


DRAFT FINAL FOR AGENCY REVIEW

Resilience Assessment Report

Newport Municipal Airport
Newport, Oregon

FINAL DRAFT
Agency Review

Prepared for
Newport Municipal Airport

Critical Oregon Airport Relief Program
Agreement No. COAR-2017-ONP-00008

January 31, 2018
Salus/HC Job #154-035-009
City of Newport Project #2016-007

www.hartcrowser.com

DRAFT FINAL FOR AGENCY REVIEW

Resilience Assessment Report

Newport Municipal Airport

Newport, Oregon

Prepared for

Newport Municipal Airport

Critical Oregon Airport Relief Program Agreement No. COAR-2017-ONP-00008

January 31, 201
Salus/HC Job #154-035-009
City of Newport Project #2016-007

Prepared by

Salus Resilience/Hart Crowser, Inc. and
Precision Approach Engineering, Inc.

FINAL DRAFT
Agency Review

DRAFT

Corley McFarland, PE
Project Manager, Civil Engineer

DRAFT

Allison M. Pyrch, PE, GE
Associate, Geotechnical Engineer

DRAFT

Janice Marsters
Principal

300 West 15th Street
Vancouver, Washington 98660-2927
Tel 360.448.4189

Contents

FINAL DRAFT
Agency Review

TABLES

FIGURES

APPENDIX A

APPENDIX B

FINAL DRAFT
Agency Review

Newport Municipal Airport

Newport, Oregon

1.0 INTRODUCTION

Salus Resilience (Salus) (represented by Hart Crowser, Inc.) and Precision Approach Engineering, Inc. (PAE) are pleased to submit this Resilience Assessment Report for the Newport Municipal Airport (Airport) completed for the City of Newport (City), Oregon. Our work was completed in general accordance with the agreement between the City and Precision Approach Engineering dated August 15, 2017.

Based on the most recent scientific data from Oregon State University, the potential risk at Newport for a magnitude 8.0 or greater earthquake along the Cascadia Subduction Zone (CSZ) is high in the geological timescale (approximately 20 percent in the next 50 years). Risks along the fault zone range between 10 and 35 percent, depending on location and magnitude (up to magnitude 9 is possible). Based on the information presented in the Oregon Resilience Plan (ORP), large scale damage due to shaking and the following tsunami is expected along the entire Oregon Coast during such an event. The City requested this assessment to review existing City emergency response measures; inventory and assess existing critical facilities; develop long-term resilience goals, including an implementation timeline; and assess the seismic resilience of the Newport Municipal Airport. The results of this assessment will support the City's commitment to response and recovery activities that will be required following a CSZ earthquake and will allow the City to better plan implementation of resilience practices. This report contains a summary of our resilience assessment, including background review of provided information and field reconnaissance for the Newport Municipal Airport. As a part of our work, a geotechnical assessment to evaluate the seismic stability of the runways and the site, as well as a structural assessment of key buildings were completed. These reports are summarized in *Section 5.0 – Inventory and Assessment* and *Section 4.2 – Emergency Plans* of this report and are included in full as Appendix A and Appendix B, respectively.

The Newport Municipal Airport has been identified as an important part of the emergency response and recovery operations for the region after a CSZ event. Oregon coastal communities, infrastructure, and ground transportation systems are projected to suffer severe damage as a result of ground shaking, landslides, tsunami waves, and subsequent flooding. Due to the expected damage to the ground transportation network, the City and other coastal communities will be separated into "islands" following the event. Coastal airports, including the Newport Municipal Airport, that are outside of tsunami zones, are critical pieces of infrastructure that are essential to facilitating the planned air response; supply distribution; and rescue, evacuation, and recovery efforts. The general location of the airport is shown on Figure 1. The location of the Airport in relation to the predicted tsunami inundation maps is included on Figure 2.

FINAL DRAFT
Agency Review

2.0 SCOPE OF SERVICES

The purpose of our work was to conduct field explorations and a resilience assessment of the Newport Municipal Airport. Our complete scope of work is summarized below.

- Inventoried and assessed existing facilities including:
  - Landside facilities and infrastructure;
  - Runway stability and pavements;
  - General geotechnical hazards, including slope stability, seismic settlement, and others;
  - Operational constraints and requirements for existing facilities; and
  - Material and equipment resources and capacities.

- Conducted a site reconnaissance that included the following:
  - Completing an inventory of on-site buildings, pavements, materials, equipment, fuel and other storage capacities;
  - Evaluating stability of existing site slopes;
  - Reviewing available emergency plans;
  - Participating in meetings with PAE and City personnel to inventory existing resilience measures and develop long-term resilience goals and a timeline to meet those goals; and

- Subcontracted a structural engineer to perform ASCE 41-13 structural evaluations of the main terminal building and the Aircraft Rescue and Fire Fighting (ARFF)/Fire Station Building and provide general guidance on the seismic performance of hangars on-site.

- Evaluated resilience assessment data in relation to resilience goals established during our meeting with Airport personnel.

- Prepared this summary report outlining our findings and recommendations.

- Provided project management and support services for the project.

FINAL DRAFT
Agency Review

3.0 GOAL DISCUSSION

Based on our discussions with airport management and our understanding of local, state, and federal emergency plans, we understand that the Newport Municipal Airport will be an important part of the emergency response and recovery operations after a CSZ event. As described in the introduction, due to the expected damage to other infrastructure, airports, such as the Newport Airport, that are outside of tsunami zones will be critical infrastructure that will be needed to facilitate air response, supply distribution, rescue and evacuation efforts, and long-term recovery.

However, due to the expected seismic settlement through the middle of the Newport Airport site, we do not anticipate that runways at this airport will be available for aircraft other than helicopters until some runway repair work is completed. Aircraft that can operate on substandard surfaces will likely be able to use the Airport once some repair work is completed. Significant runway repair will be required before typical private and commercial aircraft will be able to use the runways. This assessment and the geotechnical report included in Appendix A provide preliminary analysis and recommendations to address these concerns.

We understand that the state has yet to establish designated airports for the state response effort and the Airport is not specifically called out in the City emergency management plan. The ORP has taken a first cut at identifying potential airports and included the Newport airport in its list based on location. Further, based on discussions with the National Guard, we understand that they have trained and drilled for emergency use of the Newport Municipal Airport (Airport), installed grounding for temporary towers, and consider it a part of their response plan. Due to its central location along the coast, its elevation outside of tsunami inundation areas, and the presence of U.S. Coast Guard (USCG) and Life Flight facilities at the Airport, the Newport Municipal Airport will be an asset to all levels of emergency response efforts.

Discussions with City airport staff indicate a desire to be able to support regional response and recovery activities and an intent to include resilience improvements into long-term planning and budgeting so that the Airport is open to fixed wing aircraft as soon as possible after a design level event. Further, City staff see the Airport as providing a critical public service in the event of a disaster, in addition to being an asset to the City, the region, and the state.

4.0 RECORDS REVIEW

4.1 Site Geographical Information

We reviewed the available information on seismic hazard, tsunami inundation information, and slope hazards. These hazard maps are included as Figure 2. Geotechnical, seismic and slope hazards are described in our preliminary geotechnical assessment for the site, which is included as Appendix A.

4.2 Emergency Plans

In conjunction with this work our team has reviewed the City 2016 Emergency Operations Plan, the ORP, and the Cascadia Playbook. We also reached out to the state Office of Emergency Management, USCG, and the Oregon Military Department to determine what expectations are included in current state and military plans for the Newport Municipal Airport's role following a disaster event. Based on our reviews and discussions, the Airport is tasked with serving a significant role in response and recovery, if possible; however, per discussions with Oregon Department of Aviation, staff requirements, roles, and responsibilities are still being defined and plans are being developed.

The existing Airport General Emergency Response Plan covers typical airport hazards related to air traffic and accidents and does not specifically address a CSZ level event. The plan relies on on-site Airport personnel to respond to an event and has no specific protocol for mobilizing outside backup. The combined ARFF Facility and South Beach Fire Station serves both the Airport and the community. Based on existing plans, no specific CSZ level event is included in response plans for this facility. Under current operations, there is a possibility that the resources at this facility may not be available for airport response activities if off-airport services are requested first. However, we understand that if they are on-site, response to the Airport is the first priority.

FINAL DRAFT Agency Review

4.3 Existing Airport Plans

Airport plans, including the 2017 Airport Master Plan, 2015 Oregon Department of Aviation Pavement Evaluation/Maintenance Management Program, prior airfield design (including geotechnical work) projects performed by PAE, and the 2015 terminal/Fixed Based Operator (FBO) Building Improvements plans were reviewed by our team members and used for inventory, assessment, and the structural evaluations included in Appendix B.

5.0 INVENTORY AND ASSESSMENT

5.1 General

Our inventory and assessment was completed using both existing information provided by the City and PAE, as well as data collected during our site tour with airport management on July 24, 2017. The goal of the inventory was to collect data on the existing facilities and resources at the Airport related to resilience and disaster response. Non-essential equipment and property not owned by the Airport, including Federal Aviation Administration (FAA) owned facilities, privately owned hangars, and USCG facilities, were not included in this assessment unless otherwise noted. Once the information was collected, the elements were assessed for a generalized resilience risk and rated low, medium, and high. Elements rated "Low" are anticipated to be mostly functional and useable after a design level event and may require relatively simple pre-disaster preparation. Elements rated "Medium" will need repairs in order to be used in conjunction with response and recovery activities and could require more extensive pre-disaster preparation. Those elements rated "High" will need significant repair or are expected to be damaged beyond repair after a large earthquake or will require significant pre-disaster retrofit and preparation. The recommendations for pre-disaster mitigation are included in *Section 7.0 – Recommendations* below. Evaluation of requirements to return elements to the pre-disaster state are not a component of this evaluation or risk ratings. Information and assessment details are included in the sections below. Existing site configuration is included on Figure 3.

FINAL DRAFT
Agency Review

5.2 Structures

We collected information on-site structures from existing site plans and documents, as well as during our site tour. Airport owned and operated structures that were critical to the Airport functions were assessed for resilience. ASCE 41-13 structural assessments were completed for the FBO/Terminal Building and the ARFF facility/fire station building. These reports are included in Appendix B. A summary of the structures is included in Table 1 below.

Table 1 - Structure Assessment Summary

Structure	Airport Owned	Assessed Resilience Risk			Notes
		Low	Med	High	
FBO/Terminal Building	Yes		X		Not expected to be operable – see Appendix B Assessment
City owned T-hangars (10)	Yes	Not assessed			Other privately-owned hangars are located on-site as well and were excluded from this assessment.
Maintenance Quonset Hut	Yes			X	Expected to be severely damaged in a seismic event
Fed Ex facility	Yes – rented to FedEx	Not assessed			Double-width Manufactured Home – foundation support will likely need improvements to withstand lateral movements.
North End Airfield Electrical Equipment Building	Yes	X			Equipment should be secured against lateral forces.
Instrument Landing System Sheds/Towers	No – FAA owned	Not Assessed			Structures should be assessed and equipment secured where needed.
Aircraft Rescue and Fighting Facility (ARFF)			X		Not expected to be operable – see Appendix B Assessment
Navigation Structures (Automated Weather Observation System, Wind Socks, rotating beacon, Visual Approach Aids)	Yes (FAA owned equipment was not assessed)			X	Equipment is not secured and/or braced against lateral loading and sensitive equipment will likely need to be repaired or recalibrated after a seismic event. Given FAA requirements for frangibility (breakaway) for equipment located in close proximity to aircraft operations some structures will be especially susceptible to damage.

In general, structures at the site are vulnerable to lateral loading during an earthquake. In order to have an operational airport during response and recovery, bracing and anchoring against shaking and/or retrofits will be required for the majority of the structures at the Airport as discussed in *Section 7.0 – Recommendations* of this report.

FINAL DRAFT
Agency Review

5.3 Utility Services

Utilities at the site include electrical, water, wastewater, communications, and fuel. After a large earthquake, these services will likely be out for weeks to months if not longer. We understand there is not natural gas on-site. Often during large winter storms or other localized events, electrical and fuel supplies may be cut off- and on-site generation and storage will be needed. The inventory and assessment summary of off-site and on-site services is below in Table 2.

Table 2 – Service Assessment Summary

Service	System Details	Backup Systems	Assessed Resilience Risk			Vulnerabilities	Notes
			Low	Med	High		
Electrical	Comes into site from two locations. Overhead to ARFF Facility and a location near the USCG building and then it continues underground.	Diesel generators located at FBO (35kW) and ARFF (10kW). Propane generator is located at the north end electrical equipment building (100 kW).			X	Generally, equipment is not anchored against shaking and lateral forces. See Section 4.3.1 for fuel discussion. Hardware connections for generators are not flexible.	FAA and USCG facilities are also reported as having back-up generation power; however, some FAA navigation facilities are reported as not having auto-start capability. FAA personnel are not on-site full time and are based out of Eugene.
Water	Water comes into site from two different public systems. North end is on City system and south end is on the Seal Rock Water District system.	USCG has a 50,000-gal water supply for hangar fire suppression fed from Seal Rock Water District system; however, water is not potable. ARFF has a water filter system for up to 3000 people.			X	Long-term water disconnection and shortages are expected from both water districts.	The USCG tank contains non-potable water; however, filtration may be possible. Quality, quantity, and duration of the ARFF system also needs to be obtained.

FINAL DRAFT Agency Review

Service	System Details	Backup Systems	Assessed Resilience Risk			Vulnerabilities	Notes
			Low	Med	High		
Wastewater/Stormwater	Septic tanks used on-site. Three main systems, FBO/FedEx, ARFF, and USCG. Storm drains into creek drainages eventually flowing off-site.	Four portable toilets are on-site at all times			X	Septic system connections and equipment were not observed; however, connections are likely not flexible and/or braced/anchored against shaking. Portable toilets will only last a short time without service.	
Communications	VHF Airband Radios – 2 handhelds, 1 mounted in the ARFF truck, and a base stations located and powered at the FBO and ARFF. Public works radio system with City Hall. Fire station is putting one radio in ARFF truck. FBO phone and fax are fiberoptic and integrated with City Hall.	FBO Base Station can be powered by battery/alternate power source. Back-up generators for power/communications at City Hall/Public works. City has two satellite phones but are stored at City Hall across the river/bay. We understand that one will be stationed at the airport.		X		Off-site backup power supporting communications is vulnerable if equipment is not anchored and fuel systems are not robust.	

FINAL DRAFT
Agency Review

5.3.1 Fuel

Fuel is important for post-event response and recovery because it is required to fuel backup generators and emergency and maintenance equipment. Based on our understanding of the ORP, fuel import will be severely diminished in the event of a large earthquake. Fuel will have to be delivered by air and will be scarce for weeks to months. On-site fuel capacity and storage will be imperative to support returning the airport to a serviceable condition after a CSZ event and to support service associated with recovery activities. The inventory and assessment of the on-site liquid fuel storage facilities are outlined below in Table 3. FAA and USCG facility information was not available.

Table 3 –On-Site Liquid Fuel Assessment Summary

Location	Capacity	Fuel Type	Assessed Resilience Risk			Vulnerabilities	Notes
			Low	Med	High		
Apron 100LL self-serve tank	3,000 gal	100LL			X	Tanks are not anchored and hardware connections are not flexible. (see below table)	
Fuel Farm	8,000 gal	100LL			X		
Fuel Farm	12,000 gal	Jet-A			X		
Airfield Electrical Equipment Building Generator	1,000 gal	Propane			X		Propane company will only fill when it is 20 percent capacity or below.
Fuel Farm	200 gal	Unleaded			X		Has to be empty prior to refill. Fuels ops truck, courtesy cars, and other equipment
Operations Truck	100 gal	Diesel			X		Filled downtown.
FBO generator		Diesel			X		
ARFF generator		Diesel			X		

Note: Tank capacities shown are approximate.

FINAL DRAFT Agency Review

Based on our observations, the on-site fuel tanks are not anchored to resist seismic shaking. Further, many of the connections and pumping mechanisms associated with fueling systems do not use flexible connections and are vulnerable to damage during an earthquake, and pumps are not connected to generators or alternative power sources. Hand pumps are available on some of the tanks; however, the process of transferring fuel would be slow. We understand that current procedures and the limited capacity of the on-site storage require significant drawdown of the on-site supplies before fuel orders for refilling are placed. Generally, the risk assessment for the fuel system is high.

5.4 Equipment and Materials

Emergency response and recovery requires both supplies to respond to an emergency to repair and restart airport functions, as well as supplies to sustain those that are working to complete these tasks. Based on our understanding of the Cascadia Event Scenario, Airport personnel and possibly their families will need to shelter on-site for days to weeks. During our reconnaissance and meetings with Airport personnel, we understand that certain emergency supplies and materials are available on-site for response and recovery. These supplies are outlined below in Table 4.

Table 4 –On-Site Emergency Supplies and Materials Assessment Summary

Description	Location	Assessed Resilience Risk			Vulnerabilities	Notes
		Low	Med	High		
Emergency Food Supplies	Limited food stuffs kept at ARFF Facility for FBO and ARFF staff (estimated 3-4 days) Additional MREs are kept at FBO for 3 people for 2 days. Supplies for Life Flight and USCG are present but unknown.		X		Staff and possibly families may be on-site for days to weeks. Reserves are likely not sufficient.	
First Aid	Basic supplies are located at several locations around the Airport.		X			
Medical Equipment	The Life Flight, USCG, and ARFF installations have emergency medical equipment on hand as expected for their functions.	unknown			In the event of a large Cascadia event, significant needs for medical equipment are likely for staff and local populations.	
Construction Repair Equipment	No pavement or grading equipment is kept on-site. Various large equipment is kept at the nearby City wastewater facility. Clearing and grubbing equipment (tractor, chainsaws, and mowers) are kept on-site.			X	On-site repairs will likely be necessary. Feasibility of getting equipment from wastewater facility to the Airport via old surface roads post CSZ event was not assessed	Several body shops, maintenance shops, an RV supply store, hardware store, welding supply store are located along 101 on the same side of the Yaquina Bay Bridge. Access will be dependent on 101 access, tsunami inundation, and individual building vulnerabilities.

FINAL DRAFT
Agency Review

Description	Location	Assessed Resilience Risk			Vulnerabilities	Notes
		Low	Med	High		
Material for pavement, roadway, or other structural repairs	None kept on-site. Limited supplies to complete very minor fence repairs are kept on-site.			X		No ability to service or repair vehicles is available on-site. Vehicles are repaired off-site.
Vehicles	Operations truck and courtesy cars.		X		Fuel for on-site vehicles will be limited.	

5.5 Personnel Resources

Personnel are an important resource for emergency response and recovery after an event. Time and day that the event occurs will affect which personnel are on-site during the event. Further, once personal responsibilities are accomplished, personnel will have to be prepared and able to return to work. Staff training, support, and awareness are crucial to ensure that staff and their families are prepared to survive the anticipated emergency events as well as to return to work during the response and recovery periods.

Personnel on-site are detailed below.

- **City Airport Staff** – Minimum of 2 are on-site 7 days a week between 8am and 5pm, except for trips to City Facilities downtown (primarily limited to meetings and errands). There is a total of four City staff working at the Airport. These staff reside in various locations (near Toledo, Waldport, Newport north of the bridge, and just southwest of the Airport). Three of the four staff will likely have transportation issues getting to and from the Airport in the event of a large earthquake and tsunami. We understand that typical training associated with airport operations and maintenance duties has been completed; however, a CSZ focused training and discussion has not been completed.

- **Life Flight and USCG Stations** – Manned full time (24 hours/7 days). The exception is during missions and for the USCG during shift changes. The USCG generally has a flight crew made up of four personnel on-site.

- **FAA Tech Operations** – Personnel that perform maintenance and repair on FAA equipment work out of Eugene and do not have regular staff on-site.

5.6 Airport Compatibility with Planned Response Aircraft

Aircraft required to support response and recovery following a CSZ event involving the Newport Municipal Airport will be significantly larger and heavier than aircraft currently operating at the airport. Discussions with the Oregon Military Department indicate that Lockheed Martin C-130 and Boeing C-17 fixed wing aircraft are the fixed-wing aircraft typically used to support response and recovery activities. Given the primary response role that these fixed-wing aircraft will serve, they will be the focus of analysis for airport compatibility in this assessment. In addition to the fixed-wing response, the military will also use

FINAL DRAFT Agency Review

rotary-wing (helicopter) aircraft, including Sikorsky UH-60 Blackhawks and Boeing CH-47 Chinooks. Though helicopters may use all airport facilities, including runway and taxiway pavements, it is anticipated that most of their ground base operations will be focused on and adjacent to apron pavements. A general summary of the inventory and assessment of airport compatibility with planned response aircraft is below in Table 5. Existing pavement thicknesses are shown on Figure 4.

5.6.1 Pavement Geometry

Existing pavement widths were evaluated for compatibility with the C-130 and C-17 Critical Response Aircraft. Given the relatively large “footprint” of these aircraft, they will be unable to operate on some pavements due to limitations of the existing pavement widths and insufficient pavement in turning areas. At present, the existing pavement geometry will support operations of both aircraft on Runway 16-34 and Taxiways A, B, and E, with some areas requiring judgmental oversteering. Existing pavement compatibility, including evaluation of the existing pavement geometry, is included on Figure 5.

5.6.2 Pavement Strength

The large aircraft needed to airlift the needed volume of personnel and supplies to the Newport Municipal Airport in conjunction with CSZ response and recovery activities will exceed the capacity of most of the existing pavements. To evaluate existing pavement strength compatibility with the anticipated fixed-wing response aircraft at the planning level, use of the Aircraft Classification Number – Pavement Classification Number (ACN-PCN) method is recommended. The ACN component of this method is a number that expresses the relative effect of an aircraft at a given configuration (weight, tire pressure, gear configuration, etc.) on a pavement structure for a specified standard subgrade strength. The primary PCN component is a numerical value that expresses the load carrying capacity of a pavement for unrestricted operations. There are four secondary PCN components that follow the load carrying capacity numerical value, separated by slashes, that indicate pavement type (R-Rigid or F-Flexible), subgrade strength (for flexible pavements; A-high, B-Medium, C-Low, D-Ultra Low), and maximum tire pressure (W-No pressure limit, X – Up to 254 pounds per square inch [psi], Y – Up to 181 psi, Z – Up to 73 psi). The ACN-PCN system is structured so a pavement with a particular PCN value can support an aircraft that has an ACN value equal to or less than the pavements PCN value.

The ACN-PCN system is a method that allows evaluation of acceptable long-term aircraft operations. Therefore, exceedance of a pavements ACN for short-term emergency response activities may be acceptable but will likely result in a shortened life expectancy of the pavement and will need to be accompanied by increased pavement inspections and monitoring for accelerated wear and damage. In addition to ACN-PCN comparisons, a preliminary analysis of the number of allowable operations for the C-130 and C-17 were calculated using the FAA’s pavement design software FAARFIELD as a check. Given the preliminary nature of the FAARFIELD analysis, the outputs have been excluded from this assessment but preliminarily agree with the ACN-PCN comparison results. For this assessment, exceedance of a pavement’s ACN will serve as a threshold for recommending pavement strengthening prior to allowing significant aircraft operations. Though this approach could be considered conservative, when coupled with the unknown number of required response aircraft operations and decreases in pavement strength following significant ground disturbance it provides a good starting point for strength evaluations. See FAA Advisory Circular 150/5335-5C for additional ACN-PCN information.

FINAL DRAFT
Agency Review

The following list shows some approximate key ACNs for the critical response aircraft as obtained from the FAA's COMFAA pavement software. Charts for ACN calculations of these aircraft at all weights are included on Figure 6. A summary of the existing available PCNs is included below in Table 5.

Gross Weight versus ACN

Lockheed Martin C-130H

155,000 lbs (Gross Takeoff Weight) – 37.6
153,000 lbs – 37.0
140,000 lbs – 33.2
125,000 lbs – 29.0
100,000 lbs – 22.3
83,000 lbs (Empty Operating Weight) – 18.0

Boeing C-17

585,000 lbs (Max Gross Weight) – 74.2
500,000 lbs – 59.3
400,000 lbs – 43.1
360,000 lbs – 37.1
300,000 lbs – 28.6
282,500 lbs (Empty Operating Weight) – 26.2

FINAL DRAFT Agency Review

Table 5 –Airport Compatibility with Planned Response Aircraft General Summary

Facility	Dimensions (Runways – Length x Width) (Taxiways – Width)	Surfacing/ Pavement Classification Number (PCN)	Does Facility Support Military Response Aircraft	Notes
Runway 16-34	5,398' x100' Declared Distances[1]	Asphalt Surface PCN- 37 /F/D/X/T[b]	C-130 – Yes C-17 – Yes, restricted Helicopters – Yes, as required	Significantly restricted allowable C-17 aircraft weight and/or number of operations; C-17 judgmental oversteering required, see Figure 5
Runway 2-20	3001'x75' Declared Distances – N/A	Asphalt Surface 15 /F/D/X/T[b]	C-130 – Yes, restricted C-17 – No, Limited by pavement width/strength Helicopters – Yes, as required	Significantly restricted allowable C-130 weight and/or number of operations, see Figure 5
Taxiway A	North of T/W B – 55'	Asphalt Surface PCN not available but pavement section thickness is less than Runway 16-34	C-130 – Yes, restricted C-17 – Yes, restricted Helicopters – Yes, as required	Restricted (significant in some cases) allowable aircraft weights and/or number of operations, C-17 judgmental oversteering required, see Figure 5
	South of T/W B – 35'	Asphalt Surface PCN not available but section thickness is less than Runway 2-20	C-130 – No C-17 – No Helicopters – Yes, as required	Unable to accommodate aircraft turning movements to intersecting taxiways; Insufficient pavement section based on record drawings

Facility	Dimensions (Runways – Length x Width) (Taxiways – Width)	Surfacing/ Pavement Classification Number (PCN)	Does Facility Support Military Response Aircraft	Notes
Taxiway B	50'	Asphalt Surface PCN varies but critical section thickness is less than Runway 16-34	C-130 – Yes, restricted C-17 – Yes, restricted Helicopters – Yes, as required	Restricted (significant in some cases) allowable aircraft weights and/or number of operations, C-17 judgmental oversteering required, see Figure 5
Taxiway C	North of R/W 16-34 – 35' – 50'	Asphalt Surface PCN varies, pavement section thickness is similar to Runway 2-20	C-130 – Yes, restricted C-17 – No, Limited by pavement width Helicopters – Yes, as required	Significantly restricted allowable C-130 weight and/or number of operations, see Figure 5
	South of R/W 16-34 – 35'	Asphalt Surface PCN not available, Critical pavement section thickness is less than Runway 2-20	C-130 – No C-17 – No Helicopters – Yes, as required	Unable to accommodate aircraft turning movements to intersecting taxiways; Insufficient pavement section based on record drawings
Taxiway D	35'	Asphalt Surface PCN varies, critical pavement section thickness is similar to Runway 2-20	C-130 – No C-17 – No Helicopters – Yes, as required	Unable to accommodate aircraft turning movements to intersecting taxiways; Insufficient pavement section based on record drawings
Taxiway E	50'	Asphalt Surface PCN varies, critical pavement section thickness is similar to Runway 2-20	C-130 – Yes, restricted C-17 – Yes, restricted Helicopters – Yes, as required	Significantly restricted allowable aircraft weights and/or number of operations, see Figure 5
Aprons	27,000 square yards (Approximate)	Asphalt Surface PCN not calculated; Apron pavement thicknesses are less than Runway 2-20	C-130 – No C-17 – No Helicopters – Yes	Area includes apron taxi lanes Excludes USCG Apron (2,800 SY approximate); Insufficient pavement section for fixed wing aircraft based on record drawings

Notes:

a. Runways 16 and 34 – Takeoff Run Available (TORA), Takeoff Distance Available (TODA), Accelerate Stop Distance Available (ASDA) – 5,938'; Landing Distance Available (LDA) Runway 16 5,938', Runway 34 5,098'

b. F-Flexible Pavement; D-ultra low subgrade strength (CBR ≤ 4); X-high tire pressure (limited to 254 psi); T-PLN determined by technical study

FINAL DRAFT
Agency Review

5.7 Airfield Facilities

Table 6 –Airfield Facilities Assessment Summary

Service	Facility Details	Backup Systems	Vulnerabilities	Notes
Runway Dimensions (Length x Width), Surfacing	R/W 16-34 – 5,398x100, Asphalt R/W 2-20 – 3001x75, Asphalt	N/A	Pavement settlement/failure. See Section 6 and Appendix A for additional information.	See Section 5.6 for additional information including pavement strengths, pavement geometry, declared distances, and taxiway/apron information
Runway Marking	R/W 16-34 – Precision R/W 2-20 – Basic	N/A	Pavement settlement/failure. See Section 6 and Appendix A for additional information.	
Airfield lighting	R/W 16-34 – High Intensity Runway Edge Lighting (HIRL) R/W 2-20 – Medium Intensity Runway Edge Lighting (MIRL)	Facility is connected to backup generator	Disruption of power source Frangible (breakaway) couplings (per FAA requirements), wire, conduit, and electrical connections are vulnerable to damage during an earthquake.	System is operated via pilot control using the Airport Common Traffic Advisory Frequency (CTAF) (122.8 MHz)
Visual Approach Aids	R/W 16 – Precision Approach Path Indicator (PAPI-4L), FAA Owned; Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR), FAA Owned R/W 34 – PAPI-4L, FAA Owned; Runway End Identifier Lights (REIL), FAA Owned		Disruption of power source Frangible (breakaway) couplings (per FAA requirements), wire, conduit, and electrical connections are vulnerable to damage during an earthquake.	Systems are operated via pilot control using the Airport Common Traffic Advisory Frequency (CTAF) (122.8 MHz)
Rotating Beacon	A rotating beacon is located north of the FBO/Terminal Building	Facility is connected to backup generator	Disruption of power source Pole, foundation connection, wire, conduit, and electrical connections are vulnerable to damage during an earthquake.	

FINAL DRAFT Agency Review

Service	Facility Details	Backup Systems	Vulnerabilities	Notes
Automated Weather Observation System (AWOS)	Provides automated weather observations to pilots. Reports cloud ceiling, visibility, temperature, dew point, wind direction/speed, altimeter setting, and density altitude	Facility is connected to backup generator. Also has battery backup that powers system for approximately 8-9 hours	Disruption of power source, and limited battery backup Towers, foundation connection, wires, conduits, computers, and electrical connections are vulnerable to damage during an earthquake	System is accessed via 133.9 MHz and weather report number available (541) 867-4175
Wind Sock and Segmented Circle	Primary segmented circle and wind sock located mid-field Supplemental wind sock located near R/W 34		Disruption of power source Pole, foundation connection, wire, conduit, and electrical connections are vulnerable to damage during an earthquake	
Instrument approach procedures (IAPs)	Lowest minimums with ground based equipment in service – 250' Above Ground Level; ¾ Statute Mile Visibility Lowest minimums using non-ground based equipment – 500' Above Ground Level; 1 to 1-3/8 Statute Mile Visibility	Ground based facilities are reportedly connected to backup generators, see notes IAP's can utilize Tillamook Airport altimeter setting if available.	Disruption of power source Towers, foundation connection, wires, conduits, computers, and electrical connections are vulnerable to damage during an earthquake.	See FAA Owned Equipment this Section and Section 5.3 Electrical for additional information
Other FAA Owned Equipment	VHF Omnidirectional Range Beacon and Tactical Air Navigation system (VORTAC)	FAA ground based facilities associated with IAPs are reported to have backup generators. See section 5.3 for additional information.		FAA equipment is reportedly remotely monitored but typical outages can take up to two days to resolve FAA Personnel are not on-site full time and are based out of Eugene. Airport Staff do not have keys on-site to access FAA equipment.

Note: Equipment is owned by the City unless otherwise indicated.

FINAL DRAFT Agency Review

Generally, navigation aids and equipment are not secured and/or braced against lateral loading and sensitive equipment will likely need to be repaired or recalibrated after shaking. The resilience assessment rating for this equipment is medium to high. Given FAA requirements for frangibility (breakaway) for equipment located in close proximity to aircraft operations some structures will be especially susceptible to damage. FAA generators require a manual start. We understand that keys to the FAA equipment and generators are not kept on-site. Further, the FAA personnel are located in Eugene, and their ability to assess and repair FAA equipment will be hampered by damage to communication and surface transportation infrastructure. Discussions with FAA personnel located in Eugene indicate the Newport Airport is included in FAA CSZ response planning completed to date with specific details and prioritization to follow as plans are further developed.

6.0 GEOTECHNICAL ASSESSMENT

Hart Crowser conducted a preliminary geotechnical evaluation of the site. As part of the evaluation, six cone penetrometer test (CPT) soundings were advanced to help define the limits of on-site fills and categorize the soils for seismic performance. Based on our current understanding of the site and the subsurface conditions encountered, the site is at risk for seismic settlements and slope instability as outlined below.

- The saturated sandy soils at the site are vulnerable to seismically induced instability in the event of a major earthquake event.
  - Liquefaction will induce settlement in the sandy soils below the groundwater table, which may undermine stability of foundation systems and cause significant ground settlement under runways. Strength loss of partially saturated material above the groundwater table under strong ground shaking will result in near-surface instability for slopes, and structures supported by shallow foundations.
  - Buried structures and utilities may be subject to buoyancy and uplift forces due to shallow liquefaction and sand boils.
  - Slopes to the east and west of the runways and terminal building will likely experience slope instability and lateral displacements during seismic loading.
- Tsunami inundation may cause blockages and culvert failures in the drainages surrounding the airport.
- Regional subsidence, tsunami scour, and areal settlement may cause pipe damage and blockages.
- Ongoing slope creep and discreet shallow slope failures have caused issues at the airport for many years. These processes are expected to continue and will likely worsen during seismic shaking.

Our understanding is that the anticipated runway settlement is too severe for the runways to be useable for typical private and commercial aircraft after a large seismic event. Following some repairs, the runways may be available for aircraft that can operation on substandard surfaces. In order to prevent liquefaction and seismic settlement, ground improvement would be required in areas of weak soils and fills. Unstable slope areas where failures could encroach on runways and structures will require stabilization as well. This is discussed in more detail in the geotechnical assessment report included as Appendix A.

FINAL DRAFT Agency Review

7.0 RECOMMENDATIONS

Based on our discussions, review, and evaluation. We have outlined recommendations below that will increase resilience at the Airport to meet the stated goal of an operational airport after a large seismic event. Based on our discussions with the Airport, we have presented the recommendations as short, medium, and long-term recommendations for planning purposes. Generally high risk, and relatively low-cost fixes are included as short-term recommendations. We understand that these recommendations will be incorporated into capital improvement budgets and funding requests.

7.1 Short-Term Recommendations (5 years)

Based on our assessment, we recommend short term mitigation efforts in areas that were evaluated as high risk, are important to meet airport goals, and/or are low cost fixes that immediately increase airport resilience. The areas are weather reporting, fuel storage, emergency planning and preparation, and geotechnical improvement design. These efforts are outlined below.

7.1.1 AWOS System Backup

We understand that the Airport does not have a Certified Weather Observer on-site. The AWOS system is vulnerable to shaking and damage during an event. By training Airport personnel to be Certified Weather Observers, the Airport can provide weather updates by radio in the event of an AWOS system failure.

7.1.2 Fuel Storage

Fuel storage on-site is vulnerable because tanks are not anchored to resist lateral loads nor are connections and hardware designed to be flexible to reduce shaking damage. We recommend that the on-site tanks be anchored and the pumps and hardware be retrofitted so that spills are prevented and fuel is immediately available for response. Fuel storage and filling practices should also be evaluated and changed so that tanks are kept above a minimum level to ensure that fuel is available in the event of an earthquake. In the longer term, additional fuel capacity can also be added to increase the capacity of the Airport to aid in response efforts.

7.1.3 Emergency Planning and Preparation

Our assessment highlighted several areas where emergency planning and preparation would significantly increase the resilience of the Airport and its ability to serve the City, the region, and the public. Our specific recommendations are outlined below.

Emergency Supplies for Staff and Public

- Increase emergency food stuffs to provide food and water for all on-site staff as well as additional personnel or public expected. Airport, USCG, and Life Flight personnel should have supplies for at least 2 to 4 weeks.

- Increase the potable water storage and availability on-site to make sure sufficient supplies are available for on-site personnel as well as others expected to be at the Airport after an event.

FINAL DRAFT Agency Review

- Consider shelter for all personnel that will be on-site as well as a plan for those that may come from outside. Structure vulnerabilities should be included in this consideration.
- Re-evaluate on-site medical and first aid supplies and update as necessary.

Emergency Planning and Training

- Initiate a program to encourage home preparation for personnel and families.
- Work with all airport users and agencies to develop a more detailed emergency plan and protocols for a CSZ Level Event and make sure all on-site personnel are trained. This can include the following items.
- Develop a plan for personnel to reach the site or reach home after an event. Include a discussion of impediments to employee travel. Consider shelter capacity for families.
- Develop an alternative communication plan with employees, the City, FAA, other response agencies, and entities on-site.
- Develop a plan for post-disaster assessments of structures, runways, and equipment after an event to assess status and necessary repairs to support response and recovery activities.
- Develop protocols for public interaction and coordination with expected users (military, USCG, Life Flight), coordination with the FAA, and personnel organization and duties.
- Develop and alternate way for FAA repairs to be completed by on-site personnel. Develop a communication method with the personnel based out of Eugene.
- Develop a business continuity plan that provides for both response and long-term recovery at the Airport. This plan should address airport goals for providing private and public service to existing and potential future airport users, including emergency response providers, after a CSZ event.
- Consider needed training for Airport personnel (e.g., CERT, First Aid, Emergency Management protocols with State and City).
- Consider regularly scheduling planning meetings with agencies and stakeholders to encourage participation and updates to plans and procedures.

FINAL DRAFT
Agency Review

Materials and Equipment

- Evaluate material and equipment needs to perform pavement, slope, culvert, and settlement fixes. Consider pavement needs for military aircraft as well as outside help and where supplies are available near the Airport. Consider contracts with other City agencies and suitably located private contractors to respond after an earthquake to more rapidly assess and repair airport operations.

- Replace the Quonset hut to allow for secure material storage and to provide access to materials post event. The current structure is very vulnerable to shaking damage. Safe storage for equipment and supplies is important to build resilience.

- Assess communication hardware needs for communication with the City and other entities. Consider a satellite phone on-site.

7.1.4 Further Geotechnical Explorations and Design

As described in *Section 6.0 – Geotechnical Assessment*, the runways and other site improvements are vulnerable due to the expected liquefaction and settlement during a large earthquake. Specifically, we expect the following items.

- Liquefaction will induce settlement in the sandy soils below the groundwater table, which will cause significant ground settlement in runway areas and potentially under structures.

- Strength loss of partially saturated material above the groundwater table under strong ground shaking will result in near-surface instability for slopes and structures supported by shallow foundations.

- Slopes around the site, including those to the east and west of the runways and to the west of the terminal building will likely experience widespread lateral displacements during seismic loading.

FINAL DRAFT
Agency Review

In order to have operational runways, ground improvement, such as soil mixing, stone columns, or other soil strengthening methods, will be required. To define the extent of the issue in more detail and to design the mitigation, further exploration and design will be required. We recommend that geophysical testing be completed to better define fill areas on-site, drilled borings be advanced to collect soil samples to confirm CPT liquefaction settlement estimates, and mitigation options be evaluated to help the Airport better plan for mitigation and secure funding for construction.

7.1.5 Airport Compatibility Improvements to Support Response Aircraft

As described in the inventory and assessment portion of this report, exceedance of a pavement's ACN coupled with preliminary pavement strength analysis from FAA's FAARFIELD software was used as the basis for identification of pavement strength concerns and serves as a starting point for pavement strength improvements in support of critical response aircraft operations. With the majority of airport pavements subject to operational restrictions (to include severe restrictions on pavements immediately adjacent Runway 16-34) the following short-term items are recommended.

- Confirm intended critical response aircraft as agency plans continue to be developed. Confirm if the response agencies are aware of the current airport pavement thicknesses and provide additional information as required.

- Coordinate with the response agencies to develop a program to accommodate planned aircraft operations on existing pavements. This will need to include aircraft taxiing, parking, loading and unloading operations, and aircraft turnarounds within existing pavements that have sufficient strength.

- Begin planning for Phase I pavement strength improvements, including coordination with response agencies, to be ready for funding as it becomes available. It is recommended that at a minimum Taxiway B and Taxiway A north of Taxiway B be strengthened to accommodate unrestricted Boeing C-17 operations. If sufficient funding is available, the northeast portion of Taxiway E and an area of apron could also be strengthened to accommodate aircraft taxiing, parking, loading and unloading, and aircraft turnaround. Findings from the additional short-term geotechnical work should be incorporated into the pavement strength improvements.

FINAL DRAFT Agency Review

7.2 Medium-Term Recommendations (5 to 10 years)

Medium-term recommendations are those that will require significant funding and/or coordination with the FAA. We recommend the following items be considered in the medium term.

- Retrofit the FBO and ARFF buildings to immediate occupancy levels.

- Complete geotechnical mitigation (ground improvement) to harden runways against seismic settlement.

- Retrofit navigation and communication systems to withstand earthquake shaking.

- Execute Phase I pavement strength improvements if not able to obtain funding and complete during the short-term time period.

- Begin Planning for Phase II pavement strength improvements including additional agency coordination as the regions response plans continue to be developed. It is recommended that at a minimum the northeast portion of Taxiway E and adjacent areas of apron be strengthened. Actual limits of strengthening will need to be coordinate with response agencies. Similar to Phase 1 pavement strength improvements, additional geotechnical findings should be incorporated into these improvements.

- Execute Phase II pavement strength improvements as funds become available. Postpone to long-term recommendations period as required by funding availability.

7.3 Long-Term Recommendations (10 years +)

- Continue evaluation and implementation of emergency response and recovery plans as City, agency, and Airport planning evolves.
- Evaluate increased fuel storage capacity.
- Stabilize storm drain pipes or design a back-up drainage system.
- Continued evaluation of response aircraft pavement needs in conjunction with ongoing agency discussions. It is anticipated that this could include completion of any remaining required Taxiway E and apron pavement strengthening. Execute any required additional pavement strength improvements, including incorporation of additional geotechnical findings similar to Phase 1 pavement strength improvements, as funds become available.

8.0 LIMITATIONS

FINAL DRAFT
Agency Review

We have prepared this report for the exclusive use of the City of Newport and their authorized agents for the Newport Municipal Airport Resilience Assessment in Newport, Oregon in accordance with our agreement dated August 15, 2017. Our report is intended to provide our initial assessment of the site based on the field reconnaissance and records review described herein.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the fields of civil and geotechnical engineering in this area at the time this report was prepared. No warranty, express or implied, should be understood.

Any electronic form, facsimile, or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by Hart Crowser and will serve as the official document of record.

9.0 REFERENCES

City of Newport 2015. Addendum #5, Airport FBO Building Repair Project, #2014-021, August 18, 2015.

COMFAA – FAA software capable of calculating Aircraft Classifications Numbers in accordance with the International Civil Aviation Organization (ICAO) procedure – Version 3.0, dated August 21, 2017 was used for CAN Analyses associated with this assessment.

David Evans and Associates, Inc. 2005. Newport Municipal Airport, Airport Hangar Construction, AIP# 3-41-0040-13, Sheets No. 1 through 6, June 2005.

DH Goebel Oregon Coast Architect 1996. Newport Fire Department South Sub-Station Plans, July 12, 1996.

Ecology and Environment, Inc. 2016. *City of Newport, Lincoln County, Oregon, Emergency Operations Plan*, December 2016.

FAARFIELD – Standard FAA thickness design software for airport pavement design and evaluation. Version 1.42 released September 18, 2017 was used for analysis associated with this assessment.

Federal Aviation Administration (FAA) 2014. FAA Advisory Circular No. 150/5335-5C – Standardized Method of Reporting Airport Pavement Strength – PCN, August, 14, 2014.

HE Inc. 2015. Airport FBO Building, Exterior Repair Project, City of Newport, Newport, Oregon, Sheets S1.1, S2.1, S3.1, S4.1, and S4.2, November 5, 2015.

Kramer Gehlen Associates 2006. Newport Airport Hanger Building, Newport, Oregon, Sheets No. S1m A1-A2, E1-E4, and G1-G2, May 4, 2006.

Newport Municipal Airport 2017. Airport Master Plan, dated 2017.

Oregon Department of Aviation 2015. Pavement Evaluation/Maintenance Management Program, Newport Municipal Airport Final Report, by Pavement Consultants Inc., dated December 2015.

Oregon Seismic Safety Policy Advisory Commission (OSSPAC) 2013. The Oregon Resilience Plan, Reducing Risk and Improving Recovery for the Next Cascadia Earthquake and Tsunami, Report to the 77th Legislative Assembly, Salem, Oregon, February 2013.

Oregon Water Resources Department (OWRD) 2017. http://filepickup.wrd.state.or.us/files/Publications/obswells/jpg accessed 10/9/17.

FINAL DRAFT
Agency Review

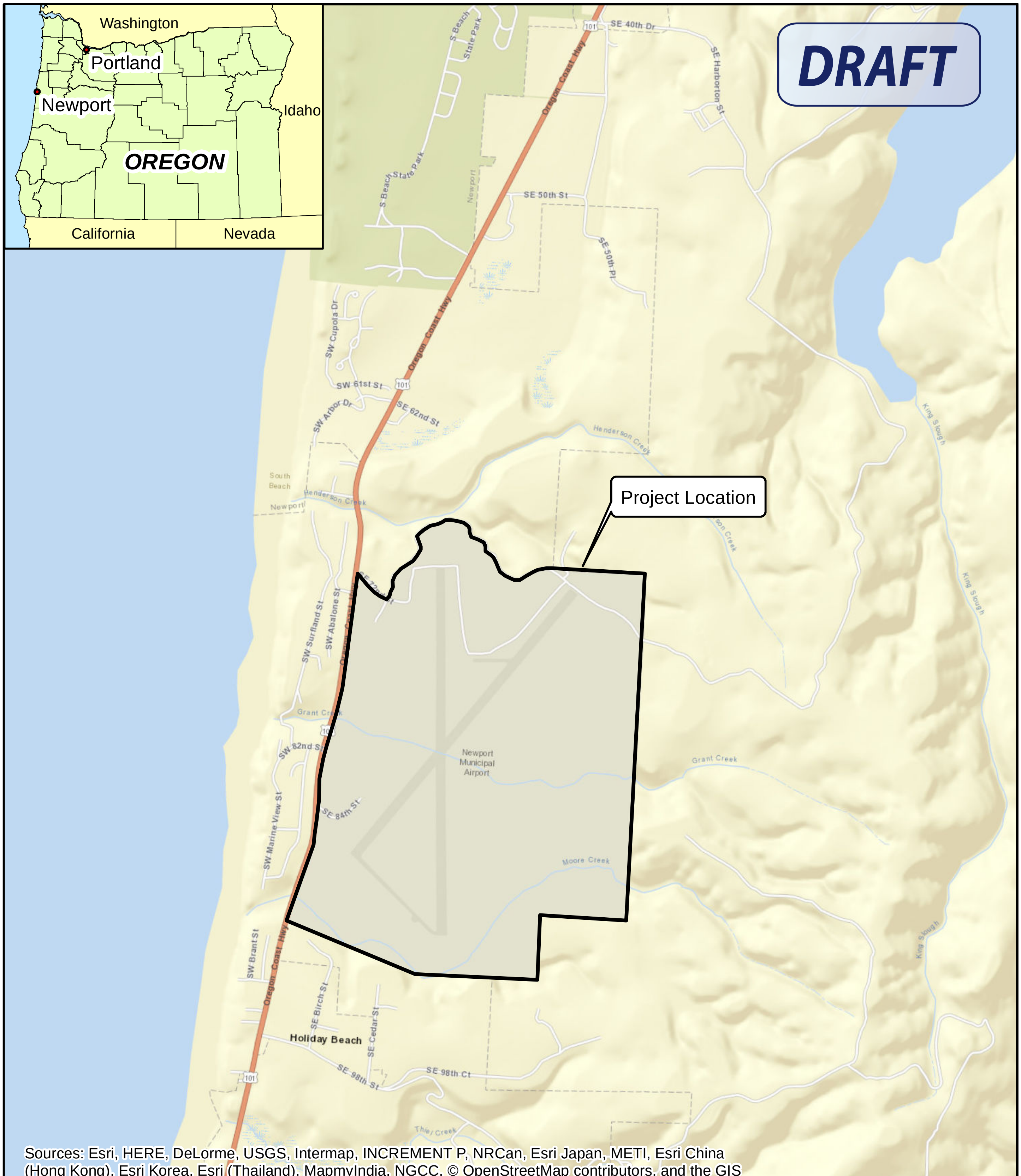
10.0 ACRONYMS

ACN	Aircraft Classification Number
Airport	Newport Municipal Airport
ARFF	Aircraft Rescue and Fire Fighting
ASDA	Accelerate Stop Distance Available
AWOS	Automated Weather Observation System
City	City of Newport
CPT	Cone Penetrometer Test
CSZ	Cascadia Subduction Zone
CTAF	Common Traffic Advisory Frequency
DOGAMI	Oregon Department of Geology and Mineral Industry
FAA	Federal Aviation Administration

FAARFIELD	FAA Rigid and Flexible Iterative Elastic Layered Design (Pavement Design Software)
FBO	Fixed Based Operator
HIRL	High Intensity Runway Edge Lighting
IAP	Instrument Approach Procedure
LDA	Landing Distance Available
MALSR	Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights
MIRIL	Medium Intensity Runway Edge Lighting
ORP	Oregon Resilience Plan
PAE	Precision Approach Engineering, Inc.
PAPI	Precision Approach Path Indicator
PCN	Pavement Classification Number
psi	pounds per square inch
REIL	Runway End Identifier Lights
R/W	Runway
Salus	Salus Resilience
TODA	Takeoff Distance Available
TORA	Takeoff Run Available
USCG	U.S. Coast Guard
VORTAC	Very High Frequency Omnidirectional Range Beacon and Tactical Air Navigation System

FINAL DRAFT
Agency Review

F:\Notebooks\154035009_Salus-Newport Airport Resilience Assessment\Deliverables\Report-Resilience_Assessment-Final Agency Draft 01-31-18\Salus-Newport Airport Resilience Assessment-DRAFT-Agency Review.docx



0 1,000 2,000 4,000
Feet

N

Newport Municipal Airport
Newport, Oregon

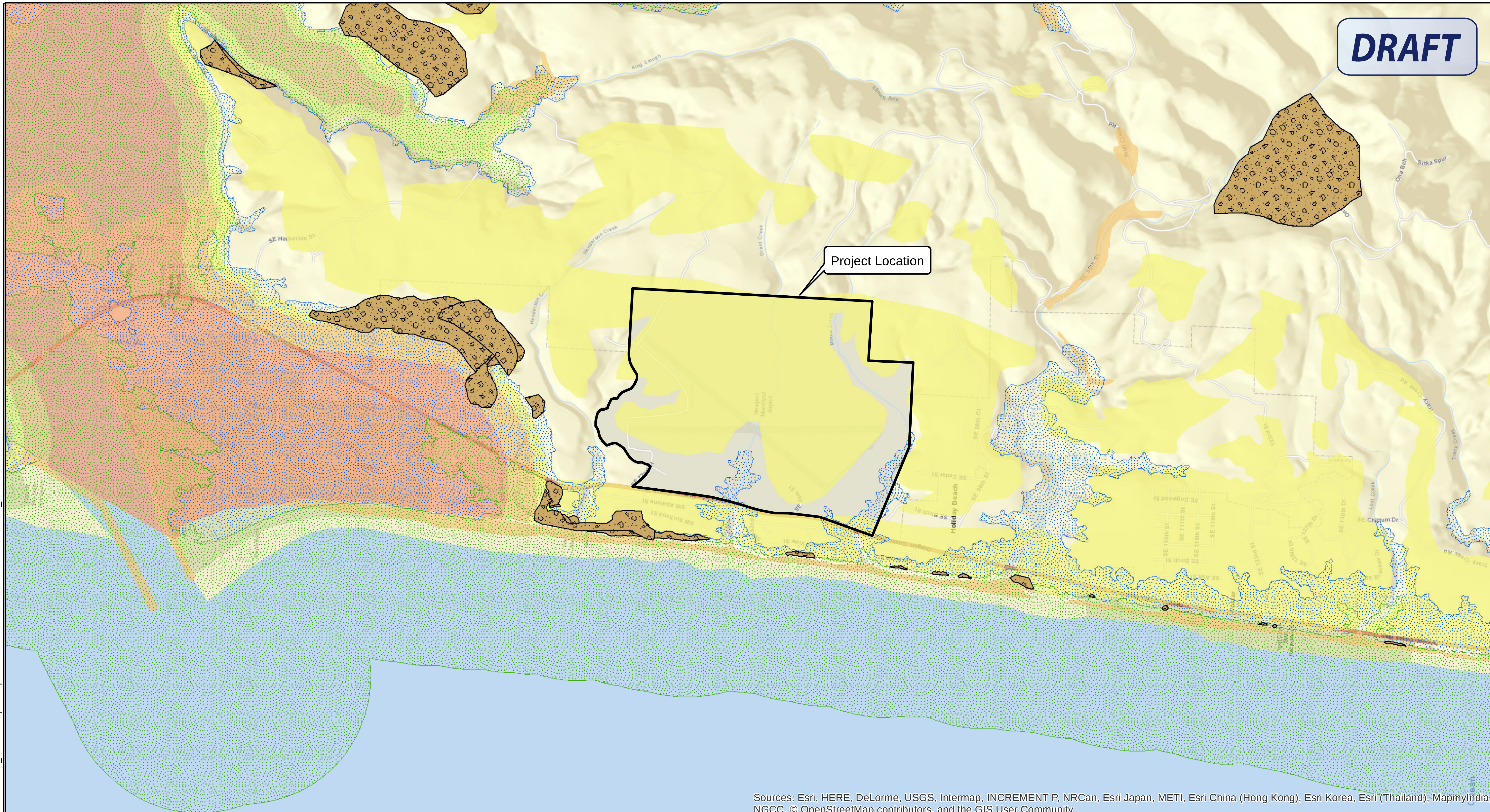
Vicinity Map

154-035-009 1/18

HARTCROWSER

Figure
1

Document Path: \\pdxsrv\data\Notebooks\154035009_Salus-Newport Airport Resilience Assessment\GIS\154035009_VMap.mxd Date: 1/31/2018 User Name: melissaschweitzer



LEGEND

SLIDO

Landslide

DOGAMI Tsunami Evacuation Zones 2013

Distant Tsunami Evacuation Zone

Local Tsunami Evacuation Zone

Oregon Liquefaction Susceptibility

Low

Moderate

High

N

0 1,000 2,000 4,000

Feet

Newport Municipal Airport
Newport, Oregon

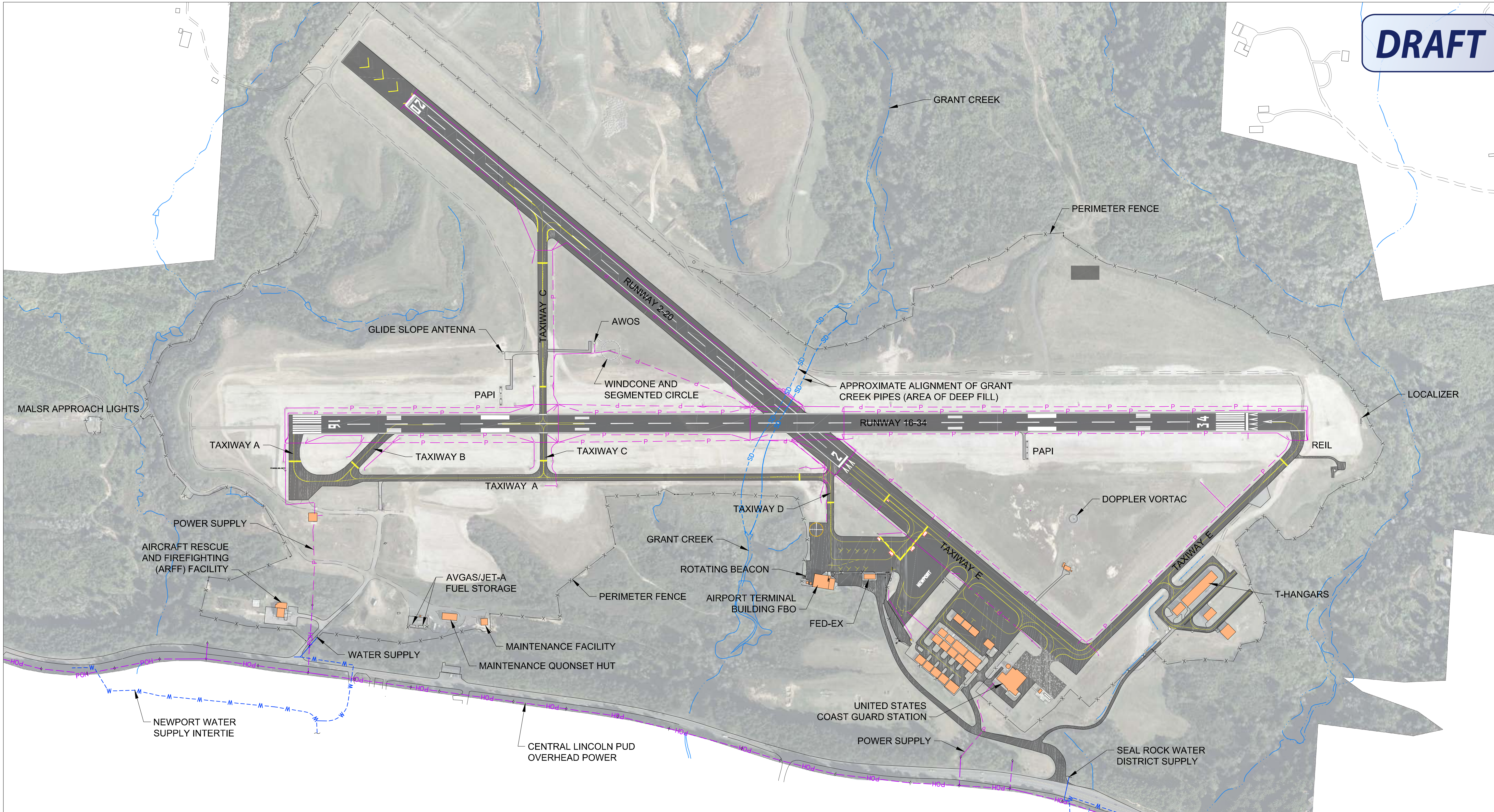
SLIDO, Liquefaction Susceptibility, and Tsunami Evacuation Zones

154-035-009 1/18

HARTCROWSER

Figure **2**

Document Path: \\pdxsrv\data\Notebooks\154035009_Salus-Newport Airport Resilience Assessment\GIS\154035009_Resiliance.mxd Date: 2/1/2018 User Name: melissaschweitzer



File: P:\NNPT010-Resilience Assessment\0400CAD\Graphics\EXH-Existing-Conditions.dwg Layout:EXIST Date: 02-01-2018 Author: jwade

NOTE: UTILITY LOCATIONS SHOWN ARE BASED ON INFORMATION PROVIDED BY OTHERS AND SHOULD BE CONSIDERED APPROXIMATE.

NEWPORT MUNICIPAL AIRPORT
RESILIENCE ASSESSMENT

EXISTING SITE PLAN

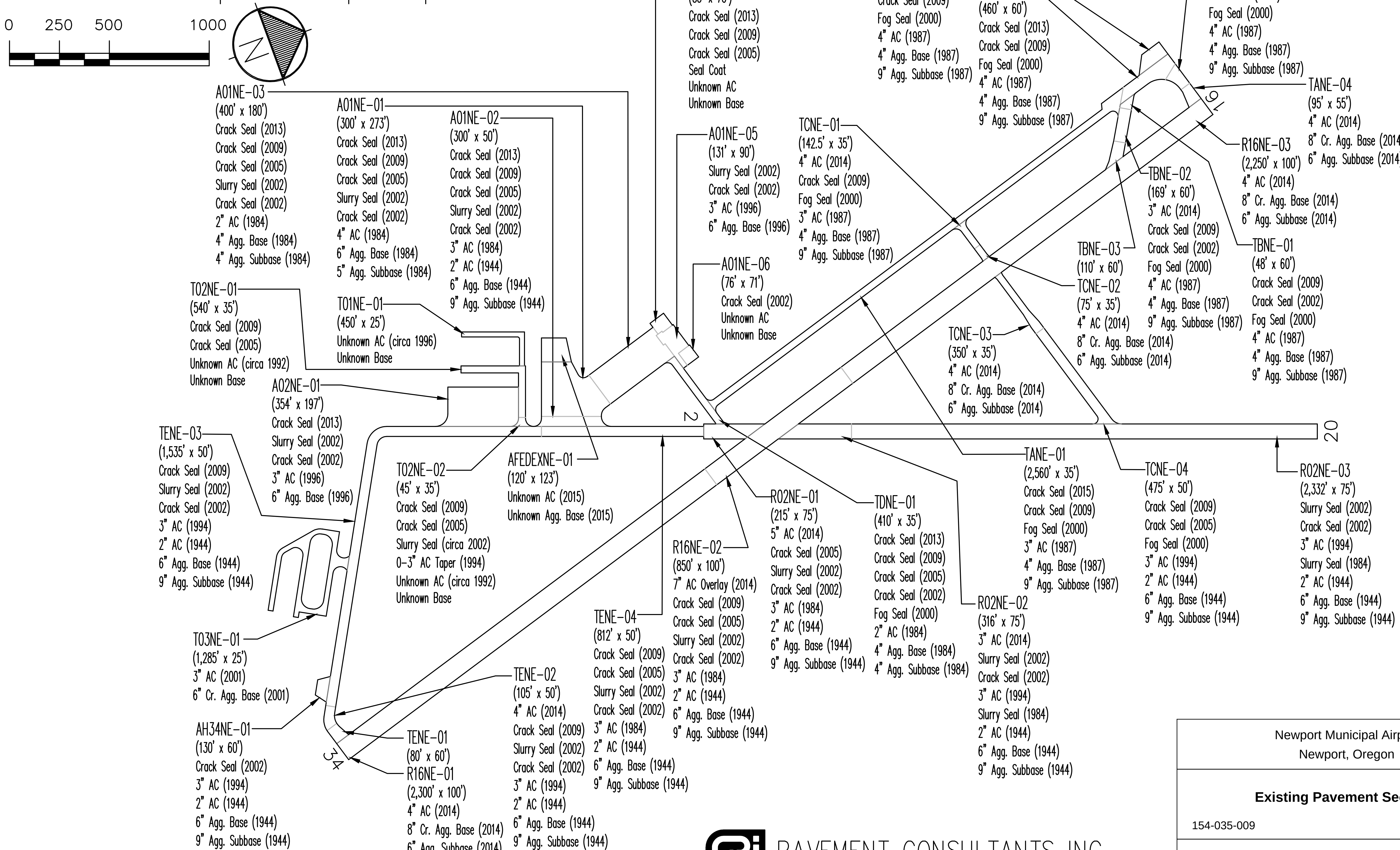
NPT010 2/18

PRECISION APPROACH ENGINEERING
5125 Southwest Hout Street
Corvallis, OR 97333
541•754•0043

Figure 3

Airport Layout, Dimensions and Pavement Cross-Sections.
Newport Municipal Airport

DRAFT



PAVEMENT CONSULTANTS INC.

Drawing Date: September 2015

Newport Municipal Airport
Newport, Oregon

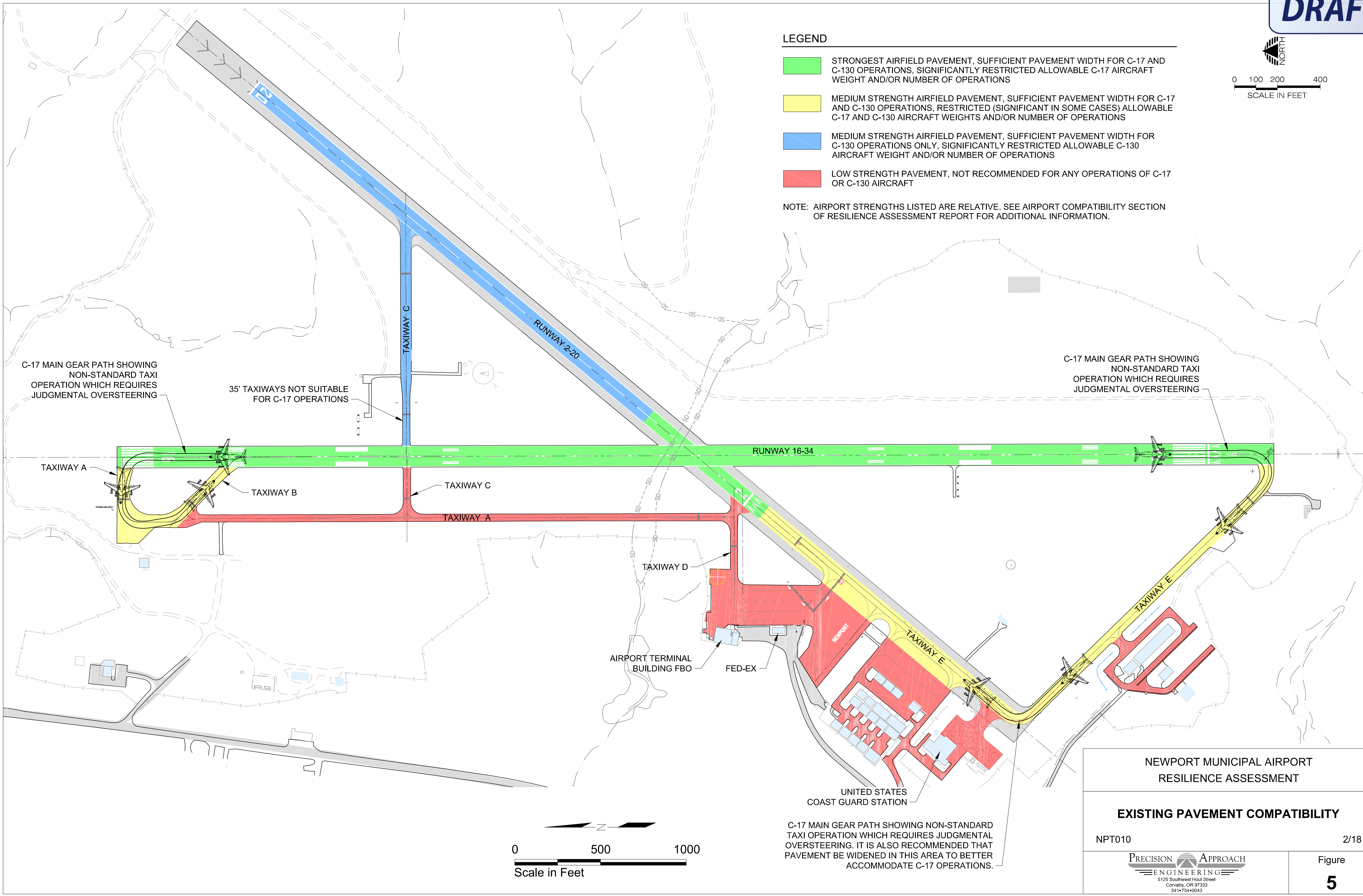
Existing Pavement Sections

154-035-009 1/18

Figure **4**

Source: Oregon Department Of Aviation Pavement Evaluation/Maintenance Management Program 2015

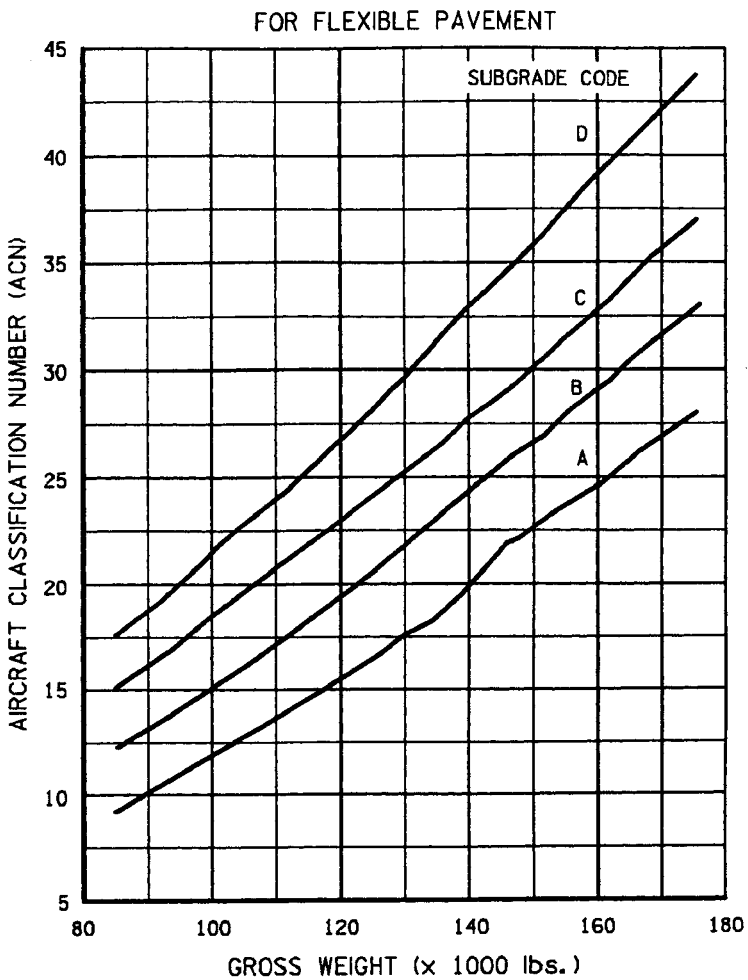
DRAFT



File: P:\NNPT010-Resilience Assessment\0400CAD\Graphics\EXH-Aircraft-Maneuvering.dwg Layout:C130 Date: 02-01-2018 Author: jwade

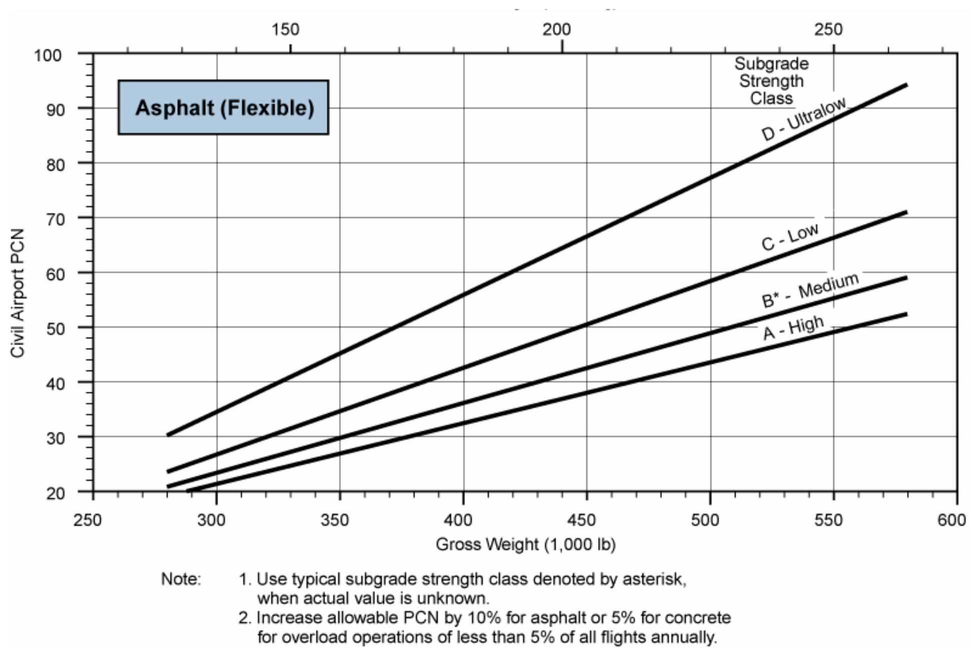
DRAFT

AIRCRAFT CAPACITY NUMBER (ACN) LOCKHEED MARTIN C-130H AND BOEING C-17



Source: NATOPS Flight Manual Navy Model C-130 Aircraft; NAVAIR 01-75GAL-1

LOCKHEED MARTIN C-130H



Source: Boeing C-17A Airport Compatibility Brochure Reference: 2005-K0079

BOEING C-17

Newport Municipal Airport Newport, Oregon	
Aircraft Capacity Numbers 154-035-009 1/18	
PRECISION APPROACH ENGINEERING	Figure **6**

APPENDIX A
Preliminary Geotechnical Site Assessment




Preliminary Geotechnical Site Assessment

Newport Municipal Airport Resilience Assessment Newport, Oregon

Prepared for
Precision Approach Engineering

January 31, 2018
HC Job #154-035-009
City of Newport project #2016-007

HARTCROWSER

www.hartcrowser.com

Preliminary Geotechnical Site Assessment

Newport Municipal Airport Resilience Assessment

Newport, Oregon

Prepared for

Precision Approach Engineering

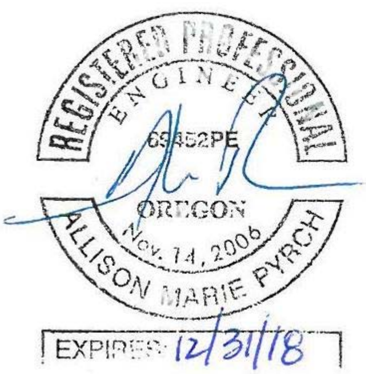
Error! Reference source not found.

HC Job #154-035-009

City of Newport project #2016-007

Prepared by

Hart Crowser, Inc.



Allison M. Pyrch, PE, GE
Associate, Geotechnical Engineer

Timothy W. Blackwood, PE, GE, CEG
Principal, Geotechnical Engineer

300 West 15th Street
Vancouver, Washington 98660-2927
360.448.4189

Contents

TABLES

FIGURES

APPENDIX A

Preliminary Geotechnical Site Assessment

Newport Municipal Airport Resilience Assessment

Newport, Oregon

1.0 INTRODUCTION

Hart Crowser, Inc. is pleased to submit this report summarizing our preliminary geotechnical assessment of the Newport Municipal Airport (Airport) in Newport, Oregon. This report supports the overall resilience assessment completed by Salus Resilience and Precision Approach Engineering (PAE). To support the resilience assessment, Hart Crowser has completed a field exploration program and a seismic hazard analysis of the site in order to evaluate the performance of the airport runways and structures in the event of a Cascadia Subduction Zone Earthquake. Our work was completed in general accordance with our agreement with PAE on July 25, 2016.

Figures 1 and 2 show the general site location, and the site layout with locations of our explorations, respectively. Logs of our explorations are presented in Appendix A.

2.0 SCOPE OF SERVICES

The purpose of our work was to conduct field explorations and perform a preliminary seismic hazards analysis of the Airport. Our complete scope of work is summarized below.

- Reviewed relevant, readily available geologic maps and geotechnical reports that cover the site vicinity to evaluate geologic hazards, regional soil mapping, and local soil and groundwater conditions.

- Conducted a field exploration program that included the following:
  - Marking the proposed exploration locations in the field and notifying the "One Call" service for public utility locates; and
  - Advancing six cone penetrometer test (CPT) soundings to depths ranging from approximately 28 to 56 feet below ground surface (bgs).

- Evaluated code-based seismic hazards, including ground shaking, ground shaking amplification, and liquefaction.

- Prepared this preliminary geotechnical report outlining our findings and recommendations, including information related to:
  - Subsurface soil and groundwater conditions,
  - Seismic analyses for seismic hazards and design criteria, and
  - Slope stability.

- Provided project management and support services, including coordinating staff and subcontractors, and conducting telephone consultations and email communications with PAE.

3.0 SITE CONDITIONS

3.1 Surface Conditions

The project area consists of an approximately 350-acre property (the Airport) located just west from OR Coast Hwy 101 (Hwy 101) on SE 84th Street in Newport, Oregon, as indicated on Figure 1. The site is bound by mostly heavily vegetated areas comprised of shrubs and trees on the north, east, and south and Hwy 101 on the west.

The site is paved with asphalt and concrete pavement, including two existing runways and five taxiways. Runway 16-34 extends north to south and is 5,398 feet long and 100 feet wide. Runway 2-20 extends northeast to southwest and is 3,0001 feet long and 75 feet wide. The portions of the site that are not paved are mostly covered with grass at the surface. Airport facilities are generally present on the western side of Taxiway E, which is in the southwestern corner of the site, just west of Runway 16-34; however, there is an electrical facility located on the northern portion of the site, just west of Taxiway B.

The ground surface of the runways and taxiways is generally level with existing surface elevations around 150 feet above mean sea level (MSL). (Note all elevations herein reference the NAV88 datum.) It is our understanding that the site surface was previously irregular and graded to support development of the airport, including filling the large ravine of Grant Creek that was up to 90 feet deep through the middle of the site. Site grades now generally slope away from the runways and taxiways down to approximately 70 feet MSL at the bottom of the slope. Slopes along the borders are generally between 2 horizontal to 1 vertical (2H:1V) and 3H:1V and are vegetated with small trees and shrubs. According to the airport manager, slope stability has been an issue at the site along the fence line, particularly immediately north of the terminal building and south of the runways.

3.2 Geologic Mapping

The geology surrounding the Airport is mapped in the *Geologic map of the Yaquina and Toledo quadrangles, Lincoln County, Oregon* at 1:62,500 scale (Snavely et al., 1976). The geology surrounding and underlying the airport is mapped as Quaternary coastal terrace deposits capping lower Miocene Nye Mudstone. The coastal terrace deposits consist primarily of fine to medium grained sand with localized cobble and pebble lenses. The Nye Mudstone, which only crops out in drainages, is a marine mudstone and sandstone with sandy siltstone and very fine-grained sandstone in the upper and lower parts of the formation. Most of the runway area is built on coastal terrace deposits, except where fill was placed to extend the runway across the GrantGrant Creek drainage. One well log (Lincoln County #52561), approximately 0.4 mile to the west/southwest within the same mapped geology records clayey silts to a depth of 30 feet followed by siltstone from 30 to 40 feet.

The near-surface soils are mapped by the U.S. Department of Agriculture (USDA), and soil profile descriptions were found on the Web Soil Survey (USDA 2017) website. Immediately beneath the runway surface, soils are mapped as Urban land-Nelscott complex, 0 to 12 percent slopes. Adjacent to the runway soils are predominately mapped as Nelscott loam 3 to 12 percent, and 12 to 50 percent slopes.
The Nelscott loam is described as Loamy aeolian deposits over stratified marine deposits derived from

mixed sources. Minor amounts of Bandon fine sandy loam of 3 to 12, and 12 to 50 percent slopes are located adjacent to the runway. The Bandon fine sandy loam is described as colluvium derived from sedimentary rock.

3.3 Subsurface Conditions

3.3.1 General

We completed field explorations at the site by advancing six CPT soundings (designated HC-1 through HC-6) to depths ranging between approximately 28 and 56 feet bgs. Based on the results of our CPT soundings, the site appears to be underlain predominately by sandy deposits with varying relative densities and fines percentages. Further, the CPT results indicate that there are interbeded layers of fine-grained deposits within the sandy deposits.

We note that CPT soundings identify soil behavior and interpret the likely soil classification associated with that behavior. However, soil samples are not collected by the CPT. Therefore, no actual soil samples were obtained during our explorations performed at the site.

3.3.2 Records Review

We understand, based on adjacent topography, our review of existing plans and reports, and information from the airport manager, that Grant Creek formerly crossed the site in a large ravine, which was filled for construction of the runways and other facilities. This fill is believed to be up to 90 feet deep. Other shallower fills are also interpreted to be present based on adjacent topography and information we reviewed. The estimated locations of the historic fills provided by PAE with our exploration locations are shown on Figure 2.

3.3.3 Soil

In general, the soil types identified from our CPT soundings were predominately relatively clean sands with varying densities and grain size, silty sands, and clayey and silty soils with varying consistency. Explorations HC-3 and HC-6 encountered silty clay to depths of 20 and 5 feet respectively. Below these layers and at the surface in HC-1, HC-2, HC-4, and HC-5, explorations encountered sands and silty sands that extended to depths between 15 and 45 feet bgs. Underlying the sands and silty sands, the explorations encountered medium stiff to very stiff fine-grained materials.

We identified soil relative density and consistency based on estimated equivalent standard penetration testing (SPT) N-values (N_{60}). These values correlate the cone tip resistance obtained from our CPT soundings to SPT blow counts, which are typically reported in blows per foot. Methods to obtain the N_{60} values are outlined by Robertson, Campanella, and Wightman (1983). Based on our CPT field results, N_{60} values within the identified sandy deposits in the upper approximately 15 feet generally corresponded to a relative density ranging between approximately loose and medium dense. The relative density of the interpreted sandy deposits below 14 to 16 feet bgs increased and ranged between approximately medium dense and dense, though some interbedded relatively loose to medium dense deposits were present at depth. Estimated N_{60} values within the interpreted silty clay soils were generally loose to dense throughout the CPT profiles. Additionally, the fine-grained deposits identified from the CPT soundings mostly exhibited a medium stiff, or better, consistency.

3.3.4 Groundwater

Groundwater was noted in our CPT soundings around 34 feet bgs. Our review of groundwater data maintained by Oregon Water Resources Department (OWRD) for a nearby monitoring well indicates a groundwater level at approximately 40 to 50 feet bgs, with potential seasonal fluctuations varying between approximately 15 to 25 feet from seasonal high to low groundwater levels.

Because our explorations identified interbedded fine-grained soils, we note that groundwater could become locally perched atop the fine-grained deposits. Further, we note that groundwater conditions may fluctuate with time and other factors, such as rainfall.

4.0 SEISMIC AND GEOLOGIC HAZARD ANALYSIS

4.1 General

The project site is in a seismically active area. In this section, we describe the seismic setting at the site, identify the seismic basis of design, provide code-based design response spectra, and discuss the seismic hazards at the site.

The seismicity of the region is controlled by the Cascadia Subduction Zone (CSZ). Plate tectonics cause the oceanic Juan de Fuca Plate to subduct beneath the continental North American Plate. Three types of earthquakes are associated with subduction zones: intraslab, interface, and crustal earthquakes. Contributions from each of these sources to the total site seismic hazard was evaluated using the National Seismic Hazard Mapping Project website (USGS 2013).

Intraslab and Interface Sources. Subduction zones are characterized by the interaction of the oceanic Juan de Fuca Plate and continental North American Plate. As the oceanic plate subducts beneath the continental plate, the two plates lock together. As the plates move together, stresses similar to a spring build in the overlying continental plate. This stress acts to unlock the two plates. When the magnitude of the spring stresses becomes large enough to overcome the stresses locking the plates together, the plates will suddenly rupture causing an interface earthquake. Interface earthquakes (such as the 2011 magnitude M9.0 Tohoku earthquake in northern Japan) are some of the largest magnitude earthquakes on record.

Intraslab earthquakes originate from a deeper zone of seismicity that is associated with bending and breaking of the subducting Juan de Fuca Plate. Intraslab earthquakes (such as the 2001 magnitude M7.0 Nisqually earthquake in west central Washington) occur at depths of 40 to 70 kilometers (km) (130,000-230,000 feet) and can produce earthquakes with magnitudes up to and greater than magnitude M7.0. Our review of the interactive deaggregations for the considered hazard level (2,475-year) indicate interface and intraslab earthquakes contribute approximately 89 percent of the total seismic hazard to the site.

Crustal Sources. Shallow crustal faults are caused by cracking of the continental crust resulting from the stress that builds as the subduction zone plates remain locked together. Based on our review of available geologic maps (Goldfinger et al. 1992; Personius 2002; and HazVu 2017), the closest known faults are the Yaquina Faults approximately 5 km north of the site. These and other crustal sources contribute 11 percent of the total seismic hazard under the 2,475-year event to the site. Details of the considered hazard event are provided below.

4.2 Seismic Shaking

We evaluated potential seismic shaking at the site for a hazard level corresponding to a probability of exceedance of 5 percent in 50 years for the maximum considered earthquake (MCE_R) (2,475-year return period). The response spectra for the considered hazard level were obtained from the U.S. Seismic Design Maps (USGS 2014).

The expected peak bedrock acceleration having a 5 percent probability of exceedance in 50 years (MCE_R event) is 0.607g. The Maximum Considered Earthquake Geometric Mean PGA (PGA_M), which accounts for ground motion amplification due to site-specific effects, is also 0.607g. The likeness of these values is due to the proximity of the site to the local source (CSZ). The PGA_M was determined by applying a site class factor to the peak bedrock acceleration. Refer to *Section 4.3 - Ground Motion Amplification (Site Class)* for further information pertaining to ground motion amplification.

We obtained a deaggregation of the seismic sources contributing to the expected peak bedrock acceleration shown above from the National Seismic Hazard Mapping Project website (USGS 2013). Seismic sources contributing to this potential ground shaking include the shallow crustal faults of the Portland Hills fault system and the CSZ megathrust and intraplate sources. The data indicated that the "modal source" for shaking at the site at all potential periods of interest (0.0 to 2.0 seconds) is a magnitude 9.0 earthquake epicentered at the CSZ approximately 17 km from the site. The modal source generally signifies the earthquake with the highest contribution to the site earthquake hazard, in this instance, a rupture along the CSZ.

4.3 Coseismic Crustal Movement

During CSZ megathrust events, permanent coseismic subsidence and displacement (lateral movement) is expected to occur at the site. Modeling of coseismic subsidence included in the 2012 Oregon Resilience Plan for CSZ earthquakes estimates 2 to 3 feet of permanent subsidence at the site (Madin and Burns 2013), similar to estimates produced by extrapolating observed episodic tremor and slip (ETS) GPS motion data along the CSZ for the average recurrence interval of 550 years (Chapman and Melbourne 2009). These model results are in general agreement with approximately 1 meter (3.3 feet) of subsidence previously recovered from drowned forests, buried peat layers and tsunami sand horizons from the 1,700 AD and previous events (Atwater 1987). Additionally, coseismic displacement observed in Japan after the magnitude 9.0 (M_w) 2011 Tohoku earthquake showed seaward movements up to 5.3 meters (17 feet) along the coastline (Ozawa et al 2011), similar to the 5.0 meters (16.4 feet) of observed seaward displacement observed after the magnitude 8.8 (M_w) 2010 Maule earthquake in central Chile (Vigny et al 2011).

4.4 Ground Motion Amplification (Site Class)

Thick sequences of unconsolidated, soft sediments typically amplify the shaking of long-period ground motions, such as those associated with subduction zone earthquakes; whereas, areas underlain by shallow soil profiles are not likely to amplify seismic waves.

The "Site Class" is a designation used by the 2015 International Building Code (IBC) (ICC 2015) to quantify ground motion amplification. The classification is based on the stiffness in the upper 100 feet of soil and bedrock materials at a site. We performed a seismic cone penetration test (SCPT) sounding at the site using a velocity seismometer incorporated into the standard electric CPT cone to obtain a shear wave velocity (V_s) profile in the upper approximately 56 feet. We note that the V_s obtained at approximately 56 feet was assumed to be continuous down to 100 feet bgs. Based on our analysis, the upper 100 feet at the site has an average V_s of approximately 1,100 feet per second. This information, without regard for liquefaction potential (see paragraph below), leads us to classify the site as **Site Class D**.

Our analyses have identified that a liquefaction hazard is present at the site. The IBC indicates that sites where a liquefaction hazard is identified should be represented as **Site Class F** and a site-specific ground response analysis be completed to determine the response spectrum for design, unless the building period is less than 0.5 second. For our study, we have assumed that the existing onsite structures have a fundamental period of less than 0.5 second, so **Site Class D** is allowed per the code. However, we note that the site class provided above should be reevaluated if our assumptions listed herein are not correct.

4.5 Seismic Design Parameters

We obtained seismic design parameters at the site based on the 2,475-year return period. The response spectra for the hazard levels were obtained from the U.S. Seismic Design Maps (USGS 2014).

We anticipate seismic design parameters may change if a site-specific ground response analysis is completed; therefore, the parameters provided in Table 1 should be considered preliminary.

Table 1 – Preliminary Seismic Design Parameters

Parameter	MCE_R
Return Period	2,475 years
Spectral Response Acceleration (Short Period), S_s	1.523 g
Spectral Response Acceleration (1-Second Period), S_1	0.739 g
Peak Ground Acceleration (0-second Period), PGA	0.607 g
Site Class	D (see discussion below)
Site Coefficient, F_a	1.000
Site Coefficient, F_v	1.500
Site Coefficient, F_{pga}	1.000
Spectral Response Acceleration (Short Period), S_{DS}	1.015 g
Spectral Response Acceleration (1-Second Period), S_{D1}	0.739 g
PGA Adjusted for Site Amplification, PGA_m	0.607 g

4.6 Liquefaction Hazards

4.6.1 General

When cyclic loading occurs during an earthquake, the shaking can increase the pore pressure in loose to medium dense saturated sands and cause liquefaction. The rapid increase in pore water pressure reduces the effective normal stress between soil particles, resulting in the sudden loss of shear strength in the soil. Granular soils, which rely on interparticle friction for strength, are susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sand soils with low silt and clay contents are the most susceptible to liquefaction. Silty soils with low plasticity are moderately susceptible to liquefaction under relatively higher levels of ground shaking. For any soil type, the soil must be saturated for liquefaction to occur.

We performed site-specific liquefaction potential analysis on the soils underlying the site using procedures outlined in Zhang, Robertson, and Brachman (2004) and Robertson (2009). The analysis was conducted using the data from the six CPT soundings and the software *CLiq.* In accordance with American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures (ASCE 7-10), we completed the liquefaction hazard analysis using the PGA_M of 0.607g and associated earthquake magnitude of 9.0 in our analysis. We considered two groundwater levels for our analyses: 16 feet bgs taken as the seasonal high groundwater level and 34 feet bgs taken as the water level observed during our site explorations. Based on our analysis, several layers between 15 and 35 feet and between 46 and 60 are liquefiable.

4.6.2 Earthquake-Induced Settlement

Post-liquefaction settlement results from densification of liquefiable sandy soils and remolding of cyclically softened clay-like soils following an earthquake. The permanent ground surface settlement is not typically uniform across the area and can result in significant differential settlement. Differential settlement will have the most significant effect on runway pavements and structures supported by shallow foundations.

We evaluated liquefaction with the CPT data collected. The deepest CPT sounding was 56 feet. However, based on local information and topography, we understand that the fill on-site is up to 90 feet deep. Therefore, we evaluated the liquefaction at a depth of 60 feet as well as an assumed depth of fill of 90 feet. Based on our evaluation, between 5 and 7 inches of settlement can be expected in the areas of approximately 55 feet of loose to medium dense materials. We anticipate that up to 9 to 12 inches is possible in the deeper areas of fill, dependent on the sand content of the lower layers.

4.6.3 Seismic Strength Loss

Our analyses indicate the soils at the site will weaken and exhibit significantly reduced shear strength during and after a major earthquake due to liquefaction and/or cyclic shear strength reduction. This will reduce the stability of slopes adjacent to the site and could potentially cause problems for structures at the site as the bearing capacity of shallow foundations could be significantly reduced during a major earthquake.

4.6.4 Sand Boils and Bearing Capacity Failures

Due to the great thickness of the potentially liquefiable soils and possibility of shallow perched groundwater at the site, it is likely that ground effects, such as sand boils and near-surface bearing capacity failure, will occur. Such conditions can cause significant movement and settlement (greater than noted above) of features that are supported on shallow foundations, and cause buoyancy in buried structures and utilities.

4.6.5 Earthquake-Induced Lateral Spreading and Flow Failures

Lateral spreading occurs when large blocks of ground are displaced down gentle slopes or towards the free face of channels as a result of earthquake-induced inertial forces acting on the soil mass. Initiation of lateral spreading is often made worse when the soils within and beneath the soil mass liquefy or soften as a result of the shaking. Lateral spreading deformations can be experienced relatively far from a free face. Similar to lateral spread, flow failures result when large volumes of soil near the free face of channels or lake bottoms displace vertically and laterally during or after earthquakes. As the ground begins to shake and the shearing resistance of liquefied soils decreases, ground displacement occurs in response to mainly static shear forces present within the soil mass and to a lesser extent earthquake-induced inertial forces. Flow failures typically manifest larger deformations than lateral spreading; however, the extent of the deformations is typically localized to the area behind the free face of the channel. Both lateral spreading and flow failures are destructive and pose a significant risk to the structures in their vicinity.

We completed a lateral spreading analysis with the software *CLiq* using the procedures of Zhang, Robertson, and Brachman (2004) and Robertson (2009). The results of the analysis indicate that the slopes just east and west of the runways and near the terminal building could be subject to lateral spreading deformations. The predicted lateral spread deformations near the slopes may be in excess of 10 feet. It should be acknowledged that the methods used to predict the lateral displacements are empirical and therefore, the magnitude of lateral spreading may vary from that provided above. More detailed numeric ground motion response analyses are required to provide more accurate lateral spread estimates.

4.6.6 Seismic Slope Stability

As described below in section 4.8, several areas of the airport perimeter have experienced slope failures such as shallow slumps and long-term creep. These areas are marginally stable and will likely experience additional movement during a seismic event.

4.7 Ground Fault Rupture

As noted previously, the closest known faults are the Yaquina Faults approximately 5 km north of the site. Therefore, we anticipate the hazard from ground fault rupture to be low, unless occurring on an unmapped or unknown fault underlying the site.

4.8 Other Geologic Hazards

We reviewed mapped geologic hazards at/near the site including: discrete landslides, landslide susceptibility, earthquake shaking, and relative liquefaction hazard. Numerous mapped landsides exist within the Nye Mudstone resulting from coastal erosion along the sea cliffs to the north and west of the airport; however, no mapped landslides exist within the immediate area of the airport on the Oregon HazVu or SLIDO inventories (SLIDO 2017; HazVu 2017). Historically active landslides have been recorded within the same geologic units along roadways to the east of nearby Holiday Beach along Thiel Creek. . The immediate area of the airport is mapped as high to moderate landslide susceptibility, “very strong” expected earthquake shaking, and “Low” liquefaction potential (HazVu 2017). Additionally, in a 1,050-year to 1,200-year tsunami event, possible erosion of the west side of the fill in Grant Creek could be a potential concern based on water levels predicted in the *Local Source (CSZ) Tsunami Inundation Map Newport South, Oregon*.

4.9 Slope Stability

The airport was constructed in an area where several drainages eroded ravines into the hillslope. The flat areas supporting the runways and buildings were created by filling in these ravines. In many areas, fill has been pushed out onto existing slopes around the perimeter of the airport. The fill was likely not adequately keyed, benched or compacted as would be performed today. Information provided by PAE and the airport indicate that ongoing slow creep failures have damaged several of the perimeter fences. Further, discreet shallow slump failures are common in the area in both natural and fill slopes. Maintenance has been required in several areas and based on our observations should be expected to continue. As discussed above, seismic shaking will likely cause slope instability and lateral spreading. This is most likely to occur in areas that are already experiencing movement. Slopes that are close to improvements, such as those close to paved areas and to the west of the terminal building, may be at risk for larger failures during an earthquake.

5.0 CONCLUSIONS

Based on our current understanding of the site and our interpretation of subsurface conditions, the airport site is likely to be adversely affected by seismic events as well as existing static conditions as detailed below.

- The saturated sandy soils at the site are vulnerable to seismically induced strength loss in the event of a major earthquake event. This strength loss is likely to result in the following effects:

    - Liquefaction will induce settlement in the sandy soils below the groundwater table that may undermine stability of foundation systems and cause significant ground settlement under structures and runways.

    - Strength loss of partially saturated material above the groundwater table under strong ground shaking will result in near-surface instability for slopes, and structures supported by shallow foundations.

- Buried structures and utilities may be subject to buoyancy and uplift forces due to shallow liquefaction and sand boils.

- Slopes to the east and west of the runways and terminal building will likely experience slope instability and lateral displacements during seismic loading.

■ Ongoing slope creep and discreet shallow slope failures have occurred under static conditions at the airport for many years. These processes are expected to continue and will likely be made worse by seismic shaking.

Our understanding is that the anticipated differential settlement of the runways will exceed an acceptable level for them to be useable after a design level event. In order to prevent liquefaction and seismic settlement, ground improvement would be required in areas of weak soils and fills. Unstable slope areas where failures could encroach on runways and structures will require stabilization, as well. A brief discussion of ground improvement techniques is described below. In order to finalize settlement estimates and ground improvement recommendations, further geotechnical investigation would be required. We recommend considering both geotechnical borings to confirm soil conditions with the CPT data and a geophysical study to better define the extents of the loose soils.

5.1 Ground Improvement Considerations

As previously discussed, the site soils are vulnerable to liquefaction and strength loss and slopes are unstable under seismic loading conditions. Therefore, significant ground improvements will be required to assure stability during a major seismic event and ensure that the Airport is serviceable after a large earthquake.

Ground improvement measures can be installed to increase the overall stiffness and strength of the soils to reduce the potential for liquefaction and strength loss. This section presents alternatives available for ground improvement construction at the site.

Stone or compacted aggregate columns is one mitigation method; however, given the fine-grained soils present and the vertical and lateral extent of liquefiable soil conditions anticipated at site, we expect that they will be cost prohibitive and not as effective as other methods. The more economical and constructible methods of ground improvement are likely deep soil mixing, compaction grouting, and jet grouting. All of these methods are described in the sections below.

5.1.1 Aggregate Piers

Rammed aggregate piers and stone columns (herein referred to as “aggregate piers”) are constructed by either vibrating a large mandrel into the ground or drilling an open or cased hole to the bottom of the improvement zone. Once at the bottom, free-draining rock is passed through the mandrel and into the column cavity or poured into the open hole. The mandrel or drill is withdrawn and the rock placed and compacted in intervals (typically 3 feet). The goal of installing these aggregate piers will be to mitigate the liquefaction hazard and reduce ground consolidation via: 1) densification, 2) stress redistribution, and/or 3) drainage effects.

Typically, as aggregate piers are constructed, they will densify the surrounding soils, provided those soils do not contain excessive amounts of fine-grained materials. However, vibrations generated during rammed aggregate pier construction can cause deterioration and softening of fine-grained soils. Because of the fine-grained nature of much of the upper site soils, aggregate piers will provide limited densification of the native soils. However, the replacement of the weak existing soils with compacted aggregate will still act to mitigate liquefaction concerns and provide sturdy elements upon which shallow foundations can be safely constructed. They will also increase the average shear strength of the soils, reducing the potential for slope instability. Although we do not anticipate the fine-grained nature of much of the soil profile to present a significant problem, the contractor should be aware of the potential for softening and exercise care in the design and installation of the aggregate piers.

5.1.2 Deep Soil Mixing

Deep soil mixing is a ground improvement method that involves mechanically mixing weak soils with cementitious binder slurry or dry cementitious material to create a higher strength, stiffer soil body for structural support. Soil mixing can be done by constructing individual soilcrete columns or rows of overlapping columns, resulting in variable strength increases of up to 100 percent mass stabilization. If deep soil mixing is being used solely for liquefaction mitigation, a much smaller replacement area is needed. Wet soil mixing is best suited for soils with moisture contents up to approximately 50 percent and is possible up to depths of 100 feet. For soils with greater than approximately 50 percent water content, dry soil mixing is typically a more economical alternative. Soil mixing causes little disturbance to surrounding soil, and therefore, allows installation near existing foundations, though it does produce spoils.

5.1.3 Jet Grouting

Jet grouting is a ground improvement technique that creates *in situ* geometries of higher strength, stiffer soilcrete. Construction involves the advancement of a grouting monitor attached to a drill stem to a design depth. High velocity jets rotate about the bottom of the drill stem, expelling grout slurry that erodes and mixes the surrounding soil body. As the drill stem is retracted to the ground surface, a cylinder of high strength soilcrete remains. These columns can be installed as discrete elements or overlapped to create walls or grids.

Jet grouting is effective in a wide range of soils and is possible to use in confined spaces or around subsurface obstructions such as utilities. However, construction of the jet grout columns generates spoils that can lead to relatively high disposal costs.

5.1.4 Compaction Grouting

Compaction grouting is a ground improvement technique that strengthens and stiffens soils by densifying them as grout is injected into and displaces the soil. A low slump grout is pumped into the ground under high pressure. Grout injection points are placed in a grid pattern (typically 5 to 12 feet on center) throughout the area of improvement and can be advanced to great depths, if needed. An injection pipe is advanced to the desire depth and then withdrawn in increments (typically 3 feet) so that grout can be injected. The grout “bulbs” displace and densify the adjacent soils, and therefore, increase their strength. Use of compaction grouting will need to be more carefully evaluated due to the presence of fine-grained soils, where its effectiveness can be decreased.

6.0 LIMITATIONS

We have prepared this preliminary report for the exclusive use of PAE and their authorized agents for the Newport Municipal Airport Resilience Assessment in Newport, Oregon, in accordance with our proposal dated July 19, 2017. Our report is intended to provide our initial opinion of geotechnical aspects of the site based on the explorations described herein. However, conditions can vary significantly between exploration locations, and our conclusions should not be construed as a warranty or guarantee of subsurface conditions or future site performance.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty, express or implied, should be understood.

Any electronic form, facsimile, or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by Hart Crowser and will serve as the official document of record.

7.0 REFERENCES

ASCE/SEI 2016. Minimum Design Loads for Buildings and Other Structures, ASCE 7-16, American Society of Civil Engineers (ASCE) - Structural Engineering Institute (SEI), 2016.

Atwater, A. F. 1987. Evidence for Great Holocene Earthquakes along the Outer Coast of Washington State. Science, New Series, Vol. 236, No. 4804 (May 22, 1987), 942-944

Chapman, J. S., and T. I. Melbourne (2009), Future Cascadia megathrust rupture delineated by episodic tremor and slip, Geophys. Res. Lett., 36, L22301, doi:10.1029/2009GL040465

Goldfinger, C., L.D. Kulm, R.S. Yeats, C. Mitchell, R. Weldon II, C.D. Peterson, M. Darienzo, W. Grant, and G.R. Priest 1992. Neotectonic map of the Oregon continental margin and adjacent abyssal plain. *Oregon Department of Geology and Mineral Industries Open-File Report O-92-4, scale, 1*(500,000).

HazVu 2017. *Oregon Statewide Geohazards Viewer.* Oregon Department of Geology and Mineral Industries (DOGAMI). Accessed 5/1/2017. http://www.oregongeology.org/hazvu/.

International Code Council (ICC) 2015. 2015 International Building Code (IBC).

Madin, I. P. and Burns, W. J. 2013. Open-File Report O-13-06 "Ground Motion, Ground Deformation, Tsunami Inundation, Coseismic Subsidence, and Damage Potential Maps for the 2012 Oregon Resilience Plan for Cascadia Subduction Zone Earthquakes". Oregon Department of Geology and Mineral Industries (DOGAMI). Accessed 12/29/2017.

Oregon Water Resources Department (OWRD) 2016. Well log query, accessed 10/9/2017, http://apps.wrd.state.or.us/apps/gw/well_log/.

Ozawa, S., Takuya Nishimura, Hisashi Suito, Tomokazu Kobayashi, Mikio Tobita and Tetsuro Imakiire 2011. "Coseismic and postseismic slip of the 2011 magnitude-9 Tohoku-Oki earthquake." Nature, 475, 373–376. doi:10.1038/nature10227

Personius, S.F., compiler, 2002. Quaternary Fault and Fold Database of the United States, U.S. Geological Survey website.

Robertson, P.K., R.G. Campanella, and A. Wightman 1983. "Spt-Cpt Correlations." *Journal of Geotechnical Engineering*, 109(11), 1449-1459.

Robertson, P.K. and C.E. Wride 1998. "Evaluating cyclic liquefaction potential using the cone penetration test." Canadian Geotechnical Journal 35(3), 442-59.

Robertson, P.K., 2009. Performance based earthquake design using the CPT. Proc. IS-Tokyo, 3-20.

Snavely, P.D. Jr., N.S. MacLeod, H.C. Wagner, and W.W. Rau 1976. Geologic map of the Yaquina and Toledo Quadrangles, Lincoln County, Oregon. United States Geological Survey Miscellaneous Investigations Map I-867, scale 1:62,500.

State Landslide Inventory Database for Oregon (SLIDO), 2017. Accessed 5/1/2017. http://www.oregongeology.org/sub/slido/.

U.S. Department of Agriculture (USDA) 2017. National Resources Conservation Service. *Soil Survey of Cowlitz County, Washington*. By Russell F. Pringle and Robert L. Evans, USDA, 1988. *Web Soil Survey.* http://websoilsurvey.nrcs.usda.gov/.

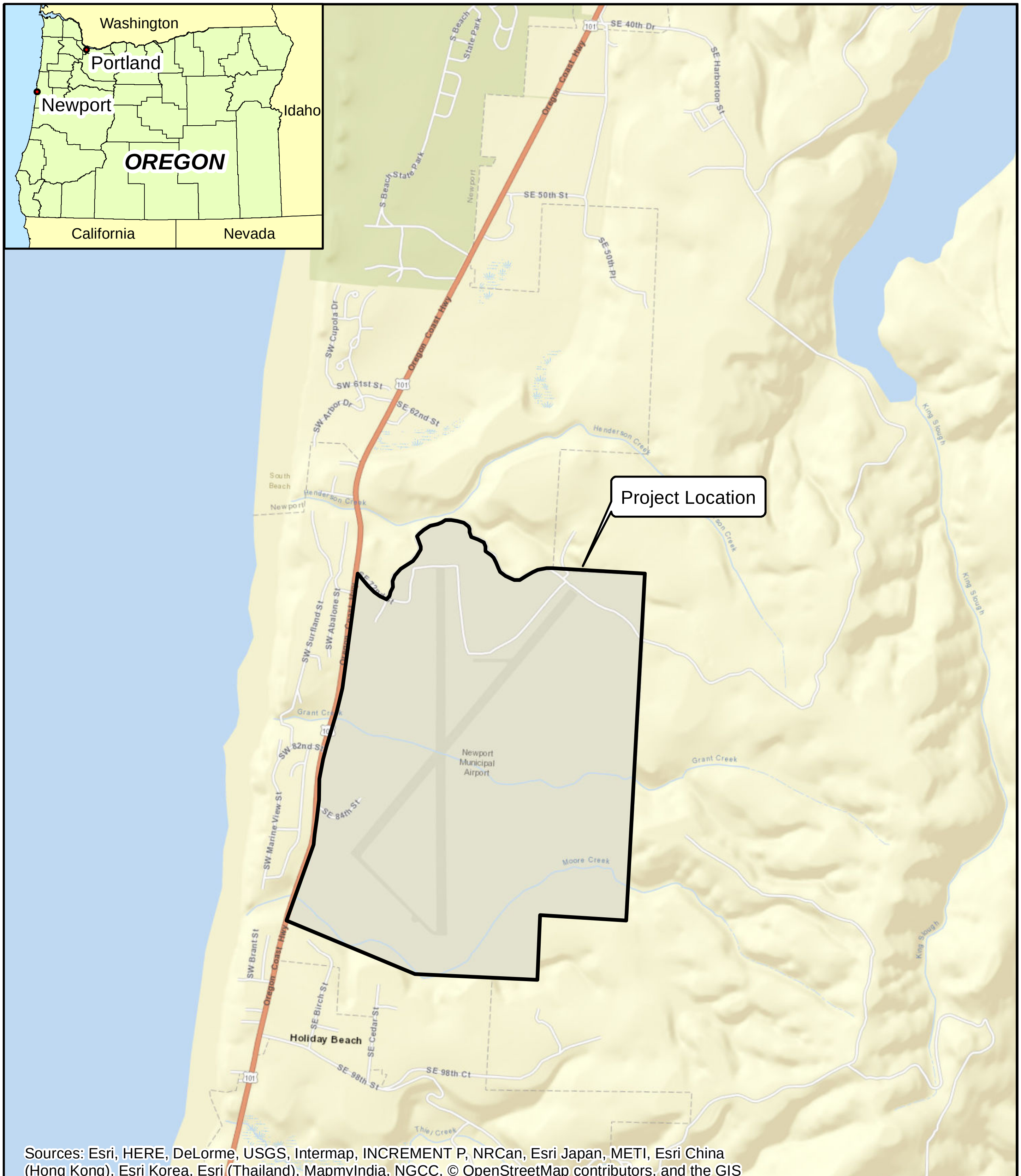
U.S. Geologic Survey (USGS) 2014. U.S. Seismic Design Maps. http://earthquake.usgs.gov/designmaps/us/application.php.

USGS 2013. National Seismic Hazard Mapping Project - Probabilistic Seismic Hazard Assessment Interactive Deaggregation website. https://geohazards.usgs.gov/deaggint/2008/.

Vigny, Christophe, Socquet, Anne. Peyrat, Sophie, Ruegg, J.C., Métois, Marianne, Madariaga, Raúl, Morvan, Sylvain, Lancieri, Maria, Lacassin, R, Campos, Jaime, Carrizo, Daniel, Bejar, Marta, Barrientos, Sergio, Armijo, Rolando, Aranda, C, Valderas Bermejo, Ma. Carolina, Ortega, I, Bondoux, Francis, Baize, Stéphane and Kendrick, E. (2011). The 2010 Mw 8.8 Maule Megathrust Earthquake of Central Chile, Monitored by GPS. Science (New York, N.Y.). 332. 1417-21. 10.1126/science.1204132.

Wang, Rongjiang, et al. "The 2011 Mw 9.0 Tohoku earthquake: Comparison of GPS and strong-motion data." Bulletin of the Seismological Society of America 103.2B (2013): 1336-1347.

Zhang, G., P.K. Robertson, and R.W.I. Brachman 2004. Estimating liquefaction-induced lateral displacements using the standard penetration test or cone penetration test. *Journal of Geotechnical and Geoenvironmental Engineering*, 130(8), 861-871.



Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS

0 1,000 2,000 4,000 Feet

N

Newport Municipal Airport
Newport, Oregon

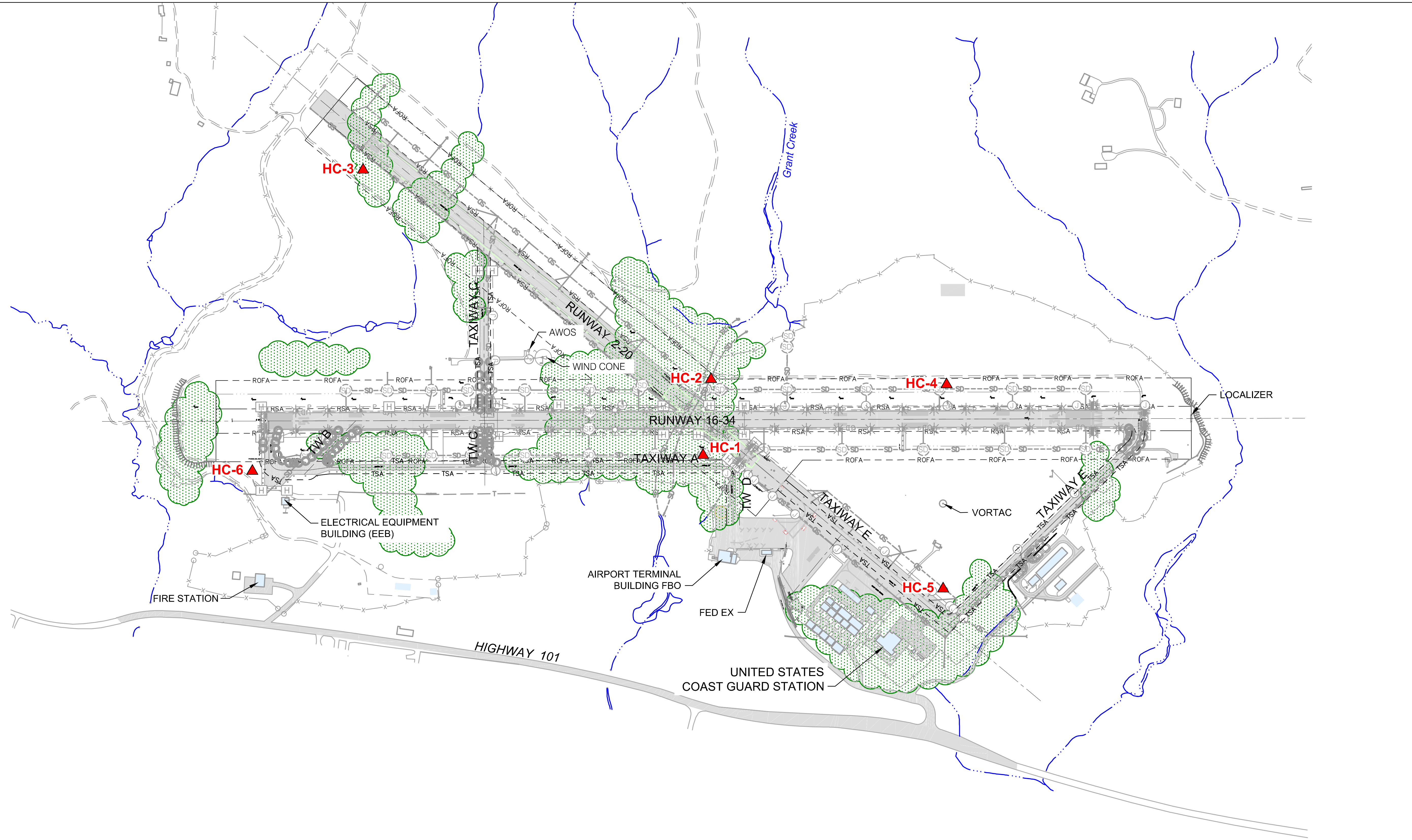
Vicinity Map

154-035-009 1/18

HARTCROWSER

Figure
1

Document Path: \\pdxsrv\data\Notebooks\154035009_Salus-Newport Airport Resilience Assessment\GIS\154035009_VMap.mxd Date: 1/31/2018 User Name: melissaschweitzer



LEGEND

HC-1 ▲ Cone Penetrometer

Approximate Limits of Fill

Source: Base map produced from AutoCAD file, "NPT-EXH-Site-Plan.dwg," provided by Precision Approach Engineering, dated April 2016.

Newport Municipal Airport
Newport, Oregon

Fill Site Plan

154-035-009 1/18

HARTCROWSER

Figure
2

File: \\pdxsrv\data\Notebooks\154035009_Salus-Newport Airport Resilience Assessment\CAD\154035009_SP.dwg Layout:GeotechFillSP Date: 01-31-2018 Author: melissaschweitzer

APPENDIX A
Field Explorations

APPENDIX A

Field Explorations

We evaluated subsurface conditions at the site by advancing six CPT soundings. The explorations were coordinated and overseen by geotechnical staff from Hart Crowser. Data reports for the CPT soundings are included herein.

The approximate locations of the explorations are shown on Figure 2 of the report. Explorations were located in the field based on measurements from existing features. HC-5 has two logs because the sounding hit an obstruction during the first hole and was moved over 10 feet to complete the sounding.

CPT Soundings

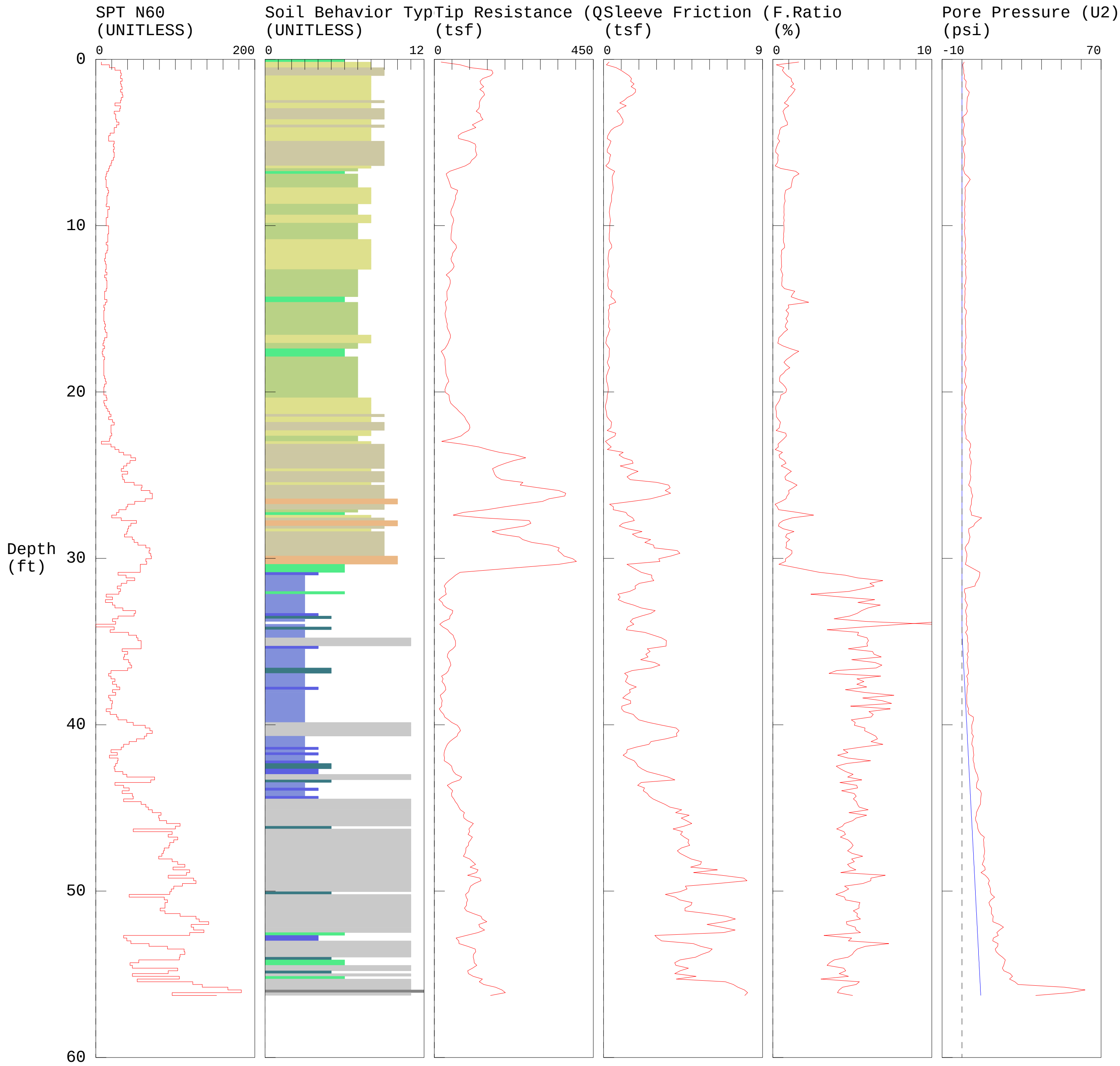
Six CPT soundings were advanced on July 24 and 25, 2017, by Oregon Geotechnical Explorations, Inc. of Keizer, Oregon. They were completed in general accordance with American Society for Testing and Materials (ASTM) D 5778 using a seismic electronic cone penetrometer. The CPT soundings are an *in situ* test that provides assistance in characterizing subsurface stratigraphy. The test includes advancing a 35.6-mm-diameter cone equipped with a load cell, friction sleeve, strain gages, porous stone, and geophone through the soil profile. For CPT testing, the cone is advanced at a rate of approximately 2 centimeters per second. Tip resistance, sleeve friction, and pore pressure are typically recorded at 0.1-meter intervals. For seismic shear wave testing, the cone penetration is stopped at prescribed depth intervals (typically every 1 meter) and a seismic profile readings are obtained at intervals of 5 seconds. The logs of the CPT soundings are presented in this appendix.

Hart Crowser / HC-1 / 135 SE 84th St. Newport

TEST DATE: 7/24/2017 11:09:09 AM
HOLE NUMBER: HC-1

CUSTOMER: 17115 / Hart Crowser / HC-1 / 135
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: 17115 / Hart Crowser / HC-1 / 135 SE 84th St. Newport
JOB NUMBER: 17115 / Hart Crowser / HC-1 / 135 SE 84th St. Newport
TEST DATE: 7/24/2017 11:09:09 AM
TOTAL DEPTH: 56.266 ft

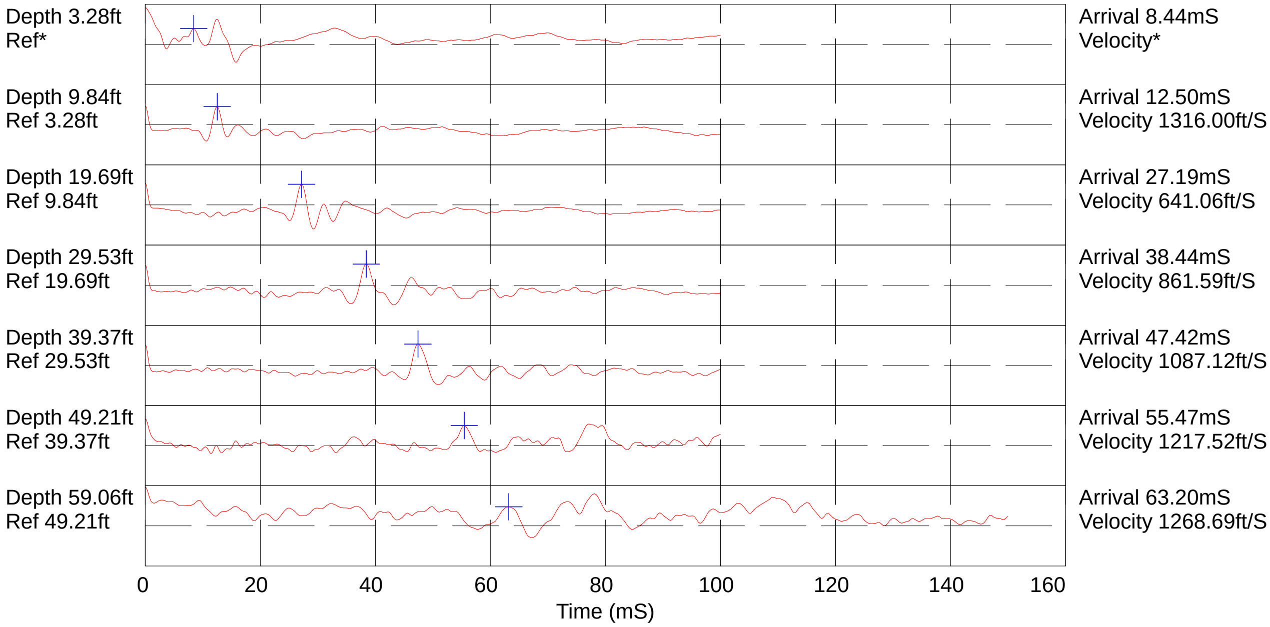


TOTAL DEPTH: 56.266 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy sil	10 gravelly sand to sand
2 organic material	5 clayey silt to silty cl	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey si	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: 17115/ HartCrowser/ HC-1/ Newport



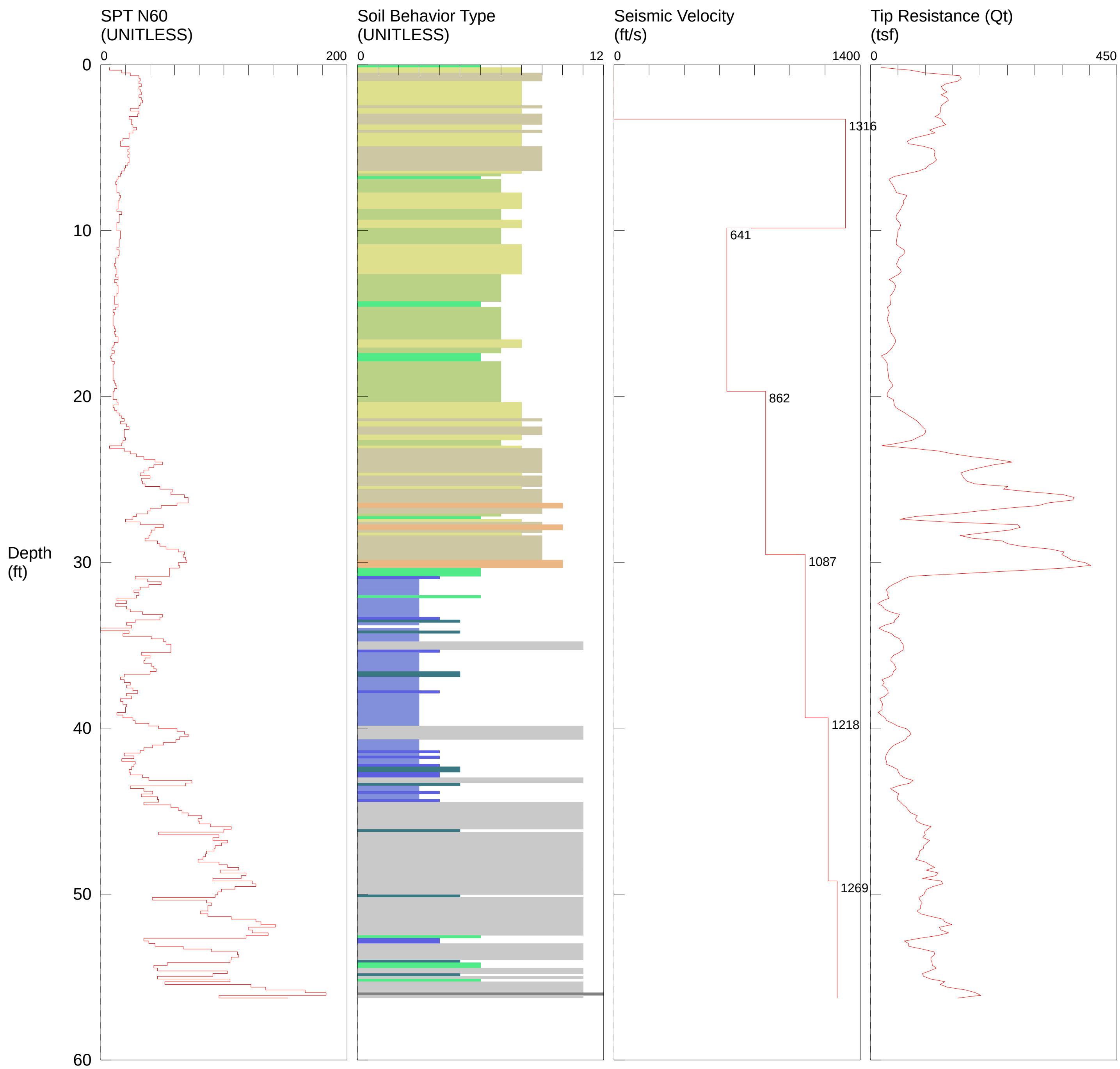
Hammer to Rod String Distance (ft): 4.27
* = Not Determined

Hart Crowser / HC-1 / 135 SE 84th St. Newport

TEST DATE: 7/24/2017 11:09:09 AM
HOLE NUMBER: HC-1

CUSTOMER: 17115 / Hart Crowser / HC-1 / 135 SE 84th St
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: 17115 / Hart Crowser / HC-1 / 135 SE 84th St. Newport
JOB NUMBER: 17115 / Hart Crowser / HC-1 / 135 SE 84th St. Newport
TEST DATE: 7/24/2017 11:09:09 AM
TOTAL DEPTH: 56.266 ft



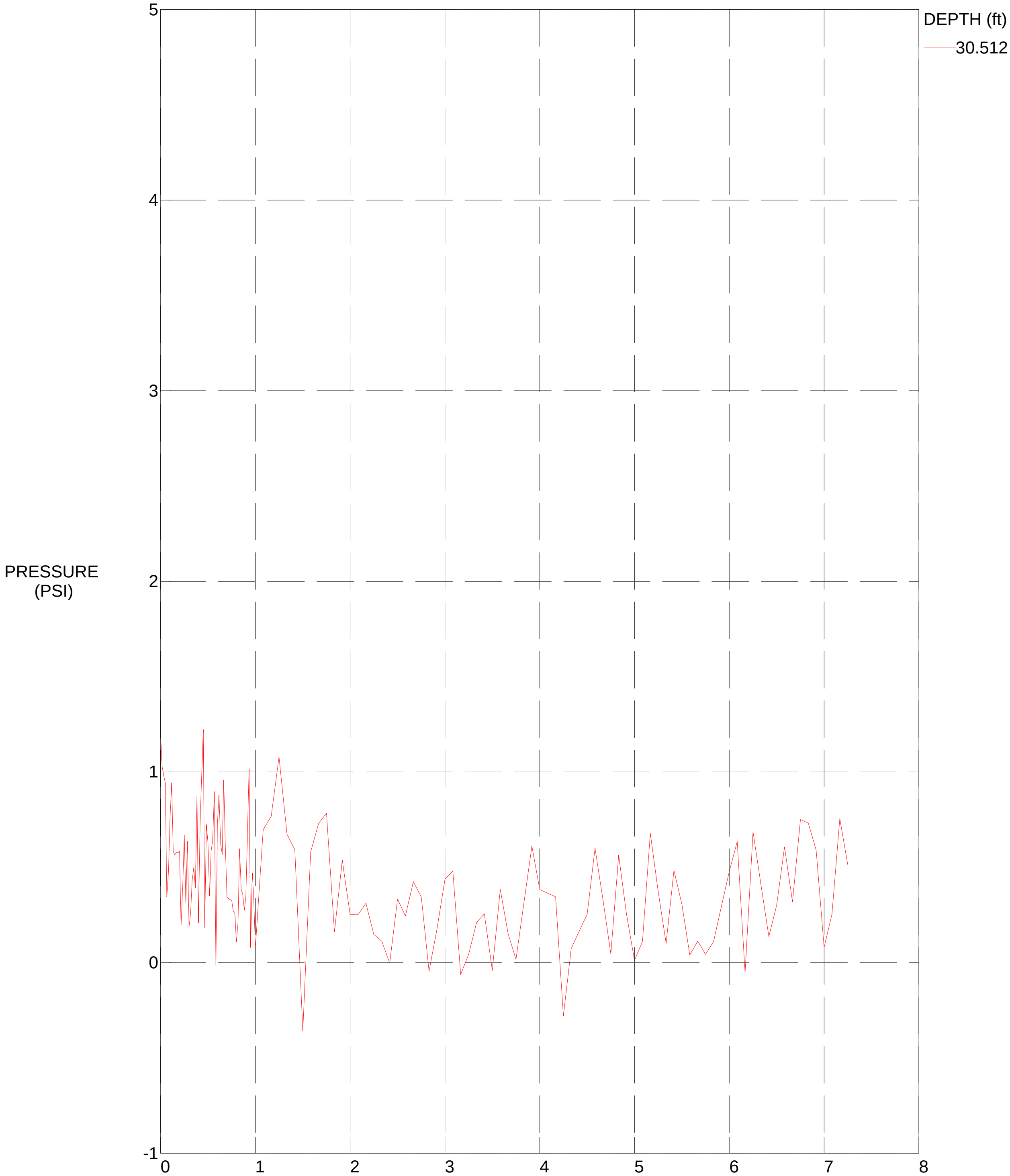
TOTAL DEPTH: 56.266 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: 17115/ HartCrowser/ HC-1/ Newport

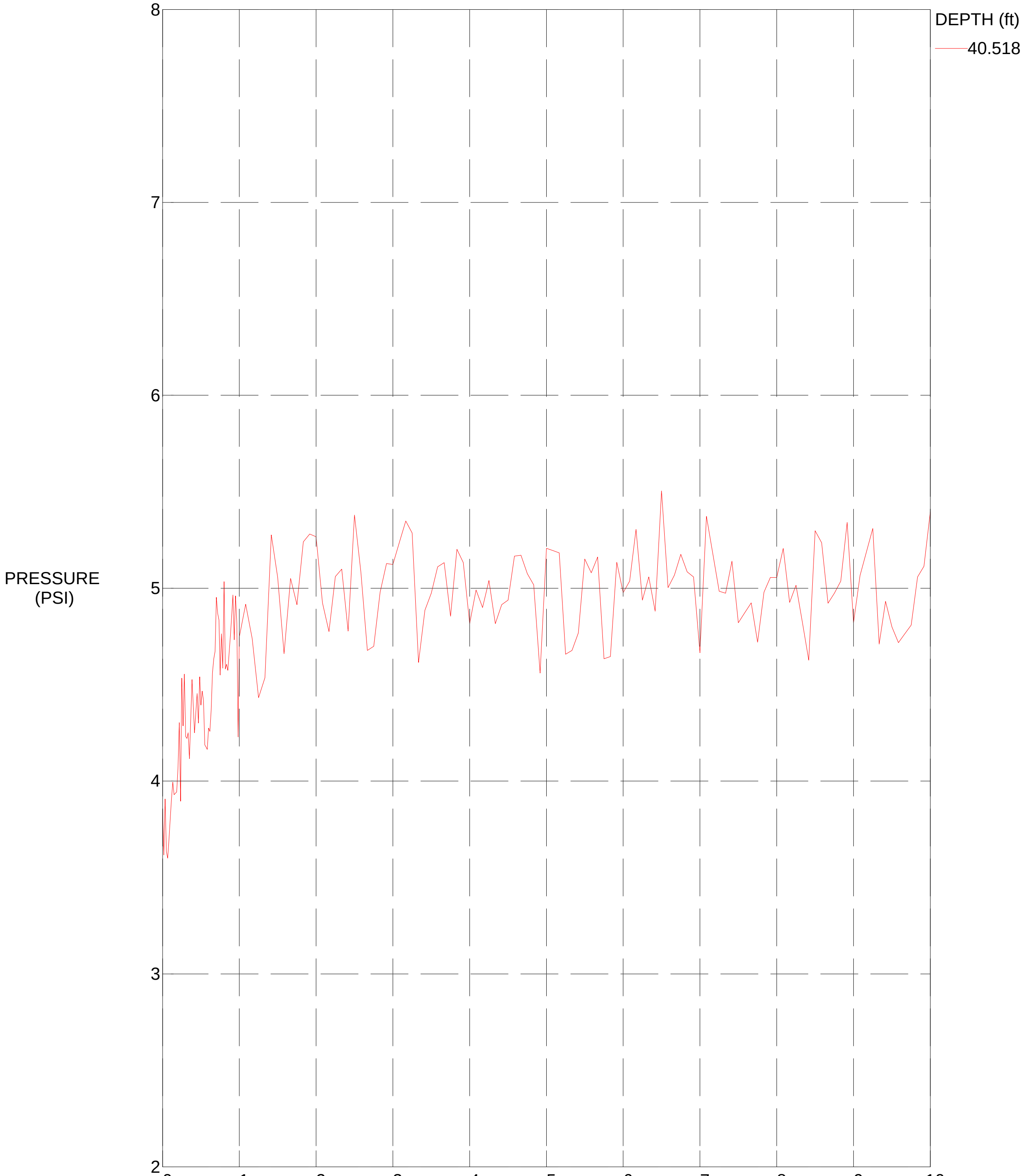
TEST DATE:
OPERATOR: OGE bb



MAXIMUM PRESSURE = 1.223 (PSI) TIME: (MINUTES)
HYDROSTATIC PRESSURE = 0.0 (PSI), WATER TABLE: 34.45 ft

COMMENT: 17115/ HartCrowser/ HC-1/ Newport

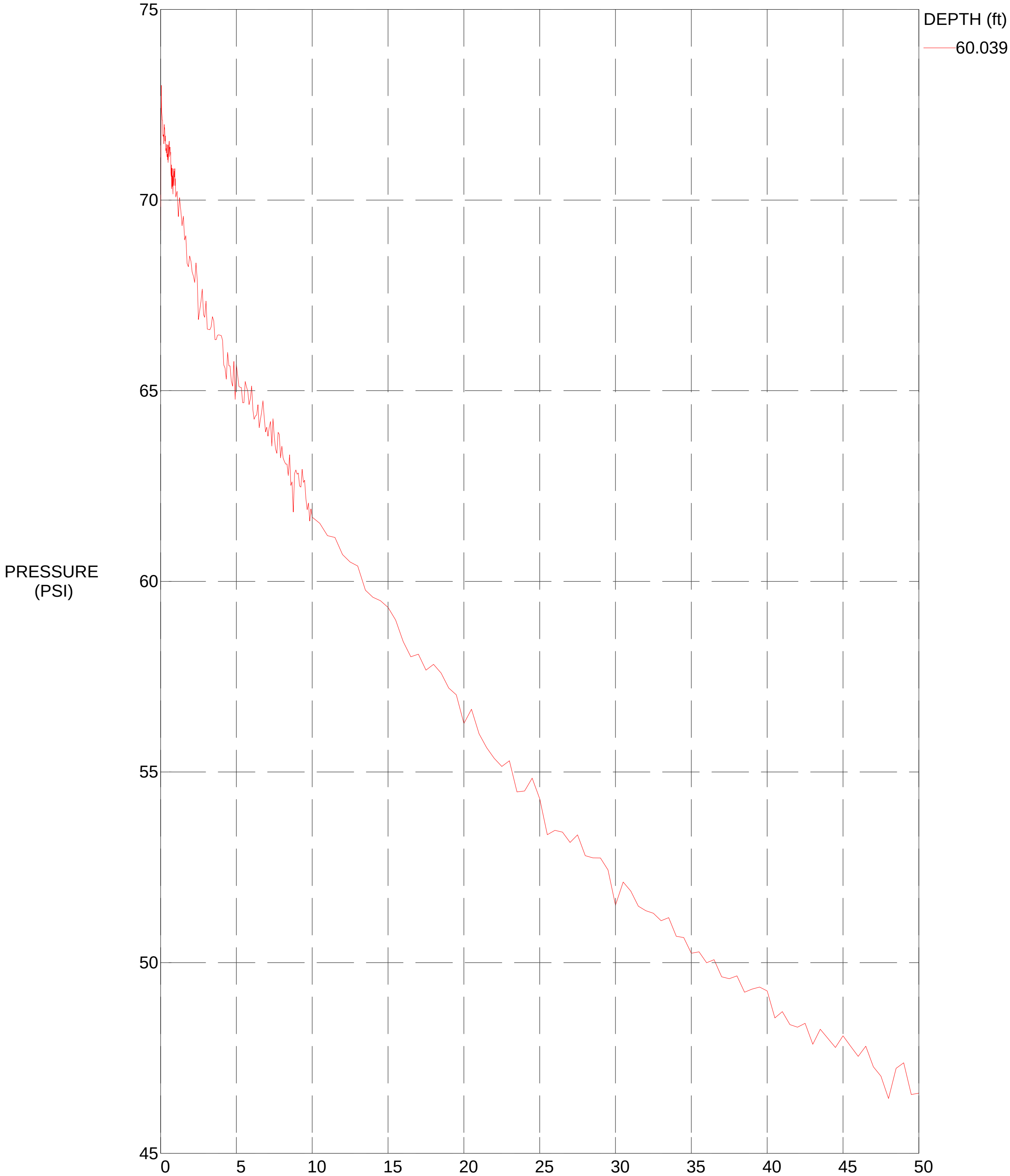
TEST DATE:
OPERATOR: OGE bb



MAXIMUM PRESSURE = 5.504 (PSI)   TIME: (MINUTES)
HYDROSTATIC PRESSURE = 2.631 (PSI), WATER TABLE: 34.45 ft

COMMENT: 17115/ HartCrowser/ HC-1/ Newport

TEST DATE:
OPERATOR: OGE bb



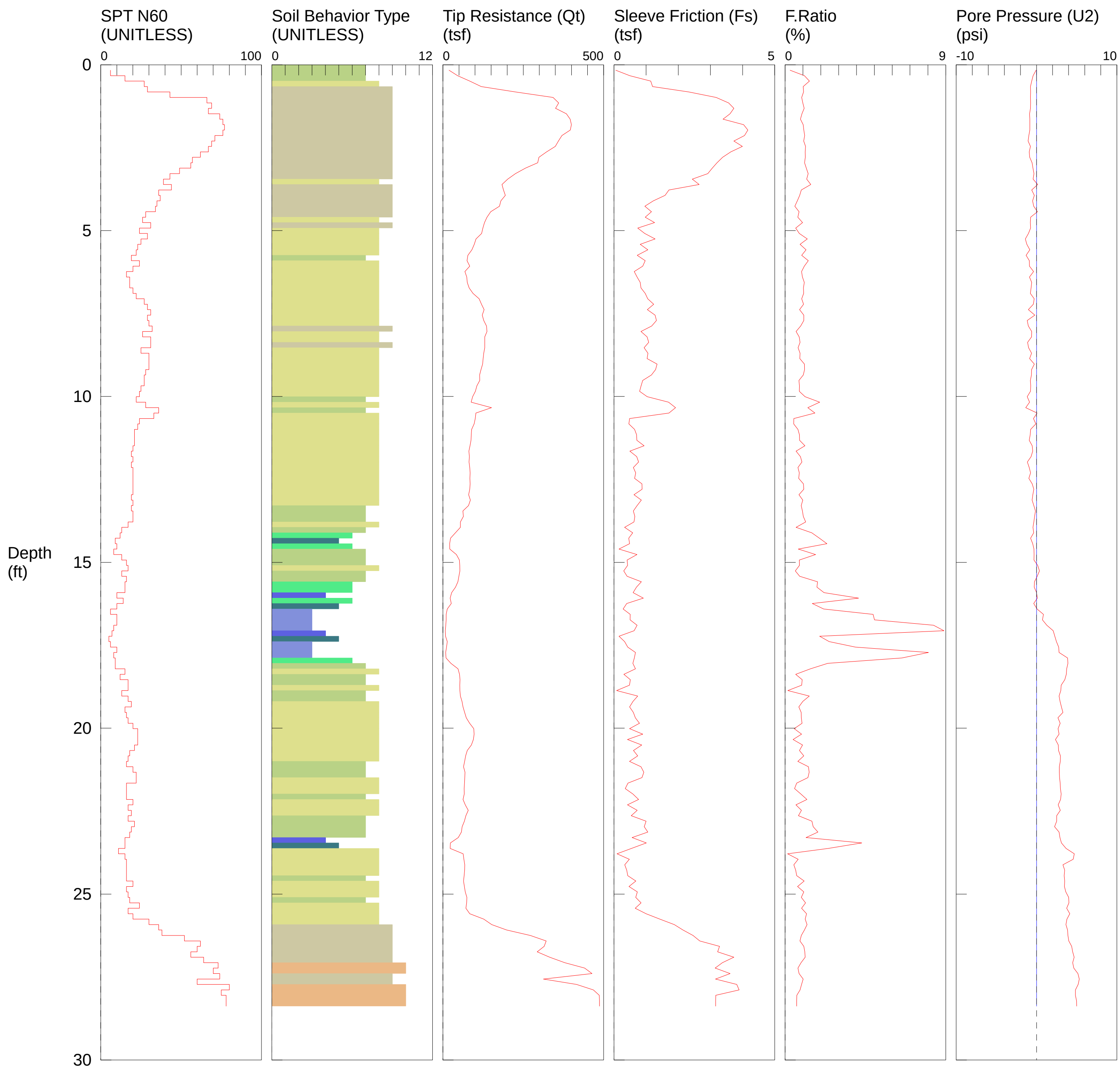
MAXIMUM PRESSURE = 73.006 (PSI) TIME: (MINUTES)
HYDROSTATIC PRESSURE = 13.452 (PSI), WATER TABLE: 29.00 ft

Hart Crowser / HC-2 / 135 SE 84th St. Newport

TEST DATE: 7/24/2017 2:46:11 PM
HOLE NUMBER: HC-2

CUSTOMER: 17115 / Hart Crowser / HC-2 / 135 SE 84th
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: 17115 / Hart Crowser / HC-2 / 135 SE 84th St. Newport
JOB NUMBER: 17115 / Hart Crowser / HC-2 / 135 SE 84th St. Newport
TEST DATE: 7/24/2017 2:46:11 PM
TOTAL DEPTH: 28.379 ft



TOTAL DEPTH: 28.379 ft

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

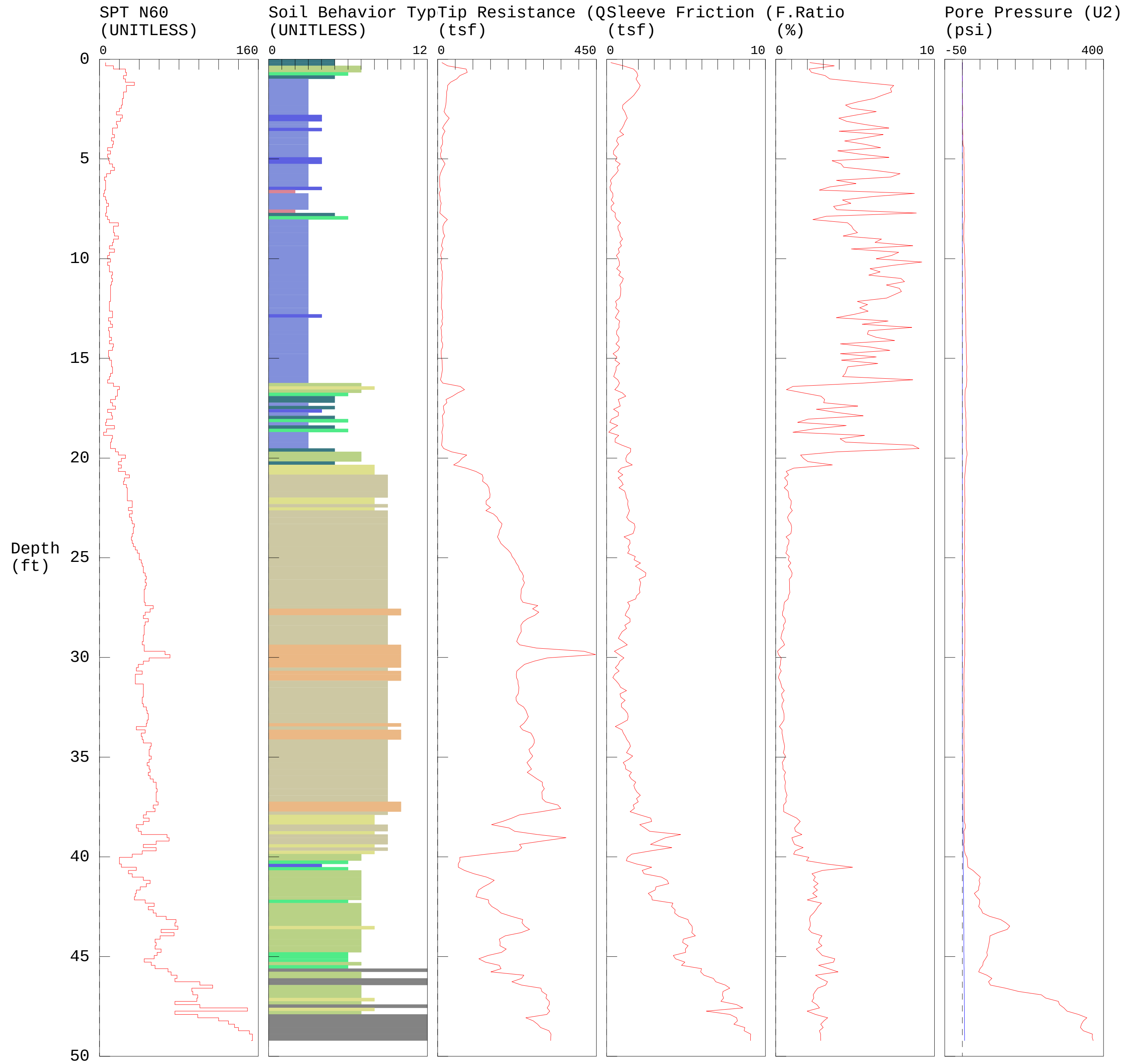
*SBT/SPT CORRELATION: UBC-1983

Hart Crowser / HC-3 / 135 SE 84th St. Newport

TEST DATE: 7/24/2017 4:23:35 PM
HOLE NUMBER: HC-3

CUSTOMER: Hart Crowser / HC-3 / 135 SE 84th
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: Hart Crowser / HC-3 / 135 SE 84th St. Newport
JOB NUMBER: Hart Crowser / HC-3 / 135 SE 84th St. Newport
TEST DATE: 7/24/2017 4:23:35 PM
TOTAL DEPTH: 49.213 ft



TOTAL DEPTH: 49.213 ft

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey si
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

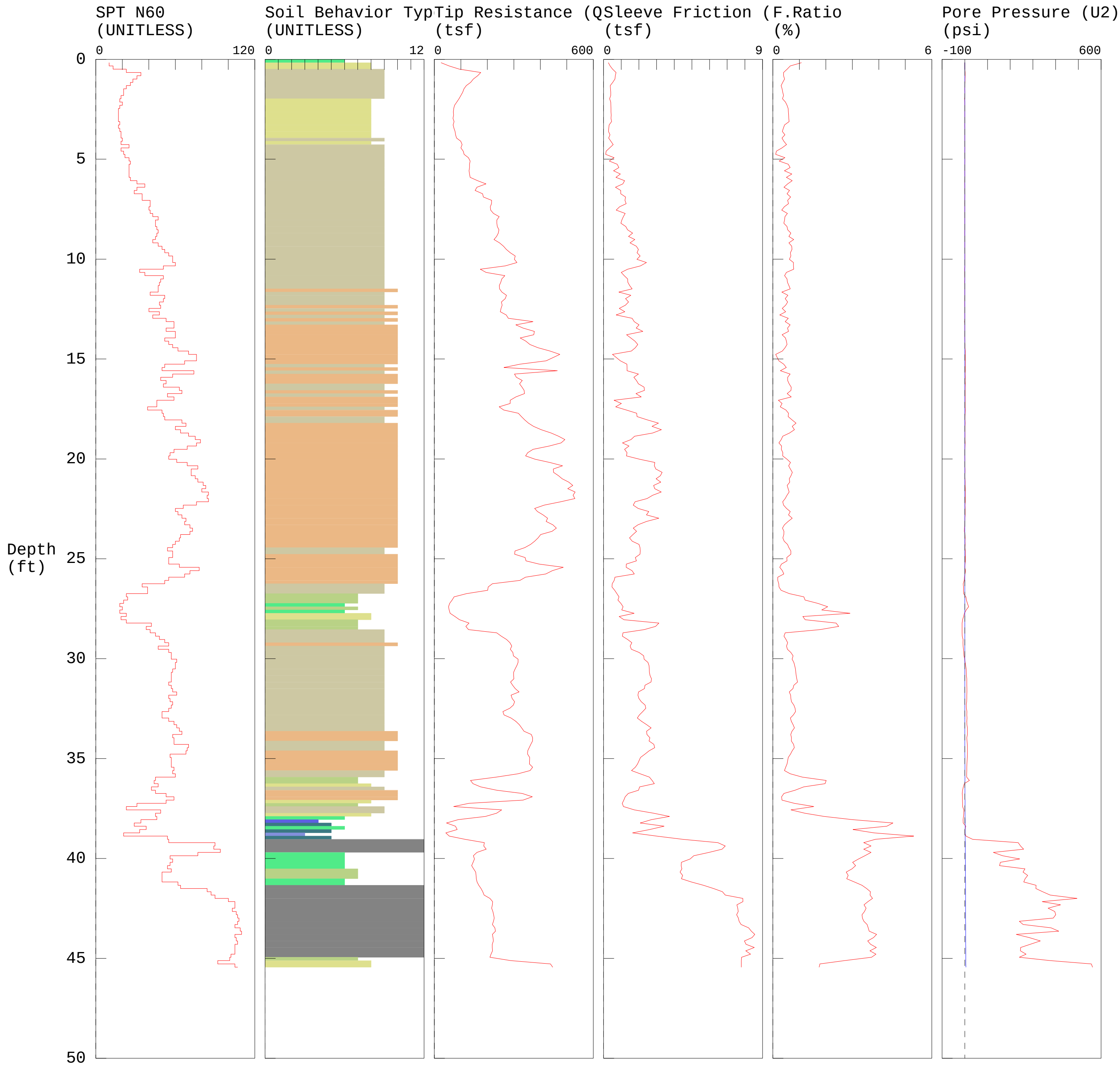
*SBT/SPT CORRELATION: UBC-1983

Hart Crowser / HC-4 / 135 SE 84th St. Newport

TEST DATE: 7/25/2017 7:55:32 AM
HOLE NUMBER: HC-4

CUSTOMER: Hart Crowser / HC-4 / 135 SE 84th
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: Hart Crowser / HC-4 / 135 SE 84th St. Newport
JOB NUMBER: Hart Crowser / HC-4 / 135 SE 84th St. Newport
TEST DATE: 7/25/2017 7:55:32 AM
TOTAL DEPTH: 45.440 ft



TOTAL DEPTH: 45.440 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy sil	10 gravelly sand to sand
2 organic material	5 clayey silt to silty cl	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey si	9 sand	12 sand to clayey sand (*)

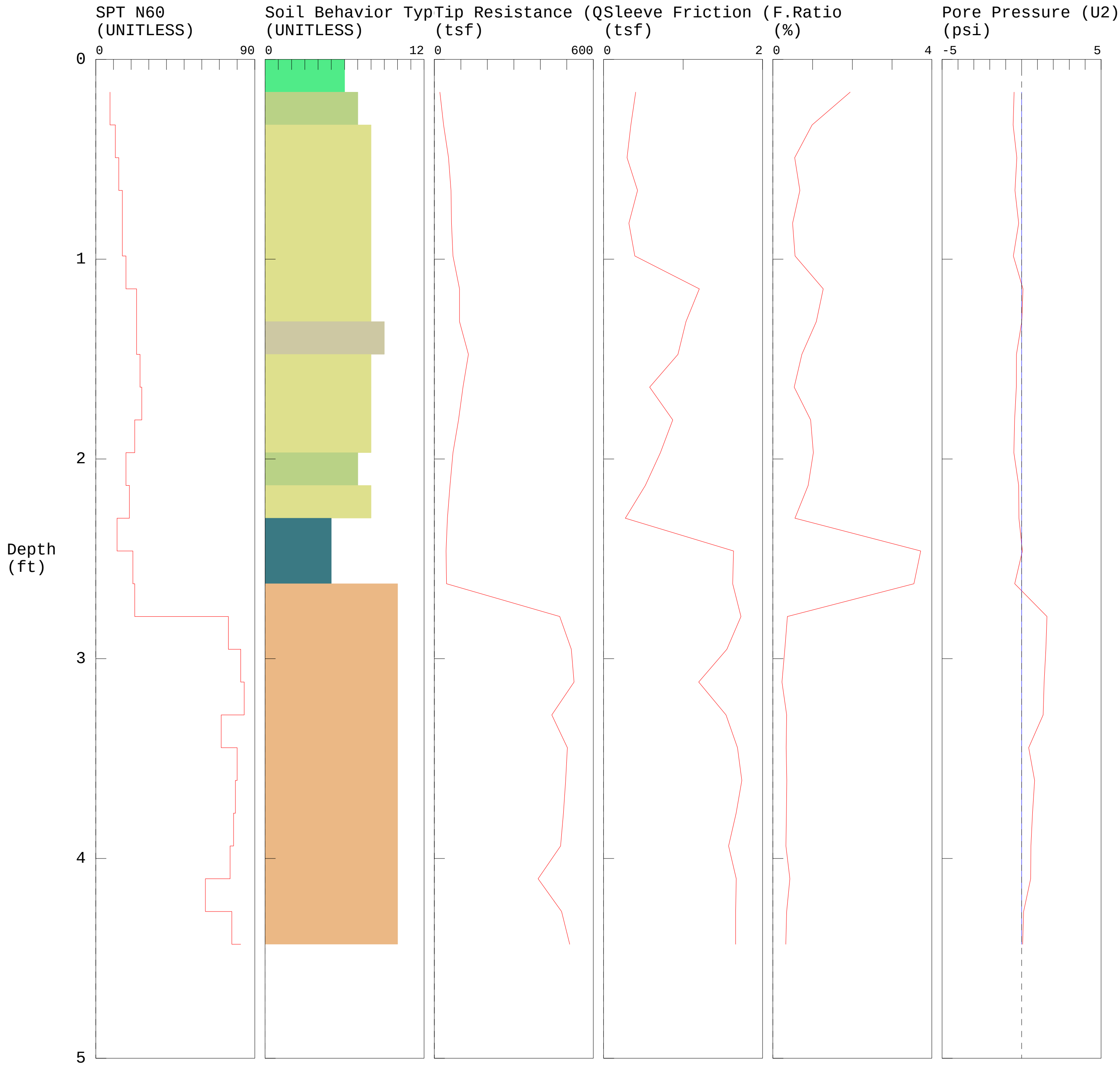
*SBT/SPT CORRELATION: UBC-1983

Hart Crowser / HC-5 / 135 SE 84th St. Newport

TEST DATE: 7/25/2017 9:39:13 AM
HOLE NUMBER: HC-5

CUSTOMER: Hart Crowser / HC-5 / 135 SE 84th
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: Hart Crowser / HC-5 / 135 SE 84th St. Newport
JOB NUMBER: Hart Crowser / HC-5 / 135 SE 84th St. Newport
TEST DATE: 7/25/2017 9:39:13 AM
TOTAL DEPTH: 4.429 ft



TOTAL DEPTH: 4.429 ft

1	sensitive fine grained	4	silty clay to clay	7	silty sand to sandy sil	10	gravelly sand to sand
2	organic material	5	clayey silt to silty cl	8	sand to silty sand	11	very stiff fine grained (*)
3	clay	6	sandy silt to clayey si	9	sand	12	sand to clayey sand (*)

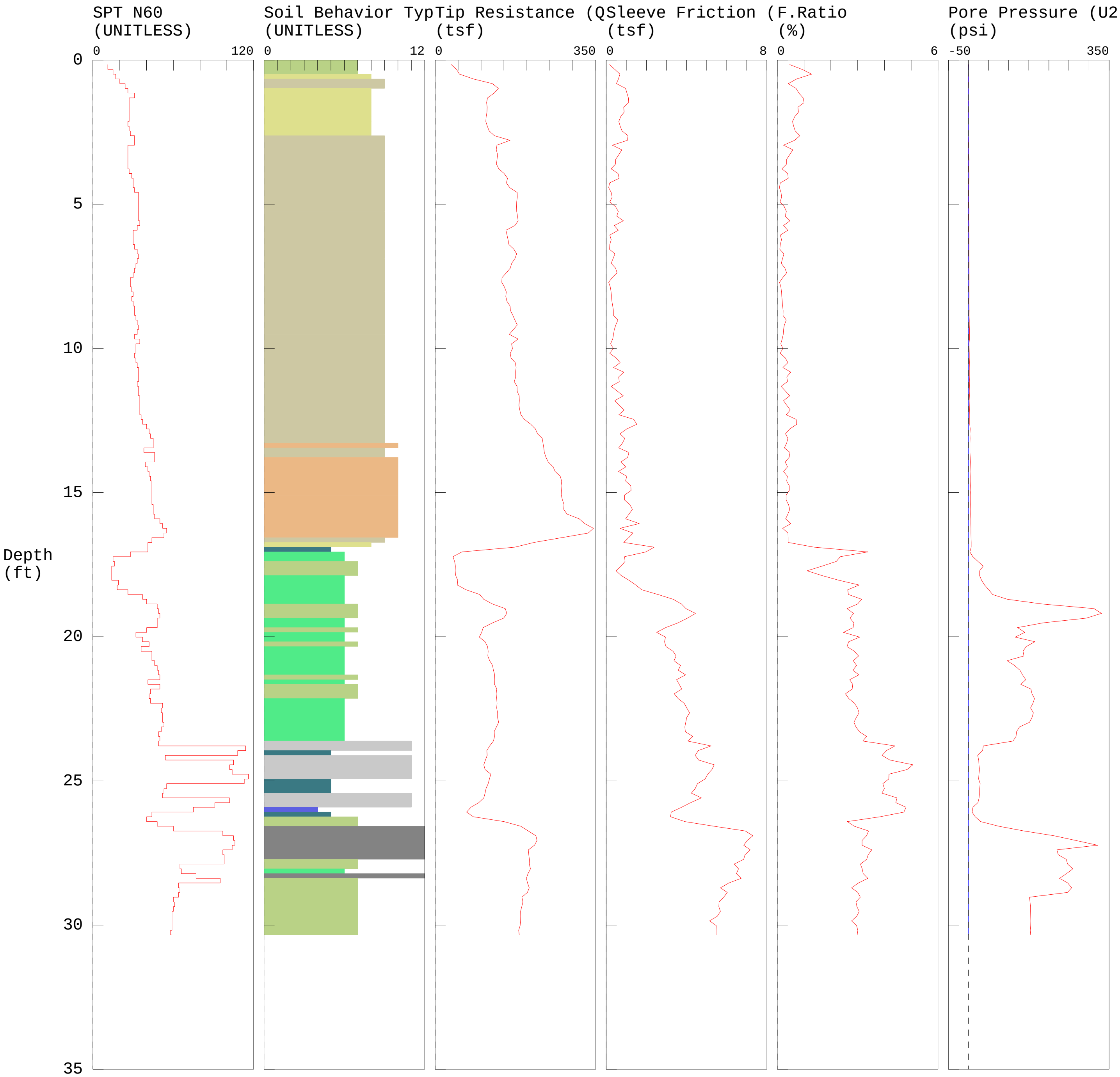
*SBT/SPT CORRELATION: UBC-1983

Hart Crowser / HC-5a / 135 SE 84th St. Newport

TEST DATE: 7/25/2017 10:15:17 AM
HOLE NUMBER: HC-5a

CUSTOMER: Hart Crowser / HC-5a / 135 SE 84tTEST DATE: 7/25/2017 10:15:17 AM
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: Hart Crowser / HC-5a / 135 SE 84th St. Newport
JOB NUMBER: Hart Crowser / HC-5a / 135 SE 84th St. Newport
TOTAL DEPTH: 30.348 ft



TOTAL DEPTH: 30.348 ft

1	sensitive fine grained	4	silty clay to clay	7	silty sand to sandy sil
2	organic material	5	clayey silt to silty cl	8	sand to silty sand
3	clay	6	sandy silt to clayey si	9	sand
10	gravelly sand to sand	11	very stiff fine grained (*)	12	sand to clayey sand (*)

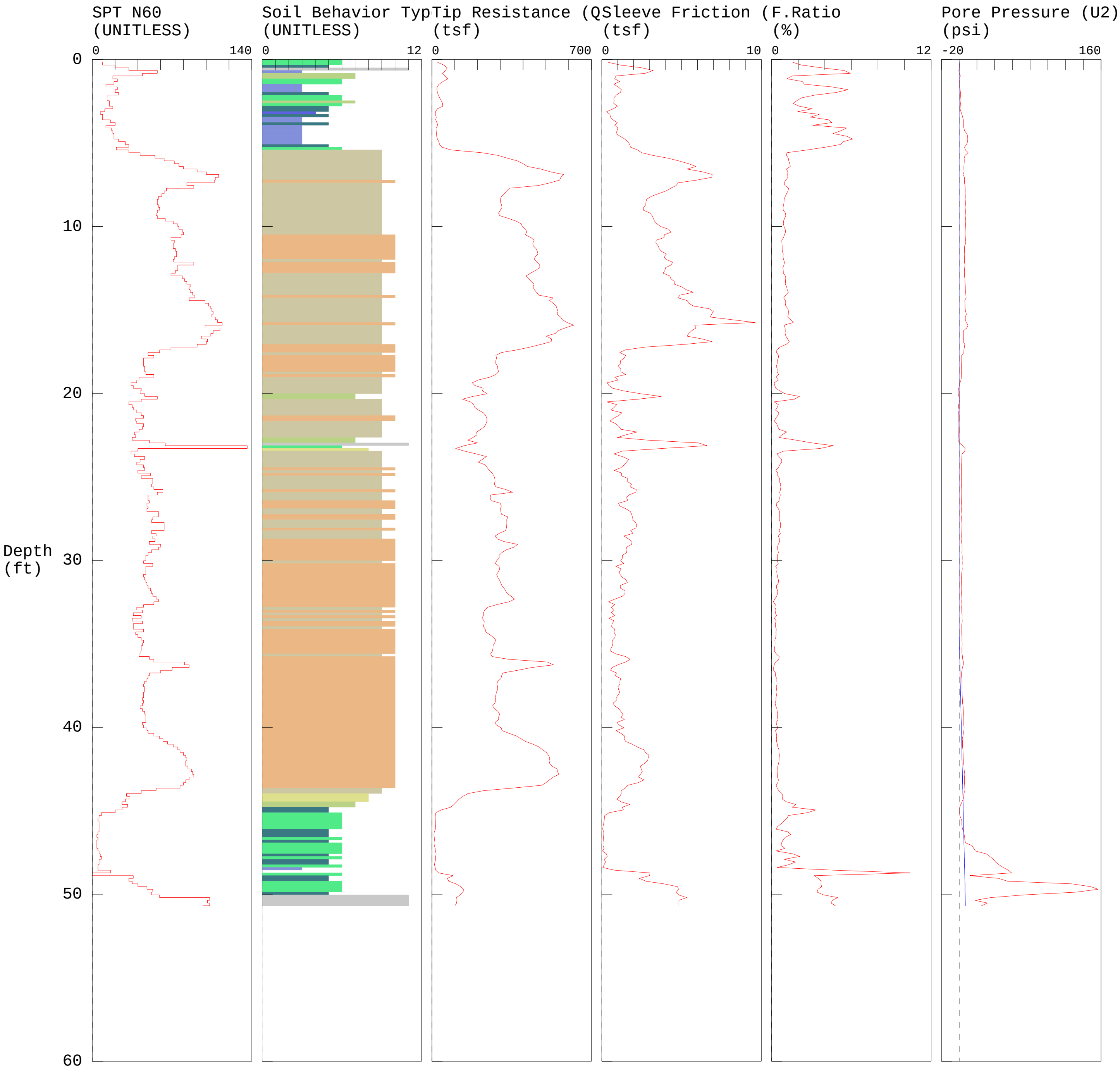
*SBT/SPT CORRELATION: UBC-1983

Hart Crowser / HC-6 / 135 SE 84th St. Newport

TEST DATE: 7/25/2017 12:44:17 PM
HOLE NUMBER: HC-6

CUSTOMER: Hart Crowser / HC-6 / 135 SE 84th
OPERATOR: OGE bb

CONE ID: DPG1386
LOCATION: Hart Crowser / HC-6 / 135 SE 84th St. Newport
JOB NUMBER: Hart Crowser / HC-6 / 135 SE 84th St. Newport
TEST DATE: 7/25/2017 12:44:17 PM
TOTAL DEPTH: 50.689 ft



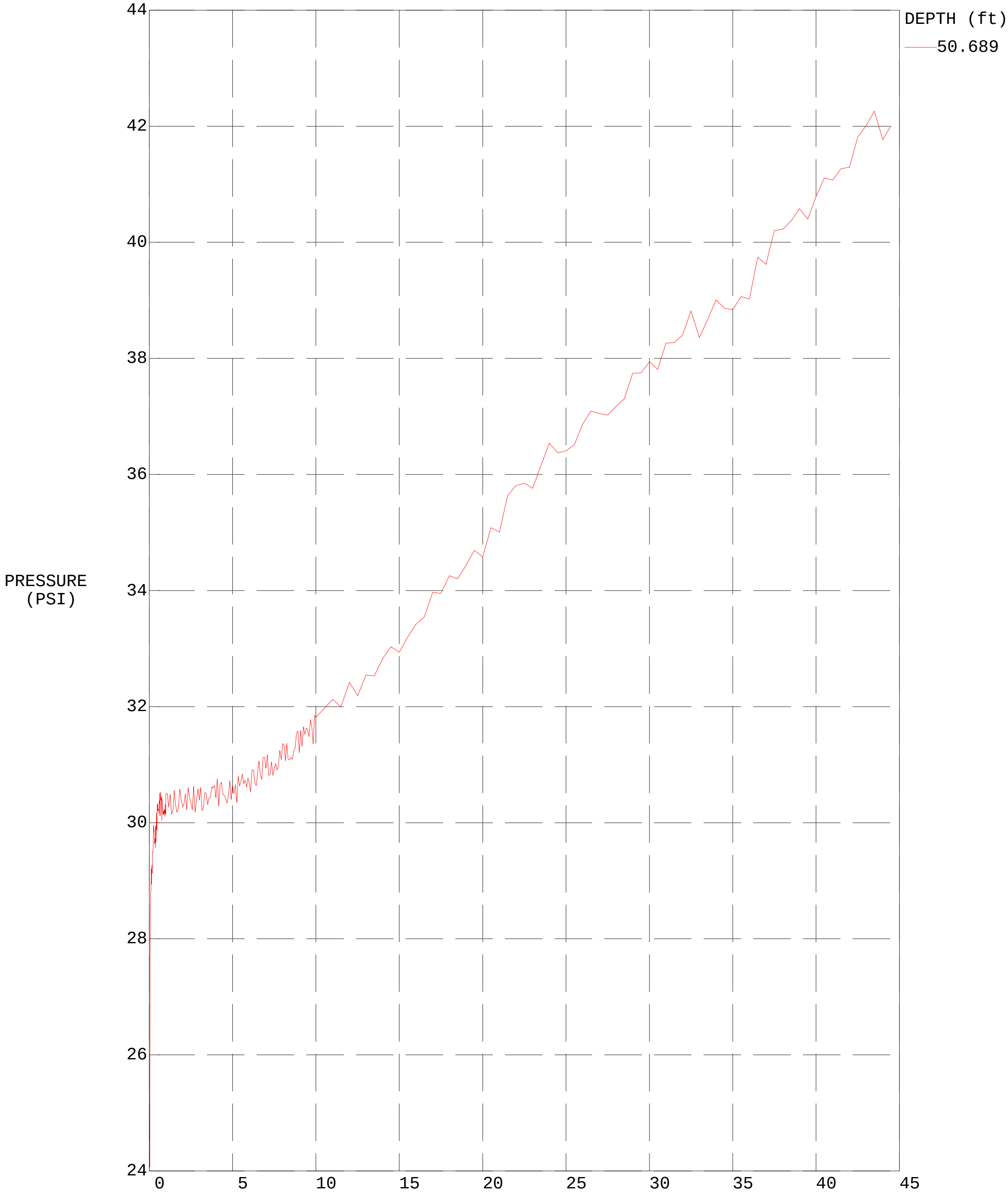
TOTAL DEPTH: 50.689 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy sil	10 gravelly sand to sand
2 organic material	5 clayey silt to silty cl	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey si	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: 17115/ HartCrowser/ HC-6/ Newport

TEST DATE: 7/25/2017 12:44:17 PM
OPERATOR: OGE bb



MAXIMUM PRESSURE = 42.26 (PSI)
HYDROSTATIC PRESSURE = 7.016 (PSI), WATER TABLE: 34.50 ft

APPENDIX B
ASCE 41-13 Structural Assessments

EQUILIBRIUM ENGINEERS LLC

November 15, 2015

Allison Pyrch
Hart Crowser
6420 Macadam Avenue Suite 100
Portland, OR 97239-3517

RE: Newport Municipal Airport FOB Building & South Beach Fire Station ASCE 41
EE LLC Job No. 17083

Dear Allison:

Attached please find ASCE 41-13 Seismic Assessment Reports for the Newport Municipal Airport FOB Building and South Beach Fire Station. The reports summarize the findings we made during our Tier 1 assessment of the two buildings in accordance with the provisions of ASCE 41-13 *Seismic Evaluation and Retrofit of Existing Buildings* and provide a list of upgrades and modifications required to bring the building in compliance with the ASCE 41 standard. As agreed upon with you, both structures were evaluated to the Immediate Occupancy performance level since they will both be needed for emergency response in the event of an earthquake in the region.

In addition to the visual assessment of these two buildings, we also walked through a Quonset hut on the site that is currently used for storage. While an ASCE 41 evaluation of this building is beyond the scope of the work we were retained to perform, we can say that the building will likely not meet the ASCE 41 Life Safety performance level due to its deteriorated condition. If this building is being considered for occupation, we would recommend a full ASCE 41 evaluation be performed to further define the deficiencies and approaches to improving its seismic performance.

We appreciate the opportunity to assist you with this study. If you have any questions, or need further information, call me.

Sincerely,

Ed Quesenberry, S.E.
Principal

STRUCTURAL REGISTERED PROFESSIONAL ENGINEER
OREGON
July 22, 1997
EDWARD P. QUESENBERRY
EXPIRES 12/31/2018

16325 Boones Ferry Road, Suite 202 ■ Lake Oswego, Oregon 97035
Phone 503.636.8388 ■ Cell 503.803.8576 ■ Email edq@equilibriumllc.com

Newport Municipal Airport
FBO Building
135 SE 84th Street
Newport, OR

ASCE 41 Evaluation

August 30, 2017
Revised January 19, 2018

Submitted to:
Hart Crowser
6420 Macadam Avenue
Suite 100
Portland, OR 97239-3517

Submitted by:
Equilibrium Engineers, LLC
16325 Boones Ferry Road, Suite 202
Lake Oswego, OR 97035
Project No. 17083

Newport Municipal Airport
FBO Building
135 SE 84th Street
Newport, OR

Table of Contents

Newport Municipal Airport
FBO Building
135 SE 84th Street
Newport, OR

ASCE 41 Evaluation
August 30, 2017

Introduction

The FBO Building at the Newport Regional Airport was originally constructed in 1998, and is a two-story premanufactured metal building housing a hanger and office space. The structure is comprised of steel truss moment frames and steel X braced frames with wood sheathed exterior walls and roof. For the purposes of this ASCE 41 evaluation, the structure will be classified as type S3 Steel Light Frame.

Since Life Flight's offices and dispatch are located within this building, we considered the building as an essential facility in this assessment. We evaluated the building using the Tier 1 Immediate Occupancy Performance Level criteria outlined by ASCE 41. A building which is compliant with the Tier 1 Immediate Occupancy Performance Level criteria is expected to have damage to both structural and nonstructural components during a design earthquake, such that:

1. The damage to the overall building is light
2. There is no permanent drift or deformation in the structure, and the structure will substantially retain its original strength and stiffness during an earthquake.
3. Non-structural components and equipment are generally secure, but power to them may be disrupted. Some cracking of partitions and ceilings may occur.
4. Very low life safety risk will exist during and after the earthquake

Executive Summary

The building's lateral-load-resisting elements were evaluated using the criteria of ASCE 41 to determine their capacity to resist earthquake ground motion. Based on this review, the primary deficiency appears to be the likelihood of liquefaction susceptibility of the soils under the building as well as the slope stability of the site during an earthquake, and the ensuing damage to the structure that will occur. Other deficiencies are also identified and described later in this report.

Scope

Hart Crowser retained Equilibrium Engineers, LLC to conduct a seismic evaluation of the Newport Airport FOB Building using ASCE 41-13, *Seismic Evaluation and Retrofit of Existing Buildings*, published in 2014 by the American Society of Civil Engineers, as the basis of our assessment of the building as it relates to seismic hazards.

Our evaluation included a limited field reconnaissance to observe the general physical status of the building and the site and an assessment of significant structural deficiencies observed. No testing or demolition of finishes to expose the existing structural elements was conducted to determine their material properties. For this reason, several items of the evaluation are noted as unknown. We also performed a review of all original construction documents made available to us, and compared those with the as-built conditions.

Observations, analyses, and conclusions contained in this report reflect our best engineering judgment. Concealed problems with the construction of the building may exist that cannot be revealed through our review. Equilibrium Engineers, therefore, can in no way warrant or guarantee the condition of the existing construction of the building or the future performance of the building.

Observations

Our conclusions about the structural system are drawn from a review of the existing building drawings and our site observations of the structure made during a site visit on July 24, 2017. The following sections present our comments regarding our review of the available documents and site visit.

Document Review

The original construction documents for the building were not available at the time of our assessment. Documents provided consisted of calculations that were done as part of addressing the original plan review comments. Drawings of the steel structure in this package were generic in nature, and did not provide any building-specific information on member sizes or connections.

Documents of the wind load upgrades were provided as well. These were prepared by DCI Engineers and were dated November 12, 2015. While these documents provided information on the strengthening measures at the beam to column joints of the moment frames, they provided little information on the sizes and connections in the original structure.

Site Reconnaissance

On July 24, 2017, a representative of Equilibrium Engineers, LLC made a site visit to assess the condition of the existing structure. The primary objective of the visit was to become familiar with the building, look for areas that may have some deterioration, and to verify and determine as many as-built conditions as possible.

The following observations were made:

- Most of the steel framing was exposed to view within the hangar portion of the building, and appeared to be in good condition.
- In the office portion, some evidence of water intrusion was visible. We were unable to determine if this intrusion had deteriorated the structure.
- In some locations, hazardous materials were on open shelving and unrestrained from falling.
- The hazardous materials cabinet was not anchored or braced to the structure.
- Tall, narrow cabinets were unanchored or unbraced, and present a falling hazard

Structural Evaluation

The building's lateral-load-resisting components were evaluated to determine their capacity to resist earthquake ground motion. The general structural seismic evaluation was performed using the criteria of ASCE 41, *Seismic Evaluation and Retrofit of Existing Buildings*. The structure was evaluated at the Immediate Occupancy Performance Level in the BSE-1N earthquake scenario. The BSE-1N seismic event represents an earthquake with a 10% chance of occurring in the next 50 years, and results in design forces that are equivalent to those used for new buildings designed to the requirements of ASCE 7.

The ASCE 41 prescribes a three-tiered method to evaluate an existing building. See below for a description of each Tier. For this project, Tier 1 and Tier 2 were used.

- Tier 1 - Screening Phase. Includes completing checklists for the structure, foundations, and nonstructural items. During this tier phase, a review is performed of any available construction documents. A site visit is made to observe the building for any indications of deterioration of the structure and finishes, and to compare the as-built information with the construction documents. A limited structural analysis is performed and computed lateral forces are applied to the structure and expected demands are compared to assumed capacities.

- Tier 2 - Evaluation Phase. Includes analysis of the non-compliant elements from Tier 1, utilizing a simplified static analysis approach. A Tier 2 analysis assists in the further evaluation of non-compliant items to get a more accurate idea of how deficient the non-compliant items are compared to actual building code calculated demands and capacities. This phase is beyond the scope of this report.

- Tier 3 - Detailed Evaluation Phase. This phase consists of a non-linear analysis of the non-compliant Tier 2 and is beyond the scope of this report.

In the ASCE 41, the base shear, or the total seismic force on the building, is calculated by a prescribed formula accounting for geographic seismicity, the type of building structure, its stiffness, and its overall mass. The base shear is distributed to each story based on a weighted proportion of the floor's mass and height above the ground. The structural elements are analyzed with these seismic demand forces distributed to each element based on their relative stiffness. For a given structural element, a demand-capacity ratio (DCR) is calculated which is the demand (D) divided by the capacity (C) of the existing element, and is a relative measure of how much is required of the structure in its current condition. The capacity (C) of the element uses nominal values obtained from the current code and multiplying that value by an m factor which can be anywhere from 1 to 4 depending on the type of element we are evaluating. This method for evaluation of the existing capacity accounts for some greater strength based on the probability of how that material has performed historically. A DCR of 1.0 means the demand is equal to the capacity of that element. A DCR of more than one means the structure is required to resist more than its capacity. For example, a DCR of 2.0 means the element is required to resist a force twice its existing capacity. A DCR of less than one means the structure has reserve capacity. The demand on each structural component is compared to the capacity of that element. For the purposes of this evaluation, we calculated the DCR values for the steel X bracing only since there was insufficient as-built information on the moment frames.

General Summary

The ASCE 41 evaluation identifies specific areas where the building structure does not comply with seismic evaluation criteria. The evaluation checklists used are attached to this report. The specific areas where seismic performance deficiencies were identified (and listed as non-compliant in the attached evaluation checklists), are listed below. We have included items that are also marked as unknown in the checklists which we believe could pose a significant threat to life safety.

Basic Life Safety Structural Items:

- According to Hart Crowser, there is potential for liquefaction and slope failure at this site during an earthquake. Liquefaction could result in excessive settlement of the soils under the building and therefore significant damage to the structure. If the slope adjacent to the building fails, building foundations could be undermined and partial collapse of the building could occur. Due to the probable extent of structural damage resulting from these geotechnical issues, the building does not meet the Immediate Occupancy Performance criteria, and poses a significant threat to the life safety of building occupants.

Building Type-Specific Structural Items:

- The steel X bracing in the frames resisting east/west seismic forces does not meet the strength criteria of ASCE 41 (DCR=2.8). This deficiency could result in excessive racking of the building during an earthquake, permanent structural displacement and potential collapse during an earthquake.

- Although the truss moment frames could not be evaluated with any detail, the strengthening of the beam to column joints that occurred during the 2015 wind load upgrade will surely improve the seismic performance of the frames. However, these truss-type frames are subject to large displacements, so an earthquake is expected to disrupt the operability of the facility greatly.

Nonstructural Components:

- Hazardous materials are on open shelves or in an unanchored/unbraced cabinet.
- Tall, narrow cabinets were not anchored or braced, and many had unrestrained materials on top of them. Some of these cabinets were adjacent to egress paths within the office portion of the building.

<u>Conclusions</u>

Based on our analysis and assessment, we believe that the building's seismic lateral-force-resisting system requires some level of retrofit in order to meet the <u>Immediate Occupancy Performance Level</u> requirements of ASCE 41. Following are the primary reasons for the retrofit:

- The liquefiable soils and slope stability issues on the site could result in damage that severely limits the operability of the building, or worst case, collapse of the building.

- Permanent structural deformation in the truss moment frames and X braced frames is highly probable, and this deformation could result in the egress paths for both personnel and vehicles to be compromised.

If seismic strengthening was to be considered, we recommend the following items be addressed (in order of importance starting with the most important) to achieve an <u>Immediate Occupancy Performance Level</u>:

1. Mitigate the liquefiable soils issues by installing deep foundations or jack grouting under the existing bearing and shear wall footings.

2. Install new retaining wall to stabilize the slope on the west side of the building.

3. Upgrade steel X bracing and truss moment frames as necessary to meet strength and displacement criteria of the current code.

.

4. Move all hazardous materials to a rated cabinet, and anchor or brace the cabinet to the structure to prevent tipping.

5. Anchor all tall, narrow cabinets to adjacent partition walls, and place all unrestrained items within the cabinet or in a closet.

SEISMIC EVALUATION (Per ASCE-41-13)

Life Safety Basic Configuration Checklist

Building Name: Newport Municipal Airport FBO Building

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
LIFE SAFETY BASIC CONFIGURATION CHECKLIST	
LOW SEISMICITY	
BUILDING SYSTEM	
General	
LOAD PATH: The structure shall contain a complete, well defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of elements of the building to the foundation. (Commentary: Sec. A.2.1.1, Tier 2: Sec. 5.4.1.1)	C
ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 4% of the height of the shorter building. This statement shall not apply for the following building types: W1, W1a, and W2. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2)	C
MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Commentary: Sec. A.2.1.3. Tier 2: Sec. 5.4.1.3)	C
Building Configuration	
WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in an adjacent story above. (Commentary: Sec. A.2.2.2. Tier 2: Sec. 5.4.2.1)	C
SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Commentary: Sec. A.2.2.3. Tier 2: Sec. 5.4.2.2)	C

SEISMIC EVALUATION (Per ASCE-41-13)

Life Safety Basic Configuration Checklist

Building Name: Newport Municipal Airport FBO Building

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3)	C
GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories. Excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4)	C
MASS: There is no change in effective mass more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Commentary: Sec. A.2.2.6. Tier 2: Sec. 5.4.2.5)	C
TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6)	C
MODERATE SEISMICITY Complete the Following Items in Additions to Items for Low Seismicity	
GEOLOGIC SITE HAZARDS	
LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 feet under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1)	NC
SLOPE FAILURE: The building site is sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: 5.4.3.1)	NC
SURFACE RAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: Sec. 5.4.3.1)	C

SEISMIC EVALUATION (Per ASCE-41-13)

Life Safety Basic Configuration Checklist

Building Name: Newport Municipal Airport FBO Building

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
HIGH SEISMICITY Complete the Following Items in Additions to Items for Low and Moderate Seismicity	
FOUNDATION CONFIGURATION	
OVERTURNING: The ratio of least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6Sa. (Commentary: Sec. A.6.2.1. Tier 2: 5.4.3.3)	C
TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Commentary: Sec. A.6.2.2. Tier 2: 5.4.3.4)	U

FOOTNOTES:

(1) C = Compliant; NC = Non-compliant; N/A = Not Applicable; U = Unable to Determine or Not Investigated

SEISMIC EVALUATION (Per ASCE-41-13)

Building Type S3: STEEL LIGHT FRAMES

Building Name: Newport Municipal Airport FBO Building

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
LOW AND MODERATE SEISMICITY	
SEISMIC-FORCE-RESISTING SYSTEM	
BRACE AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check procedure of Section 4.5.3.4, is less than $0.50F_y$. (Commentary: Sec. A.3.3.1.2. Tier 2: Sec. 5.5.4.1)	NC
CONNECTIONS	
TRANSFER TO STEEL FRAMES: Diaphragms are connected for transfer of seismic forces to the steel frames. (Commentary: Sec. A.5.2.2. Tier 2: Sec. 5.7.2)	C
STEEL COLUMNS: The columns in seismic-forces-resisting frames are anchored to the building foundation. (Commentary: Sec. A.5.3.1. Tier 2: Sec. 5.7.3.1)	C
HIGH SEISMICITY	
SEISMIC-FORCE-RESISTING SYSTEM	
MOMENT-RESISTING CONNECTIONS: All moment connections are able to develop the elastic moment (F_yS) of the adjoining members. (Commentary: Sec. A.3.1.3.4. Tier 2: Sec. 5.5.2.2.1) *The available documentation of the original moment frame construction did not have sufficient detail to complete this check.*	U

SEISMIC EVALUATION (Per ASCE-41-13)

Building Type S3: STEEL LIGHT FRAMES

Building Name: Newport Municipal Airport FBO Building

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
COMPACT MEMBERS: All brace elements meet compact section requirements set forth by AISC 360, Table B4.1. (Commentary: Sec. A.3.1.3.8. Tier 2: Sec. 5.5.2.2.4) *Bracing is tension-only, so compact section requirements do not apply*	N/A
OTHER DIAPHRAGMS: The diaphragm does not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec.5.6.5)	C
CONNECTIONS	
ROOF PANELS: Metal, plastic, or cementitious roof panels are positively attached to the roof framing to resist seismic forces. (Commentary: Sec. A.5.5.1. Tier 2: Sec. 5.7.5)	U
WALL PANELS: Metal, fiberglass, or cementitious wall panels are positively attached to the framing and foundation to resist seismic forces. (Commentary: Sec. A.5.5.2. Tier 2: Sec. 5.7.5)	C

FOOTNOTES:

(1) C = Compliant; NC = Non-compliant; N/A = Not Applicable; U = Unable to Determine or Not Investigated

(2) Quick Check refers to ASCE 31 Procedures

SEISMIC EVALUATION (Per ASCE-41-13)

Building Name: Newport Municipal Airport FBO Building

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
NONSTRUCTURAL CHECKLIST	
LIFE SAFETY SYSTEMS	
LS-LMH; PR-LMH (3). FIRE SUPRESSION PIPING: Fire suppression piping is anchored and braced in accordance with NFPA-13. (Commentary: Sec A.7.13.1. Tier 2: Sec 13.7.4)	N/A
LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Fire suppression piping has flexible couplings in accordance with NFPA-13. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.4)	N/A
LS-LMH; PR-LMH. EMERGENCY POWER: Equipment used to power or control life safety systems is anchored or braced. (Commentary: Sec. A.7.12.1. Tier 2: Sec.13.7.7)	U
LS-LMH; PR-LMH. STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Commentary: Sec. A.7.14.1. Tier 2: Sec. 13.7.6)	N/A
LS-MH; PR-MH. SPRINKLER CEILING CLEARANCE: Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Commentary: Sec. A.7.13.3. Tier 2: 13.7.4)	N/A
LS-not required; PR-LMH. EMERGENCY LIGHTING: Emergency and egress lighting equipment is anchored or braced. (Commentary: Sec. A.7.3.1. Tier 2: Sec.13.7.9)	C
HAZARDOUS MATERIALS	
LS-LMH; PR-LMH. HAZARDOUS MATERIAL EQUIPMENT: Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Commentary: Sec. A.7.12.2. Tier 2: Sec. 13.7.1)	N/A
LS-LMH; PR-LMH. HAZARDOUS MATERIAL STORAGE: Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Commentary: Sec. A.7.15.1. Tier 2: Sec.13.8.4)	C

Evaluation Statement	Evaluation (1)
LS-MH; PR-MH. HAZARDOUS MATERIAL DISTRIBUTION: Piping or ductwork conveying hazardous material is braced or otherwise protected from damage that would allow hazardous material release. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and Sec. 13.7.5)	N/A
LS-MH; PR-MH. SHUT-OFF VALVES: Piping containing hazardous material, including natural gas, has shut-off valves or other devices to limit spills or leaks. (Commentary: Sec. A.7.13.3. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Hazardous material ductwork and piping, including natural gas piping, has flexible couplings. (Commentary: Sec. A.7.15.4. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-MH; PR-MH. PIPING OR DUCTS CROSSING SEISMIC JOINTS: Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.13.6. Tier 2: Sec. 13.7.3, 13.7.5, and 13.7.6)	N/A
PARTITIONS	
LS-LMH; PR-LMH. UNREINFORCED MASONRY: Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 feet in Low or Moderate Seismicity, or at 6 feet in High Seismicity. (Commentary: Sec. A.7.1.1. Tier 2: Sec. 13.6.2)	N/A
LS-LMH; PR-LMH. HEAVY PARTITIONS SUPPORTED BY CEILINGS: The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)	N/A
LS-MH; PR-MH. DRIFT: Rigid cementations partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Commentary A.7.1.2. Tier 2: Sec. 13.6.2)	N/A
LS-not required; PR-MH. LIGHT PARTITIONS SUPPORTED BY CEILINGS: The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)	N/A

Evaluation Statement	Evaluation (1)
LS-not required; PR-MH. STRUCTURAL SEPARATIONS: Partitions that cross structural separations have seismic or control joints. (Commentary: Sec. A.7.1.3. Tier 2: Sec. 13.6.2)	N/A
LS-not required; PR-MH. TOPS: The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 feet. (Commentary: Sec. A.7.1.4. Tier 2: Sec. 13.6.2)	N/A
CEILINGS	
LS-MH; PR-LMH. SUSPENDED LATH AND PLASTER: Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 square feet of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)	N/A
LS-MH; PR-LMH. SUSPENDED GYPSUM BOARD: Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 square feet of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)	N/A
LS-not required; PR-MH. INTEGRATED CEILINGS: Integrated suspended ceilings with continuous areas greater than 144 square feet, and ceilings of smaller areas that are not surrounded by restraining partitions, are laterally restrained at a spacing no greater than 12 feet with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Commentary: Sec. A.7.2.2. Tier 2: Sec. 13.6.4)	N/A
LS-not required; PR-MH. EDGE CLEARANCE: The free edges of integrated suspended ceilings with continuous areas greater than 144 square feet have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, ½"; in High Seismicity, ¾". (Commentary: Sec. A.7.2.4. Tier 2: Sec.13.6.4)	N/A
LS-not required; PR-MH. CONTINUITY ACROSS STRUCTURE JOINTS: The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Commentary: Sec. A.7.2.5. Tier 2: Sec. 13.6.4)	N/A

Evaluation Statement	Evaluation (1)
LS-not required; PR-H. EDGE SUPPORT: The free edges of integrated suspended ceilings with continuous areas greater than 144 square feet are supported by closure angles or channels not less than 2" wide. (Commentary: Sec. A.7.2.6. Tier 2: Sec. 13.6.4)	N/A
LS-not required; PR-H. SEISMIC JOINTS: Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2500 square feet and has a ratio of long-to-short dimension no more than 4-to-1. (Commentary: Sec. A.7.2.7. Tier 2: Sec. 13.6.4)	N/A
LIGHT FIXTURES	
LS-MH; PR-MH. INDEPENDENT SUPPORT: Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Commentary: Sec. A.7.3.2. Tier 2: Sec. 13.6.4 and 13.7.9)	N/A
LS-not required; PR-H. PENDANT SUPPORTS: Light fixtures on pendant supports are attached at a spacing equal to or less than 6 feet and, if rigidly supported, are free to move with the structure to which they are attached without damaging adjoining components. (Commentary: Sec. A.7.3.3. Tier 2: Sec.13.7.9)	N/A
LS-not required; PR-H. LENS COVERS: Lens covers on light fixtures are attached with safety devices. (Commentary: Sec. A.7.3.4. Tier 2: Sec. 13.7.9)	N/A
CLADDING AND GLAZING	
LS-MH; PR-MH. CLADDING ANCHORS: Cladding components weighing more than 10 psf are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 feet; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 feet. (Commentary: Sec. A.7.4.1. Tier 2: Sec. 13.6.1)	N/A
LS-MH; PR-MH. CLADDING ISOLATION: For steel or concrete moment frame buildings, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in an seismicity, 0.02. (Commentary: Sec. A.7.4.3. Tier 2: Sec. 13.6.1)	N/A

Evaluation Statement	Evaluation (1)
LS-MH; PR-MH. MULTI-STORY PANELS: For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in ay seismicity, 0.02. (Commentary: Sec. A.7.4.4. Tier 2: Sec. 13.6.1)	N/A
LS-MH; PR-MH. PANEL CONNECTIONS: Cladding panels are anchored out-of-plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Commentary: Sec. A.7.4.5. Tier 2: Sec. 13.6.1.4)	N/A
LS-MH; PR-MH. BEARING CONNECTIONS: Where bearing connections are used, there is minimum of two bearing connections for each cladding panel. (Commentary: Sec. A.7.4.6. Tier 2: Sec. 13.6.1.4)	N/A
LS-MH; PR-MH. INSERTS: Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Commentary: Sec. A.7.4.7. Tier 2: Sec. 13.6.1.4)	N/A
LS-MH; PR-MH. OVERHEAD GLAZING: Glazing panes of any size in curtain walls and individual interior or exterior panes over 16 square feet in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Commentary: Sec. A.7.4.8. Tier 2: Sec. 13.6.1.5)	N/A
MASONRY VENEER	
LS-LMH; PR-LMH. TIES: Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2.66 square feet, and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36”; for Life Safety in High Seismicity and for Position Retention in any seismicity, 24”. (Commentary: Sec. A.7.5.1. Tier 2: Sec. 13.6.1.2)	N/A
LS-LMH; PR-LMH. SHELF ANGLES: Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Commentary: Sec. A.7.5.2. Tier 2: Sec. 13.6.1.2)	N/A

Evaluation Statement	Evaluation (1)
LS-LMH; PR-LMH. WEAKENED PLANES: Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the location of flashing. (Commentary: Sec. A.7.5.3. Tier 2: Sec. 13.6.1.2)	N/A
LS-LMH; PR-LMH. UNREINFORCED MASONRY BACKUP: There is no unreinforced masonry backup. (Commentary: Sec. A.7.7.2. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)	N/A
LS-MH; PR-MH. STUD TRACKS: For veneer with metal stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24" on center. (Commentary: Sec. A.7.6.1. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)	N/A
LS-MH; PR-MH. ANCHORAGE: For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 feet along the floors and roof. (Commentary: Sec. A.7.7.1. Tier 2: Sec 13.6.1.1 and 13.6.1.2)	N/A
LS-not required; PR-MH. WEEP HOLES: In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Commentary: Sec. A.7.5.6. Tier 2: 13.6.1.2)	N/A
LS-not required; PR-MH. OPENINGS: For veneer with metal stud backup, steel studs frame window and door openings. (Commentary: Sec. A.7.6.2. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)	N/A
PARAPETS, CORNICES, ORNAMENTATION AND APPENDAGES	
LS-LMH; PR-LMH. URM PARAPETS OR CORNICES: Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life and Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Commentary: Sec. A.7.8.1. Tier 2: Sec. 13.6.5)	N/A
LS-LMH; PR-LMH. CANOPIES: Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 feet; for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 feet. (Commentary: Sec. A.7.8.2. Tier 2: Sec. 13.6.6)	N/A

Evaluation Statement	Evaluation (1)
LS-MH; PR-LMH. CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Commentary: Sec. A.7.8.3. Tier 2: Sec 13.6.5)	N/A
LS-MH; PR-LMH. APPENDAGES: Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 feet. This checklist item does not apply to parapets or cornices covered by other checklist items. (Commentary: Sec. A.7.8.4. Tier 2: Sec. 13.6.6)	N/A
MASONRY CHIMNEYS	
LS-LMH; PR-LMH. URM CHIMNEYS: Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Positioning Retention in any seismicity, 2 times the least dimension of the chimney. (Commentary: Sec. A.7.9.1. Tier 2: Sec. 13.6.7)	N/A
LS-LMH; PR-LMH. ANCHORAGE: Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Commentary: Sec. A.7.9.2. Tier 2: Sec.13.6.7)	N/A
STAIRS	
LS-LMH; PR-LMH. STAIR ENCLOSURES: Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out-of-plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life and Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Commentary: Sec. A.7.10.1. Tier 2: 13.6.8)	N/A
LS-LMH; PR-LMH. STAIR DETAILS: In moment frame structures, the connection between the stairs and the structure does not rely on shallow anchors in concrete. Alternatively, the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.5.3.1 without including any lateral stiffness contribution from the stairs. (Commentary: Sec. A.7.10.2. Tier 2: Sec. 13.6.8)	U

Evaluation Statement	Evaluation (1)
CONTENTS AND FURNISHING	
LS-MH; PR-MH. INDUSTRIAL STORAGE RACKS: Industrial storage racks or pallet racks more than 12 feet high meet the requirements of ANSI/MH 16.1 as modified by ASCE 7 Chapter 15. (Commentary: Sec. A.7.11.1. Tier 2: Sec. 13.8.1)	N/A
LS-H; PR-MH. TALL NARROW CONTENTS: Contents more than 6 feet high with a height-to width ratio greater than 3-to-1 are anchored to the structure or to each other. (Commentary: Sec. A.7.11.2. Tier 2: Sec. 13.8.2)	NC
LS-H; PR-H. FALL-PRONE CONTENTS: Equipment, stored items, or other contents weighing more than 20 lbs whose center of mass is more than 4ft above the adjacent floor level are braced or otherwise restrained. (Commentary: Sec. A.7.11.3. Tier 2: Sec. 13.8.2)	NC
LS-not required; PR-MH. ACCESS FLOORS: Access floors more than 9” high are braced. (Commentary: Sec. A.7.11.4. Tier 2: Sec. 13.8.3)	N/A
LS-not required; PR-MH. EQUIPMENT ON ACCESS FLOORS: Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Commentary: Sec. A.7.11.5. Tier 2: Sec. 13.7.7. and 13.8.3)	N/A
LS-not required; PR-H. SUSPENDED CONTENTS: Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Commentary: Sec. A.7.11.6. Tier 2: Sec.13.8.2)	N/A
MECHANICAL AND ELECTRICAL EQUIPMENT	
LS-H; PR-H. FALL-PRONE EQUIPMENT: Equipment weighing more than 20 lbs whose center of mass is more than 4 feet above the adjacent floor level, and which is not in-line equipment, is braced. (Commentary: Sec. A.7.12.4. Tier 2: Sec. 13.7.1 and 13.7.7)	C

Evaluation Statement	Evaluation (1)
LS-H; PR-H. IN-LINE EQUIPMENT: Equipment installed in-line with a duct or piping system, with an operating weight more than 75 lbs, is supported and laterally braced independent of the duct or piping system. (Commentary: Sec. A.7.12.5. Tier 2: Sec. 13.7.1)	N/A
LS-H; PR-MH. TALL NARROW EQUIPMENT: Equipment more than 6 feet high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Commentary: Sec. A.7.12.6. Tier 2: Sec. 13.7.1 and 13.7.7)	N/A
LS-not required; PR-MH. MECHANICAL DOORS: Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Commentary: Sec. A.7.12.7. Tier 2: Sec.13.6.9)	U
LS-not required; PR-H. SUSPENDED EQUIPMENT: Equipment suspended without lateral bracing is free to swing or move with the structure from which is suspended without damaging itself or adjoining components. (Commentary: Sec. A.7.12.8. Tier 2: Sec. 13.7.1 and 13.7.7)	N/A
LS-not required; PR-H. VIBRATION ISOLATORS: Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Commentary: Sec. A.7.12.9. Tier 2: Sec. 13.7.1)	N/A
LS-not required; PR-H. HEAVY EQUIPMENT: Floor-supported or platform-supported equipment weighing more than 400 lbs is anchored to the structure. (Commentary: Sec. A.7.12.10. Tier 2: Sec. 13.7.1 and 13.7.7)	N/A
LS-not required; PR-H. ELECTRICAL EQUIPMENT: Electrical equipment is laterally braced to the structure. (Commentary: Sec. A.7.12.11. Tier 2: Sec. 13.7.7)	N/A
LS-not required; PR-H. CONDUIT COUPLINGS: Conduit greater than 2½" trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Commentary: Sec. A.7.12.12. Tier 2: Sec. 13.7.8)	N/A

Evaluation Statement	Evaluation (1)
PIPING	
LS-not required; PR-H. FLEXIBLE COUPLINGS: Fluid and gas piping has flexible couplings. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-not required; PR-H. FLUID AND GAS PIPING: Fluid and gas piping is anchored and braced to the structure to limit spills and leaks. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-not required; PR-H. C-CLAMPS: One-sided C-clamps that support piping larger than 2½" in diameter are restrained. (Commentary: Sec. A.7.13.5. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-not required; PR-H. PIPING CROSSING SESIMIC JOINTS: Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.13.6. Tier 2: Sec. 13.7.3 and 13.7.5)	N/A
DUCTS	
LS-not required; PR-H. DUCT BRACING: Rectangular ductwork larger than 6 square feet in cross-sectional area and round ducts larger than 28" in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 feet. The maximum spacing of longitudinal bracing does not exceed 60 feet. (Commentary: Sec. A.7.14.2. Tier 2: Sec. 13.7.6)	U
LS-not required; PR-H. DUCT SUPPORT: Ducts are not supported by piping or electrical conduit. (Commentary: Sec. A.7.14.3. Tier 2: Sec. 13.7.6)	U
LS-not required; PR-H. DUCTS CROSSING SEISMIC JOINTS: Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.14.5. Tier 2: Sec.13.7.6)	N/A

Evaluation Statement	Evaluation (1)
ELEVATORS	
LS-H; PR-H. RETAINER GUARDS: Sheaves and drums have cable retainer guards. (Commentary: Sec. A.7.16.1. Tier 2: Sec. 13.8.6)	N/A
LS-H; PR-H. RETAINER PLATE: A retainer plate is present at the top and bottom of both car and counterweight. (Commentary: Sec. A.7.16.2. Tier2: 13.8.6)	N/A
LS-not required; PR-H. ELEVATOR EQUIPMENT: Equipment, piping, and other components that are part of the elevator system are anchored. (Commentary: Sec. A.7.16.3. Tier 2: Sec. 13.8.6)	N/A
LS-not required; PR-H. SEISMIC SWITCH: Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Commentary: Sec. A.7.16.4. Tier 2: Sec. 13.8.6)	N/A
LS-not required; PR-H. SHAFT WALLS: Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Commentary: Sec. A.7.16.5. Tier 2: Sec.13.8.6)	N/A
LS-not required; PR-H. COUNTERWEIGHT RAILS: All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.6. Tier 2: Sec: 13.8.6)	N/A
LS-not required; PR-H. BRACKETS: The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.7. Tier 2: Sec. 13.8.6)	N/A
LS-not required; PR-H. SPREADER BRACKET: Spreader brackets are not used to resist seismic forces. (Commentary: Sec. A.7.16.8. Tier 2: Sec. 13.8.6)	N/A
LS-not required; PR-H. GO-SLOW ELEVATORS: The building has a go-slow elevator system. (Commentary: Sec. A.7.16.9. Tier 2: Sec. 13.8.6)	N/A

Evaluation Statement	Evaluation (1)

FOOTNOTES:

(1) C = Compliant; NC = Non-compliant; N/A = Not Applicable; U = Unable to Determine or Not Investigated

(2) Quick Check refers to ASCE 41-13 Procedures

(3) Applies to: LS-LMH = Life Safety for Low, Moderate and High Levels of Seismicity; PR-LMH = Position Retention for Low, Moderate and High Levels of Seismicity

Summary Data Sheet

Building Data

Building Name: Newport Municipal Airport-FBO Building   Date: August 2017

Building Address: 135 SE 84th Street
Newport, OR

Latitude:	45.585	Longitude:	-124.063	By:	Ed Quesenberry, S.E.
Year Built:	1998	Year(s) Remodeled:	N/A	Original Design Code:	1994 UBC
Area (sf):	10,000 sf	Length (ft):	112	Width (ft):	72
No. Stories	1 (Partial 2nd flr)	Story Height:	10	Total Height:	30

Use ☐ Industrial ☐ Office ☐ Warehouse ☐ Hospital ☐ Residential ☐ Educational ☒ Other: Institutional

Construction Data

Gravity Load Structural System:			
Exterior Transverse Walls:	Trussed Steel Frames	Openings?	Man Doors
Exterior Longitudinal Walls	Trussed Steel Frames	Openings?	Hangar Opening Man Doors
Roof Materials/Framing:	Wood joists with Plywood Sheathing		
Intermediate Floors/Framing:	Steel Framed with Concrete slab		
Ground Floor:	Concrete slab on grade		
Columns:	Trussed Steel	Foundation:	Unknown
General Condition of Structure:	Good		
Levels Below Grade:	None		
Special Features and Comments:			

Lateral-Force-Resisting System

	Longitudinal	Transverse
System:	Steel Truss Moment Frames	Steel X Braced Frames
Vertical Elements:	Truss Columns	Truss columns
Diaphragms:	Plywood	Plywood
Connections:	Unknown	Unknown

Evaluation Data

Soil Factors:	Class =	D		
BSE-1N Spectral Response Accelerations:	S_{XS} =	1.08	S_{X1} =	.75
Level of Seismicity:		High	Performance Level:	Immediate Occupancy
Building Period:	T =	0…26s		
Spectral Acceleration:	S_a =	1.08		
Modification Factor:	C =	1.4	Building Weight: W =	170 kips
Pseudo Lateral Force:	V = CS_AW =	256K		

BUILDING CLASSIFICATION: S#- Steel Light Frame

Required Tier 1 Checklists	*YES*	*NO*
BASIC CONFIGURATION CHECKLIST	☒	☐
BUILDING TYPE S3 STRUCTURAL CHECKLIST	☒	☐
NONSTRUCTURAL COMPONENT CHECKLIST	☒	☐

FURTHER EVALUATION REQUIREMENT:___Not In Scope

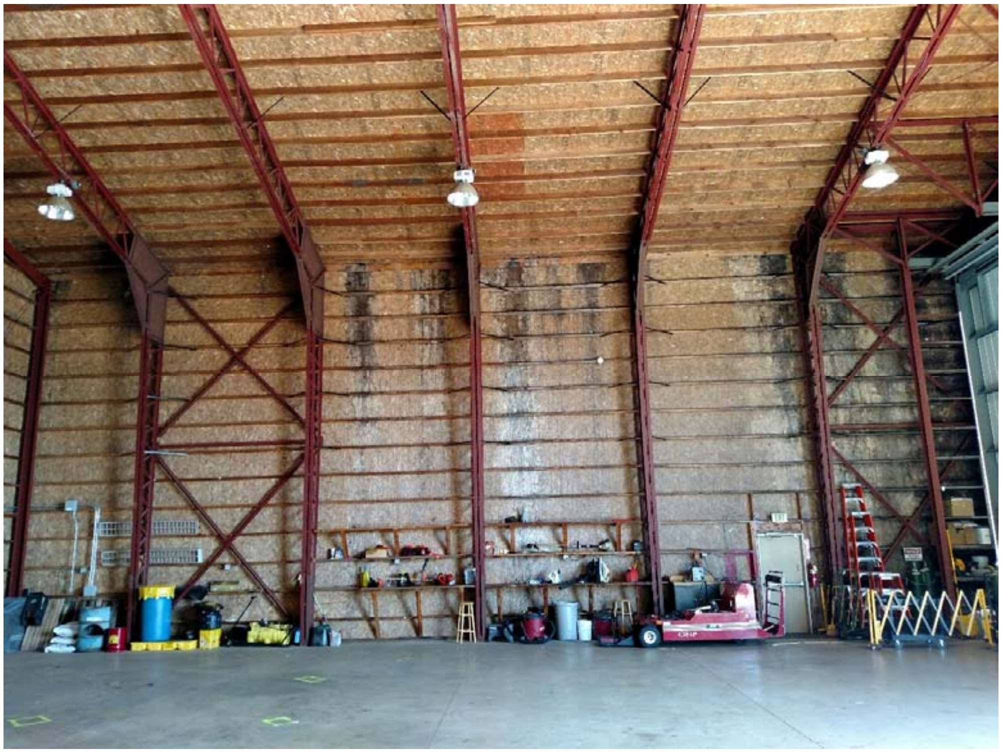


Photo 1 – Interior With Braced Frames and Moment Frames

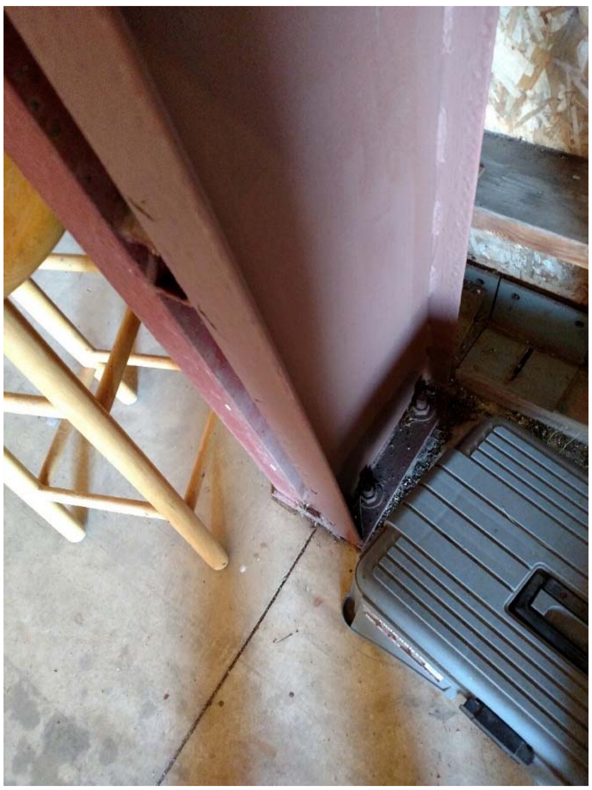


Photo 2 – Building Column with Cladding Removed at Base

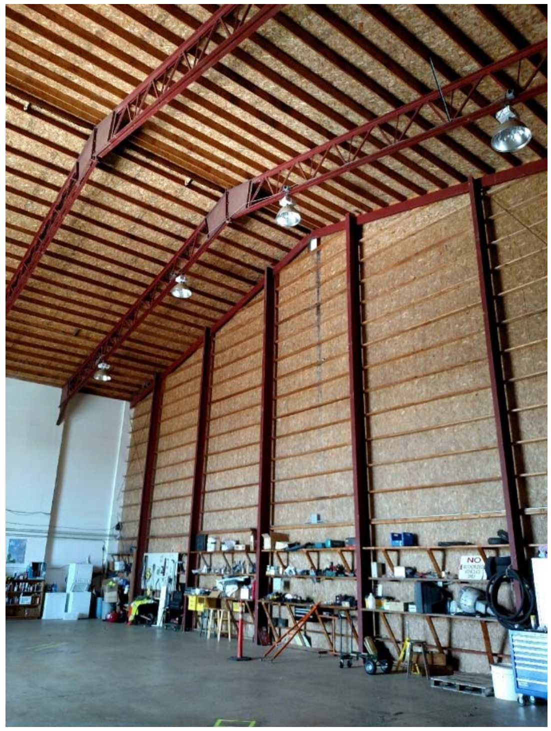


Photo 3 - End Wall

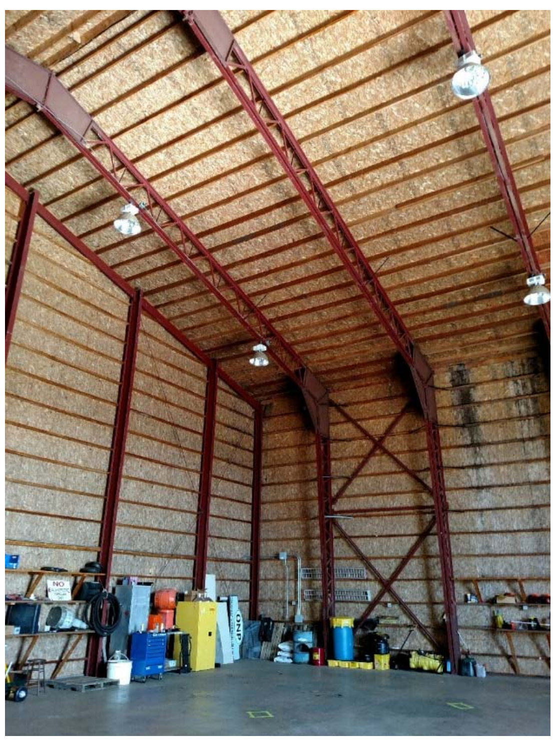


Photo 4 – Interior (Note Unanchored Cabinets)

Photo 5 – Unanchored Cabinet w/ Unsecured Contents on Top (Note Proximity to Door)

Photo 6 – Unrestrained Heavy Contents

Project FOB BLDG	EQUILIBRIUM ENGINEERS LLC	By Q	Sheet # 1
Location NEWPORT OR		Date 8/28/17	
Client HC		Revised	Job # 17083
		Date	

TIER 1 ANALYSIS

- STRUCTURE IS TYPE S3 STEEL LIGHT FRAME
- EVALUATE FOR IMMEDIATE OCCUPANCY (IO) PERF. LEVEL

$V = C S_a W$

$S_a = \frac{S_{X1}}{T}$

PER USGS: $S_{X1} = .745$, $S_{XS} = 1.08$

$T = C_T (h_n)^{\beta} = .02(30')^{.75} = .26s$

$S_a = .745/.26 = 2.9 > 1.08$

$\therefore S_a = S_{XS} = 1.08$

$C = 1.4$

$V = 1.4(1.08)W = \underline{1.51W}$

SEISMIC MASS

ROOF DL = 5 PSF (PER ORIG)

WALL DL = 10 PSF 2ND FL DL = 40 PSF (PER ORIG CALCS)

$A_{ROOF} = 112(72) = 8060$ SF

PERIMETER = 370'

$A_{2ND\,FL} = 32 \times 58 = 1860$ SF

$W_{TOT} = 5(8060) + 10\left(\frac{30}{2}\right)(370') + 40(1860) = 170$ K

$V = 1.51(170) = 256$ K

CHECK X BRACING AXIAL STRESS

(4) FRAMES RESIST

$V/_{FRAME} = \frac{256}{4} = 64^k$

$T_{BRACE} = 1.414(64) = 90^k$

JL $1\frac{3}{4} \times 1\frac{3}{4} \times \frac{3}{16}$ PER ORIG CALCS

$A = 1.3$ in²

$f_{AVG} = \frac{1}{M_S}\left(\frac{V}{sN_{br}}\right)\left(\frac{L_{br}}{A_{br}}\right)$

$= \frac{1}{1.5}\left(\frac{64^k}{12'(1)}\right)\left(\frac{18.4}{1.3}\right) = 50$ ksi

$.50F_y = .50(36) = 18$ ksi

$DCR = 50/18 = \underline{2.8}$

Newport Fire Department
South Beach Substation

ASCE 41 Evaluation

August 30, 2017

Submitted to:
Hart Crowser
6420 Macadam Avenue
Suite 100
Portland, OR 97239-3517

Submitted by:
Equilibrium Engineers, LLC
16325 Boones Ferry Road, Suite 202
Lake Oswego, OR 97035
Project No. 17083

Newport Fire Department
South Beach Substation
145 SE 72nd Street
South Beach, OR

Table of Contents

Newport Fire Department
South Beach Substation
145 SE 72nd Street
South Beach, OR

ASCE 41 Evaluation
August 30, 2017

Introduction

The South Beach Substation of the Newport Fire Department was originally constructed in 1996, and is a one-story wood framed building with premanufactured roof trusses. For the purposes of this ASCE 41 evaluation, the structure will be classified as type W2-Wood Frame (Commercial).

As this is an essential facility, we evaluated the building using the Tier 1 Immediate Occupancy Performance Level criteria outlined by ASCE 41. A building which is compliant with the Tier 1 Immediate Occupancy Performance Level criteria is expected to have damage to both structural and nonstructural components during a design earthquake, such that:

1. The damage to the overall building is light
2. There is no permanent drift or deformation in the structure, and the structure will substantially retain its original strength and stiffness during an earthquake.
3. Non-structural components and equipment are generally secure, but power to them may be disrupted. Some cracking of partitions and ceilings may occur.
4. Very low life safety risk will exist during and after the earthquake

Executive Summary

The building's lateral-load-resisting elements were evaluated using the criteria of ASCE 41 to determine their capacity to resist earthquake ground motion. Based on this review, the primary deficiency appears to be the likelihood of liquefaction of the soils under the building during an earthquake, and the ensuing damage to the structure that will occur. Other deficiencies are also identified and described later in this report.

Scope

Hart Crowser retained Equilibrium Engineers, LLC to conduct a seismic evaluation of the South Beach Substation using ASCE 41-13, *Seismic Evaluation and Retrofit of Existing Buildings*, published in 2014 by the American Society of Civil Engineers, as the basis of our assessment of the building as it relates to seismic hazards.

Our evaluation included a limited field reconnaissance to observe the general physical status of the building and the site and an assessment of significant structural deficiencies observed. No testing or demolition of finishes to expose the existing structural elements was conducted to determine their material properties. For this reason, several items of the evaluation are noted as unknown. We also performed a review of all original construction documents made available to us, and compared those with the as-built conditions.

Observations, analyses, and conclusions contained in this report reflect our best engineering judgment. Concealed problems with the construction of the building may exist that cannot be revealed through our review. Equilibrium Engineers, therefore, can in no way warrant or guarantee the condition of the existing construction of the building or the future performance of the building.

<u>*Observations*</u>

Our conclusions about the structural system are drawn from a review of the existing building drawings and our site observations of the structure made during a site visit on July 24, 2017. The following sections present our comments regarding our review of the available documents and site visit.

Document Review

Original building construction documents were provided by Hart Crowser. The original Construction Drawings were prepared by DH Goebel, dated July 12, 1996, and sheets A0 through A9.1 were used as the basis for our evaluation.

Site Reconnaissance

On July 24, 2017, a representative of Equilibrium Engineers, LLC made a site visit to assess the condition of the existing structure. The primary objective of the visit was to become familiar with the building, look for areas that may have some deterioration, and to verify and determine as many as-built conditions as possible.

The following observations were made:

- In general, the South Beach Substation appears to be constructed as indicated on the available drawings.
- The building appears to be in good condition, with no visible signs of deterioration or distress.
- In some locations, hazardous materials were on open shelving and unrestrained from falling.
- The hazardous materials cabinet was not anchored or braced to the structure.

<u>*Structural Evaluation*</u>

The building's lateral-load-resisting components were evaluated to determine their capacity to resist earthquake ground motion. The general structural seismic evaluation was performed using the criteria of ASCE 41, *Seismic Evaluation and Retrofit of Existing Buildings*. The structure was evaluated at the Immediate Occupancy Performance Level in the BSE-1N earthquake scenario. The BSE-1N seismic event represents an earthquake with a 10% chance of occurring in the next 50 years, and results in design forces that are equivalent to those used for new buildings designed to the requirements of ASCE 7.

The ASCE 41 prescribes a three-tiered method to evaluate an existing building. See below for a description of each Tier. For this project, Tier 1 and Tier 2 were used.

- Tier 1 - Screening Phase. Includes completing checklists for the structure, foundations, and nonstructural items. During this tier phase, a review is performed of any available construction documents. A site visit is made to observe the building for any indications of deterioration of the structure and finishes, and to compare the as-built information with the construction documents. A limited structural analysis is performed and computed lateral forces are applied to the structure and expected demands are compared to assumed capacities.

- Tier 2 - Evaluation Phase. Includes analysis of the non-compliant elements from Tier 1, utilizing a simplified static analysis approach. A Tier 2 analysis assists in the further evaluation of non-compliant items to get a more accurate idea of how deficient the non-compliant items are compared to actual building code calculated demands and capacities. This phase is beyond the scope of this report.

- Tier 3 - Detailed Evaluation Phase. This phase consists of a non-linear analysis of the non-compliant Tier 2 and is beyond the scope of this report.

In the ASCE 41, the base shear, or the total seismic force on the building, is calculated by a prescribed formula accounting for geographic seismicity, the type of building structure, its stiffness, and its overall mass. The base shear is distributed to each story based on a weighted proportion of the floor's mass and height above the ground. The structural elements are analyzed with these seismic demand forces distributed to each element based on their relative stiffness. For a given structural element, a demand-capacity ratio (DCR) is calculated which is the demand (D) divided by the capacity (C) of the existing element, and is a relative measure of how much is required of the structure in its current condition. The capacity (C) of the element uses nominal values obtained from the current code and multiplying that value by an m factor which can be anywhere from 1 to 4 depending on the type of element we are evaluating. This method for evaluation of the existing capacity accounts for some greater strength based on the probability of how that material has performed historically. A DCR of 1.0 means the demand is equal to the capacity of that element. A DCR of more than one means the structure is required to resist more than its capacity. For example, a DCR of 2.0 means the element is required to resist a force twice its existing capacity. A DCR of less than one means the structure has reserve capacity. The demand on each structural component is compared to the capacity of that element. For the purposes of this evaluation, we calculated the DCR values for the wood shear walls only.

General Summary

The ASCE 41 evaluation identifies specific areas where the building structure does not comply with seismic evaluation criteria. The evaluation checklists used are attached to this report. The specific areas where seismic performance deficiencies were identified (and listed as non-compliant in the attached evaluation checklists), are listed below. We have included items that are also marked as unknown in the checklists which we believe could pose a significant threat to life safety.

Basic Life Safety Structural Items:

- According to Hart Crowser, there is potential for liquefaction at this site during an earthquake. Liquefaction could result in excessive settlement of the soils under the building and therefore significant damage to the structure. Due to the probable extent of structural damage resulting from liquefaction, the building does not meet the Immediate Occupancy Performance criteria.

Building Type-Specific Structural Items:

- In the east/west direction, there is an insufficient amount of shear walls (DCR=1.05). This deficiency could result in excessive racking of the building during an earthquake.

- Some of the shear walls are very tall and narrow in elevation, which will result in high tension and compression forces at the ends of the wall in an earthquake. Tall, narrow shear walls could sustain significant permanent deformations during an earthquake, resulting in doors not operating correctly, thereby preventing fire trucks and personnel to respond to an emergency.

- The large garage door openings have minimal shear walls at their jambs, which could result in significant permanent displacements and loss of functionality of the doors.

- The large step in the roof diaphragm, and the shear transfer through this step is not detailed in the original drawings. The diaphragm's capacity to transfer stresses through the step is unknown as a result.

Nonstructural Components:

- Hazardous materials are on open shelves or in an unanchored/unbraced cabinet.

Conclusions

Based on our analysis and assessment, we believe that the building's seismic lateral-force-resisting system requires some level of retrofit in order to meet the Immediate Occupancy Performance Level requirements of ASCE 41. Following are the primary reasons for the retrofit:

- The liquefiable soils could result in damage that severely limits the operability of the building.

- Permanent structural deformation in the shear walls is highly probable, and this deformation could result in the egress paths for both personnel and trucks to be compromised.

If seismic strengthening was to be considered, we recommend the following items be addressed (in order of importance starting with the most important) to achieve an Immediate Occupancy Performance Level:

1. Mitigate the liquefiable soils issues by installing deep foundations or jack grouting under the existing bearing and shear wall footings.

2. Upgrade shear walls that are deficient by adding sheathing to inside face of wall, anchor bolts and new higher-capacity holdowns.

3. Install blocking and nailing to reinforce the roof diaphragm at the step.

4. Move all hazardous materials in to a rated cabinet, and anchor or brace the cabinet to the structure to prevent tipping.

Evaluation Statement	Evaluation (1)
LIFE SAFETY BASIC CONFIGURATION CHECKLIST	
LOW SEISMICITY	
BUILDING SYSTEM	
General	
LOAD PATH: The structure shall contain a complete, well defined load path, including structural elements and connections, that serves to transfer the inertial forces associated with the mass of elements of the building to the foundation. (Commentary: Sec. A.2.1.1, Tier 2: Sec. 5.4.1.1)	C
ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building is greater than 4% of the height of the shorter building. This statement shall not apply for the following building types: W1, W1a, and W2. (Commentary: Sec. A.2.1.2. Tier 2: Sec. 5.4.1.2)	C
MEZZANINES: Interior mezzanine levels are braced independently from the main structure or are anchored to the seismic-force-resisting elements of the main structure. (Commentary: Sec. A.2.1.3. Tier 2: Sec. 5.4.1.3)	N/A
Building Configuration	
WEAK STORY: The sum of the shear strengths of the seismic-force-resisting system in any story in each direction is not less than 80% of the strength in an adjacent story above. (Commentary: Sec. A.2.2.2. Tier 2: Sec. 5.4.2.1)	C
SOFT STORY: The stiffness of the seismic-force-resisting system in any story is not less than 70% of the seismic-force-resisting system stiffness in an adjacent story above or less than 80% of the average seismic-force-resisting system stiffness of the three stories above. (Commentary: Sec. A.2.2.3. Tier 2: Sec. 5.4.2.2)	C

SEISMIC EVALUATION (Per ASCE-41-13)

Life Safety Basic Configuration Checklist

Building Name: Newport Fire Department, South Substation

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
VERTICAL IRREGULARITIES: All vertical elements in the seismic-force-resisting system are continuous to the foundation. (Commentary: Sec. A.2.2.4. Tier 2: Sec. 5.4.2.3)	C
GEOMETRY: There are no changes in the net horizontal dimension of the seismic-force-resisting system of more than 30% in a story relative to adjacent stories. Excluding one-story penthouses and mezzanines. (Commentary: Sec. A.2.2.5. Tier 2: Sec. 5.4.2.4)	C
MASS: There is no change in effective mass more than 50% from one story to the next. Light roofs, penthouses, and mezzanines need not be considered. (Commentary: Sec. A.2.2.6. Tier 2: Sec. 5.4.2.5)	C
TORSION: The estimated distance between the story center of mass and the story center of rigidity is less than 20% of the building width in either plan dimension. (Commentary: Sec. A.2.2.7. Tier 2: Sec. 5.4.2.6)	C
MODERATE SEISMICITY Complete the Following Items in Additions to Items for Low Seismicity	
GEOLOGIC SITE HAZARDS	
LIQUEFACTION: Liquefaction-susceptible, saturated, loose granular soils that could jeopardize the building's seismic performance shall not exist in the foundation soils at depths within 50 feet under the building. (Commentary: Sec. A.6.1.1. Tier 2: 5.4.3.1) *According to Hart Crowser, there is liquefaction potential at this site*	NC
SLOPE FAILURE: The building site is sufficiently remote from potential earthquake-induced slope failures or rockfalls to be unaffected by such failures or is capable of accommodating any predicted movements without failure. (Commentary: Sec. A.6.1.2. Tier 2: 5.4.3.1)	C
SURFACE RAULT RUPTURE: Surface fault rupture and surface displacement at the building site are not anticipated. (Commentary: Sec. A.6.1.3. Tier 2: Sec. 5.4.3.1)	C

SEISMIC EVALUATION (Per ASCE-41-13)

Life Safety Basic Configuration Checklist

Building Name: Newport Fire Department, South Substation

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
HIGH SEISMICITY Complete the Following Items in Additions to Items for Low and Moderate Seismicity	
FOUNDATION CONFIGURATION	
OVERTURNING: The ratio of least horizontal dimension of the seismic-force-resisting system at the foundation level to the building height (base/height) is greater than 0.6Sa. (Commentary: Sec. A.6.2.1. Tier 2: 5.4.3.3)	C
TIES BETWEEN FOUNDATION ELEMENTS: The foundation has ties adequate to resist seismic forces where footings, piles, and piers are not restrained by beams, slabs, or soils classified as Site Class A, B, or C. (Commentary: Sec. A.6.2.2. Tier 2: 5.4.3.4)	N/A

FOOTNOTES:

(1) C = Compliant; NC = Non-compliant; N/A = Not Applicable; U = Unable to Determine or Not Investigated

SEISMIC EVALUATION (Per ASCE-41-13)

Building Type W2: Wood Frames, Commercial and Industrial
Building Name: Newport Fire Department, South Substation
Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
LOW AND MODERATE SEISMICITY	
SEISMIC-FORCE-RESISTING SYSTEM	
REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2. (Commentary: Sec. A.3.2.1.1. Tier 2: Sec. 5.5.1.1)	C
SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 4.5.3.3, shall be less than the following values (Commentary: Sec. A.3.2.7.1. Tier 2: Sec. 5.5.3.1.1): Structural panel sheathing 1,000 plf Diagonal sheathing 700 plf Straight sheathing 100 plf All other conditions 100 plf *In the east/west direction, the shear DCR is 1.05.*	NC
STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multi-story buildings shall not rely on exterior stucco walls as the primary seismic-force-resisting system. (Commentary: Sec. A.3.2.7.1. Tier 2: Sec. 5.5.3.1.1)	C
GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard is not be used as shear walls on buildings more than one story in height with the exception of the uppermost level of a multi-story building. (Commentary: Sec. A.3.2.7.3. Tier 2: Sec. 5.5.3.6.1)	C
NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2-to-1 are not used to resist seismic forces. (Commentary: Sec. A.3.2.7.4. Tier 2: Sec. 5.5.3.6.1)	NC

SEISMIC EVALUATION (Per ASCE-41-13)

Building Type W2: Wood Frames, Commercial and Industrial
Building Name: Newport Fire Department, South Substation
Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
WALLS CONNECTED THROUGH FLOORS: Shear walls shall have interconnection between stories to transfer overturning and shear forces through the floor. (Commentary: Sec. A.3.2.7.5. Tier 2: Sec. 5.5.3.6.2)	N/A
HILLSIDE SITE: For structures that are taller on at least one side by more than one-half story because of a sloping site, all shear walls on the downhill slope shall have an aspect ratio less than 1-to-1. (Commentary: Sec. A.3.2.7.6. Tier 2: Sec. 5.5.3.6.3)	N/A
CRIPPLE WALLS: Cripple walls below first-floor-level shear walls are braced to the foundation with wood structural panels. (Commentary: Sec. A.3.2.7.7. Tier 2: Sec. 5.5.3.6.5)	N/A
OPENINGS: Walls with openings greater than 80% of the length are braced with wood structural panel shear walls with aspect ratios of not more than 1.5-to-1 or are supported by adjacent construction through positive ties capable of transferring the seismic forces. (Commentary: Sec. A.3.2.7.8. Tier 2: Sec. 5.5.3.6.5)	NC
CONNECTIONS	
WOOD POSTS: There is a positive connection of wood posts to the foundation. (Commentary: Sec. A.5.3.3. Tier 2: Sec. 5.7.3.3) *There are no interior posts*	N/A
WOOD SILLS: All wood sills are bolted to the foundation. (Commentary: Sec. A.5.3.4. Tier 2: Sec. 5.7.3.3)	C
GIRDER/COLUMN CONNECTION: There is a positive connection using plates, connection hardware, or straps between the girder and the column support. (Commentary: Sec. A.5.4.1. Tier 2: Sec. 5.7.4.1)	N/A

SEISMIC EVALUATION (Per ASCE-41-13)

Building Type W2: Wood Frames, Commercial and Industrial
Building Name: Newport Fire Department, South Substation
Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
HIGH SESIMICTY	
DIAPHRAGMS	
DIAPHRAGM CONTINUITY: The diaphragms are not composed of split-level floors and do not have expansion joints. (Commentary: Sec. A.4.1.1. Tier 2: Sec. 5.6.1.1) *Roof Diaphragm has significant step, and shear transfer through the step is not detailed in the construction documents.*	NC
ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation. (Commentary: Sec. A.4.1.3. Tier 2: Sec. 5.6.1.1)	C
DIAPHRAGM REINFORCEMENT AT OPENINGS: There is reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. (Commentary: Sec. A.4.1.8. Tier 2: Sec. 5.6.1.5)	N/A
STRAIGHT SHEATHING: All straight sheathed diaphragms have aspect ratios less than 2-to-1. (Commentary: Sec. A.4.2.1. Tier 2: Sec. 5.6.2)	N/A
SPANS: All wood diaphragms with spans greater than 24ft consist of wood structural panels or diagonal sheathing. Wood commercial and industrial buildings may have rod-braced systems. (Commentary: Sec. A.4.2.2. Tier 2: Sec. 5.6.2)	C
UNBLOCKED DIAPHRAGMS: All diagonally sheathed or unblocked wood structural panel diaphragms have horizontal spans less than 40ft and have aspect ratios less than or equal to 4-to-1. (Commentary: Sec. A.4.2.3. Tier 2: Sec. 5.6.2)	C
OTHER DIAPHRAGMS: The diaphragm does not consist of a system other than wood, metal deck, concrete, or horizontal bracing. (Commentary: Sec. A.4.7.1. Tier 2: Sec. 5.6.5)	C

SEISMIC EVALUATION (Per ASCE-41-13)

Building Type W2: Wood Frames, Commercial and Industrial

Building Name: Newport Fire Department, South Substation

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
CONNECTIONS	
WOOD SILL BOLTS: Sill bolts shall be spaced at 6ft or less, with proper edge and end distance provided for wood and concrete. (Commentary: Sec. A.5.3.7. Tier 2: Sec. 5.7.3.3)	C

FOOTNOTES:

(1) C = Compliant; NC = Non-compliant; N/A = Not Applicable; U = Unable to Determine or Not Investigated

(2) Quick Check refers to ASCE 31 Procedures

Evaluation Statement	Evaluation (1)
NONSTRUCTURAL CHECKLIST	
LIFE SAFETY SYSTEMS	
LS-LMH; PR-LMH (3). FIRE SUPRESSION PIPING: Fire suppression piping is anchored and braced in accordance with NFPA-13. (Commentary: Sec A.7.13.1. Tier 2: Sec 13.7.4)	N/A
LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Fire suppression piping has flexible couplings in accordance with NFPA-13. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.4)	N/A
LS-LMH; PR-LMH. EMERGENCY POWER: Equipment used to power or control life safety systems is anchored or braced. (Commentary: Sec. A.7.12.1. Tier 2: Sec.13.7.7) *Emergency Power Generator is located away from building, but appears to be anchored to equipment pad.*	C
LS-LMH; PR-LMH. STAIR AND SMOKE DUCTS: Stair pressurization and smoke control ducts are braced and have flexible connections at seismic joints. (Commentary: Sec. A.7.14.1. Tier 2: Sec. 13.7.6)	N/A
LS-MH; PR-MH. SPRINKLER CEILING CLEARANCE: Penetrations through panelized ceilings for fire suppression devices provide clearances in accordance with NFPA-13. (Commentary: Sec. A.7.13.3. Tier 2: 13.7.4)	N/A
LS-not required; PR-LMH. EMERGENCY LIGHTING: Emergency and egress lighting equipment is anchored or braced. (Commentary: Sec. A.7.3.1. Tier 2: Sec.13.7.9)	C
HAZARDOUS MATERIALS	
LS-LMH; PR-LMH. HAZARDOUS MATERIAL EQUIPMENT: Equipment mounted on vibration isolators and containing hazardous material is equipped with restraints or snubbers. (Commentary: Sec. A.7.12.2. Tier 2: Sec. 13.7.1)	N/A

Evaluation Statement	Evaluation (1)
LS-LMH; PR-LMH. HAZARDOUS MATERIAL STORAGE: Breakable containers that hold hazardous material, including gas cylinders, are restrained by latched doors, shelf lips, wires, or other methods. (Commentary: Sec. A.7.15.1. Tier 2: Sec.13.8.4) *Shelves above work bench have unrestrained solvent and cleaner canisters*	NC
LS-MH; PR-MH. HAZARDOUS MATERIAL DISTRIBUTION: Piping or ductwork conveying hazardous material is braced or otherwise protected from damage that would allow hazardous material release. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and Sec. 13.7.5)	N/A
LS-MH; PR-MH. SHUT-OFF VALVES: Piping containing hazardous material, including natural gas, has shut-off valves or other devices to limit spills or leaks. (Commentary: Sec. A.7.13.3. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-LMH; PR-LMH. FLEXIBLE COUPLINGS: Hazardous material ductwork and piping, including natural gas piping, has flexible couplings. (Commentary: Sec. A.7.15.4. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-MH; PR-MH. PIPING OR DUCTS CROSSING SEISMIC JOINTS: Piping or ductwork carrying hazardous material that either crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.13.6. Tier 2: Sec. 13.7.3, 13.7.5, and 13.7.6)	N/A
PARTITIONS	
LS-LMH; PR-LMH. UNREINFORCED MASONRY: Unreinforced masonry or hollow-clay tile partitions are braced at a spacing of at most 10 feet in Low or Moderate Seismicity, or at 6 feet in High Seismicity. (Commentary: Sec. A.7.1.1. Tier 2: Sec. 13.6.2)	N/A
LS-LMH; PR-LMH. HEAVY PARTITIONS SUPPORTED BY CEILINGS: The tops of masonry or hollow-clay tile partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)	N/A

Evaluation Statement	Evaluation (1)
LS-MH; PR-MH. DRIFT: Rigid cementations partitions are detailed to accommodate the following drift ratios: in steel moment frame, concrete moment frame, and wood frame buildings, 0.02; in other buildings, 0.005. (Commentary A.7.1.2. Tier 2: Sec. 13.6.2)	N/A
LS-not required; PR-MH. LIGHT PARTITIONS SUPPORTED BY CEILINGS: The tops of gypsum board partitions are not laterally supported by an integrated ceiling system. (Commentary: Sec. A.7.2.1. Tier 2: Sec. 13.6.2)	C
LS-not required; PR-MH. STRUCTURAL SEPARATIONS: Partitions that cross structural separations have seismic or control joints. (Commentary: Sec. A.7.1.3. Tier 2: Sec. 13.6.2)	N/A
LS-not required; PR-MH. TOPS: The tops of ceiling-high framed or panelized partitions have lateral bracing to the structure at a spacing equal to or less than 6 feet. (Commentary: Sec. A.7.1.4. Tier 2: Sec. 13.6.2)	C
CEILINGS	
LS-MH; PR-LMH. SUSPENDED LATH AND PLASTER: Suspended lath and plaster ceilings have attachments that resist seismic forces for every 12 square feet of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)	N/A
LS-MH; PR-LMH. SUSPENDED GYPSUM BOARD: Suspended gypsum board ceilings have attachments that resist seismic forces for every 12 square feet of area. (Commentary: Sec. A.7.2.3. Tier 2: Sec. 13.6.4)	N/A
LS-not required; PR-MH. INTEGRATED CEILINGS: Integrated suspended ceilings with continuous areas greater than 144 square feet, and ceilings of smaller areas that are not surrounded by restraining partitions, are laterally restrained at a spacing no greater than 12 feet with members attached to the structure above. Each restraint location has a minimum of four diagonal wires and compression struts, or diagonal members capable of resisting compression. (Commentary: Sec. A.7.2.2. Tier 2: Sec. 13.6.4)	N/A

Evaluation Statement	Evaluation (1)
LS-not required; PR-MH. EDGE CLEARANCE: The free edges of integrated suspended ceilings with continuous areas greater than 144 square feet have clearances from the enclosing wall or partition of at least the following: in Moderate Seismicity, ½"; in High Seismicity, ¾". (Commentary: Sec. A.7.2.4. Tier 2: Sec.13.6.4)	N/A
LS-not required; PR-MH. CONTINUITY ACROSS STRUCTURE JOINTS: The ceiling system does not cross any seismic joint and is not attached to multiple independent structures. (Commentary: Sec. A.7.2.5. Tier 2: Sec. 13.6.4)	N/A
LS-not required; PR-H. EDGE SUPPORT: The free edges of integrated suspended ceilings with continuous areas greater than 144 square feet are supported by closure angles or channels not less than 2" wide. (Commentary: Sec. A.7.2.6. Tier 2: Sec. 13.6.4)	N/A
LS-not required; PR-H. SEISMIC JOINTS: Acoustical tile or lay-in panel ceilings have seismic separation joints such that each continuous portion of the ceiling is no more than 2500 square feet and has a ratio of long-to-short dimension no more than 4-to-1. (Commentary: Sec. A.7.2.7. Tier 2: Sec. 13.6.4)	N/A
LIGHT FIXTURES	
LS-MH; PR-MH. INDEPENDENT SUPPORT: Light fixtures that weigh more per square foot than the ceiling they penetrate are supported independent of the grid ceiling suspension system by a minimum of two wires at diagonally opposite corners of each fixture. (Commentary: Sec. A.7.3.2. Tier 2: Sec. 13.6.4 and 13.7.9)	C
LS-not required; PR-H. PENDANT SUPPORTS: Light fixtures on pendant supports are attached at a spacing equal to or less than 6 feet and, if rigidly supported, are free to move with the structure to which they are attached without damaging adjoining components. (Commentary: Sec. A.7.3.3. Tier 2: Sec.13.7.9)	N/A
LS-not required; PR-H. LENS COVERS: Lens covers on light fixtures are attached with safety devices. (Commentary: Sec. A.7.3.4. Tier 2: Sec. 13.7.9)	N/A

Evaluation Statement	Evaluation (1)
CLADDING AND GLAZING	
LS-MH; PR-MH. CLADDING ANCHORS: Cladding components weighing more than 10 psf are mechanically anchored to the structure at a spacing equal to or less than the following: for Life Safety in Moderate Seismicity, 6 feet; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 feet. (Commentary: Sec. A.7.4.1. Tier 2: Sec. 13.6.1)	N/A
LS-MH; PR-MH. CLADDING ISOLATION: For steel or concrete moment frame buildings, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in an seismicity, 0.02. (Commentary: Sec. A.7.4.3. Tier 2: Sec. 13.6.1)	N/A
LS-MH; PR-MH. MULTI-STORY PANELS: For multi-story panels attached at more than one floor level, panel connections are detailed to accommodate a story drift ratio of at least the following: for Life Safety in Moderate Seismicity, 0.01; for Life Safety in High Seismicity and for Position Retention in ay seismicity, 0.02. (Commentary: Sec. A.7.4.4. Tier 2: Sec. 13.6.1)	N/A
LS-MH; PR-MH. PANEL CONNECTIONS: Cladding panels are anchored out-of-plane with a minimum number of connections for each wall panel, as follows: for Life Safety in Moderate Seismicity, 2 connections; for Life Safety in High Seismicity and for Position Retention in any seismicity, 4 connections. (Commentary: Sec. A.7.4.5. Tier 2: Sec. 13.6.1.4)	N/A
LS-MH; PR-MH. BEARING CONNECTIONS: Where bearing connections are used, there is minimum of two bearing connections for each cladding panel. (Commentary: Sec. A.7.4.6. Tier 2: Sec. 13.6.1.4)	N/A
LS-MH; PR-MH. INSERTS: Where concrete cladding components use inserts, the inserts have positive anchorage or are anchored to reinforcing steel. (Commentary: Sec. A.7.4.7. Tier 2: Sec. 13.6.1.4)	N/A
LS-MH; PR-MH. OVERHEAD GLAZING: Glazing panes of any size in curtain walls and individual interior or exterior panes over 16 square feet in area are laminated annealed or laminated heat-strengthened glass and are detailed to remain in the frame when cracked. (Commentary: Sec. A.7.4.8. Tier 2: Sec. 13.6.1.5)	N/A

Evaluation Statement	Evaluation (1)
MASONRY VENEER	
LS-LMH; PR-LMH. TIES: Masonry veneer is connected to the backup with corrosion-resistant ties. There is a minimum of one tie for every 2.66 square feet, and the ties have spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 36"; for Life Safety in High Seismicity and for Position Retention in any seismicity, 24". (Commentary: Sec. A.7.5.1. Tier 2: Sec. 13.6.1.2)	N/A
LS-LMH; PR-LMH. SHELF ANGLES: Masonry veneer is supported by shelf angles or other elements at each floor above the ground floor. (Commentary: Sec. A.7.5.2. Tier 2: Sec. 13.6.1.2)	N/A
LS-LMH; PR-LMH. WEAKENED PLANES: Masonry veneer is anchored to the backup adjacent to weakened planes, such as at the location of flashing. (Commentary: Sec. A.7.5.3. Tier 2: Sec. 13.6.1.2)	N/A
LS-LMH; PR-LMH. UNREINFORCED MASONRY BACKUP: There is no unreinforced masonry backup. (Commentary: Sec. A.7.7.2. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)	N/A
LS-MH; PR-MH. STUD TRACKS: For veneer with metal stud backup, stud tracks are fastened to the structure at a spacing equal to or less than 24" on center. (Commentary: Sec. A.7.6.1. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)	N/A
LS-MH; PR-MH. ANCHORAGE: For veneer with concrete block or masonry backup, the backup is positively anchored to the structure at a horizontal spacing equal to or less than 4 feet along the floors and roof. (Commentary: Sec. A.7.7.1. Tier 2: Sec 13.6.1.1 and 13.6.1.2)	N/A
LS-not required; PR-MH. WEEP HOLES: In veneer anchored to stud walls, the veneer has functioning weep holes and base flashing. (Commentary: Sec. A.7.5.6. Tier 2: 13.6.1.2)	N/A
LS-not required; PR-MH. OPENINGS: For veneer with metal stud backup, steel studs frame window and door openings. (Commentary: Sec. A.7.6.2. Tier 2: Sec. 13.6.1.1 and 13.6.1.2)	N/A

Evaluation Statement	Evaluation (1)
PARAPETS, CORNICES, ORNAMENTATION AND APPENDAGES	
LS-LMH; PR-LMH. URM PARAPETS OR CORNICES: Laterally unsupported unreinforced masonry parapets or cornices have height-to-thickness ratios no greater than the following: for Life Safety in Low or Moderate Seismicity, 2.5; for Life and Safety in High Seismicity and for Position Retention in any seismicity, 1.5. (Commentary: Sec. A.7.8.1. Tier 2: Sec. 13.6.5)	N/A
LS-LMH; PR-LMH. CANOPIES: Canopies at building exits are anchored to the structure at a spacing no greater than the following: for Life Safety in Low or Moderate Seismicity, 10 feet; for Life Safety in High Seismicity and for Position Retention in any seismicity, 6 feet. (Commentary: Sec. A.7.8.2. Tier 2: Sec. 13.6.6)	N/A
LS-MH; PR-LMH. CONCRETE PARAPETS: Concrete parapets with height-to-thickness ratios greater than 2.5 have vertical reinforcement. (Commentary: Sec. A.7.8.3. Tier 2: Sec 13.6.5)	N/A
LS-MH; PR-LMH. APPENDAGES: Cornices, parapets, signs, and other ornamentation or appendages that extend above the highest point of anchorage to the structure or cantilever from components are reinforced and anchored to the structural system at a spacing equal to or less than 6 feet. This checklist item does not apply to parapets or cornices covered by other checklist items. (Commentary: Sec. A.7.8.4. Tier 2: Sec. 13.6.6)	N/A
MASONRY CHIMNEYS	
LS-LMH; PR-LMH. URM CHIMNEYS: Unreinforced masonry chimneys extend above the roof surface no more than the following: for Life Safety in Low or Moderate Seismicity, 3 times the least dimension of the chimney; for Life Safety in High Seismicity and for Positioning Retention in any seismicity, 2 times the least dimension of the chimney. (Commentary: Sec. A.7.9.1. Tier 2: Sec. 13.6.7)	N/A
LS-LMH; PR-LMH. ANCHORAGE: Masonry chimneys are anchored at each floor level, at the topmost ceiling level, and at the roof. (Commentary: Sec. A.7.9.2. Tier 2: Sec.13.6.7)	N/A

Evaluation Statement	Evaluation (1)
STAIRS	
LS-LMH; PR-LMH. STAIR ENCLOSURES: Hollow-clay tile or unreinforced masonry walls around stair enclosures are restrained out-of-plane and have height-to-thickness ratios not greater than the following: for Life Safety in Low or Moderate Seismicity, 15-to-1; for Life and Safety in High Seismicity and for Position Retention in any seismicity, 12-to-1. (Commentary: Sec. A.7.10.1. Tier 2: 13.6.8)	N/A
LS-LMH; PR-LMH. STAIR DETAILS: In moment frame structures, the connection between the stairs and the structure does not rely on shallow anchors in concrete. Alternatively, the stair details are capable of accommodating the drift calculated using the Quick Check procedure of Section 4.5.3.1 without including any lateral stiffness contribution from the stairs. (Commentary: Sec. A.7.10.2. Tier 2: Sec. 13.6.8)	N/A
CONTENTS AND FURNISHING	
LS-MH; PR-MH. INDUSTRIAL STORAGE RACKS: Industrial storage racks or pallet racks more than 12 feet high meet the requirements of ANSI/MH 16.1 as modified by ASCE 7 Chapter 15. (Commentary: Sec. A.7.11.1. Tier 2: Sec. 13.8.1)	N/A
LS-H; PR-MH. TALL NARROW CONTENTS: Contents more than 6 feet high with a height-to width ratio greater than 3-to-1 are anchored to the structure or to each other. (Commentary: Sec. A.7.11.2. Tier 2: Sec. 13.8.2)	NC
LS-H; PR-H. FALL-PRONE CONTENTS: Equipment, stored items, or other contents weighing more than 20 lbs whose center of mass is more than 4ft above the adjacent floor level are braced or otherwise restrained. (Commentary: Sec. A.7.11.3. Tier 2: Sec. 13.8.2)	NC
LS-not required; PR-MH. ACCESS FLOORS: Access floors more than 9" high are braced. (Commentary: Sec. A.7.11.4. Tier 2: Sec. 13.8.3)	N/A
LS-not required; PR-MH. EQUIPMENT ON ACCESS FLOORS: Equipment and other contents supported by access floor systems are anchored or braced to the structure independent of the access floor. (Commentary: Sec. A.7.11.5. Tier 2: Sec. 13.7.7. and 13.8.3)	N/A

Evaluation Statement	Evaluation (1)
LS-not required; PR-H. SUSPENDED CONTENTS: Items suspended without lateral bracing are free to swing from or move with the structure from which they are suspended without damaging themselves or adjoining components. (Commentary: Sec. A.7.11.6. Tier 2: Sec.13.8.2)	N/A
MECHANICAL AND ELECTRICAL EQUIPMENT	
LS-H; PR-H. FALL-PRONE EQUIPMENT: Equipment weighing more than 20 lbs whose center of mass is more than 4 feet above the adjacent floor level, and which is not in-line equipment, is braced. (Commentary: Sec. A.7.12.4. Tier 2: Sec. 13.7.1 and 13.7.7)	C
LS-H; PR-H. IN-LINE EQUIPMENT: Equipment installed in-line with a duct or piping system, with an operating weight more than 75 lbs, is supported and laterally braced independent of the duct or piping system. (Commentary: Sec. A.7.12.5. Tier 2: Sec. 13.7.1)	C
LS-H; PR-MH. TALL NARROW EQUIPMENT: Equipment more than 6 feet high with a height-to-depth or height-to-width ratio greater than 3-to-1 is anchored to the floor slab or adjacent structural walls. (Commentary: Sec. A.7.12.6. Tier 2: Sec. 13.7.1 and 13.7.7)	N/A
LS-not required; PR-MH. MECHANICAL DOORS: Mechanically operated doors are detailed to operate at a story drift ratio of 0.01. (Commentary: Sec. A.7.12.7. Tier 2: Sec.13.6.9)	U
LS-not required; PR-H. SUSPENDED EQUIPMENT: Equipment suspended without lateral bracing is free to swing or move with the structure from which is suspended without damaging itself or adjoining components. (Commentary: Sec. A.7.12.8. Tier 2: Sec. 13.7.1 and 13.7.7)	N/A
LS-not required; PR-H. VIBRATION ISOLATORS: Equipment mounted on vibration isolators is equipped with horizontal restraints or snubbers and with vertical restraints to resist overturning. (Commentary: Sec. A.7.12.9. Tier 2: Sec. 13.7.1)	N/A
LS-not required; PR-H. HEAVY EQUIPMENT: Floor-supported or platform-supported equipment weighing more than 400 lbs is anchored to the structure. (Commentary: Sec. A.7.12.10. Tier 2: Sec. 13.7.1 and 13.7.7)	N/A

SEISMIC EVALUATION (Per ASCE-41-13)

Building Name: Newport Fire Department, South Substation

Building Location: Newport, Oregon

Evaluation Statement	Evaluation (1)
LS-not required; PR-H. ELECTRICAL EQUIPMENT: Electrical equipment is laterally braced to the structure. (Commentary: Sec. A.7.12.11. Tier 2: Sec. 13.7.7)	C
LS-not required; PR-H. CONDUIT COUPLINGS: Conduit greater than 2½" trade size that is attached to panels, cabinets, or other equipment and is subject to relative seismic displacement has flexible couplings or connections. (Commentary: Sec. A.7.12.12. Tier 2: Sec. 13.7.8)	U
PIPING	
LS-not required; PR-H. FLEXIBLE COUPLINGS: Fluid and gas piping has flexible couplings. (Commentary: Sec. A.7.13.2. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-not required; PR-H. FLUID AND GAS PIPING: Fluid and gas piping is anchored and braced to the structure to limit spills and leaks. (Commentary: Sec. A.7.13.4. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-not required; PR-H. C-CLAMPS: One-sided C-clamps that support piping larger than 2½" in diameter are restrained. (Commentary: Sec. A.7.13.5. Tier 2: Sec. 13.7.3 and 13.7.5)	U
LS-not required; PR-H. PIPING CROSSING SESIMIC JOINTS: Piping that crosses seismic joints or isolation planes or is connected to independent structures has couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.13.6. Tier 2: Sec. 13.7.3 and 13.7.5)	N/A
DUCTS	
LS-not required; PR-H. DUCT BRACING: Rectangular ductwork larger than 6 square feet in cross-sectional area and round ducts larger than 28" in diameter are braced. The maximum spacing of transverse bracing does not exceed 30 feet. The maximum spacing of longitudinal bracing does not exceed 60 feet. (Commentary: Sec. A.7.14.2. Tier 2: Sec. 13.7.6)	U
LS-not required; PR-H. DUCT SUPPORT: Ducts are not supported by piping or electrical conduit. (Commentary: Sec. A.7.14.3. Tier 2: Sec. 13.7.6)	U

Evaluation Statement	Evaluation (1)
LS-not required; PR-H. DUCTS CROSSING SEISMIC JOINTS: Ducts that cross seismic joints or isolation planes or are connected to independent structures have couplings or other details to accommodate the relative seismic displacements. (Commentary: Sec. A.7.14.5. Tier 2: Sec.13.7.6)	N/A
ELEVATORS	
LS-H; PR-H. RETAINER GUARDS: Sheaves and drums have cable retainer guards. (Commentary: Sec. A.7.16.1. Tier 2: Sec. 13.8.6)	N/A
LS-H; PR-H. RETAINER PLATE: A retainer plate is present at the top and bottom of both car and counterweight. (Commentary: Sec. A.7.16.2. Tier2: 13.8.6)	N/A
LS-not required; PR-H. ELEVATOR EQUIPMENT: Equipment, piping, and other components that are part of the elevator system are anchored. (Commentary: Sec. A.7.16.3. Tier 2: Sec. 13.8.6)	N/A
LS-not required; PR-H. SEISMIC SWITCH: Elevators capable of operating at speeds of 150 ft/min or faster are equipped with seismic switches that meet the requirements of ASME A17.1 or have trigger levels set to 20% of the acceleration of gravity at the base of the structure and 50% of the acceleration of gravity in other locations. (Commentary: Sec. A.7.16.4. Tier 2: Sec. 13.8.6)	N/A
LS-not required; PR-H. SHAFT WALLS: Elevator shaft walls are anchored and reinforced to prevent toppling into the shaft during strong shaking. (Commentary: Sec. A.7.16.5. Tier 2: Sec.13.8.6)	N/A
LS-not required; PR-H. COUNTERWEIGHT RAILS: All counterweight rails and divider beams are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.6. Tier 2: Sec: 13.8.6)	N/A
LS-not required; PR-H. BRACKETS: The brackets that tie the car rails and the counterweight rail to the structure are sized in accordance with ASME A17.1. (Commentary: Sec. A.7.16.7. Tier 2: Sec. 13.8.6)	N/A

Evaluation Statement	Evaluation (1)
LS-not required; PR-H. SPREADER BRACKET: Spreader brackets are not used to resist seismic forces. (Commentary: Sec. A.7.16.8. Tier 2: Sec. 13.8.6)	N/A
LS-not required; PR-H. GO-SLOW ELEVATORS: The building has a go-slow elevator system. (Commentary: Sec. A.7.16.9. Tier 2: Sec. 13.8.6)	N/A

FOOTNOTES:

(1) C = Compliant; NC = Non-compliant; N/A = Not Applicable; U = Unable to Determine or Not Investigated

(2) Quick Check refers to ASCE 41-13 Procedures

(3) Applies to: LS-LMH = Life Safety for Low, Moderate and High Levels of Seismicity; PR-LMH = Position Retention for Low, Moderate and High Levels of Seismicity

Summary Data Sheet

Building Data

Building Name: South Beach SubStation-Newport Fire Department | Date: August 2017

Building Address: 145 SE 72nd Street
South Beach, OR

Latitude:	45.585	Longitude:	-124.063	By:	Ed Quesenberry, S.E.
Year Built:	1996	Year(s) Remodeled:	N/A	Original Design Code:	1994 UBC
Area (sf):	3900 sf	Length (ft):	100	Width (ft):	60
No. Stories	1	Story Height:	17'	Total Height:	25'

Use ☐ Industrial ☐ Office ☐ Warehouse ☐ Hospital ☐ Residential ☐ Educational ☒ Other: Institutional

Construction Data

Gravity Load Structural System:			
Exterior Transverse Walls:	Wood Stud Bearing Walls	Openings?	Large Roll Up Doors, Man Doors
Exterior Longitudinal Walls	Wood Stud Bearing Walls	Openings?	Man Doors
Roof Materials/Framing:	Wood Trusses with Plywood Sheathing		
Intermediate Floors/Framing:	None		
Ground Floor:	Concrete slab on grade		
Columns:	None	Foundation:	Concrete Stemwall
General Condition of Structure:	Good		
Levels Below Grade:	None		
Special Features and Comments:			

Lateral-Force-Resisting System

	Longitudinal	Transverse
System:	Plywood Shear Walls	Plywood Shear Walls
Vertical Elements:	Wood Bearing Walls	Wood Bearing Walls
Diaphragms:	Plywood	Plywood
Connections:	Nails	Nails

Evaluation Data

Soil Factors:	Class =	D		
BSE-1N Spectral Response Accelerations:	S_{XS} =	1.08	S_{X1} =	.75
Level of Seismicity:		High	Performance Level:	Immediate Occupancy
Building Period:	T =	0..21		
Spectral Acceleration:	S_a =	1.08		
Modification Factor:	C =	1.3	Building Weight: W =	84 kips
Pseudo Lateral Force:	$V = CS_AW$ =	118K		

BUILDING CLASSIFICATION: W2-Wood Frame (Commercial)

Required Tier 1 Checklists	*YES*	*NO*
BASIC CONFIGURATION CHECKLIST	☒	☐
BUILDING TYPE W2 STRUCTURAL CHECKLIST	☒	☐
NONSTRUCTURAL COMPONENT CHECKLIST	☒	☐

FURTHER EVALUATION REQUIREMENT:___Not In Scope

Photo 1 – Step in Roof Diaphragm

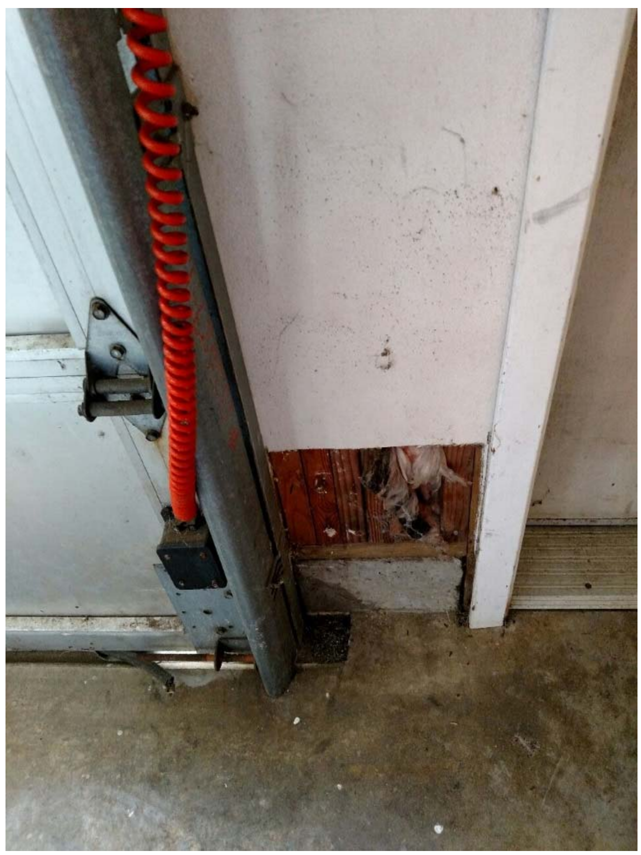


Photo 2 – Existing Sill Plate and Wall Framing

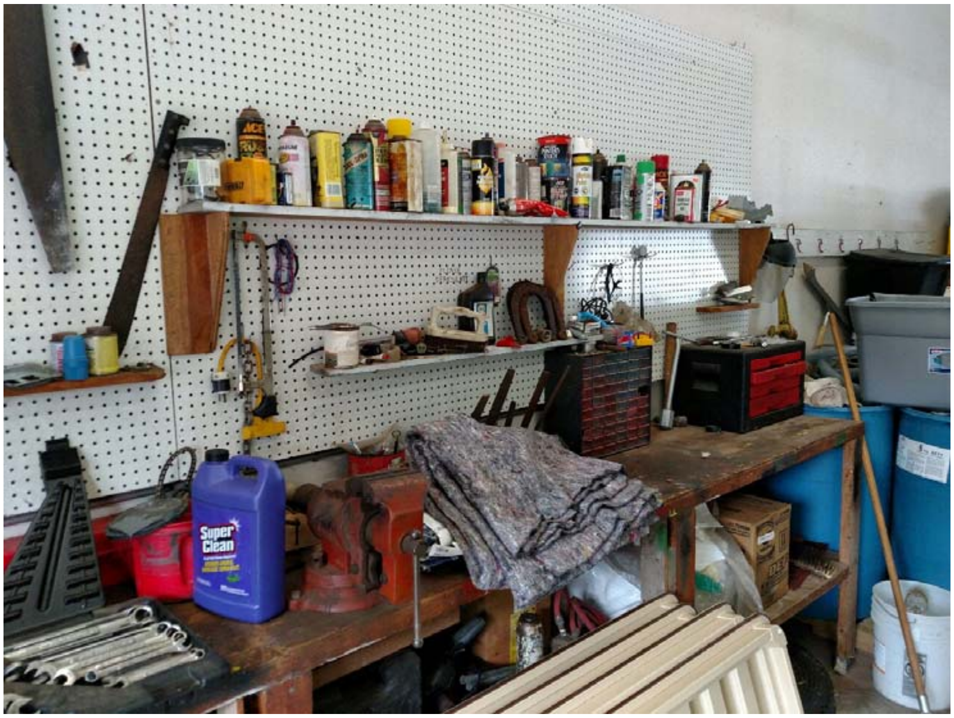


Photo 3 - Shelving w/ Unrestrained Hazardous Materials

Photo 4 – Unbraced Hazmat Cabinet

Photo 5 – Unanchored Mech Equipment

Project: SOUTH SUB STATION	EQUILIBRIUM ENGINEERS LLC	By: Q.	Sheet #: C1
Location: NEWPORT, OR		Date: 8/25/17	
Client: HC		Revised	Job #: 17083
		Date	

TIER 1 ANALYSIS

- STRUCTURE IS W2 - 1 STORY COMMERCIAL WOOD FRAME
- IMMEDIATE OCCUPANCY

$C = 1.3$ (1 STORY)

$V = C S_a W$

WHERE $S_a = \frac{S_{X1}}{T}$

$T = C_T h_n^{B} = .02(22)^{.75}$

$= .21s$

$S_{X1} = .745g$

$S_a = .745/.21 = 3.55 >> S_{XS}$

$\therefore S_a = S_{XS} = 1.08g$

$V = 1.3(1.08)W = \underline{1.4W}$

SEISMIC MASS

ROOF DL = 15 PSF

WALL DL = 10 PSF

$A_{ROOF} = 46(44) + 30(62)$

$= 3900 SF$

PERIMETER = (74+60)(2) = 270 LF

$W = 15(\overset{ROOF}{3900}) + 10(\overset{EXT\ WALL}{\tfrac{17}{2}})(270)$

$+ \overset{INT\ WALL}{7(^{10}/_2)(75)} = 84^k$

$V = 1.4(84) = \underline{\underline{118\ K}}$

CHECK AVERAGE SHEAR STRESS IN SHEAR WALLS PER SECT 4.5.3.3

$v_{j\,AVG} = \frac{1}{M_S}\left(\frac{V}{l_w}\right) = \frac{1}{2.0}\left(\frac{118}{l_w}\right)$

$= 59/l_w$ — $M = 2.0$ (IMMED. OCC)

$l_{w\,N/S} = 114'$ — $v_{N/S} = 520$ PLF

$l_{w\,E/W} = 56'$ — $v_{E/W} = 1050$ PLF

$v_{ALLOWABLE} = 1,000$ PLF

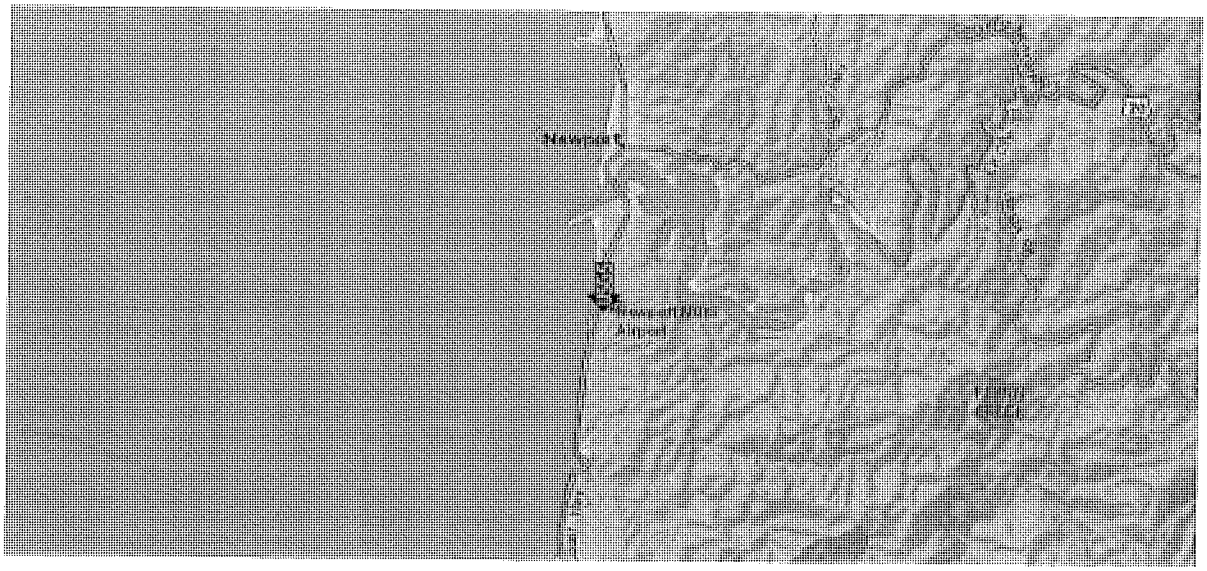
$DCR_{N/S} = .52$
$DCR_{E/W} = 1.05$

C2

USGS Design Maps Summary Report

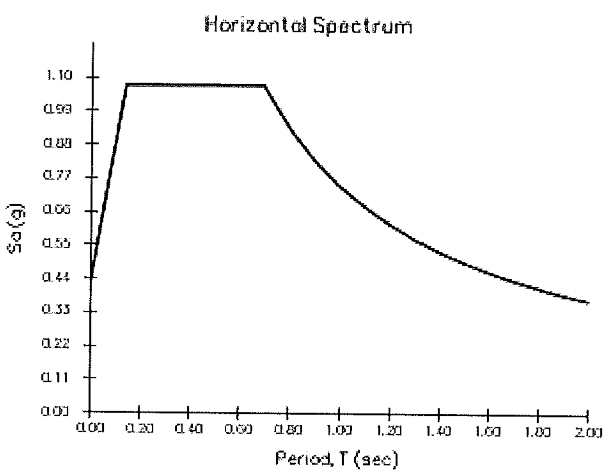
User–Specified Input

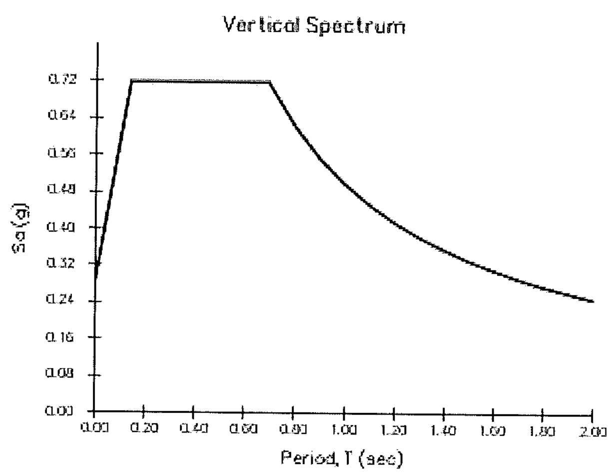
Report Title	Newport Fire Station and Airport Terminal Fri August 25, 2017 17:29:29 UTC
Building Code Reference Document	ASCE 41-13 Retrofit Standard, BSE-1N (which utilizes USGS hazard data available in 2008)
Site Coordinates	44.58579°N, 124.063°W
Site Soil Classification	Site Class D – "Stiff Soil"



USGS–Provided Output

$S_{XS,BSE-1N}$	1.077 g
$S_{X1,BSE-1N}$	0.745 g





Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.