If the work equipment has to be partially in the travel lane, maintain a lane width of ten feet or occupy the adjacent travel lane and use the appropriate mobile lane closure diagram. On low volume roads, a minimum lane width of 9 feet may be allowed.
4. A shadow vehicle should be used when:
   a. Sight distance is periodically less than 750 feet, or
   b. Dust created by the operation, fog or other low visibility conditions reduces sight distance to less than 500 feet.

   If the above conditions are not met, the shadow vehicle is optional.
5. A shadow vehicle is also optional when the volume is below 400 ADT.
6. When a shadow vehicle is used:
   a. Signs on work vehicle are optional, and
   b. The shadow vehicle may replace the advance warning signs.
7. The shadow vehicle should:
   a. Adjust the space between the work vehicle and between each additional shadow vehicle to maintain traveling distances found in Table 2-4; and,
   b. Slow down in advance of curves that restrict sight distance.
8. If a shadow vehicle is not used:
   a. Advance warning signs or PCMS should be used, and
   b. The signs may cover up to five miles and should include the distance on the sign.
9. When the work vehicle is traveling alone, a TMA should be considered.
10. Use “SHOULDER WORK” (W21-5), “RIGHT SHOULDER CLOSED” (W21-5aR) or other work-appropriate sign on the initial vehicle. Minimum sign size is 36 inches. A PCMS may be used in place of signs.
11. Where practical and when needed, the work and shadow vehicles should pull over periodically to allow motor vehicle traffic to pass.

Mobile Operation on Shoulder Diagram 100



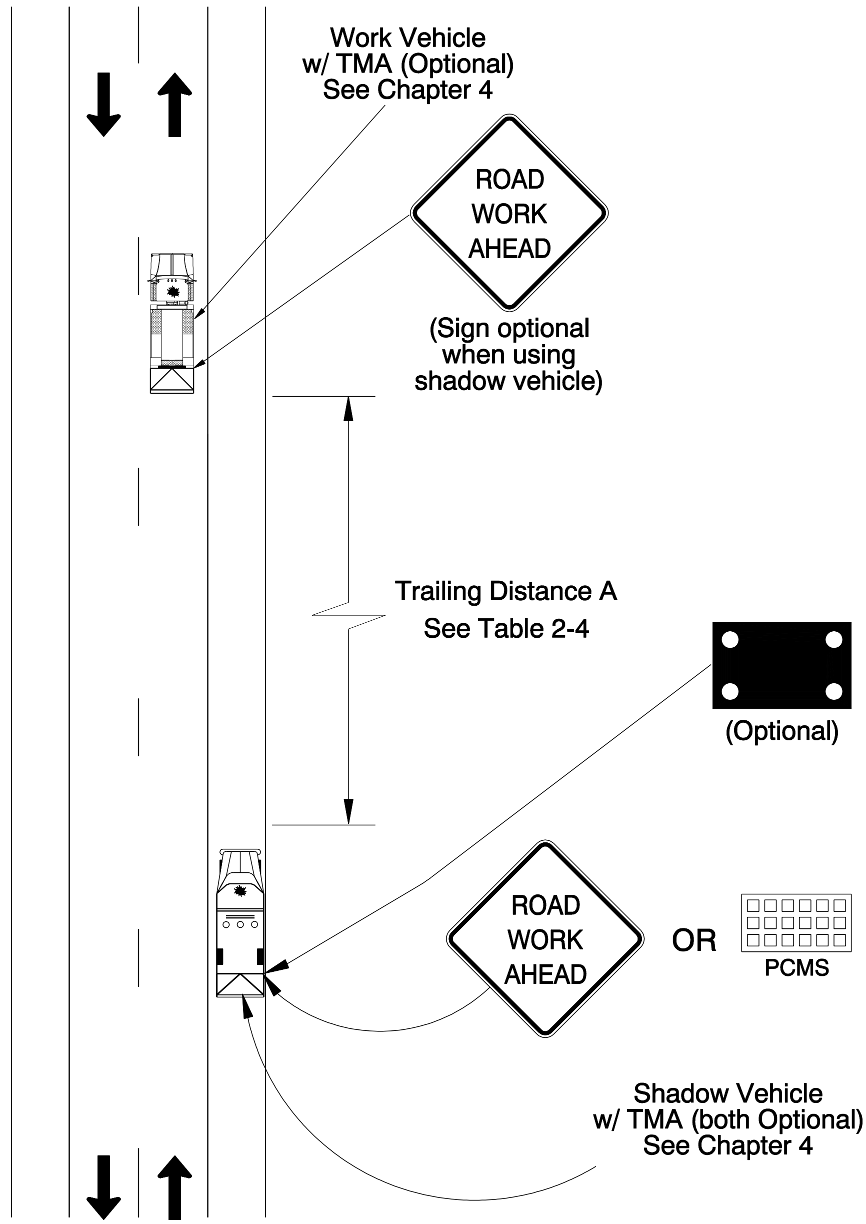
Mobile Operation on Two-Lane, Two-Way Roads Diag. 110

Use this detail for continuous slow-moving operations in the travel lane of a two-lane, two-way road. It does not include a layout for every possible work situation, but shows the minimum requirements for this type of operation.

For Striping Operations, use this detail, then move on to the next detail - Striping on Two-Lane, Two-Way Roads, Diagram 120 – for additional information.

1. Use truck mounted flashing warning lights on work and shadow vehicles.
2. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.
3. A shadow vehicle should be used when:
    a. Sight distance is less than 750 feet; or,
    b. Dust created by the operation, fog or other low visibility conditions reduces the sight distance to less than 500 feet; or,
    c. Speed is 45 mph or higher with the work vehicle operating within the lane.
4. The shadow vehicle is optional when the traffic volume is < 400 ADT.
5. When a shadow vehicle is used:
    a. Signs on work vehicle are optional.
    b. The shadow vehicle may replace the advance warning signs.
6. The shadow vehicle should:
    a. Adjust the space between the work vehicle and each additional shadow vehicle to maintain traveling distances found in Table 2-4.
    b. Slow down before vertical or horizontal curves that restrict sight distance.
    c. Maintain a position on the right side of the highway as far as practical.
7. If a shadow vehicle is not used:
    a. Advance warning signs or PCMS should be used.
    b. Signs may cover up to five miles and should include the distance on the sign.
8. When the work vehicle is traveling alone, a TMA should be considered. The initial vehicle, either work or shadow vehicle, which will be exposed to traffic in the travel lane may be equipped with an attenuator.
9. Where practical and when needed, the work and shadow vehicles should pull over periodically to allow motor vehicle traffic to pass.
10. Use ROAD WORK AHEAD, “ROAD MACHINERY (AHEAD)” (W21-3) or other appropriate rear-mounted signs with a minimum dimension of 36”. If there are limited opportunities to pass, the sign may be substituted with a combination “YIELD” (R1-2) sign and “TO ONCOMING TRAFFIC” (R1-2a) rider; or, a “DO NOT PASS” (R4-1) sign.
11. A PCMS may be placed at the beginning of the section of road to warn traffic of the work ahead. The sign should state the type of work on panel one and NEXT X MILES on panel two. The distance between the work and the PCMS should be limited to five miles or less.
12. For unpaved roads, refer to the guidance given in Section 1.13 in Chapter 1.

Mobile Operation on Two-Lane, Two-Way Roads Diag. 110

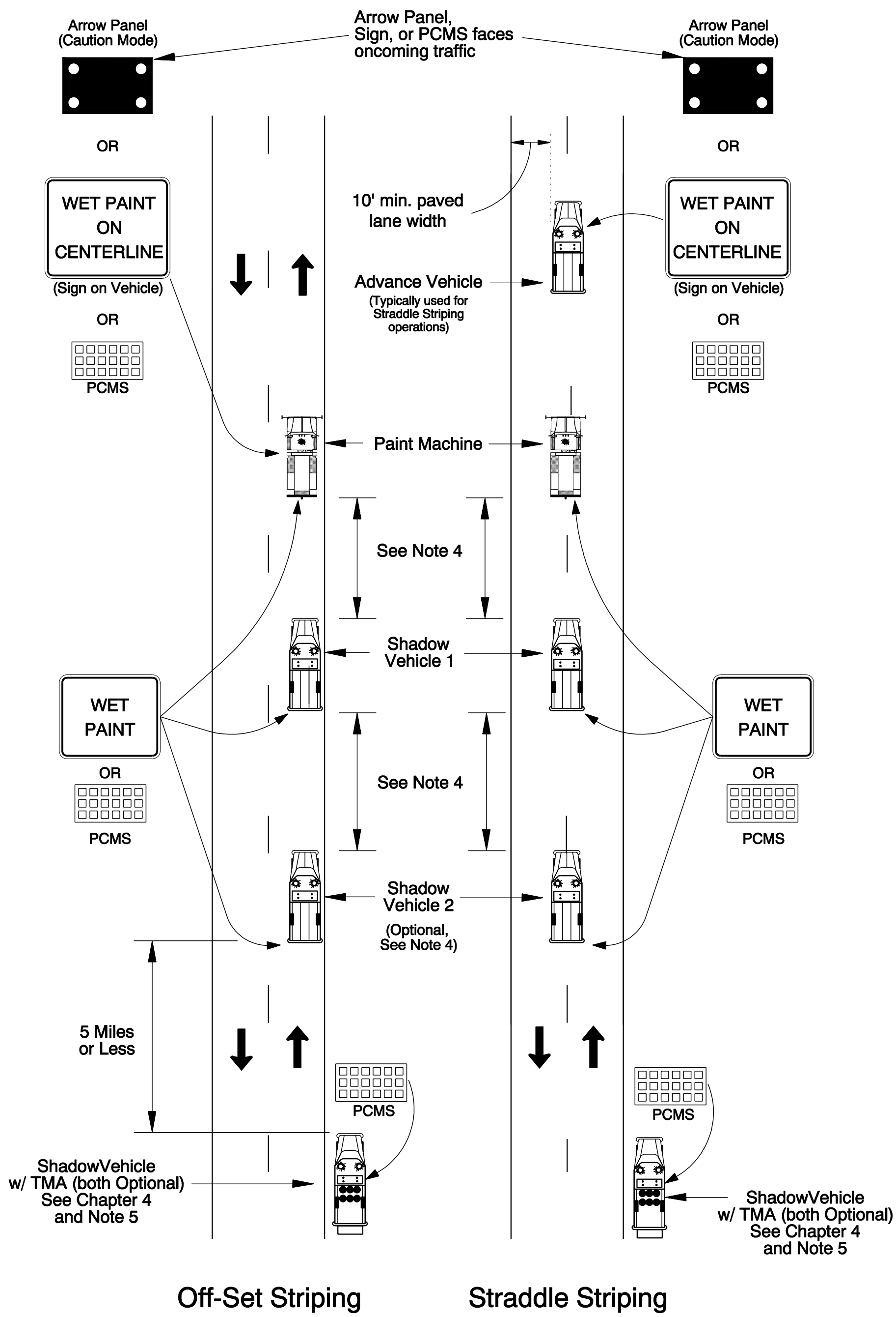


Striping on Two-Lane, Two-Way Roads Diagram 120

Diagram 120 covers striping operations on a two-way, two-lane road. The left-hand drawing illustrates a typical layout when using paint equipment, which marks up to two lines from the side of the equipment. Consider using an advanced vehicle if striping the center line. The right-hand drawing illustrates a typical layout when the paint equipment straddles and marks a single line at a time. These drawings cover any equipment configuration which accomplishes the applicable marking operation.

1. Use truck-mounted flashing warning lights and appropriate signs on work and shadow vehicles.
2. Arrow boards should be used in “caution” mode. “Arrow” mode should only be used when a traffic lane is being closed and directed to merge with an adjacent lane. A truck-mounted PCMS may be used in lieu of an arrow board.
3. Appropriate messages for a PCMS include: “WET PAINT/KEEP RIGHT (LEFT)”; or, “WET PAINT/PASS TO RIGHT (LEFT)”.
4. The number of vehicles and vehicle spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately to take traffic without smearing.
5. A vehicle with truck-mounted PCMS may shadow the work array on the right shoulder as advance warning. This vehicle may be the service truck for the paint machine.
6. A PCMS may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. The PCMS should identify the type of work on the first panel and “NEXT X MILES” on the second panel.
7. The distance between the work and the PCMS should be limited to five miles or less.

Striping on Two-Lane, Two-Way Roads — Diagram 120



Mobile Operations on Multi-Lane Roads — Diagram 130

Diagram 130 covers mobile operations occupying one lane of a multi-lane road, ***non-freeway*** (see Section 5.7 – Freeway Work). Work should normally be done in off-peak hours on high speed or high volume roads.

For Striping Operations on multi-lane roads and freeways, use this detail, and Diagram 140 – Striping on Multi-Lane Roads and Freeways for additional information.

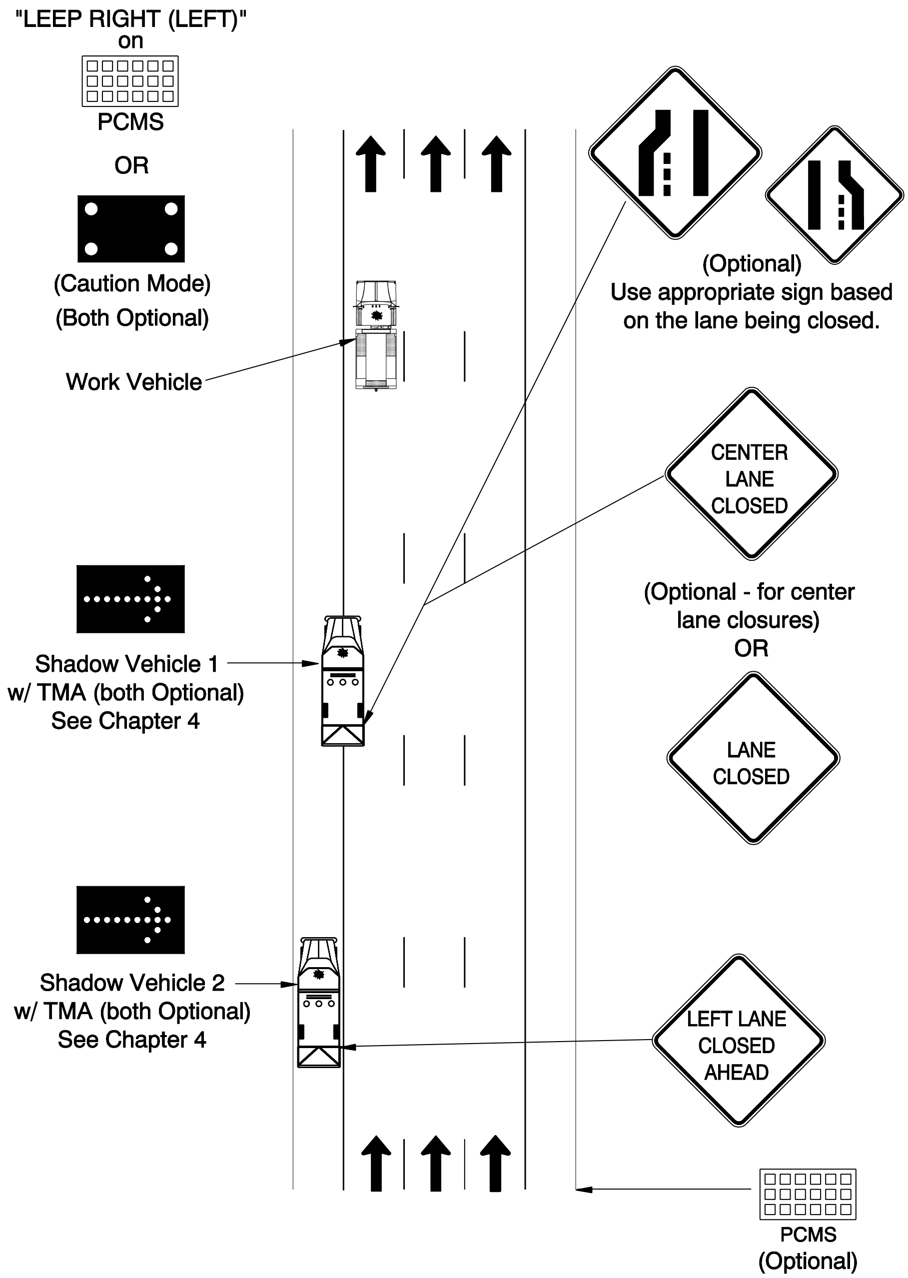
1. Use truck-mounted flashing warning lights on work and shadow vehicles. Arrow boards or PCMS are desirable.
2. Use the following table to determine the need for a Shadow Vehicle on multi-lane roads:

Table 5-1: Shadow Vehicle Requirements

Speed	Shadow Vehicle
0 – 40 mph	Optional
45 mph and above	One Required

3. All shadow vehicles should:
   a. Be equipped with an arrow display or PCMS. Consider using a truck-mounted attenuator where speed is 45 mph or greater.
   b. Have an appropriate lane closure sign placed on the vehicle so as not to obscure the arrow display.
   c. Adjust the space between the work vehicle and each additional shadow vehicle to maintain traveling distances found in Table 2-4.
   d. Vary distance from the work operation so as to provide adequate sight distance for traffic approaching from the rear.
   e. Not protrude into traffic any further than the work vehicle.
4. Additional shadow vehicles may be used. The trailing shadow vehicle should be on the shoulder. A second vehicle would straddle the edge line with other vehicles driving in the closed lane. If inadequate shoulder width, the trailing vehicle may drive partially in the lane.
5. A PCMS may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. The sign should state the type of work on panel one and “NEXT X MILES” on panel two. The distance between the work and the PCMS should be limited to five miles or less.
6. For Mobile Operations in center lanes, see Diagram 135.

Mobile Operations on Multi-Lane Roads Diagram 130



Mobile Operations in Center Lanes — Diagram 135

Diagram 135 addresses mobile operations occupying the center or middle lane(s) of a multi-lane road or freeway.

For striping operations on multi-lane roads and freeways, see Diagram 140 – Striping on Multi-Lane Roads and Freeways for additional information.

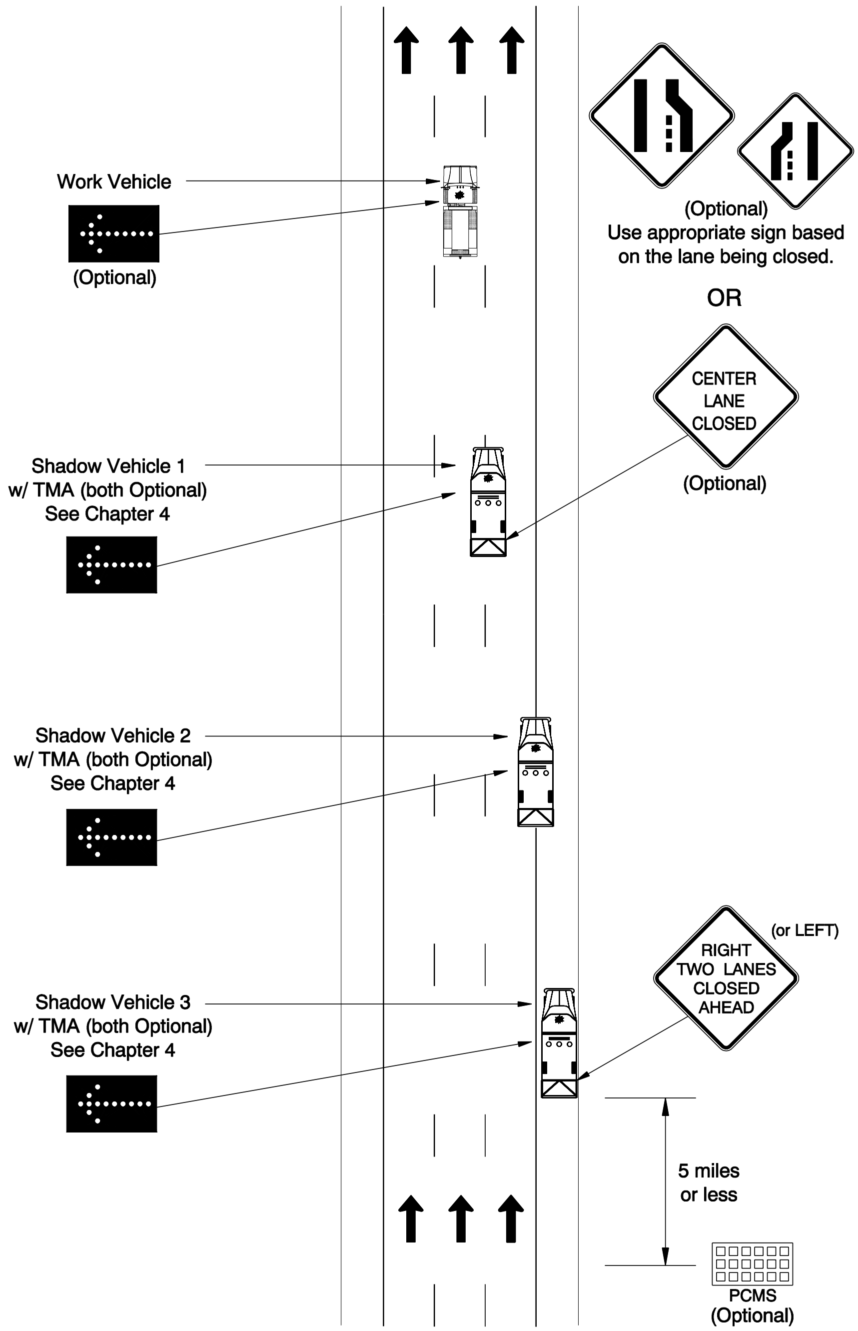
See **Section 5.7 – Freeway Work** for additional information on freeway work.

Work should normally be done in off-peak hours on high speed or high volume roads.

1. Use truck-mounted flashing warning lights on work and shadow vehicles. Arrow boards or PCMS are desirable.
2. Use Table 5-1 from Diagram 130 to determine the need for a Shadow Vehicle.
3. All shadow vehicles should:
   a. Be equipped with an arrow display or PCMS. Consider using a truck-mounted attenuator where speed is 45 mph or greater.
   b. Adjust the space between the work vehicle and each additional shadow vehicle to maintain traveling distances found in Table 2-4.
   c. Vary distance from the work operation so as to provide adequate sight distance for traffic approaching from the rear.
4. Shadow Vehicle 3 should be on the shoulder and display appropriate signing – for example, “RIGHT (LEFT) TWO LANES CLOSED AHEAD” (CW20-5a). If inadequate shoulder width, vehicle may drive partially in the adjacent lane.
5. Shadow Vehicle 2 should straddle the right fog line and display the Arrow Panel in “arrow” mode.
6. Shadow Vehicle 1 should straddle the right skip line and display the Arrow Panel in “arrow” mode. Additional lane closure signing may be used (e.g. “CENTER LANE CLOSED”).
7. Additional shadow vehicles may be used.
8. A PCMS may be placed at the beginning of the road work section to warn traffic of the closures ahead. Messages should state the type of work on panel one (e.g. “STRIPING AHEAD”) and “NEXT X MILES” on panel two.

   Distance between the work and the PCMS should be five miles or less.

Mobile Operations in Center Lanes — Diagram 135



Striping on Multi-Lane Roads and Freeways Diagram 140

Use for line marking (striping) operations on a one-way, multi-lane road or freeway. See Diagram 700 for additional information on freeway work.

1. Use truck-mounted flashing warning lights and appropriate signs on work and shadow vehicles.

2. Maintain at least a ten foot lane in the adjacent travel lanes.

3. When striping the center lane of a three lane or more highway, additional devices and advance warning may be needed. See Diagram 135.

   Use corresponding legend on lane closure signs based on which

4. A trailing vehicle may shadow the work array on the shoulder at a distance of up to ½ mile in advance, as a warning (½ mile min. for freeways). Vehicle may be the service truck for the paint machine. A vehicle with a truck-mounted PCMS is preferable for warning traffic. If a PCMS is not available, a ROAD WORK AHEAD sign should be used. Do not use an arrow display for this vehicle as it is too far from the work.

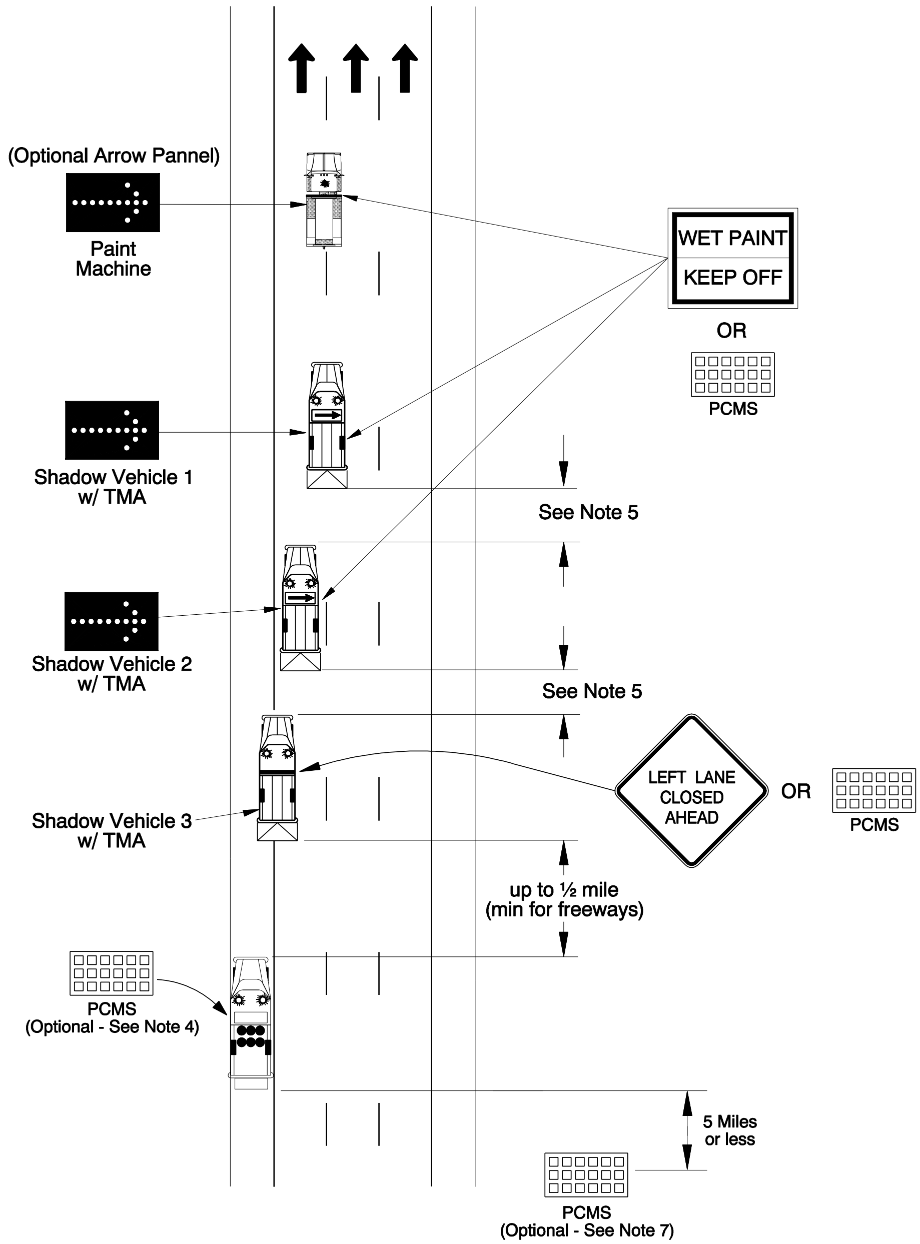
5. The vehicle array and spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately without smearing. However, the spacing should not encourage traffic to travel in the space between work vehicles. This may be the deciding factor in how many vehicles to use.

6. Use of TMAs on freeways is required. On other roads with a posted speed of 45 mph or more, use of at least one TMA is recommended. If used, the TMA should be on the first vehicle exposed to traffic in any part of the travel lane. In this case, a hazard assessment conducted by the supervisor will determine which vehicle should be equipped with the TMA.

7. A PCMS may be placed at the beginning of the section of road to be worked to warn traffic of the obstruction ahead. The PCMS should identify the type of work on the first panel and “NEXT X MILES” on the second panel.

8. The distance between the work and the PCMS should be limited to five miles or less.

Striping on Multi-Lane Roads and Freeways Diagram 140

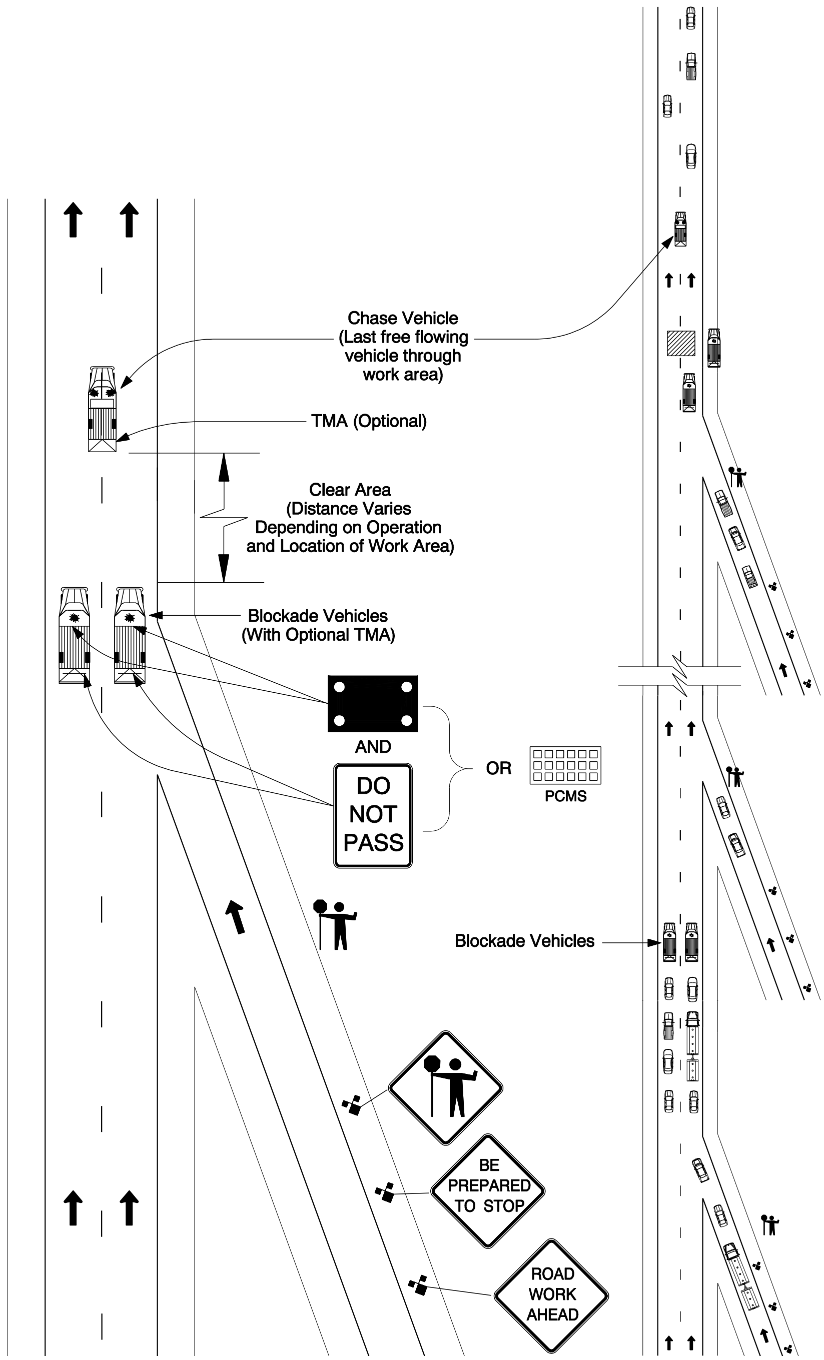


Rolling Slowdown — Diagram 150

A rolling slowdown provides short road closures for such activities as cleaning debris from the road, pushing disabled vehicles to the shoulder or pulling power lines across the road. Although rolling slowdowns are typically done on freeways, they may be used on other limited access roads as well. The diagram shows the standard configuration for performing a rolling slowdown.

1. The slowdown should be scheduled during off-peak traffic periods except in emergencies. Inform all local enforcement.
2. Use truck-mounted flashing lights on work and blockade vehicles.
3. The slowdown should be planned to maintain at least 15 mph. If the work is progressing more slowly than planned, the traffic speeds can be reduced as needed. The queue should never stop completely.
4. Advance warning is required at least ½ mile before the start of the slowdown. Changeable messages signs, either portable or permanent, are required at least as the initial sign.
   a. A typical message sequence would be "SLOW TRAFFIC AHEAD/ PREPARE TO SLOW".
   b. The slowdown may be announced in advance on changeable message signs. Consider public service announcements when there is primarily local traffic.
   c. Start the sign displays when the blockade vehicles are ready to enter the road and continue until the traffic speeds are close to normal.
5. Advance signing **shall** be placed at the approach to each entry ramp except when not practical for emergency operations.
6. All ramps and entrances to the road between the moving blockade and the work space **shall** be temporarily closed.
7. One blockade (slowdown) vehicle per lane should be used. Each vehicle **shall** have an arrow panel in caution mode with "DO NOT PASS" (R4-1) sign or a truck-mounted PCMS ("DO NOT PASS / ROLLING SLOWDOWN").
8. The slowdown proceeds as follows:
   a. The chase vehicle follows the last free moving vehicles and communicates when it is safe to begin work.
   b. Traffic is held at every entrance until the rolling slowdown passes.
   c. The blockade vehicles notify flaggers when to release traffic.
9. Good communication is essential among all traffic control vehicles, flaggers, chaser vehicle and the job site. Assign a competent person at the job site to keep in contact with the blockade vehicles and work crew for adjustments.

Rolling Slowdown Diagram 150



5.2 Shoulder Work

Short Duration Road Work — Diagram 200

Diagram 200 covers activity in the roadway of 15 minutes or less with vehicles parked on the shoulder. Typical work includes debris removal, tagging of survey markers, or marking utility lines. Work in the roadway coincides with gaps in the traffic so flow is not impeded.

1. Do not use this diagram if traffic must be controlled to gain safe access to the work space due to conditions such as high travel speeds or traffic volumes. Use the appropriate lane closure or mobile work zone layout.

2. Use truck-mounted flashing warning lights on work vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

3. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.

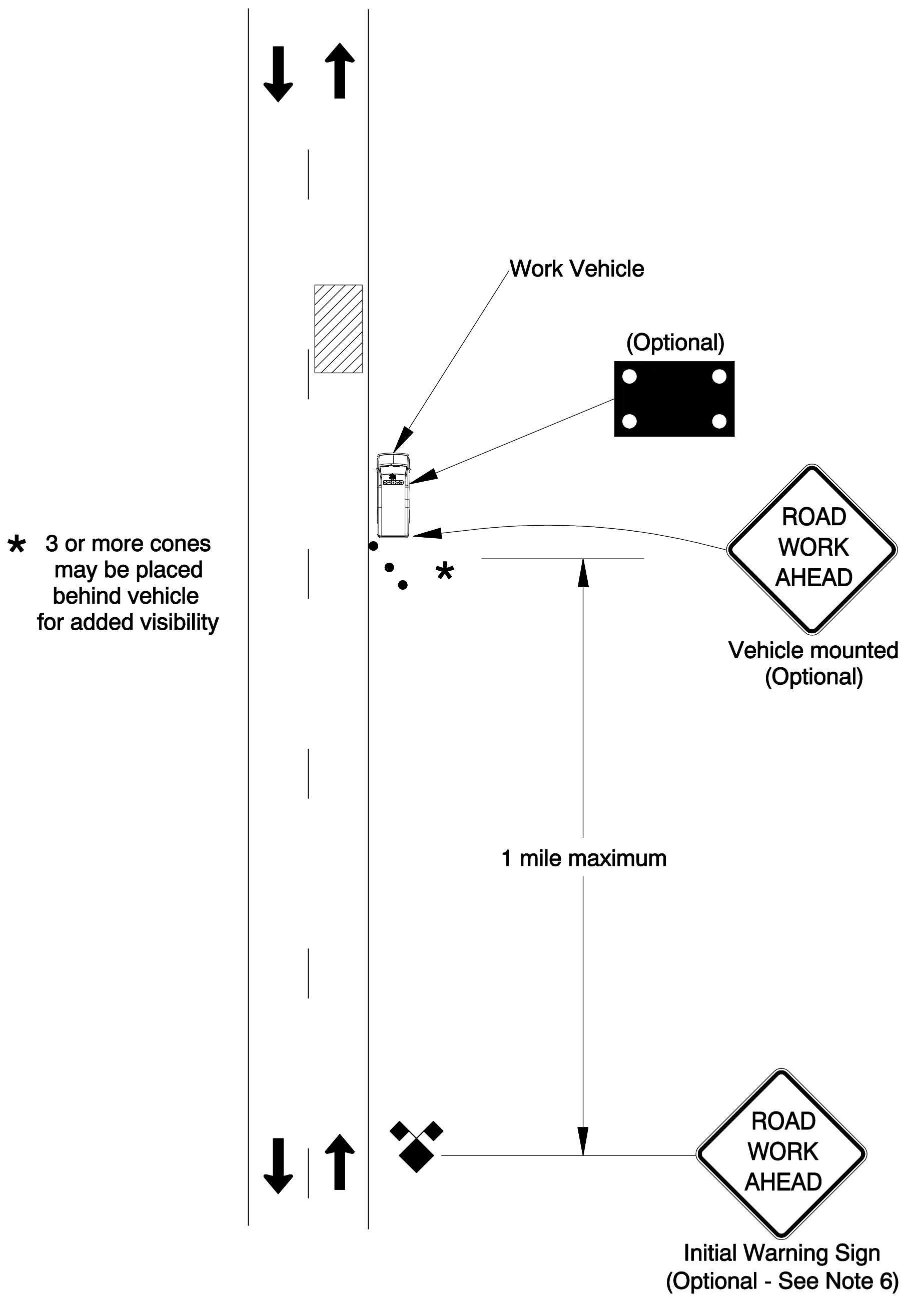
4. The work vehicles should be parked as far off the travel lanes as practical.

5. If a ten-foot minimum travel lane cannot be maintained or when opposing direction of traffic cannot safely pass, use the appropriate lane closure diagrams such as Diagrams 310 through 350.

6. The initial warning sign should be used if the sight distance is less than 750 feet and traffic volumes are over 400 ADT.

7. A spotter may be used to warn workers of approaching traffic. This is especially appropriate when sight distances are limited or speeds are high. See Section 1.12 – Spotter Performance and Training Guidelines for additional information.

Short Duration Road Work **Diagram 200**



Work on Shoulder — Diagram 210

Diagram 210 covers stationary work with work or parked equipment on the shoulder. This diagram does not cover work on a freeway shoulder. See Diagram 710 for Freeway Shoulder work.

1. Vehicles should be parked as far off the roadway as practical.
2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
3. For added visibility, truck-mounted arrow boards or PCMS in caution mode may be used.
4. Arrow panels in caution mode are recommended for work on roads with posted speeds of 45 mph or greater and high traffic volumes, greater than 2000 average daily traffic (ADT).
5. Requirements for signing and devices are shown in Table 5-2, below.

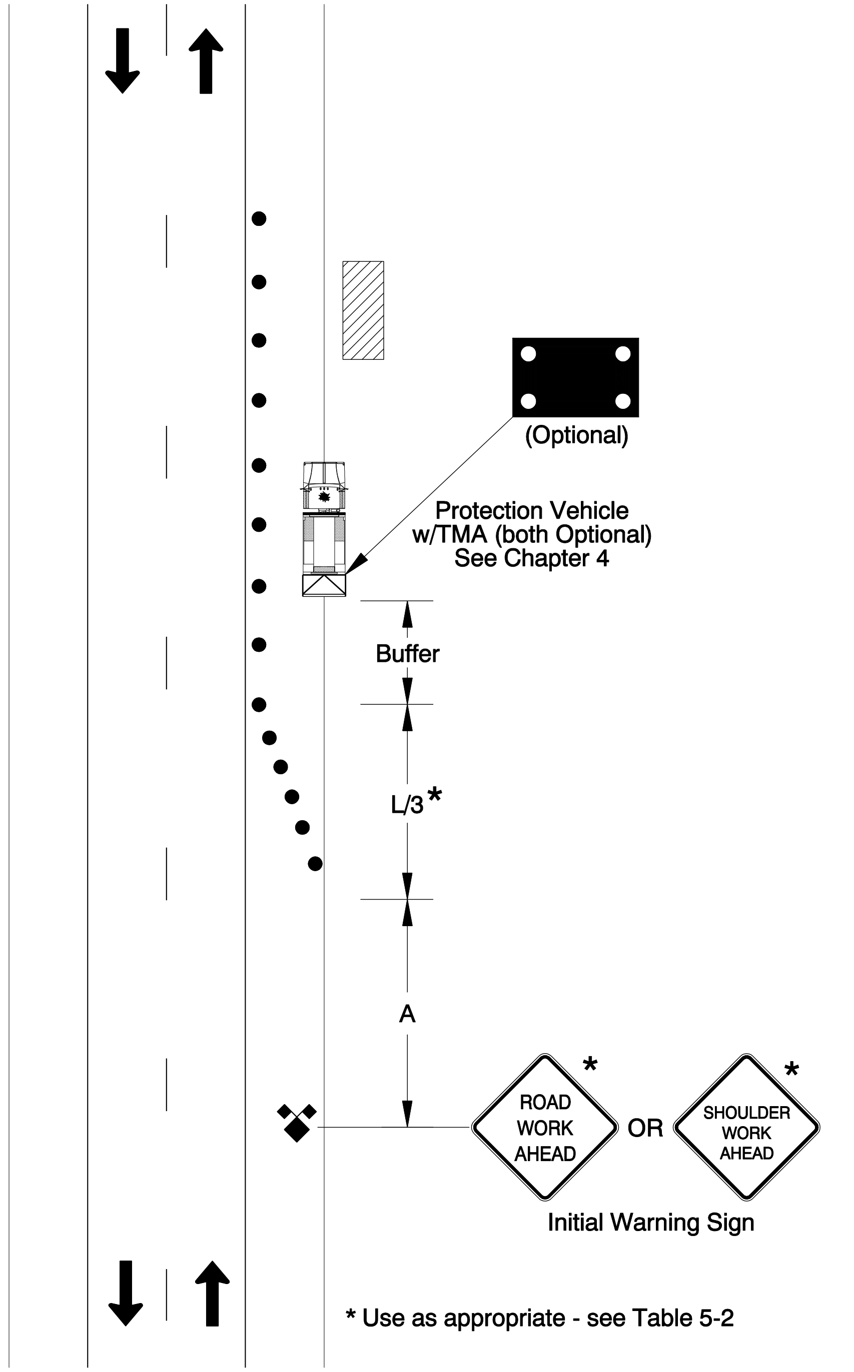
Table 5-2: Device and Signage Guidelines

	Proximity to Edge of Traveled Way	
	More than 15 feet or behind Barrier or Guardrail	**Less than 15 feet**
Work in Place More than 1 Hour	Advance warning signs, devices, and flashing warning lights are optional.	One advance warning sign is required and two signs are recommended. Cone taper is required. Cones along the edge of traveled way are optional.
Work in Place Less than 1 Hour	Advance warning signs and devices are optional.	

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work on Shoulder   Diagram 210



5.3 Two-Lane, Two-Way Roads

Shoulder Work w/ Minor Road Encroachment Diag. 300

Use this detail for non-freeway work which extends into a travel lane and maintains a minimum 10 foot travel lane. If a minimum 10 foot travel lane cannot be maintained, or when traffic cannot safely pass by in both lanes simultaneously, use the appropriate lane closure diagrams – for example, Diagrams 310 through 350.

A lane closure may be appropriate for conditions such as high traffic volumes, high speeds, and inadequate approach sight distance to the work space, or heavy equipment adjacent to the travel lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. Cones **shall** be placed along the entire length of the work space. If a protection vehicle is used and work is in place one hour or less, the taper and tangent devices may be omitted.

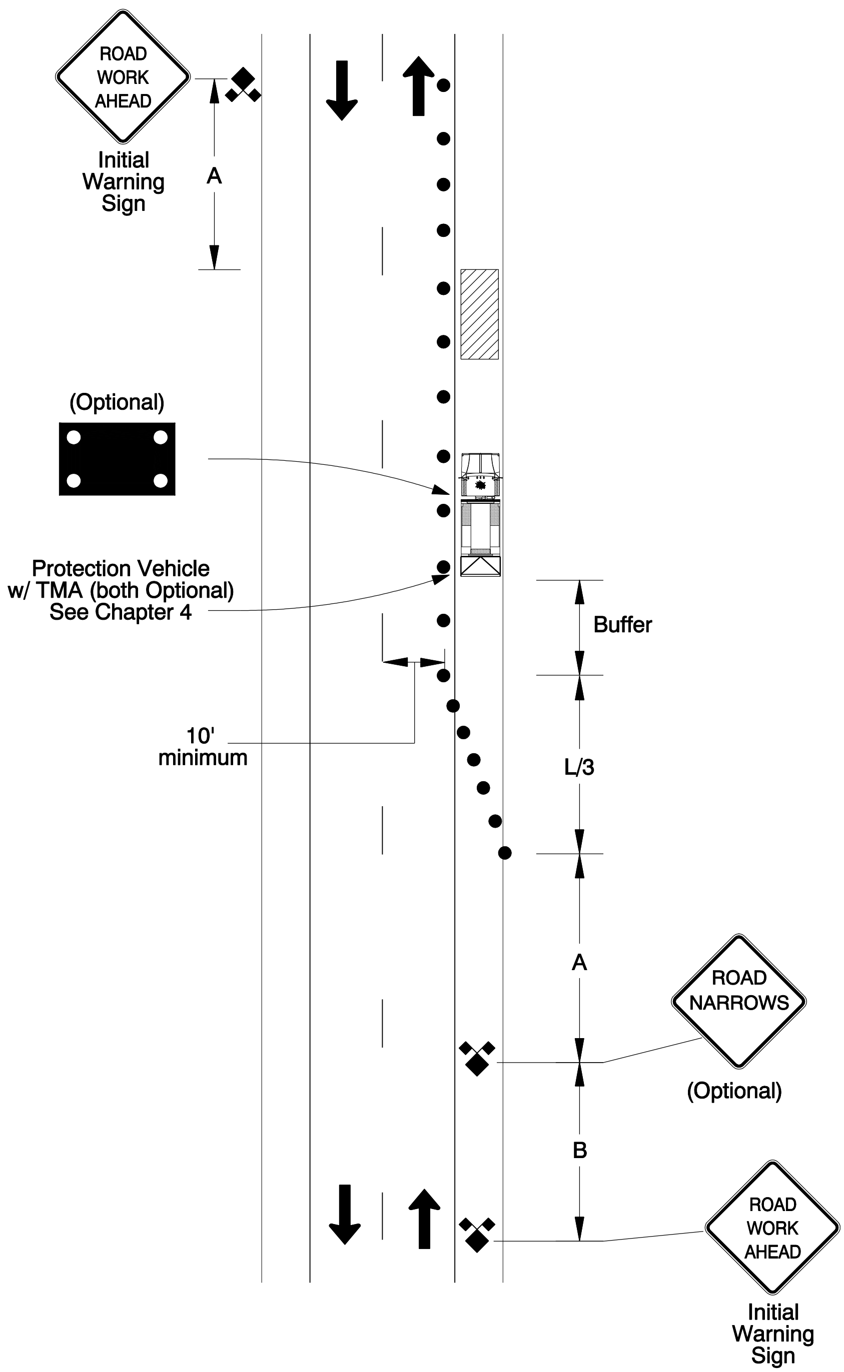
4. If the speed is 45 mph or higher, volumes exceed 2000 ADT, or there is limited sight distance, consider placing cones or tubular markers on centerline.

5. An arrow board in caution mode or truck-mounted PCMS with "SHOULDER WORK" or other appropriate message may be used for higher visibility.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Shoulder Work w/ Minor Road Encroachment Diag. 300



Two-Lane Traffic Diversion Using Shoulder Diagram 310

Diagram 310 covers shifting traffic lanes on a two-lane, two-way roadway around the work site with one lane partially or fully on the shoulder.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. All travel lanes should have a minimum 10 foot lane width.

4. Shoulder **shall** be adequate in width and surfacing to carry traffic.

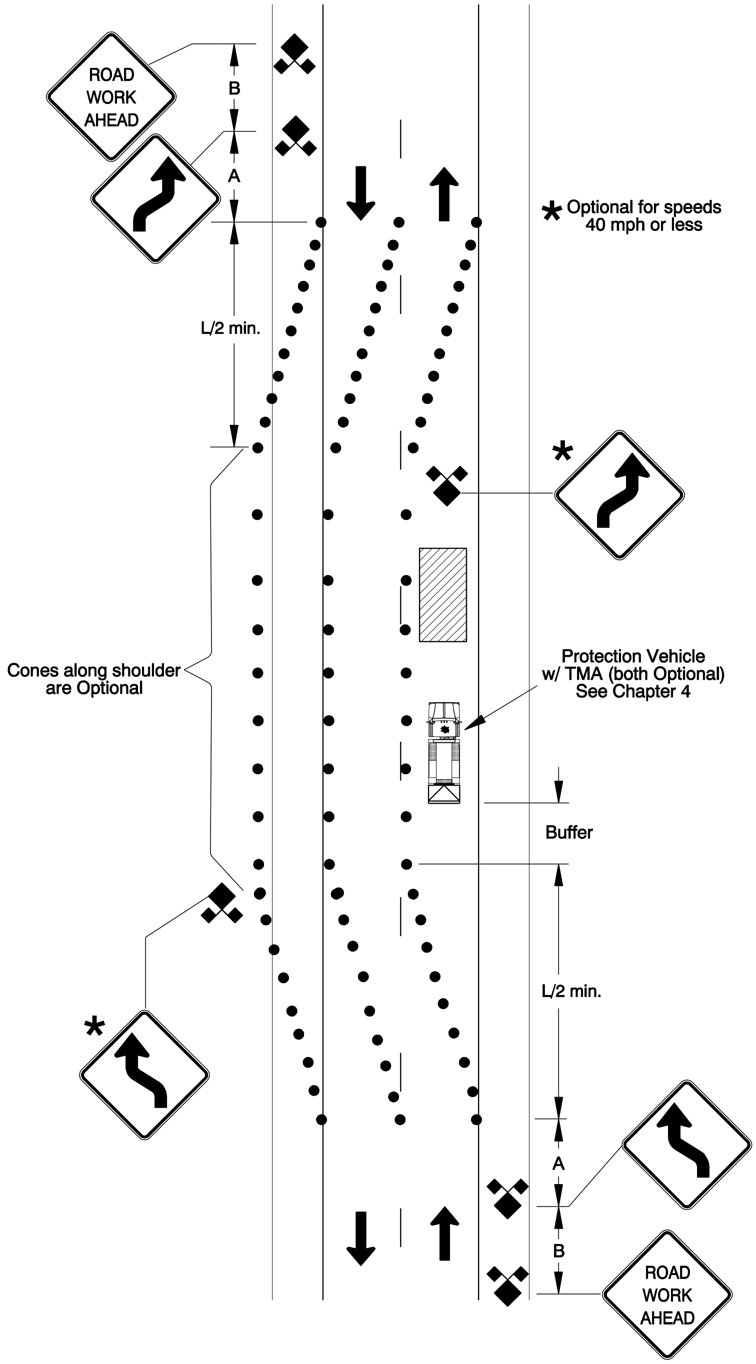
5. Two advance warning signs are required.

6. Place cones as shown. Cones along the far edge of travel lane, farthest from the work space, are optional and may be added to clearly mark the travel path.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Two-Lane Traffic Diversion Using Shoulder — Diagram 310



Stationary Lane Closure with Flagging — Diagram 320

Diagram 320 covers total closure of one lane of a two-lane, two-way roadway. See the detail inset for the layout if using a single flagger to control both directions of traffic on low volume roads (less than 400 ADT) with good sight distance as discussed below.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. Flaggers at each approach are required if any of the following conditions exist:
    a. Night Operations.
    b. Work space is over 200 feet in length.
    c. Sight distance is less than 750 feet from each approach through the lane closure.
    d. Traffic volumes are greater than 400 ADT.

4. The length between the Flagger Ahead signs **shall** not exceed one mile. Use Diagram 340 – Lane Closure with Pilot Car if exceeding one mile.

5. Cones should be used to outline the work space when curves or other roadway alignments prevent clear direction for the motorists to pass the work space safely.

6. Cones along the work space are recommended when posted speeds are 45 mph or greater, when working under heavy traffic or when travel lanes are narrower than 11 feet.

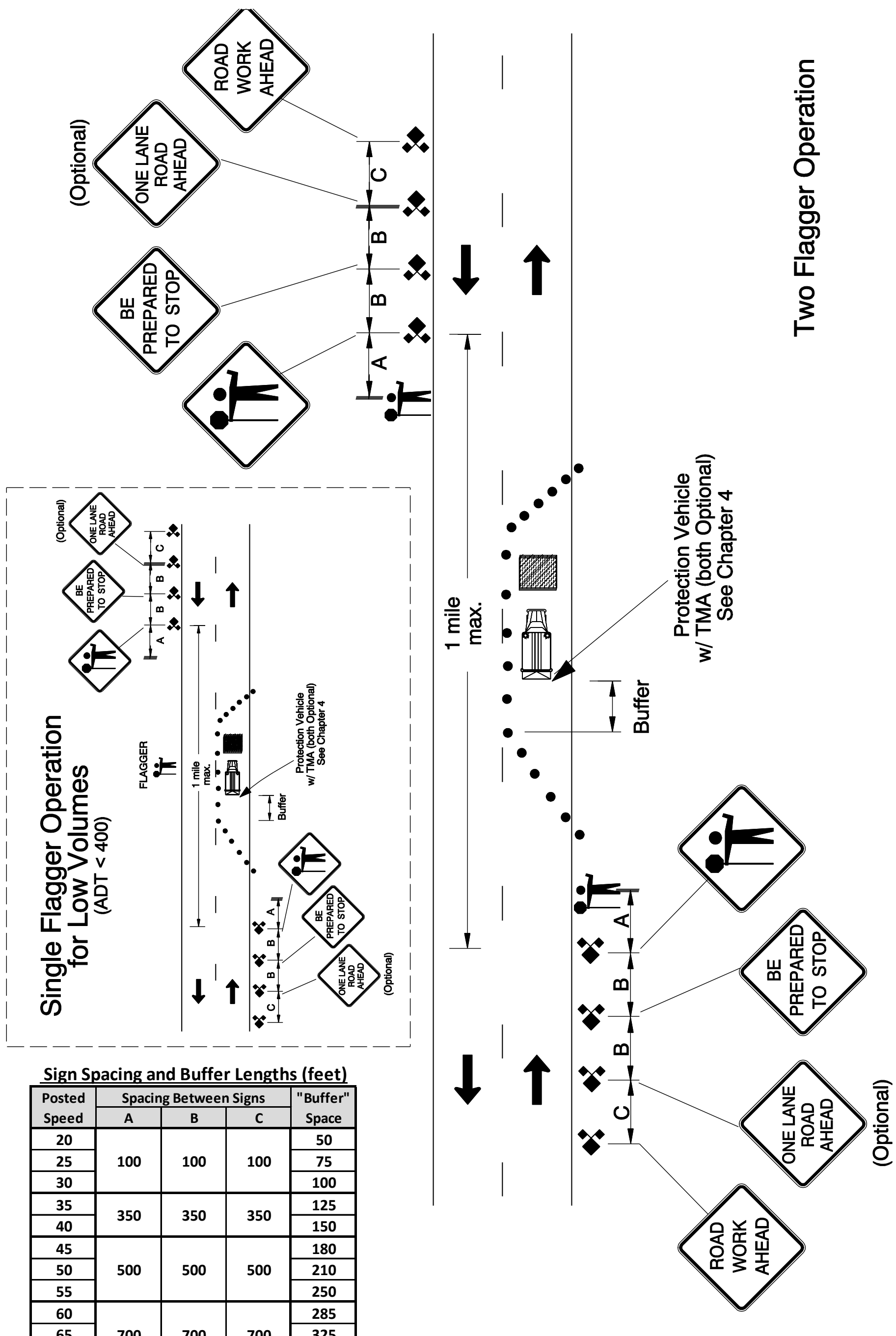
7. Extended queue signing (see Diagram 5-4) should be used when traffic queues extend beyond the initial advance warning sign.

8. When flagging near an intersection, the “Flagger Ahead” (CW23-2) sign should be visible to traffic entering from any side road. Additional advance warning and Flagger Ahead symbol signs may be placed on the side road(s).

9. Sign set-up and flagger placement shown may be used for intermittent full road closures of 20 minutes or less.

10. The “ONE LANE ROAD AHEAD” (W20-4) sign is optional and should be considered on high volume or high speed roads, or when extended queues are expected.

Stationary Lane Closure with Flagging — Diagram 320



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Operations with Moving Flagger Stations Diagram 325

Diagram 325 covers work activities that move along the road intermittently and involve frequent short stops.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. Flaggers **shall** be stationed for the best visibility for the situation and within sight distance of the active work space except at curves or crests on the road.

4. When the Flagger is more than 1000 feet from the “FLAGGER NEXT MILE” (CW20-7b) sign, intermittent cones **shall** be placed on the shoulder, as shown.

5. Flaggers are required at each end of the work space if any of the following conditions exist:
   a. Night operations, or
   b. Work space is over 200 feet in length, or
   c. Sight distance is less than 750 feet from each approach through the lane closure, or
   d. Traffic volumes are greater than 400 ADT.

6. The length between Flagger Ahead signs **shall** not exceed one mile in length.

7. Extended Traffic Queue signing (as shown on Diagram 5-4) should be used when the line of vehicles (queue) stopped at the beginning of a work zone extend beyond the ROAD WORK AHEAD signs.

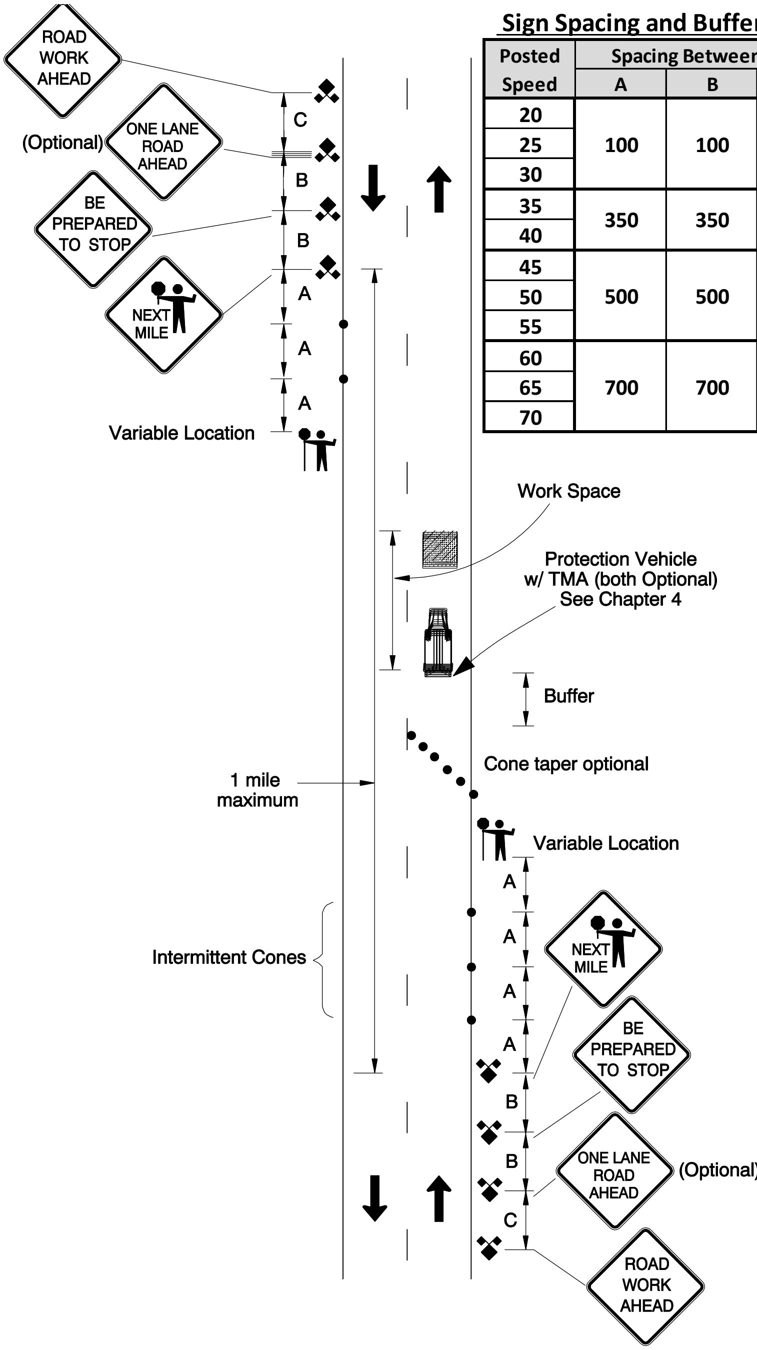
8. When flagging near an intersection, the Flagger Ahead sign should be visible to traffic entering from any side road. Additional advance warning and Flagger Ahead signs may be placed on the side road(s).

9. The “ONE LANE ROAD AHEAD” (W20-4) sign is optional and should be considered on high volume or high speed roads, or when extended queues may be expected.

Operations with Moving Flagger Stations Diagram 325

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365



Lane Closure with Portable Traffic Signals — Diagram 330

Use this detail for a lane closure on a two-lane, two-way road using portable traffic signals. The distance between STOP bars should be less than 1,000 feet. Traffic volumes should be less than 3500 ADT.

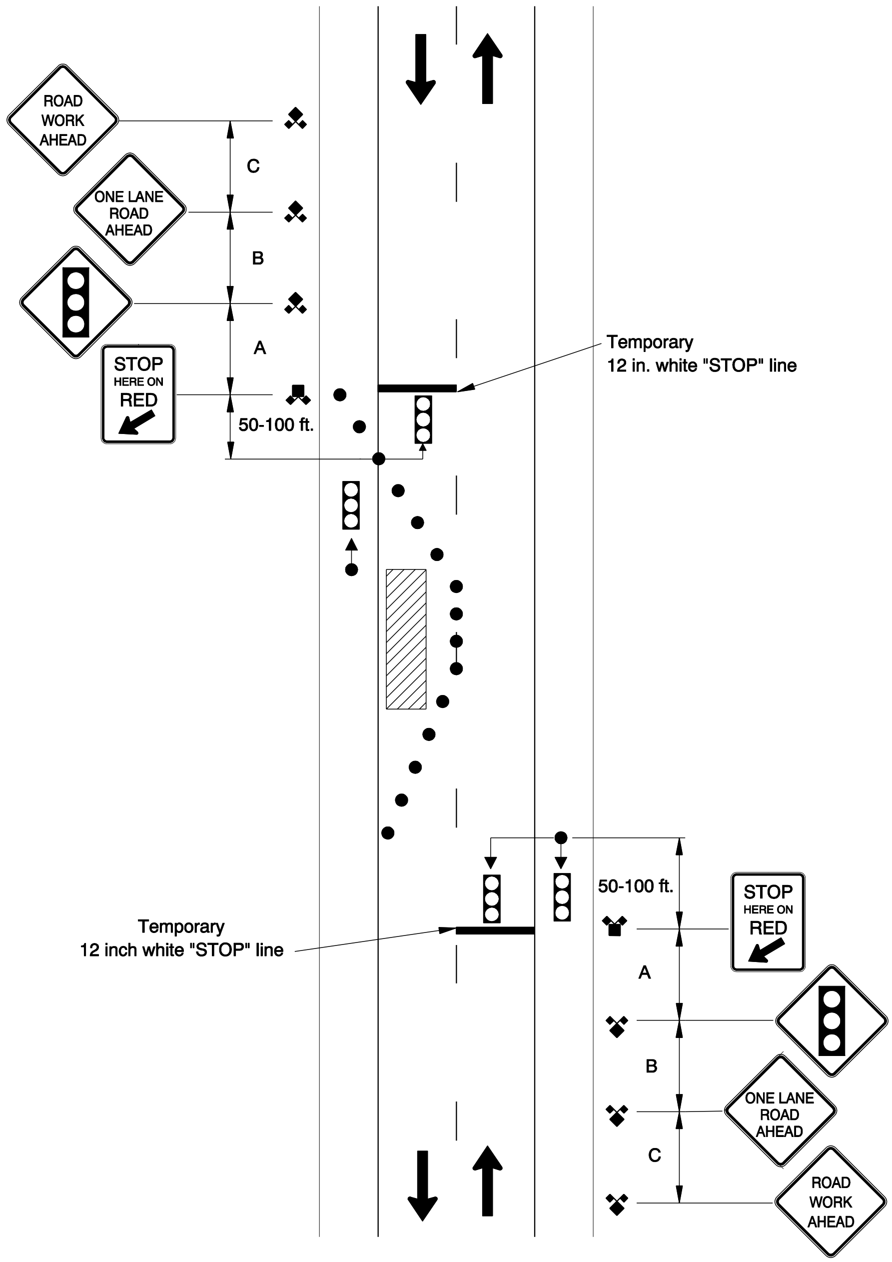
Place one dual-head unit each direction with the overhead signal head between the center of the approach lane and centerline, and the pole mounted signal head on the shoulder.

1. Provide line of sight at all times between stop bars.
2. The signal timing parameters on which the signal timing will be based **shall** be provided by the traffic engineering staff of the road jurisdiction. The parameters **shall** not be changed without approval. The red light time **shall** allow sufficient time for all vehicles to clear the work space completely before opposing traffic is released. Consider bicycle or pedestrian traffic when relevant.
3. Place enough warning signs to provide adequate warning for traffic approaching the end of the traffic queue. It may be necessary to add a second set of signs or adjust the placement during the day. There **shall** be a Signal Ahead warning sign at distance A from the stop bar.
4. A temporary stop bar is required for work that will be in place for more than one hour.
5. The closest edge of the signal head on the pole and/or the trailer **shall** be at least two feet back from the edge of travel lane.
6. The bottom of the pole-mounted signal head **shall** be eight to 19 feet above the road surface or sidewalk. The bottom of the overhead signal head **shall** be 17 to 19 feet above the road surface.
7. Direct each head for maximum visibility of the lens to vehicles approaching at 550 feet in rural areas to a minimum of 200 feet on low speed urban streets.
8. On state highways, approval from the State Traffic Engineer is required before the required permit is issued for portable traffic control signals. Also for state highways, equipment **shall** be listed on the ODOT Qualified Products List (QPL). On local roads, check with local jurisdictions for signal approval and approved equipment lists.

Sign Spacing and Buffer Lengths (feet)

Posted	Spacing Between Signs			"Buffer"
Speed	A	B	C	Space
20				50
25	100	100	100	75
30				100
35	350	350	350	125
40				150
45				180
50	500	500	500	210
55				250
60				285
65	700	700	700	325
70				365

Lane Closure with Portable Traffic Signals Diagram 330



Lane Closure with Pilot Car — Diagram 340

Use this detail when closing a long section of one lane on a two-lane, two-way road and using a pilot car to guide traffic through the closure past the work space.

1. Consider using a pilot car when approaching traffic cannot see from one flagger station to the other; or, conducting work at night.

2. A pilot car operation should be limited to 3-5 miles, depending on volume and roadway geometry.

3. Operation of the pilot car **shall** be coordinated with flagging operations at each end of the one lane section.

4. Radios or other reliable communications **shall** be used between flaggers, the pilot car and the work superintendent, or designated worker, at all times.

5. Instead of flaggers, the “WAIT FOR PILOT CAR” (CR4-20) sign may be posted on side roads or accesses intersection state highways when pilot cars are being used to control traffic on the mainline through the work zone, provided:

    a. Accesses or side road traffic is being stopped for no more than 20 minutes (per Section 00220 of the Oregon Standard Specifications for Construction, and Chapter 3 of the Oregon Temporary Traffic Control Handbook).

    b. Access or side road is a dead-end facility or has no immediate alternate access, has an ADT of 100 vehicles per day or less, and does not access public service facilities (e.g. parks, rest stops, waysides, ranger stations, landfills, utility hubs, treatment plants, etc.).

    For private residential driveways, see sign CR4-20a.

    Intersections or accesses using the WAIT FOR PILOT CAR sign should be checked regularly to ensure safe and effective traffic operations.

    For a facility with an ADT greater than 100 vpd, but not exceeding 400 vpd, the sign may be used only if closely monitored and frequently checked for traffic compliance, operation and safety. If operational issues are observed at these or any other location using the WAIT FOR PILOT CAR sign, the sign should be replace by Flagging or other traffic control measures as quickly as practical.

6. Mount the “PILOT CAR FOLLOW ME” (G20-4) sign in a conspicuous location on the rear of the pilot car. A truck-mounted PCMS may be substituted for the PILOT CAR FOLLOW ME sign.

7. The last vehicle in the pilot car queue can be identified by communication between flaggers. Alternately, the last vehicle may be identified by handing off a flag between the driver and flaggers.

8. No vehicles should be allowed to pass the pilot car.

9. Cones along the work space are optional.

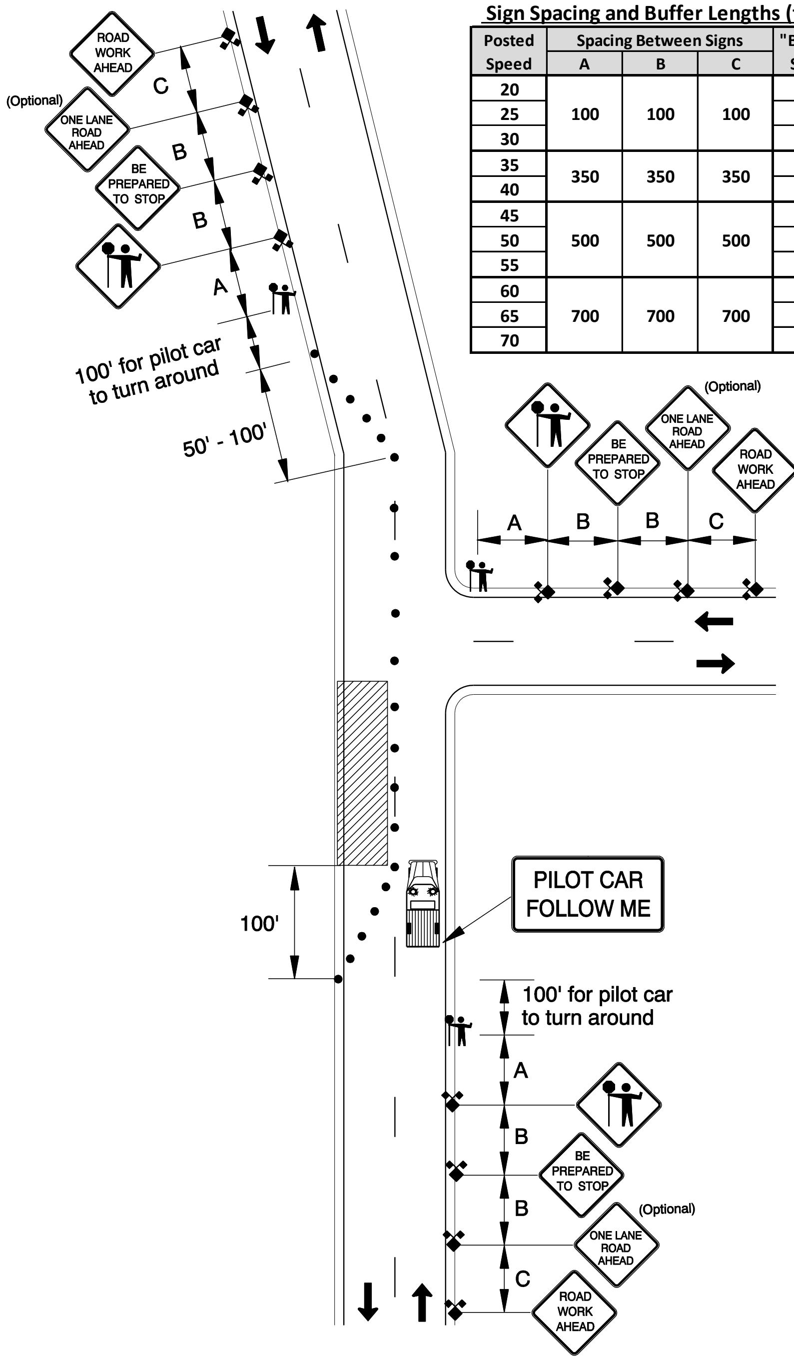
10. The “ONE LANE ROAD AHEAD” (W20-4) sign is optional and should be considered on high volume or high speed roads, or when extended queues are expected.

11. For oiling and chip seal operation details, see Diagram 345.

12. Lane Closure with Pilot Car — Diagram 340

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20				50
25	100	100	100	75
30				100
35	350	350	350	125
40				150
45				180
50	500	500	500	210
55				250
60				285
65	700	700	700	325
70				365



Oiling and Chip Seal Operations — Diagram 345

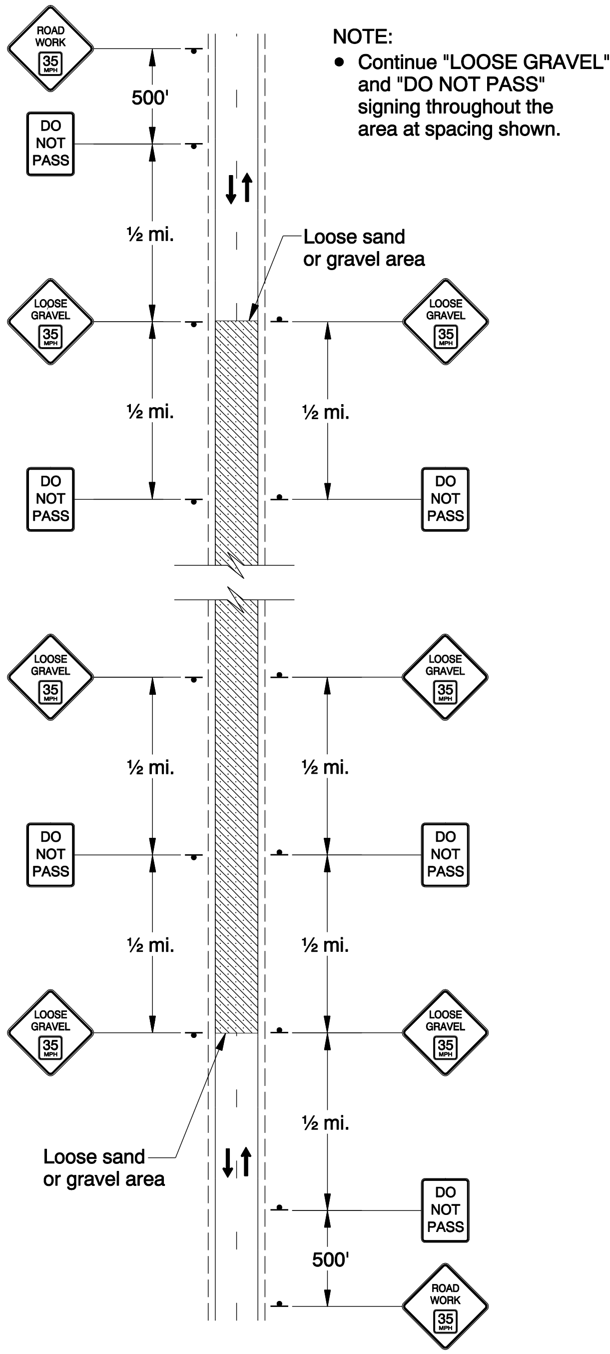
Use this diagram to identify and locate traffic control devices used for emulsified asphalt surface treatments (“EAST” – commonly referred to as “chip seals”) and oiling operations.

1. When traffic is allowed on loose gravel, the following signs (or equivalent) should be used to warn traffic of the changed pavement surface. Use a speed appropriate for the conditions – typical speeds used range from 30 – 35 mph:
   a. For chip seal projects, use the “LOOSE GRAVEL XX MPH” (CW8-7a) sign, as shown in the diagram.
   b. For oiling operations, use the “ROAD WORK XX MPH” (CW20-1a) in place of the LOOSE GRAVEL XX MPH signs shown in the diagram.
2. Signs should remain in place until the majority of loose rock is removed.
3. The sign sequence should be repeated, as shown, throughout the affected area in both directions.
4. See Diagram 5-10 for temporary centerline pavement markings.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Oiling and Chip Seal Operations Diagram 345



Self-Regulating Lane Closure Diagram 350

Use this detail for closures of one lane of a low-speed, two-lane, two-way road.

1. Use this diagram only if all of the following are true:
   a. Work space is less than 200 feet.
   b. The posted speed is 40 mph or less (unless not posted and speed governed by basic rule).
   c. Average Daily Traffic (ADT) is less than 400.
   d. Sight distance (in feet) is more than 750 at each end.

2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

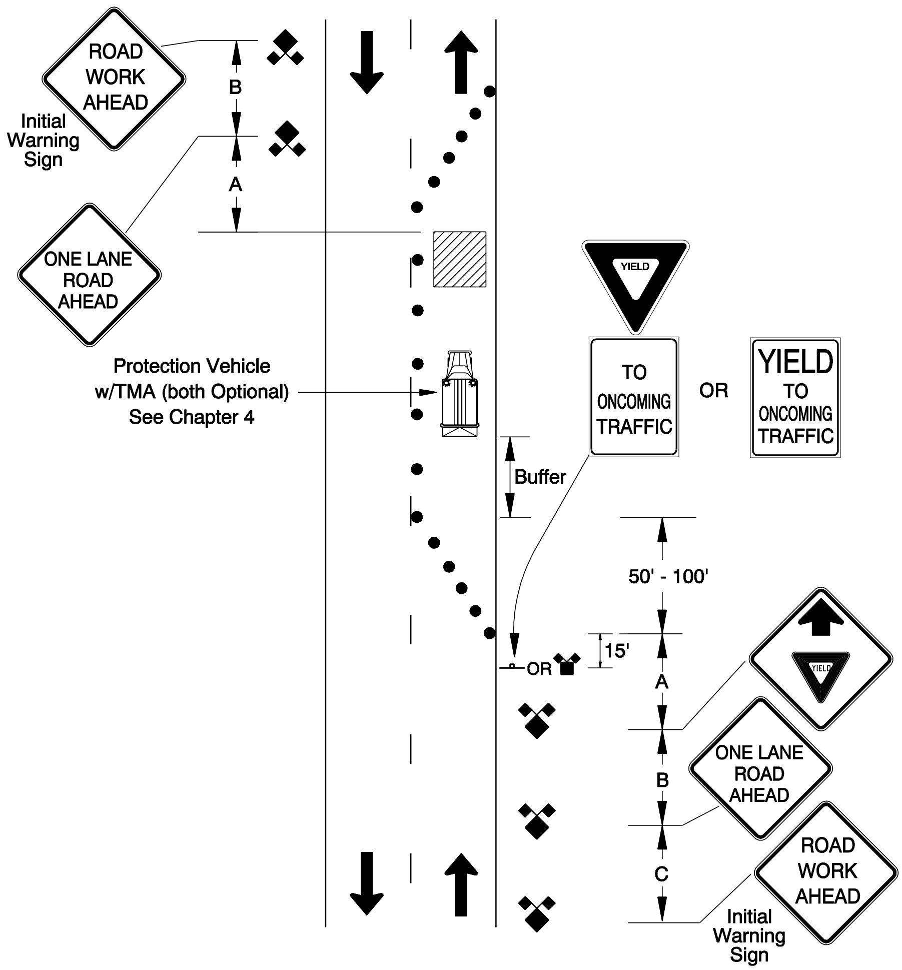
3. For added visibility, a truck-mounted arrow panel or PCMS in caution mode may be used.

4. A "Lane Ends (Right)" (W4-2R) symbol sign, or "RIGHT LANE ENDS" (W9-1R) sign, may be placed inside the cone taper for more emphasis.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Self-Regulating Lane Closure — Diagram 350



Work in Center of Low-Speed Road — Diagram 360

Use Diagram 360 only on two-lane, two-way roads with a posted speed of 40 mph or less (unless not posted and speed governed by basic rule); and, when there is sufficient lane and shoulder width to allow a minimum of 10 feet on each side of the work space.

1. When work vehicle(s) are in the work space, use truck-mounted flashing lights on work and protection vehicles. Allow a sufficient distance between the vehicle and work activity for safe run out if the vehicle is struck.

2. Cones and signs shown are required.

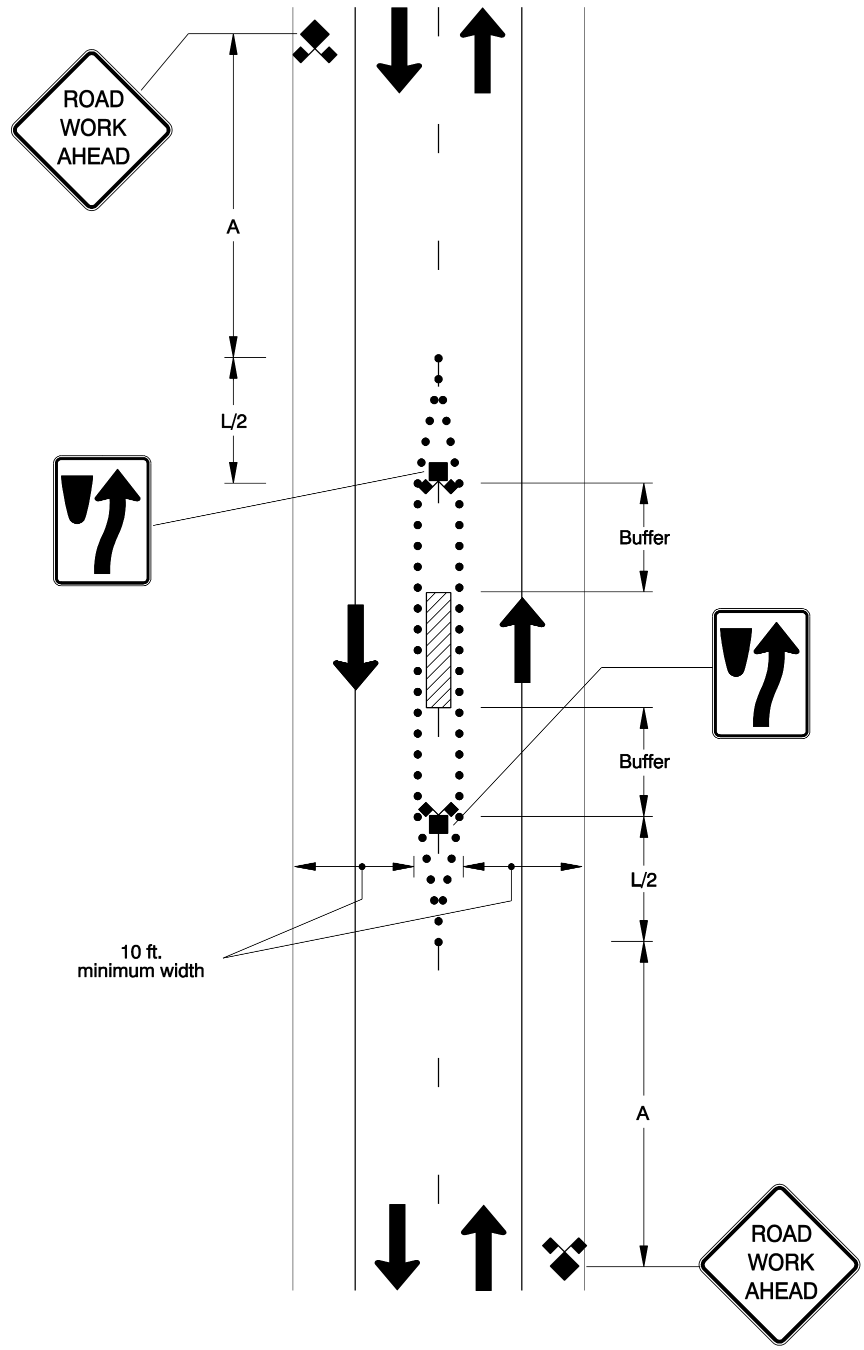
3. A strobe or flashing warning light mounted on a Type II barricade may be used just inside each end of the closed section.

4. The “Keep Right” (R4-7) symbol sign may be mounted on a portable sign support or a barricade (if the sign-barricade combination has passed NCHRP 350 or MASH crash testing criteria).

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in Center of Low-Speed Road **Diagram 360**



Work with In-Street Running Transit Tracks Diagram 370

Use Diagram 370 where work is within or adjacent to two-way streets which include in-street running transit rail tracks. The rail or transit “right of way” (the width needed and path used by the rail or transit vehicle) may occupy and share one traffic lane of the roadway.

1. Do not block transit right of way or impede train traffic with temporary signs, barricades or channelization devices.

2. Traffic control plans **shall** be approved by the railroad or transit authority. Review of traffic control plans may define additional requirements beyond those shown in the Diagram.

3. Workers and flaggers **shall** be trained and authorized in track access procedures or worker protection safety prior to work in or adjacent to the Right of way and grade crossings by the railroad or transit authority.

4. Emergency Traffic control for work zones that are outside the right of way may require vehicles to enter the right of way. The railroad or transit authority **shall** be notified of such work zones.

5. Railroad signals and signs **shall** not be covered or deactivated without permission from the railroad or transit authority.

6. The grade of side roads approaching a crossing may block sight distance. Use additional advance warning signing and spacing, as needed.

Sign Spacing and Buffer Lengths (feet)

<table>
<tr><th rowspan="2">Posted Speed</th><th colspan="3">Spacing Between Signs</th><th rowspan="2">"Buffer" Space</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>20</td><td rowspan="3">100</td><td rowspan="3">100</td><td rowspan="3">100</td><td>50</td></tr>
<tr><td>25</td><td>75</td></tr>
<tr><td>30</td><td>100</td></tr>
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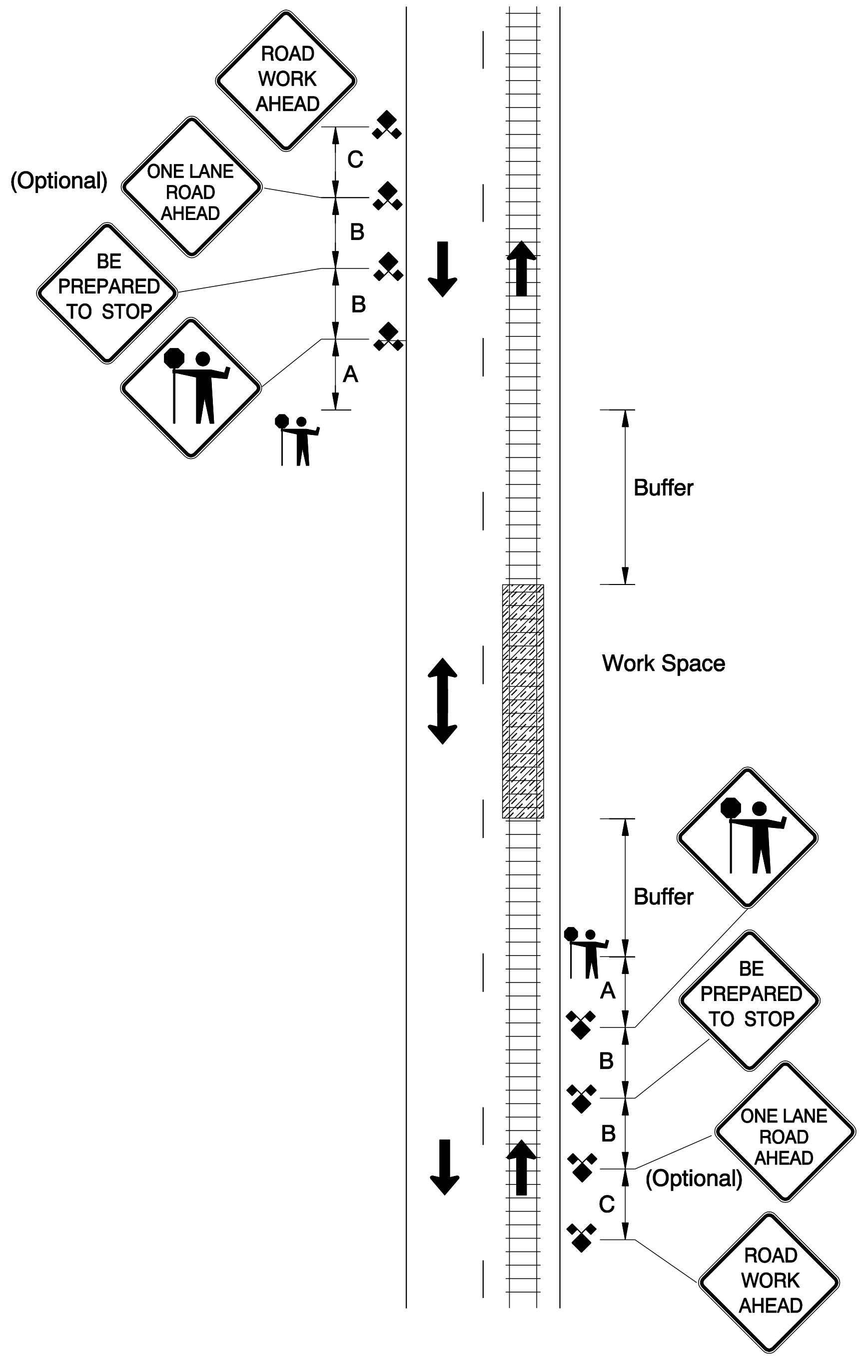
<tr><td>40</td><td>150</td></tr>
<tr><td>45</td><td rowspan="3">500</td><td rowspan="3">500</td><td rowspan="3">500</td><td>180</td></tr>
<tr><td>50</td><td>210</td></tr>
<tr><td>55</td><td>250</td></tr>
<tr><td>60</td><td rowspan="3">700</td><td rowspan="3">700</td><td rowspan="3">700</td><td>285</td></tr>
<tr><td>65</td><td>325</td></tr>
<tr><td>70</td><td>365</td></tr>
</table>

Work with In-Street Running Transit Tracks Diagram 370



5.4 Two-Way Roads with Passing Lanes

Work in the Single-Lane Direction — Diagram 400

Diagram 400 shows work in the single lane direction of a three-lane, two-way road with two travel lanes in one direction and a single travel lane in the opposing direction.

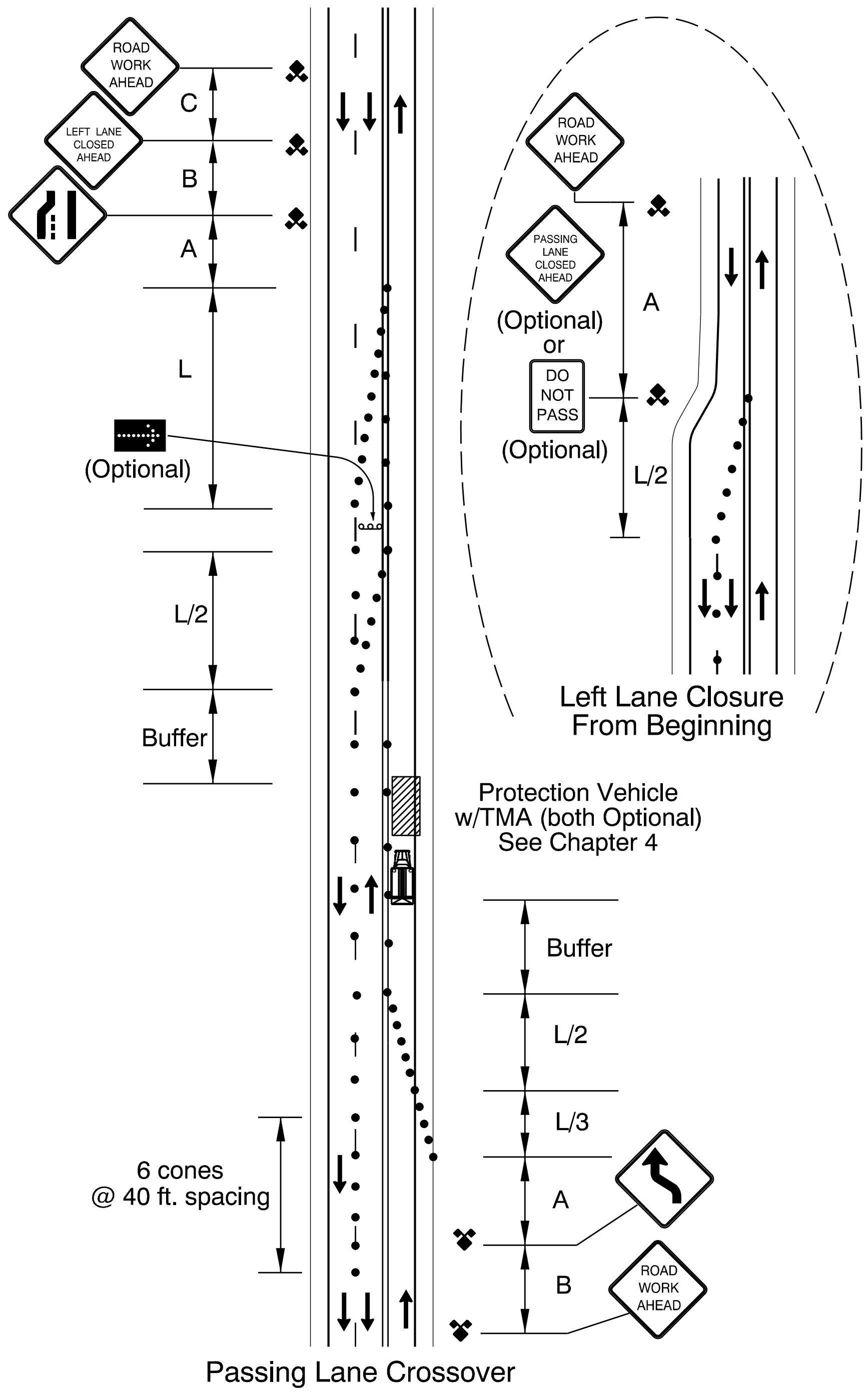
Use the diagram to close the single travel lane and maintain a travel lane for each direction.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. On the single lane approach, cover any passing lane signs such as YIELD CENTER LANE TO UPHILL TRAFFIC.
4. On the single lane approach, extending the cones across the shoulder in a shoulder taper (L/3) is recommended.
5. On the two lane approach, the use of 3 to 6 cones on centerline in advance of the taper is recommended.
6. An advance PCMS may be used, when closing a passing lane.
7. If there is less than 1000 feet of passing lane remaining beyond the lane closure, the passing lane should be closed to the end.
8. If the work space is less than ½ mile from the beginning of the passing lane:
    a. The passing lane should be closed from the beginning.
    b. For details, see Left Lane Closed from Beginning Option.
    c. Cover the permanent advance passing lane signs. These can include PASSING LANE 1 MILE, a Lane Transition sign and KEEP RIGHT EXCEPT TO PASS.

Sign Spacing and Buffer Lengths (feet)

Posted	Spacing Between Signs			"Buffer"
Speed	A	B	C	Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in the Single-Lane Direction — Diagram 400



Work in the Two-Lane Direction Diagram 410

Diagram 410 shows work in the two-lane direction of a three-lane, two-way road with two travel lanes (e.g. a passing lane) in one direction and a single travel lane in the opposite direction. Use this diagram to close one lane of the two-lane section, maintaining one open lane in each direction.

Refer to Diagram 500 for right lane closure information when the work is greater than ½ mile from the beginning of the passing lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. For a middle lane closure, 3 to 6 cones on centerline in advance of the closed area in the single lane direction may be used especially at speeds of 45 mph or greater.

4. For a right lane closure, cones may be placed on the yellow center line if lanes are narrow, sight distances are limited, or the extra separation is needed for other conditions.

   "PASSING LANE CLOSED AHEAD" (CW23-6) and "DO NOT PASS" (R4-1) signs are optional.

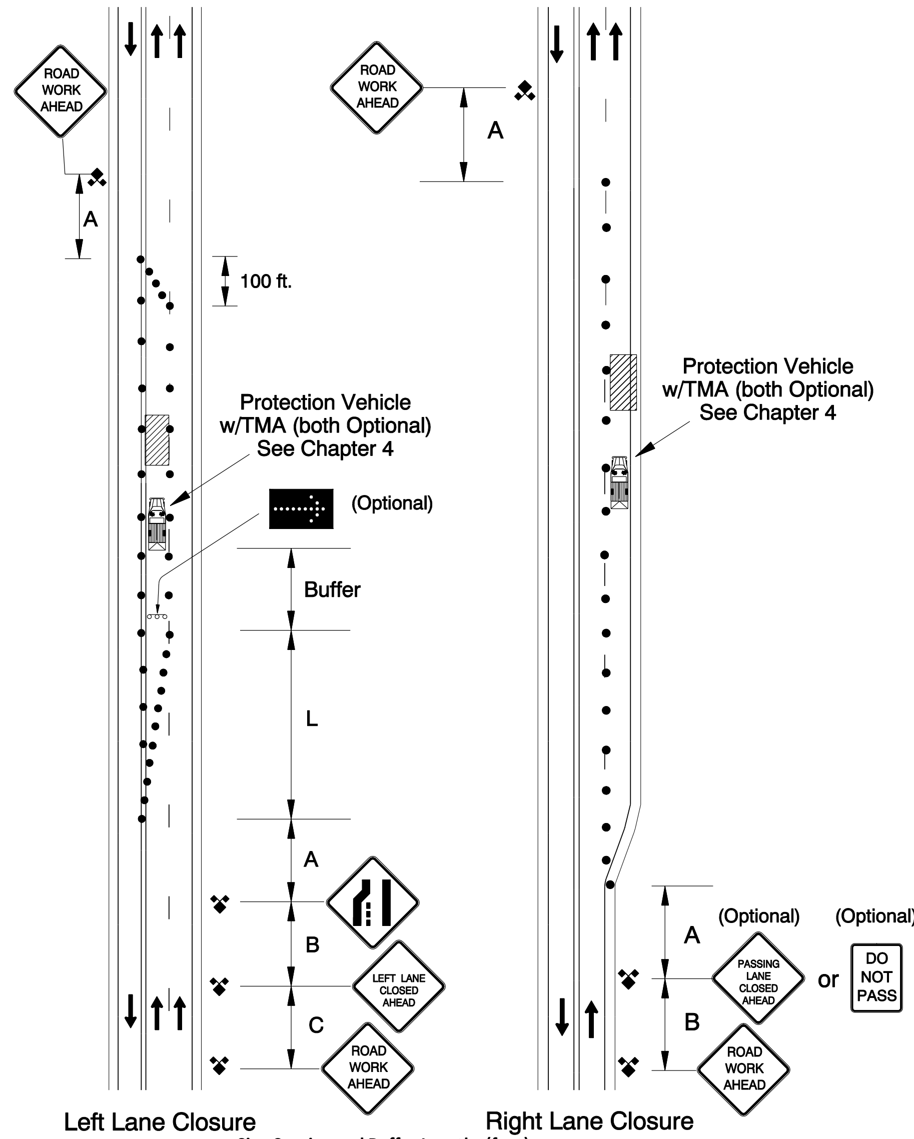
5. On the single lane approach, cover any passing lane signs such as, "YIELD CENTER LANE TO UPHILL TRAFFIC" (OR4-11).

6. An advance PCMS is recommended and should be considered when closing a passing lane.

7. If there is less than 1000 feet of passing lane remaining beyond the lane closure, the passing lane should be closed to the end.

8. If the work space is less than ½ mile from the beginning of the passing lane:
   a. The passing lane should be closed from the beginning.
   b. For left lane closure details, see Diagram 400.
   c. Cover the permanent advance passing lane signs. Signs may include "PASSING LANE 1 MILE" (OR4-10), the Lane Transition sign and "KEEP RIGHT EXCEPT TO PASS" (OR4-3) sign.

Work in the Two-Lane Direction — Diagram 410



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in a Continuous Left Turn Lane — Diagram 420

Diagram 420 shows work in the continuous two-way left turn lane of a two-way road with three or more lanes.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. For operations of more than one hour, cones and signs are required as shown. Protection vehicles are optional.

4. For operations between 15 minutes and one hour, including work that will relocate intermittently, cones are required and signs may be replaced by protection vehicles with flashing lights.

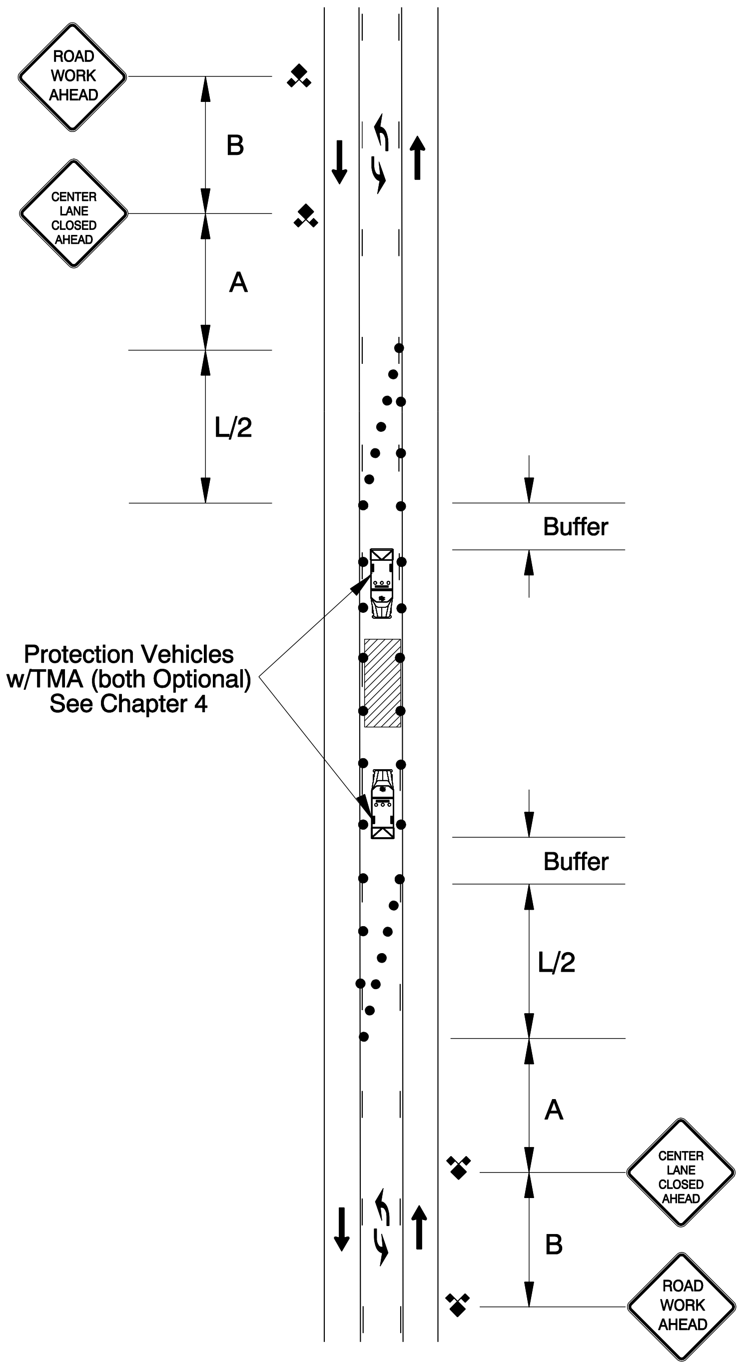
5. For operations of 15 minutes or less, signs and cones may be replaced by one or more protection vehicles with flashing lights.

6. When only one protection vehicle is used, the use of a spotter(s) is recommended to warn workers of approaching traffic.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in a Continuous Left Turn Lane Diagram 420



Diversion into a Continuous Left Turn Lane Diagram 430

Diagram 430 shows work in the travel lane(s) next to a continuous two-way left turn lane with one direction of traffic diverted into the continuous two-way left turn lane.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

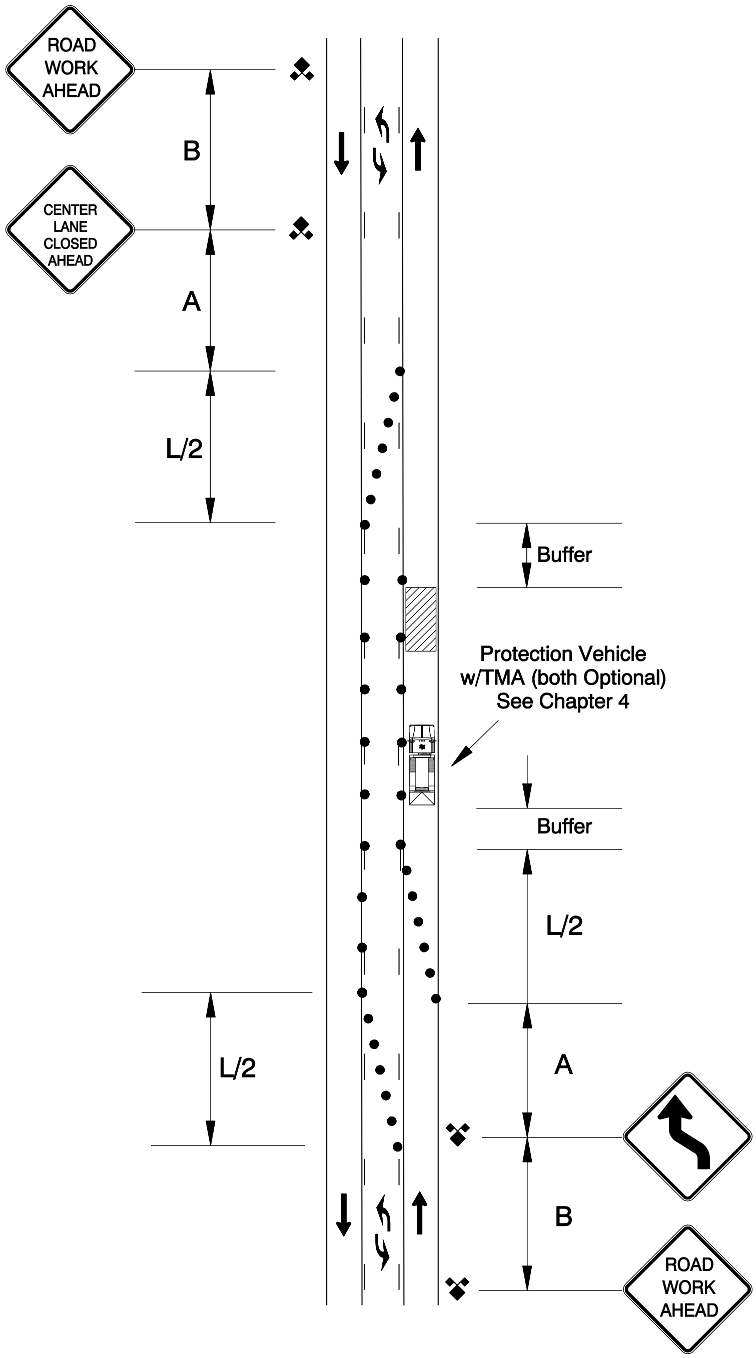
3. When two or more travel lanes are reduced to a single lane before the diversion, each lane **shall** be closed separately. Layout traffic control according to ODOT Standard Drawing TM 852 for 5-lane sections.

4. A shifting taper (L/2) may be added in the diverted traffic direction across the continuous two-way left turn lane (as shown). This option is recommended when the speed is 45 mph or greater.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Diversion into a Continuous Left Turn Lane Diagram 430



5.5 Multi-Lane Roads

Right Lane Closure, Multi-Lane Non-Freeway Diag. 500

Diagram 500 covers work which closes the right lane of a multi-lane non-freeway road.

If closing more than one lane on a multi-lane road, provide a minimum tangent distance of 2L between the end of the first lane closure taper and the beginning of the second lane closure taper.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.

2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.

3. When the posted speed is 40 mph or less, the RIGHT LANE CLOSED AHEAD signs may be omitted.

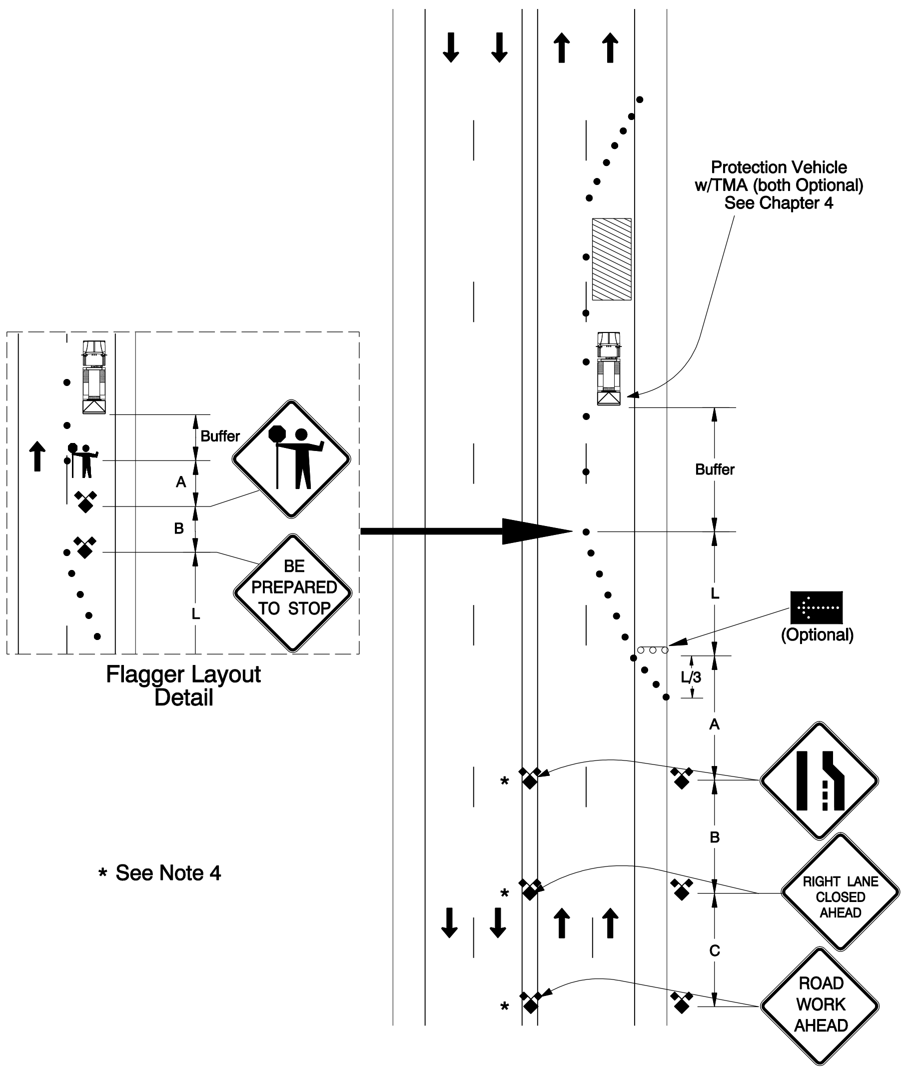
4. Placement of signs in a non traversable median or other median that is not a two-way left turn lane is required for lane closures any time there is room for a truck to be parked on the left, out of the travel lane. When there is no room for a truck to be parked on the left an additional RIGHT LANE CLOSED AHEAD sign should be placed on the right side and placement of signs in the median is optional.

5. If flagging is needed for work vehicle ingress/egress, use Flagger Layout Detail (see Inset).

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Right Lane Closure, Multi-Lane Non-Freeway Diag. 500



Interior Lane Closure, Multi-Lane Non-Freeway Diag. 510

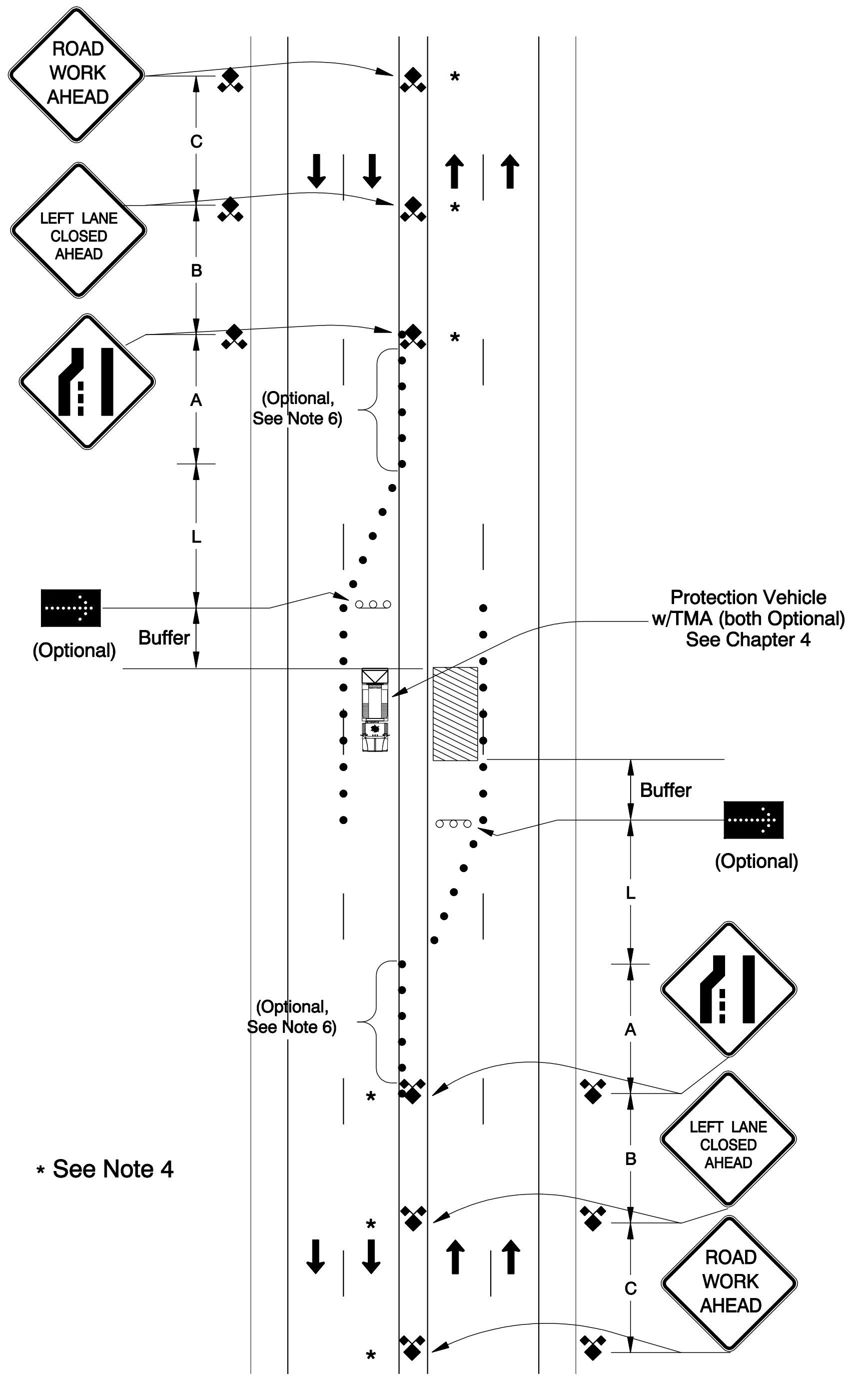
Diagram 510 covers work which will block the left lane(s) of a multi-lane non-freeway road.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. If the adjacent lane in the opposing direction is not closed, cone off the work space placing the cones in the median or along the centerline if there is one.
4. Placement of signs in a non traversable median or other median that is not a two-way left turn lane is required for lane closures any time there is room for a truck to be parked on the left, out of the travel lane. When there is no room for a truck to be parked on the left an additional LEFT LANE CLOSED AHEAD sign should be placed on the right side and placement of signs in the median is optional.
5. When the posted speed is 40 mph or less, the LEFT LANE CLOSED AHEAD signs may be omitted.
6. Cones may be placed as shown on centerline in advance of the work to better gain the attention of motorists.
7. Work vehicle(s) with or without a TMA may be used to protect the workers and work space.

Sign Spacing and Buffer Lengths (feet)

Posted	Spacing Between Signs			"Buffer"
Speed	A	B	C	Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Interior Lane Closure, Multi-Lane Non-Freeway Diag. 510



* See Note 4

5.6 Intersection Operations

Lane Closure – Near Side of Intersection Diagram 600

Diagram 600 covers closure of an intersection approach lane. Work vehicles may or may not be in the work space.

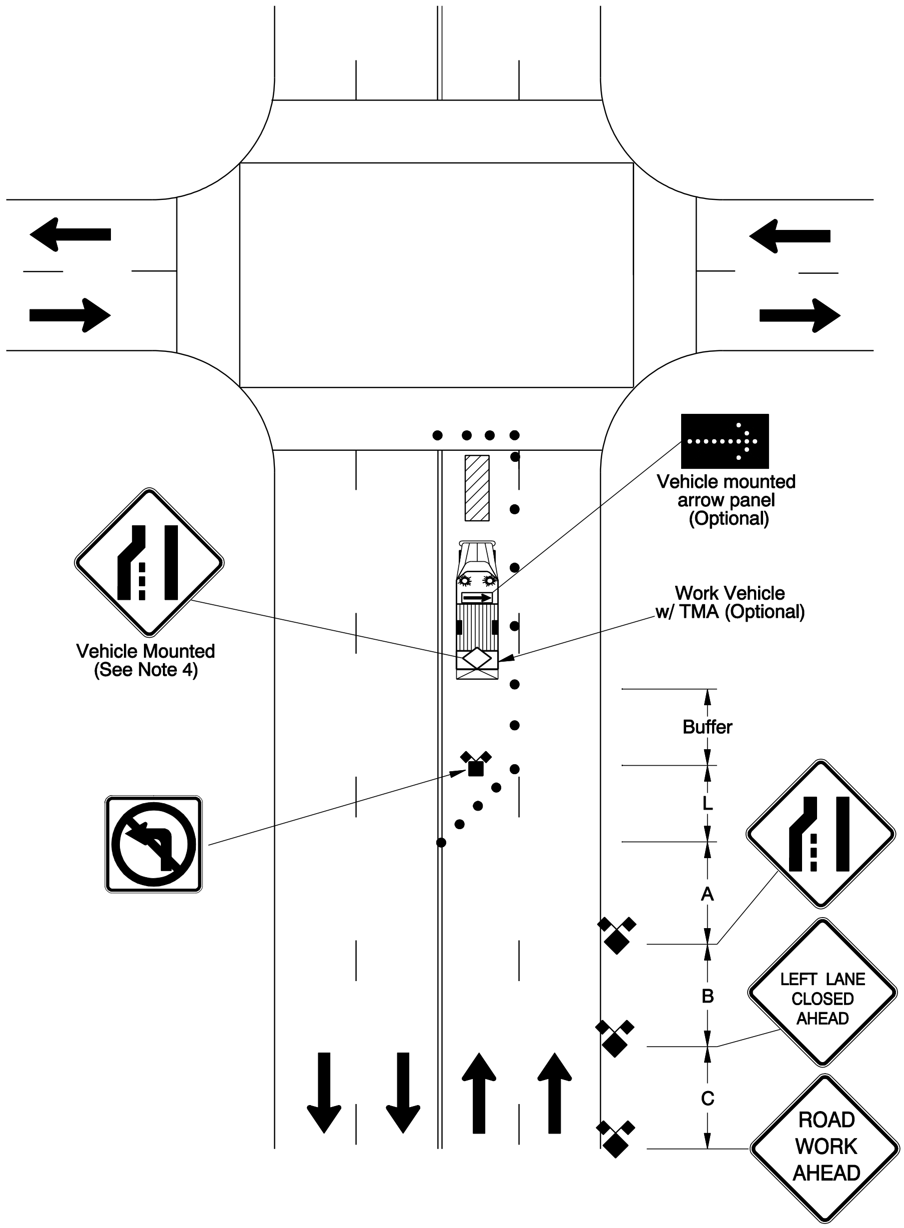
Movement of traffic through the intersection is regulated by existing traffic control only.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. For speeds 40 mph or less and for work in place less than 15 minutes, a truck-mounted arrow panel or PCMS in arrow mode may be used in place of signs shown on the shoulder.
4. For speeds over 40 mph and for work in place more than 15 minutes, a 36” (min.) LANE REDUCTION or LANE CLOSED sign is required inside the merging taper or mounted on the work vehicle. The sign may be displayed using a truck-mounted PCMS.
5. Prohibiting left turns will require additional advance warning and regulatory signs. Check with the road jurisdiction before placing regulatory “Left Turn Prohibition” (R3-2) symbol signs.
6. The lane closure merging taper shown is required for all speeds and work durations.
7. Where space allows, install advance warning signs in the median on multi-lane roads, especially for left lane closures.
8. A “Left Turn Prohibition” (R3-2) symbol sign may be installed on a Type II barricade inside the closure taper.
9. When closing an interior lane of a three or more-lane facility, the closure taper **shall** direct traffic into only one of the adjacent lanes, but not both.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure – Near Side of Intersection Diagram 600



Left Turn Refuge Closure Diagram 605

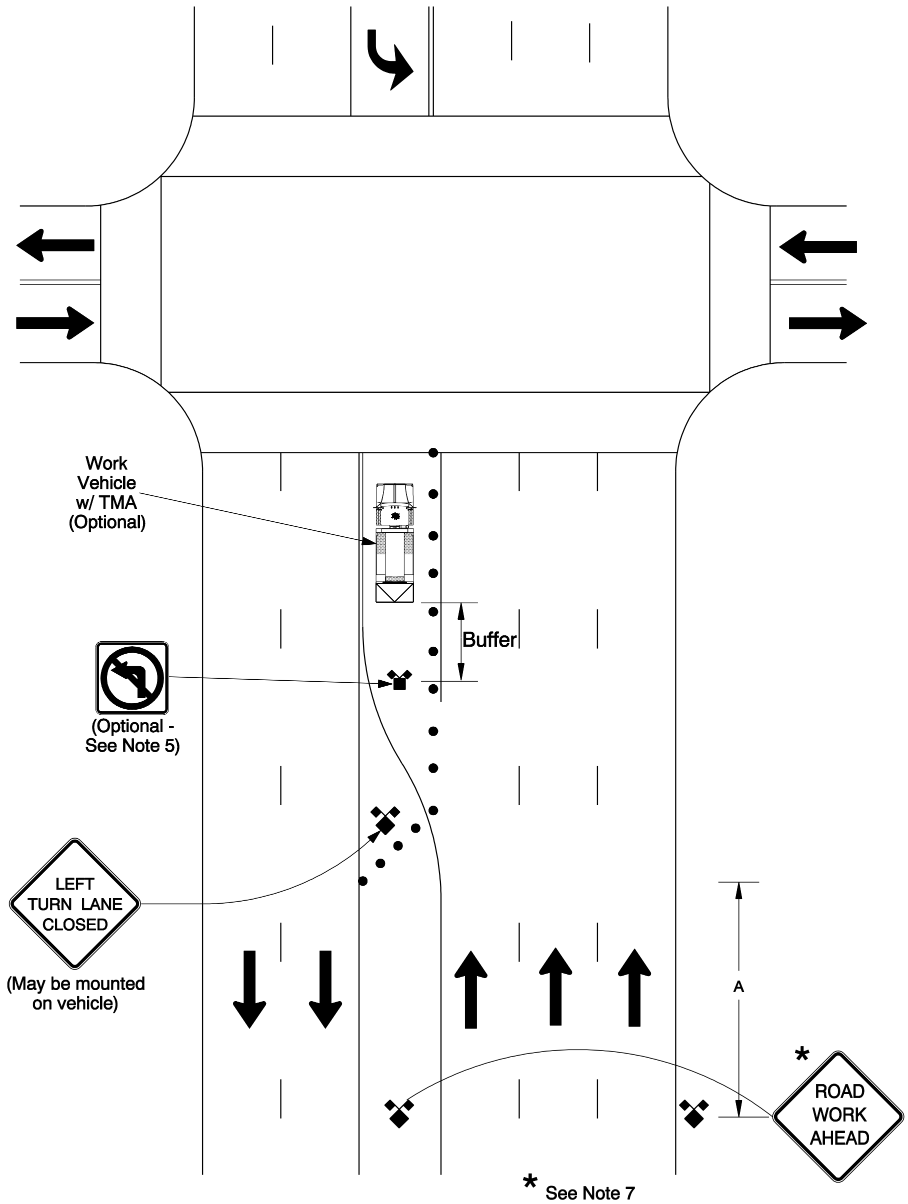
Diagram 605 covers work which closes an exclusive left turn refuge. When working in a left turn refuge, close the entire refuge.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. For speeds 40 mph or less and for work in place less than 15 minutes, a truck-mounted arrow panel or PCMS in arrow mode may be used in place of signing shown on the shoulder. Turn lane closure taper is required, as shown.
4. For speeds over 40 mph and for work in place more than 15 minutes, a 36” (min.) LEFT TURN LANE CLOSED (CW23-13) sign is required inside the cone taper or mounted on the work vehicle. The sign may be displayed using a truck-mounted PCMS.
5. Left turn movements can be made from the left-most through-lane unless regulatory signs prohibit turns from that lane. Check with the road jurisdiction before placing regulatory “Left Turn Prohibition” (R3-2) symbol signs.
6. The left turn lane closure merging taper shown is required for all speeds and work durations.
7. If median is not a continuous two-way left turn lane and there is adequate space available, place an additional advance warning sign in the median.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Left Turn Refuge Closure — Diagram 605



Lane Closure – Far Side of Intersection Diagram 610

Diagram 610 covers work within an area immediately downstream of an intersection. Work vehicles may or may not be in the work space. Movement of traffic through the intersection is regulated by existing traffic control only.

1. When left turns can be prohibited use the No Left Turn Option (see inset).

2. If left turns cannot be prohibited, a left turn lane may be set up after the lane closure by leaving an opening long enough for vehicles to enter. There should be a minimum of 75 feet of storage beyond the opening in the left turn lane. Adjust the length of the lane closure to accommodate the left turn lane.

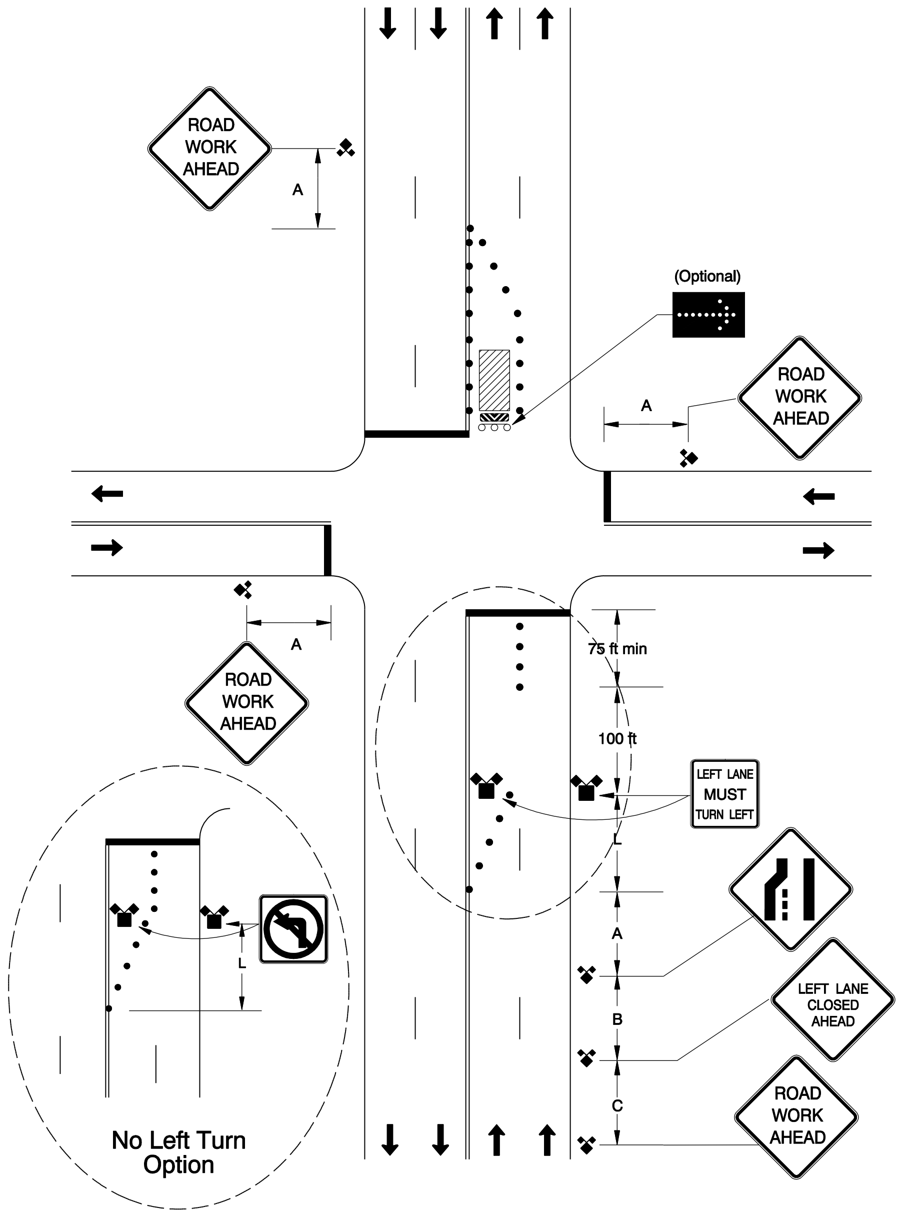
3. If providing a left turn lane, place black-on-white, rectangular, “LEFT LANE MUST TURN LEFT” (R3-7L) signs on the right shoulder and inside the closed lane in advance of the left turn opening and in place of the “Left Turn Prohibition” (R3-2) sign(s).

4. When closing an interior lane of a three or more-lane facility, the merging taper **shall** direct traffic into only one of the adjacent lanes, but not both.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure – Far Side of Intersection Diagram 610



Lane Closure at Intersection with Flagging — Diagram 620

Diagram 620 covers work within an intersection when normal traffic control must be interrupted. Work vehicles may or may not be in the work space.

1. During flagging, traffic signals **shall** be turned off. Contact the road jurisdiction for approval and assistance (see Chapter 3).

2. For multi-lane facilities, traffic approaching the intersection **shall** be reduced to a single lane on each approach. See Chapter 3 for information on flagging through intersections.

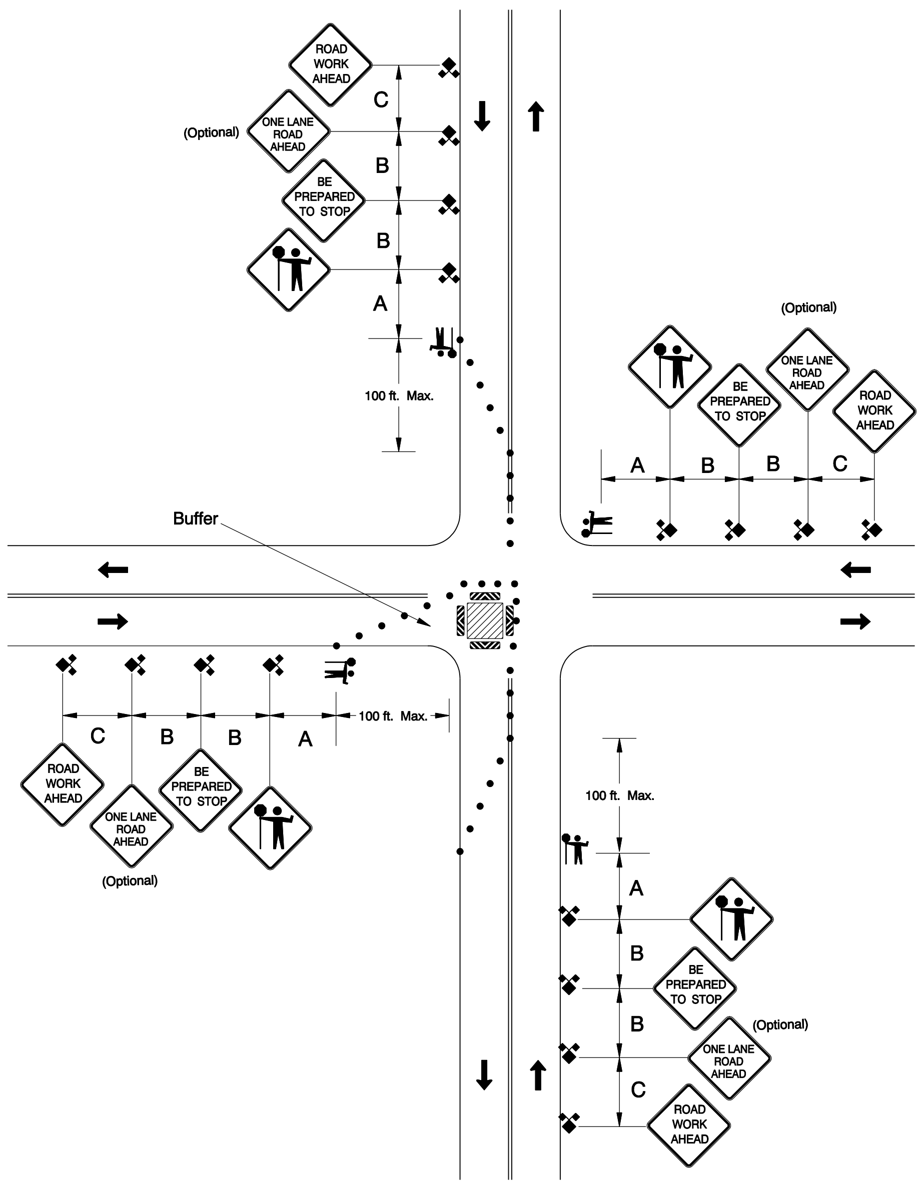
3. There should be one flagger for each approach. One flagger may control two adjacent approaches if sight distance, low volumes on side roads, and flagger position allows for safe operation and clear direction to motorists. For low traffic volume intersections (fewer than 400 entering vehicles per day), one flagger may be used.

4. The "ONE LANE ROAD AHEAD" (W20-4) sign is optional and should be considered on high volume or high speed roads, or when extended queues may be expected.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure at Intersection with Flagging Diagram 620



Work in the Center of an Intersection Diagram 630

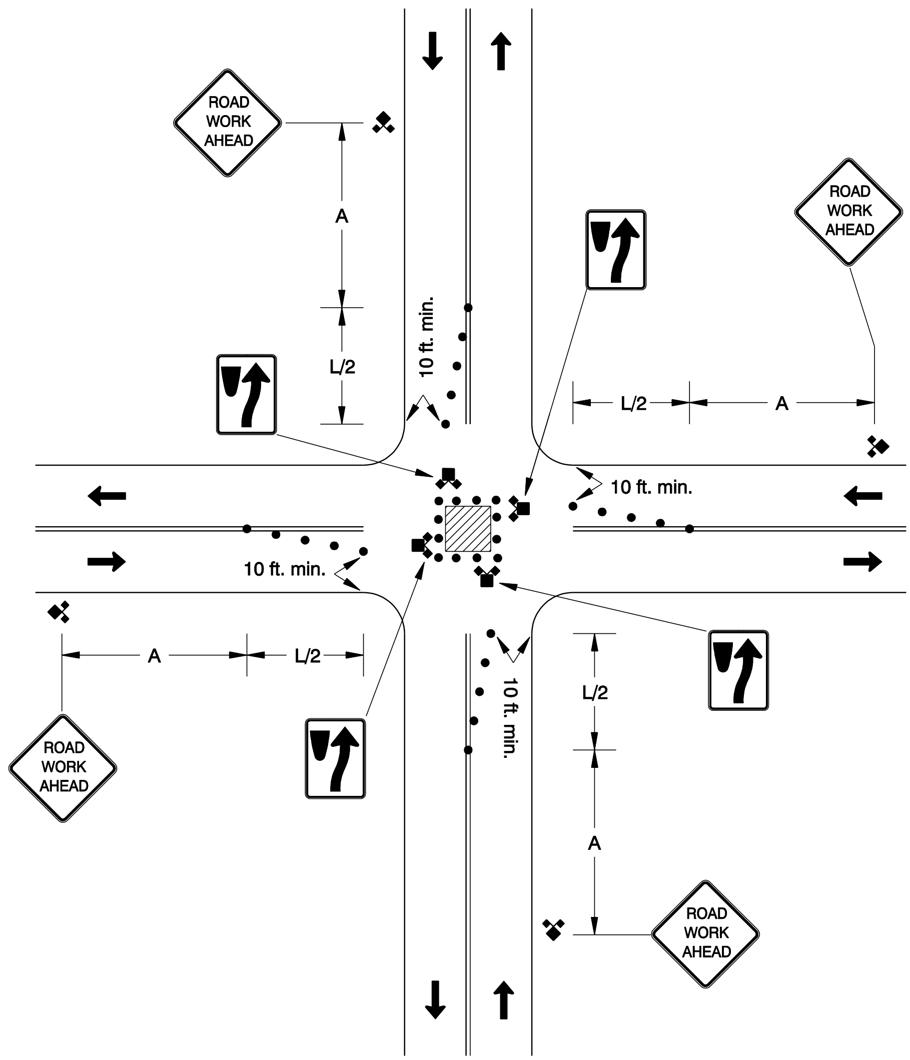
Diagram 630 covers work within an intersection of two-way streets. Movement of traffic through the intersection is regulated by existing traffic control only.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. For multi-lane approaches, merge traffic into one lane in advance of the intersection.
4. For high speed or high traffic volume operations, consider using flaggers to control traffic.
5. When the posted speed is 40 mph or less and work is in place for less than 15 minutes, cones and signs are not required.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Work in the Center of an Intersection Diagram 630

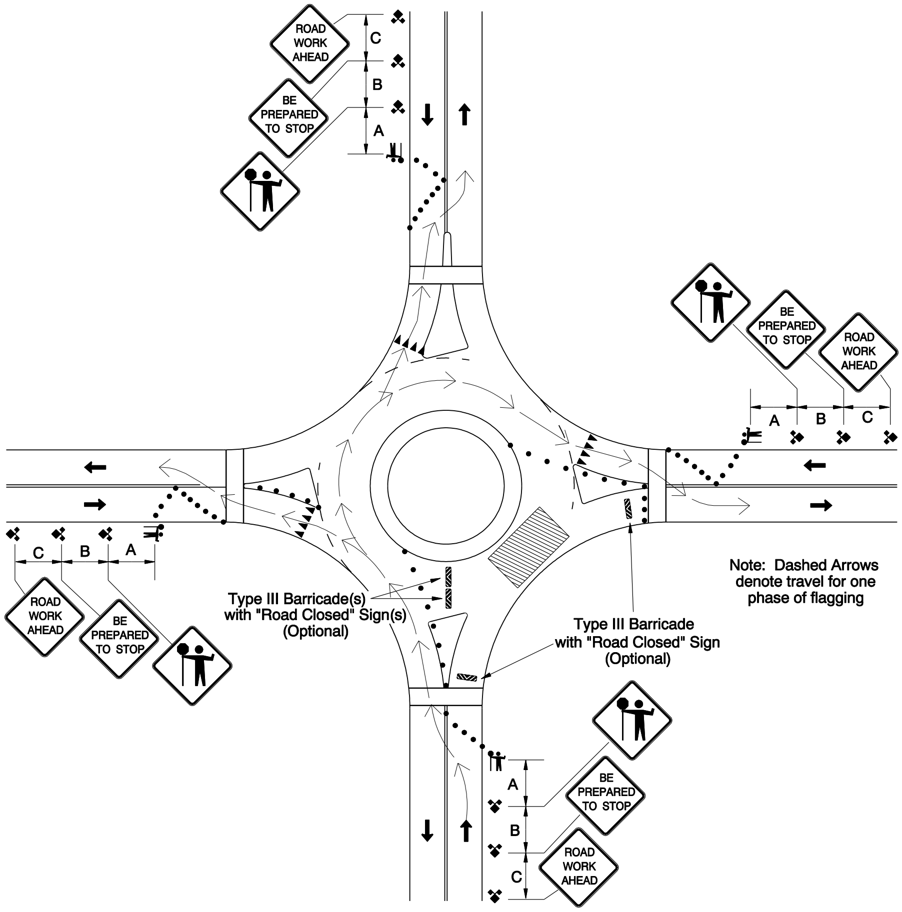


Work in a Roundabout Diagram 640

Diagram 640 covers an example of work within a roundabout. The diagram shows closure of a portion of the roundabout with flagging control of alternating one-way traffic.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. If any of the road approaches cannot access the intersection due to the work space, a detour may be required. Road closure approval and the detour route should be provided by the road jurisdiction. For short closures of 20 minutes or less, traffic may be held in place.
4. For work within the roundabout island, initial advance warning signs are required on each approach leg. If the work and all work vehicles are off of the travel lanes and island apron, a single sign per approach is all that is required.
5. If the center island apron will be impacted by the work or equipment, treat it as a shoulder closure for the length of work. But, consider diverting truck traffic due to large vehicle off-tracking.
6. For multi-lane roundabouts, if work can be done without closing both travel lanes, flaggers may not be needed. Appropriate signs for the lane closure at each entry are required.
7. Cones may not be needed along the splitter islands on the approaches if these are raised islands. In such cases, the flagger may have to move far enough ahead on the approach of the splitter island so that traffic can maneuver into the roundabout.
8. If work occurs in an approach leg, a minimum of two flaggers **shall** be used to control traffic. High approach volumes may require additional flaggers for the remaining legs. The ROAD WORK AHEAD, BE PREPARED TO STOP and Flagger Symbol signs are required in advance of each leg as shown.
9. If a travel lane width of at least ten feet can be maintained for shoulder work on an approach lane, the lane can remain open to traffic. Close the work space with shoulder taper and tangent cones. An initial advance sign and a SHOULDER (SIDEWALK) CLOSED sign are required unless the work will take less than 15 minutes.
10. In multi-lane roundabouts, merge traffic into one through lane prior to work.
11. See Diagram 640B – Roundabout Detour Alternative – for details needed if using a detour route in lieu of flagging.

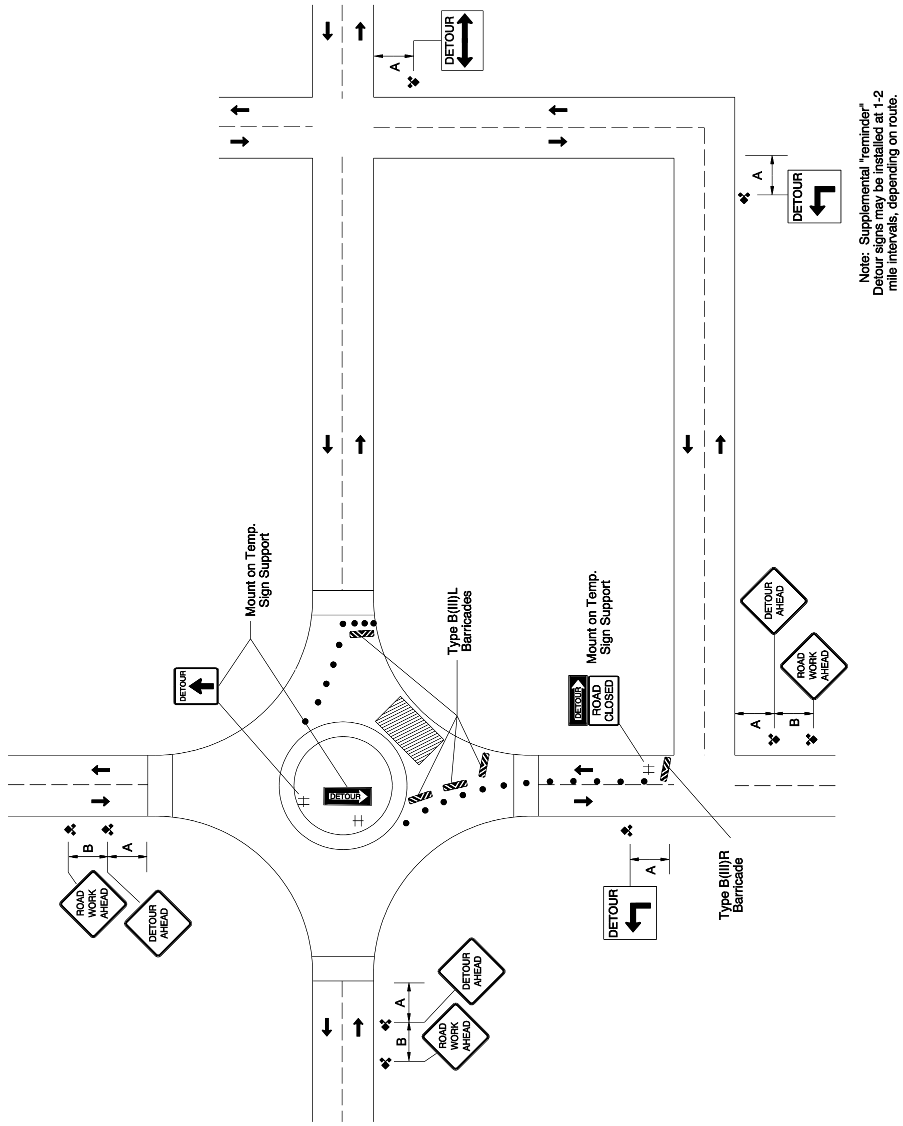
Work in a Roundabout Diagram 640



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Roundabout Detour Alternative Diagram 640B



Note: Roundabouts pose unique problems. The traffic control and flagger communications need to be adapted to accommodate each situation.

5.7 Freeway Work

Freeways are defined by separation of traffic directions, high speed road design and controlled accesses. Freeways have only separated grade interchanges with exit and entrance ramps which are considered part of the freeway.

The high speeds and normally uninterrupted flow on freeways increases the risks for workers and road users. More visibility, better protection and earlier advance warning are needed for freeway work spaces than on other roads.

Some highways may have portions with freeway-like characteristics (e.g. high speeds, grade-separated interchanges, access control, or positive separation of traffic directions), yet still function overall as a multi-lane highway. For such facilities, diagrams in Section 5.5 – Multi-lane Roads may be the more appropriate for temporary traffic control conducted on these roads.

Depending on the type of work and at the discretion of the responsible person, the freeway applications shown in this section may be applicable.

Some Oregon freeway interchanges have limited merging or diverging capacities, or limited sight distances. At these locations, engineered traffic control plans should be prepared for the work being done. If an interchange is reconstructed or improved, the traffic control plans should be updated to reflect these changes.

Freeway Mobile Operations — Diagram 700

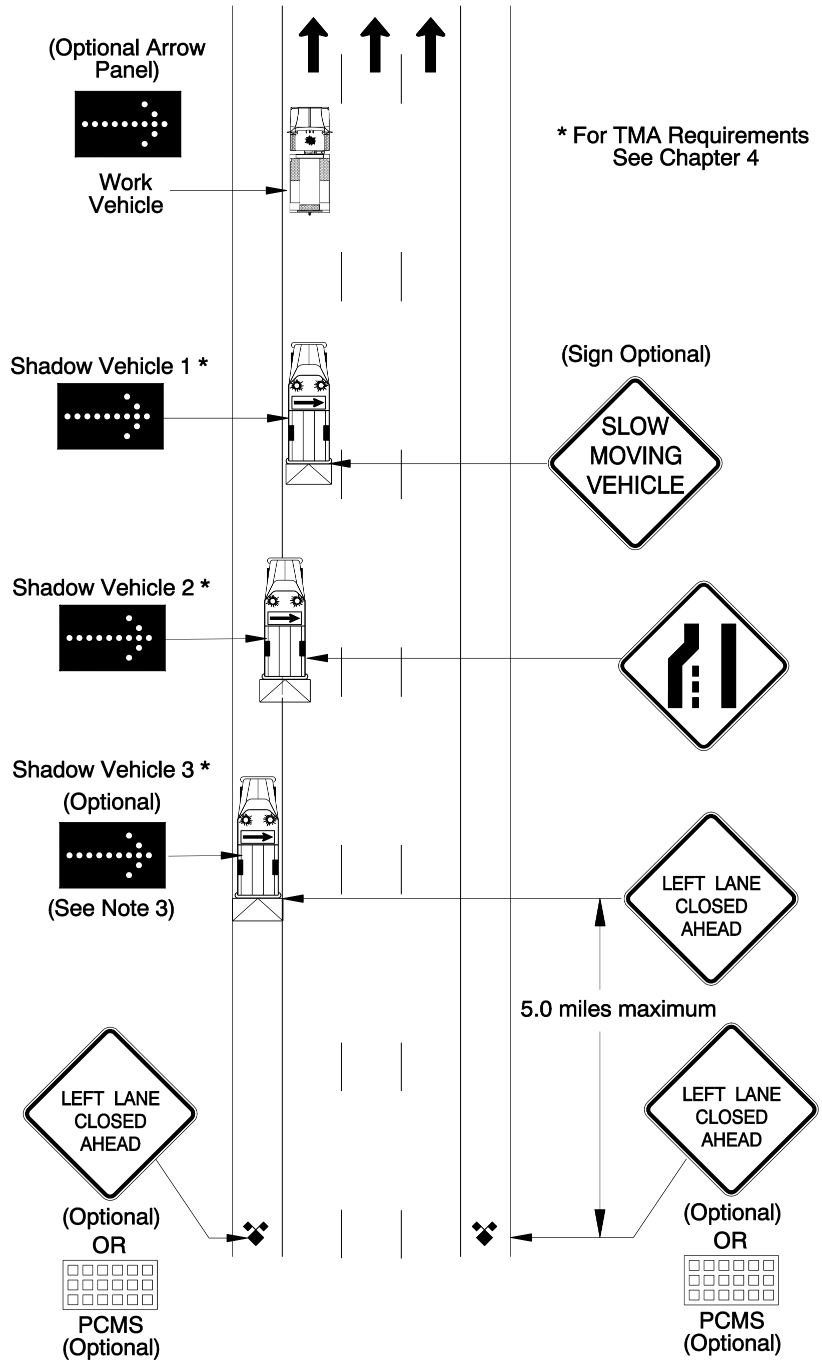
Diagram 700 covers mobile operations occupying one lane or the shoulder of a freeway. See Diagram 140 for line marking (striping) details on freeways.

1. Use truck-mounted flashing warning lights on work and shadow vehicles.
2. Moving operations that take place on the shoulder (i.e. brooming and spraying) where there is no encroachment and the operation does not stop, one shadow vehicle with an advance warning sign is required. An additional sign or PCMS are recommended if sight distance of 1000 feet cannot be maintained.
3. Two shadow vehicles are required (three recommended) when work is in the travel lane. All shadow vehicles **shall** be equipped with an arrow board or PCMS. Any signs placed on the vehicle **shall** not obscure the arrow board or PCMS.
4. Each shadow vehicle should vary the trailing distance from the next shadow or work vehicle to provide adequate sight distance for traffic approaching from the rear.
5. Spacing between work vehicles and shadow vehicles should be controlled to deter road users from driving in between.
6. A truck-mounted attenuator (TMA) is **required** on the first vehicle exposed to approaching traffic in any part of a travel lane.
7. Shadow Vehicle 1 stays in the closed lane and covers the Work Vehicle. Shadow Vehicle 1 displays a truck-mounted “SLOW MOVING VEHICLE” (W21-4) sign, or equivalent, so the full message can be read by approaching traffic.
8. Shadow Vehicle 2 displays a truck-mounted “Lane Ends” (W4-2) symbol sign, or as an option, a LANE CLOSED AHEAD sign, so the full message can be read by approaching traffic.
9. Shadow Vehicle 3, when used, displays a truck-mounted sign such as, LEFT (RIGHT) LANE CLOSED AHEAD or other appropriate message so the full message can be read by oncoming traffic. When adequate shoulder width is not available, Shadow Vehicle 3 should stay as far onto the shoulder as practical and not protrude into traffic any further than necessary.
10. A truck or trailer-mounted PCMS or advanced warning sign placed at the start of the work section is optional. Panel one of the PCMS should give warning of the type of work with, “NEXT X MILES” on panel two.
11. Signs and PCMS should be moved during the day to keep them within five miles of the work.

For Striping Operations:

1. When striping the center lane(s) of a multi-lane (3 or more) freeway, place additional advance warning signage on the right shoulder.
2. The vehicle array and spacing are important factors in establishing a clean marking. Maintain spacing between vehicles to allow enough time for the marking material to set up adequately without smearing. However, the spacing should not encourage traffic to travel in the space between work vehicles. This may be the deciding factor in how many vehicles to use.

Freeway Mobile Operations Diagram 700



Freeway Shoulder Work Diagram 710

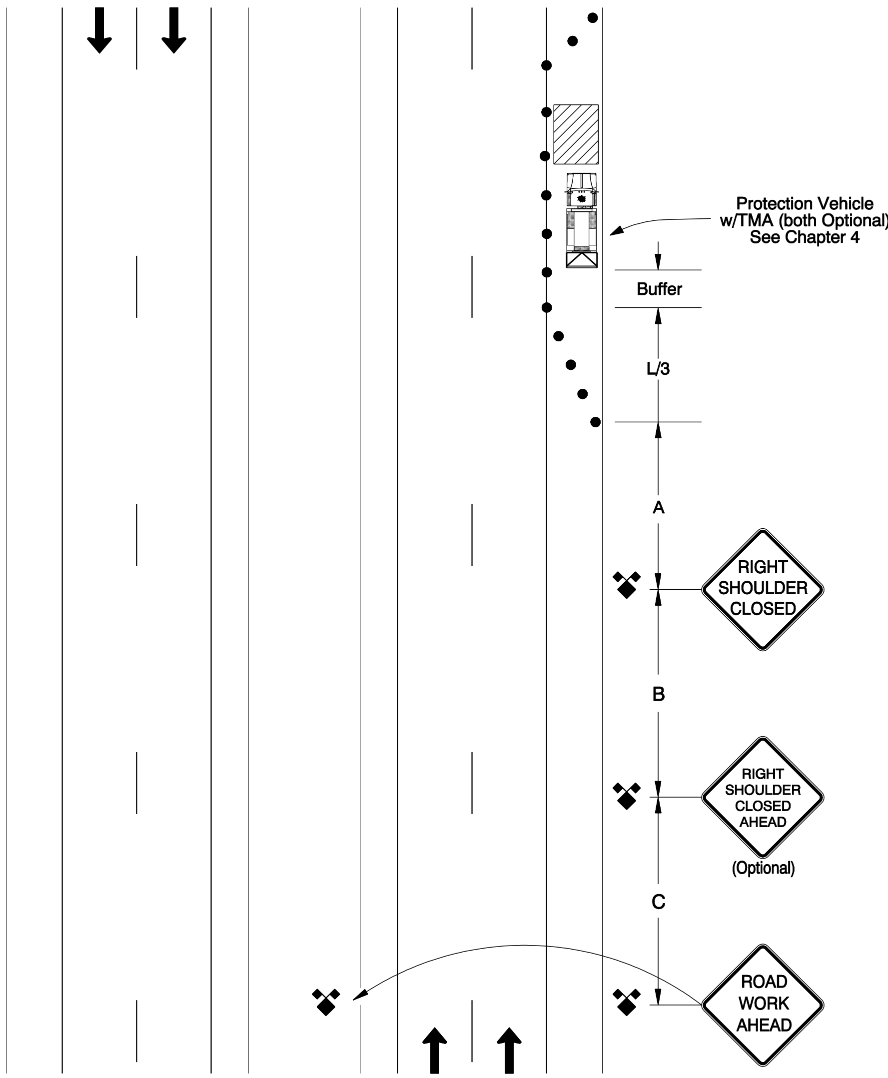
Diagram 710 covers stationary work with work operations and/or parked equipment on the shoulder and not encroaching on the travel lanes.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. For work that is in place less than 15 minutes and within 15 feet of the travel lane if more than 1000 feet of stopping sight distance is maintained, no signs or devices are needed.
4. The shoulder should be closed as shown with cones and a minimum of two signs for work lasting longer than 15 minutes and if the work is within 15 feet of the travel way.
5. If work is in the median, signs **shall** be on the left.
6. For work that moves frequently, advance warning signing may be placed to cover a distance that includes all work locations for a maximum 5 miles.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Freeway Shoulder Work — Diagram 710



Freeway Lane Closures — Diagram 720

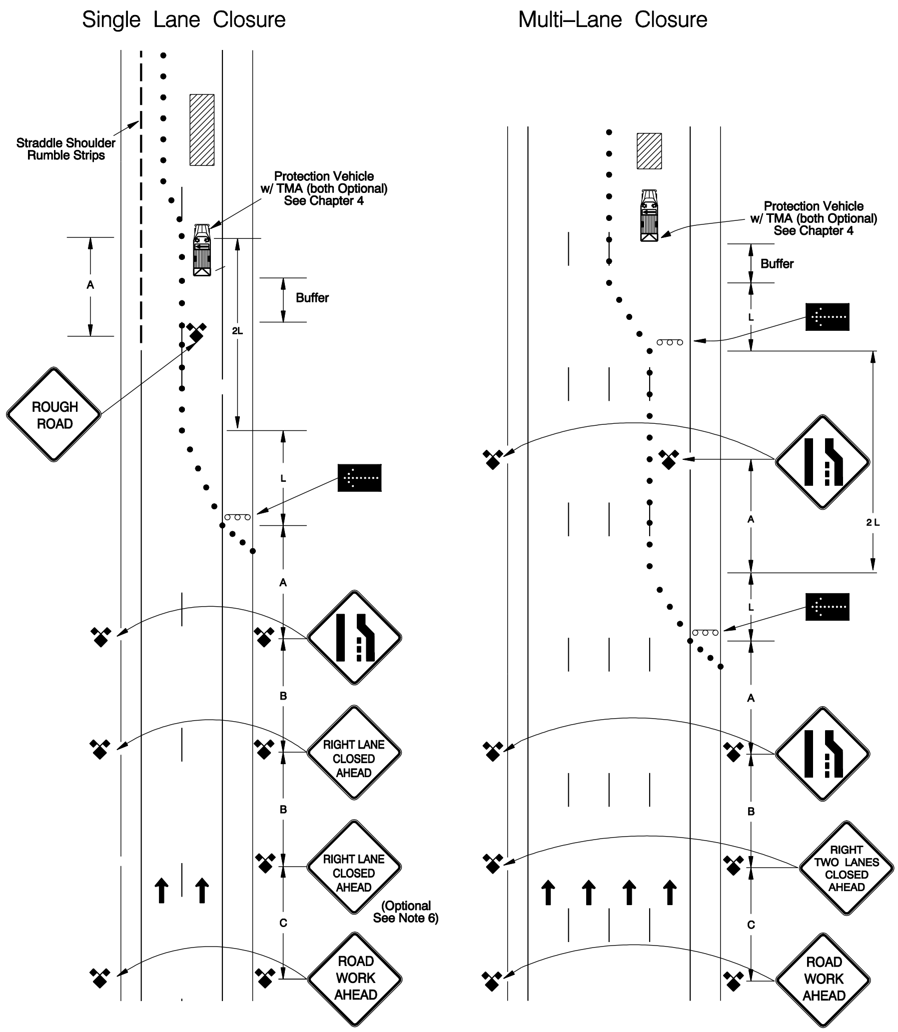
Diagram 720 covers lane closures on a freeway. It is recommended that lane closures only be in place during off peak hours. The traffic control should be placed during the lowest traffic volume period available.

1. A minimum of three advance warning signs is required.
2. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
3. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
4. An arrow panel or PCMS in arrow mode is required for each lane closure. Only one arrow panel per lane closure is allowed.
5. Placement of signs in a median is required for left lane closures or any time there is room for a truck to be parked on the left out of the travel lane.
6. When closing a right lane and it is not practical to install signs on the left shoulder, or there is inadequate room to park a truck on the left out of the travel lane:
    a. Install an additional RIGHT LANE CLOSED AHEAD sign 1500 feet in advance of or following the other RIGHT LANE CLOSED AHEAD sign, or
    b. Install a PCMS at least ½ mile before the initial advance warning sign. The PCMS should display the closure information (RIGHT, LEFT, LANE or 2 LANES) and the distance to the closure.
7. When an interior lane must be closed, close the adjacent lanes from the shoulder toward the work space. Start from the closest shoulder to minimize the number of closed lanes. When closing lanes from the median side extra attention should be given to advance warning and good sight exposure for the transition areas.
8. The length of lane closures should be adjusted and sign spacing may be lengthened to provide for safe transition movements in unusual situations such as crest or horizontal curves.
9. A downstream taper may be used at the end of the lane closure(s) to transition traffic back to normal lane use.
10. If traffic backs up beyond the initial advance warning signs, place additional appropriate advance warning signs.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
55	1000	1500	2640	250
60				285
65				325
70				365

Freeway Lane Closures **Diagram 720**



SUGGESTED MESSAGES

	PANEL 1	PANEL 2		
Right Lane Closure	TRAFFIC USE LEFT SHOULDER	ROUGH ROAD AHEAD	or	RIGHT LANE CLOSED
Left Lane Closure	TRAFFIC USE RT SHOULDER	ROUGH ROAD AHEAD		LEFT LANE CLOSED

Work Near an Exit Ramp — Diagram 730

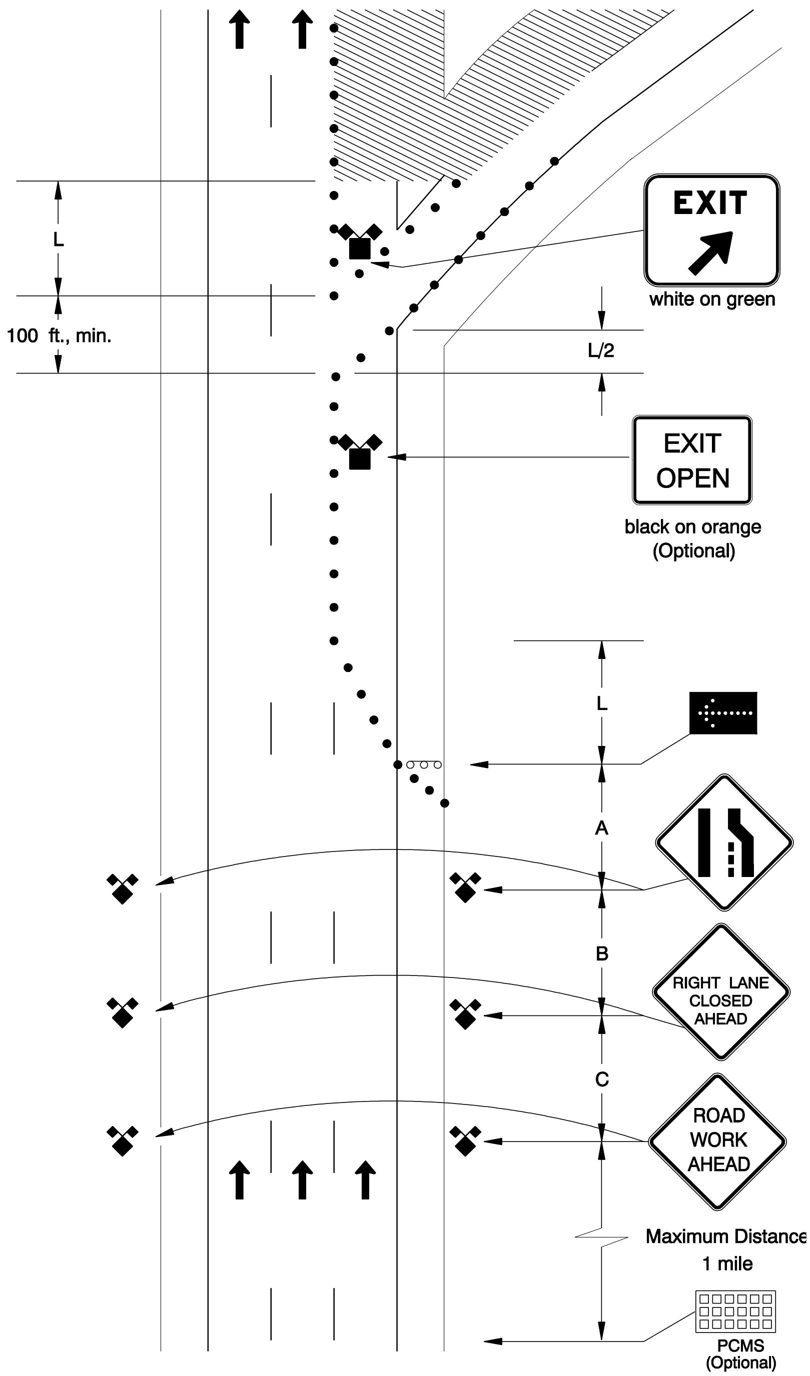
Diagram 730 covers work that affects the approach to an exit ramp. The drawing shows work in the gore area. Similar traffic control would be placed for work near the entry area and shoulder. Traffic control should make the exit path clear to approaching motorists.

1. Use enough cones, barricades or tubular markers to provide a clear, smooth exit for motorists.
2. A white-on-green EXIT/arrow (E5-1) sign is required if the exit point is moved or re-shaped and the permanent sign is obscured or directs traffic inappropriately. Cover or remove inappropriate permanent EXIT/arrow signs.
3. A black-on-orange "EXIT OPEN" (E5-2) sign with an arrow or a PCMS, trailer or truck-mounted, may be used to indicate the point of exit in advance.
4. For multi-lane exits, keep exiting vehicles to one lane until past the work space.
5. Park equipment and vehicles inside the coned off area.
6. When closing a right lane and there is not room to park a truck on the left out of the travel lane, install an additional RIGHT LANE CLOSED AHEAD sign 1500 feet in advance of or following the other RIGHT LANE CLOSED AHEAD sign. An alternative to the additional advance warning sign is to install a PCMS as described in Note 7, below.
7. A PCMS located at least ½ mile before the initial advance warning sign is recommended. The PCMS should give the closed lane information (RIGHT, LANE or 2 LANES) and the distance ahead of the closure.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Work Near an Exit Ramp **Diagram 730**



Work On an Exit Ramp — Diagram 740

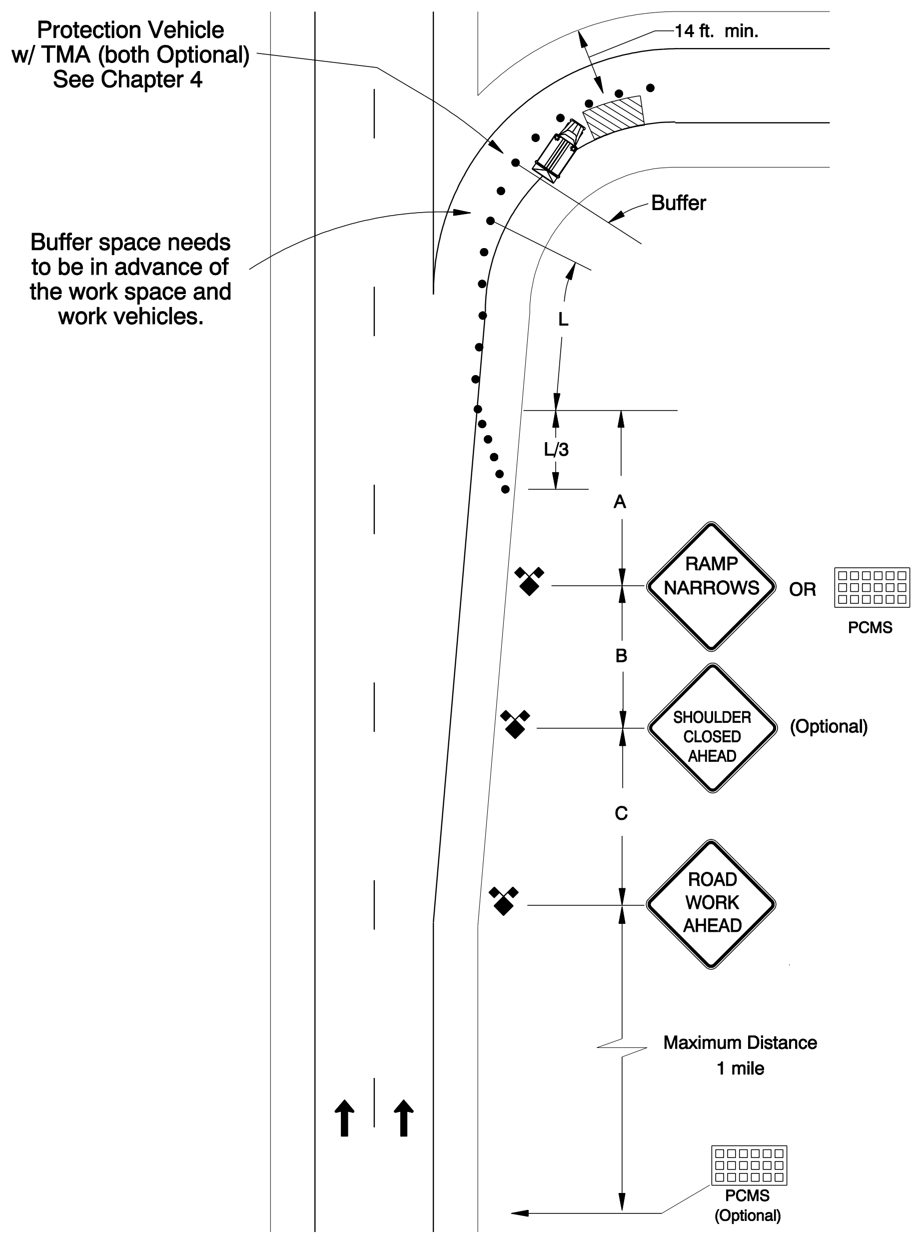
Diagram 740 covers work that encroaches on the travel lane of an exit ramp.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. Maintain a minimum 14 foot width for traffic. Truck off-tracking should be considered.
3. Use enough cones, drums or tubular markers to provide a clear, smooth exit for motorists.
4. Place SHOULDER CLOSED signs, as needed.
5. For multi-lane exits, merge exiting vehicles into one lane until past the work space.
6. Use Table 2-3 and the posted speed on mainline to determine the appropriate value for "L".

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Work on an Exit Ramp Diagram 740



Exit Ramp Closure — Diagram 750

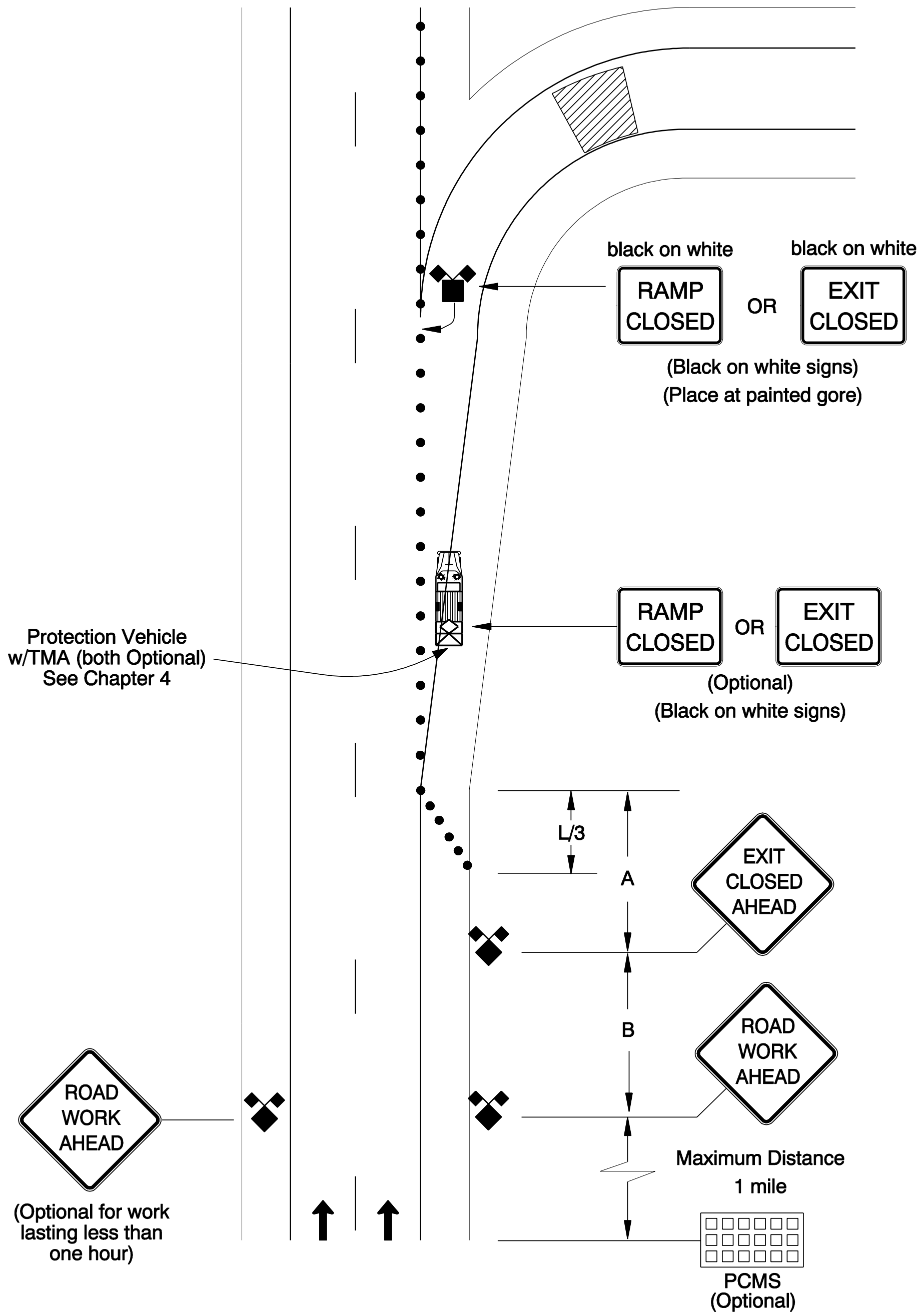
Diagram 750 covers full closure of an exit ramp.

1. Place cones across the exit.
2. Black-on-white EXIT CLOSED (E5-2a) or RAMP CLOSED (OR22-18) roll-up signs **shall** be placed in the closed travel lane on the ramp, as shown.
3. Placement of a sign on the left shoulder is required for ramp closures any time there is room for a truck to be parked on the left, out of the travel lane. Placement of the sign on the left shoulder is optional for work lasting less than one hour. When there is no room for a truck to be parked on the left, additional advance warning signs should be placed on the right side. There should be at least 1500 feet between each advance sign sequence.
4. Use truck-mounted flashing lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
5. For added visibility, truck-mounted arrow panels or PCMS in the caution mode may be used.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs			"Buffer" Space
	A	B	C	
55	1000	1500	2640	250
60				285
65				325
70				365

Exit Ramp Closure — Diagram 750



Work Near an Entrance Ramp — Diagram 760

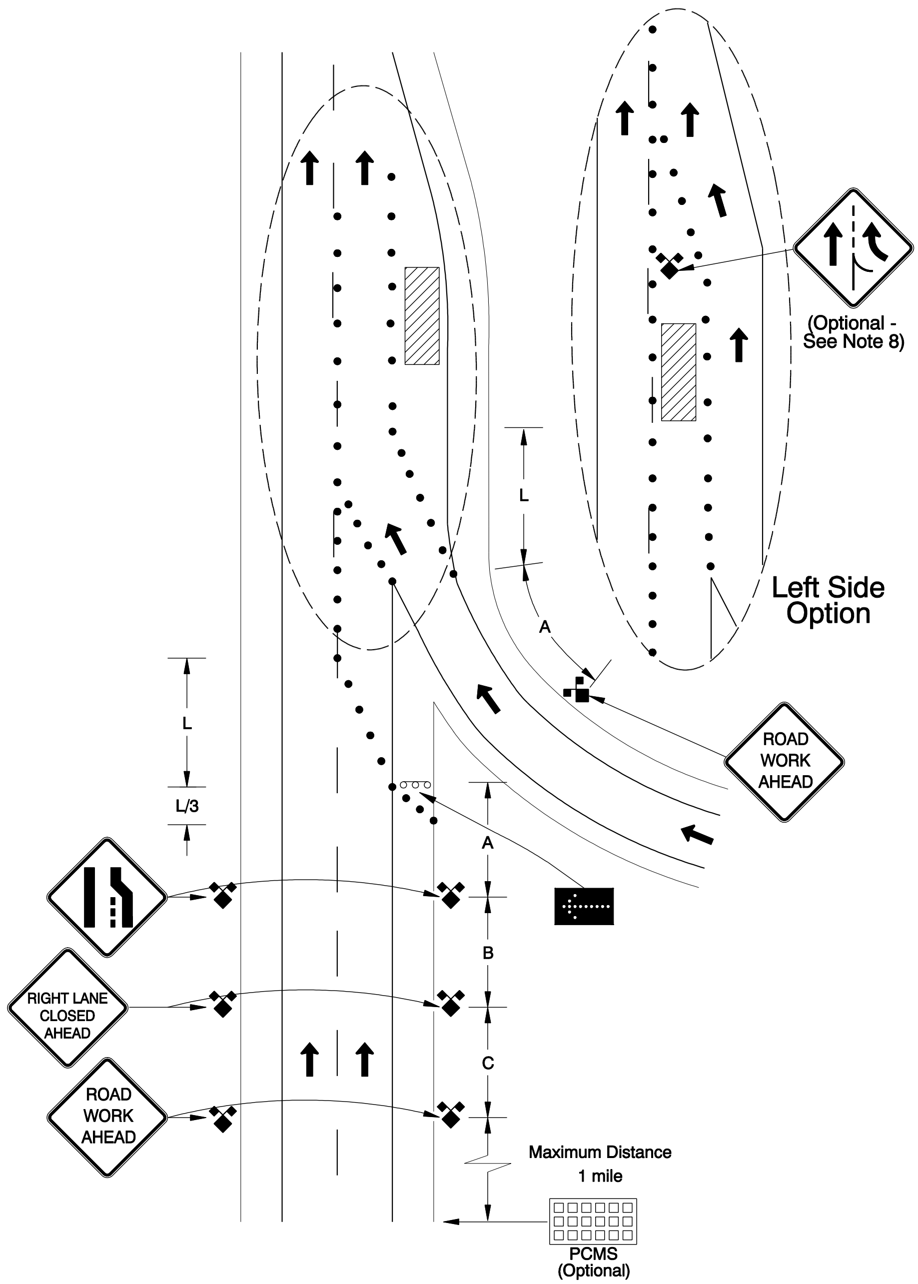
Diagram 760 covers work on or near the right-hand side of a freeway entrance ramp. Traffic on the freeway is moved out of the right lane to create an adequate merge area (refer to Diagram 720, Freeway Lane Closures). Ramp traffic is carried onto the freeway in the closed lane to merge with freeway traffic beyond the work space.

1. If the freeway merge area cannot be established by merging the freeway through lanes, consider closing the ramp.
2. If an exit ramp is in close proximity, consider closing the ramp. Weaving maneuvers, entering and exiting traffic occupying the same lane, may require a special analysis to determine if they can be accommodated safely.
3. If closing the ramp, advance signing of the closure will be needed on the cross road in all approach directions.
4. The ramp should be restricted to one lane. Flagging may be considered when work will sometimes use the entire width of the ramp. If flagging will impact traffic beyond the ramp, work and flagger advance signs **shall** be placed on the appropriate approaches.
5. The mainline merging taper with the arrow panel at its starting point should be located sufficiently in advance so that the arrow panel is not confusing to drivers on the entrance ramp. The mainline traffic merging from the lane closure should have the opportunity to stabilize before encountering the merging ramp traffic.
6. Placement of signs on the left shoulder is required for lane closures any time there is room for a truck to be parked on the left, out of the travel lane. When there is no room for a truck to be parked on the left, additional advance warning signs should be placed on the right side. There should be at least 1500 feet between each advance sign sequence.
7. A PCMS located at least ½ mile before the initial advance warning sign is recommended. The PCMS should give the closed lane information (RIGHT, LANE or 2 LANES) and the distance ahead of the closure.
8. If the “Added Lane” (W4-3) sign is not used, cones on the skip stripe **shall** extend a minimum of 300 feet past the gore point.

Freeway Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
55	1000	1500	2640	250
60				285
65				325
70				365

Work Near an Entrance Ramp — Diagram 760



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CHAPTER 6 – INCIDENT TRAFFIC CONTROL

A traffic incident can be any emergency, natural disaster, or other unplanned event that affects or impedes the normal flow of traffic. Incident Traffic Control takes priority over planned activities.

6.1 Incident Traffic Control

Traffic incidents can be emergencies that are road-related, such as a traffic crash or fuel spill, or non-road-related, such as a wildfire or flood.

Responders may use any available devices or equipment to guide traffic through the incident area until proper equipment is available, as long as the devices themselves do not create additional hazards. As soon as practical, MUTCD-compliant devices and equipment should be used.

Incident Response temporary signing may be made using retroreflective fluorescent coral (pink) sign sheeting.

The **goal of Incident Traffic Control** is the safe and effective control of traffic through the incident management area.

The **objectives** of the incident traffic control plan are to:

- Protect responders, victims and other personnel at the site,
- Provide reasonably safe traffic flow,
- Prevent secondary traffic crashes, and
- Manage the impact to the surrounding local road system.

A traffic **incident management area** is the section of highway where temporary traffic control devices are placed to delineate the incident area and keep traffic away from workers and equipment. The management area extends from the initial warning device (i.e. a sign or cone) to the last temporary traffic control device or to where vehicles return to their normal travel path beyond the incident.

A **staging area** for arrival and placement of emergency response vehicles may be included in the incident management area. It may be inside, in advance of, or beyond the activity area. It may also include space for emergency vehicles, incident command, and/or an enforcement vehicle (See Figure 6-1).

The **incident traffic control plan** should use the diagrams in Chapter 5 that are appropriate for the incident.

6.2 Incident Response Needs

Incident traffic control needs are classified into three categories based on their duration. The duration includes clean-up and any road or utility repairs that may continue the impact to traffic. The assessment of the incident duration should be made as soon as possible.

The duration categories should be used as a guideline for setting up traffic control for an incident. Other factors such as traffic volumes, speeds, road geometry or complexity of the response activities can also affect the traffic control needed.

The incident response duration categories are:

- **Major Incident** – more than two hours
- **Intermediate Incident** – 30 minutes to two hours
- **Minor Incident** – under 30 minutes

If the incident is anticipated to last more than 24 hours, a site specific traffic control layout plan should be implemented by the road jurisdiction.

Major Incidents involve closing all or part of a road facility for **more than two hours**.

Contact road jurisdictions whose systems are affected by the incident or may carry diverted traffic.

Temporary traffic control measures for Major Incidents may include:

- Advance warning signs
- Additional advance warning signs for extended traffic queues
- Signed detour route(s)
- Shoulder and/or lane closure devices and signing
- Channelization devices for the incident area
- Media contacts and frequent bulletins
- Flaggers and/or Uniformed Police officers, as needed

Intermediate Incidents affect travel lane operation from **30 minutes to two hours**. Full road closures may be needed for short periods during clearance or clean-up operations.

Temporary traffic control measures for Intermediate Incidents may include:

- Advance warning signs
- Additional advance warning signs for extended traffic queues

- Shoulder and/or lane closure devices and signing
- Channelization devices for the incident area
- Flaggers and/or Uniformed Police officers, as needed

Minor Incidents disrupts traffic operations typically for less **than 30 minutes**. On-scene responders typically include law enforcement, emergency medical services (EMS), road and transit authorities, and towing companies. Diversion of traffic into other lanes and lane closures are often not needed or are needed only briefly. Traffic control is usually conducted by on-scene responders.

6.3 Detours

Before establishing any detour, contact all appropriate road jurisdictions whose systems are affected by the incident or that may carry diverted traffic. Some degree of traffic engineering and enforcement is needed for an effective detour.

The local road jurisdiction and enforcement jurisdiction will:

- Determine the most appropriate detour route(s),
- Install detour route signing,
- Maintain the detour route, and
- Remove all devices and signing when the detour is no longer needed.

Consideration for large trucks **shall** be made if they are being routed onto a local highway or street network. Large trucks may need to follow a separate detour route.

Local road authorities should work together to choose the best detour route and determine if it can support the additional traffic, including large trucks, while the detour is in effect.

6.4 Safety Apparel

It is important that all personnel exposed to traffic be highly visible and easily recognizable as a person.

All personnel within the right of way who are exposed to traffic, with the exception of law enforcement, **shall** wear high-visibility safety apparel upon adoption of the 2009 MUTCD by ODOT. Safety apparel **shall** meet the requirements of the ANSI/ISEA *High Visibility Safety Apparel Guidelines*, or equivalent revisions, and labeled as ANSI 107-2004 or later for standard performance for Class 2 or 3 risk exposure.

6.5 Emergency Response Example

Figure 6-1 shows an example of modifying a typical application from this handbook for temporary traffic control for emergency response activity. Note that the layout and placement of all resources for incident response is determined by the incident command.

The layout has been adapted from the MUTCD typical application for closing one direction of a two-way, multi-lane road. The added elements include an incident command post, staging area and heavy engine protection vehicle.

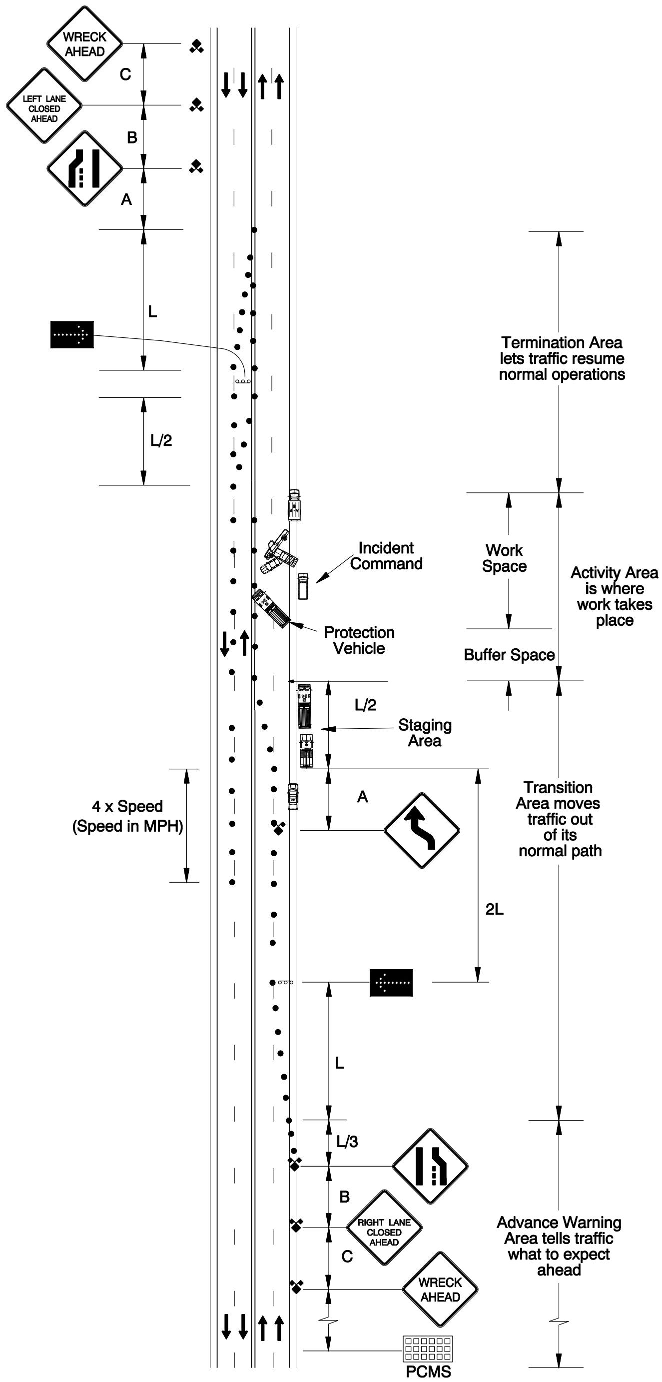
Figure 6-1 is not intended to be interpreted as a standard layout. Not all elements will be present, and there can be additional elements needed. For instance, the incident command post may be set up outside the incident work area, on a side road, ramp or other location that allows for best function. It can be advantageous to have more than one staging area so that incoming vehicles are positioned for easy and safe access where needed.

An additional PCMS, not shown, may be placed in advance of the work area in the opposite travel lanes.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	Spacing Between Signs B	Spacing Between Signs C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365
Freeways:				
55	1000	1500	2640	250
60				285
65				325
70				365

Figure 6-1: Emergency Response Example



APPENDIX A
GLOSSARY OF TERMS

ACTIVITY AREA – The area within a work zone that contains the buffer space and work space.

ADT – Average Daily Traffic. The volume or average number of vehicles per day (number shown typically represents both directions of travel combined).

ADVANCE FLAGGER – An additional flagger(s), stationed in advance of the primary flagger, responsible for warning approaching traffic that traffic is slowed or stopped ahead and that they need to slow down themselves. The advance flagger is preceded by additional flagger signing – see Advance Flagger detail. The advance flagger does not stop traffic, and uses the SLOW sign paddle only to get the approaching drivers' attention.

ADVANCE WARNING AREA – An essential portion of all work zones and may vary from a series of signs starting a mile or more in advance of the work space to a single sign or flashing lights on a work vehicle.

ARROW BOARDS – Lighted sign panels conforming to the requirements of the MUTCD with a matrix of lights capable of either flashing or sequential display of directional mode arrows or chevrons or non-directional (caution) mode. These devices are also referred to as (sequential) arrow panels.

AT GRADE CROSSING (MIXED AND CROSS TRAFFIC) – Railway right-of-way (ROW) over which other traffic moving in the same direction or the cross directions may pass.

AT GRADE CROSSING (CROSS TRAFFIC ONLY) – Railway right-of-way (ROW) over which no other traffic may pass, except to cross at grade-level crossings. A median strip right-of-way with grade-level crossing at intersection streets is included.

BEACON (TRUCK-MOUNTED) – A yellow rotating flashing light or strobe light mounted on a vehicle.

BARRICADES – A portable device having one to three horizontal reflective rails with appropriate markings, used to control traffic by closing, restricting, delineating or channelizing all or a portion of the highway.

BLOCKADE VEHICLE – A traffic control vehicle used to control the speed of following traffic in a rolling slowdown. A blockade vehicle is made highly visible with high-intensity rotating, flashing, oscillating, or strobe lights, an arrow board and sign or PCMS.

BUFFER SPACE – A section of clear road between the taper and the work space providing an extra margin of safety for both traffic and workers. The buffer space should be kept clear of vehicles, equipment, materials and personnel to provide a clear recovery area.

CATENARY – An overhead wire conductor and support system that supplies the 750-volt direct current (DC) power to the streetcar's current collecting pantograph.

CHASE VEHICLE – The vehicle that enters the road first in a rolling slowdown. The chase vehicle moves forward with traffic in front of the rolling blockade, positioning itself behind the last through vehicle before entering the work space. Seeing the chase vehicle go by, workers can move into the open travel lanes and begin working.

CLEAR ZONE – The unobstructed area provided beyond the edge of the travel lane(s) for the recovery of errant vehicles, including any shoulders or auxiliary lanes.

CONES – A conical-shaped channelization device with a weighted base. Cones are used to temporarily redirect traffic traveling through a work zone or incident response area. Cones can be used in tapers and along tangent areas to separate traffic from a work space and guide traffic along a desired path.

DEVICE SPACING – The longitudinal distances between channelization devices (cones, tubular markers, drums) in a taper or along tangent sections of the work and buffer spaces.

DRUMS (BARRELS) – Lightweight, flexible, and deformable barrel-shape channelization devices used to temporarily redirect traffic traveling through a work zone or incident response area. Drums can be used in tapers and along tangent areas to separate traffic from a work space and guide traffic along a desired path.

EDGE OF TRAVELED WAY – The traveled way is the portion of the highway for the movement of vehicles not including shoulders. The edge of traveled way is often delineated by the "fog line" or edge of pavement.

EXTENDED TRAFFIC QUEUE – When the line of vehicles (queue) stopped at the beginning of a work zone extend beyond the initial ROAD WORK AHEAD sign. To prevent rear-end collisions at the end of the queue, additional advance warning signs are installed further in advance of the work zone (see Extended Traffic Queue detail).

FLAGGER – A trained and qualified person responsible for controlling the flow of traffic through a work zone. A flagger **shall** be trained as outlined under Flagger Training Requirements in Chapter 3 of this handbook and **shall** be able to show proof of such training.

FLAGGER TAPER – A series of channelization devices (i.e. cones, tubular markers) placed at an angle to the highway at the flagger station to make the flagger station more visible. Taper is 50 – 100 ft and consists of 4 – 6 devices.

FOG LINE – A pavement marking line that delineates the edge of the traveled way. Also referred to as the "edge line."

FREEWAY – A high-speed, access-controlled roadway where access points to the roadway are facilitated through grade-separated interchanges. Having the highest level of importance in Oregon's infrastructure, a higher level of traffic control should be considered when conducting work on freeways.

GRADE CROSSING – A location where a public highway, road, street, or private roadway, including associated sidewalks and pathways, crosses one or more railroad tracks at grade.

HIGH SPEED – A designated (posted) speed of 45 mph or above.

HIGH VOLUME – While defined by each Agency, typically identified as average daily traffic (ADT) volumes greater than 2000 vehicles per day.

LOW SPEED – A designated (posted) speed of 40 mph or below.

LOW VOLUME – An average daily traffic volume (ADT) of 400 vehicles per day or less.

MAY – Indicates an allowed (optional) alternative to a mandatory condition or action.

MOBILE OPERATION – Work activities where work equipment is continuously moving along the road at an average speed of 3 mph or more.

MULTI-LANE ROAD – A road with at least two lanes in at least one direction.

MUTCD – The national *Manual on Uniform Traffic Control Devices* published by the Federal Highway Administration and adopted as the statewide standard for traffic control devices by OAR 734-20-005 under the authority of ORS 810.200.

PILOT CAR – A four-wheeled vehicle no smaller than a compact pickup, identified by a 36” x 18” PILOT CAR FOLLOW ME (sign mounted on the rear) and equipped with a beacon and two-way radios or other communication devices. The communication devices **shall** have a range suitable for the length and terrain of the project. A vehicle-mounted PCMS may be used in lieu of the 36” x 18” rigid sign.

PORTABLE CHANGEABLE MESSAGE SIGN (PCMS) – Includes a portable message sign panel capable of displaying more than one message. They **shall** conform to all requirements in the MUTCD. For use on state highways, a PCMS **shall** be listed on the ODOT Qualified Products List.

PORTABLE TEMPORARY SIGNAL – A portable temporary signal is a self-contained, self-powered green-yellow-red traffic signal used for controlling traffic through a short term traffic control section. Portable signals used on state highways **shall** be on the ODOT Qualified Products List or Conditional Use List and have State Traffic Engineer approval.

PROTECTION VEHICLE – A vehicle strategically placed to protect the workers and work activity. The protection vehicle may be in a stationary work zone or be the vehicle immediately behind the work vehicle(s) in an array of mobile work vehicles. The protection vehicle is placed after the buffer space and sufficiently in advance of the work space protected to allow for run-out if hit but not so far in advance that traffic can enter the space before the work space.

RAILWAY RIGHT OF WAY – The horizontal and vertical space occupied by the rail system; includes track, ballast, rail systems, platforms and overhead catenary system. Horizontal area is typically measured from curb to curb or fence line to fence line. This area may be shared by a variety of vehicles or may be an exclusive rail corridor.

ROAD – Every public way, state highway, county road, or city street.

RUN-OUT – The distance in front of a protection vehicle it is likely to move if hit. The length of the space between a protection vehicle and the work activity should be at least equal to the run-out. For TMA-equipped protection vehicles, follow the manufacturer’s recommendations in determining the proper run-out distance.

SHADOW VEHICLE – A trailing vehicle used as a warning and traffic control vehicle in a mobile work zone. Shadow vehicles provide both the advance warning area and any lane or shoulder closures for a mobile work zone.

SHALL – Indicates a mandatory condition or action.

SHORT DURATION WORK – Short duration work that involves short stops of up to one hour such as litter cleanup or pothole patching.

SHOULD – A strong recommendation for an action or practice, and is the standard treatment under normal conditions.

SHOULDER – That portion of a road adjoining but outside of the normal travel lanes.

SIGHT DISTANCE – The length of unobstructed roadway ahead that is visible to the driver. Sight distance may be obstructed by the road surface (hills or dips) or some feature beyond the shoulder (trees or vegetation).

SPEED (POSTED SPEED) – The designated (posted) speed as shown on roadside signs or, if no signs, the statutory speed set in Oregon Revised Statutes.

SPOTTER – A worker who takes a position near the work with a clear view of the work space and the road whose primary duty is to warn the other worker(s) of approaching traffic. A spotter is not a flagger and does not control traffic.

TAPER – A series of channelization devices (i.e. cones, tubular markers, drums) placed at an angle to the traffic flow to slowly guide traffic out of its normal path. Commonly used to close a travel lane or shoulder, or to shift traffic from one portion of the roadway to another.

TERMINATION AREA – A short distance after the work space that allows traffic to clear the work space and return to normal operation.

TRAFFIC CONTROL DEVICE (TCD) – All signs, signals, markings, and other devices use to regulate, warn, or guide traffic.

TRANSITION AREA – Where traffic is moved out of normal traffic paths and into a temporary path around the work space. It commonly contains channelization tapers used to shift or close the travel lane(s) or to close the shoulder.

TRUCK-MOUNTED ATTENUATORS (TMA) – Truck-mounted attenuators (TMAs) are energy absorbing devices attached to the rear of a heavy vehicle. They are used on equipment located in advance of workers or work equipment to reduce the severity of rear-end crashes from errant vehicles. A TMA may be used on a work vehicle, protection vehicle or shadow vehicle.

TUBULAR MARKERS – Tubular markers are channelization devices that are cylindrical in shape with a weighted base.

WORK COMMENCEMENT – The start of work activity in or along the road.

WORK SPACE – That portion of the work zone which contains the work activity, equipment, materials and workers.

WORK VEHICLE – Any vehicle in the work area or work zone (mobile operations) conducting work. Examples include sweepers, rollers, paver, striping truck, one-ton utility truck, and supervisor’s pickup truck.

WORK ZONE – An area identified by advance warning where road construction, repair, utility or maintenance work is being done by workers on or adjacent to a highway, regardless of whether or not workers are present. The work zone begins with the initial advance warning sign (e.g. ROAD WORK AHEAD) and ends at the END ROAD WORK sign; or the last TCD, or where traffic resumes normal operations.

APPENDIX B
WORK ZONE TRAFFIC CONTROL PLANS

These pages are provided as an example of the format for Work Zone Traffic Control Plans. They can be copied and enlarged as needed. An enlargement of 150% will result in an 8 ½ x 11 inch letter-size page.

ODOT'S
Short Term Traffic Control Plan

Task Information

Task Description:	Date(s) / / - / /	Time: Start: Finish:
	Authorized Signature:	Hwy #: MP to

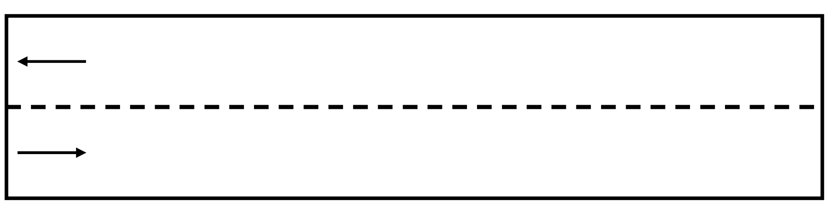
Equipment/Safety Considerations/Personnel Required

Equipment	No.	Safety & Roadway Considerations		Personnel (Names)
Loaders		ADT		
Sweepers		Site Distance		
Graders		Posted Speed		
10 Yd Trucks		Communication Plan		
5 Yd Trucks				
Belly Dumps		Evacuation Route		
Water Trucks				
Grinders		Emergency Vehicles		
Backhoes		PPE		
Mobile Crane		Media Notified		
Flatbed Trucks		Equipment Parking		
Other:		Other:		

Use the Table and Diagrams below to design your temporary traffic control plan. These plans should be maintained for a minimum of 1 year from the date of the maintenance operation.

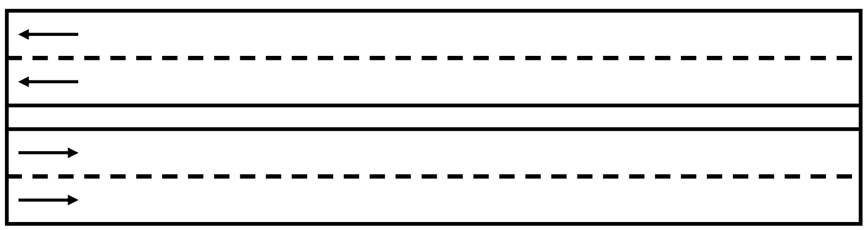
Two Lane, 2-way Road Diagram – Page # from Temporary Traffic Control Handbook (______)

Type of Signs Required	No.	Type of Signs Required	No.	Other Traffic Control	No.
Flagger Ahead		Transition		Cones	
Be Prepared to Stop		Road Narrows		Signs	
Road Work Ahead		Right Lane Ends		Shadow Vehicles	
End Road Work		Left Lane Ends		Flaggers	
Shoulder Work		Pilot Car Follow Me		Arrow Boards	
Survey Crew Ahead		One Lane Ahead		Variable Message Signs	
Road Closed		Road Machinery Ahead		Barricades	
Right Lane Closed		Bridge Work Ahead		Portable Lighting	
Left Lane Closed		Other:		Pilot Vehicle	
Comments or revisions:					



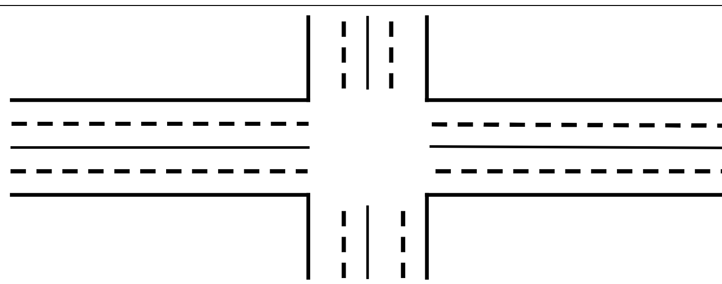
Freeway/Multi-Lane, Road Diagram – Pg. # from Temporary Traffic Control Handbook (______)

Type of Signs Required	No.	Type of Signs Required	No.	Other Traffic Control	No.
Flagger Ahead		Transition		Cones	
Be Prepared to Stop		Road Narrows		Signs	
Road Work Ahead		Right Lane Ends		Shadow Vehicles	
End Road Work		Left Lane Ends		Flaggers	
Shoulder Work		Pilot Car Follow Me		Arrow Boards	
Survey Crew Ahead		One Lane Ahead		Variable Message Signs	
Road Closed		Road Machinery Ahead		Barricades	
Right Lane Closed		Other:		Portable Lighting	
Left Lane Closed		Other:		Other:	
Comments or revisions:					



Intersection Road Diagram – Page # from Temporary Traffic Control Handbook (______)

Type of Signs Required	No.	Type of Signs Required	No.	Other Traffic Control	No.
Flagger Ahead		Transition		Cones	
Be Prepared to Stop		Road Narrows		Signs	
Road Work Ahead		Right Lane Ends		Shadow Vehicles	
End Road Work		Left Lane Ends		Flaggers	
Shoulder Work		Pilot Car Follow Me		Arrow Boards	
Survey Crew Ahead		One Lane Ahead		Variable Message Signs	
Road Closed		Road Machinery Ahead		Barricades	
Right Lane Closed		Other:		Portable Lighting	
Left Lane Closed		Other:		Other:	
Comments or revisions:					



APPENDIX C
CHECK LIST FOR WORK ZONE LAYOUT & OPERATION

Use the following check list for good practices in work zone layout and operations:

- ☐ **Each operation requires a work zone traffic control plan.**
  - ✓ Determine and note the relevant diagram(s) in the handbook.
  - ✓ Note any special or unique traffic control needs and revisions to a diagram to accommodate the work and site conditions.
  - ✓ Consult with a qualified person in your agency and/or the permitting agency for any changes not discussed in this handbook.
  - ✓ All changes **shall** meet the standards and guidelines of this handbook and the MUTCD.
- ☐ **Stay out of the travel lanes as much as possible.**
  - ✓ Maintain normal travel paths as much as possible while allowing for work space safety.
  - ✓ The traffic control should be designed to move traffic past the area smoothly.
- ☐ **Do not tell drivers to break the law.**
  - ✓ This means being aware of regulatory signs, pavement markings and traffic signals that will conflict with your traffic control.
  - ✓ Be sure you have road jurisdiction permission to override and cover any regulatory traffic movement signs and signals.
  - ✓ For work that is in place less than an hour, emphasize your work activity by using a combination of highly visible signs, flashing/rotating beacons or light bar, arrow board or truck-mounted PCMS.
- ☐ **Do not let traffic stop on or across the tracks or between the crossing markings and the tracks at a railroad crossing.**
  - ✓ Extend the work space if it is close to the tracks to include the railroad crossing inside your work zone.
  - ✓ If the work site is away from the crossing but traffic queues may reach across the tracks, provide flaggers at the railroad crossing to prevent vehicles from stopping on or too near the tracks.

- ☐ **Always give advance warning.**
  - ✓ Use advance warning shown in this handbook for the type of work.
  - ✓ Be sure that approaching drivers can see the work space in plenty of time to be able to pass by safely. Adjust the spacing of signs and tapers as necessary.
  - ✓ Maintain a consistent distance between warning signs. If one distance needs to be adjusted, adjust all the distances similarly.
- ☐ **Delineate the work space and travel paths clearly with cones, tubes, drums or barricades. Driver confusion may result in crashes.**
  - ✓ Chevrons, arrows, or flashers on cones may be added if needed.
  - ✓ Too many devices can make curved section travel path hard.
  - ✓ Drive through the work zone and then adjust if necessary.
- ☐ **Place signs where they will do their job properly.**
  - ✓ Keep at least the minimum spacing between signs from the sign spacing table.
  - ✓ Keep sign spacing consistent for each approach to the work site.
  - ✓ Maintain good sight distances:
    - o for each sign,
    - o for lane shifts and changes, and
    - o for equipment and workers in the road or on the immediate shoulder. Use at least three cones placed near the work if the work is not visible from the nearest advance warning sign.
  - ✓ Make sure the signs are placed in the driver's line of sight and within the headlight beams if headlights are needed.
  - ✓ Make sure signs are not blocked by parked vehicles, trees, utility poles or other roadside features. Adjust the sign spacing if necessary.

- ☐ **Remove signs, cones and drums as soon as they are no longer appropriate.**
  - ✓ Keep in place only what is needed.
  - ✓ Inappropriate signs and devices can confuse drivers or lead them into your work space.
- ☐ **Ensure that all workers are wearing high visibility clothing appropriate for the work.**
  - ✓ Safety apparel **shall** be clean and in good condition.
  - ✓ Safety apparel **shall** be worn and function properly so that the reflective area has 360° visibility.
  - ✓ The type of clothing **shall** meet the minimum requirements for the work as determined by the employer and/or permit or contract.
- ☐ **Leave a safety clearance area or buffer.**
  - ✓ Maintain the buffer area clear of work vehicles, equipment, materials and activity.
  - ✓ Leave as close to 5 feet or more as practical of clearance between your work space and the line of cones used to mark the edge of the travel lane.
  - ✓ Allow for a leading buffer on the near traffic approach to the work space if possible. Consider closing off parking spaces if there is on-street parking.
- ☐ **For worker protection, you may position a work vehicle in an area closed to traffic and in front of the work.**
  - ✓ Leave enough buffer space to the work activity to allow for run-out if the vehicle is hit.
  - ✓ Turn the vehicle wheels so that if it's hit, the vehicle will move away from both traffic and the work activity.
- ☐ **Accommodate safe and convenient access for pedestrians and bicyclists including pedestrians with disabilities.**
  - ✓ Consider any pedestrian and cyclist needs including accessibility when setting up the traffic control for a work space.

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INDEX

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PGE/324

Traffic Control Plan

Exhibit 324 contains protected information

and is subject to

General Protective Order 23-132

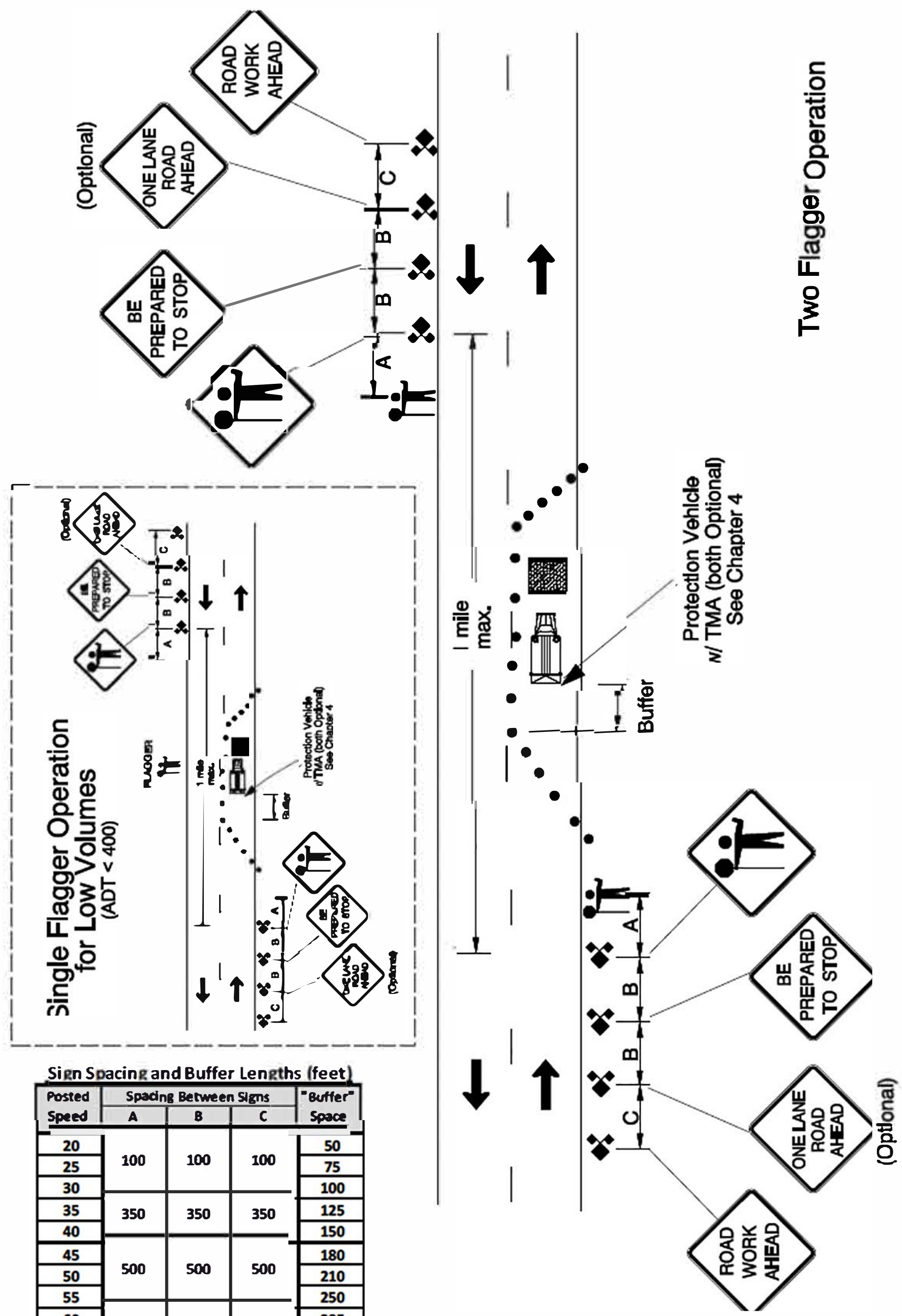
(Redacted Copy)

Stationary Lane Closure with Flagging — Diagram 320

Diagram 320 covers total closure of one lane of a two-lane, two-way roadway. See the detail inset for the layout if using a single flagger to control both directions of traffic on low volume roads (less than 400 ADT) with good sight distance as discussed below.

1. Use truck-mounted flashing warning lights on work and protection vehicles. See Section 4.3 – Lights and Lighted Signs for exceptions.
2. For added visibility, a truck-mounted arrow board or PCMS in caution mode may be used.
3. Flaggers at each approach are required if any of the following conditions exist:
   a. Night Operations.
   b. Work space is over 200 feet in length.
   c. Sight distance is less than 750 feet from each approach through the lane closure.
   d. Traffic volumes are greater than 400 ADT.
4. The length between the Flagger Ahead signs **shall** not exceed one mile. Use Diagram 340 – Lane Closure with Pilot Car if exceeding one mile.
5. Cones should be used to outline the work space when curves or other roadway alignments prevent clear direction for the motorists to pass the work space safely.
6. Cones along the work space are recommended when posted speeds are 45 mph or greater, when working under heavy traffic or when travel lanes are narrower than 11 feet.
7. Extended queue signing (see Diagram 5-4) should be used when traffic queues extend beyond the initial advance warning sign.
8. When flagging near an intersection, the “Flagger Ahead” (CW23-2) sign should be visible to traffic entering from any side road. Additional advance warning and Flagger Ahead symbol signs may be placed on the side road(s).
9. Sign set-up and flagger placement shown may be used for intermittent full road closures of 20 minutes or less.
10. The “ONE LANE ROAD AHEAD” (W20-4) sign is optional and should be considered on high volume or high speed roads, or when extended queues are expected.

Stationary Lane Closure with Flagging — Diagram 320



Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure at Intersection with Flagging — Diagram 620

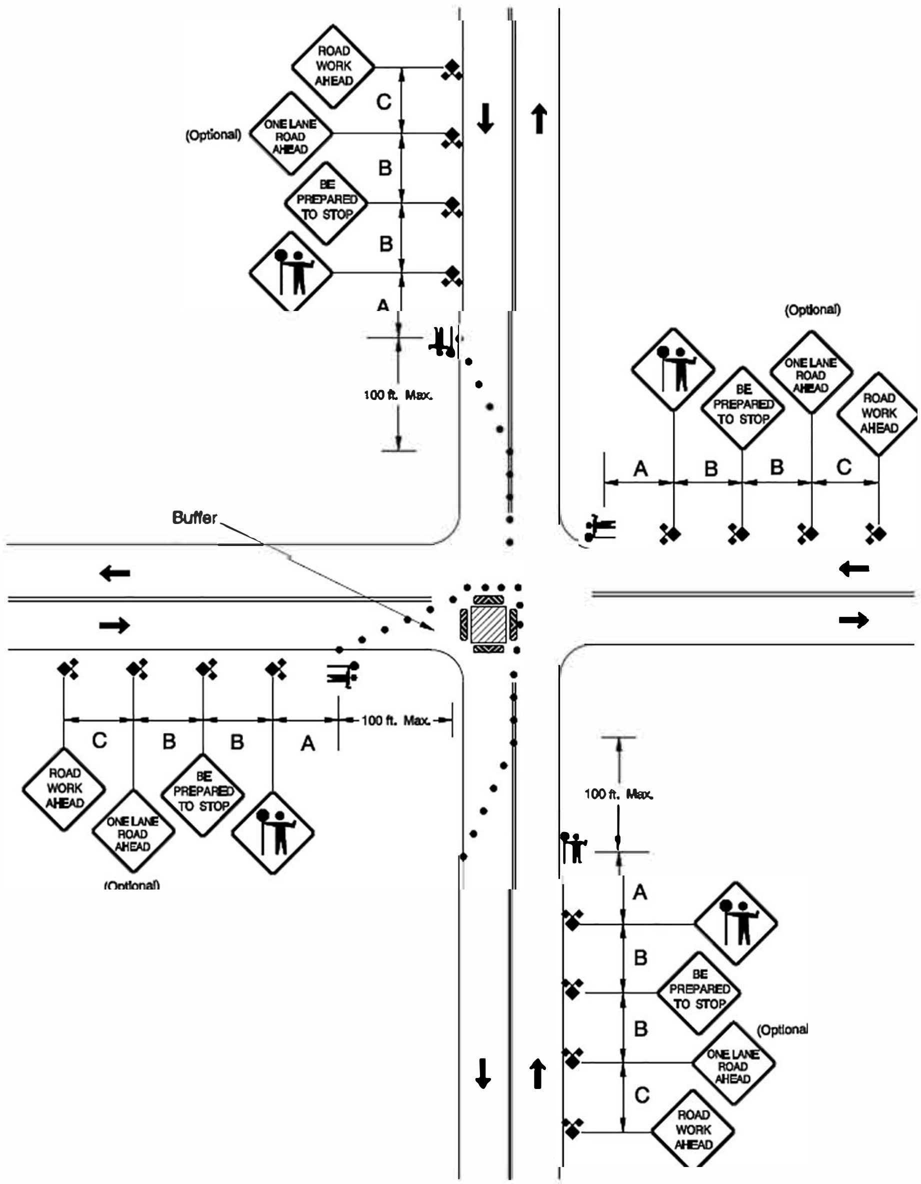
Diagram 620 covers work within an intersection when normal traffic control must be interrupted. Work vehicles may or may not be in the work space.

1. During flagging, traffic signals **shall** be turned off. Contact the road jurisdiction for approval and assistance (see Chapter 3).
2. For multi-lane facilities, traffic approaching the intersection **shall** be reduced to a single lane on each approach. See Chapter 3 for information on flagging through intersections.
3. There should be one flagger for each approach. One flagger may control two adjacent approaches if sight distance, low volumes on side roads, and flagger position allows for safe operation and clear direction to motorists. For low traffic volume intersections (fewer than 400 entering vehicles per day), one flagger may be used.
4. The “ONE LANE ROAD AHEAD” (W20-4) sign is optional and should be considered on high volume or high speed roads, or when extended queues may be expected.

Sign Spacing and Buffer Lengths (feet)

Posted Speed	Spacing Between Signs A	B	C	"Buffer" Space
20	100	100	100	50
25				75
30				100
35	350	350	350	125
40				150
45	500	500	500	180
50				210
55				250
60	700	700	700	285
65				325
70				365

Lane Closure at Intersection with Flagging Diagram 620



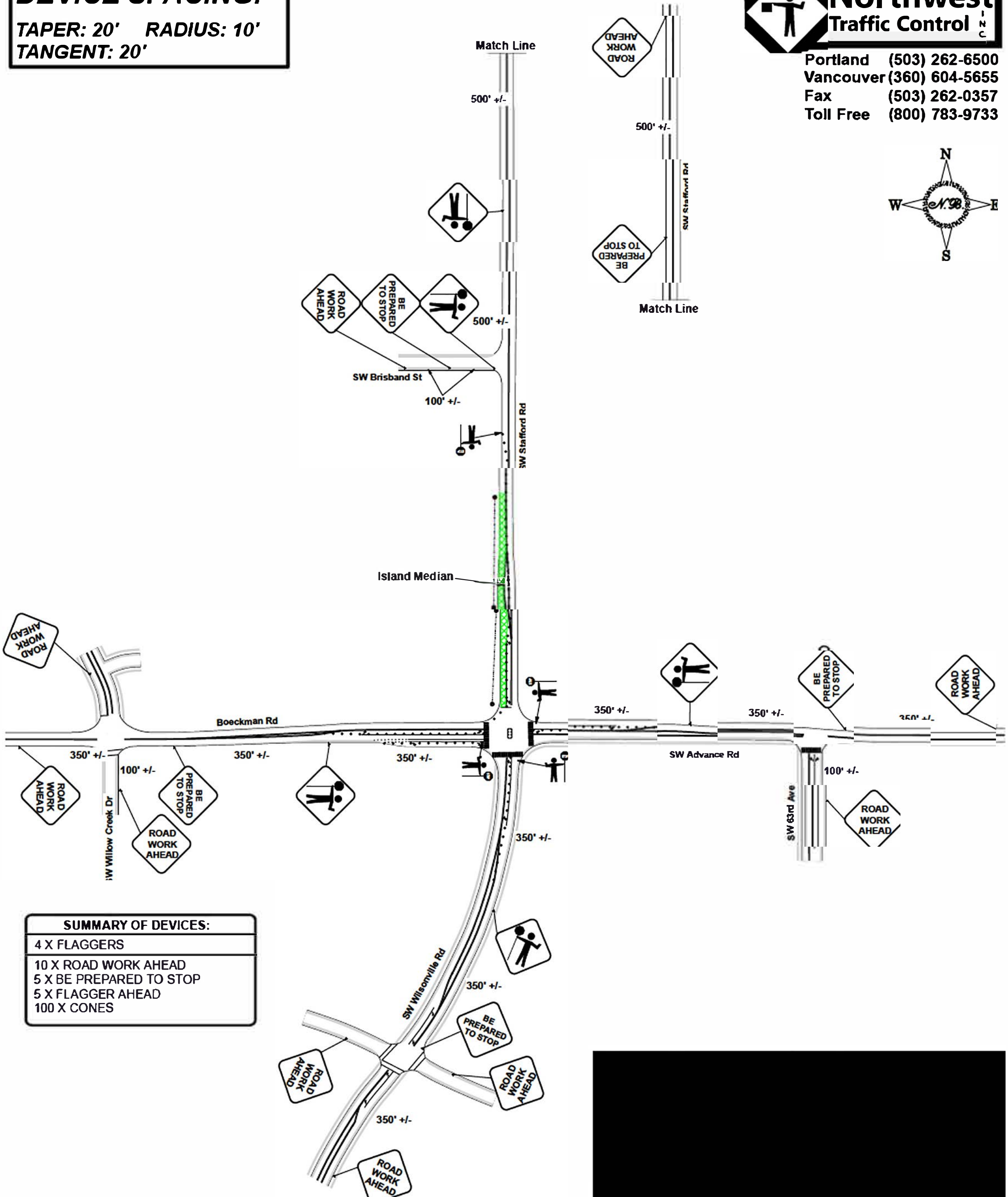
REDACTED

DEVICE SPACING:

TAPER: 20' RADIUS: 10'
TANGENT: 20'

Northwest Traffic Control INC

Portland	(503) 262-6500
Vancouver	(360) 604-5655
Fax	(503) 262-0357
Toll Free	(800) 783-9733



SUMMARY OF DEVICES:
4 X FLAGGERS
10 X ROAD WORK AHEAD 5 X BE PREPARED TO STOP 5 X FLAGGER AHEAD 100 X CONES

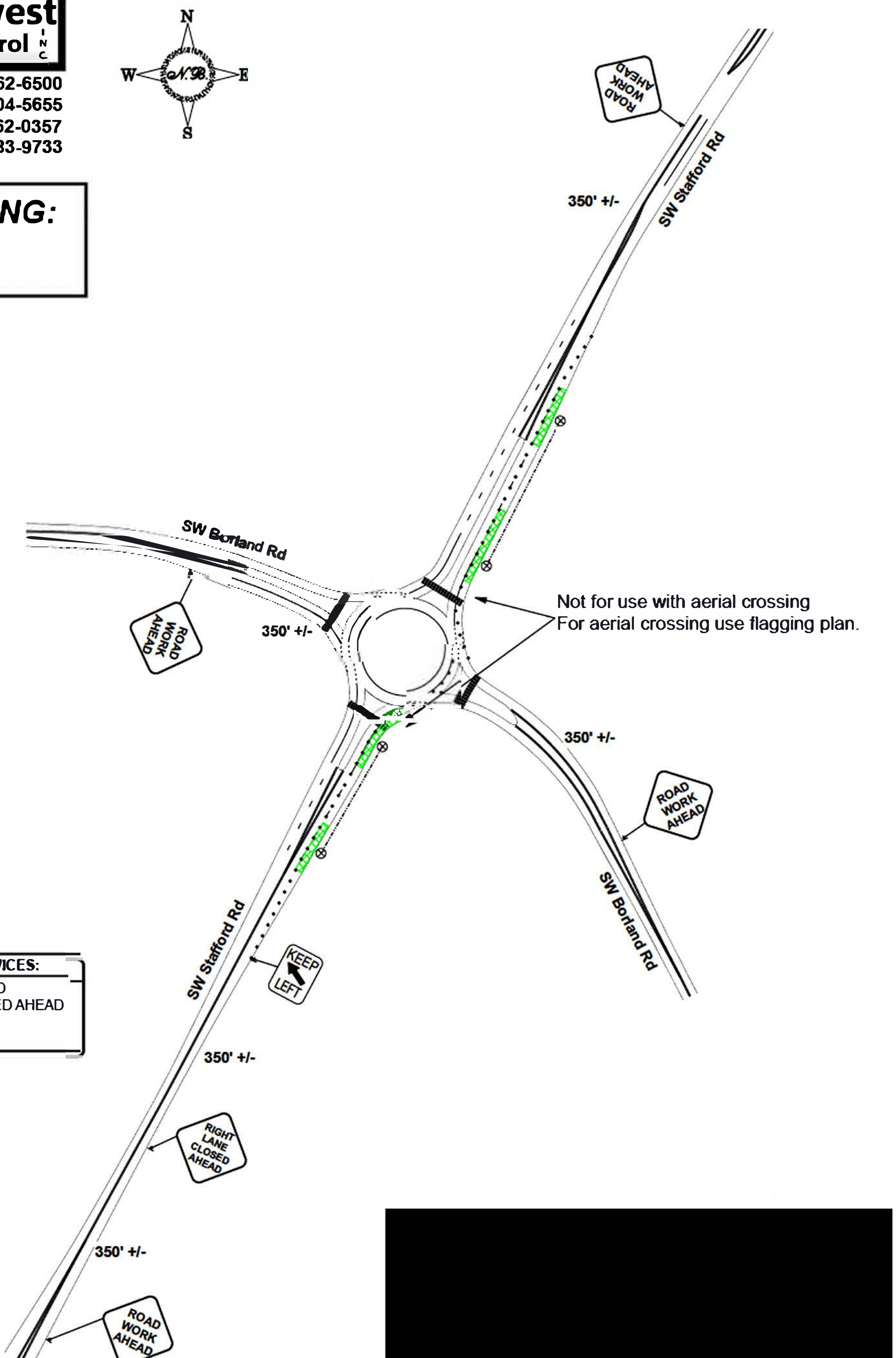
All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

[redacted]

Northwest Traffic Control INC
Portland (503) 262-6500
Vancouver (360) 604-5655
Fax (503) 262-0357
Toll Free (800) 783-9733

DEVICE SPACING:

TAPER: 20'
TANGENT: 20'



SUMMARY OF DEVICES:
4 X ROAD WORK AHEAD
1 X RIGHT LANE CLOSED AHEAD
1 X KEEP LEFT
65 X CONES

All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

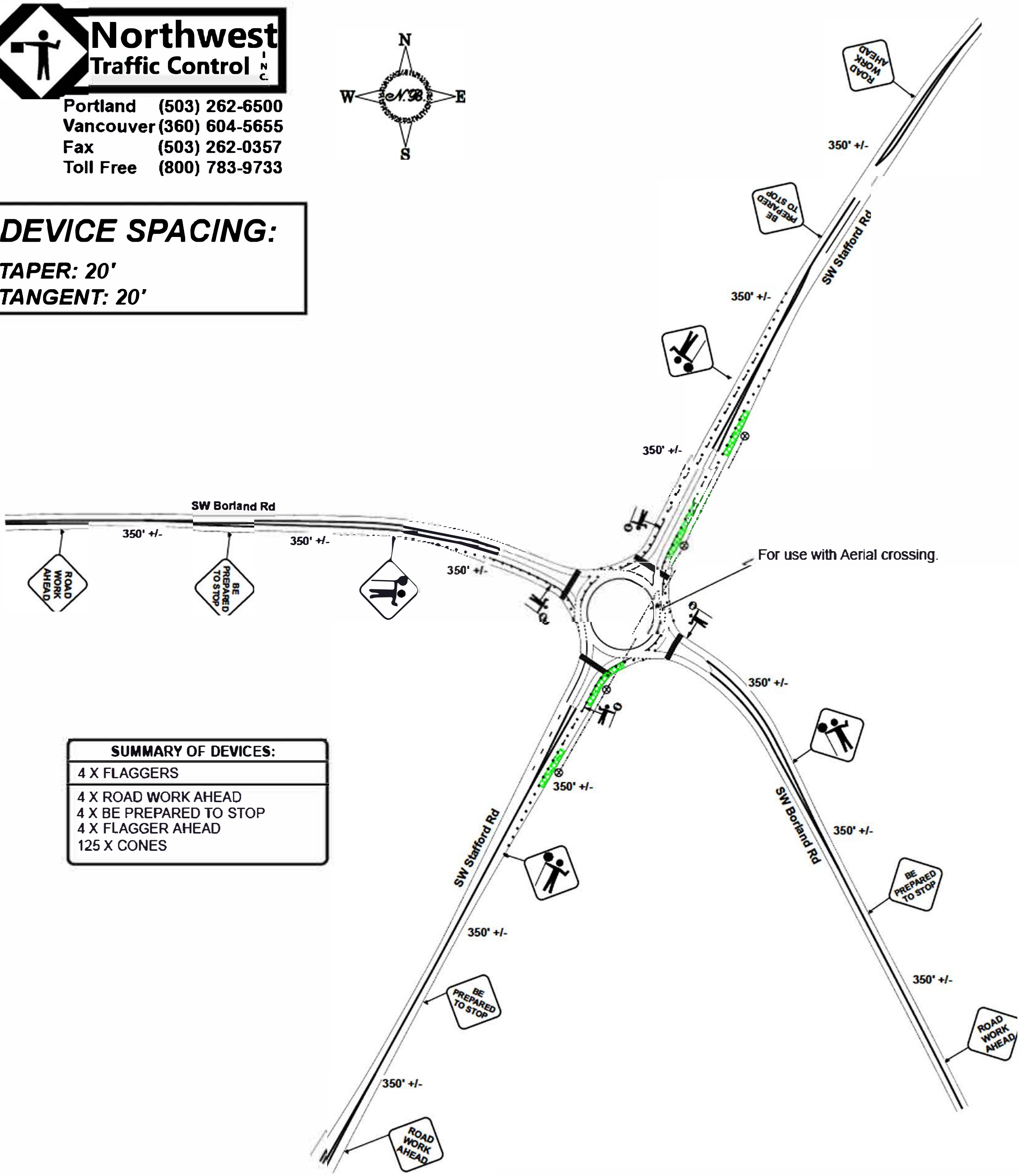
[redacted]

REDACTED

Northwest Traffic Control INC.
Portland (503) 262-6500
Vancouver (360) 604-5655
Fax (503) 262-0357
Toll Free (800) 783-9733

DEVICE SPACING:

TAPER: 20'
TANGENT: 20'



SUMMARY OF DEVICES:
4 X FLAGGERS
4 X ROAD WORK AHEAD 4 X BE PREPARED TO STOP 4 X FLAGGER AHEAD 125 X CONES

ODOT PERMIT #______________________________.

[redacted]

All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

REDACTED

Northwest Traffic Control INC.
Portland (503) 262-6500
Vancouver (360) 604-5655
Fax (503) 262-0357
Toll Free (800) 783-9733

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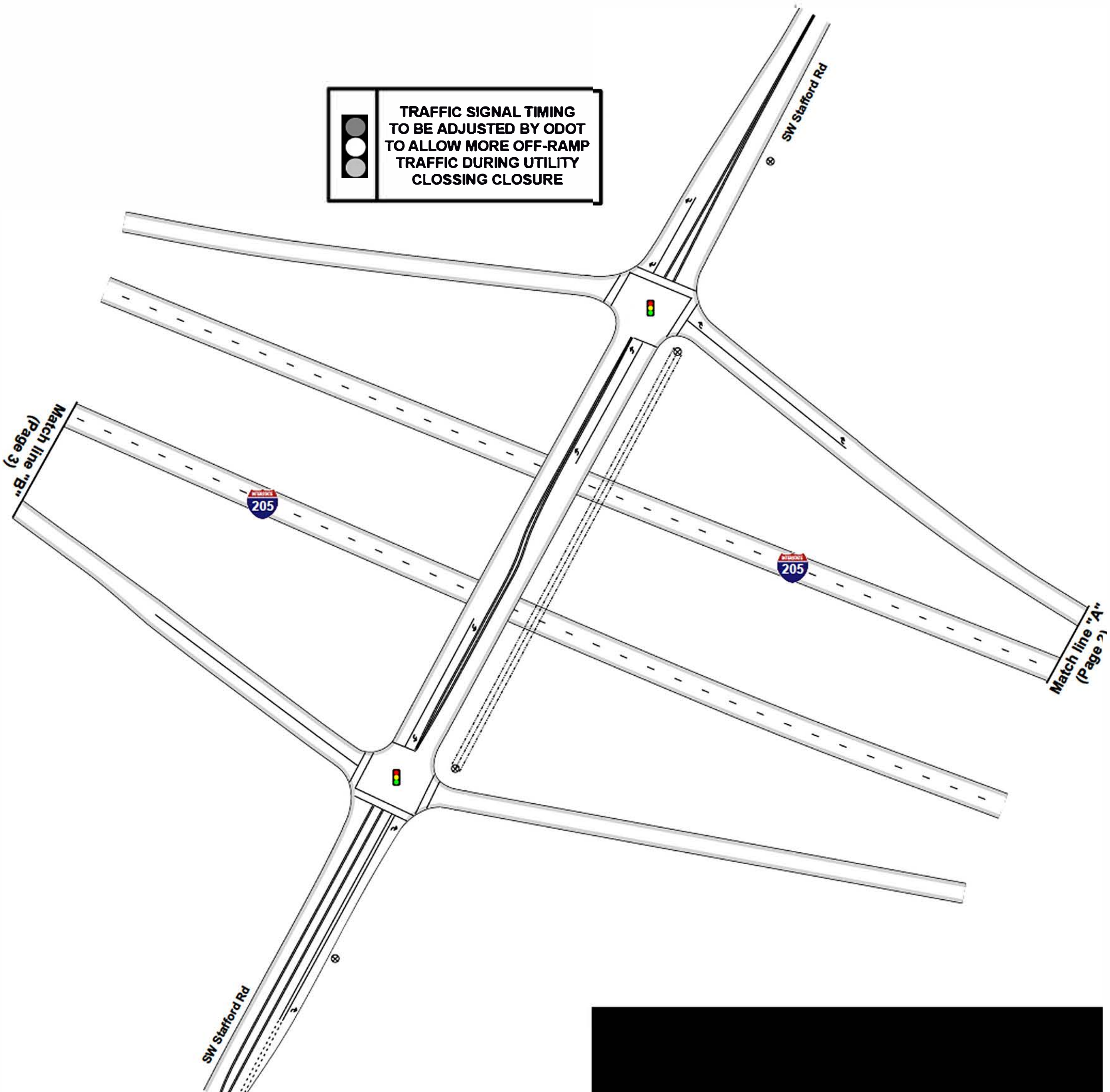
I-205 Closure
(Page #1)



[redacted]

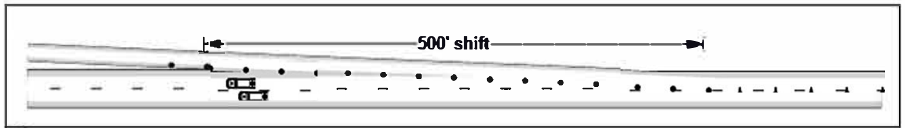
All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

REDACTED

Northwest Traffic Control INC
Portland (503) 262-6500
Vancouver (360) 604-5655
Fax (503) 262-0357
Toll Free (800) 783-9733

DEVICE SPACING:

TAPER: 40' Maximum
TANGENT: 40' Maximum



SUMMARY OF DEVICES:
2 X ROAD WORK AHEAD
2 X LEFT 2 LANES CLOSED AHEAD
2 X TRANSITION RIGHT
1 X REVERESE CURVE RIGHT
1 X ARROW BOARDS
(1 type III barricaded (L))
1 X MESSAGE BOARDS
(6 drums, 1 type III barricades)
2 X TMA (1 per closed lane)
75 X CONES
40 X SLIM LINE DRUMS

Reference Diagram #720

ODOT PERMIT #______________________________.

[redacted]

All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

REDACTED

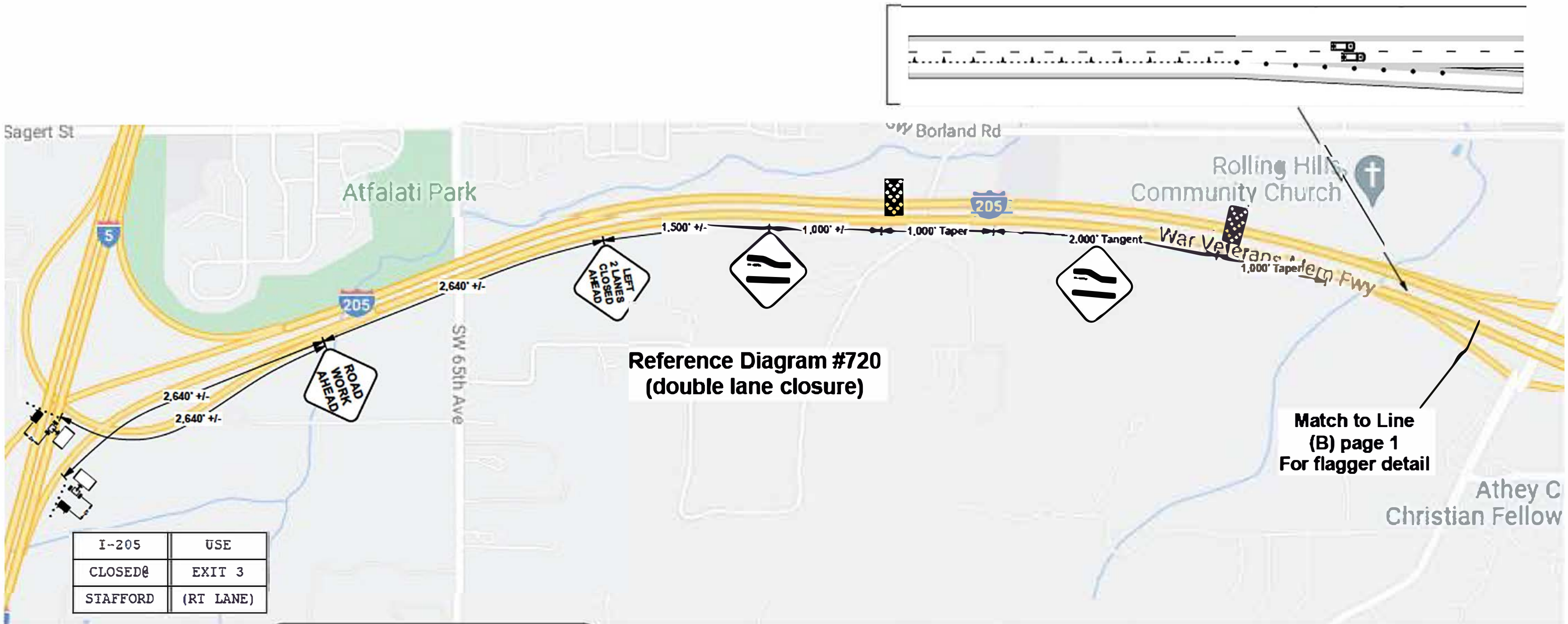
PCN 6 / PGE / 324
Putnam - Nuñez - Gordanier / 10

DEVICE SPACING:

TAPER: 40' Maximum
TANGENT: 40' Maximum

Northwest Traffic Control INC

Portland	(503) 262-6500
Vancouver	(360) 604-5655
Fax	(503) 262-0357
Toll Free	(800) 783-9733



SUMMARY OF DEVICES:

2 X ROAD WORK AHEAD
2 X LEFT 2 LANES CLOSED AHEAD
4 X TRANSITION RIGHT
2 X ARROW BOARDS
(2 type III barricaded (L))
2 X MESSAGE BOARDS
(12 drums, 2 type III barricades)
2 X TMA (1 per closed lane)
100 X CONES
60 X SLIM LINE DRUMS

ODOT PERMIT #____________________________.

[redacted]

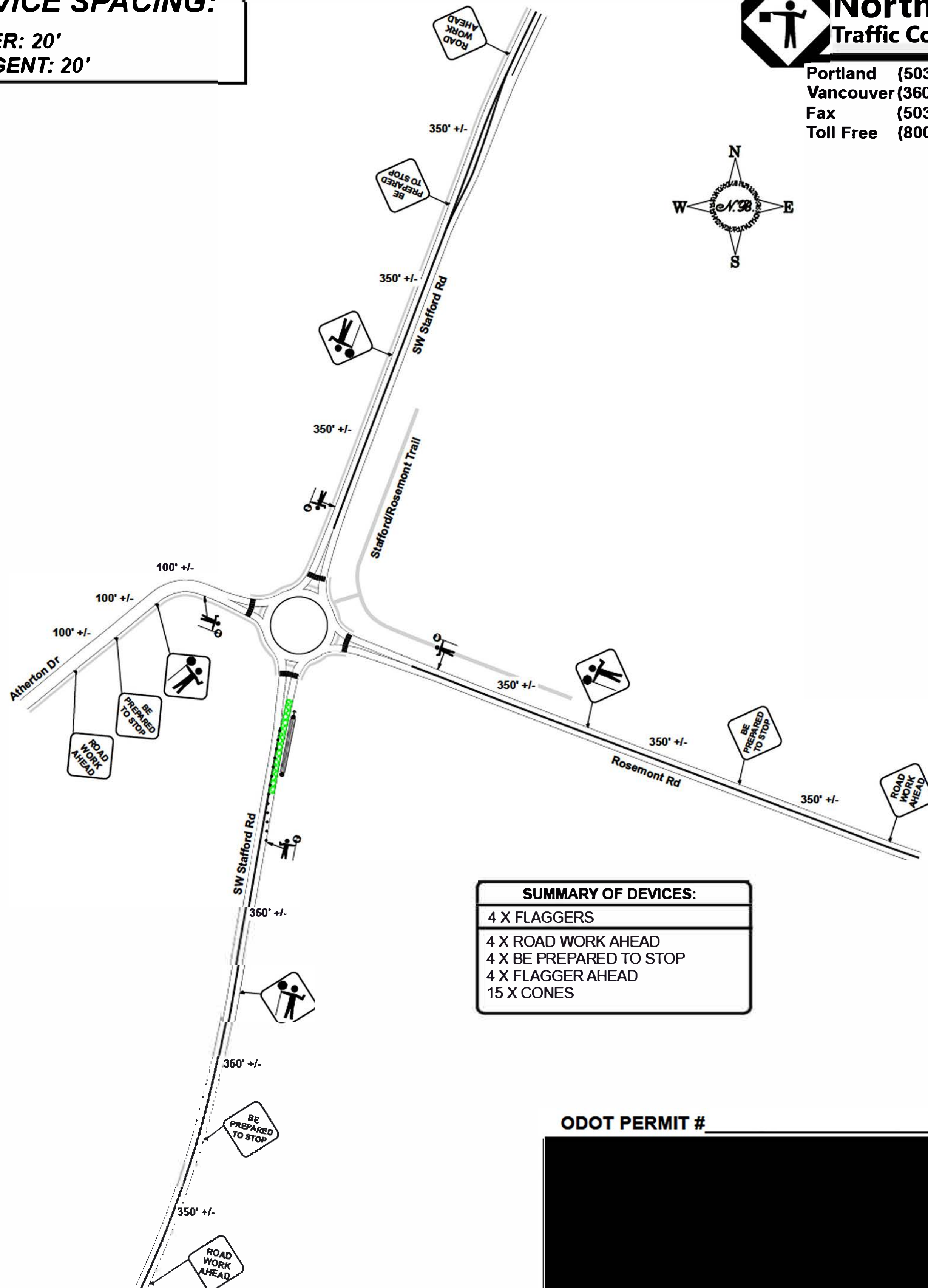
All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

REDACTED

DEVICE SPACING:

TAPER: 20'
TANGENT: 20'

Northwest Traffic Control INC.
Portland (503) 262-6500
Vancouver (360) 604-5655
Fax (503) 262-0357
Toll Free (800) 783-9733



SUMMARY OF DEVICES:
4 X FLAGGERS
4 X ROAD WORK AHEAD 4 X BE PREPARED TO STOP 4 X FLAGGER AHEAD 15 X CONES

ODOT PERMIT #______________________________.

[redacted]

All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

REDACTED

Northwest Traffic Control INC
Portland (503) 262-6500
Vancouver (360) 604-5655
Fax (503) 262-0357
Toll Free (800) 783-9733

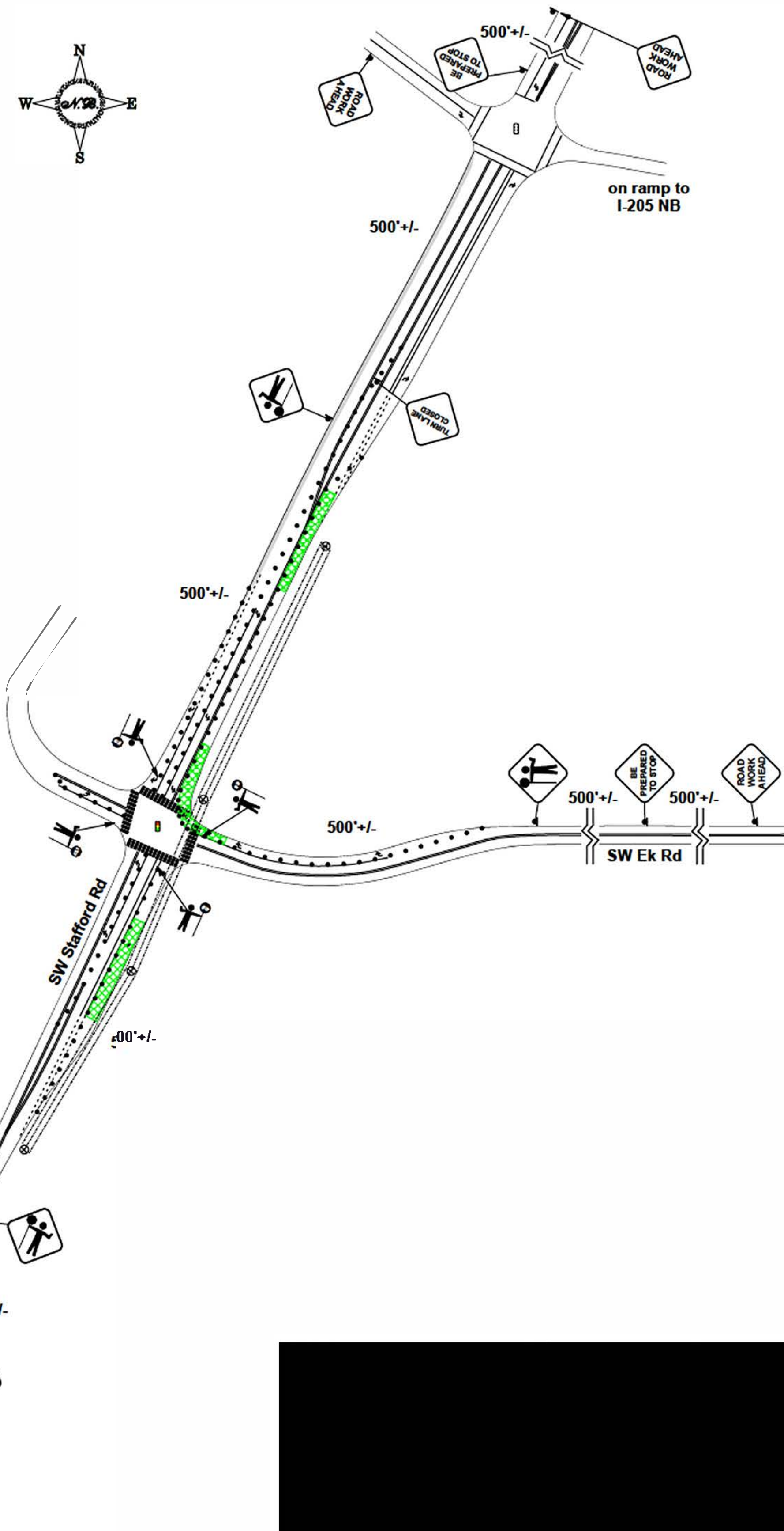
DEVICE SPACING:

TAPER: 20'
TANGENT: 20'

TRAFFIC LIGHT TO BE TURNED OFF DURING FLAGGING OPERATIONS

NOTE:

FLAGGERS SHALL BE ILLUMINATED DURING NON DAYLIGHT HOURS



SUMMARY OF DEVICES:
4 X FLAGGERS
5 X ROAD WORK AHEAD (1 not shown on plan)
3 X BE PREPARED TO STOP
3 X FLAGGER AHEAD
1 X TURN LANE CLOSED
140 X CONES

All signs and devices SHALL conform to the MUTCD / OTTCH.
Will adjust to fit field conditions.
Plan NOT to scale.

[redacted]

CERTIFICATE OF SERVICE

I hereby certify that I served a true and correct copy of Portland General Electric Company's Direct Testimonies of Dr. Ian Beil, Larry Bekkedahl, Matt Gordanier, Jordan Messinger, Kevin Putnam, and Dan Nuñez on the parties to Docket PCN 6 on the date indicated below by email addressed to said person(s) at his or her last-known address(es) indicated below. Copies containing Highly Protected Information and Protected Information are being sent via encrypted zip file to the Filing Center and parties who have signed Modified Protective Order No. 24-087 and General Protective Order No. 23-132.

SERVICE LIST

PCN 6

Staff Isaac Kort-Meade **(C)(HC)** Public Utility Commission of Oregon P.O. Box 1088 Salem, OR 97308 Isaac.kort.meade@puc.oregon.gov	**Staff** Johanna Riemenschneider **(C)(HC)** Oregon Department of Justice Business Activities Section 1162 Court St. NE Salem, OR 97301-4796 Johanna.riemenschneider@doj.state.or.us
PGE Brendan McCarthy **(C)(HC)** Portland General Electric Company 121 SW Salmon St. 1WTC1301 Portland, OR 97204 Brendan.mccarthy@pgn.com Opucdockets@pgn.com	**PGE** Jocelyn C. Pease **(C)(HC)** McDowell Rackner Gibson PC 419 SW 11th Ave. Ste. 400 Portland, OR 97205 jocelyn@mrg-law.com dockets@mrg-law.com

DATED: April 17, 2024

Cole Albee

Cole Albee
Paralegal