Exhibit H
Geological Hazards and Soil Stability

Boardman to Hemingway Transmission Line Project

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Preliminary Application for Site Certificate

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ACRONYMS AND ABBREVIATIONS

Note: Not all acronyms and abbreviations listed will appear in this Exhibit.

°C	degrees Celsius
4WD	4-wheel-drive
A	ampere
A/ph	amperes/phase
AC	alternating current
ACDP	Air Contaminant Discharge Permit
ACEC	Area of Critical Environmental Concern
ACSR	aluminum conductor steel reinforced
AIMP	Agricultural Impact Mitigation Plan
AMS	Analysis of the Management Situation
aMW	average megawatt
ANSI	American National Standards Institute
APE	Area of Potential Effect
APLIC	Avian Power Line Interaction Committee
ARPA	Archaeological Resource Protection Act
ASC	Application for Site Certificate
ASCE	American Society of Civil Engineers
ASP	Archaeological Survey Plan
AST	aboveground storage tank
ASTM	American Society of Testing and Materials
ATC	available transmission capacity
ATV	all-terrain vehicle
AUM	animal unit month
B2H	Boardman to Hemingway Transmission Line Project
BCCP	Baker County Comprehensive Plan
BCZSO	Baker County Zoning and Subdivision Ordinance
BLM	Bureau of Land Management
BMP	best management practice
BPA	Bonneville Power Administration
BOR	Bureau of Reclamation
C and D	construction and demolition
CAA	Clean Air Act
CadnaA	Computer-Aided Noise Abatement
CAFE	Corona and Field Effects
CAP	Community Advisory Process
CBM	capacity benefit margin
CFR	Code of Federal Regulations
CH	critical habitat
CIP	critical infrastructure protection
CL	centerline
cm	centimeter
cmil	circular mil
COA	Conservation Opportunity Area
CO_2e	carbon dioxide equivalent

COM Plan	Construction, Operations, and Maintenance Plan
CPCN	Certificate of Public Convenience and Necessity
cps	cycle per second
CRP	Conservation Reserve Program
CRT	cathode-ray tube
CRUP	Cultural Resource Use Permit
CSZ	Cascadia Subduction Zone
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	*Clean Water Act of 1972*
CWR	Critical Winter Range
dB	decibel
dBA	A-weighted decibel
DC	direct current
DoD	Department of Defense
DOE	U.S. Department of Energy
DOGAMI	Oregon Department of Geology and Mineral Industries
DPS	Distinct Population Segment
DSL	Oregon Department of State Lands
EA	environmental assessment
EDRR	Early Detection and Rapid Response
EIS	Environmental Impact Statement (DEIS for Draft and FEIS for Final)
EFSC or Council	Energy Facility Siting Council
EFU	Exclusive Farm Use
EHS	extra high strength
EMF	electric and magnetic fields
EPA	Environmental Protection Agency
EPC	Engineer, Procure, Construct
EPM	environmental protection measure
EPRI	Electric Power Research Institute
ERO	Electric Reliability Organization
ERU	Exclusive Range Use
ESA	Endangered Species Act
ESCP	Erosion and Sediment Control Plan
ESU	Evolutionarily Significant Unit
EU	European Union
FAA	Federal Aviation Administration
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFT	find, fix, track, and report
FLPMA	Federal Land Policy and Management Act
Forest Plan	Land and Resource Management Plan
FPA	Forest Practices Act
FSA	Farm Services Agency
FWS	U.S. Fish and Wildlife Service
G	gauss

GeoBOB	Geographic Biotic Observation
GF	Grazing Farm Zone
GHG	greenhouse gas
GHz	gigahertz
GIL	gas insulated transmission line
GIS	geographic information system
GPS	Global Positioning System
GRMW	Grande Ronde Model Watershed
GRP	Grassland Reserve Program
HAC	Historic Archaeological Cultural
HCNRA	Hells Canyon National Recreation Area
HPFF	high pressure fluid-filled
HPMP	Historic Properties Management Plan
HUC	Hydrologic Unit Code
Hz	hertz
I-84	Interstate 84
ICC	International Code Council
ICES	International Committee on Electromagnetic Safety
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDWR	Idaho Department of Water Resources
ILS	intensive-level survey
IM	Instructional Memorandum
INHP	Idaho Natural Heritage Program
INRMP	Integrated Natural Resources Management Plan
IPC	Idaho Power Company
IPUC	Idaho Public Utilities Commission
IRP	integrated resource plan
IRPAC	IRP Advisory Council
ISDA	Idaho State Department of Agriculture
JPA	Joint Permit Application
KCM	thousand circular mils
kHz	kilohertz
km	kilometer
KOP	Key Observation Point
kV	kilovolt
kV/m	kilovolt per meter
kWh	kilowatt-hour
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
lb	pound
LCDC	Land Conservation and Development Commission
LDMA	Lost Dutchman’s Mining Association
LiDAR	light detection and ranging
LIT	Local Implementation Team

LMP	land management plan
LOLE	Loss of Load Expectation
LRMP	land and resource management plan
LUBA	Land Use Board of Appeals
LWD	large woody debris
m	meter
mA	milliampere
MA	Management Area
MAIFI	Momentary Average Interruption Frequency Index
MCC	Malheur County Code
MCCP	Morrow County Comprehensive Plan
MCE	Maximum Credible Earthquake
MCZO	Morrow County Zoning Ordinance
mG	milligauss
MHz	megahertz
mm	millimeter
MMI	Modified Mercalli Intensity
MP	milepost
MPE	maximum probable earthquake
MRI	magnetic resonance imaging
MVAR	megavolt ampere reactive
Mw	mean magnitude
MW	megawatt
μV/m	microvolt per meter
N_2O	nitrous oxide
NAIP	National Agriculture Imagery Program
NED	National Elevation Dataset
NEMS	National Energy Modeling System
NEPA	*National Environmental Policy Act of 1969*
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NF	National Forest
NFPA	National Fire Protection Association
NFS	National Forest System
NGDC	National Geophysical Data Center
NHD	National Hydrography Dataset
NHOTIC	National Historic Oregon Trail Interpretive Center
NHT	National Historic Trail
NIEHS	National Institute of Environmental Health Sciences
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration Fisheries Division
NOI	Notice of Intent to File an Application for Site Certificate
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service

NRHP	National Register of Historic Places
NSR	noise sensitive receptor
NTTG	Northern Tier Transmission Group
NWGAP	Northwest Regional Gap Analysis Landcover Data
NWI	National Wetlands Inventory
NWPP	Northwest Power Pool
NWR	National Wildlife Refuge
NWSRS	National Wild and Scenic Rivers System
NWSTF	Naval Weapons Systems Training Facility
O_3	ozone
O&M	operation and maintenance
OAIN	Oregon Agricultural Information Network
OAR	Oregon Administrative Rules
OATT	Open Access Transmission Tariff
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOE	Oregon Department of Energy
ODOT	Oregon Department of Transportation
OHGW	overhead ground wire
OHV	off-highway vehicle
OPGW	optical ground wire
OPRD	Oregon Parks and Recreation Department
OPS	U.S. Department of Transportation, Office of Pipeline Safety
OPUC	Public Utility Commission of Oregon
OR	Oregon (State) Highway
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statutes
ORWAP	Oregon Rapid Wetland Assessment Protocol
OS	Open Space
OSDAM	Oregon Streamflow Duration Assessment Methodology
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Structural Specialty Code
OSWB	Oregon State Weed Board
OWC	Oregon Wetland Cover
P	Preservation
PA	Programmatic Agreement
pASC	Preliminary Application for Site Certificate
PAT	Project Advisory Team
PCE	Primary Constituent Element
PEM	palustrine emergent
PFO	palustrine forested
PGA	peak ground acceleration
PGE	Portland General Electric
PGH	Preliminary General Habitats
Pike	Pike Energy Solutions

PNSN	Pacific Northwest Seismic Network
POD	Plan of Development
POMU	Permit to Operate, Maintain and Use a State Highway Approach
PPH	Preliminary Priority Habitats
Project	Boardman to Hemingway Transmission Line Project
PSD	Prevention of Significant Deterioration
PSS	palustrine scrub-shrub
R	Retention
R-F	removal-fill
RCM	Reliability Centered Maintenance
RCRA	Resource Conservation and Recovery Act
ReGAP	Regional Gap Analysis Project
RFP	request for proposal
RLS	reconnaissance-level survey
RMP	resource management plan
ROD	Record of Decision
ROE	right of entry
RNA	research natural area
ROW	right-of-way
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SC	Sensitive Critical
SEORMP	Southeastern Oregon Resource Management Plan
SF6	sulfur hexafluoride
Shaw	Shaw Environmental and Infrastructure, Inc.
SHPO	State Historic Preservation Office
SLIDO	Statewide Landslide Inventory Database for Oregon
SMS	Scenery Management System
SMU	Species Management Unit
SPCC	Spill Prevention, Containment, and Countermeasures
SRMA	Special Recreation Management Area
SRSAM	Salmon Resources and Sensitive Area Mapping
SSURGO	Soil Survey Geographic Database
STATSGO	State Soil Geographic Database
SUP	special-use permit
SV	Sensitive Vulnerable
SWPPP	Stormwater Pollution Prevention Plan
T/A/Y	tons/acre/year
TDG	Total Dissolved Gas
TES	threatened, endangered, and sensitive (species)
TG	Timber Grazing
TMIP	Transmission Maintenance and Inspection Plan
TNC	The Nature Conservancy
tpy	tons per year
TSD	treatment, storage, and disposal
TV	television
TVES	Terrestrial Visual Encounter Surveys

TVMP	Transmission Vegetation Management Program
UBAR	Umatilla Basin Aquifer Restoration
UBWC	Umatilla Basin Water Commission
UCDC	Umatilla County Development Code
UCZPSO	Union County Zoning, Partition and Subdivision Ordinance
UDP	Unanticipated Discovery Plan
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USFS	U.S. Department of Agriculture, Forest Service
USGS	U.S. Geological Survey
UWIN	Utah Wildlife in Need
V/C	volume to capacity
V	volt
VAHP	Visual Assessment of Historic Properties
VMS	Visual Management System
VQO	Visual Quality Objective
VRM	Visual Resource Management
WAGS	Washington ground squirrel
WCU	Wilderness Characteristic Unit
WECC	Western Electricity Coordinating Council
WHO	World Health Organization
WMA	Wildlife Management Area
WOS	waters of the state
WOUS	waters of the United States
WPCF	Water Pollution Control Facility
WR	winter range
WRCC	Western Regional Climate Center
WRD	(Oregon) Water Resources Division
WRP	Wetland Reserve Program
WWE	West-wide Energy
XLPE	cross-linked polyethylene

Exhibit H
Geological Hazards and Soil Stability

1.0 INTRODUCTION

Exhibit H provides an analysis of geologic hazards and soil stability for the Boardman to Hemingway Transmission Line Project (Project). Exhibit H demonstrates that Idaho Power Company (IPC) will comply with the approval standard for geologic hazards and soil stability in accordance with Oregon Administrative Rule (OAR) 345-022-0020, based on information provided pursuant to OAR 345-021-0010(1)(h) paragraphs (A) through (I).

Specifically, Exhibit H provides the information relating to geological hazards and soil stability that IPC has gathered to date, and concludes that, based on the information presented and summarized herein, this Project can be designed, engineered, and constructed to avoid dangers to human safety resulting from the known geological and soil hazards of the site.

2.0 APPLICABLE RULES AND STATUTES

The Oregon Energy Facility Siting Council (EFSC or Council) structural standard is set forth in OAR 345-022-0020. Under OAR 345-022-0020(1), the Council must find that:

> *(a) The applicant, through appropriate site-specific study, has adequately characterized the site as to the Maximum Considered Earthquake Ground Motion as shown for the site in the 2009 International Building Code and maximum probable ground motion, taking into account ground failure and amplification for the site specific soil profile under the maximum credible and maximum probable seismic events; and*
>
> *(b) The applicant can design, engineer, and construct the facility to avoid dangers to human safety presented by seismic hazards affecting the site that are expected to result from maximum probable ground motion events. As used in this rule "seismic hazard" includes ground shaking, ground failure, landslide, liquefaction, lateral spreading, tsunami inundation, fault displacement, and subsidence;*
>
> *(c) The applicant, through appropriate site-specific study, has adequately characterized the potential geological and soils hazards of the site and its vicinity that could, in the absence of a seismic event, adversely affect, or be aggravated by, the construction and operation of the proposed facility; and*
>
> *(d) The applicant can design, engineer and construct the facility to avoid dangers to human safety presented by the hazards identified in subsection (c).*

To demonstrate compliance with the structural standard, and in accordance with OAR 345-021-0010(1)(h), Exhibit H must provide information regarding the geological and soil stability within the analysis area, including the following:

> *(A) A geologic report meeting the guidance in Oregon Department of Geology and Mineral Industries open file report 00-04 "Guidelines for Engineering Geologic reports and Site-Specific Seismic Hazard Reports."*
>
> *(B) A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions.*
>
> *(C) Evidence of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate site-specific geotechnical work that must be*

performed before submitting the application for the Department to determine that the application is complete.

(D) For all transmission lines, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends, corners, and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides or marginally stable slopes that could be made unstable by the planned construction.

(E) For all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings and portions of the proposed alignment where geologic reconnaissance and other site specific studies provide evidence of existing landslides or marginally stable slopes that could be made unstable by the planned construction.

(F) An assessment of seismic hazards. For the purposes of this assessment, the maximum probable earthquake (MPE) is the maximum earthquake that could occur under the known tectonic framework with a 10 percent chance of being exceeded in a 50 year period. If seismic sources are not mapped sufficiently to identify the ground motions above, the applicant shall provide a probabilistic seismic hazard analysis to identify the peak ground accelerations expected at the site for a 500 year recurrence interval and a 5000 year recurrence interval. In the assessment, the applicant shall include:

(i) Identification of the Maximum Considered Earthquake Ground Motion as shown for the site under the 2009 International Building Code.

(ii) Identification and characterization of all earthquake sources capable of generating median peak ground accelerations greater than 0.05g on rock at the site. For each earthquake source, the applicant shall assess the magnitude and minimum epicentral distance of the maximum credible earthquake (MCE).

(iii) A description of any recorded earthquakes within 50 miles of the site and of recorded earthquakes greater than 50 miles from the site that caused ground shaking at the site more intense than the Modified Mercalli III intensity. The applicant shall include the date of occurrence and a description of the earthquake that includes its magnitude and highest intensity and its epicenter location or region of highest intensity.

(iv) Assessment of the median ground response spectrum from the MCE and the MPE and identification of the spectral accelerations greater than the design spectrum provided in the 2010 Oregon Structural Specialty Code. The applicant shall include a description of the probable behavior of the subsurface materials and amplification by subsurface materials and any topographic or subsurface conditions that could result in expected ground motions greater than those characteristic of the Maximum Considered Earthquake Ground Motion identified above.

(v) An assessment of seismic hazards expected to result from reasonably probable seismic events. As used in this rule "seismic hazard" includes ground shaking, ground failure, landslide, lateral spreading, liquefaction, tsunami inundation, fault displacement and subsidence.

(G) An assessment of soil-related hazards such as landslides, flooding and erosion which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility.

(H) An explanation of how the applicant will design, engineer and construct the facility to avoid dangers to human safety from the seismic hazards identified in paragraph (F). The applicant shall include proposed design and engineering features, applicable construction codes, and any monitoring for seismic hazards.

(I) An explanation of how the applicant will design, engineer and construct the facility to adequately avoid dangers to human safety presented by the hazards identified in paragraph (G).

Additionally, the Project Order includes the following specific direction with regard to Exhibit H:

- *The Department understands that detailed site-specific geotechnical investigation for the entire site boundary is not practical in advance of completing the final facility design and obtaining full site access. However, the rule requires evidence of consultation with the Oregon Department of Geology and Mineral Industries (DOGAMI) prior to submitting the application if the applicant proposes to base Exhibit H on limited pre-application geotechnical work.*
- *Note that OAR 345-021-0010(1)(h), paragraphs (A), (F)(i) and (F)(v) contain references to outdated guidelines and codes. Until such time as the Council rules can be revised to reflect current standards, the Department requests that applicants consult directly with DOGAMI, determine the most current structural standards that apply to its facility, then use those codes to prepare Exhibit H. The application should clearly note which codes and guidelines were used to prepare the information in Exhibit H. Exhibit H should also provide evidence that the current codes are equivalent to or more stringent than those cited in the Council's rules, and that the applicant agrees to construct the facility in accordance with the current codes and guidelines.*

As documented in Table H-7 (Submittal Requirements Matrix), IPC has drafted Exhibit H to respond to each paragraph of OAR 345-021-0010(1)(h) described above, as well as the additional requirements set forth in the Project Order.

3.0 ANALYSIS

3.1 Analysis Area

Pursuant to the Project Order, the analysis area for Exhibit H is the Site Boundary, which is defined in OAR 345-001-0010(55) as "the perimeter of the site of a proposed energy facility, its related or supporting facilities, all temporary laydown and staging areas, and all corridors and micrositing corridors proposed by the applicant." The Site Boundary for the Project includes the following related and supporting facilities in Oregon:

- Proposed Corridor: 277.2 miles of 500-kilovolt (kV) transmission line corridor, 5.0 miles of double circuit 138/69-kV transmission line corridor, and 0.3 mile of 138-kV transmission line corridor.
- Alternate Corridor Segments: Seven alternate corridor segments consisting of approximately 134.1 miles that could replace certain segments of the Proposed Corridor. IPC has proposed these alternate corridor segments in order to allow flexibility for IPC

and EFSC, as well as federal agencies, to reconcile competing resource constraints in several key locations.

- One proposed substation expansion of 3 acres; two alternate substation sites (one 3-acre substation expansion and one new 20-acre substation). IPC ultimately needs to construct and operate only one substation expansion or substation in the Boardman area.
- Eight communication station sites of less than one acre each in size; four alternate communication station sites along alternate corridor segments.
- Temporary and permanent access roads.
- Temporary multi-use areas, pulling and tensioning sites, and fly yards.

The features of the Project are fully described in Exhibit B and the Site Boundary for each Project feature is described in Exhibit C, Table C-21. The location of the Project (Site Boundary) is outlined in Exhibit C.

3.2 Methods

Consistent with direction in the Project Order, IPC will complete the studies necessary to generate the detailed information required by OAR 345-0210-0010(1)(h) in two phases. IPC has already completed Phase 1 of its Exhibit H Geological Hazards and Soil Stability studies. Exhibit H relies on published data, and also field and literature information compiled by IPC’s geotechnical consultants, Pike Energy Solutions (Pike), Shaw Environmental and Infrastructure, Inc. (Shaw), and Shannon & Wilson, Inc. The Engineering and Seismic Hazards Supplement (Attachment H-1) presents the regional geologic and tectonic setting, seismic hazards, and non-seismic geologic hazards that could affect the Project. The Engineering Geology and Seismic Hazards Supplement was based on review of literature and existing mapping, including the following:

- Oregon Department of Geology and Mineral Industries (DOGAMI) geologic maps, geographic information system (GIS)-based maps and earthquake hazard maps;
- U.S. Geological Survey (USGS 2008) geology, fault, fold, and seismic hazard maps;
- Oregon Water Resources Department (OWRD) well logs;
- Natural Resources Conservation Service (NRCS) soil maps; and
- The Statewide Landslide Inventory Database for Oregon (SLIDO-2) mapping, updated summer 2011.

The Engineering and Seismic Hazards Supplement describes a reconnaissance-level survey that examined the proposed transmission line corridor from its starting point at Grassland Substation, near Boardman, Oregon, to its end point at the Hemingway Substation in Owyhee County, Idaho. IPC recognizes that any desktop analysis or regional study is generally useful for regional applications and should not be used as an alternative to site-specific studies in critical areas.

As described further in Section 3 of the Engineering Geology and Seismic Hazards Supplement (Attachment H-1), IPC proposes to conduct a Phase 2 site-specific geotechnical investigation, which will be conducted prior to final design and construction. Phase 2 will support final design, engineering, and construction specifications and will be used to avoid or mitigate site-specific geologic hazards. Following completion of Phase 2, IPC will develop a Phase 2 Site-Specific Geotechnical Report. IPC will submit the Phase 2 Site-Specific Geotechnical Report to DOGAMI and ODOE prior to construction.

Also, since the issuance of the Project Order, EFSC has revised the references to the guidelines and codes in OAR 345-021-0010(1)(h). Consistent with these revisions and consistent with the direction provided by DOGAMI, the most up-to-date building and structural codes that apply to transmission line projects will be used during the final design and construction of the Project. Current codes will be used to meet reliability standards and other external regulations. It is specifically assumed that current requirements embedded in structural, electrical building, and other codes meet or exceed the requirements of prior codes.

3.3 Information Required by OAR 345-021-0010(1)(h)

3.3.1 Geologic Report

> **OAR 345-021-0010(1)(h)(A)**
>
> A geologic report meeting the guidance in Oregon Department of Geology and Mineral Industries open file report 00-04 "Guidelines for Engineering Geologic reports and Site-Specific Seismic Hazard Reports."

DOGAMI's *Guidelines for Engineering Geologic Reports* (DOGAMI Guidelines) provide general guidance for completing engineering geology reports in Oregon. Adopted by the Oregon State Board of Geologist Examiners in 2004, it contains a suggested guide for the preparation of engineering geologic reports in Oregon. The DOGAMI Guidelines state that "the engineering geologic report should include sufficient facts and interpretation of the suitability of the site for the proposed use. Because of the wide variation in size and complexity of projects and scope of work, the guidelines are intended to be flexible and should be tailored to the specific project." As such, the guidelines do not provide rigid requirements for every engineering geologic report.

The DOGAMI Guidelines include general types of information that may be considered in an engineering geology report. All of these may or may not be included, depending on the Project, or additional information may be necessary not mentioned in the DOGAMI Guidelines. General project information may include: client, supervising geologist, project location and setting, purpose of report, topography, earth materials present, reference sources, geologic hazards, locations of test holes and excavations, field and laboratory test methods, statement of geologist's financial information if applicable, and signature and seal of certified engineering geologist. Geologic maps and cross-sections may be necessary to define the geologic conditions present. Geologic descriptions are typically found in an engineering report including bedrock rock types, relative age or formation names, distribution and thickness, and physical characteristics, structural features, surficial deposits, surface and subsurface hydrologic conditions, and seismic considerations. The geologic factors observed are typically discussed in the context of suitability for proposed land use to identify geologic conditions that may result in risk to land use, recommendations for site grading, drainage considerations, and limitations of study. Recommendations for additional investigations or hazard mitigations are also a part of typical engineering geology and seismic hazard reports.

The Engineering Geology and Seismic Hazards Supplement (Attachment H-1) includes an introduction, summary of topographical and geological features, general description of the scope of the proposed site-specific investigation, and summaries and mitigation strategies for seismic and non-seismic hazards. In turn, Exhibit H supplements the data contained in Attachment H-1 in a format that closely matches the requirements of OAR 345-021-0010(1)(h)(A).

To support the detailed design, IPC will carry out the Phase 2 program of site-specific geological and geotechnical work to investigate subsurface soil and geologic conditions following site certificate approval and apply site-specific geotechnical design recommendations. The geotechnical investigation will emphasize areas that require engineering design and areas identified as potential geologic hazards in the Engineering Geology and Seismic Hazards Supplement, including seismicity, slope failure, liquefaction, and subsidence. The site-specific geotechnical investigation will be performed prior to final design and construction.

Using the results of the geotechnical investigation, IPC will prepare a final engineering geologic report, the Phase 2 Site-Specific Geotechnical Report, prior to final design and construction to assess site-specific hazards in conformance the DOGAMI Guidelines. As described in the DOGAMI Guidelines, the Phase 2 Site-Specific Geotechnical Report will include additional facts and site-specific interpretation regarding geologic materials, processes, and history to allow evaluation of the suitability of specific affected sites for the proposed Project uses.

IPC has responded to many portions of the DOGAMI Guidelines in Exhibit H and Exhibit I, and will respond to the remaining applicable guidelines in the Phase 2 Site-Specific Geotechnical Report and related studies.

3.3.2 Site-specific Geotechnical Work

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

A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions.

Site-specific geologic and geotechnical investigations will include more detailed geologic field reconnaissance to identify faults and landslides and geologic data acquisition for soil, seismic, slope stability, and flood analyses.

Based on the geologic reconnaissance performed to date, IPC's geotechnical engineers have identified approximately 124 initial geotechnical boring locations (see Appendix C of Attachment H-1). Appendix A of Attachment H-1 includes maps of these proposed borehole locations. Section 3 of the Attachment H-1 provides an overview of the proposed site-specific geotechnical work, including right-of-way considerations, access and disturbance, and exploration methods.

A minimum of one boring will be drilled approximately every 3 miles. Additional borings will be completed at angle points, dead-end structures, near populated areas, or in locations identified as requiring additional geotechnical information. Reconnaissance and test borings, trenching techniques, and collection of rock and soil samples will be employed to help assess subsurface conditions. Collected rock and soil samples will be field classified and tested to determine geotechnical behaviors. Upon completion of soil and rock sampling, further laboratory tests will be conducted to measure physical and engineering properties of the soil and rock. Laboratory tests may include natural water content, particle size analysis, liquid and plastic limits, and moisture-density relationship. All testing will be performed in accordance with American Society of Testing and Materials (ASTM) or U.S. Army Corps of Engineers (USACE) testing requirements for consistency. Depending upon the materials encountered, additional testing in general accordance with ASTM or USACE testing procedures may be required to evaluate swell or settlement potential, direct shear, unconfined compressive strength, specific gravity and corrosion.

The results of the initial geotechnical investigation may identify data gaps that could result in additional investigation until sufficient information is received to ensure that the Project can be designed, engineered, and constructed. As detailed in Attachment H-1, it is anticipated that boring depths will generally be no more than 50 feet below the designed finish grade of the transmission center line. Subsurface investigation will be accomplished by hollow stem auger in unconsolidated areas above the groundwater level and by mud rotary methods below groundwater level. In areas where rock is encountered, the rock will be cored using HQ triple tube rock coring techniques. Soil and bedrock samples will be collected for analysis of geotechnical properties. Rock-coring methods will be used in an attempt to obtain continuous samples of rock, where encountered during drilling. Other standard sample collection methods are described in Attachment H-1.

Depth to groundwater will also be measured in the borings. If seasonal high groundwater is anticipated to interact with foundations, piezometers may be installed to assess groundwater fluctuations.

For proposed structures (such as substations or communication stations) near identified faults or within historical landslide areas, additional geotechnical investigation will be conducted to acquire necessary data for seismic and slope stability analysis. The degree of analysis will be contingent on hazard present, facility to be constructed, and potential danger to human safety and infrastructure.

IPC will obtain the necessary detailed information through invasive field and laboratory studies essential for the design, engineering, and constructing of the proposed facilities. When appropriate, IPC may use geophysical methods to investigate the underlying soils and rock. Typical indirect methods would include, but not be limited to, seismic refraction and resistivity methods.

Based on the results of the geotechnical field work, other studies employing alternative investigation methods may be required to expand design knowledge necessary to assess seismic hazards and failure-prone slopes. For example, preliminary seismic sources and maximum probable ground shaking were analyzed and are presented in Attachment H-1. However, during the field investigation, faults that cross the Project will be evaluated to confirm location and assess activity. Additional investigative methods may include field geomorphic and geologic investigation, followed by trenching where towers would need to be relocated to avoid active faults.

In known landslide-prone areas, steep slopes will also be evaluated to examine the potential for slope failure. Subsurface investigations will examine soil/rock properties, depth to slide planes, groundwater depths, groundwater fluctuations, or depth to bedrock or specific soil horizons. Investigation methods may include borings, trenches, geophysical surveys, inclinometer installation and monitoring, and laboratory testing of soil/rock. Site modifications and mitigation strategies will be developed and implemented for each unstable area as required. IPC's preferred mitigation strategy will be to construct towers in stable locations and avoid unstable areas.

Geotechnical field investigations will commence when IPC obtains access and permission to proposed field investigation sites. The results will inform the final design and siting of the transmission line and related and supporting facilities; substation, fly yards, stream crossings, roadway intersections, laydown yards, and multi-use yards. Table H-1 describes the general timeframe for detailed geotechnical work by facility and location. IPC will submit the results of the site-specific geotechnical investigation in the Phase 2 Site-Specific Geotechnical Report, which will be provided to DOGAMI and ODOE prior to construction.

Table H-1. Schedule of Site-Specific Geotechnical Work

Facility	Location	General Timeframe
Substation	Morrow County	Summer and Fall 2015[1]
Transmission line Spread 1	Morrow, Umatilla, and Union Counties	Summer and Fall 2015[1]
Transmission Line Spread 2	Baker and Malheur Counties	Summer and Fall 2015[1]

[1] Actual schedule will depend upon federal access approvals to conduct geotechnical investigations.

3.3.3 Consultation with DOGAMI

> **OAR 345-021-0010(1)(h)(C)**
>
> Evidence of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate site-specific geotechnical work that must be performed before submitting the application for the Department to determine that the application is complete.

DOGAMI and the ODOE were consulted at an in-person meeting on April 4, 2011, in Portland, Oregon. Mr. Bill Burns, Engineering Geologist for DOGAMI, commented as follows:

1) *The SLIDO (Statewide Landslide Inventory Database for Oregon) was being updated based on new LIDAR data, and you requested that the updated SLIDO 2 data should be incorporated into the geotechnical hazard assessment and engineering design prior to construction.*
2) *Geological and soil hazard analysis is not required at each tower location. The degree of investigation should be contingent on the type of hazards present, facility to be constructed, and potential danger to human safety. The degree of analysis will vary across the Project corridor.*
3) *The most recent IBC and Oregon Structural Specialty Code (OSSC) requirements should be used although current Oregon Administrative Rules reference historical IBC requirements.*
4) *You were aware that in transmission line construction, design for wind and ice forces is more than sufficient to account for typical seismic forces.*
5) *A detailed geotechnical plan may be submitted concurrently with the Application for Site Certification (ASC) and the Engineering Geologic Report for the Project may be submitted after filing the ASC.*
6) *Exhibit H should contain as much detail as possible. DOGAMI will only review Exhibit H and its Attachment so reference should not be made to other documents.*
7) *You indicated that the April 2011 meeting would satisfy the requirements of DOGAMI consultation.*

Attachment H-2 contains a letter to DOGAMI, confirming DOGAMI's acknowledgement of the bulleted items listed above. The Engineering Geology and Seismic Hazards Supplement was attached to the letter to DOGAMI for the agency's review and evaluation.

3.3.4 Locations of Geotechnical Work

> **OAR 345-021-0010(1)(h)(D)**
>
> For all transmission lines, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends, corners, and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides or marginally stable slopes that could be made unstable by the planned construction.

In compliance with OAR 345-021-0010(1)(h)(D), sites for geotechnical investigation shall include indicative tower or substation locations and the following:

- railroad crossings;
- major road crossings;
- dead ends;
- corners or angles in transmission line greater than 5 degrees;
- area of potential subsidence;
- landslide-prone areas;
- areas with high erosion potential, and
- areas near recent or active faults.

Appendix C of Attachment H-1 presents a summary table with the approximate locations and rationale for the initial 124 proposed geotechnical boreholes. Additional borings may be necessary to fill data gaps from the initial drilling program. Appendix A of Attachment H-1 presents a series of geologic maps, showing the transmission line indicative alignment, and geologic features.

3.3.5 Pipelines

> **OAR 345-021-0010(1)(h)(E)**
>
> For all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings and portions of the proposed alignment where geologic reconnaissance and other site specific studies provide evidence of existing landslides or marginally stable slopes that could be made unstable by the planned construction.

This subpart of the regulations does not apply because the Project contains no pipelines.

3.3.6 Earthquakes and Seismic Hazards

> **OAR 345-021-0010(1)(h)(F)**
>
> An assessment of seismic hazards. For the purposes of this assessment, the maximum probable earthquake (MPE) is the maximum earthquake that could occur under the known tectonic framework with a 10 percent chance of being exceeded in a 50 year period. If seismic sources are not mapped sufficiently to identify the ground motions above, the applicant shall provide a probabilistic seismic hazard analysis to identify the peak ground accelerations expected at the site for a 500 year recurrence interval and a 5000 year recurrence interval. In the assessment, the applicant shall include:
>
> (i) Identification of the Maximum Considered Earthquake Ground Motion under the 2009 International Building Code.

> (ii) Identification and characterization of all earthquake sources capable of generating median peak ground accelerations greater than 0.05g on rock at the site. For each earthquake source, the applicant shall assess the magnitude and minimum epicentral distance of the maximum credible earthquake (MCE).
>
> (iii) A description of any recorded earthquakes within 50 miles of the site and of recorded earthquakes greater than 50 miles from the site that caused ground shaking at the site more intense than the Modified Mercalli III intensity. The applicant shall include the date of occurrence and a description of the earthquake that includes its magnitude and highest intensity and its epicenter location or region of highest intensity.
>
> (iv) Assessment of the median ground response spectrum from the MCE and the MPE and identification of the spectral accelerations greater than the design spectrum provided in the Oregon Structural Specialty Code (2010 edition). The applicant shall include a description of the probable behavior of the subsurface materials and amplification by the subsurface materials and any topographic or subsurface conditions that could result in expected ground motions greater than those characteristic of the Maximum Considered Earthquake Ground Motion identified above.
>
> (v) An assessment of the seismic hazards expected to result from reasonably probable seismic events. As used in this rule “seismic hazard” includes ground shaking, ground failure, landslide, lateral spreading, liquefaction, tsunami inundation, fault displacement and subsidence.

The detailed seismic evaluation is presented in the Engineering Geology and Seismic Hazards Supplement (Attachment H-1). IPC is governed by the National Electric Safety Code (NESC) and required to apply various weather-related structural loading cases while designing transmission lines. IPC will apply all NESC-required, weather-related loading cases as well as additional cases identified to be important to the integrity of the lines.

Notably, NESC Section 250.A.4 indicates that by designing for the required line and tower loading cases, nothing further is required to resist earthquake loads. It states, “The structural capacity provided by meeting the loading and strength requirements of Sections 25 (Loadings for Grades B and C) and 26 (Strength Requirements) provides sufficient capability to resist earthquake ground motions.”

Additionally, the American Society of Civil Engineers (ASCE) *Guidelines for Electrical Transmission Line Structural Loading* (Wong and Miller 2010) states the following:

> *Transmission structures need not be designed for ground-induced vibrations caused by earthquake motion because, historically, transmission structures have performed well under earthquake events, and transmission structure loadings caused by wind/ice combinations and broken wire forces exceed earthquake loads. This may not be the case if the transmission structure is partially erected or if the foundations fail due to earth fracture or liquefaction.*
>
> *Transmission structures are designed to resist large, horizontal loads of wind blowing on the wires and structures. These loads and the resulting strengths provide ample resistance to the largely transverse motions of the majority of earthquakes. Decades of experience with lines of all sizes has shown that very infrequent line damages have resulted from soil liquefaction or when earth failures affect the structural capacity of the foundation.*

For these reasons IPC does not intend to perform additional design efforts specific to earthquakes; NESC-mandated combined ice and loading cases have been determined by the industry to be sufficient to address seismic hazards from earthquakes.

Although seismic design criteria do not apply to transmission structures seismic hazards must be evaluated in accordance with the OAR. The detailed seismic hazards evaluation is presented in Attachment H-1. For the purposes of this preliminary evaluation the seismic sources are not mapped sufficiently to perform a deterministic evaluation of ground motions along a severa-hundred-mile-long power line alignment. Therefore, probabilistic peak ground acceleration (PGA) for a 500- and 5,000-year return period have been included in this evaluation and are shown in Attachment H-1.

3.3.6.1 Maximum Considered Earthquake Ground Motion

> **OAR 345-021-0010(1)(h)(F)(i)**
>
> Identification of the Maximum Considered Earthquake Ground Motion under the 2009 International Building Code.

In accordance with section F(i) seismic hazards will be evaluated according to the International Building Code (IBC). This evaluation provides PGA, short- and long-period (0.2 and 1.0 second) spectral accelerations. The OAR specifies use of IBC 2009 for design, however we assume the most recent version of IBC will be used during final design. The 2012 IBC provides Maximum Considered Earthquake ground motions (MConE) that correspond to a 2 percent probability of exceedance in 50 years, or a 2,500 return period. The PGA, short- and long-period (0.2 and 1.0 second) spectral accelerations are shown in Attachment H-1.

3.3.6.2 Earthquake Sources

> **OAR 345-021-0010(1)(h)(F)(ii)**
>
> Identification and characterization of all earthquake sources capable of generating median peak ground accelerations greater than 0.05g on rock at the site. For each earthquake source, the applicant shall assess the magnitude and minimum epicentral distance of the maximum credible earthquake (MCE).

Evaluation of source specific probabilistic ground motions along the 300 mile alignment has been provided using USGS 2008 PGA and spectral accelerations on rock. Site class determinations and site specific hazard evaluations for structure locations will be determined during geotechnical design studies.

The four sources of earthquakes and seismic activity in Oregon are crustal, interplate, intraplate, and volcanic (DOGAMI 2010). The Project is not located on a plate boundary and the nearest is over 80 miles from the Project. However the Project may experience ground shaking from any of the earthquake types. The most significant earthquake sources near the Project are intraplate or crustal earthquakes, however intraplate earthquakes may rarely occur and are located hundreds of miles from the Project.

- <u>Crustal earthquakes</u> are generally shallow (<30 kilometers [km] depth), resulting from active faulting in the upper North American Plate. Crustal earthquakes typically have a maximum magnitude near 7.0, and recurrence intervals are dependent on stress accumulation and release but can range from 10s to 100s of years.
- <u>Interplate earthquakes</u> are those which occur between two plate boundaries. Interplate seismicity in Oregon is generated from the convergence of the Juan de Fuca Plate and the North American Plate at the Cascadia Subduction Zone (CSZ) just off the coast of Washington and Oregon (USGS 2009a). These plates converge at a rate of 1 to 2 inches per year and accumulate large amounts of stress that are released abruptly in earthquake events. The CSZ and similar plate boundaries are capable of producing

large 9.0 magnitude subduction zone earthquakes. Recurrence intervals are typically on the order of 300 to 500 years.

- Deep Intraplate earthquakes occur deep (50-70 km depth) in the CSZ and have a maximum magnitude potential near 7.0. Recurrence intervals for deep intraplate earthquakes are generally between 500 to 600 years.

Because of their proximity, crustal faults represent the most significant seismic hazard to the proposed transmission alignment. Quaternary Fault maps are presented in Attachment H-1, Appendix D. The maps present the locations of known and inferred faults.

Table H-2 is a summary table of significant faults considered capable of generating a large earthquake within 5 miles of the proposed and alternate corridor segments. These faults are potentially capable of producing a PGA greater than 0.05g along the proposed and alternate corridor segments. Of the youthful Quaternary faults identified by USGS (Table H-2), faults less than 15,000 years old are recent by geologic standards and likely pose the greatest potential for future earthquakes. These faults are assumed to be active.

Table H-2. USGS Quaternary Faults by County

County	Fault Name	Approximate Milepost	Age (years)	Active?
Morrow	None	N/A	N/A	N/A
Umatilla	Hite Fault System, Thorn Hollow Section	75–80	<130,000	No
	Hite Fault System, Agency Section	86	<1,600,000	No
Union	West Grande Ronde Valley Fault Zone (includes Mount Emily, La Grande, and Craig Mountain Sections	106–126	<15,000	Yes
	South Grande Ronde Valley Fault Zone	126–133	<750,000	No
Baker	Unnamed East Baker Valley Faults	140–160	<1,600,000	No
	West Baker Valley Faults	157–162	<130,000	No
Malheur	Cottonwood Mountain Fault	216–243	<15,000	Yes
	Juniper Mountain Fault	216–222	<15,000	Yes
	Faults Near Owyhee Dam	244–271	Class B[1]	No

[1] Class B Faults are faults of uncertain origin that may be older than Quaternary.

3.3.6.3 Recorded Earthquakes

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

A description of any recorded earthquakes within 50 miles of the site and of recorded earthquakes greater than 50 miles from the site that caused ground shaking at the site more intense than the Modified Mercalli III intensity. The applicant shall include the date of occurrence and a description of the earthquake that includes its magnitude and highest intensity and its epicenter location or region of highest intensity.

Due to their large areas of impact, the analysis area for recorded earthquakes was larger than the Site Boundary, and chosen by a variable buffer distance around epicenters, or groups of epicenters, of historical earthquakes. The seismology department at University of Nevada at Reno states that earthquakes of Richter magnitude 6.1 to 6.9 may affect areas up to 100 kilometers from the epicenter (UNR 1996). Given that estimate, an analysis area radius of 25 miles was selected for earthquakes less than magnitude 6. A radius of 50 miles was assumed for earthquakes of magnitude 6 to less than 7, and the analysis area was extended out to 100 miles for earthquakes of magnitude 7 or greater. The distance of 100 miles was chosen because, above that distance, the effect on the proposed transmission line from earthquakes would be minimal from even the strongest recorded past earthquakes. The locations of historical earthquake epicenters were also reviewed relative to the proposed and alternate corridor segments. Earthquake data for Idaho and Oregon were obtained from the applicable state geologic survey departments. None of the recorded earthquakes within the Site Boundary exceeded Richter magnitude 6.0. The recommended design earthquake magnitudes of 6.0 to 6.2 appear realistic, given the maximum magnitude of historic earthquakes.

Historical earthquakes recorded by the USGS Earthquake Search Data Base (USGS 2009b, 2011), the National Geophysical Data Center (NGDC 1985), and the Pacific Northwest Seismic Network (PNSN 2008) are evaluated in Appendix D of Attachment H-1. A map of recorded earthquakes with magnitudes of 2 or greater within 50 miles of the Project is shown in Figure D-2, Appendix D of Attachment H-1.

The NGDC reports 169 records from earthquakes known to have caused Modified Mercalli Intensity (MMI) III or greater within 50 miles of the Project. MMI values within the 50-mile corridor ranged from III to VII. For earthquakes that were reported in terms of magnitude only, a MMI was estimated. The furthest recorded earthquake estimated to cause an MMI greater than III was approximately 740 miles from the northern portion of the Project. The USGS (2009a) provides the following descriptions of MMI values (abbreviated from the 12 levels of MMI):

> III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
>
> IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
>
> V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
>
> VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
>
> VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

Based on the number of historical earthquakes that have occurred within 50 miles of the Project, it is assumed that earthquakes will occur during the life of the Project. However, the Project will be designed to withstand weather-related forces; according to the NESC, the structural capacity provided by meeting the loading and strength requirements for weather-related stresses provide sufficient capability to resist earthquake ground motions.

3.3.6.4 Median Ground Response, MCE and MPE

> **OAR 345-021-0010(1)(h)(F)(iv)**
>
> Assessment of the median ground response spectrum from the MCE and the MPE and identification of the spectral accelerations greater than the design spectrum provided in the Oregon Structural Specialty Code (2010 edition). The applicant shall include a description of the probable behavior of the subsurface materials and amplification by the subsurface materials and any topographic or subsurface conditions that could result in expected ground motions greater than those characteristic of the Maximum Considered Earthquake Ground Motion identified above.

The MPE is the largest earthquake that a fault is predicted capable of generating under the known tectonic framework within a 500 year return period while the maximum credible earthquake (MCE) is the largest earthquake that an active or potentially active fault is capable of generating. For this preliminary evaluation the seismic sources are not mapped sufficiently to perform deterministic evaluations of ground motions along a several hundred mile long power line alignment. The location, length and age of offset for credible fault ruptures are not sufficiently documented to determine magnitude and minimum epicentral distance. Therefore as discussed in Section 3.3.6, probabilistic PGA for a 500- and 5,000-year return period have been evaluated.

The ground motions provided in Attachment H-1 correspond to a Site Class B/C (soft rock) soil profile. The OAR requires “assessment of the median ground response spectrum” and “a description of the probable behavior of the subsurface materials and amplification by subsurface materials and any topographic of subsurface conditions that could result in expected ground motions greater than those characteristic of the MConE.” To develop ground motions that correspond to other Site Class types, Site Coefficients that consider site soil type and level of ground shaking are required. The Site Class definitions and Site Coefficients can be obtained from ASCE 7-10. Subsurface explorations along the alignment have not been performed. Therefore, site specific design criteria for structures will be prepared upon completion of the geotechnical investigations program.

3.3.6.5 Seismic Hazards Resulting from Seismic Events

> **OAR 345-021-0010(1)(h)(F)(v)**
>
> An assessment of the seismic hazards expected to result from reasonably probable seismic events. As used in this rule “seismic hazard” includes ground shaking, ground failure, landslide, lateral spreading, liquefaction, tsunami inundation, fault displacement and subsidence.

The Project may be subject to ground shaking, ground failure, landslides, liquefaction, fault displacement, and subsidence from reasonably probable seismic events. The Project is well above sea level and far from the Pacific Coast; therefore, tsunami inundation was not considered.

Interplate events occur between two tectonic plates, such as the CSZ where the Juan de Fuca Plate subducts beneath the North American Plate. Interplate events include subduction earthquakes that have the potential to be the largest earthquakes that may occur in the Pacific Northwest. Intraplate events are seismic events that occur within a tectonic plate. The Nisqually earthquake of 2001 was identified as an intraplate seismic event. Crustal earthquakes typically occur within 10 miles of the surface along shallow faults and are considered the most likely source to impact the Project. IPC identified known significant faults near the facility.

Ground Motion or Seismic Shaking

Ground shaking will be evaluated after subsurface explorations are performed and soil site classes can be determined. IPC's engineers have relied on the seismic results from Attachment H-1 to perform initial designs, and as additional information is collected during the site-specific geotechnical investigation, designs will be modified if necessary to construct facilities to avoid dangers to human safety presented by seismic hazards.

Ground Failure

Ground failure and fault displacement can occur from fault rupture in an active fault zone. Known Quaternary faults located within 5 miles of the Proposed Corridor that could be considered active include the Cottonwood Mountain fault, Juniper Mountain fault, and segments of the West Grande Ronde Valley fault zone (see Table H-2). Of these active faults, only the Cottonwood Mountain fault crosses the Proposed Corridor and should be considered during final design. Ground failure including landslide, lateral spreading, liquefaction, and surface rupture or settlement will be evaluated once ground accelerations and subsurface conditions are known.

A preliminary seismic risk assessment was conducted from a review of earthquake hazard zones included in Federal Emergency Management Agency (FEMA) data, prepared for the U.S. Department of Transportation, Office of Pipeline Safety (OPS; 1996). The OPS data provide earthquake hazard rankings for the United States, including those portions of Idaho and Oregon near the proposed transmission lines. The OPS report utilized information from the USGS National Earthquake Hazards Reduction Program. The USGS compiled a large database of past earthquake magnitudes and locations. Based on those data, earthquake hazards were assigned to all parts of the country. Based on historical earthquake magnitudes and locations, geographic areas were assigned an earthquake hazard ranking, ranging from zero (no earthquake hazard) to 100 (highest earthquake hazard). For this earthquake hazard assessment, a high earthquake hazard was assigned for areas with earthquake hazard rankings of 85 to 100. Locations with earthquake hazard rankings between 70 and 84 were considered as medium risk, and rankings less than 70 were considered low risk. To identify existing earthquake conditions the mileage crossed for each earthquake hazard risk (low, medium, or high) was mapped and expressed as a percent for each county. To disclose overall hazard risk, the mileage crossed by the Proposed Corridor and alternate corridor segments in each county was identified.

Table H-3 presents the percent of low, medium, and high earthquake risk (in miles) along the Proposed Corridor and alternate corridor segments by county. The OPS data indicate that earthquake risk is greatest in the northern portion of the Proposed Corridor, with all of Morrow County and 13 percent of Umatilla County in medium earthquake risk. The OPS data indicate the remainder of the Proposed Corridor contains low risk of earthquakes. In the areas of feasible alternate corridor segments, earthquake risks are medium for the Horn Butte and Longhorn alternate corridor segments, and all other alternate corridor segments contain low risk. Therefore, earthquake hazard risks for the alternate corridor segments are comparable to those in the Proposed Corridor.

Table H-3. OPS Earthquake Hazard Risk – Proposed Corridor and Alternate Corridor Segments

Facility	County	Miles Crossed	Earthquake Hazard Risk by Centerline Miles Crossed/Percent of Miles Crossed – Proposed Corridor and Alternate Corridor Segments		
			Low < 70	Medium 70 to 85	High 85 to 100
Proposed Corridor	Morrow	46.8	0	46.8/100	0
	Umatilla	49.5	43.2/87	6.3/13	0
	Union	39.8	39.8/100	0	0
	Baker	69.2	69.2/100	0	0
	Malheur	72.0	72.0/100	0	0
IPC Proposed 138/69kV Rebuild	Baker	5.3	5.3/100	0	0
Total Proposed Corridor		***281.6***	***229.5/81***	***53.1/19***	***0***
Alternate Corridor Segments					
Horn Butte	Morrow	27.5	0	27.5/100	0
Longhorn	Morrow	18.4	0	18.4/100	0
Glass Hill	Union	7.5	7.5/100	0	0
Flagstaff	Baker	15.1	15.1/100	0	0
Willow Creek	Malheur/Baker	24.6	24.6/100	0	0
Malheur S	Malheur	33.6	33.6/100	0	0
Double Mountain	Malheur	7.4	7.4/100	0	0

Landslides

Appendix E of Attachment H-1 contains a detailed reconnaissance of the Proposed Corridor and alternate corridor segments showing the locations of known landslides and soil instabilities. Accessible areas where landslides have been identified in the literature review have been visited by IPC's engineers to observe the landslide. The review includes site photographs and preliminary maps of unstable or landslide surfaces. The Engineering Geology and Seismic Hazards Supplement (Attachment H-1) included review of the DOGAMI SLIDO-1 and SLIDO-2 databases, site reconnaissance of the Proposed Corridor and alternate corridor segments, aerial imagery review, review of Digital Terrain Model data, and review of DOGAMI LiDAR data where available. The data were used to map landslides within one mile of the Proposed Corridor. IPC's engineers will include the areas of soil instabilities in the site-specific geotechnical analysis.

Liquefaction

Liquefaction is a phenomenon in which saturated, primarily cohesionless soils temporarily lose their strength when subjected to dynamic forces such as intense and prolonged ground shaking and seismic activity. All portions of the Site Boundary have the potential for ground shaking from earthquakes. Areas that are most susceptible to liquefaction have a combination of thick unconsolidated sediments, and a shallow water table (within 50 feet of the surface). Because the majority of the transmission line crosses relatively stable terrain with shallow bedrock and deep groundwater, the majority of the Site Boundary has a low susceptibility to liquefaction.

Prior to the development of final engineering design, liquefaction studies will be conducted for susceptible areas, including areas that cross or approach rivers and areas where thick unconsolidated sediments are encountered in the field. Additional evaluation of liquefaction also may be needed as the final alignment and tower locations are chosen. The geotechnical engineer will recommend additional exploration and/or analysis as applicable to assess liquefaction hazards in the geotechnical design report for the transmission line.

Subsidence

Subsidence is the sinking or the gradual downward settlement of the land surface, and is often related to groundwater drawdown, compaction, tectonic movements, mining or explosive activity. Seismic activity in the area could lead to the settling of sediment and could also exacerbate potential subsidence associated with groundwater withdrawal in more populous regions. No historical cases of subsidence in the Site Boundary have been identified, and the majority of the site has a low susceptibility to subsidence. At this time there are no specific locations where subsidence studies will be performed. However, if subsidence-prone areas are identified during the Phase 2 geotechnical investigation, the transmission line will be designed and located to avoid subsidence hazards.

Lateral Spreading

Lateral spreading is the permanent horizontal movement of a liquefiable soil deposit due to the presence of initial shear stresses on horizontal planes within the soil during a seismic event. It occurs predominantly within gradual slopes or on flat sites situated near riverbanks, shorelines, bulkheads, or wharves. Due to the location of the proposed alignment, coupled with the steep terrain and shallow bedrock anticipated along much of the alignment, the risk of lateral spreading is very low.

3.3.7 Soil-Related and Geologic Hazards

> **OAR 345-021-0010(1)(h)(G)**
>
> An assessment of soil-related hazards such as landslides, flooding, and erosion which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility.

3.3.7.1 Mass Wasting and Landslides

Mass wasting is a generic term for landslides, rockslides, rockfall, debris flows, soil creep, and other processes that include the downslope movement of masses of soil and rock. Mass wasting can be initiated by precipitation events, sometimes in conjunction with land use. Slope stability is a function of moisture content, slope gradient, rock and soil type, slope aspect, vegetation, seismic conditions and ground-disturbing activities. As discussed in Section 3.3.6.5, Appendix E of the Engineering Geology and Seismic Hazards Supplement (Attachment H-1) contains a detailed reconnaissance of the Site Boundary showing the locations of known landslides and soil instabilities. Additional information will be collected on unstable areas during the site-specific, Phase 2 geotechnical investigation. Those data will assist in design of a transmission line that avoids unstable areas, or is built to withstand the effects of land movements to avoid dangers to human safety.

3.3.7.2 Flooding

Floodplain maps published by FEMA were reviewed to evaluate flooding potential within the Site Boundary. Because FEMA floodplain maps typically provide coverage for use by insurers in populated areas, and FEMA data are scarce away from populated areas, more comprehensive data also were evaluated. To evaluate flood hazards OPS (1996) floodplain hazard zones were compared to the Temporary Disturbance Area and the Permanent Disturbance Area (Table H-4). Flood hazards of 85 percent to 100 percent were considered moderate to high risk for flooding and are typically spanned to avoid flood prone areas. A total of only 8 acres in Morrow County and 1.2 acres in Malheur County contain moderate to high flood risks in the permanent disturbance area. The Horn Butte and Willow Creek alternate corridor segments contain some areas of temporary and permanent flood risks. The other alternate corridor segments contain low flooding risk. Towers, substations, communication sites, roads, multi-use areas, and fly-yards will be located outside of flood-prone areas where practical and will employ specific designs in flood prone areas, as required to eliminate flood hazards.

Table H-4. Floodplain Hazards in Temporary and Permanent Disturbance Areas – Proposed Corridor and Alternate Corridor Segments

Facility	County	Area[1] (acres)	Moderate to High Flood Risk (acres)	
			Temporary	Permanent
Proposed Corridor	Morrow	3,760.2	65.2	8.0
	Umatilla	3,972.3	0	0
	Union	3,047.0	0	0
	Baker	6,213.1	0	0
	Malheur	5,756.8	48.9	1.2
IPC Proposed 138/69-kV Rebuild	Baker	NA	0	0
Total Proposed Corridor			***114.1***	***9.2***
Alternate Corridor Segments				
Horn Butte	Morrow	2,234.7	52.1	6.8
Longhorn	Morrow	1,954.6	0	0
Glass Hill	Union	683.5	0	0
Flagstaff	Baker	1,195.4	0	0
Willow Creek	Malheur/Baker	2,011.7	37.9	1.4
Malheur S	Malheur	2,973.6	0	0
Double Mountain	Malheur	791.2	0	0

[1] Area is area of Site Boundary.

3.3.7.3 Erosion

Erosion is a continuing natural process that can be accelerated by human disturbances. Factors that influence soil erosion include soil texture, structure, length and slope steepness, vegetative cover density and rainfall or wind intensity. Soils most susceptible to erosion by wind and water are typically non-cohesive soils with low infiltration rates, residing on moderate to steep and sparsely vegetated slopes. Non-cohesive soils include silty, sandy, or gravelly soils, with little to no clay sized particles. Wind erosion processes are less affected by slope angles but highly influenced by wind intensity. The potential for soil erosion within the Site Boundary varies based on the erosion mechanism and soil characteristics.

The erosion potential was analyzed using three factors: soil K factor, wind erodibility, and slope. The Phase 2 geotechnical analysis will provide further evaluation of soil erosion potential, based on additional review of soil properties, and based on laboratory testing of soil samples collected during geotechnical drilling. Soil erodibility will be considered in design of the Project to avoid dangers to human safety.

Soil K Factor

Soil erosion hazards were mapped throughout the Site Boundary based on the soil's K factor, the soil-erodibility factor. The standard measurement condition is the unit plot. The unit plot is 72.6 feet (22.1 meters) long on a 9 percent slope, maintained in continuous fallow, tilled up and down hill periodically to control weeds and break crusts that form on the surface of the soil. The plots are plowed, disked and cultivated the same for a row crop of corn or soybeans except that no crop is grown on the plot.

Soils high in clay have low K values, because they are resistant to detachment. Coarse textured soils, such as sandy soils, have low K values, because of low runoff even though these soils are easily detached. Medium textured soils, such as the silt loam soils, have a moderate K values, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having a high silt content are the most erodible of all soils. They are easily detached, tend to crust, and produce high rates of runoff.

The State Soil Geographic (STATSGO) database was used to characterize soil erosion factors. The U.S. Department of Energy, Pacific Northwest National Laboratory website (DOE 2003) guideline was used to segregate the mapped soils into low, moderate, or high K Factor soils. Low K values ranged from 0.05 to 0.15, moderate K values were from 0.25 to 0.4, and high K values were greater than 0.4. However, the closest category in the NRCS GIS data file to 0.4 was 0.37. As such, a K factor of 0.37 was used to define soils mostly likely to erode. Appendix B of Attachment H-1 presents further information concerning soil erosion potential. Areas of soils with high K factor that could be affected during construction and operations are contained in Exhibit I, Section 3.3.3.1, Table I-5 and Section 3.3.3.2, Table I-9.

Wind Erosion

The potential for soil erosion by wind was evaluated using NRCS wind erodibility group data, which are based on the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion. Project construction activities that could expose soils particularly erodible to wind erosion include any surface disturbance (e.g., road construction and improvements, vegetation clearing).

Slope

In general, steep slopes possess a greater potential for erosion by water or mass movements than flat areas. Areas containing greater than 25 percent slope were considered to have greater erosion potential.

3.3.8 Geologic Hazard Mitigation

The following section discusses anticipated Project design, engineering, and construction measures to avoid or mitigate dangers to human safety resulting from the geologic hazards described above. Additional mitigation strategies will be developed following completion of the Phase 2 geotechnical investigations, consistent with the approaches summarized below.

3.3.8.1 Seismic Hazard Mitigation

> **OAR 345-021-0010(1)(h)(H)**
>
> An explanation of how the applicant will design, engineer and construct the facility to avoid dangers to human safety from the seismic hazards identified in paragraph (F). The applicant shall include proposed design and engineering features, applicable construction codes, and any monitoring for seismic hazards.

In general, transmission towers are designed for large wind and tension loads, which results in ample capacity to resist seismic loads. Towers will be designed in accordance with the NESC C2 (IEEE 2006), ASCE Standard 10-97 (ASCE 1997), and ASCE Manual of Practice MOP-74 (Wong and Miller 2010). Substation structures will be designed in accordance with applicable portions of the OSSC.

All towers and facilities for the Project will be designed to meet or exceed the 2010 OSSC. The codebook contains the amendments to the 2009 IBC as adopted by the State of Oregon and local agencies. A qualified engineer will assess and review the seismic, geologic and soil hazards associated with the construction of the towers and facilities. The Project will be designed to withstand wind and ice loads, which are greater than typical seismic forces. All designs and subsequent construction requirements may be modified based on the site-specific characterization of seismic, geologic and soil hazards. By following the appropriate codes; NESC C-2, OSSC Section 1604, 2009 IBC, ASCE 10-97, and ASCE MOP 74, the Project will be designed, engineered, and constructed to adequately avoid potential dangers to human safety presented by seismic hazards.

The Project facilities are generally unmanned and located in sparsely populated areas. Therefore, the risks to human safety due to seismic hazards are minimal due to the low probability of human presence. All Project facilities will be constructed in accordance with the 2010 OSSC and 2009 IBC, or the more recent standards applicable at the time of detailed design.

3.3.8.2 Soil-Related Hazard Mitigation

> **OAR 345-021-0010(1)(h)(I)**
>
> An explanation of how the applicant will design, engineer and construct the facility to adequately avoid dangers to human safety presented by the hazards identified in paragraph (G).

A desktop analysis of soil conditions was conducted prior to initial Project siting (Shaw 2012). This analysis incorporated data from many sources as previously described. The transmission line siting was based partly on engineering constraints related to known geologic hazards, soil stability, water crossings, and areas of steep topography. By considering soil and slope conditions throughout the siting and design process, IPC has avoided soil impacts to the extent possible.

The Project will use existing roads to access Project sites to the extent practicable. Where needed, existing roads will be improved to reduce sediment generation and minimize impacts to soils. Site Boundary impacts to soils at and around tower locations, access roads, and facility footprints will be avoided or minimized through the use of best management practices (BMPs) and restoration measures to restore soil surfaces and vegetation following disturbances. IPC will meet Bureau of Land Management (BLM)-, U.S. Department of Agriculture, Forest Service (USFS)-, and Oregon Department of Transportation (ODOT)-required design standards for new roads and will implement BMPs described below and in the Erosion and Sediment Control Plan

(ESCP) and National Pollutant Discharge Elimination System (NPDES) permits to reduce potential soil erosion during the construction process. Construction of roads, facilities and towers will be regulated by the NPDES 1200-C Stormwater Construction Permit and the associated ESCP. To minimize soil erosion, where practical IPC will implement revegetation procedures, such as recontouring, scarification, soil replacement, seedbed preparation, fertilization, seed mixtures, seeding timing, seeding methods, supplemental wetland and riparian plantings, and supplemental forest plantings.

Once the roads, towers, and other facilities have been constructed to the designed specifications, operations will have minimal potential for soil erosion. Slopes and cut banks will be stabilized with riprap and/or planted or seeded with vegetation as practical, and Project facilities will be maintained as required to prevent erosion. Temporary access road sites and other compacted soils will be mechanically loosened where necessary, and where required previously salvaged topsoil will be replaced and non-cropped areas will be revegetated.

Vegetation management methods employed during maintenance operations will not result in soil erosion.

Mitigation for Soil Erosion by Water

Erosion control measures will be designed with attention to the mapped soil erosion hazards (described in Section 3.3.7), with particular attention to areas with medium and high hazard ratings. Work on access roads will include grading and re-graveling of existing roads and construction of new roads. Soil erosion will be minimized by constraining traffic, heavy equipment and construction to existing roads where possible. Where new road construction is required, road widths will be limited to the width necessary to accommodate construction equipment. New roads will be located to avoid steep areas as much as possible.

Areas affected by construction will be reseeded with vegetation to minimize future erosion and to restore the systems to their natural state. Erosion and sediment control measures will be designed to remain intact until natural vegetation is sufficient to protect against erosion. The substation operational footprint areas will be graveled to prevent erosion. The area outside the substation fence may also be graveled where practical to prevent soil erosion during operations.

The Project has applied for and will obtain a 1200-C permit (see Exhibit I, Attachment I-3). The ESCP includes the following general erosion and sediment control measures to be implemented during Project construction:

- Scheduling to avoid earth disturbing activities that can result in significant increases in disturbance during wet weather;
- Work area erosion and sediment controls;
- Storm drain inlet protection;
- Non-storm water pollution controls, such as materials use and waste management BMPs;
- Covering or otherwise protecting stockpiles; and
- Runoff and erosion prevention measures for slopes susceptible to erosion.

Mitigation for Wind Erosion

To mitigate the risk of accelerating soil erosion by wind in areas rated with wind erodibility groups 1 through 4, IPC will implement reseeding efforts, apply mulch, and use water for dust control. Areas that are susceptible to aeolian processes that will be disturbed by construction activities and not permanently covered by aboveground facilities will be vegetated using a seed mixture specified by the applicable agencies as being capable of surviving in local conditions, and withstanding burial and deflation from aeolian processes. Disturbed areas susceptible to wind erosion may be hydroseeded when temperatures and moisture levels are conducive to seed germination.

Flood Mitigation

Flood hazard mitigation goals are to avoid and reduce damage to constructed tower and facility locations, prevent construction that could exacerbate flooding, minimize economic losses associated with repair of structures influenced by flooding hazards and avoid dangers to human safety. Federal and state policies related to development in flood-prone areas were developed according to FEMA requirements and guidelines. These policies include zoning ordinances found in local regulations and building code ordinances in the OSSC Section 1612. This code establishes flood protection standards for all construction, including criteria to ensure that the foundation will withstand flood forces.

To reduce flood hazards, Project structures and towers will be set back from areas of high flood risks where possible. Where structures cannot be set back, a site-specific structural and erosion hazard assessment will be conducted to determine mitigation requirements.

Standards for protecting foundations against flood damage include requirements for soil testing and prepared fill. Building code provisions impose conditions to ensure that structures built in flood zones meet minimum standards. The primary structural code in Oregon is the OSSC, Section 1612. This code establishes flood protection standards for all construction, including criteria to ensure that the foundation will withstand flood forces and that all portions of the structures subject to damage are above, or otherwise protected from, flooding.

Landslide Mitigation

Landslide hazards will be thoroughly evaluated to assess the potential for failure. If landslides or slumps are identified in the field, the first step will be to adequately characterize the mass wasting or landslide hazards, after which roads and transmission facilities will be designed to meet structural and zoning requirements. Structural requirements will adhere to soil lateral load requirements in the OSSC (Section 1610). In general, structures will be located to avoid potential landslide hazards where possible, and new constructed slopes will be designed with an adequate safety factor against sliding. If feasible, structures will be constructed with sufficient setback from slopes to mitigate the potential for landslides during construction and operations.

Appropriate landslide mitigation methods will be selected based on site characteristics and the structure to be constructed. Where structures cannot be moved or realigned, various techniques can be implemented through slope geometry, hydrogeological, and reinforcement methods.

Hydrogeological mitigation may include surface drainage, shallow drainage and deep drainage. These drainage mechanisms vary in intensity; however, all mechanisms attempt to prevent water infiltration into the ground and reduce soil water content. This will decrease soil pore pressures and reduce overburden weights, which will increase effective soil strength and thereby decrease landslide potential. Types of drains may include trenches, drain wells, siphon drains, or micro drains.

Reinforcement measures may be implemented when geometric slope modifications, draining or chemical techniques are not sufficient or practical. Reinforcement modifications can involve the use of anchors or tieback systems, geofabric installation at depth, steel or geofabric mesh on ground surface, and cellular and crib face installation. Vegetation will also be used (in combination with the above-described methods) to help prevent shallow slides by intercepting rainfall, decreasing runoff and providing root stabilization.

4.0 CONCLUSIONS

IPC has provided evidence required by OAR 345-021-0010(1)(h) that the Project will meet the structural approval standard in OAR 345-022-0020. IPC has adequately characterized the site in regard to seismic hazards and can design, engineer, and construct the Project to avoid dangers to human safety presented by seismic hazards affecting the site. IPC has adequately characterized the potential geological and soils hazard affecting the site and its vicinity and has demonstrated that the Project can be designed, constructed, operated, and retired to avoid dangers to human safety presented by potential geological and soil hazards.

5.0 SUBMITTAL AND APPROVAL REQUIREMENTS MATRICES

Tables H-5 and H-6 provide cross references between Exhibit submittal requirements of OAR 345-021-0010 and the Council's Approval standards of OAR 345-022-0000 and where discussion can be found in the Exhibit.

Table H-5. Submittal Requirements Matrix

Requirement	Location
OAR 345-021-0010(1)(h)	
(h) **Exhibit H.** Information from reasonably available sources regarding the geological and soil stability within the analysis area, providing evidence to support findings by the Council as required by OAR 345-022-0020, including:	
(A) A geologic report meeting the guidance in Oregon Department of Geology and Mineral Industries open file report 00-04 "Guidelines for Engineering Geologic reports and Site-Specific Seismic Hazard Reports."	Section 3.3.1; Attachment H-1
(B) A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions.	Section 3.3.2; Attachment H-1
(C) Evidence of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate site specific geotechnical work that must be performed before submitting the application for the Department to determine that the application is complete.	Section 3.3.3; Attachment H-2
(D) For all transmission lines, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends, corners, and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides or marginally stable slopes that could be made unstable by the planned construction.	Section 3.3.4; Attachment H-1
(E) For all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings and portions of the proposed alignment where geologic reconnaissance and other site specific studies provide evidence of existing landslides or marginally stable slopes that could be made unstable by the planned construction.	Not Applicable because the Project does not contain pipelines. (Section 3.3.5)

Table H-5. Submittal Requirements Matrix (continued)

Requirement	Location
(i) Identification of the Maximum Considered Earthquake Ground Motion under the 2009 International Building Code.	Section 3.3.6.1; Attachment H-1
(ii) Identification and characterization of all earthquake sources capable of generating median peak ground accelerations greater than 0.05g on rock at the site. For each earthquake source, the applicant shall assess the magnitude and minimum epicentral distance of the maximum credible earthquake (MCE).	Section 3.3.6.2; Attachment H-1
(iii) A description of any recorded earthquakes within 50 miles of the site and of recorded earthquakes greater than 50 miles from the site that caused ground shaking at the site more intense than the Modified Mercalli III intensity. The applicant shall include the date of occurrence and a description of the earthquake that includes its magnitude and highest intensity and its epicenter location or region of highest intensity.	Section 3.3.6.3; Attachment H-1
(G) An assessment of soil-related hazards such as landslides, flooding and erosion which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility.	Section 3.3.7; Attachment H-1
(H) An explanation of how the applicant will design, engineer and construct the facility to avoid dangers to human safety from the seismic hazards identified in paragraph (F). The applicant shall include proposed design and engineering features, applicable construction codes, and any monitoring for seismic hazards.	Section 3.3.8.1; Attachment H-1
(I) An explanation of how the applicant will design, engineer and construct the facility to adequately avoid dangers to human safety presented by the hazards identified in paragraph (G).	Section 3.3.8.2
Project Order Section VI (h) Comments	
The Department understands that detailed site-specific geotechnical investigation for the entire site boundary is not practical in advance of completing the final facility design and obtaining full site access. However, the rule requires evidence of consultation with the Oregon Department of Geology and Mineral Industries (DOGAMI) prior to submitting the application if the applicant proposes to base Exhibit H on limited pre-application geotechnical work. Exhibit H should include written evidence of consultation with DOGAMI regarding the level of geologic and geotechnical investigation determined to be practical for the application submittal.	Section 3.3.3; Attachment H-2
Any geotechnical reports included in Exhibit H as supporting evidence that the proposed facility will meet the Council's structural standard should follow the guidelines of DOGAMI's "Open File Report 00-04 "Guidelines for Engineering Geologic Reports and Site Specific Seismic Hazard Reports."	Section 3.3.3; Attachment H-1
Note that OAR 345-021-0010(1)(h), paragraphs (A), (F)(i), and (F)(iv) contain references to outdated guidelines and codes. Until such time that the Council rules can be revised to reflect current standards, the Department requests that applicants consult directly with DOGAMI, determine the most current structural standards that apply to its facility, then use those codes to prepare Exhibit H. The application should clearly note which codes and guidelines were used to prepare the information in Exhibit H. Exhibit H should also provide evidence that the current codes are equivalent to or more stringent than those cited in the Council's rules, and that the applicant agrees to construct the facility in accordance with the current codes and guidelines.	Section 3.3.1; Attachment H-1

Table H-6. Approval Standard

Requirement	Location
OAR 345-022-0020 Structural Standard	
To issue the requested Site Certificate, the Council must find that: (a) The applicant, through appropriate site-specific study, has adequately characterized the site as to the Maximum Considered Earthquake Ground Motion as shown for the site in the 2009 International Building Code and maximum probable ground motion, taking into account ground failure and amplification for the site specific soil profile under the maximum credible and maximum probable seismic events; and	Sections 3.3.6 through 3.3.6.5; Attachment H-1
(b) The applicant can design, engineer, and construct the facility to avoid dangers to human safety presented by seismic hazards affecting the site that are expected to result from maximum probable ground motion events. As used in this rule "seismic hazard" includes ground shaking, ground failure, landslide, liquefaction, lateral spreading, tsunami inundation, fault displacement, and subsidence;	Sections 3.3.8.1 and 4.0
(c) The applicant, through appropriate site-specific study, has adequately characterized the potential geological and soils hazards of the site and its vicinity that could, in the absence of a seismic event, adversely affect, or be aggravated by, the construction and operation of the proposed facility; and	Sections 3.3.8.2 and 4.0
(d) The applicant can design, engineer and construct the facility to avoid dangers to human safety presented by the hazards identified in subsection (c).	Sections 3.3.8.1, 3.3.8.2, and 4.0

6.0 RESPONSE TO COMMENTS FROM REVIEWING AGENCIES AND THE PUBLIC

Table H-7 provides cross references between comments cited in the Project Order from reviewing agencies and the public and where discussion can be found in the Exhibit.

Table H-7. Reviewing Agency and Public Comments

Requirements	Location
Project Order Section VIII (g) Comments	
Geological hazards, including seismic hazards, steep terrain, and landslides, should be addressed in Exhibit H.	Section 3.3
A commenter expressed concern about “thermal vents” on Lindsey Mountain—if the proposed route is in the area and might be impacted by such vents, it should be addressed in Exhibit H.	The Project is not in the vicinity of Lindsey Mountain.
A commenter expressed concern about “27 recognized fault lines” present in the John Day Valley. The applicant should address identified fault lines in Exhibit H.	The Project is not in the vicinity of the John Day Valley.

7.0 REFERENCES

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